Matter is Listed on 11.05.2022

Section XVII

IN THE SUPREME COURT OF INDIA
CIVIL APPELLATE JURISDICTION
CIVIL APPEAL NO. 2201 OF 2021

IN THE MATTER OF:

Bonani Kakkar ... **Appellant**

Versus

Oil India Limited and others ... **Respondents**

INDEX

S. No.	Particulars	Copies	Court Fees
01.	Affidavit on behalf of Respondent No. 1	1+3	20/-
02.	Annexures Rl-R31	1+3	62/-
	TOTAL		82/-

Filed by



Advocate for Respondent No 1
Trust Legal House C-224,
Defence Colony, New Delhi 11024
(Computer Code: 2725, Mob No.:9899545281)
Email: gaichangadvocate@gmail.com

New Delhi:

Date: 09.05.2022

Gmail **Gaichangpou Gangmei <gaichangadvocate@gmail.com>**

Copy of Affidavit by Respondent No.1 Oil India Ltd in C.A No.2201 of 2021 - M/s Trust Legal

1 message

Gaichangpou Gangmei <gaichangadvocate@gmail.com> Mon, May 9, 2022 at 3:20 PM
To: agarwalshruti@hotmail.com, abhishekatrey@gmail.com, gs.makkar@gov.in, mail@lmchambers.in

Sub : C.A No.2201 of 2021
Bonani Kakkar Vs. Oil India Ltd. & Ors

Sir / Madam,

In the above referred appeal, please find attached with this email the Affidavit with Documents (Vol-1, 2 & 3) of Respondent No.1 for your record and the same may be treated as effective service.

This is for your kind information.

Thank you,
Regards,



M/S TRUST LEGAL,
Advocate-on-Record
Mob. +91 9899545281
Office:
Q22 B First Floor,
Jangpura Extension,
New Delhi-110 014
Off : 011-41112715
email: ***gaichang@gaichangadvocate.com***

VOl-3 Affidavit of R1 in C.A No.2201 of 21 Bona...

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Vol-1 & 2 Affidavit of R1 in C.A No.2201 of 21 Bonani Kakar Vs. Oil Ondia Ltd & Ors.pdf
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IN THE SUPREME COURT OF INDIA
(CIVIL APPELLATE JURISDICTION)
CIVIL APPEAL NO. 2201 OF 2021

IN THE MATTER OF:

Bonani Kakkar ...Appellant

Versus

Oil India Limited &Ors ...Respondents

AFFIDAVIT ON BEHALF OF RESPONDENT NO. 1, OIL INDIA LTD.

PAPER-BOOK

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TRUST LEGAL
Advocate for Respondent No 1
Trust Legal House C-224,
Defence Colony, New Delhi 11024
(Computer Code: 2725, Mob No.:9899545281)
Email: gaichangadvocate@gmail.com

New Delhi

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IN THE SUPREME COURT OF INDIA
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Advocate for Respondent No 1
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Defence Colony, New Delhi 11024
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IN THE MATTER OF:

Bonani Kakkar ...Appellant

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Oil India Limited and others ...Respondents

AFFIDAVIT ON BEHALF OF RESPONDENT NO. 1, OIL INDIA LIMITED

MOST RESPECTFULLY SHOWETH:

I, Dr. Kumudani Sharma, Dy. General Manager (Legal), the Authorized Representative of the Answering Respondent company, having its Corporate Office at Plot No. 19, Sector 16 A, Film City, Noida – 201301, Uttar Pradesh, and duly authorized vide a General Power of Attorney dated 12.09.2021, do hereby solemnly affirm and submit as under:

1. That in my official capacity I am well acquainted with the facts and circumstances of the present case on the basis of the records thereof maintained by the Answering Respondent and I am as such competent to swear the instant Affidavit.

Dr. Kumudani Sharma
Head (Legal)
Oil India Limited
Authorised Signatory

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Expiry 29-10-2022
29-10-2013

2. I state and submit that the Answering Respondent is filing the present affidavit before this Hon'ble Court to place on record the developments that have taken

place *inter alia* depicting the present on ground situation of the Baghjan Well No. 5, which includes but is not limited to various assessment studies and reportscarried out in and around the Baghjan Well No. 5 by various organisations engaged by the Answering Respondent, along with the visuals, videos, etc. thereof.

3. I, on behalf of the Answering Respondent hereby reserve our right to further file a detailed affidavit and reply to the instant petition in the matter at a later stage, as and when required.I hereby state that the instant Affidavit is not in response to the Petition and only to bring on record certain facts of the instant matter. I further humbly state that the non-dealing of the instant Petition para-wise may not be considered as an admission to any contentions, grounds or allegations raised against the Answering Respondent.

PRELIMINARY SUBMISSIONS

4. It is hereby stated and submitted, that the Answering Respondent, Oil India Ltd. is a Central Government Company under the Ministry of Petroleum and Natural Gas, having its registered office at Duliajan in the district of Dibrugarh and is engaged in the business of exploration, development and production

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Head (Legal)
Oil India Limited
Authorised Signatory

of crude oil and natural gas, transportation of crude oil and extraction and bottling of LPG.

5. It is pertinent to mention that the Baghjan structure was identified by the Answering Respondent way back in 1991 and the discovery of oil and gas in Baghjan area was made in the year 2003. The Baghjan field is located at a distance of approximately 70 km from Digboi, Eastern Asset Field Office and Field Headquarters (FHQ), Duliajan. Baghjan is one of the main hydrocarbon producing fields within the Answering Respondent's operational area in Assam. So far, 31 Nos. of wells have been drilled in Baghjan Oilfield including 3 water disposal wells out of which 21 wells are on regular production in Baghjan Early Production Setup (EPS). Out of these 28 wells drilled for hydrocarbon prospects, 05 wells including Baghjan Well No. 5 were completed as gas wells and the remaining 23 wells were completed as Oil India Ltd wells. Currently, out of these 28 wells, 05 wells are temporarily shut-in and 01 well is permanently abandoned. As such, prior to workover of Baghjan well no. 5, 22 wells were on production. After the blowout of the well no. 5, 21 wells are in production with a total production of 1222 KLPD crude oil and approx 1.77 MMSCMD natural gas.

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6. I state that the Baghjan Well No. 5 was producing 88000 standard cubic meters per day (SCMD) of gas

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Head (Legal)
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with 29 kilo litre per day (KLPD) condensate from 3870 m Langpar sand since September 2015. Geology & Reservoir Department anticipated that further production may lead to fast depletion of the reservoir pressure of the gas cap of BHN001 Block resulting in lesser recovery. Accordingly, the workover operation at Baghjan Well No. 5 were commenced for enhancement of production and therefore Rig: CH#9 of M/s John Energy Ltd was deployed to carry out the workover operation. The workover operation was commencedon 25.04.2020 and the initial objective was completed on 18.05.2020 as per workover program. But after the perforation when the well was about to divert to oil collection station, pressure rose in the casing side due to leakage from tubing side. So, it was decided to kill/subdue the well and again recomplete with same tubing. While well killing/subduing, a pressure was observed at the outer casing which may have come from inner casing through a spool called Well Finish Spool (WF Spool). After the well was subdued and killed, the WF was tested and upon the finding of leakage, it was decided to change the WF. After the well was subdued/ killed (Sodium Format Solution was infused to cap well pressure), tubing was pulling out of hole. Further in between the WF spool was tested and was found to be leaking and accordingly, it was decided to change the WF spool. Prior to changing of WF spool,

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Head (Legal)
Oil India Limited
Authorised Signatory

it was decided to put a secondary barrier as cement plug of 100m in the well. Accordingly, a program was made to carry out cement plug job as per the program on 26.05.2020. On 27.05.2020, the operation for change of WF spool was taken up. However, the well suddenly became very active and had resulted into a major blowout at around 10:30 am. There was no incident of any fire/injury/casualty.

7. It is pertinent to note that the District Authority was immediately informed about the incident and were also requested for support including support for addressing any law-and-order situation that could arise. Further, Crisis Management Team (CMT) members from Oil and Natural Gas Corporation Ltd. (ONGC) and an Expert Team from ONGC, Vadodara, approached the well head taking all precautionary measures. A number of arrangements were also made to bring the well under control. That the Answering Respondent had also appointed three global experts from M/s Alert Disaster Control (Asia) Pte Ltd, Singapore who worked on the blowout site since 08.06.2020.

8. That despite the above measures, the blowout unfortunately caught fire on 09.06.2020 at 01:14 pm. Upon which, the Answering Respondent along with the experts from ONGC and ALERT team chalked out a new plan of action for controlling the well under fire.

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That a number of efforts were undertaken by the Answering Respondent to evacuate the families from the nearby affected areas and a number of relief camps were also set up and all necessary supports for stay, food, water, toilets, electricity, medical and veterinary care were provided by the Answering Respondent in accordance with the prevalent COVID-19 guidelines, with support from District Administration and local organizations.

9. It is hereby submitted that pursuant to the said blowout incident at Baghjan Well No. 5 several efforts and measures have been undertaken by the Answering Respondent by engaging various organizations of national and international repute, to identify, assess,mitigatethe impact of the blowout on the environment and restore the damage caused.

I. STUDIES/REPORTS POST BLOWOUT [2020-2021(FIRST HALF)]

10. It is hereby submitted that the following assessment studies have been conducted by the Answering Respondent till date by engaging various organisations to analyse the impact of the blowout on the surrounding areas and assess the environment damage caused;

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Head (Legal)
Oil India Limited
Authorised Signatory

7

10.1 **ASSESSMENT OF AIR QUALITY IN THE VICINITY OF BAGHJAN WELL NO. 5 BY M/S ARIHANT ANALYTICAL LABORATORY PVT. LTD.**

10.1.1 I state that M/s Arihant Analytical Laboratory Pvt. Ltd. was engaged by the Answering Respondent vide Contract No. 6113508 dated 27.11.2019 for a duration of 02 (two) years with a provision of extension of 01 (One) year with same terms and conditions for Monitoring of Ambient Air quality, Stack gas emission, Mercury (Hg) in ambient Air, Total Hydrocarbon (THC) in ambient Air, Volatile Organic Compound (VOC) in Ambient Air and measurement of illumination and noise levels at OIL's Drilling, Work over locations and OIL's installations of Upper Assam and Arunachal Pradesh as per National Ambient Air Quality Standard (NAAQS), Environment Clearance, Ministry of Environment and Forest, Govt. of India (MoEF, GOI), State Pollution Control Board (SPCB) and Central Pollution Control Board (CPCB) guidelines. It is humbly stated that the Answering Respondent, as a responsible organization, was fulfilling its obligations towards the environment by regular monitoring of ambient air quality even before the unfortunate incident of blowout.

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A copy of the Contract bearing number 6113508 between the Answering Respondent and M/s Arihant

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Head (Legal)
Oil India Limited
Authorised Signatory

Analytical Laboratory Pvt. Ltd. dated 27.11.2019 is annexed herewith and marked as **Annexure-R1.**

A copy of the test reports of Ambient Air Quality Monitoring Report by M/s Arihant Analytical Laboratory Pvt. Ltd. from 29.05.2020 to 12.06.2020 are hereby annexed and marked as **Annexure-R2**

10.2 **ASSESSMENT OF AIR QUALITY IN THE VICINITY OF BAGHJAN WELL NO. 5 BY M/S THE ENERGY AND RESOURCES INSTITUTE (TERI)**

10.2.1 It is submitted that M/s The Energy and Resources Institute (TERI) was engaged by the Answering Respondent vide Letter of Award (LOA) bearingnumber LOA/G/102 dated 15.06.2020to assessment of the air quality in the vicinity of Baghjan Well No. 5. The Letter of Award was subsequently amended on 28.07.2020 and 08.12.2020. A copy of the Letter of Award (LOA) bearing number LOA/G/102 dated 15.06.2020 along with subsequent amendments on 28.07.2020 and 08.12.2020are annexed herewith and marked as **Annexure-R3.**

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10.2.2 That a report on assessment of Air Quality and noise levels was submitted on 05.08.2020 by M/s TERI, *inter alia*recording the observations at various locations around the blowout site for a duration of one and a half (1.5) months. A copy of the report dated

Dr. Kumudani Sharma
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Oil India Limited

05.08.2020 submitted by M/s TERI on the Assessment of Air Quality in the vicinity of Baghjan Well No. 5 is annexed herewith and marked as **Annexure R4.**

10.2.3 As per the noise levels recorded from 19.06.2020 to 03.08.2020, the following observations were made by M/s TERI;

(a) That the equivalent sound pressure levels (Leq) measured at 0.5 km from the well are exceeding the industrial noise level daytime standard of 75 dB (A) in all the monitored days except for few days.

(b) However, at other points at a distance of 1 km, 1.5 km and 2 km from the fire point, the levels are within the daytime industrial noise level standard of 75dBA.

10.2.4 As per the $PM_{2.5}$, SO_2, and NO_2 levels measured at different locations from the fire point of the Baghjan Well No. 5 from 19.06.2020 to 29.07.2020, the following observations were made by M/s TERI;

(a) The results of $PM_{2.5}$, SO_2, and NO_2, concentrations measured at different locations from the fire point indicated that all the values during the monitoring period from 19.06.2020 to 22.07.2020 for $PM_{2,5}$ and from 19.06.2020 to 28.07.2020 for SO_2 and NO_2 were found to be well within the National Ambient Air Quality

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Head (Legal)
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Authorised Signatory

Standard (NAAQS) prescribed by the Central Pollution Control Board (CPCB.)

(b) The levels of Benzene and Benzo(alpha) pyrene measured at different location on 30.07.2020 were found to be well within the annual average NAAQS prescribed by CPCB.

10.3 **GEOPHYSICAL STUDY BY M/S COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR)- NORTH EAST INSTITUTE OF SCIENCE AND TECHNOLOGY (NEIST) FROM 18.06.2020 TO 21.07.2020**

10.3.1 It is submitted thatM/s CSIR- NEIST – Jorhat, Assam was engaged by the Answering Respondent vide Letter of Award bearing number LOA No. 6208951 dated 24.06.2020 for conducting a Geophysical Study in the vicinity of Baghjan Well no. 5 of Oil India Limited, Duliajan for a duration of thirty (30) days. A copy of the Letter of Award (LOA) bearing number LOA No. 6208951 issued by the Answering Respondent to M/s CSIR-NEIST on 24.06.2020 is annexed herewith and marked as **Annexure-R5.**

10.3.2 It is submitted that the seismic data acquisition was done by M/s CSIR-NEIST for a period of one month, i.e. from 18.06.2020 to 21.07.2020. That a report was submitted on 21.08.2020where the project was *inter alia* designed to investigate the reported seismic activities at the neighborhood of the incident site and

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Head (Legal)
Oil India Limited
Authorised Signatory

also to conduct a series of other geophysical surveys to detect any observable change near the blowout site including ground deformation, if any, in the vicinity of the blowout site. A copy of the report dated 21.08.2020 submitted by M/s CSIR- NEIST – Jorhat, regarding the Seismological and Geophysical Investigation at the Baghjan Well Blowout Site and its vicinity is annexed herewith and marked as **Annexure-R6.**

10.3.3 The findings of the investigation by CSIR – NEIST, Jorhat as per the said report dated 21.08.2020are as follows:

(a) During the investigation period, the network of five seismograph stations recorded several,local, distant/teleseismic earthquakes occurring in the NE India and its neighbourhood.

(b) A number of very local and shallow micro-earthquake activities are also detected, and someof these events may be related to the well blowout incident. However, such microearthquakesare reported globally near producing hydrocarbon reservoir due to disturbance of hydrostatic balance inside the reservoir during production activities. These micro-earthquakes are very small and are usually not felt unless extremely close to the epicenter.

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(c) High frequency ground motion as continuous oscillation is observed in the records of all theseismic sensors as far as 4.5km from the blowout site. These noises are not uniform andsudden spikes are observed, which sometime lasted for several hours.

(d) The Peak Particle Velocity (PPV) observed due to the noise ranges from 0.095 mm/sec to0.22 mm/sec. However, the maximum PPV recorded during the study period was 1.08mm/sec, which was due to an M5.6 earthquake that occurred in Mizoram on 21 June, 2020.The PPV due to this earthquake far exceeds the highest PPV generated by the continuousnoise.

(e) Directivity study of the noise spectrum indicates that the source of the high frequencydisturbances observed at the seismic stations is the Baghjan Blowout site.

(f) Ground vibration at seismic stations BJN2, BJN4 and BJN5 reaches the human perceptiblelimit and sometime may be quite disturbing to people. However, the continuous groundvibration does not always reach human perceptible limit.

(g) The recorded PPV is much lesser as compared to damage threshold of a normal house oreven sensitive historical monuments. Therefore, it is highly unlikely to cause any structural oreven

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architectural damage of dwellings. The maximum Peak Ground Acceleration (PGA)recorded by the accelerometer is 0.0027g, which is also quite insignificant from any structuraldamage potential.

(h) Reported felt vibrations on dwellings as far as 10-12km from the blowout site could not beverified as the investigation was restricted to a radial distance of 4.5km only.

(i) Significantvariation of recorded geophysical parameters has been observed for differentsurvey episodes. The survey period was much rainy with subsequentflooding. The measuredgeophysical parameters are highly sensitive to variation of water saturation in the subsurfacelayers. Hence, influence of water saturation in observed variation of the geophysicalparameters cannot be ruled out.

(j) Temporal variations in ground resistivity value are observed at several sites. The resistivityreadings of the nearest site to the blowout incident, probably, influenced by contamination inthe upper layer.

(k) Large variation in measured magnetic intensities by the PPM record may indicate presence ofmagnetic anomalies underneath the subsurface of the prescribed survey sites. Very Low Frequency (VLF)pseudo sections of real

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anomaly readings present high limits, which tend to distort the models.The VLF survey may indicate that the zones of higher current density orient with the waterstagnated, muddy, areas of the site.

(l) InSAR (Interferometric Synthetic Apperture Radar) data analysis does not show any surface deformation at the vicinity of the blowout site.

(m) There is scope to investigate the reported vibration effects, if any, on dwellings locatedbeyond the covered 4.5km radial distance from the incident site. Such study should be veryuseful in hazard mitigation in case unfortunate incidents like the Baghjan well blowout recurs in the near future.

10.4 **MEASUREMENT OF THERMAL MAPPING OF STRUCTURE AND SONIC BOOM BY M/S IIT GUWAHATI**

10.4.1 It is hereby submitted that M/s Indian Institute of Technology (IIT) Guwahati was engaged by the Answering Respondent vide Letter of Award bearing number LOA/G/189 dated 06.07.2020for the Measurement of Thermal Mapping of structure and Sonic Boom in Baghjan. A copy of the Letter of Award bearing number LOA/G/189 issued by the Answering Respondent to M/s IIT Guwahati on 06.07.2020 , is annexed herewith and marked as **Annexure-R7**

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10.4.2 A report was submitted by IIT Guwahati on 28.08.2020 on Measurement of Thermal Mapping of Structure and Sonic Boom in Baghjan. A copy of the report submitted by IIT Guwahati on 28.08.2020 is annexed herewith and marked as **Annexure-R8.**

10.4.3 The conclusion from the scientific study are based on thermal mapping and sound measurement conducted between 16.07.2020 and 21.07.2020 after the blowout incident.As per the report dated 28.08.2020, IIT- Guwahati observed the following;

(a) The sound time history with high pressure intensity in dB emitting at low occurrence rate was not detrimental to the structural integrity.

(b) Overall, the sound intensity was not too intense to cause any detrimental effect on structural integrity.

(c) The sound pressure intensities from the gas blowout had no significant influence on the formation of cracks in the buildings.

(d) Based on the Thermal map, it was concluded that there was no significant effect of fire in blowout well in BGN Well No. 5 on the formation of crack in the structures.

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11. I, on behalf of the Answering Respondent further state that several agencies including the Chemical Department of the Answering Respondent had undertaken sample testing of various elements, such

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as the air, water, soil, condensate, etc. The details of the reports are as follows: 16

11.1 **DRINKING WATER ANALYSIS REPORT ON 06.04.2020 BY THE DISTRICT LABORATORY, TINSUKIA (PUBLIC HEALTH ENGINEERING (PHE)) DIVISION, TINSUKIA, ASSAM, ISSUED BY THE EXECUTIVE ENGINEER (PHE) TINSUKIA**

11.1.1 I state that pre-blowout, that is, on 06.04.2020 the District Laboratory, Tinsukia (Public Health Engineering (PHE)) Division, Tinsukia, Assam, collected samples from 10 different locations of Baghjan Gaon and carried examination of the same from 06.04.2020 - 08.04.2020.Copy of the Water Analysis Report for 06.04.2020 of the District Laboratory, Tinsukia (Public Health Engineering (PHE)) Division, Tinsukia, Assam is annexed herewith and marked as **Annexure-R9**

11.1.2 The water samples were examined on various parameters such as Turbidity, TDS, PH, Iron, Alkalinity, Chloride, CA-Hardness, Hardness, Fluoride and Bacteria.

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11.1.3 Out of the 10 water samples collected on 06.04.2020, from10 locations of Baghjan Gaon, water samples from two location points, that is,Niranjan Tanti and Raju Lakra were found to have slightly high Iron(Fe) Contamination, that is 1.37 and 1.28 respectively,

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whereas the ideal level is between 0.3 – 1.0. However, all other parameters were within the permissible limit at all 10 locations and water at 8 of the locations was safe for drinking purposes.

11.2 **CHROMATOGRAPHIC ANALYSIS OF CONDENSATE SAMPLE EXTRACT BY CHEMICAL LABORATORY, CHEMICAL DEPARTMENT, OIL INDIA LIMITED, DULIAJAN;**

11.2.1 I, on behalf of the Answering Respondent, hereby submitted that pit water sample was collected from nearby pit of Baghjan Well No. 5 and the oil sample was extracted from the pit water on 31.05.2020. Since, it was extracted from water, therefore lighter hydrocarbon may loss/evaporate during the extraction process.

11.2.2 A Chromatographic Analysis of the condensate sample as extract from the water sample from pit near Baghjan Well no. 5 was conducted on 06.06.2020 by the Chemical Laboratory, Chemical Department, Oil India Limited, Duliajan. A copy of the Report dated 08.06.2020 of the Chromatographic Analysis of the condensate sample as extract from the water sample from pit near Baghjan Well No. 5 is annexed herewith and marked as **Annexure-R10**.

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11.3 **REPORT ON AMBIENT AIR AND WATER QUALITY MONITORING IN AND AROUND THE WELL NO. 5 OF OIL, BAGHJAN, TINSUKHIA, ASSAM BY THE CENTRAL POLLUTION CONTROL BOARD (CPCB);**

11.3.1 As directed by the committee of experts constituted by the Hon'ble National Green Tribunal (NGT), O.A. No. 43/2020/EZ and O.A. No. 44/2020/EZ on Baghjan incident, the Central Pollution Control Board (CPCB), Regional Directorate NorthEast (RDNE) conducted monitoring/assessment of Ambient Air quality and Water quality in and around the Well no. 5 at Baghjan during 09.10.2020 to 13.10.2020.A copy of the report dated 29.10.2020 of the Central Pollution Control Board on Ambient Air and Water Quality Monitoring is annexed herewith and marked as **Annexure-R11**.

11.3.2 In the Report dated 29.10.2020 on Ambient Air and Water Quality Monitoring by the Central Pollution Control Board (CPCB), Regional Directorate North East, the following observations were made

11.3.3 **AMBIENT AIR QUALITY**

(a) The ambient air quality monitoring was conducted at 4 stations located at 100 m, 150m, 300m and 500m from the accident site to the Northwest, West, West and South East directions respectively.

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(b) The Air Quality was tested on various parameters such as the time weighted average of Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Particulate Matter 10 (PM_{10}) and Particulate Matter 2.5 ($PM_{2.5}$).

(c) It was observed in the Report that all the parameters were within the National Ambient Air Quality Standard (NAAQS).

11.3.4 **WATER QUALITY MONITORING**

(a) Water Samples were collected from 5 stations in the vicinity of the Baghjan Well No.5, all located at different locations in Dibru river at about 150 m away from the well site towards the west, pond adjacent to the well site, stagnant water 500 m away from the well site, Maguri Wetland about 500m away from well site and Maguri Wetland stagnant water 150m from the well site respectively.

(b) Water samples were tested on 21 parameters such as pH, Temperature, suspended Solids, Zinc, BOD, COD, Chlorides, Sulphate, TDS, percentage of Sodium, Oil & Grease, Phenolics, Cyanides, Fluorides, Sulphides, Chromium (Cr+6), Chromium (total), Copper, Lead, Mercury, and Nickle.

(c) The samples were analysed in three laboratories SPCB Assam (EPA recognised Laboratory), SPCB Meghalaya (NABL Accredited laboratory) and

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CPCB RDNE Shillong laboratory. The analysis was given on the basis of the compiled results. The results provided were the highest among the three test results.

(d) The Report observed that except Lead in Station-2, that is the pond adjacent to the blowout site, all other tested parameters are found within the Discharge Standard for "Oil drilling and Gas Extraction Industry".

11.4 **DRINKING WATER ANALYSIS REPORT ON 03.11.2020 BY THE DISTRICT LABORATORY, TINSUKIA (PUBLIC HEALTH ENGINEERING (PHE)) DIVISION, TINSUKIA, ASSAM, ISSUED BY THE EXECUTIVE ENGINEER (PHE) TINSUKIA**

11.4.1 I state that during-blowout, that is, on 03.11.2020 the District Laboratory, Tinsukia (Public Health Engineering (PHE)) Division, Tinsukia, Assam, collected samples from 10 different locations of Baghjan Gaon and carried examination of the same from 03.11.2020 - 05.11.2020. Copy of the Water Analysis Report for 03.11.2020 of the District Laboratory, Tinsukia (Public Health Engineering (PHE)) Division, Tinsukia, Assam is annexed herewith and marked as **Annexure-R12.**

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11.4.2 The water samples were examined on various parameters such as Turbidity, TDS, PH, Iron,

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Alkalinity, Chloride, CA-Hardness, Hardness, Fluoride and Bacteria.

11.4.3 Out of the 10 water samples collected on 03.11.2020, from 10 locations water at 6 of the 10 locations was safe for drinking purpose.

11.5 **REPORT OF THE TEAM OF EXPERTS BY ASSAM AGRICULTURE UNIVERSITY (AAU) VISIT TO BAGHJAN GAS BLOWOUT AREA;**

11.5.1 I on behalf of the Answering Respondent humbly submit that on 04.06.2020, the Answering Respondent made a request to the Director of Research (Agriculture),Assam Agriculture University, Assam to conductan assessment of damage to Crops /Tree /Plants (Paddy/ Tea/ Fruit/ Vegetation) in the area in the vicinity of the Baghjan Well No. 5 due to the blowout in the said Well. The team of experts of the AAU visited the site on 08.06.2020 and partially on 09.06.2020, however owing to the fire caught in the said Well, no assessment could be carried out. Accordingly, the Answering Respondent requested the Director of Research (Agriculture), Assam Agriculture University, Assam to depute the experts again for the said assessment. However, owing to series of unfavorable events such as the prevailing condition the area, floods due to heavy rains, etc. the assessment could not be carried out and the experts

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finally visited the site on 27.01.2021-28.01.2021.Copies of the various communication exchanged between the Answering Respondent and the Office of the Director of Research (Agriculture), Assam Agriculture University, Assam, are annexed herewith and marked as **Annexure-R13**.

11.5.2 I state that a team of scientists was constituted by the Director of Research (Agriculture), Assam Agriculture University(AAU), Jorhat vide letter bearing No. 7(15)/13/DRA(T)/Pt/2020-2021/11887-92 dated 28.11.2020 to assess the damage due to the gas blowout area of Baghjan on crops, soil and water body of the site. The team of experts visited the site on 27.01.2021-28.01.2021. The team of experts collected soil samples from the North, South, East and West direction within 500m radius of the Baghjan Well No. 5 on 28.01.2021, which were analyzed in the Laboratory at AAU, Jorhat. Samples of water from 10 various locations around the well sites were also taken and were further analyzed in the Laboratory. On 20.07.2021, the team of experts from AAU, Jorhat submitted its report on the Assessment of Damage at Gas Blowout Area of Baghjan. A copy of the report dated 20.07.2021 of the Team of Experts from Assam Agricultural University, Jorhat on the Gas Blowout Area of Baghjan is annexed herewith and marked as **Annexure-R14**.

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11.5.3 The soil samples were analysed on various parameters such as the porosity, alkalinity, pH, electrical conductivity (EC), Total Dissolved Solid (TDS), Walkley & Black Carbon (WBC), Available Nitrogen, Phosporous and Potassium. The water sample was analysed on the parameters such as physical look/Colour, etc., pH, electrical conductivity (EC), TDS, Calcium, Magnesium, Carbonate, Biocarbonate.

11.5.4 The following observations were made in the final report dated 20.07.2021 of the Team of Experts from Assam Agricultural University, Jorhat on the Gas Blowout Area of Baghjan:

(a) The physio chemical properties such as porosity, alkalinity, pH and electrical conductivity (EC) of the soil samples were in the safe limit.

(b) Soil pH ranged between minimum 5.33 (acidic) and maximum 7.64 (slightly saline). The soil in Assam is normally acidic in nature, thusthe neutral pH or slightly saline pH in the case of some soil samples indicated the after effects due to oil contamination (salt content high) from the Baghjan Blowout incident.

(c) The soil carbon (WBC) data ranged from 0.97 to 2.27%.Thehigh content of soil carbon might be

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due to the fact that the soil was affected by the oil contaminants (having high content of hydrocarbons). 24

(d) Soil available nitrogen was found to be in the lower range. This indicated wider C:N ratio in the soil which may affect the microbial activity. Data also indicated lower range of available phosphorus and potassium in the soils.

(e) The water analysis report showed safe limit of all the parameters.

II. RESTORATION MEASURES

12. I on behalf of the Answering Respondent hereby humbly submit that pursuant to the Baghjan blowout the following restoration measures including bioremediation works were carried out by the Answering Respondent by engaging various organisations of international repute.

13. **PICKING UP OF SPILLED OIL CONDENSATE MANUALLY AND BY TURBO PUMP:**

13.1 I on behalf of the Answering Respondent state that after the incident of blowout, several bunds were constructed around the area of blowout to arrest the spilled oil condensate flowing to the nearby water bodies. The oil arrested insider the bundhs were picked up by manual efforts in drums and transferred

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to EPS- Baghjan. Turbo pumps driven by water jet were also used for lifting spilled oil condensate. 25

13.2 I on behalf of the Answering Respondent state that on 31.05.2020 M/s Deep Construction was engaged by the Answering Respondent vide LOA bearing number OIL/CONT/LOA/G/98/2020-21 for bio-remediation services for carrying out the following work;

(a) Cleaning services of Oil spillage from Roof, Wall, Trees, Ground Surface etc.

(b) Fixing and Replacement of Roof, Painting of Roof and Wall.

(c) Oil pickup, carriage, Transportation, Storage etc.

(d) Supply of gravel, spreading, Levelling including Excavator services.

(e) Supply, erection of boundary fencing.

(f) Earth cutting, Filling, Dressing, Levelling etc.

(g) Development of various village roads, sand begging etc.

(h) Cutting, trimming and uprooting of trees

(i) Service of boat for oil pickup & manpower including supply of diesel, etc.

(j) Mitigation of any other contingencies.

Copy of LOA dated 31.05.2020, bearing number OIL/CONT/LOA/G/98/2020-21 issued by Answering Respondent to M/s Deep Construction is annexed herewith and marked as **Annexure-R15**

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14. I further state that the Answering Respondent engaged M/s The Energy and Resource Institute (TERI) for Bioremediation services around Baghjan Well No. 5 in two phases that is phase No. I for a total area of 1,60,000 square metersstarting on 21.06.2020 and subsequently phase No. II for a total area of 150 square meters was carried out. Bioremediation is the process that uses naturally occurring microorganisms to transform harmful substances to nontoxic compounds. The process eliminates the need to transfer large quantities of contaminated waste off site, as potential threats to human health and the environment can arise during such transportation. It is further humbly submitted that owing to the bioremediation process carried out in and around Baghjan Area, there has been significant restoration of the environment, that had been captured via photographs on 26.08.2021. Copies of photographs captured on 26.08.2021 is attached herewith and marked as **Annexure-R16**.

14.1 **PHASE-I: IN-SITU & EX-SITU BIOREMEDIATION OF OILY SLUDGE BY M/S THE ENERGY AND RESOURCES INSTITUTE (TERI) FOR AREA AROUND THE BAGHJAN WELL NO. 5**

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14.1.1 I on behalf of the Answering Respondent, most humbly submit that during the blowout time period,

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the Answering Respondent hadcommenced the work for bioremediation in the area surrounding the Baghjan Well No.5.It is humbly submitted that M/s TERI was engaged by the Answering Respondent videContract No. 6114478dated 06.06.2020 for bioremediation of oily soil and water at Baghjan Well No. 5 for a total area if 1,60,000 Sq. meters. The total area for remediation was divided in two zone - Land and Water. Copy of the joint site recce by Answering Respondent and M/s TERI is annexed herewith and marked as **Annexure-R17.**

14.1.2 The Bioremediation of the phase I was completed by M/s TERI on 04.12.2020.A copy of the Certificate of payment dated 20.08.2021 paid by the Answering Respondent to M/s TERI for the work done during the period 21.06.2020to 07.09.2020 is annexed herewith and marked as **Annexure-R18.**

14.2 **PHASE II: IN-SITU & EX-SITU BIOREMEDIATION OF OILY SOIL AND WATER BY M/S THE ENERGY AND RESOURCES INSTITUTE (TERI) AT THE BAGHJAN WELL NO. 5 PLINTH**

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14.2.1 It on behalf of the Answering Respondent most humbly submit that after blowout was controlled and the Baghjan Well No. 5 was killed, steps were undertaken to further bioremediate the Plinth of the Baghjan Well No.5. However, owing to law-and-order

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concerns, even the machineries and equipment of the Answering Respondents could not be collected by the Answering Respondent without the due support and assistance of the law enforcement and district administrative authorities. It was only on 10.08.2021 that the Answering Respondent could collect its equipments and machinery at the Baghjan Well No. 5 site and have the control and possession of the site. In view of the aforesaid, the bioremediation work at the Plinth Baghjan Well No. 5 Site could be commence in the later half of the year 2021.Copies of the news article dated 24.07.2021 published in Indian Today titled "Protestors clash with police at site of Baghjan Fire in Assam's Tinsukia: several injured", is annexed herewith and marked as **Annexure-R19**.

14.2.2 I state that on 13.10.2021, the Contract bearing No. 6116306 was executed between the Answering Respondent and M/s TERI, vide which the services of M/s TERI were further extended o for a period of 01 (one year) for In-situ and Ex-Situ Bioremediation of oily sludge /oil contaminated soil/water of various production Installations, fields and water bodies in Assam and Arunachal Pradesh Fields. Thereafter,bioremediation work on the main blowout site plinth for an area of 150 square meters was undertaken.Copy of the Amendment No.1 dated 23.03.2021 to the Contract No. 6114478/PDNO/2020 for "Hiring of Services for bioremediation services of

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contaminated soil/water bodies due to oil spillage resulting from blowout of well no. BGN#05" is annexed herewith and marked as **Annexure-R20**.

14.3 I further state that on 29.09.2020, vide a Letter of Award bearing number OIL/CONT/LOA/S/394/2020-21, M/s Balmer Lawrie & Co. Ltd.wasalso engaged by the Answering Respondent and awarded Contract bearing No. 6114629 towards Hiring Services of Handling and Processing of Oily Sludge for a duration of 24 (Twenty-Four) months.A Copy of the Letter of Award dated 29.09.2020 bearing number OIL/CONT/LOA/S/394/2020-21 to M/s Balmer Lawrie & Co. Ltd. is a annexed herewith and marked as **Annexure-R21**.

III. STUDIES/REPORTS [SECOND HALF OF 2021 ONWARDS (POST BIOREMEDIATION)]

15. **EFFLUENT PIT WATER SAMPLE ANALYSIS BY CHEMICAL LABORATORY, CHEMICAL DEPARTMENT, OIL INDIA LIMITED, DILIJAN**

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15.1 I on behalf of the Answering Respondent state that on 03.11.2021 pit water samples were collected from the Effluent pits near the Baghjan Well No. 5 location from 4 locations, which within 70 m, 100 m, 40m and 45 mfrom the well site respectively.

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15.2 An Effluent Pit Water Sample Analysis was conducted by the Chemical Laboratory Department of the Answering Respondent. The sample was tested on the parameters for pH, Chloride, Phenolic Compounds, Sulphate, Chromium, Total Dissolved Solids, Suspended Solids, Oil and Grease. A copy of the report dated 10.11.2021 of the Effluent Pit Water Sample Analysis near Baghjan Well No. 5 is annexed herewith and marked as **Annexure-R22**.

15.3 The key findings of the report dated 10.11.2021 are as follows;

(a) The results for pH, Chloride, Phenolic compounds, Sulphate, Chromium, total dissolved solids, oil and grease were within the tolerance limits prescribed by the State Pollution Control Board of Assam. The suspended solids in the effluent pit water in two (02) samples out of four (04)area within 70m and 100 meters of the Baghjan Well No. 5 were marginally above the acceptable limit.

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16. **LETTER DATED 15.11.2021 FROM THE OFFICE OF THE DISTRICT FISHERY DEVELOPMENT OFFICER, TINSUKIA, GOVERNMENT OF ASSAM**

16.1 I state on behalf of the Answering Respondent that the District Fishery Development Officer (DFDO), Tinsukia, Government of Assam, had in its letter

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dated 15.11.2021 bearing number AFT-9/2021-22/289 to the Answering Respondentmade the following observations: 31

16.1.1 As per the reports of the concerned field officials, there was no sign of adverse impact and deterioration of water quality due to the said blowout at MaguriMotapungbeel during the period from 15.11.2020 to the date of the communication, that is 15.11.2021.

16.1.2 There were no reports received of any extinction fish species during the said period from 15.11.2020 to 15.11.2021.

16.1.3 No unnatural death of fish species were detected or reported from that the area during the said period from 15.11.2020 to 15.11.2021.

Copy of the letter dated 15.11.2021 bearing number AFT-9/2021-22/289 from the District Fishery Development Officer (DFDO), Tinsukia, Government of Assam, to the Answering Respondent is annexed herewith and marked as **Annexure-R23**.

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17. **LETTER DATED 13.11.2021 FROM THE OFFICE OF THE DISTRICT ANIMAL HUSBANDRY & VETERINARY OFFICER, TINSUKIA, GOVERNMENT OF ASSAM**

17.1 I state on behalf of the Answering Respondent that the District Animal Husbandry & Veterinary Officer,

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Tinsukia, Government of Assam, had in its letter dated 13.11.2021 bearing number DVOT/G-9/Baghjan/2021-22/638 to the Answering Respondent observed that post the blowout in Baghjan Oil Field, No unnatural diseases were detected or reported from the area amongst livestock and poultry apart from certain seasonal diseases, viz. worms' infestation etc. Copy of the letter dated 13.11.2021 bearing number DVOT/G-9/Baghjan/2021-22/638 from the District Animal Husbandry & Veterinary Officer, Tinsukia, Government of Assam, to the Answering Respondent is annexed herewith and marked as **Annexure-R24**.

18. **ASSESSMENT OF ENVIRONMENTAL QUALITY OF SOIL AND VEGETATION FINAL REPORT BY M/S THE ENERGY AND RESOURCES INSTITUTE**

18.1 I on behalf of the Answering Respondent hereby submit that the M/s The Energy and Resources Institute was engaged by the Answering Respondent to undertake the assessment of environmental quality of soil and vegetation in the vicinity of Baghjan Well No. 5 vide the _LOA dated 16.11.2021 bearingNo. OIL/62/7/LOA-323.A copy of the LOA dated 16.11.2021 bearing number OIL/62/7/LOA-323 issued by the Answering Respondent to M/s TERI is annexed herewith and marked as **Annexure-R25**.

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18.2 M/s TERI had undertaken environmental assessment and sampling activities during the period 30.11.2021 to 04.12.2021. The initial reconnaissance survey was conducted on 30.11.2021 along with the officials of the Answering Respondent to understand the environmental conditions and selection of sampling locations. The soil, sediment, water and vegetation sampling was carried out from 01.12.2021 to 04.12.2021.

18.3 **SAMPLING**

18.3.1 Soil and plant samples were taken within 2 km radius of the affected areas, including the bioremediated sites.All the sampling process has been carried out as per the standard sampling guidelines and analyzed as per the Indian and international standard methods. The collected samples have been preserved and transported to NABL and MOEF & CC accredited laboratory for the analysis.

18.3.2 Total 13 water samples consisting of groundwater and surface water, 16 plant/vegetation, 17 soil and 4 sludge samples were collected. The representative water (surface and ground), soil, sediment/sludge and plant/vegetation samples were collected from surrounding area including in and around Baghjan Well No. 5, tea garden, settlements, agricultural crop

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fields and biodiversity parks covering Dibru-Saikhowa National Park and Maguri Motapung Beel.

18.3.3 Soils from wetlands, agricultural fields, Residential zones and Dibru National Park were collected.

18.3.4 Representative plant samples were collected from an area covering 2 km radius of the Baghjan Well No. 5 along with Dibru Saikhowa National Park (DSNP) (2.3 km from well site) and Maguri Motapung Beel (2.5 km from well site).

18.3.5 Water samples were collected in and around Bhagjan gas well blowout site covering a 2 km radius and from Plastic Park, Tinsukia at 5 km away from the Baghjan well No. 5 Site to compare the quality of water.

18.3.6 The Report on Assessment of Environmental quality of soil and vegetation in the vicinity of Well Baghjan 5, OIL, Duliajan, Assam, the was submitted by M/s TERIon 10.02.2022. A copy of the Report of M/s The Energy and Resources Institute for the Assessment of Environmental Quality of Soil and Vegetation in the vicinity of Baghjan Well No. 5 is annexed herewith and marked as **Annexure-R26**.

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18.4 Observations: The following observations were made in the Report:

18.4.1 **SOIL QUALITY**

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18.4.1.1 All the collected soil samples showed the TPH (Total Petroleum Hydrocarbon) concentration within the remediation standard guideline range of <5000 mg/kg given by Central Pollution Control Board.

18.4.1.2 Among 17 soil samples collected from different locations, South west zone of Maguri Beel sample showed trace level of Fluoranthene (0.15 mg/kg) and Pyrene (0.11 mg/kg). Remaining all other samples, the PAH level was below detectable limit.

18.4.1.3 The BTEX (Benzene Toluene Ethyl Xylenes) concentration was also below detection limit in all tested soil samples.

18.4.1.4 These results revealed that the surrounding soil environment is free from contamination due to natural process like heavy rainfall during the monsoon.

18.4.2 **WATER QUALITY**

18.4.2.1 The oil & grease, PAH and heavy metals concentration were below the detection limit in all the 13 samples.

18.4.2.2 The pH, electrical conductivity, TDS, TSS, Total hardness, chloride, sulphide and sulphate were within the acceptable limit of IS: 10500, 2012 drinking water standard.

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18.4.2.3 The sampling area was rich in biodiversity and agricultural field with high groundwater table leads to good quality of water table in the region.

18.4.2.4 The metallic salts and heavy metals such as Zinc, Nickle, Chromium, Lead, Cadmium, etc. were found to be below detection limits in all the tested water sample showed that the absence of pollutants plume in the ground water ecosystem.

18.4.2.5 The parameters like total phenolic compounds found to be more than the permissible limit prescribed in IS 10500:2012 which may be due to peculation from natural sources of phenols to aquatic systems include decomposition of aquatic vegetation.

18.4.3 **VEGETATION/PLANT AND FISH SAMPLE**

18.4.3.1 One representative fish sample has been collected from Maguri Motapung Beel and analyzed for the Heavy metals, PAH and BTEX. The analysis result shows that there is no accumulation of PAH, BTEX and tested heavy metals like cadmium, lead, mercury, nickel and hexavalent chromium. It was further observed by M/s TERI during their field visit that there was no fish mortality or any other oil floating material or condensate.

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18.4.3.2 There is no accumulation of TPH and total PAH in the analyzed plant biomass.

18.4.3.3 It was observed that the affected surrounding environment is free from contamination may be due to post monsoon investigation.

18.5 CONCLUSION: Based on the sampling and analysis of soil, water and vegetation sample in surround environment including bioreserve, the said study reveal the absence of significant pollutants except traces of TPH content in the soil (within the acceptable limit) may be the only concern in further assessment and mitigation

19. **INTERIM PROGRESS REPORT ON BIODIVERSITY IMPACT ASSESSMENT STUDY BY INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN) SUBMITTED TO ASSAM BIODIVERSITY BOARD**

19.1.1 It is most humbly submitted that the Answering Respondent by a tripartite Memorandum of Understanding (MOU) dated 04.05.2021 engaged International Union for Conservation of Nature (IUCN) and Assam Biodiversity Board for conducting a biodiversity impact assessment study as well as to develop a comprehensive Biodiversity plan with its implementation strategy & framework.

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19.1.2 The study area is situated in Baghjan village and which includes three main components – ecological assessment, biodiversity impact assessment and ecosystem services review.

19.1.3 It is submitted that baseline data was collected during the monsoon (August 2021) and winter (December 2021) and that an interim progressreport for season 1 and season 2 was submitted on 18.01.2022 by IUCN. A copy of the interim progress report of two seasons submitted by IUCN to Assam Biodiversity Board and the Answering Respondent is annexed herewith and marked as **Annexure-R27**.

19.1.4 As per the report Various species including those falling under IUCN Red List and Indian Wildlife (Protection) Act, 1972 Schedules were observed during the primary data collection. The details of the species recorded during the two seasons are as follows:

Particular	Season 1 Monsoon Season	Season 2 Winter Season	Combined
Birds	65	133	147
Butterflies	70	80	112
Mammals	4	10	10

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Herpetofauna	4	2	6
Fishes	17	19	19
Trees	39	44	85
Shrubs	33	33	57
Herbs	62	86	152
Pteridophytes	13	20	47

19.1.5 It is most humbly submitted that IUCN (International Union for Conservation of Nature and Natural Resources) Red List for worldwide population and conservation status of the species and Indian Wildlife (Protection) Act (WPA), 1972 which provides legal protection level to different species in India are referred by IUCN while analysing the biodiversity data collected by it. The said information helps the organisation to predict the sensitive species present in the study area to formulate an action plan for their protection and conservation within the study area. The quantitative analysis involves the calculation of relative density and relative frequency for the recorded population of floral and faunal biodiversity. These values indicate species with the densest population, most frequently encountered species and areas with good biodiversity richness.

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19.1.6 It is submitted that the red list categorizes all the species in 8 broad categories with varying degrees of conservation importance. The most critical categories are the 'threatened categories' consisting of Vulnerable, Endangered and Critically Endangered Species; whereas, 'Near Threatened' category denotes likeliness of a species to fall in the threatened categories due to the decline in the population.

19.1.7 It is submitted that 7 birds and one mammal species, falling in the Near Threatened category of IUCN Red List were also observed in the study area, while 2 birds in vulnerable and 1 in critical endangered were also recorded. The details of the same are as follows:

Taxa	Critically Endangered	Endangered	Vulnerable	Near Threatened
Birds	1	0	3	7
Mammals	0	3	1	1
Fishes	0	0	1	0

19.1.8 I most humbly submit that Indian Wildlife (Protection) Act, 1972 (hereinafter referred to as the "WPA") categorizes the wildlife of India in six different schedules, the first five of which are for animals and the sixth for plants. It is submitted that organisms listed in these schedules are accorded varying degrees of protection, with animals falling

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under Schedule I and Schedule II being accorded maximum protection.

19.1.9 I most humbly submit that a number of birds, mammals, butterflies and replies protected under the Schedule I and II of the WPA were observed, the details of the same are as follows:

Taxa	Bird	Mammals	Reptiles	Butterflies
Schedule I	4	3	0	4
Schedule II	0	5	1	19

20. I on behalf of the Answering Respondent also submit thata number of migratory birds arrive at the Maguri Motapung wetland during winters and stays there from November till March. It is most humbly submitted that a number of migratory birds were sighted in the Maguri Motapung Wetland and Dibru Saikhowa National Park during the said period in 2021. In fact, it is pertinent to note that rare Mandarin Duck was also sighted at the wetland during the month of February 2021 after a period of almost 118 years. Copy of the Print out of various newspapers articles reporting the sighting of the MandarinDuck after a period of 118 years are annexed herewith and marked as **Annexure-R28**.

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21. I on behalf of the Answering Respondent further submit that the rare Mandarin Duck was further again sighted in the month of February of 2022 along with a number of migratory birds in the Maguri Motapung Wetland and at the Dibru Saikhowa National Park. Copy of the Photographs of the Migratory Birds along with other birds and wild animals during the period of December 2021-February 2022 sighted at Maguri Motapung Wetland and at the Dibru Saikhowa National Park are annexed herewith and marked as **Annexure -R29**.

22. It is further humbly submitted that in order to carry out a self-assessment, the Answering Respondent also carried out an inspection in April 2022 to map and understand the bio-remediation efforts taken by the Answering Respondent. It is humbly submitted that the Answering Respondent was only provided possession of the incident blowout site in August 2021, thereby providing 08 months for the Answering Respondent to carry out the restoration works in an around the blow-out site.

23. It is submitted that the Answering Respondent has spent more than 28 crores in bio-remediation activities till now, in and around the Baghjan area. Further, owing to such efforts by the Answering Respondent while the inspection was carried out by the internal health, safety and environment (HSE)

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team of the Answering Respondent, a significant impact was visible in the environment including flora, fauna and even in the lives of the locals.

24. It is humbly submitted that the HSE team visited and made observations in primarily four main areas including the main blowout site being Baghjan well no. 5, Maguri Motapung Wetland, Dibru Saikhowa National Park and the nearby villages of Baghjan and Natun. A copy of a map indicating at the relevant areas is annexed herewith and marked as **Annexure-R30**.

25. In all the areas, the common observations made by the HSE team was as under:

(i) significant traces of flora which depicts fertility of soil,

(ii) agricultural activities indicating quality of water and fertility of soil,

(iii) presence of fauna including birds, butterflies, insects, fishes, cattle and livestock indicating at the quality of ambient air quality and th environment on the whole,

(iv) locals leading normal lives and engaged in fishing, agricultural and other local activities,

(v) well-built huts and houses indicating at the social impact on the locals in and around baghjan area; and

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(vi) no trace of oily sludge, condensate on water bodies or foul smell indicating at the restoration of the areas.

26. In view of the observations made by the HSE team, it is humbly submitted that while the Answering Respondent shall continue with its restoration efforts especially by carrying out an afforestation drive at the Baghjan site, significant restoration impact is being witnessed in and around the Baghjan area indicating at the *bona fide* of the Answering Respondent. A copy of the restoration report showing the visual representation of the areas prepared by the HSE team is annexed herewith and marked as **Annexure-R31**.

27. It is humbly submitted that there has been gross suppression of material facts in the instant civil appeal, *inter-alia,* pertaining to the steps and efforts taken by the Answering Respondent pursuant to the blowout at Baghjan Well No. 5.

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28. In view of the aforementioned facts and submissions, it is most humbly prayed that this Hon'ble Court may be pleased to take the instant short affidavit on record.

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Head (Legal)
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DEPONENT

VERIFICATION:

I, the above-named Deponent do hereby verify that the averments stated herein above in paragraphs 1 to 28 are true to my knowledge and belief, and they are on the basis of the documents maintained by the Respondent No.1 and no part of it is false and nothing material has been concealed therefrom.

09 MAY 2022

Verified at New Delhi on this _____ day of May, 2022.

Identified
Petal 9/5/2022
I Identify the Deponent who has signed in my presence.

DEPONENT
Dr. Kumudani Sharma
Head (Legal)
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CERTIFIED THAT THE DEPONENT
Sh./Smt./Km. Dr. Kumudani Sharma
S/o W/o D/o By General Manager (Legal)
R/o
Identified by Adv. Petal Chandak
has solemn affirmation before me at
Delhi on No. 4/22
That the contents of the affidavit
which have been read him and explained to
him/her are true & correct to his knowledge.

Oath Commissioner, Delhi

"ANNEXURE-R1"

CONTRACT NO.6113508

FOR

Hiring of services for Monitoring of Ambient air quality, Stack gas emission, Mercury (Hg) in ambient Air, Methane in ambient Air, Non-methane in ambient Air, Total Hydrocarbon (THC) in ambient Air, Volatile Organic Compound (VOC) in Ambient Air and measurement of illumination and noise levels at OIL's Drilling, Workover locations and OIL's installations of Upper Assam and Arunachal Pradesh as per National Ambient Air Quality (NAAQ) standard, Environment Clearance, Ministry of Environment and Forest, Govt. of India (MoEF, GOI), State Pollution Control Board (SPCB) and Central Pollution Control Board (CPCB) guidelines for a period of 02 (Two) years with a provision of extension of 01 (One) year with same terms and conditions.

This Agreement is made on **27th day of November, 2019** between Oil India Limited, a Government of India Enterprise, incorporated under the Companies Act 1956, having its registered office at Duliajan in the State of Assam, hereinafter called the "Company" which expression unless repugnant to the context shall include executors, administrators and assignees on the one part, and **M/s. Arihant Analytical Laboratory Pvt. Ltd., T 306, Vikash Chamber, D Block, Central Market, Prasant Vihar, Delhi-110085, India** (Name and address of Contractor) hereinafter called the "Contractor" which expression unless repugnant to the context shall include executors, administrators and assignees on the other part,

WHEREAS, Contractor engaged themselves in the business of offering such services represents that they have adequate resources and equipment, material etc. in good working order and fully trained personnel capable of efficiently undertaking the operations and is ready, willing and able to carry out the said services for the Company as per Part-II attached herewith for this purpose and

WHEREAS, Company had issued a firm Letter of Award (LOA) No. **OIL/CONT/LOA/O/452/2019-20** dated **08.11.2019** based on Offer No. **60071143** dtd. **04.06.2019** submitted by the contractor against **IFB No. CDO1274P20.**

WHEREAS, Contractor accepted the LOA vide Email dated 21.11.2019.

WHEREAS, Contractor submitted Performance Bank Guarantee **No. 0650ILG005419** dated **20.11.2019**, issued by Punjab National Bank, Model Town Branch, Delhi-9, amounting to **Rs.3,54,750.00** (Rupees Three Lakh Fifty Four Thousand Seven Hundred Fifty only). All these aforesaid documents shall be deemed to form and be read and construed as part of this agreement/contract. However, should there be any dispute arising out of interpretation of this contract in regard to the terms & conditions with those mentioned in Company's tender document and subsequent letters including the Letter of Intent and Contractor's offer and their subsequent letters, the terms and conditions attached hereto shall prevail. Changes, additions or deletions to the terms of the contract shall be authorized solely by an amendment to the contract executed in the same manner as this contract.

NOW WHEREAS, in consideration of the mutual covenants and agreements hereinafter contained, it is hereby agreed as follows -

Contractor

Company

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.

2. In addition to documents herein above, the following Sections and Annexures attached herewith shall be deemed to form and be read and construed as part of this agreement viz.:

(a) PART-I	indicating the General Conditions of this Contract;
(b) PART-II	indicating the Schedule of work, unit, quantities & rates;
(c) PART-III	indicating the Special Conditions of Contract;
(d) PART-V	indicating the Safety Measures.

3. In consideration of the payments to be made by the Company to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Company to provide the Services and to remedy defects therein in conformity in all respect with the provisions of this Contract.

4. The Company hereby covenants to pay the Contractor in consideration of the provision of the Services and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of this Contract at the times and in the manner prescribed by this Contract.

IN WITNESS thereof, each party has executed this contract at Duliajan, Assam as of the date shown above.

Signed, Sealed and Delivered,

Dy. General Manager - Contracts (Operation)
Oil India Limited
Duliajan - 786602
ASSAM

For and on behalf of
Company (**Oil India Limited**)

Name: **BINTYMA SHARMA**

Status: **DGM – CONTRACTS (O)**

In presence of

1. (U. Raj Konwar)

2. Nabajit Rajkhowa

ARIHANT ANALYTICAL LABORATORY (P) LTD. AUTHORISION

For and on behalf of Contractor
(**M/s. Arihant Analytical Laboratory Pvt. Ltd.**)

Name: DR. D. R. SHARMA

Status: General Manager (Q & A)

In presence of

1. SUNIL RAGHAV – CM

2. Kamal Rika.

Contractor

CONTRACTS DEPARTMENT DULIAJAN PIN 786602 ASSAM OIL INDIA LTD.

Company

PART-I: GENERAL CONDITIONS OF CONTRACT (GCC)

A. DEFINITIONS:

In the contract, the following terms shall be interpreted as indicated:

(a) "**The Contract**" means agreement entered into between Company and Contractor, as recorded in the contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein;

(b) "**The Contract Price**" means the price payable to Contractor under the contract for the full and proper performance of its contractual obligations;

(c) "**The Work**" means each and every activity required for the successful performance of the services described in Section II, the Terms of Reference.

(d) "**Company**" or "**OIL**" means Oil India Limited;

(e) "**Contractor**" means the Contractor performing the work under this Contract.

(f) "**Contractor's Personnel**" means the personnel to be provided by the Contractor to provide services as per the contract.

(g) "**Company's Personnel**" means the personnel to be provided by OIL or OIL's Contractor (other than the Contractor executing the Contract). The Company representatives of OIL are also included in the Company's personnel.

(h) "**Gross Negligence**" means any act or failure to act (whether sole, joint or concurrent) by a person or entity which was intended to cause, or which was in reckless disregard of or wanton indifference to, avoidable and harmful consequences such person or entity knew, or should have known, would result from such act or failure to act. Notwithstanding the foregoing, Gross negligence shall not include any action taken in good faith for the safeguard of life or property.

(i) "**Wilful Misconduct**" means intentional disregard of good and prudent standards of performance or proper conduct under the Contract with knowledge that it is likely to result in any injury to any person or persons or loss or damage of property.

WITNESSETH:

1.0 a) The contractor hereby agrees to carry out the work set down in the Schedule of work which forms part-II of this Contract in accordance with the 1968 General Conditions of Contract of Oil India Limited and General Specifications read in conjunction with any drawings and Particular Specifications & instructions which forms Part-III of the contract utilizing any materials/services as offered by the Company as per Part-IV of the contract in **Naharkatiya, Jorajan, Salmari, Kathaloni, Dikom, Tengakhat, Hapjan, Moran, Baghjan, Chabua, Barekuri, Makum, Digboi, Manabhum, Kharsang, Kusijan area and other areas as instructed by the Company.**

b) In this Contract all words and expressions shall have the same meaning as are respectively assigned to them in the 1968 General Conditions of Contract of Oil India Limited which the Contractor has perused and is fully conversant with before entering into this Contract.

c) The clauses of this contract and of the specifications set out hereunder shall be paramount and in the event of anything herein contained being inconsistent with any term or terms of the 1968 General Conditions of Contract of Oil India Limited, the said term or terms of the 1968 General conditions of Contract to the extent of such inconsistency, and no further, shall not be binding on the parties hereto.

2.0 The contractor shall provide all labour, supervision and transport and such specified materials described in part-II of the Contract including tools and plants as necessary for the work and shall be responsible for all royalties and other levies and his rates shall include for these. The work executed and materials supplied shall be to the satisfaction of the Company's Engineer and Contractor's rates shall include for all incidental and contingent work which although not specifically mentioned in this contract are necessary for its completion in a sound and workman like manner.

3.0 The Company's Engineer shall have power to:

a) Reduce the rates at which payments shall be made if the quality of work although acceptable is not up to the required standard set forth in the OIL Standard Specifications which have been perused and fully understood by the Contractor.

b) Order the Contractor to remove any inferior material from the site and to demolish or rectify any work of inferior workmanship, failing which the Company's Engineer may arrange for any such work to be demolished or rectified by any other means at the Contractor's expenses.

c) Order the Contractor to remove or replace any workman who he (The Engineer) considers incompetent or unsuitable; the Engineer's opinion as to the competence and suitability of any workman engaged by the Contractor shall be final and binding on the Contractor.

d) Issue to the Contractor from time to time during the progress of the work such further drawings and instructions as shall be necessary for the purpose of proper and adequate execution and maintenance of the works and the Contractor shall carry out and be bound by the same.

e) Order deviations in Part II and III of this Contract. All such deviation orders shall be in writing and shall show the financial effect, if any, of such deviation and whether any extra time is to be allowed.

4.0 The Contractor shall have no claim against the company in respect of any work which may be withdrawn but only for work actually completed under this contract. The contractor shall have no objection to carry out work in excess of the quantities stipulated in Part-II if so ordered by the company at the same rates, terms and conditions.

5.0 The Company reserves the right to cancel this Contract at any time upon full payment of work done and the value of the materials collected by the contractor for permanent incorporation in the work under this contract particularly for execution of this contract up to the date of cancellation of the Contract. The valuation of the work done and

Contractor

Company

the materials collected shall be estimated by the company's Engineer in presence of the contractor. The Contractor shall have no claim to any further payment whatsoever. The valuation would be carried out exparte if Contractor fails to turn up despite reasonable notice which will be binding on the Contractor.

6.0 The Contractor hereby undertakes to indemnify the Company against all claims which may arise under the under noted Acts:

i) The Mines Act.
ii) The Minimum Wages Act, 1948.
iii) The Workman's Compensation Act, 1923.
iv) The Payment of wages Act, 1936.
v) The Payment of Bonus Act, 1965.
vi) The Contract Labour (Regulation & Abolition) Act, 1970 and the rules framed there under.
vii) Employees' Pension Scheme, 1995.
viii) Inter-State Migrant (Regulation of Employment and Condition of Service) Act. 1979.
ix) The Employees Provident Fund and Miscellaneous Provisions Act, 1952.
x) GST Act.

or any other Acts or Statute not here in above specifically mentioned having bearing over engagement of workers directly or indirectly for execution of work. The Contractor shall not make the Company liable to reimburse the Contractor for the statutory increase in the wage rates of the Contract Labour appointed by the Contractor. Such Statutory increase in the wage rates of Contract Labour shall be borne by the contractor.

7.0 The Contractor shall clear away all rubbish and surplus material from the site on completion of work and shall leave the site clean and tidy.

8.0 The duration of the contract shall be initially for a period of **02 (Two) Years** from the commencement of the same i.e. after completion of mobilization as per Company's requirement with a provision of extension by another **01 (One) year**. The Contractor must complete the work as mentioned in PART – III (SPECIAL CONDITIONS OF CONTRACT: SCC) within the contract period. In the event of there being undue delay in execution of the Contract, the Company reserves the right to cancel the Contract and/or levy such additional damages as it deems fit based on the actual loss suffered by the company attributable to such delay. The company's decision in this regard shall be final.

9.0 In order to promote, safeguard and facilitate the general operational economic in the interest of the Company during the continuance of this contract the Contractor hereby agrees and undertakes not to take any direct or indirect interest and or support, assist, maintain or help any person or persons engaged in antisocial activities, demonstration, riots, or in any agitation prejudicial to the Company's interest and any such even taking shape or form at any place of the Company's works or and its neighborhood.

10.0 The tendered price inclusive of all liabilities and exclusive of GST (i.e. the Contract price) is **Rs.70,95,000.00(Rupees Seventy Lakh Ninety Five Thousand only)** but the Company shall pay the Contract or only for actual work done at the all-inclusive rates set down in the Schedule of work Part II of this Contract.

Contractor

Company

T-C

On account payment may be made, not often than monthly, up to the amount of **100%** of the value of work done. Final payment will be made only after satisfactory completion of the work. Such final payment shall be based on the work actually done allowing for deviations and any deductions and the measurement shall be checked and certified correct by the Company's Engineer before any such final payment is made.

Note: All Invoices are to be sent to the following address:
Chief General Manager – R&D
Oil India Limited,
P.O. Duliajan-786602
Dist. Dibrugarh, Assam.

11.0 The contractor employing **20 (twenty)** or more workmen on any day preceding 12 months shall be required to obtain requisite license at his cost from the appropriate Licensing Officer before undertaking any Contract work. The Contractor shall also observe the rules & regulations framed under the Contract Labour (Regulation & Abolition) Act.

12.0 The Contractor will not be allowed to construct any structure (for storage/housing purpose) with thatch, bamboo or any other inflammable materials within any company's fenced area.

13.0 The Contractor shall ensure that all men engaged by him/her are provided with appropriate protective clothing and safety wear in accordance with regulation 89(a) and 89(b) in the Oil Mines Regulations 1984. The Company's representative shall not allow/accept those men who are not provided with the same.

14.0 The Contractor shall deploy local persons in all works.

15.0 The Contractor shall not engage minor labour below 18 (eighteen) years of age under any circumstances.

16.0 The Contractor and his/her workmen shall strictly observe the rules and regulations as per Mines Act (Latest editions).

17.0 GENERAL OBLIGATIONS OF COMPANY:

COMPANY shall, in accordance with and subject to the terms and conditions of this contract:

i) Pay the Contractors in accordance with terms and conditions of the contract.

ii) Allow access to Contractors and their personnel, subject to normal security and safety procedures, to all areas as required for orderly performance of the work.

18.0 SPECIAL CONDITIONS:

a) The contractor will be required to allow OIL Officials to inspect the work site and documents in respect of the workers' payment.

b) Contractor(s) whosoever is liable to be covered under the P.F. Act and contract cost is inclusive of P.F., must ensure strict compliance of provisions of Provident Fund

Contractor

Company

and Miscellaneous Provisions Act, 1952 in addition to the various Acts mentioned elsewhere in this contract. Any contractor found violating these provisions will render themselves disqualified from any future tendering. As per terms of the contract, if applicable, the Contractor must deposit Provident Fund Contribution (covering Employee's & Employer's share) with the competent authority monthly under their direct code. The Contractor shall be required to submit documentary evidence of deposit of P.F. Contribution to the Company. In case of failure to provide such documentary evidence, the Company reserves the right to withhold the amount equivalent to applicable P.F. Contribution.

19.0 ARBITRATION:

19.1 ARBITRATION (APPLICABLE FOR SUPPLIERS/CONTRACTORS OTHER THAN PSU)

Except as otherwise provided elsewhere in the contract, if any dispute, difference, question or disagreement arises between the parties hereto or their respective representatives or assignees, in connection with construction, meaning, operation, effect, interpretation of the contract or breach thereof which parties are unable to settle mutually, the same shall be referred to Arbitration as provided hereunder:

a) A party wishing to commence arbitration proceeding shall invoke Arbitration Clause by giving 30 days' notice to the other party. The notice invoking arbitration shall specify all the points of dispute with details of the amount claimed to be referred to arbitration at the time of invocation of arbitration and not thereafter. If the claim is in foreign currency, the claimant shall indicate its value in Indian Rupee for the purpose of constitution of the arbitral tribunal.

b) The number of arbitrators and the appointing authority will be as under:

Claim amount (excluding claim for interest and counter claim, if any)	Number of Arbitrator	Appointing Authority
Up to Rs. 5 Crore	Sole Arbitrator	OIL
Above Rs. 5 Crore	3 Arbitrators	One Arbitrator by each party and the 3rd Arbitrator, who shall be the presiding Arbitrator, by the two Arbitrators.

c) The parties agree that they shall appoint only those persons as arbitrators who accept the conditions of the arbitration clause. No person shall be appointed as Arbitrator or Presiding Arbitrator who does not accept the conditions of the arbitration clause.

d) Parties agree that there will be no objection if the Arbitrator appointed holds equity shares of OIL and/or is a retired officer of OIL/any PSU. However, neither party shall appoint its serving employees as arbitrator.

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Company

e) If any of the Arbitrators so appointed dies, resigns, becomes incapacitated or withdraws for any reason from the proceedings, it shall be lawful for the concerned party/arbitrators to appoint another person in his place in the same manner as aforesaid. Such person shall proceed with the reference from the stage where his predecessor had left if both parties consent for the same; otherwise, he shall proceed de novo.

f) Parties agree that neither shall be entitled for any pre-reference or pendente-lite interest on its claims. Parties agree that any claim for such interest made by any party shall be void.

g) The arbitral tribunal shall make and publish the award within time stipulated as under:

Amount of Claims and counter claims(excluding interest)	Period for making and publishing of the award (counted from the date of first meeting of the Arbitrators)
Up to Rs. 5 Crore	Within 8 months
Above Rs. 5 Crore	Within 12 months

The above time limit can be extended by Arbitrator, for reasons to be recorded in writing, with the consent of the other parties.

h) If after commencement of the arbitration proceedings, the parties agree to settle the dispute mutually or refer the dispute to conciliation, the arbitrators shall put the proceedings in abeyance until such period as requested by the parties.

i) Each party shall be responsible to make arrangements for the travel and stay etc. of the arbitrator pointed by it. Claimant shall also be responsible for making arrangements for travel/stay arrangements of the Presiding Arbitrator and the expenses incurred shall be shared equally by the parties.

In case of sole arbitrator, OIL shall make all necessary arrangements for his travel, stay and the expenses incurred shall be shared equally by the parties.

j) The Arbitration shall be held at **Duliajan, Assam**. However, parties to the contract can agree for a different place for the convenience of all concerned.

k) The Arbitrator(s) shall give reasoned and speaking award and it shall be final and binding on the parties.

l) Subject to aforesaid, provisions of the Arbitration and Conciliation Act, 1996 and any statutory modifications or re-enactment thereof shall apply to the arbitration proceedings under this clause.

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DULIAJAN PIN 786 602 ASSAM OIL INDIA LTD.
Company

19.2 ARBITRATION (APPLICABLE IN CASE OF CONTRACT AWARDED ON PUBLIC SECTOR ENTERPRISE):

In the event of any dispute or difference relating to, arising from or connected with the Contract, such dispute or difference shall be referred by either party to the arbitration of one of the Arbitrators in the Department of Public Enterprises, to be nominated by the Secretary to the Government of India, In-Charge of the Bureau of Public Enterprises. The Arbitration and Conciliation Act 1996 shall not be applicable to the Arbitration under this clause. The award of the Arbitrator shall be binding upon the parties to the dispute, provided however, any party aggrieved by such award may make a further reference for setting aside or revision of the award to the Law Secretary, Deptt. of Legal Affairs, Ministry of Law and Justice, Government of India. Upon such reference, the dispute shall be decided by the Law Secretary or the Special Secretary/Additional Secretary, whose decision shall bind the parties finally and conclusively. The parties in the dispute will share equally the cost of the arbitration as intimated by the Arbitrator.

The venue of all arbitrations under both 19.1 & 19.2 will be **Duliajan, Assam**. The award made in pursuance thereof shall be binding on the parties.

20.0 FORCE MAJEURE:

20.1 In the event of either party being rendered unable by 'Force majeure' to perform any obligations required to be performed by them under the contract the relative obligations of the party affected by such 'Force Majeure' shall upon notification to the other party be suspended for the period during which force majeure event lasts. The cost and loss sustained by the either party shall be borne by the respective parties.

The term 'Force Majeure' as employed herein shall mean acts of God, earthquake, war (declared/undeclared) revolts, riots, fires, floods, rebellions, explosions, hurricane, sabotage, civil commotions, and acts and regulations of respective Govt. of the two parties, namely the Company and the contractor.

20.2 Upon the occurrence of such cause(s) and upon its termination, the party alleging that it has been rendered unable as aforesaid thereby, shall notify the other party in writing immediately but not later than 72 (Seventy-two) hours of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of its claim.

Time for performance of the relative obligations suspended by the force majeure shall then extended by the period for which such cause lasts.

20.3 Should 'force majeure' condition as stated above occurs and should the same be notified within Seventy-Two (72) hours after its occurrence the 'force majeure' rate shall apply for the first fifteen days. Parties will have the right to terminate the Contract if such 'force majeure' conditions continue beyond fifteen (15) days with prior written notice. Should either party decide not to terminate the Contract even under such condition, no payment would apply after expiry of fifteen (15) days force majeure period unless otherwise agreed to.

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Contractor

CONTRACTS DEPARTMENT DULIAJAN PIN 786 602
Company

21.0 TERMINATION:

21.1 TERMINATION ON EXPIRY OF THE TERMS (DURATION): The contract shall be deemed to have been automatically terminated on the expiry of duration of the Contract or the extension period, if exercised by Company under the provision of the Contract.

21.2 TERMINATION ON ACCOUNT OF FORCE MAJEURE: Either party shall have the right to terminate this Contract on account of Force Majeure as set forth in Article 20.0 above.

21.3 TERMINATION ON ACCOUNT OF INSOLVENCY: In the event that the Contractor or its collaborator at any time during the term of the Contract, becomes insolvent or makes a voluntary assignment of its assets for the benefit of creditors or is adjudged bankrupt, then the Company shall, by a notice in writing have the right to terminate the Contract and all the Contractor's rights and privileges hereunder, shall stand terminated forthwith.

21.4 TERMINATION FOR UNSATISFACTORY PERFORMANCE: If the Company considers that, the performance of the Contractor is unsatisfactory, or not up to the expected standard, the Company shall notify the Contractor in writing and specify in details the cause of the dissatisfaction. The Company shall have the option to terminate the Contract by giving 15 days' notice in writing to the Contractor, if Contractor fails to comply with the requisitions contained in the said written notice issued by the Company.

21.5 TERMINATION DUE TO CHANGE OF OWNERSHIP & ASSIGNMENT: In case the Contractor's rights and/or obligations under this Contract and/or the Contractor's rights, title and interest to the equipment/material, are transferred or assigned without the Company's consent, the Company may at its absolute discretion, terminate this Contract.

21.6 If at any time during the term of this Contract, breakdown of Contractor's equipment results in Contractors being unable to perform their obligations hereunder for a period of 15 successive days, Company at its option, may terminate this Contract in its entirely without any further right or obligation on the part of the Company, except for the payment of money then due. No notice shall be served by the Company under the condition stated above.

21.7 Notwithstanding any provisions herein to the contrary, the Contract may be terminated at any time by the Company on giving 30 (thirty) days written notice to the Contractor due to any other reason not covered under the above clause from 21.1 to 21.6 and in the event of such termination the Company shall not be liable to pay any cost or damage to the Contractor except for payment for services as per the Contract upto the date of termination including the De-mob cost, if any.

22.0 CONSEQUENCES OF TERMINATION: In all cases of termination herein set forth, the relative obligations of the parties to the Contract shall be limited to the period up to the date of termination. Notwithstanding the termination of this Contract, the parties shall continue to be bound by the provisions of this Contract that reasonably require some action or forbearance after such termination.

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22.1 Upon termination of this Contract, Contractor shall return to Company all of Company's items, which are at the time in Contractor's possession.

22.2 In the event of termination of contract, Company will issue Notice of termination of the contract with date or event after which the contract will be terminated. The contract shall then stand terminated and the Contractor shall demobilize their personnel & materials.

23.0 I.B. VERIFICATION REPORT AND SECURITY REVIEW: Contractor will be required to submit the verification report to ascertain character and antecedents from the Civil Administration towards the persons engaged under this contract to the Head of the user Department before engagement.

24.0 In case of any doubt or dispute as to the interpretation of any clause herein contained, the decision of the Company's Engineer shall be final and binding on the contractor.

25.0 SET OFF CLAUSE: "Any sum of money due and payable to the contractor (including Security Deposit refundable to them) under this or any other contract may be appropriated by Oil India Limited and set off against any claim of Oil India Limited (or such other person or persons contracting through Oil India Limited) for payment of a sum of money arising out of this contract or under any other contract made by the contractor with Oil India Limited (or such other person or persons contracting through Oil India Limited)."

26.0 FURNISHING FRAUDULENT INFORMATION/DOCUMENT: The information and documents furnished by the bidder/contractor in respect of the subject tender/contract are expected to be true and genuine. However, if it is detected during technical scrutiny or after award of the contract or after expiry of the contract, that the bidder had submitted any fake/fraudulent document or furnished false statement, the offer/contract shall be rejected/cancelled, as the case may be and the bidder (if fake document/false statement pertains to such bidder) shall be dealt as per the Banning Policy (available in OIL's website) of Company.

27.0 PROVISION FOR ACTION IN CASE OF ERRING/DEFAULTING AGENCIES: Action against erring and defaulting agencies like bidder, contractor, supplier, vendor, service provider will be as per OIL's Banning Policy dated 6th January, 2017 available in OIL's website www.oil-india.com.

28.0 LIQUIDATED DAMAGES FOR DELAY IN MOBILIZATION/COMPLETION OF WORKS AND SERVICES: In the event of the Contractor's default in timely mobilization/completion within the stipulated period, the Contractor shall be liable to pay liquidated damages @ 0.5% of contract value, per week or part thereof of delay subject to maximum ceiling of 7.5% of contract value.

29.0 SUBCONTRACTING: CONTRACTORS shall not subcontract or assign, in whole or in part, their obligations to perform under this contract, except with COMPANY'S prior written consent.

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30.0 MISCELLANEOUS PROVISIONS: Contractors shall conform in all respects with the provisions of any Statute, Ordinance of Law and the regulations or bye-law of any local or other duly constituted authority which may be applicable to the services and with such rules and regulation public bodies and Companies as aforesaid and shall keep OIL indemnified against all penalties and liability of every kind for breach of any such Statute, Ordinance or Law, regulation or byelaw.

31.0 LIABILITY:

31.1 Except as otherwise expressly provided, neither Company nor its servants, agents, nominees, Contractors, or sub-contractors shall have any liability or responsibility whatsoever to whomsoever for loss of or damage to the equipment and/or loss of or damage to the property of the Contractor and/or their Contractors or sub-contractors, irrespective of how such loss or damage is caused and even if caused by the negligence of Company and/or its servants, agent, nominees, assignees, contractors and sub-contractors. The Contractor shall protect, defend, indemnify and hold harmless Company from and against such loss or damage and any suit, claim or expense resulting there from.

31.2 Neither Company nor its servants, agents, nominees, assignees, Contractors, sub-contractors shall have any liability or responsibility whatsoever for injury to, illness, or death of any employee of the Contractor and/or of its contractors or sub-contractor irrespective of how such injury, illness or death is caused and even if caused by the negligence of Company and/or its servants, agents nominees, assignees, Contractors and sub-contractors. Contractor shall protect, defend, indemnify and hold harmless Company from and against such liabilities and any suit, claim or expense resulting there from.

31.3 The Contractor hereby agrees to waive its right to recourse and further agrees to cause their underwriters to waive their right of subrogation against Company and/or its underwrites, servants, agents, nominees, assignees, Contractors and sub-contractors for loss or damage to the equipment of the Contractor and/or its sub-contractors when such loss or damage or liabilities arises out of or in connection with the performance of the contract.

31.4 The Contractor hereby further agrees to waive its right of recourse and agrees to cause its underwriters to waive their right of subrogation against Company and/or its underwriters, servants, agents, nominees, assignees, Contractors and sub-contractors for injury to, illness or death of any employee of the Contractor and of its contractors, sub-contractors and/or their employees when such injury, illness or death arises out of or in connection with the performance of the contract.

31.5 Except as otherwise expressly provided, neither Contractor nor its servants, agents, nominees, Contractors or sub-contractors shall have any liability or responsibility whatsoever to whomsoever for loss of or damage to the equipment and/or loss or damage to the property of the Company and/or their Contractors or sub-contractors, irrespective of how such loss or damage is caused and even if caused by the negligence of Contractor and/or its servants, agents, nominees, assignees, Contractors and sub-contractors. The Company shall protect, defend, indemnify and hold harmless Contractor from and against such loss or damage and any suit, claim or expense resulting therefrom.

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31.6 Neither Contractor nor its servants, agents, nominees, assignees, Contractors, sub-contractors shall have any liability or responsibility whatsoever to whomsoever or injury or illness, or death of any employee of the Company and/or of its contractors or sub-contractors irrespective of how such injury, illness or death is caused and even if caused by the negligence of Contractor and/or its servants, agents, nominees, assignees, contractors and sub-contractors. Company shall protect, defend indemnify and hold harmless Contractor from and against such liabilities and any suit, claim or expense resulting there from.

31.7 The Company agrees to waive its right of recourse and further agrees to cause its underwriters to waive their right of subrogation against Contractor and/or its underwriters, servants, agents, nominees, assignees, Contractors and sub-contractors for loss or damage to the equipment of Company and/or its contractors or sub-contractors when such loss or damage or liabilities arises out of or in connection with the performance of the contract.

31.8 The Company hereby further agrees to waive its right of recourse and agrees to cause it underwriters to waive their right of subrogation against Contractor and/or its underwriters, servants, agents, nominees, assignees, Contractors and sub-contractors for injury to, illness or death of any employee of the Company and of its Contractors, sub-contractors and/or their employees when such injury, illness or death arises out of or in connection with the performance of the Contract.

31.9 LIMITATION OF LIABILITY: Notwithstanding any other provisions except only in cases of willful misconduct and/or criminal acts,

(a) Neither the Contractor nor the Company (OIL) shall be liable to the other, whether in Contract, tort, or otherwise, for any consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs.

(b) Notwithstanding any other provisions incorporated elsewhere in the contract, the aggregate liability of the Contractor in respect of this contract, whether under Contract, in tort or otherwise, shall not exceed 100% of the Contract price, provided however that this limitation shall not apply to the cost of repairing or replacing defective equipment by the Contractor, or to any obligation of the Contractor to indemnify the Company with respect to Intellectual Property Rights.

Company shall indemnify and keep indemnified Contractor harmless from and against any and all claims, costs, losses and liabilities in excess of the aggregate liability amount in terms of clause (b) above.

32.0 CONSEQUENTIAL DAMAGE: Except as otherwise expressly provided, neither party shall be liable to the other for special, indirect or consequential damages resulting from or arising out of the contract, including but without limitation, to loss or profit or business interruptions, howsoever caused and regardless of whether such loss or damage was caused by the negligence (either sole or concurrent) of either party, its employees, agents or sub-contractors.

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33.0 INDEMNITY AGREEMENT:

33.1 Except as provided hereof Contractor agrees to protect, defend, indemnify and hold Company harmless from and against all claims, suits, demands and causes of action, liabilities, expenses, cost, liens and judgments of every kind and character, without limit, which may arise in favour of Contractor's employees, agents, Contractors and subcontractors or their employees on account of bodily injury or death, or damage to personnel/property as a result of the operations contemplated hereby, regardless of whether or not said claims, demands or causes of action arise out of the negligence or otherwise, in whole or in part or other faults.

33.2 Except as provided hereof Company agrees to protect, defend, indemnify and hold Contractor harmless from and against all claims, suits, demands and causes of action, liabilities, expenses, cost, liens and judgments of every kind and character, without limit, which may arise in favour of Company's employees, agents, Contractor and subcontractors or their employees on account of bodily injury or death, or damage to personnel/property as a result of the operations contemplated hereby, regardless of whether or not said claims, demands or causes of action arise out of the negligence or otherwise, in whole or in part or other faults.

34.0 APPLICABLE LAW:

34.1 This Contract shall be deemed to be a Contract made under, governed by and construed in accordance with the laws of India for the time being in force and shall be subject to the exclusive jurisdiction of Courts situated at Dibrugarh in Assam.

34.2 The Bidders shall ensure full compliance of various Indian Laws and Statutory Regulations, to the extent applicable for performing under this Contract.

35.0 TAXES: Tax levied as per the provisions of Indian Income Tax Act and any other enactment/rules on income derived/payments received under the contract will be on Contractor's account.

36.0 SUBSEQUENTLY ENACTED LAWS:

36.1 In the event of introduction of any new legislation or any change or amendment or enforcement of any Act or Law, rules or regulations of Government of India or State Government(s) or Public Body which becomes effective after the date of submission of Price Bid or revised price bid, if any, for this CONTRACT and which results in increased/decreased cost of the works under the CONTRACT through increased/decreased liability of taxes, (other than personnel and Corporate taxes), duties, the Parties shall agree to a revision in pricing to reflect such change subject to the production of documentary proof to the satisfaction of the COMPANY/CONTRACTOR as applicable to the extent which directly is attributable to such introduction of new legislation or change or amendment as mentioned above and adjudication by the competent authority (applicable when disputed by COMPANY) & the courts wherever levy of such taxes/duties are disputed by COMPANY/CONTRACTOR.

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36.2 Any increase in net amount of the duties and taxes (i.e. the amount of taxes/duties payable minus eligible credit of taxes/duties paid on input services/inputs) after the contractual completion/mobilization date during the extended period will be to the contractor's account, where delay in completion/mobilization period is attributable to the CONTRACTOR. However, any decrease in net amount of the duties and taxes (i.e. the amount of taxes/duties payable minus eligible credit of taxes/duties paid on input services/inputs) after the contractual completion/mobilization date will be to COMPANY's account.

36.3 The Contract Price and other prices given in the Schedule of Prices are based on the applicable tariff as indicated by the CONTRACTOR in the Schedule of Prices. In case this information subsequently proves to be wrong, incorrect or misleading, COMPANY will have no liability to reimburse/pay to the CONTRACTOR the excess duties, taxes, fees, if any finally levied/imposed by the concerned authorities. However, in such an event, COMPANY will have the right to recover the difference in case the rate of duty/tax finally assessed is on the lower side.

36.4 Notwithstanding the provision contained in clause 28.1 to 28.2 above, the COMPANY shall not bear any liability in respect of:

i. Personal taxes on the personnel deployed by CONTRACTOR, his sub-contractor/ sub-sub-contractors and Agents etc.

ii. Corporate taxes and Fringe benefit tax in respect of contractor and all of their sub-contractors, agents etc.

iii. Other taxes & duties including Customs Duty, Excise Duty and Service Tax in addition to new taxes etc. in respect of sub-contractors, vendors, agents etc. of the CONTRACTOR.

36.5 In order to ascertain the net impact of the revisions/enactment of various provisions of taxes/duties, the CONTRACTOR is liable to provide following disclosure to COMPANY:

i. Details of each of the input services used in relation to providing service to COMPANY including estimated monthly value of input service and service tax amount.

ii. Details of Inputs (material/consumable) used/required for providing service to Company including estimated monthly value of input and excise duty/CVD paid/payable on purchase of inputs.

37.0 GOODS AND SERVICES TAX:

37.1 GENERAL REMARKS ON TAXES & DUTIES:

In view of **GST** Implementation from 1st July 2017, all taxes and duties including Excise Duty, CST/VAT, Service tax, Entry Tax and other indirect taxes and duties have been submerged in **GST**. Accordingly reference of Excise Duty, Service Tax, VAT, Sales Tax, Entry Tax or any other form of indirect tax except of **GST** mentioned in the bidding document shall be ignored.

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37.2 Bidders are required to submit copy of the GST Registration Certificate while submitting the bids wherever **GST** (CGST & SGST/UTGST or IGST) is applicable.

37.3 "**GST**" shall mean Goods and Services Tax charged on the supply of material(s) and services. The term "**GST**" shall be construed to include the Integrated Goods and Services Tax (hereinafter referred to as "IGST") or Central Goods and Services Tax (hereinafter referred to as "CGST") or State Goods and Services Tax (hereinafter referred to as "SGST") or Union Territory Goods and Services Tax (hereinafter referred to as "UTGST") depending upon the import/interstate or intrastate supplies, as the case may be. It shall also mean GST compensation Cess, if applicable.

37.4 Quoted price/rate(s) should be inclusive of all taxes and duties, except **GST (i.e. IGST or CGST and SGST/UTGST applicable in case of interstate supply or intra state supply respectively and cess on GST if applicable) on the final service**. However, GST rate (including cess) to be provided in the respective places in the Price Bid. Please note that the responsibility of payment of GST (CGST & SGST or IGST or UTGST) lies with the Supplier of Goods/Services (Service Provider) only. Supplier of Goods/Services (Service Provider) providing taxable service shall issue an Invoice/Bill, as the case may be as per rules/regulation of **GST**. Further, returns and details required to be filled under GST laws & rules should be timely filed by Supplier of Goods/Services (Service Provider) with requisite details.

37.4.1 Bidder should also mention the **Harmonized System of Nomenclature** (HSN) and **Service Accounting Codes (SAC)** at the designated place in SOR.

37.5 **Where the OIL is entitled to avail the input tax credit of GST**:

37.5.1 OIL will reimburse the **GST** to the Supplier of Goods/Services (Service Provider) at actuals against submission of Invoices as per format specified in rules/regulation of GST to enable OIL to claim input tax credit of **GST** paid. In case of any variation in the executed quantities, the amount on which the **GST** is applicable shall be modified in same proportion. Returns and details required to be filled under GST laws & rules should be timely filed by supplier with requisite details.

37.5.2 The input tax credit of **GST** quoted shall be considered for evaluation of bids, as per evaluation criteria of tender document.

37.6 **Where the OIL is not entitled to avail/take the full Input Tax Credit of GST**:

37.6.1 OIL will reimburse **GST** to the Supplier of Goods/Services (Service Provider) at actuals against submission of Invoices as per format specified in rules/regulation of **GST** subject to the ceiling amount of **GST** as quoted by the bidder. In case of any variation in the executed quantities (If directed and/or certified by the In-Charge) the ceiling amount on which **GST** is applicable will be modified on pro-rata basis.

37.6.2 The bids will be evaluated based on total price including **GST**.

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37.7 Payments to Service Provider for claiming **GST** amount will be made provided the above formalities are fulfilled. Further, OIL may seek copies of challan and certificate from Chartered Accountant for deposit of **GST** collected from OIL.

37.8 Contractor/vendor shall be required to issue tax invoice in accordance with GST Act and/or Rules so that input credit can be availed by OIL. In the event that the contractor/vendor fails to provide the invoice in the form and manner prescribed under the GST Act read with GST Invoicing Rules thereunder, OIL shall not be liable to make any payment on account of **GST** against such invoice.

37.9 **GST** shall be paid against receipt of tax invoice and proof of payment of **GST** to government. In case of non-receipt of tax invoice or non-payment of **GST** by the contractor/vendor, OIL shall withhold the payment of **GST**.

37.10 **GST** payable under reverse charge mechanism for specified services or goods under GST act or rules, if any, shall not be paid to the contractor/vendor but will be directly deposited to the government by OIL.

37.11 Where OIL has the obligation to discharge **GST** liability under reverse charge mechanism and OIL has paid or is/liable to pay **GST** to the Government on which interest or penalties becomes payable as per GST laws for any reason which is not attributable to OIL or ITC with respect to such payments is not available to OIL for any reason which is not attributable to OIL, then OIL shall be entitled to deduct/setoff/recover such amounts against any amounts paid or payable by OIL to Contractor/Supplier.

37.12 Notwithstanding anything contained anywhere in the Agreement, in the event that the input tax credit of the **GST** charged by the Contractor/Vendor is denied by the tax authorities to OIL for reasons attributable to Contractor/Vendor, OIL shall be entitled to recover such amount from the Contractor/Vendor by way of adjustment from the next invoice. In addition to the amount of **GST**, OIL shall also be entitled to recover interest at the rate prescribed under GST Act and penalty, in case any penalty is imposed by the tax authorities on OIL.

37.13 TDS under GST, if applicable, shall be deducted from contractor's/vendor's bill at applicable rate and a certificate as per rules for tax so deducted shall be provided to the contractor/vendor.

37.14 The Contractor will be under obligation for charging correct rate of tax as prescribed under the respective tax laws. Further the Contractor shall avail and pass on benefits of all exemptions/concessions available under tax laws. Any error of interpretation of applicability of taxes/duties by the contractor shall be to contractor's account.

37.15 It is the responsibility of the bidder to quote the correct GST rate. The classification of goods/services as per GST (Goods & Service Tax) Act should be correctly done by the contractor to ensure that input tax credit on GST (Goods & Service Tax) is not lost to the OIL on account of any error on the part of the contractor.

37.16 In case, the quoted information related to various taxes, duties & levies subsequently proves wrong, incorrect or misleading, OIL will have no liability to reimburse the difference in the duty/tax, if the finally assessed amount is on the higher side and OIL

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will have to right to recover the difference ~~and~~ in case the rate of duty/taxes finally assessed is on the lower side.

37.17 Notwithstanding anything mentioned elsewhere in the Bidding Document the aggregate liability of OIL towards Payment of GST shall be limited to the volume of GST declared by the bidder in its bid & nothing shall be payable extra except for the statutory variation in GST.

37.18 Further, it is the responsibility of the bidders to make all possible efforts to make their accounting/IT system GST compliant in order to ensure availability of Input Tax Credit (ITC) to Oil India Ltd.

37.19 GST liability, if any on account of supply of free samples against any tender shall be to bidder's account.

37.20 In case of statutory variation in **GST,** other than due to change in turnover, payable on the contract value during contract period, the Supplier of Goods/Services (Service Provider) shall submit a copy of the 'Government Notification' to substantiate the rate as applicable on the Bid due date and on the date of revision.

Beyond the contract period, in case OIL is not entitled for input tax credit of **GST**, then any increase in the rate of **GST** beyond the contractual delivery period shall be to Service provider's account whereas any decrease in the rate **GST** shall be passed on to the OIL.

Beyond the contract period, in case OIL is entitled for input tax credit of **GST**, then statutory variation in applicable **GST** on supply and on incidental services, shall be to OIL's account.

Claim for payment of **GST**/Statutory variation, should be raised within two [02] months from the date of issue of 'Government Notification' for payment of differential (in %) **GST**, otherwise claim in respect of above shall not be entertained for payment of arrears.
The base date for the purpose of applying statutory variation shall be the Bid Opening Date.

37.21 The contractor will be liable to ensure to have registered with the respective tax authorities, wherever applicable and to submit self-attested copy of such registration certificate(s) and the Contractor will be responsible for procurement of material in its own registration (GSTIN) and also to issue its own Road Permit/E-way Bill, if applicable etc.
37.22 In case the bidder is covered under Composition Scheme under GST laws, then bidder should quote the price inclusive of the GST (CGST & SGST/UTGST or IGST). Further, such bidder should mention "Cover under composition system" in column for GST (CGST & SGST/UTGST or IGST) of price schedule.

37.23 OIL will prefer to deal with registered supplier of goods/services under GST. Therefore, bidders are requested to get themselves registered under GST, if not registered yet. However, in case any unregistered bidder is submitting their bid, their prices will be loaded with applicable GST while evaluation of bid. Where OIL is entitled for input credit of GST, the same will be considered for evaluation of bid as per evaluation methodology of tender document.

Contractor

Company

37.24 Procurement of Specific Goods: Earlier, there is no tax incidence in case of import of specified goods (i.e. the goods covered under List-34 of Customs Notification no. 12/2012-Cus dated. 17.03.2012 as amended). Customs duty is not payable as per the policy. However, under GST regime, IGST Plus GST compensation cess (if applicable) would be liveable on such imports. Bidders should quote GST as inclusive considering IGST component for the imported Materials portion while quoting their prices on destination basis. However, GST rate to be specified in the price bid format.

37.25 **Documentation requirement for GST:**

The vendor will be under the obligation for invoicing correct tax rate of tax/duties as prescribed under the GST law to OIL, and pass on the benefits, if any, after availing input tax credit.

Any invoice issued shall contain the following particulars:

a) Name, address and GSTIN of the supplier;
b) Serial number of the invoice;
c) Date of issue;
d) Name, address and GSTIN or UIN, if registered of the recipient;
   Note: OIL GSTIN numbers are as follows:
   Assam :18AAACO2352C1ZW
   Arunachal Pradesh :12AAACO2352C1Z8
e) Name and address of the recipient and the address of the delivery, along with the State and its code,
f) HSN code of goods or Accounting Code of services[SAC];
g) Description of goods or services;
h) Quantity in case of goods and unit or Unique Quantity Code thereof;
i) Total value of supply of goods or services or both;
j) Taxable value of supply of goods or services or both taking into discount or abatement if any;
k) Rate of tax (IGST, CGST, SGST/UTGST, cess);
l) Amount of tax charged in respect of taxable goods or services (IGST, CGST, SGST/UTGST, cess);
m) Place of supply along with the name of State, in case of supply in the course of interstate trade or commerce;
n) Address of the delivery where the same is different from the place of supply and
o) Signature or digital signature of the supplier or his authorized representative.
   GST invoice shall be prepared in triplicate, in case of supply of goods, in the following manner
a) The original copy being marked as ORIGINAL FOR RECIPIENT;
b) The duplicate copy being marked as DUPLICATE FOR TRANSPORTER and
c) The triplicate copy being marked as TRIPLICATE FOR SUPPLIER.

In case of any advance given against any supplies contract, the supplier of the goods shall issue Receipt Voucher containing the details of details of advance taken along with particulars as mentioned in clause no. (a), (b), (c), (d), (g), (k), (l), (m) & (o) above.

Contractor

Company

37.26 **ANTI-PROFITEERING CLAUSE:**

As per Clause 171 of GST Act it is mandatory to pass on the benefit due to reduction in rate of tax or from input tax credit to the consumer by way of commensurate reduction in prices. The Supplier of Goods/Services may note the above and quote their prices accordingly.

37.26.1 In case the GST rating of vendor on the GST portal/Govt. official website is negative/black listed, then the bids may be rejected by OIL. Further, in case rating of bidder is negative/black listed after award of work for supply of goods/services, then OIL shall not be obligated or liable to pay or reimburse GST to such vendor and shall also be entitled to deduct/recover such GST along with all penalties/interest, if any, incurred by OIL.

38.0 **WITHHOLDING**:

Company may withhold or nullify the whole or any part of the amount due to Contractor, after informing the Contractor of the reasons in writing, on account of subsequently discovered evidence in order to protect Company from loss on account of:

a) For non-completion of jobs.
b) Contractor's indebtedness arising out of execution of this Contract.
c) Defective work not remedied by Contractor.
d) Claims by sub-Contractor of Contractor or others filed or on the basis of reasonable evidence indicating probable filing of such claims against Contractor.
e) Failure of Contractor to pay or provide for the payment of salaries/wages, contributions, unemployment compensation, taxes or enforced savings with-held from wages etc.
f) Failure of Contractor to pay the cost of removal of unnecessary debris, materials, tools, or machinery.
g) Damage to another Contractor of Company.
h) All claims against Contractor for damages and injuries, and/or for non-payment of bills etc.
i) Any failure by Contractor to fully reimburse Company under any of the indemnification provisions of this Contract. If, during the progress of the work Contractor shall allow any indebtedness to accrue for which Company, under any circumstances in the opinion of Company may be primarily or contingently liable or ultimately responsible and Contractor shall, within five days after demand is made by Company, fail to pay and discharge such indebtedness, then Company may during the period for which such indebtedness shall remain unpaid, with-hold from the amounts due to Contractor, a sum equal to the amount of such unpaid indebtedness.

Withholding will also be effected on account of the following:

i) Order issued by a Court of Law in India.

ii) Income-tax deductible at source according to law prevalent from time to time in the country.

Contractor

Company

iii) Any obligation of Contractor which by any law prevalent from time to time to be discharged by Company in the event of Contractor's failure to adhere to such laws.

iv) Any payment due from Contractor in respect of unauthorized imports.
When all the above grounds for withholding payments shall be removed, payment shall thereafter be made for amounts so with-hold.

Notwithstanding the foregoing, the right of Company to withhold shall be limited to damages, claims and failure on the part of Contractor, which is directly/indirectly related to some negligent act or omission on the part of Contractor.

39.0 In case any part of the work is sub-contracted to a Micro or Small Enterprise as per contract conditions than the contractor shall provide complete details (i.e. name of the subcontractor, value of sub-contacted work, copy of valid registration certificate etc.) of the sub-contractor to OIL.

40.0 PERFORMANCE SECURITY: The Contractor has furnished to Company a Bank Guarantee No.**0650ILG005419** dated **20.11.2019** issued by Punjab National Bank, Model Town Branch, Delhi-9 for **Rs.3,54,750.00**(Rupees Three Lakh Fifty Four Thousand Seven Hundred Fifty only) (being 10% of annualized contract value) with validity of 03(Three) months beyond the contract period. The performance security shall be payable to Company as compensation for any loss resulting from Contractor's failure to fulfill their obligations under the Contract. If the performance security is submitted in the form of bank guarantee then in the event of extension of the Contract period, the validity of the bank guarantee shall be suitably extended by the Contractor. The bank guarantee will be discharged by Company not later than 30 days following its expiry.

END OF PART-I

Contractor

Company

Part-II: Schedule of Work, Unit and Quantity (SOQ)

Item No.	Description of Services	UOM	Qty.	Unit Rate	Amount (Rs.) Exclusive of GST
10	Ambient Air Quality Monitoring	LSM (Lump sum)	3000	1,045.00	31,35,000.00
20	Stack Gas Monitoring	LSM (Lump sum)	800	750.00	6,00,000.00
30	Monitoring Hg in Ambient Air	LSM (Lump sum)	3000	100.00	3,00,000.00
40	Monitoring Methane in Ambient Air	LSM (Lump sum)	3000	130.00	3,90,000.00
50	Monitoring Non-methane in Ambient Air	LSM (Lump sum)	3000	130.00	3,90,000.00
60	Monitoring Total HC in Ambient Air	LSM (Lump sum)	3000	130.00	3,90,000.00
70	Monitoring VOC in Ambient Air	LSM (Lump sum)	3000	200.00	6,00,000.00
80	Noise level measurement	LSM (Lump sum)	800	300.00	2,40,000.00
90	Illumination level measurement	LSM (Lump sum)	800	200.00	1,60,000.00
100	Mobilisation & Demobilisation cost	NO (Number)	1	80,000.00	80,000.00
110	Transportation Charge	DAY	1800	450.00	8,10,000.00
				Total Contract Cost (Exclusive of GST @18%)Rs.	70,95,000.00
1. Tenure of Agreement: 02(Two) years from the date of commencement of the contract.					
2. Mobilization Period: 6(Six) weeks from the date of issue of Work Order.					

END OF PART-II

Contractor

Company

PART-III: SPECIAL CONDITIONS OF CONTRACT (SCC)

1.0 DESCRIPTION:

A. The Testing jobs shall be carried out as per frequency indicated below :

i. Once in a month or as per requirement in each installation and thrice in Drilling location (Before, During and After Drilling) for ambient air quality monitoring/Illumination and noise level monitoring/other parameters as specified.

ii. Only once in Workover site during operation or as per requirement.

iii. Noise level and Illumination level reading is required to be taken at 40 different places or as instructed at the same location/ installation, however, quantity of measurement will be considered as one per location/installations.

The above jobs are to be carried out as per the directives and procedure of NAAQ standard and CPCB guideline.

B. i. Work order has to be collected within two weeks from the date of signing of the contract agreement.

ii. The party has to start the work within six weeks from the date of issue of work order.

iii. Once the job has been started, the party has to maintain the schedule/ periodicity as per the terms and condition of the contract.

iv. The party/bidder must be an approved certifier of Central Pollution Control Board (CPCB)or Ministry of Environment and Forest (MOEF) or Respective State Pollution Control Board (SPCB). In case, the validity of approval is due expire within the contract period, fresh approval for additional period must be obtained before 10 (Ten) days of expiry of such approval. Documentary evidence has to be submitted along with the bid.

C. Emergency requirement of testing of ambient air quality in any installation at any time of the year may arise from time to time and shall have to be executed by the Contractor without any extra cost except as stipulated in the contract.

D. The procedures for monitoring/testing/sampling should conform to relevant guidelines of NAAQM standards and CPCB guidelines.

E. The party will have to carry out the following tests in respect of Ambient air Quality as well as of stack emission monitoring of exhaust of gas engines. The parameters to be tested as per requirement of NAAQ standards notified on Nov 18, 2009, by MOEF or any latest standard issued at the time of execution of the contract. Presently the standard is as follows:

i. Ambient Air Quality Monitoring Parameters:

a. Particulate matter (size less than 10µg)or PM10 µg/m3
b. Oxides of Sulphur (SOx) in µg/m3
c. Oxides of Nitrogen, NOX (NO and NO2) in µg/m3
d. Particulate matter (size less than 2.5 µg) or PM2.5 µg/m3
e. Carbon monoxide, (CO) in mg/m3
f. Lead in µg/m3

Contractor

Company

g. Ozone in µg/m3
h. Benzene (C6H6) in µg/m3
i. Benzo(a)Pyrene (BaP) in ng/m3
j. Arsenic in ng/m3
k. Nickel (Ni) ng/m3
l. Ammonia (NH3)in µg/m3

ii. Stack Gas Monitoring Parameters:

a. Particulate matter
b. Sulphur Dioxide (SO2)
c. NOX (NO and NO2)
d. Carbon monoxide (CO) in mg/m3
e. Carbon Di oxide (CO2)
f. Lead
g. Oxygen
h. Temperature
i. Flue gas flow rate
j. Unburnt hydrocarbon
k. Non Methane Hydro Carbon

iii. Monitoring Mercury (Hg) in Ambient Air
iv. Monitoring Methane in Ambient Air
v. Monitoring Non-methane in Ambient Air
vi. Monitoring Total HC in Ambient Air
vii. Monitoring VOC in Ambient Air
viii. Noise level monitoring
ix. Illumination level monitoring

However, the above parameters may vary from time to time as directed by the respective State Pollution Control Board/ NAAQ standard/Environment Pollution act and the party will have to do the same accordingly without any extra cost.

F. The protocols of measurement must be carried out according to the norms approved by the State Pollution Control Board/Central Pollution Control Board/any other agency approved by the Govt. of India and a copy of the procedures of various measurements to be submitted along with the offer.

G. The contractor must have laboratory set up of their own to carry out the job.

H. The contractor has to provide all the necessary equipment/ consumables etc. for carrying out all the tests either in the field or at laboratories for measuring the various parameters.

I. The contractor shall provide for purposes of inspection, access ladders and necessary instruments at his own cost.

J. All instruments, equipment, laboratory wares, consumables, chemicals, Electrical fittings, sample collection, laboratory analysis and report generation etc. are to be arranged and born by the contractor.

K. The laboratory must have all the necessary measuring equipment with qualified and trained personnel to carry out all the required tests as per NAAQ/CPCB guidelines. The personnel engaged by the contractor must be well qualified and must have ability to explain any queries related to the jobs to the officials at any point of time.

L. The lab equipment should not be more than 5 (Five) years old. Documentary evidence required to be submitted by the bidder along with the bid.

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M. Reports have to be submitted online as well as in signed hard copy format to OIL within a period of two weeks from the date of sample collection and testing.

Failure to carry out the tests as per Clause Nos. 1.0 (E) (i), 1.0 (E) (ii), 1.0 (E) (iii), 1.0 (E) (iv), 1.0 (E) (v), 1.0 E (vi), 1.0 (E) (vii), 1.0 (E) (viii), 1.0 (E) (ix) and to deliver the report in due time will attract penalty. Penalty for late submission of report after stipulated time of two weeks and before four weeks from the date of sample collection and testing will be charged @ 20% against that particular line item. Submission of report beyond four weeks from the date of sample collection and testing will be considered as non-submission of report and penalty will be charged @100% against the particular line item.

N. All equipment, motors which would be used for sampling of ambient air to be flameproof. Motors, in any of the equipment should be flame proof nature.

O. The Contractor/Firm should have valid authorization from CPCB/State PCB/MoEF (GOI) for carrying out air quality monitoring and documentary proof has to be submitted along with the bid.

P. In case the Ambient Air Quality is monitored by a mobile van, the engine of the van should be kept off during the monitoring and the van should have flame arrestor.

Q. At present the total number of measurement for Ambient Air Quality and other parameters are aprox 1500 per year and for Stack Gas Monitoring is approx. 118 per year and for Illumination & noise level measurement is approx 250 per year. The number of Installations may vary as per the requirement of OIL. If it is more than the above limit, the measurement has to be carried out by the party at the same terms & condition.

R. Contractor personnel have to abide by the rules and regulations of OIL during the contractual period with OIL.

S. Storage and security of the equipment/consumables/accommodation of the personnel will be the responsibility of the contractor.

T. Transportation of contractor's personnel and equipment to the various locations/installations will be the responsibility of the contractor.

U. The contract should have provision to incorporate new parameters as & when notified by the Ministry/ required under statute.

V. To carry out 1500 no. (lumpsum) of jobs for Ambient Air Quality, Mercury, Methane, Non Methane, Total Hydrocarbon, VOC in ambient air, 400 no. (lumpsum) of Stack Emission, 400 no. (lumpsum) of noise level and 400 no. (lumpsum) of Illumination level monitoring per year the party must have minimum three set of measurement facilities along with all other required equipment, accessories, consumables etc.(300 working days in a year is considered)

W. The party must also have minimum three set of transporting facilities for carrying out the job as specified in service line item no. 10 to 90.

2.0 PAYMENT TERMS AND CONDITIONS:

A. If, any of the parameters as specified in clause nos. 1.E) is not measured, payment will be made on pro-rata basis for the actual number of parameter monitored.

ANALYTICAL LABORATORY (P) LTD. AUTH. SIGN

Contractor

CONTRACTS DEPARTMENT DULIAJAN PIN 786 602 ASSAM INDIA

Company

B. In case, the job/measurement could not be carried out due to some unavoidable situation like bandh/road blockage/local problem etc. after reaching the site or in between, then only the transportation charges will be reimbursed.

C. The payment will be made on actual basis monthly after due verification of the work and certification by OIL representative & work manager/authorized representative of the contractor. OIL reserves the right to question the adequacy/correctness of the measurement. The party has to submit the invoice giving the details of the job carried out during the bill period.

D. Payment towards mobilization (50% of the mobilization & demobilization cost) will be made after completion of mobilization and against submission of invoice. Rest 50% payment towards demobilization will be paid after completion of demobilization and submission of invoice.

Note: Mobilization will be considered as complete only after all the equipment and man power as required against NIT are in place within the stipulated time period and after laboratory verification by OIL's personnel.

3.0 SUPERVISION:

A. One or two authorized employees of OIL will accompany the contractor personnel and will be present during the tests and the contractor shall have to make proper arrangement for their transportation without any extra cost.

B. The company reserves the right to inspect the instruments and labs as and when required during the whole service period.

C. The Instruments for measuring the Ambient Air Quality have to be calibrated by authorized Govt. agency half yearly and documentary proof for the same has to be submitted to OIL.

D. The vehicle which will be used inside the installation for testing must be provided with flame arrestor in the engine exhaust for entry into hazardous area.

4.0 DESTINATION:

A. Various Drilling and workover locations, Oil collecting stations (OCSs) and Gas Compressor Stations (GCSs) in Naharkatia, Jorajan, Shalmari, Kathaloni, Dikom, Barekuri, Baghjan, Kusijan, Kharsang fields (at present the operating GCSs are 1, 2, 4, 5, 6, 8, Jorajan, Kathalguri, Ushapur, Nagajan, Langkashi, Joypur, Salmari, Moran,Digboi, Kathaloni, Dikom, Tengakhat, Hapjan, LPG Off take point, NEEPCO Off take, CGGS & OTP (Madhuban and Kathalguri), Kusijan FGGS, Hatiali FGGS, Deohal FGGS, Chabua FGGS, FGGS-336, Madhuting FGGS etc.) and any other installations as instructed by the OIL.

B. All the locations required to be tested are at a distance of maximum 100 km from Duliajan.

5.0 OTHER TERMS & CONDITIONS:

A. The supplier will be responsible for-

a. Providing valid photo identity cards to its all employees working under the contract.

Contractor

Company

b. Providing all persons working in the vehicle with proper safety gears i.e. Safety Helmet, Safety Shoes, and Hand Gloves etc. as required.

All the above safety gears are to be provided by the contractor to his personnel before commencement of the work.

c. The contractor will be solely responsible for the safety of his instruments, his men, material etc for all activities for execution of the contract. In no case, company will provide any compensation for accident/damage to Contractor's men & materials. Personnel engaged by the contractor for the service contract will required to be insured by the contractor for any accident during work and travel to worksite and back.

d. The contractor shall not engage any employees for OIL's job

- if found to achieve superannuation age,
- if declared medically unfit, and
- if found guilty on account of misconduct.

e. The bidder(s) must also indicate the following:

i. Bank Account Number together with name, branch and address of the Bank.
ii. PAN Number from Income Tax Authority.
iii. Service Tax Registration No. (If the services under this contract come under Service Tax).
iv. AGST Registration No.
v. P.F. Code No.

f. Bidder must carry out the supervision of the contract by his/her competent person (if there's provision of appointment of competent by State PCB, then his/her name must be there in certification as competent person and should provide a copy of it or if not, then contractor should certify himself/herself the competent person) having adequate experience.

g. The initial health check up of contractor's personnel is to be done by the contractor in authorized Health Centers as per OIL's requirement & proof of such test(s)/ reports is to be submitted to OIL before start of the job.

The Initial Medical Examination (IME) will include the following:

- General Medical Examination
- Physical Examination to include systemic examination of all the system
- Laboratory Examination which includes:

i. Blood RE
ii. Urine RE/ME
iii. FBS
iv. PPBS
v. S. Creatinine
vi. S. Urea
vii. Lipid Profile
viii. X-Ray (PA View Chest)
ix. ECG
x. Lung Function Test
xi. Audiometry
xii. Stool RE/ME

Contractor

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B. i. The Contractor's personnel have to take every possible care to keep the environment clean and free from pollution.

ii. To ensure that the Workers understand the work to be done, the hazards that may be encountered and the proper precautions/procedure for carrying out the work safely.

iii. The contractor should deploy only MVT (Mines Vocational Training) trained persons for carrying out the jobs.

iv. The contractor's personnel has to abide by all relevant statutory safety and environment rules, regulations, applicable codes and standards (i.e. OMR, OISD standards, BIS ,EP Act etc.).

v. Sub letting of work without prior written permission from OIL : No contractor / contracting firm shall sub let or assign any work in part or whole to any individual, proprietorship firm, partnership firm, private Ltd etc. without prior permission from OIL.

6.0 HSE POINTS: SAFETY MEASURES:

i. It will be solely the Contractor's responsibility to fulfill all the legal formalities with respect to the Health, Safety and Environmental aspects of the entire job (namely; the person employed by him, the environment, etc.) under the jurisdiction of the district of that state where it is operating.

ii. The Contractor shall ensure that his/her employees are properly explained about the jobs and hazards associated with the jobs in consultation with the respective Installation Managers.

iii. The contractor personnel must use the safety gadgets during working hours. It will be the Contractor's sole responsibility to ensure that the persons engaged in the mines use the proper PPE while at work. Any worker found without proper safety gadgets will not be allowed to work and no mandays will be considered for the same though the contractor's personnel is present.

iv. The Contractor shall prepare written Safe Operating Procedure (SOP) for the work to be carried out, including an assessment of risk, wherever possible and safe methods to deal with it/ them. The SOP should clearly state the risk arising to men, machineries & material from the mining operation/ operations to be done by the contractor and how it is to be managed and copy of the same to be submitted to OIL.

v. The contractor shall provide a copy of the SOP to the person designated by the mine owner who shall be supervising the contractor's work.

vi. The contractor has to keep an up to date SOP and provide a copy of changes to a person designated by the Mine Owner/Agent/Manager.

vii. Contractor has to ensure that all work is carried out in accordance with the Statute and SOP and for the purpose he may deploy adequate qualified and competent personnel for the purpose of carrying out the job in a safe manner. For work of a specified scope/nature, he should develop and provide to the mine owner a site specific code of practice in line.

viii. All persons deployed by the contractor for working in a mine must undergo Mines Vocational Training (MVT), initial medical examination (IME) and periodic medical examination (PME). They should be issued cards stating the name of the contractor and the work and its validity period, indicating status of MVT, IME & PME.

AUTH. SIGN.
Contractor

DULIAJAN PIN 786 602
Company

ix. The contractor shall submit to DGMS returns indicating - Name of his firm, Registration number, Name and address of person heading the firm, Nature of work, type of deployment of work persons, Number of work persons deployed, how many work persons hold MVT Certificate, how many work persons undergone IME and type of medical coverage given to the work persons.

x. The return shall be submitted quarterly (by 10th of April, July, October & January) for contracts of more than one year.

xi. It will be entirely the responsibility of the Contractor/his Supervisor/ representative to ensure strict adherence to all HSE measures and statutory rules during operation in OIL's installations and safety of workers engaged by him. The crew members will not refuse to follow any instruction given by company's Installation Manager/ Safety Officer/Engineer/Official/Supervisor/Junior Engineer for safe operation.

xii. Any compensation arising out of the job carried out by the Contractor whether related to pollution, Safety or Health will be paid by the contractor only.

xiii. Any compensation arising due to accident of the Contractor's personnel while carrying out the job, will be payable by the contractor only.

xiv. The contractor shall have to report all incidents including near miss to Installation Manager/departmental representative of the concerned department of OIL.

xv. The contractor has to keep a register of the persons employed by him/her. The contractor's supervisor shall take and maintain attendance of his men every day for the work, punctually.

xvi. If the company arranges any safety class/training for the working personnel at site (company employee, contractor worker, etc.) the contractor will not have any objection to any such training.

xvii. To arrange daily tool box meeting and regular site safety meetings and maintain records.

xviii. Records of daily attendance, accident report etc. are to be maintained in Form B, E, J (as per Mines Rules 1955) by the contractor.

xix. A contractor employee must, while at work, take reasonable care for the health and safety of people who are at the employee's place of work and who may be affected by the employee's act or omissions at work.

xx. A contractor employee must, while at work, cooperate with his or her employer or other persons as far as is necessary to enable compliance with any requirement under the act or the regulations that is imposed in the interest of health, safety and welfare of the employee or any other person.

xxi. Contractor's arrangements for health and safety management shall be consistent with those for the mine owner.

xxii. In case Contractor is found non-compliant of HSE laws as required company will have the right for directing the contractor to take action to comply with the requirements, and for further non-compliance, the contractor will be penalized prevailing relevant Acts/ Rules/ Regulations.

AUTH. SIGN.
Contractor

DULIAJAN PIN 786 602 ASSAM
Company

xxiii. When there is a significant risk to health, environment or safety of a person or place arising because of a non-compliance of HSE measures, company will have the right to direct the contractor to cease work until the non-compliance is corrected.

xxiv. The contractor should frame a mutually agreed bridging document between OIL & the contractor with roles and responsibilities clearly defined.

xxv. For any HSE matters not specified in the contract document, the contractor will abide the relevant and prevailing Acts/rules/regulations/pertaining to Health, Safety and Environment while carrying out the job in OIL installations.

END OF PART-III

Contractor

Company

To,
GM-CONTRACTS(HoD)
OIL INDIA LIMITED
DULIAJAN-786602

SUB: SAFETY MEASURES

Description of service: Hiring of services for Monitoring of Ambient air quality, Stack gas emission, Mercury (Hg) in ambient Air, Methane in ambient Air, Non-methane in ambient Air, Total Hydrocarbon (THC) in ambient Air, Volatile Organic Compound (VOC) in Ambient Air and measurement of illumination and noise levels at OIL's Drilling, Workover locations and OIL's installations of Upper Assam and Arunachal Pradesh as per National Ambient Air Quality (NAAQ) standard, Environment Clearance, Ministry of Environment and Forest, Govt. of India (MoEF, GOI), State Pollution Control Board (SPCB) and Central Pollution Control Board (CPCB) guidelines for a period of 02 (Two) years with a provision of extension of 01 (One) year with same terms and conditions.

Sir,

We hereby confirm that we have fully understood the safety measures to be adopted during execution of the above contract and that the same have been explained to us by the concerned authorities. We also give the following assurances.

a) Only experienced and competent persons shall be engaged by us for carrying out work under the said contract.

b) The names of the authorized persons who would be supervising the jobs on day to day basis from our end are the following:

i) DR D.R SHARMA

ii) SUNIL RAGHAV

iii) MR ANKUR SAINI

The above personnel are fully familiar with the nature of jobs assigned and safety precautions required.

c) Due notice would be given for any change of personnel under item (b) above.

d) We hereby accept the responsibility for the safety of all the personnel engaged by us and for the safety of the Company's personnel and property involved during the course of our working under this contract. We would ensure that all the provisions under the Oil Mines Regulations, 1984 and other safety rules related to execution of our work would be strictly followed by our personnel. Any violation pointed out by the Company's Engineers would be rectified forthwith or the work suspended till such time the rectification is completed by us and all expenditure towards this would be on our account.

e) We confirm that all persons engaged by us would be provided with the necessary Safety Gears at our cost.

f) All losses caused due to inadequate safety measures or lack of supervision on our part would be fully compensated by us and the Company will not be responsible for any lapses on our part in this regard.

g) We shall abide by the following HSE (Health, Safety & Environmental) POINTS:

Contractor

Company

GENERAL HEALTH, SAFETY & ENVIRONMENT (HSE) POINTS:

1. It will be solely the Contractor's responsibility to fulfill all the legal formalities with respect to the Health, Safety and Environmental aspects of the entire job (namely; the person employed by him, the equipment, the environment, etc.) under the jurisdiction of the district of that state where it is operating. Ensure that all sub-contractors hired by him comply with the same requirement as the contractor himself and shall be liable for ensuring compliance all HSE laws by the sub or sub-sub contractors.

2. Every person deployed by the contractor in a mine must wear safety gadgets to be provided by the contractor. The Contractor shall provide proper Personnel Protective Equipment as per the hazard identified and risk assessed for the job and conforming to statutory requirement and company PPE schedule. Safety appliances like protective footwear, Safety Helmet and Full Body harness has to be DGMS approved. Necessary supportive document shall have to be submitted as proof. If the Contractor fails to provide the safety items as mentioned above to the working personnel, the Contractor may apply to the Company (OIL) for providing the same. OIL will provide the safety items, if available. But in turn, OIL will recover the actual cost of the items by deducting from Contractor's Bill. However, it will be the Contractor's sole responsibility to ensure that the persons engaged by him in the mines use the proper PPE while at work. All the safety gears mentioned above are to be provided to the working personnel before commencement of the work.

3. The Contractor shall prepare written Safe Operating Procedure (SOP) for the work to be carried out, including an assessment of risk, wherever possible and safe methods to deal with it/them. The SOP should clearly state the risk arising to men, machineries & material from the mining operation/operations to be done by the contractor and how it is to be managed.

4. The contractor shall provide a copy of the SOP to the person designated by the mine owner who shall be supervising the contractor's work.

5. Keep an up to date SOP and provide a copy of changes to a person designated by the Mine Owner/Agent/Manager.

6. Contractor has to ensure that all work is carried out in accordance with the Statute and SOP and for the purpose he may deploy adequate qualified and competent personnel for the purpose of carrying out the job in a safe manner. For work of a specified scope/nature, he should develop and provide to the mine owner a site specific code of practice in line.

7. All persons deployed by the contractor for working in a mine must undergo Mines Vocational Training, initial medical examination, PME. They should be issued cards stating the name of the contractor and the work and its validity period, indicating status of MVT, IME & PME.

8. The contractor shall submit to DGMS returns indicating - Name of his firm, Registration number, Name and address of person heading the firm, Nature of work, type of deployment of work persons, Number of work persons deployed, how many work persons hold VT Certificate, how many work persons undergone IME and type of medical coverage given to the work persons.
9. The return shall be submitted quarterly (by 10th of April, July, October & January) for contracts of more than one year. However, for contracts of less than one year, returns shall be submitted monthly.

10. It will be entirely the responsibility of the Contractor/his Supervisor/representative to ensure strict adherence to all HSE measures and statutory rules during operation in OIL's installations and safety of workers engaged by him. The crew members will not refuse to follow any instruction given by company's Installation Manager/Safety Officer /Engineer/Official/Supervisor/Junior Engineer for safe operation.

Contractor

Company

11. Any compensation arising out of the job carried out by the Contractor whether related to pollution, Safety or Health will be paid by the contractor only.

12. Any compensation arising due to accident of the Contractor's personnel while carrying out the job, will be payable by the contractor.

13. The contractor shall have to report all incidents including near miss to Installation Manager/departmental representative of the concerned department of OIL.

14. The contractor has to keep a register of the persons employed by him/her. The contractor's supervisor shall take and maintain attendance of his men every day for the work, punctually.

15. If the company arranges any safety class/training for the working personnel at site (company employee, contractor worker, etc) the contractor will not have any objection to any such training.

16. The health check up of contractor's personnel is to be done by the contractor in authorized Health Centers as per OIL's requirement & proof of such test(s) is to be submitted to OIL. The frequency of periodic medical examinations should be every five years for the employees below 45 years of age and every three years for employees of 45 years of age and above.

17. To arrange daily tool box meeting and regular site safety meetings and maintain records.

18. Records of daily attendance, accident report etc. are to be maintained in Form B, E, J (as per Mines Rules 1955) by the contractor.

19. A contractor employee must, while at work, take reasonable care for the health and safety of people who are at the employee's place of work and who may be affected by the employee's act or omissions at work.

20. A contractor employee must, while at work, cooperate with his or her employer or other persons so far as is necessary to enable compliance with any requirement under the act or the regulations that is imposed in the interest of health, safety and welfare of the employee or any other person.

21. Contractor's arrangements for health and safety management shall be consistent with those for the mine owner.

22. In case Contractor is found non-compliant of HSE laws as required company will have the right for directing the contractor to take action to comply with the requirements, and for further non-compliance, the contractor will be penalized prevailing relevant Acts/Rules/Regulations.

23. When there is a significant risk to health, environment or safety of a person or place arising because of a non-compliance of HSE Measures Company will have the right to direct the contractor to cease work until the non-compliance is corrected.

24. The contractor should prevent the frequent change of his contractual employees as far as practicable.

Contractor

Company

25. The contractor should frame a mutually agreed bridging document between OIL & the contractor with roles and responsibilities clearly defined.

26. For any HSE matters not specified in the contract document, the contractor will abide the relevant and prevailing Acts/rules/regulations/pertaining to Health, Safety and Environment.

(Seal)

Yours Faithfully

Date 27/11/2019

M/s. Arihant Analytical Laboratory Pvt. Ltd.
FOR & ON BEHALF OF CONTRACTOR

Contractor

Company

ARIHANT ANALYTICAL LABORATORY PVT. LTD.

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200602001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	02/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	02/06/2020
Date of Sampling:	29/05/2020	**Date of Completion:**	04/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	04/06/2020
GPS Code:	N27°60.524′ E 95°39.217′	**Weather Condition:**	Sunny
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	64.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	38.4	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	21.4	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.80	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.8	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
14	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	5.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	63.4	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana
Authorised Signatory

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200603001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	03/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	03/06/2020
Date of Sampling:	31/05/2020	**Date of Completion:**	04/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	04/06/2020
GPS Code:	N27°60.524' E 95°39.217'	**Weather Condition:**	Sunny
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	58.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	32.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	19.7	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.50	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.2	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
14	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	48.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200604001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	04/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	04/06/2020
Date of Sampling:	01/06/2020	**Date of Completion:**	06/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	06/06/2020
GPS Code:	N27°60.524' E 95°39.217'	**Weather Condition:**	Sunny
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	59.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	35.6	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	14.6	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	37.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	2.4	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
14	Methane Hydrocarbon	ppm	7.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	14.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	87.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200605001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	05/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	05/06/2020
Date of Sampling:	02/06/2020	**Date of Completion:**	06/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	06/06/2020
GPS Code:	N27°60.524' E 95°39.217'	**Weather Condition:**	Sunny
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	52.4	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	31.6	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	13.8	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	38.3	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	2.2	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
14	Methane Hydrocarbon	ppm	6.0	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	13.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	82.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
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Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200606001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	06/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	06/06/2020
Date of Sampling:	03/06/2020	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	52.5	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	31.8	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	11.6	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	35.2	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=10.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	2.1	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
14	Methane Hydrocarbon	ppm	5.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	3.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	11.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	81.6	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana
Authorised Signatory

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272, Phase-IV, Sec-57, HSIIDC, Kundli, Sonepat-131028 (Haryana)

Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com

Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200606001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	06/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	06/06/2020
Date of Sampling:	03/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524′ E 95°39.217′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	64.8	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	37.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	15.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	39.6	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	2.6	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 09:00 AM)**				
14	Methane Hydrocarbon	ppm	9.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	14.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	88.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200606001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	06/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	06/06/2020
Date of Sampling:	03/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	9.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	4.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	18.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	93.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	10.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	7.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	23.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	102.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	9.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	6.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	20.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	98.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Anilesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200606001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	06/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	06/06/2020
Date of Sampling:	03/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	48.3	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	27.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	12.6	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	27.4	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	2.4	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	10.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	5.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	19.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	101.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Supdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200606001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	06/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	06/06/2020
Date of Sampling:	03/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	12.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	18.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	94.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	9.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	6.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	19.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	87.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	8.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	4.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	15.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	89.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200606001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	06/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	06/06/2020
Date of Sampling:	03/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	41.3	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	24.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	10.6	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	23.4	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.2	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.8	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	6.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	12.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	82.4	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200606001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	06/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	06/06/2020
Date of Sampling:	03/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	3.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL-1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	7.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	70.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	3.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	8.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	73.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	4.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	9.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	81.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	04/06/2020	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	48.8	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	33.6	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	10.2	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	32.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.7	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
14	Methane Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	9.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	74.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	04/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524′ E 95°39.217′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	49.5	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	33.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	13.6	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	24.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.9	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 09:00 AM)**				
14	Methane Hydrocarbon	ppm	7.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	3.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	15.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	82.4	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	04/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	7.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	5.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	16.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	89.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	10.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	6.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	19.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	91.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	8.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	6.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	17.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	88.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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Suptdg. Research Scientist, R & D Dept.
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	04/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	41.4	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	30.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	11.8	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	20.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.4	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	2.2	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	6.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	3.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	14.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	81.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
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Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	04/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524′ E 95°39.217′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-1	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	8.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	4.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	15.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	86.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	6.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	13.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	89.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	4.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	10.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	72.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
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Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	04/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	40.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	32.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.7	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	18.3	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.7	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
1	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	5.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	7.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	72.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

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Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com
Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	04/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	09/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	09/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	5.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	2.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	11.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	80.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	7.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	68.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	5.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	2.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	12.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	73.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608002
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	05/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	10/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	10/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	35.4	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	21.6	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	21.2	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.0	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.2	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	Gas Analysis for every 2 Hours (Time: 09:00 AM)				
14	Methane Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	7.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	54.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar, Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608002
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	05/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	10/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	10/06/2020
GPS Code:	N27°60.524′ E 95°39.217′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	4.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	7.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	51.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	4.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	8.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	57.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	3.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	5.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	61.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
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Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608002A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	05/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	10/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	10/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	32.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	26.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	18.6	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.0	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
1	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	8.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	46.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608002A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	05/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	10/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	10/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	5.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	7.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	51.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	4.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	8.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	42.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	5.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	44.4	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
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Arihant Analytical Laboratory Pvt. Ltd.
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Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608002B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	05/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	10/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	10/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	26.3	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	15.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	8.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	15.2	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=10)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=10)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	4.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	36.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200608002B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	08/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	08/06/2020
Date of Sampling:	05/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	10/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	10/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	2.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	3.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	µg/m³	39.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	5.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	µg/m³	35.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	µg/m³	41.6	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200609001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	09/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	09/06/2020
Date of Sampling:	06/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	11/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	11/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	41.5	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	27.6	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	10.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	16.8	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.0	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.0	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	Gas Analysis for every 2 Hours (Time: 09:00 AM)				
14	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	6.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	68.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200609001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	09/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	09/06/2020
Date of Sampling:	06/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	11/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	11/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	3.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	6.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	74.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	2.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	7.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	85.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	3.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	7.0	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Authorized By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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T&D

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200609001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	09/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	09/06/2020
Date of Sampling:	06/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	11/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	11/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	34.7	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	22.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.2	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	17.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.2	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
1	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	5.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	62.4	NS	IS-5182 (P-17)-1979 Reaff. 2003

Authorized By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200609001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	09/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	09/06/2020
Date of Sampling:	06/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	11/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	11/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	5.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	3.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	10.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	65.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	5.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	60.2	NS	IS-5182 (P 17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	48.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
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Suptdg. Research Scientist, R & D Dept.
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-202006090018
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	09/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	09/06/2020
Date of Sampling:	06/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	11/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	11/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	33.5	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	20.8	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	10.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	17.6	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	55.0	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
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Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200609001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	09/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	09/06/2020
Date of Sampling:	06/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	11/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	11/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	57.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	2.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	60.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	60.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200610001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	10/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	10/06/2020
Date of Sampling:	07/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	12/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	12/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	38.3	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	26.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	10.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	19.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.6	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=10)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=10)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 09:00 AM)**				
14	Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	55.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200610001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	10/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	10/06/2020
Date of Sampling:	07/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	12/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	12/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	5.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	8.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	71.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	4.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	2.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	8.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	75.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	6.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	68.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200610001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	10/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	10/06/2020
Date of Sampling:	07/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	12/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	12/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	32.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	21.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	14.2	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.5	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.0	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.01)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	62.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200610001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	10/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	10/06/2020
Date of Sampling:	07/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	12/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	12/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	6.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	9.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	65.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	4.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	7.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	64.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	51.6	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar, Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200610001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	10/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	10/06/2020
Date of Sampling:	07/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	12/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	12/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	36.1	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	22.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	14.6	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.6	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.1	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	57.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analysed By
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Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200610001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	10/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	10/06/2020
Date of Sampling:	07/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	12/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	12/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	45.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	55.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	6.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	58.6	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com
Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200611001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	11/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	11/06/2020
Date of Sampling:	08/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	13/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	13/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	41.4	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	26.4	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	11.2	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	24.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.0	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=10)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.1	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 09:00 AM)**				
14	Methane Hydrocarbon	ppm	5.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	2.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	9.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	63.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200611001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	11/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	11/06/2020
Date of Sampling:	08/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	13/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	13/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	7.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	10.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	74.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	6.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	9.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	61.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	4.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	6.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	65.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200611001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	11/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	11/06/2020
Date of Sampling:	08/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	13/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	13/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	37.3	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	28.8	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	12.2	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	21.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.0	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.3	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	Gas Analysis for every 2 Hours (Time: 05:00 PM)				
14	Methane Hydrocarbon	ppm	3.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	6.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	69.4	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200611001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	11/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	11/06/2020
Date of Sampling:	08/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	13/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	13/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	5.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	2.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	8.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	63.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	5.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	9.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	72.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	6.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	58.4	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200611001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	11/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	11/06/2020
Date of Sampling:	08/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	13/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	13/06/2020
GPS Code:	N27°60.524′ E 95°39.217′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	31.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	24.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	17.4	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	1.3	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	3.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	6.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	55.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200611001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	11/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	11/06/2020
Date of Sampling:	08/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	13/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	13/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	5.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	52.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	3.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	7.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	72.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	2.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	5.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	68.6	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analysed By
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Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com

Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	30.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	19.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.7	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	14.8	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	42.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana
Authorised Signatory

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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	51.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	56.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	1.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	44.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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TC-2

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	31.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	19.8	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	8.6	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	14.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=10)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=10)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	49.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	2.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	58.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	46.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	49.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analysed By
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Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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Suptdg. Research Scientist, R & D Dept.
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Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	34.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	22.8	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.8	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	17.8	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.2	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia (asNH_3)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=10)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 09:00 AM)**				
14	Methane Hydrocarbon	ppm	3.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	5.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	51.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
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Suptdg. Research Scientist, R & D Dept.
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Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	17/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-1	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	3.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	5.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	47.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	4.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	7.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	53.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	44.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
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Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Supdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Refereuce:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	30.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	19.5	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.7	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	14.8	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	Gas Analysis for every 2 Hours (Time: 01:00 AM)				
14	Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	42.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana
Authorised Signatory

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Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com
Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	51.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	56.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	1.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	44.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	31.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	19.8	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	8.6	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	14.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=10)	6	IS-5182(P-22)-2004
11	Benzene ($as C_6H_6$)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	Gas Analysis for every 2 Hours (Time: 05:00 PM)				
14	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	49.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	17/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	2.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	58.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	46.5	NS	IS-5182 (P 17) 1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	49.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Approved By
Mr. Anilesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Supdg. Research Scientist, R & D Dept.
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Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	34.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	22.8	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.8	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	17.8	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	1.2	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	Gas Analysis for every 2 Hours (Time: 09:00 AM)				
14	Methane Hydrocarbon	ppm	3.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	5.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	51.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
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Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200615001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	15/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	15/06/2020
Date of Sampling:	11/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	17/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	17/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	3.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	5.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	47.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	4.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	7.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	53.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	44.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

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Kundli, Sonepat, Haryana

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	30.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	21.3	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	10.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	16.6	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.7	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=10)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=10)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 01:00 AM)**				
14	Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	49.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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272, Phase-IV, Sec-57, HSIIDC, Kundli, Sonepat-131028 (Haryana)

Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com

Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bludder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	42.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	44.7	NS	IS-5182 (P-17) 1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	48.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
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Kundli, Sonepat, Haryana
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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°60.524′ E 95°39.217′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	27.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	17.3	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	8.4	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	18.3	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.6	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	52.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana
Authorised Signatory

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	42.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	4.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	53.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	47.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	18/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°60.524′ E 95°39.217′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	31.5	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	20.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	16.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=10)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=10)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 09:00 AM)**				
14	Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	49.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
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Kundli, Sonepat, Haryana

Approved By
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Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	18/06/2020
Sampling Location:	**Baghjan Relief Camp (Baghjan ME School)**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°60.524' E 95°39.217'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	4.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	57.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	51.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	1.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	46.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analysed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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T.C.

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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	30.6	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	21.3	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	10.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	16.6	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.7	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	Gas Analysis for every 2 Hours (Time: 01:00 AM)				
14	Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	49.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana
Authorised Signatory

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T. & C.

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272, Phase-IV, Sec-57, HSIIDC, Kundli, Sonepat-131028 (Haryana)
Ph. : 7082301442, 9250014551 Email : aalkundli@gmail.com
Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001B
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 01:00 AM – 09:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 03:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	42.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 05:00 AM)**				
14(b)	Methane Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	44.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 07:00 AM)**				
14(c)	Methane Hydrocarbon	ppm	1.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	48.8	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

End of Report

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	27.2	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	17.3	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	8.4	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	18.3	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.6	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=20.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20.0)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=1.0)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 05:00 PM)**				
14	Methane Hydrocarbon	ppm	1.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	52.2	NS	IS-5182 (P-17)-1979 Reaff. 2003

Approved By
Mr. Anilesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

Verified By
Dr. D R Sharma, General Manger (Q&T)
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Authorised Signatory

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Website : www.aalkundli.com

TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001A
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 05:00 PM – 01:00 AM	**Date of Completion:**	18/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°36.202′ E 95°24.286′		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 07:00 PM)**				
14(a)	Methane Hydrocarbon	ppm	1.9	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	3.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	42.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 09:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	2.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	4.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	53.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 11:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	2.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	47.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
Mr. Amlesh Kumar , Sr.Analyst
Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

Approved By
Mr. Ranjeet Kumar Bardoloi
Suptdg. Research Scientist, R & D Dept.
Oil India Ltd. , Dibrugarh , Assam

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AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	18/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
1	Particulate Matter, PM_{10}	$\mu g/m^3$	31.5	100	IS-5182(P-23)-2006
2	Particulate Matter, $PM_{2.5}$	$\mu g/m^3$	20.2	60	CPCB Guideline/Gravimetric/ (AAL/SOP/ENV/002)
3	Sulphur Dioxide (as SO_2)	$\mu g/m^3$	9.5	80	IS-5182 (P-2)-2001
4	Oxide of Nitrogen (as NO_2)	$\mu g/m^3$	16.5	80	IS-5182(P-6)-2006
5	Carbon Monoxide (as CO)	mg/m^3	0.8	2 (8hr)/4 (1hr)	IS-5182(P-10)-1999 Reaff. 2003
6	Ozone (asO_3)	$\mu g/m^3$	BDL (DL=2.0)	100(8hr)/180(1hr)	IS-5182(P-9)-1999/ Photometric
7	Ammonia ($asNH_3$)	$\mu g/m^3$	BDL (DL=20)	400	Indi-Phenol Blue Method
8	Lead (as Pb)	$\mu g/m^3$	BDL (DL=0.1)	1	IS-5182(P-22)-2004
9	Nickel (as Ni)	ng/m^3	BDL (DL=10)	20	IS-5182(P-22)-2004
10	Arsenic (as As)	ng/m^3	BDL (DL=1.0)	6	IS-5182(P-22)-2004
11	Benzene (as C_6H_6)	ng/m^3	BDL (DL=1.0)	5	NIOSH 6015-2005
12	Benzo a-pyrene (BaP)	ng/m^3	BDL (DL=0.1)	1	CPCB/GC Method
13	Mercury (as Hg)	$\mu g/m^3$	BDL (DL=0.001)	NS	By Air APHA
I	**Gas Analysis for every 2 Hours (Time: 09:00 AM)**				
14	Methane Hydrocarbon	ppm	1.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
15	Non Methane Hydrocarbon	ppm	BDL (DL=1.0)	NS	IS-5182 (P-17)-1979 Reaff. 2003
16	Total Hydrocarbon	ppm	2.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
17	Volatile Organic Compound	$\mu g/m^3$	49.5	NS	IS-5182 (P-17)-1979 Reaff. 2003

Analyzed By
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Kundli, Sonepat, Haryana

Approved By
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Suptdg. Research Scientist, R & D Dept.
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TEST CERTIFICATE

AMBIENT AIR QUALITY MONITORING REPORT

Name of Organization:	**M/s Oil India Limited**	**Report No.**	AAL /OIL/ASM-20200616001
Customer Address:	Duliajan, Dibrugarh, Assam - 786602		
Customer Reference:	WO No.8122640 of Contract No.6113508	**Date of Receiving:**	16/06/2020
Sample Description:	**Ambient Air Quality Monitoring**	**Date of Starting:**	16/06/2020
Date of Sampling:	12/06/2020 Time: 09:00 AM – 05:00 PM	**Date of Completion:**	18/06/2020
Sampling Location:	**EPS Baghjan**	**Date of Reporting:**	18/06/2020
GPS Code:	N27°36.202' E 95°24.286'		
Sample Qty & Packing:	Filter Paper, Charcoal Tube, Bladder, Plastic Bottle	**Sampling Done By:**	AAL

S. No.	Test Parameter	Unit	Results	Limits NAAQS Monitoring & Analysis Guidelines Volume-I	Test Methods
II	**Gas Analysis for every 2 Hours (Time: 11:00 AM)**				
14(a)	Methane Hydrocarbon	ppm	2.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(a)	Non Methane Hydrocarbon	ppm	1.3	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(a)	Total Hydrocarbon	ppm	4.8	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(a)	Volatile Organic Compound	$\mu g/m^3$	57.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
III	**Gas Analysis for every 2 Hours (Time: 01:00 PM)**				
14(b)	Methane Hydrocarbon	ppm	2.2	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(b)	Non Methane Hydrocarbon	ppm	1.4	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(b)	Total Hydrocarbon	ppm	4.5	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(b)	Volatile Organic Compound	$\mu g/m^3$	51.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
IV	**Gas Analysis for every 2 Hours (Time: 03:00 PM)**				
14(c)	Methane Hydrocarbon	ppm	1.7	NS	IS-5182 (P-17)-1979 Reaff. 2003
15(c)	Non Methane Hydrocarbon	ppm	1.1	NS	IS-5182 (P-17)-1979 Reaff. 2003
16(c)	Total Hydrocarbon	ppm	3.6	NS	IS-5182 (P-17)-1979 Reaff. 2003
17(c)	Volatile Organic Compound	$\mu g/m^3$	46.3	NS	IS-5182 (P-17)-1979 Reaff. 2003

NS=Not Specified, BDL=Below Detection Limit & DL=Detection Limit

****End of Report****

Analyzed By
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Arihant Analytical Laboratory Pvt. Ltd.
Kundli, Sonepat, Haryana

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Suptdg. Research Scientist, R & D Dept.
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Oil India Limited
(A Govt. of India Enterprise)
P.O. DULIAJAN, DIST. DIBRUGARH,
ASSAM, INDIA, PIN-786 602

CONTRACTS DEPARTMENT
TEL: (91) 374-2800548
E-mail: *contracts@oilindia.in*
Website: www.oil-india.com
FAX: (91) 374-2803549

Ref. No. OIL/CONT/LOA/G/102/2020-21 **Date: 15.6.2020**

M/s THE ENERGY AND RESOURCES INSTITUTE,
DARBARI SETH BLOCK, IHC COMPLEX,
LODHI ROAD, NEW DELHI-110003
Email: spandey@teri.res.in

Sub: Letter of Award (LOA) for Assessment of Air Quality in the vicinity of Well Baghjan 5 of Oil India Limited, Duliajan

Dear Sir,

With reference to your Technical and financial Proposal through email dated 14.06.2020, we have the pleasure in awarding you our LOA/Work Order no. LOA/G/102 for Hiring of services for Assessment of Air Quality in the vicinity of Well Baghjan 5 of Oil India Limited, Duliajan.

2.0 Mobilisation of your Professionals are to be done on urgent basis so as to reach the Well Site. Towards the services, the rates applicable are as under:

	Description/Particulars	Est. Qty.	UOM	Total INR
A	Professional Charges	1	Lump sum	4,66,648.00
B	Laboratory Cost	1	Lump sum	13,82,400.00
C	Travel including local travel, boarding, lodging and instrument transportation	1	Lump sum	7,50,000.00
D	Miscellaneous	1	Lump sum	50,000.00
	Total Expenditure exclusive of GST			26,49,048.00

Other Terms:

a) GST @18% extra.
b) Payment term: 50% on completion of monitoring exercise and 50% on completion of study and submission of report
c) To release Payment against B, C & D above, supporting document to be submitted alongwith the Invoice.

3.0 Considering the Urgency of the requirement of the services, please do coordinate and ensure that Services are provided within 48 Hours.

4.0 Kindly confirm acceptance of this LOA and complete the mobilization at the earliest.

Thanking you,

Yours faithfully,
Oil India Limited

(A J Sarmah)
GM-CONTRACTS
For RESIDENT CHIEF EXECUTIVE

Oil India Limited
(A Govt. of India Enterprise)
P.O. DULIAJAN, DIST. DIBRUGARH,
ASSAM, INDIA, PIN-786 602

CONTRACTS DEPARTMENT
TEL: (91) 374-2800548
E-mail: contracts@oilindia.in
Website: www.oil-india.com
FAX: (91) 374-2803549

Ref. No. OIL/CONT/LOA/G/301/2020-21 Date: 28.07.2020

M/s THE ENERGY AND RESOURCES INSTITUTE,
DARBARI SETH BLOCK, IHC COMPLEX,
LODHI ROAD, NEW DELHI-110003
Email: spandey@teri.res.in

Sub: Amendment No. 1 to extend the duration of Services for Assessment of Air Quality in the vicinity of Well Baghjan 5 of Oil India Limited, Duliajan

Dear Sir,

Further to our LOA and your with reference to your Technical and financial Proposal through email dated 14.06.2020 and subsequent proposal aceptaing extension of the Contract duration upto 06.08.2020, we have the pleasure in extending the Contract duration for Hiring of services for Assessment of Air Quality in the vicinity of Well Baghjan 5 of Oil India Limited, Duliajan upto 06.08.2020.

2.0 Towards the extension of the services duration w.e.f. 0707.2020 to 06.08.2020, the additional rates applicable are as under:

	Description/Particulars	Est. Qty.	UOM	Total INR
A	Professional Charges	1	Lump sum	4,16,664.00
B	Laboratory Cost	1	Lump sum	13,09,200.00
C	Boarding and Lodging @ 4000 per day per person for 5 persons for 30 days	1	Lump sum	6,00,000.00
D	Local Travel @6500 per day for 21 days (Two Vehicle)	1	Lump sum	1,36,500.00
E	Miscellaneous charges incl. Courier charges, DG Set, Tedlar Bags, filter papers & chemicals	1	Lump sum	2,05,000.00

Other Terms:

a) GST @18% extra.
b) Payment term: 50% on completion of monitoring exercise and 50% on completion of study and submission of report
c) To release Payment against B, C, D & E above, supporting document to be submitted alongwith the Invoice.

3.0 Kindly confirm acceptance of this Amendment.

Thanking you,

Yours faithfully,
Oil India Limited

(A J Sarmah)
GM-CONTRACTS
For RESIDENT CHIEF EXECUTIVE

Oil India Limited
(A Govt. of India Enterprise)
P.O. DULIAJAN, DIST. DIBRUGARH,
ASSAM, INDIA, PIN-786 602

CONTRACTS DEPARTMENT
TEL: (91) 374-2800548
E-mail: contracts@oilindia.in
Website: www.oil-india.com
FAX: (91) 374-2803549

Ref. No. OIL/CONT/G/V/1554/2020-21 Date: 08.12.2020

M/s THE ENERGY AND RESOURCES INSTITUTE,
DARBARI SETH BLOCK, IHC COMPLEX,
LODHI ROAD, NEW DELHI-110003
Email: spandey@teri.res.in

Sub: Amendment No. 2 to extend the duration of Services for Assessment of Air Quality in the vicinity of Well Baghjan 5 of Oil India Limited, Duliajan against Contract no. 6114201

Dear Sir,

Further to our LOA and your Technical and financial Proposal through email dated 14.06.2020 & and subsequent proposal accepting extension of the Contract duration upto 06.08.2020 and based on the consolidated proposal dated 22.10.2020, we have the pleasure in extending the Contract duration for Hiring of services for Assessment of Air Quality in the vicinity of Well Baghjan 5 of Oil India Limited, Duliajan upto 14.08.2020.

2.0 Considering the total services duration w.e.f. 16.06.2020 to 14.08.2020, the applicable rates/value are as under:

	Description/Particulars	Est. Qty.	UOM	Total INR
A	Professional Charges	1	Lump sum	10,72,705.00
B	Laboratory Cost	1	Lump sum	30,82,800.00
C	Travel(Boarding & Lodging and included local travel)	1	Lump sum	13,09,876.00
D	Miscellaneous charge including courier, DG set etc.	1	Lump sum	3,00,674.00

Other Terms:

a) GST @18% extra.
b) Payment term: 50% on completion of monitoring exercise and 50% on completion of study and submission of report
c) To release Payment against C & D above, supporting document to be submitted alongwith the Invoice.

3.0 Kindly confirm acceptance of this Amendment.

Thanking you,

Yours faithfully,
Oil India Limited

(A J Sarmah)
GM-CONTRACTS
For RESIDENT CHIEF EXECUTIVE

Tel

Web www.teriin.org

The Energy and Resources Institute
Darbari Seth Block
IHC Complex
Lodhi Road
New Delhi - 110 003
Tel. 2468 2100 or 7110 2100
E-mail mailbox@teri.res.in
Fax 2468 2144 or 2468 2145
India +91 • Delhi (0) 11

email: spandey@teri.res.in

Regional centres within India

North-Eastern Regional Centre
Guwahati
Tel. (361) 233 4790
E-mail terine@teri.res.in
Fax (361) 233 4869

Southern Regional Centre
Bangalore
Tel. (80) 2535 6590 (5 lines)
E-mail terisrc@teri.res.in
Fax (80) 2535 6589

Goa
Tel. (832) 245 9306 or 245 9328
E-mail terisrc@teri.res.in
Fax (832) 245 9338

Western Regional Centre
Mumbai
Tel. (22) 2758 0021 or 4024 1615
E-mail terimumbai@teri.res.in
Fax (22) 2758 0022

Himalayan Centre
Mukteshwar
Tel. (5942) 286 433
E-mail praveen.sharma@teri.res.in
Fax (5942) 286 460/433

TERI Japan
Tokyo
Tel. (+81 3) 3519 8970
E-mail teri@iges.or.jp
Fax +81 33 5195 1084

An ISO 9001:2015 certified organization

Suneel Pandey, PhD
Director, Environment & Waste Management Div.

August 5, 2020

Dr. Neeraj Mathur
CGM (R&D)
Oil India Limited
Duliajan 786 602
Assam

Sub: Assessment of Air Quality in the vicinity of Well Baghjan 5 of Oil India Limited, Duliajan

Dear Dr Neeraj Mathur,

The VOCs and Noise levels recorded at different locations are shown in Table bellow

Location	Distance from well (km)	Date	VOCs (ppm)	Noise level, dB(A)
1	0.5		0.18-0.33 (0.27)	71.3-84.2 (79.1)
2	1		0.13-0.19 (0.17)	45.5-77 (61.3)
3	1.5		0.16-0.34 (0.22)	56.8-73.3 (64.5)
4	2	19/06/2020	0.15-0.28 (0.20)	53.4-71.8 (60.3)
1	0.5		0.09-0.16 (0.12)	70.6-81.9 (77.2)
2	1		0.06-0.09 (0.07)	51.5-75.1 (66.5)
3	1.5		0.06-0.12 (0.09)	48.6-70.9 (63.2)
4	2	20/06/2020	0.09-0.16 (0.13)	49.7-77.4 (62.5)
Fire point	0	21/06/2020	0.17-0.65 (0.22)	92.6-100.1 (**95.9**)
1	0.5		0.15-0.37 (0.23)	70.8-75.3 (73)
2	1		0.02-0.09 (0.06)	48-78.9 (65.3)
3	1.5		0.07-0.14 (0.1)	42-67.5 (56.9)
4	2	21/06/2020	0.02-0.26 (0.09)	58.2-78.3 (68.5)
1	0.5		0.05-0.1 (0.06)	77.6-89 (**83.4**)
2	1		0.08-0.14 (0.1)	42-76.2 (59.5)
3	1.5		0.08-0.36 (0.14)	48-74.7 (61.2)
4	2	22/06/2020	0.04-0.69 (0.17)	59.5-77.7 (70.4)
1	0.5		0.11-0.29 (0.18)	79.6-90.1 (**84.2**)
2	1		0.1-0.27 (0.18)	67.1-79.3 (72.8)
3	1.5	23/06/2020	0.12-0.28 (0.2)	59.5-76.9 (68.5)

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(2)

Location	Distance from well (km)	Date	VOCs (ppm)	Noise level, dB(A)
4	2		0.1-0.52 (0.25)	62.1-83.4 (71.9)
1	0.5	25/06/2020	0.15-0.41 (0.17)	85-89.5 (**86.9**)
2	1		0.14-0.26 (0.17)	69.8-82.4 (74.3)
3	1.5		0.15-0.55 (0.23)	67.8-80.8 (72.2)
4	2		0.13-1.13 (0.19)	59-77.8 (69.4)
1	0.5	26/06/2020	0.24-0.45 (0.29)	83-90.1(**82.5**)
2	1		0.17-0.22 (0.20)	59.5-71.3 (63)
3	1.5		0.16-0.22 (0.19)	52.1-75.2 (63.5)
4	2		0.17-0.40 (0.27)	60.6-85.6 (72.9)
1	0.5	27/06/2020	0.12-0.16 (0.13)	84-89.3 (**86.9**)
2	1		0.05-0.12 (0.08)	42-69.9 (56.3)
3	1.5		0.05-0.18 (0.08)	42-56.8 (50.2)
4	2		0.05-0.29 (0.12)	62.8-78.3 (68.3)
1	0.5	28/06/2020	0.07-0.16 (0.11)	78.4-81.9(**80.5**)
2	1		0.05-0.15 (0.11)	36-73.5 (56.9)
3	1.5		0.09-0.2 (0.12)	35.9-65.5 (52.7)
4	2		0.07-0.53 (0.19)	60.6-75.2 (67.6)
1	0.5	29/06/2020	0.06-0.12 (0.09)	75.9-83.5 (**78.5**)
2	1		0.05-0.11 (0.09)	49.9-69.4 (59.6)
3	1.5		0.05-0.11 (0.07)	45.5-62 (55.1)
4	2		0.05-0.19 (0.10)	45.5-70.4 (61.2)
1	0.5	30/06/2020	0.07-0.13 (0.10)	76.4-83.0(**79.4**)
2	1		0.05-0.11 (0.07)	45.5-68.9 (60.7)
3	1.5		0.05-0.22 (0.1)	42-56.8 (50.2)
4	2		0.08-0.13 (0.11)	62.8-78.3 (68.3)
1	0.5	01/07/2020	0.04-0.5 (0.14)	76.2-82.6 (**79.1**)
2	1		0.06-0.23 (0.13)	42-70.4 (56.5)
3	1.5		0.05-0.12 (0.09)	35.9-60 (49.7)
4	2		0.11-0.52 (0.21)	58.9-73.1 (66.4)
1	0.5	02/07/2020	0.06-0.24 (0.12)	77.2-81.1 (**79.4**)
2	1		0.06-0.09 (0.08)	42-60 (49.3)
3	1.5		0.03-0.1 (0.07)	42-58.2 (49)
4	2		0.04-0.13 (0.08)	58.9-69.4 (62.2)
1	0.5	03/07/2020	0-0.1 (0.05)	76.3-83.2 (**79.9**)
2	1		0.07-0.11 (0.1)	35.9-62.8 (54.1)
3	1.5		0.07-0.17 (0.1)	49.5-63.9 (56.6)

Contd. ...

(3)

Location	Distance from well (km)	Date	VOCs (ppm)	Noise level, dB(A)
4	2		0.05-0.11 (0.07)	54-69.2 (58.4)
1	0.5	04/07/2020	0.09-0.18 (0.12)	77.9-82.7 (**81.1**)
2	1		0.1-0.19 (0.13)	50.1-69.1 (59.8)
3	1.5		0.07-0.33 (0.2)	49.9-64.2 (57.7)
4	2		0.05-0.11 (0.08)	52.6-63.9 (59.6)
1	0.5	05/07/2020	0.03-0.11 (0.06)	74.5-80 (**76.9**)
2	1		0.05-0.1 (0.07)	42-59.5 (52.4)
3	1.5		0.04-0.09 (0.08)	42-58.9 (51.2)
4	2		0.04-0.15 (0.08)	56.8-64.6 (59.7)
1	0.5	06/07/2020	0.04-0.09 (0.06)	75.9-82 (**78.6**)
2	1		0.07-0.14 (0.1)	56.8-71.1 (64.5)
3	1.5		0.07-0.17 (0.12)	52.9-69.2 (62.4)
4	2		0.05-0.13 (0.09)	48-70.4 (60.4)
1	0.5	07/07/2020	0.06-0.1 (0.08)	78.2-88.6 (**83**)
2	1		0.05-0.09 (0.06)	42-60 (48.2)
3	1.5		0.05-0.09 (0.08)	42-64.9 (47.9)
4	2		0.09-0.54 (0.22)	48-72.3 (58.8)
1	0.5	08/07/2020	0.09-0.12 (0.11)	76.2-84 (**80.6**)
2	1		0.09-0.19 (0.14)	42-62.4 (55.8)
3	1.5		0.09-0.13 (0.11)	42-69.8 (57.1)
4	2		0.09-0.33 (0.16)	48-66.3 (55.4)
1	0.5	09/07/2020	0.16-0.35 (0.23)	76.4-83.3 (**79.6**)
2	1		0.11-0.18 (0.14)	42-64.2 (55.4)
3	1.5		0.16-0.21 (0.18)	42-71.9 (61.9)
4	2		0.17-0.38 (0.23)	56.8-77.6 (64.2)
1	0.5	10/07/2020	0.15-0.23 (0.18)	74-88.8 (**81.9**)
2	1		0.12-0.15 (0.14)	42-76.7 (60.7)
3	1.5		0.16-0.2 (0.17)	42-71.2 (55.9)
4	2		0.16-0.22 (0.18)	42-65.6 (53.8)
1	0.5	11/07/2020	0.13-0.2 (0.17)	77.1-85.5 (**80.8**)
2	1		0.15-0.27 (0.19)	42-60 (48)
3	1.5		0.16-0.2 (0.18)	35.9-58.2 (45.7)
4	2		0.18-0.29 (0.22)	48-77.1 (59.5)
1	0.5	12/07/2020	0.16-0.26 (0.20)	74.9-81.9 (**78.3**)
2	1		0.15-0.17 (0.16)	35.9-51.5 (43.1)
3	1.5		0.17-0.28 (0.22)	35-49.9 (42.9)

Contd. ...

(4)

Location	Distance from well (km)	Date	VOCs (ppm)	Noise level, dB(A)
4	2		0.15-0.18 (0.17)	42-55.5 (48.7)
1	0.5	21/07/2020	0.19-0.24 (0.22)	73.7-90.9 **(81)**
2	1		0.18-0.31 (0.24)	42-67.3 (55.1)
3	1.5		0.19-0.26 (0.22)	42-66.1 (56.1)
4	2		0.26-0.75 (0.38)	42-74.7 (57.9)
1	0.5	22/07/2020	0.18-0.29 (0.22)	70.4-81.5 **(76)**
2	1		0.15-0.21 (0.17)	42-68.6 (52.5)
3	1.5		0.08-0.26 (0.17)	42-69.6 (57)
4	2		0.10-0.36 (0.19)	45.5-63.9 (56.7)
1	0.5	23/07/2020	0.10-0.15 (0.13)	69.2-74.8 (71.9)
2	1		0.13-0.17 (0.14)	48-72.2 (58.6)
3	1.5		0.13-0.18 (0.16)	45.5-67.3 (57.8)
4	2		0.12-0.36 (0.22)	42-64.4 (48.7)
1	0.5	24/07/2020	0.11-0.18 (0.13)	70.4-75.9 (72.7)
2	1		0.14-0.19 (0.15)	35.9-55 (48)
3	1.5		0.12-0.15 (0.14)	35.9-67.5 (50.2)
4	2		0.14-0.39 (0.19)	42-63.5 (56.2)
1	0.5	26/07/2020	0.12-0.21 (0.16)	70.3-80.7 (73.1)
2	1		0.13-0.17 (0.15)	35.9-49.9 (44.1)
3	1.5		0.15-0.19 (0.17)	35.9-66.1 (47)
4	2		0.16-0.58 (0.24)	55-71.4 (64.6)
1	0.5	26/07/2020	0.11-0.21 (0.14)	72.9-79.9 **(76.1)**
2	1		0.14-0.19 (0.17)	58.9-69.5 (64.2)
3	1.5		0.13-0.20 (0.17)	62.8-76.9 (68.9)
4	2		0.15-0.20 (0.17)	48-63.2 (54.7)
1	0.5	28/07/2020	0.09-0.15 (0.12)	71.7-77.5 (73)
2	1		0.10-0.19 (0.15)	59.5-69.4 (64.3)
3	1.5		0.11-0.19 (0.14)	51.5-73.9 (62.3)
4	2		0.11-0.29 (0.19)	51.5-66.8 (58.6)
1	0.5	29/07/2020	0.17-0.20 (0.19)	69.9-77.9 (73.6)
2	1		0.12-0.15 (0.13)	58.2-65.5 (61.1)
3	1.5		0.15-0.19 (0.18)	45.5-63 (53.8)
4	2		0.19-0.24 (0.21)	55.1-77.8 (69.5)
1	0.5	30/07/2020	0.19-0.27 (0.23)	68.2-76.8 (73.3)
2	1		0.20-0.24 (0.23)	35.9-70.9 (51.3)
3	1.5		0.18-0.22 (0.21)	42-63.9 (52.9)

Contd. ...

(5)

Location	Distance from well (km)	Date	VOCs (ppm)	Noise level, dB(A)
4	2		0.19-0.27 (0.25)	45.5-57.6 (51.1)
1	0.5	31/07/2020	0.150.24 (0.20)	71.2-77.7 (74.3)
2	1		0.14-0.21 (0.17)	45.5-62.3 (55.9)
3	1.5		0.2-0.29 (0.25)	51.5-67.8 (56.8)
4	2		0.14-0.41 (0.24)	48-65.9 (54.6)
1	0.5	01/08/2020	0.07-0.23 (0.13)	74.1-79.9 (77)
2	1		0.07-0.19 (0.12)	60-78.6 (67.7)
3	1.5		0.09-0.26 (0.17)	55-69.9 (63.6)
4	2		0.13-0.47 (0.26)	56.8-67.5 (61)
1	0.5	02/08/2020	0.08-0.27 (0.14)	71.8-81.2 (75.5)
2	1		0.14-0.23 (0.17)	45.5-61.2 (55.4)
3	1.5		0.12-0.16 (0.15)	45.5-71.2 (59.3)
4	2		0.12-0.37 (0.22)	49.9-74.3 (63.8)
1	0.5	03/08/2020	0.08-0.11 (0.1)	72.1-82.4 (77.6)
2	1		0.06-0.1 (0.08)	52.3-64.9 (59.5)
3	1.5		0.11-0.15 (0.14)	45-62 (54.3)
4	2		0.13-0.24 (0.18)	45.5-62.4 (57.6)
National Ambient Air Quality Standard			**NA**	**75**

NA: Not Available, Values are in the form Min-Max (Mean), the min, max and mean values are taken from the monitoring carried out at different timings between 10 AM and 3 PM. Noise level standard is the day time industrial area standard. Day time is between 6AM and 10PM.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

It is clear form table that the equivalent sound pressure levels (Leq) measured at 0.5 km from the well are exceeding the industrial noise level day time standard of 75 dB (A) in all the monitored days except for few days. However, at other points at a distance of 1 km, 1.5 km and 2 km from the fire point, the levels are well within the day time industrial noise level standard of 75dBA.

The levels of $PM_{2.5}$ measured at different locations from the fire point is shown in table below.

Date	Location	Distance from fire (km)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
19-06-2020	1	0.5	14	7	19
	2	1	39	<5	13
	3	1.5	14	<5	12
	4	2	18	<5	10

Contd. ...

(6)

Date	Location	Distance from fire (km)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
20-06-2020	1	0.5	21	5	10
	2	1	21	<5	12
	3	1.5	22	12	14
	4	2	20	7	12
21-06-2020	1	0.5	22	11	15
	2	1	14	7	10
	3	1.5	17	<5	23
	4	2	15	9	16
22-06-2020	1	0.5	30	13	17
	2	1	20	8	28
	3	1.5	16	6	11
	4	2	14	6	17
23-06-2020	1	0.5	27	6	20
	2	1	24	5	22
	3	1.5	10	9	16
	4	2	19	8	14
25-06-2020	1	0.5	NA	NA	NA
	2	1	26	7	19
	3	1.5	26	9	14
	4	2	16	11	11
26-06-2020	1	0.5	14	7	16
	2	1	42	6	11
	3	1.5	18	6	10
	4	2	12	6	9
27-06-2020	1	0.5	20	11	11
	2	1	35	6	18
	3	1.5	18	10	10
	4	2	9	9	11
28-06-2020	1	0.5	45	13	20
	2	1	47	7	22
	3	1.5	11	7	9
	4	2	10	6	10
29-06-2020	1	0.5	41	6	18
	2	1	33	9	16
	3	1.5	24	9	11
	4	2	25	8	14

Contd. ...

(7)

Date	Location	Distance from fire (km)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
30-06-2020	1	0.5	38	7	13
	2	1	32	7	16
	3	1.5	21	9	14
	4	2	17	8	10
1-07-2020	1	0.5	17	8	19
	2	1	30	6	14
	3	1.5	16	7	16
	4	2	13	6	22
2-07-2020	1	0.5	19	<5	12
	2	1	23	<5	18
	3	1.5	14	6	16
	4	2	13	9	20
3-07-2020	1	0.5	16	6	9
	2	1	31	7	11
	3	1.5	24	11	21
	4	2	21	10	18
4-07-2020	1	0.5	14	6	11
	2	1	20	5	15
	3	1.5	12	9	14
	4	2	12	11	19
5-07-2020	1	0.5	13	7	9
	2	1	23	<5	15
	3	1.5	17	<5	18
	4	2	15	7	27
6-07-2020	1	0.5	26	8	17
	2	1	22	9	11
	3	1.5	12	11	23
	4	2	13	7	14
7-07-2020	1	0.5	10	9	22
	2	1	30	<5	10
	3	1.5	16	10	21
	4	2	13	12	22
8-07-2020	1	0.5	12	12	25
	2	1	21	<5	9
	3	1.5	10	12	25
	4	2	11	13	27

Contd. ...

T-C

(8)

Date	Location	Distance from fire (km)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
9-07-2020	1	0.5	14	6	17
	2	1	23	5	12
	3	1.5	10	12	28
	4	2	14	10	32
10-07-2020	1	0.5	15	<5	13
	2	1	30	6	15
	3	1.5	22	9	27
	4	2	13	12	29
11-07-2020	1	0.5	21	<5	14
	2	1	23	14	22
	3	1.5	18	6	16
	4	2	15	9	30
12-07-2020	1	0.5	17	6	13
	2	1	18	9	16
	3	1.5	18	8	12
	4	2	11	7	22
21-07-2020	1	0.5	12	10	24
	2	1	18	<5	9
	3	1.5	14	<5	10
	4	2	13	14	32
22-07-2020	1	0.5	10	12	27
	2	1	28	9	17
	3	1.5	11	12	21
	4	2	13	<5	13
23-07-2020	1	0.5		7	9
	2	1		13	32
	3	1.5		8	16
	4	2		11	19
24-07-2020	1	0.5		8	19
	2	1		9	19
	3	1.5		11	22
	4	2		10	16
25-07-2020	1	0.5		<5	12
	2	1		6	16
	3	1.5		7	11
	4	2		<5	9

Contd. ...

T.C.

(9)

Date	Location	Distance from fire (km)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
26-07-2020	1	0.5		9	17
	2	1		11	21
	3	1.5		7	19
	4	2		14	26
27-07-2020	1	0.5		20	21
	2	1		<5	<5
	3	1.5		9	21
	4	2		12	21
28-07-2020	1	0.5		9	23
	2	1		7	22
	3	1.5		6	13
	4	2		8	22
29-07-2020	1	0.5			
	2	1			
	3	1.5			
	4	2			
24-hr NAAQS			**60**	**80**	**80**

NAAQS: National Ambient Air Quality Standard

The results of $PM_{2.5}$, SO_2 and NO_2 concentrations measured at different locations from the fire point indicated that all the values during the monitoring period from 19/06/20 to 22/07/2020 for $PM_{2.5}$ and 19/06/20 to 28/07/20 for SO_2 and NO_2were found to be well within the NAAQS prescribed by CPCB.

The results of methane, non-methane hydrocarbons and total hydrocarbons measured at different locations are shown in table 3 below:

Date	Location	Methane (ppm)	NMHC (ppm)	THC (ppm)
19/06/2020	1 (0.5 km)	1.92	0.97	2.89
	2 (1 km)	1.12	2.1	3.22
	3 (1.5 km)	3.98	0.98	4.96
	4 (2 km)	1.93	1.02	2.95
21/06/2020	1 (0.5 km)	2.12	2.14	4.26
	2 (1 km)	0.9	1.44	2.34
	3 (1.5 km)	1.02	0.83	1.85
	4 (2 km)	3.1	2.3	5.4
22/06/2020	1 (0.5 km)	2.62	1.65	4.27
	2 (1 km)	1.56	3.09	4.65
	3 (1.5 km)	3.19	0.97	4.16

Contd. ...

(10)

Date	Location	Methane (ppm)	NMHC (ppm)	THC (ppm)
	4 (2 km)	1.1	0.87	1.97
23/06/2020	1 (0.5 km)	2.7	0.54	3.24
	2 (1 km)	0.5	1.22	1.72
	3 (1.5 km)	3	1.58	4.58
	4 (2 km)	1.32	1.51	2.83
27/06/2020	1 (0.5 km)	2.15	1.57	3.72
	2 (1 km)	0.98	0.98	1.96
	3 (1.5 km)	3.15	1.21	4.36
	4 (2 km)	2.99	1.56	4.55
29/06/2020	1 (0.5 km)	0.98	2.33	3.31
	2 (1 km)	0.45	0.96	1.41
	3 (1.5 km)	4.02	0.66	4.68
	4 (2 km)	0.56	2.11	2.67
30/06/2020	1 (0.5 km)	2.2	1.92	4.12
	2 (1 km)	0.98	1.48	2.46
	3 (1.5 km)	2.05	1.19	3.24
	4 (2 km)	2.56	2.15	4.71
04/07/2020	1 (0.5 km)	1.73	2.41	4.14
	2 (1 km)	0.89	2.07	2.96
	3 (1.5 km)	1.19	2.34	3.53
	4 (2 km)	3.1	1.97	5.07

The results of Benzene and Benzo (α) pyrene is shown in Table below

Date	Location	Benzene ($\mu g/m^3$)	BAP (ng/m^3)
30/07/2020	1 (0.5 km)	<4.2	<0.5
	2 (1 km)	5	0.7
	3 (1.5 km)	<4.2	0.9
	4 (2 km)	<4.2	<0.5
Annual average NAAQS		**5**	**1**

The levels of Benzene and BAP measured at different locations on 30/07/2020 were found to be well within the annual average NAAQS prescribed by CPCB.

With regards,

Yours sincerely,

Suneel Pandey

TJC

Oil India Limited
(A Govt. of India Enterprise)
P.O. DULIAJAN, DIST. DIBRUGARH,
ASSAM, INDIA, PIN-786 602

CONTRACTS DEPARTMENT
TEL: (91) 374-2800548
E-mail: contracts@oilindia.in
Website: www.oil-india.com
FAX: (91) 374-2803549

Ref. No. OIL/CONT/LOA/G/134/2020-21 Date: 24.06.2020

M/s CSIR- NEIST
NH 37, Pulibor, Jorhat,
Assam 785006
Email: baruahs@neist.res.in

Sub: Letter of Award for Geophysical study at OIL's Blowout Site at Baghjan.

Sir(s),

With reference to your Offer No. NIL dated 17.06.2020 and emails dated 19.06.2020 and 23.06.2020 for **Geophysical study at OIL's Blowout Site at well Baghjan**, we are please to award you our firm LOA No. **6208951** with the rate schedule as under:

Description of Services	Rate
Travel (hiring of vehicle) +TA/DA of Touring official	10,00,000.00
Manpower	20,70,000.00
Sr. Level Scientist (Min. 7 Nos.)	
S&T Assistant (Min. 6 Nos.)	
Cost of Geophysical Survey	26,17,000.00
Intellectual Fees	18,76,000.00
	75,63,000.00
GST @18%	13,61,340.00
Est. Contract Cost with GST @18%	89,24,340.00

2.0 Duration of contract: The contract shall be for a period of 30 (Thirty) days.

3.0 The payment to be made in two instalments, 70% of amount as 1st instalment and 30% after the submission of final report.

4.0 The expenses under Travel and TA/DA head will against documentary evidence limiting to Rs. 10 Lakhs only.

5.0 Detailed minimum scope of work are as per annexure-A

6.0 The interim reports to be submitted at shortest possible time.

7.0 Please confirm acceptance of this LOA.

Thanking you,

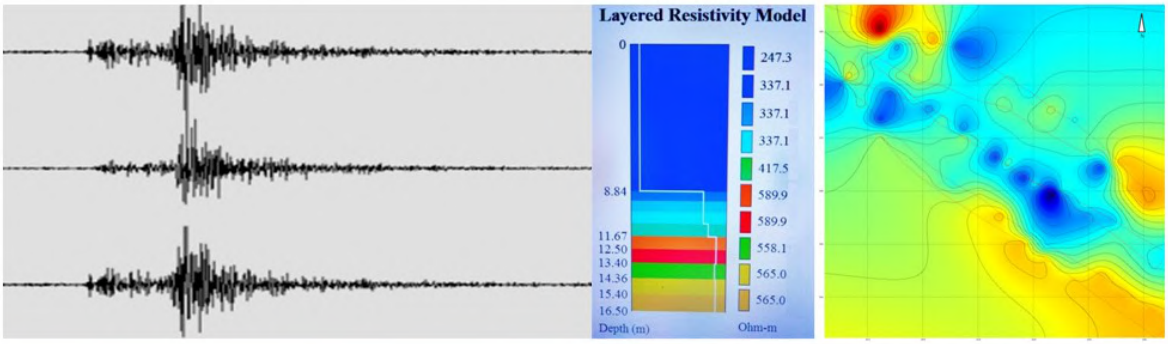
Yours faithfully,
Oil India Limited

(A.J Sarmah)
General Manager-Contracts
For Resident Chief Executive

Annexure-A

- Setting up of a minimum of 5 Geophysical Stations with broadband seismic network in the area surrounding the blow out site of well Baghjan-5 for monitoring seismic activity, if any
- Installation of Accelerographs to monitor ground tremors if any and also to estimate the site response of the of tremors in the vicinity of the site.
- Installation of Instruments like Resistivity meter, Proton precision magnetometer and VLF (very low frequency) meter to understand the subsurface activity.
- InSAR studies to be carried out to observe subsidence if any.
- Other relevant studies related to geophysical monitoring of tremors, if any in the vicinity of the site of the blowout.

Seismological and Geophysical Investigation at the Baghjan Well Blowout Site and its Vicinity, Tinsukia, Assam







Geosciences & Technology Division
CSIR-North East Institute of Science & Technology
Jorhat - 6

Investigating team:

Scientists:

- **Dr. Manoj Kr. Phukan, Senior Scientist, Principal Investigator (PI)**
- **Dr. Santanu Baruah, Senior Scientist, Co-PI**
- **Dr. Sangeeta Sharma, Senior Scientist, Co-PI**
- **Dr. Bijit Kr. Choudhury, Senior Scientist, Co-PI**
- **Dr. Saurabh Baruah, Chief Scientist, Member**

Technical Officers and Project Assistants:

Mr. Sausthov M. Bhattacharyya, Mr. Paresh Kalita, Mr. Pradip Dutta, Dr. Goutom Baruah, Mr. Timangshu Chetia, Mr. Chandan Dey, Mr. Ashim Gogoi, and Mr. Prachurjya Borthakur

Acknowledgement:

The geophysical investigation post well blowout at Baghjan was sponsored by Oil India Ltd. (OIL). We are thankful to OIL for the opportunity provided to conduct the rare study and also for all possible logistic supports. In this regard, untiring efforts of OIL officials who accompanied us to the sites and helped in putting the seismic sensors is thankfully acknowledged. We acknowledge our gratitude to the district administration of Tinsukia, particularly Mr. Sarangapani Sharma, District Development Commissioner of Tinsukia district who personally helped in site selection for installation of seismic stations. We take this opportunity to sincerely thank all the persons who allowed us to install seismograph at their residences. Special thanks goes to the officers and staff of Barekuri police station and the staff of JB drilling company stationed at Limbuguri wellsite for their active cooperation in maintaining the seismic stations installed there. We take the opportunity to convey our sincere thanks to Sri Indrajit Baruah, basin Manager, OIL and Sri Jishnu Baruah, Addl. Secy. Govt. of Assam for their keen concern and kind help to expedite the project. We will remain grateful to all the anonymous people without whose active cooperation and help the study would not have materialized. Last but not the least; we extend our sincere gratitude to Dr. G. Narahari Sastry, Director, CSIR-NEIST for his constant inspiration and advice in successful completion of this work.

Disclaimer: CSIR-NEIST, Jorhat and the project members are not responsible for any decision based on the data, information or methodology provided in this scientific report.

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सीएसआईआर- उत्तर पूर्व विज्ञान तथा प्रौद्योगिकी संस्थान
वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्
जोरहाट-785006, आसाम, भारत

CSIR-NORTH EAST INSTITUTE OF SCIENCE & TECHNOLOGY
COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH (CSIR)
JORHAT-785006, ASSAM, INDIA

Dr. G. Narahari Sastry, FASc, FNASc, FAPAS, FTAS
DST-JC Bose National Fellow
DIRECTOR

MESSAGE

CSIR-NEIST, Jorhat is delighted to present the project report compiling geophysical inferences of several parameters, such as seismic, strong motion, InSAR, electrical resistivity, electromagnetic resistivity and magnetic survey, acquired from the areas in and around Baghjan well blow out site. The report aims in studying occurrences of seismic perturbations, variation of geophysical parameters as well as ground deformation, if any, in the vicinity of the blow out site. The entire project was carried out utilizing robust and efficient instrumentation facility available at GSTD, CSIR-NEIST.

An incident of the Baghjan oil well blowout at a diverse biological habitat is rare, and therefore a through geophysical investigation, inculcating multiple parameters, in and around the site is considered critical for understanding the seismic dynamics as well as subsurface variation over time. It may also help in developing pre and post-disaster models for future mitigation and preparedness against any such disposition.

Throughout the project period, all the team members have received a great deal of support and assistance from various corners.

First of all, I would like to acknowledge and thank Honourable Chief Minister of Assam, Shri Sarbananda Sonowal for his keen interest and sparing his valuable time with me and initiating us to scale up the work.

Our team would like to express their very profound gratitude to Mr Indrajit Baruah, Executive Director cum Basin Manager, OIL Duliajan and his team at OIL for extending their help as well as providing the necessary logistic support and kind hospitality.

We also thank the Deputy Commissioner of Tinsukia District, National Disaster Management Authority (NDMA), New Delhi and Chief Justice of National Green Tribunal for their support and encouragement in carrying out this vital project.

I would also like to thank the team members of the project namely, Dr Saurabh Baruah, Chief Scientist, Dr Manoj Kr. Phukan, Senior Scientist, Dr Santanu Baruah, Senior Scientist, Dr Bijit Kr. Choudhury, Senior Scientist, Dr Sangeeta Sharma, Senior Scientist, Mr Sausthov Maunash Bhattacharyya, Technical Officer, Dr Goutam Kr. Boruah, Mr Timangshu Chetia, Mr Chandan Dey, Mr. Prachurjya Borthakur and Mr Ashim Gogoi for their dedicated efforts in successfully completing the project in time. As a national institute, we are very happy to work in this very important issue.

Date: 21.08.2020

(G. Narahari Sastry)

Phone: +91-376-2370012 (O), +91-376-2372742 (O) * Fax: +91-376-2370011
E-mail: director@neist.res.in/gnsastry@neist.res.in/gnsastry@gmail.com * website: www.neist.res.in

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Outline

The work ***Geophysical investigation at Baghjan well blowout site, Tinsukia, Assam*** was initiated at the request of Oil India Ltd. (OIL) as well as Govt. of Assam following the well blowout incident at Baghjan No.5 well in Tinsukia district and subsequent complains of ground vibrations in the area. The project was designed to investigate the reported seismic activities at the neighbourhood of the incident site and also to conduct a series of other geophysical surveys to detect any observable change near the blowout site including ground deformation. The seismic data acquisition was done for a period of one month (18 June to 21 July, 2020) using five sets of broadband 3D seismograph and a Strong Motion Accelerograph. A series of geophysical surveys conducted and possibility of ground deformation was studied using InSAR data.

Some limitations of the investigation are:

i. The seismic investigation covered only a radial distance of 4.5km from the blowout site and any ground vibration beyond this distance remains unexplored.
ii. Geophysical surveys were conducted during periods of heavy rain and floods. The geophysical parameters are known to be influenced by water saturation. Therefore, slight inadvertent deviation in the data cannot be ruled out.
iii. Ideally, long-time observation is required to precisely detect any ground deformation using InSAR data.

The investigating team sincerely feels that a more exhaustive study considering a radial distance of up to 30km and a time period of nine months to one year is needed to arrive at assessment of potential adverse impacts.

Executive Summary:

On 27th May 2020, there was a blowout at the well No.5 of Baghjan Oilfield of Oil India Ltd. (OIL) and subsequently caught fire on 9th June 2020, and the effects could be seen in its vicinity around. Apart from the high intensity continuous sound that could be heard from as far as 10km away from the blowout site, there were complains of earthquake occurrences by the residents of Baghjan area and the neighbourhood. In this regard, Govt. of Assam requested CSIR-NEIST to conduct an investigation of the same and advised OIL to sponsor the project. Subsequent to the request, CSIR-NEIST worked out a plan to execute a seismological and geophysical investigation of the blowout site as well as the adjoining areas. The study plan involved seismic investigation with broadband (BB) seismograph and Strong Motion Accelerograph (SMA), a series of surveys using ground resistivity meter, proton precession magnetometer (PPM) and Very Low Frequency (VLF) electromagnetic sensors, apart from Interferometric Synthetic-aperture Radar (InSAR) study.

On acceptance by OIL to sponsor the investigation CSIR-NEIST deployed five sets of 3D high resolution BB seismographs and a SMA at five locations in the Baghjan and adjoining areas within a radial distance of 4.5km from the incident site. The stations were BJN1 (at Limbuguri), BJN2 (at Dhelakhat T.E.), BJN3 (at Barekuri Police station), BJN4 (Near Baghjan EPS) and BJN5 (at Baghjan village), the nearest ones being BJN5 and BJN4. Data recording started from 18th June, 2020 and continued till 21 July 2020 with a few interruptions due to flash flood water inundating the seismic stations. Three seismic stations had to be relocated to nearby convenient sites due to the flooding. The seismic data was periodically retrieved from the seismic stations through several field visits and subsequently analyzed. On the other hand, the above mentioned geophysical surveys were conducted at selected convenient locations in and around the blowout site through a series of field visits. The geophysical measurements were repeated at the same locations to find out any temporal variation of the parameters. Simultaneously, InSAR data were acquired and several sets of data covering the area with pre- and post- blowout time period were analyzed using special software to detect any probable surface deformation related to the incident site.

The broadband seismic sensors basically recorded the following data:

i. Local earthquakes occurring in the NE India and adjoining areas
ii. Regional/teleseismic earthquakes
iii. A number of very local micro-earthquake occurring at Baghjan and adjoining areas
iv. Continuous vibration coming from the blowout site and
v. Intermittent high frequency disturbances

The local temporary seismic network installed at Baghjan and adjoining areas recorded nine local earthquakes occurring in the NE India and adjoining areas and five distant/teleseismic events, which indicates that the detection capability of the network and sensitivity to the extent. Most of these events are also reported by global seismic network, except a few small local events. Most of the local and regional events recorded during the period occurred in Indo-Burma border region including

Mizoram, Manipur, Nagaland, Arunachal Pradesh and Assam. The biggest event recorded by the seismic network during the time period was M6.3 event that occurred in China on 25.06.2020. Another significant event of M5.6 occurred in Mizoram on 21st June, 2020 caused the largest ground motion during the recorded period. Apart from the local and distant earthquakes we have also observed a number of very local micro-earthquakes occurring at Baghjan area and it neighbourhood. These events were characteristically of high frequency content, very shallow and some probably related to Baghjan blowout incident and other oil/gas exploitation activities in the area. Such micro-earthquakes are observed in producing reservoirs globally, which are induced by the disturbance of hydrostatic balance during production activities. However, they are so small that they are usually not felt unless very near to the epicenter and as such, probability of any damage to dwellings is very less. These micro-earthquakes are observed mainly near a wellsite at Limbuguri, which is about 4.4km away from Baghjan 5 well and where the well drilling is completed and production activities are awaited. Another station showing micro-earthquake activity is located about 2km from the Baghjan well No. 5, and some of the events occurring here may be related to the blowout incident.

The main feature of the seismic records in the area is however, not the micro-earthquake or the local/distant earthquakes; rather, it is the continuous high frequency vibration recorded by each seismic station, probably generated due to emanation of gas at very high pressure from the blowout site. Another salient feature of the seismic records is the intermittent high level of disturbances, probably generated due to the ongoing activities related to the attempts to control the blowout, which sometime lasted for several hours. In all the seismic stations deployed at Baghjan we could observe periods of highly disturbing noises followed up by relatively calm periods. The phenomenon is more dominant in the stations nearer to the blowout site than the distant stations. From the nature of vibration the noise data can be categorized as, a) Continuous vibration, b) Transient vibration, c) Intermittent vibration and d) Pseudo steady state. So far as the frequency content of the noise is concerned, there is a clear amplitude peak at around 2-3Hz for all the stations and another peak within 5-8Hz for seismic stations BJN3, BJN4 and BJN5.

The significantly high level of disturbances is not uniform throughout the day as evident from the records. Further, the ground oscillation clearly attenuates with increasing distance from the blowout site. In terms of Peak Particle Velocity (PPV) of the noise data, the maximum value was 0.22 mm/sec recorded by BJN5 and the minimum PPV was 0.095 mm/sec observed at BJN3. Despite, located further from the blowout site the stations BJN1 and BJN2 showed higher PPV values than BJN3, which may be attributed to local site effects. However, the maximum PPV recorded at Baghjan during the period was caused by an M5.6 earthquake occurred in Mizoram as mentioned above. The maximum PPV due the said event was recorded by seismic station BJN2, which is about 1.08 mm/sec and the minimum is 0.85 mm/sec as recorded by BJN1. Both these value far exceeds the ground motion value generated by the continuous noise.

The directivity of the noise source was investigated and it was observed that all the seismic stations had clear directivity towards the blowout site. After change of location and bearing of station BJN5,

the directivity of noise source found to be changed confirming the source of noise as the Baghjan well No. 5. Therefore, it can be concluded that the continuous high frequency ground vibration observed in the records of each station of Baghjan local seismic network have its origin at the blowout site.

The maximum level of recorded PPV at BJN5 comes within the limit of human perception and may be disturbing at station BJN2, BJN4 and BJN5. However, the ground vibration at other two stations (BJN1 and BJN3) are quite less in terms of PPV and should not be very disturbing, expect for the occasional spikes. The intermittent transient vibration also comes as series of spikes, sometimes lasting for hours and may cause some degree of disturbances.

The damage criteria of normal residential houses start at a minimum PPV of around 5.0 mm/sec, and some historical monuments/ruins may suffer minor architectural damage if PPV exceeds 3.0 mm/sec. PPV observed in and around Baghjan area, up to an average radial distance of 4.5km from the blowout site is much below the threshold value that may cause damage to normal residential houses. However, immision of predominantly low frequency sound components may cause considerable disturbances to dwellings.

There are several unconfirmed reports, media coverage etc. mentioning felt vibration to a distance of more than 10km from the incident site, which we could not be verified, as the investigation was limited to a radial distance of 4.5km from the blowout site. It is evident from observations through several studies that ground motion, though may not be felt near the source, while the same may be felt at far away due to site effects. It has been proved that when wave travel through subsurface they slows down while interacting with unconsolidated layers resulting in amplification of the wave train. If the predominant period of oscillation matches with the natural period of a building/structure it may suffer some degree of damage. Similar situation may cause felt vibration on houses located at a distance from the blowout site, while the houses situated nearby the source may not feel any. Therefore, it leaves scope to investigate the effect of such ground motion at a much larger distance than that was covered by the present study. Such investigation may prove significant in handling of such unfortunate incident in near future.

Earthquakes occurrence probability in the Baghjan area was also analyzed by using the past earthquake records of about 90 years. It is observed that there is 65% probability that an Mw $\geq$ 5 earthquake may occur within 200km radius of Baghjan 125 days preceding the last such earthquake. However, from earthquake occurrence point of view the area within 100km radius of Baghjan is found to be less risky.

So far the geophysical investigations are concerned; three types of surveys were conducted: a) ground resistivity, b) proton precession magnetometer (PPM) and c) Very low frequency (VLF) electromagnetic systems. Significant temporal variations of resistivity values could be observed at

three sites, whereas, at two sites only one survey could be performed. The site nearest to the well blowout shows uniform resistivity (~250Ωm) upto a depth of 8.7m, and probably, influenced by contamination. Hydrocarbon residuals and ashes of burnt out elements was observed in the soil during the survey.

Large variation in measured magnetic intensities by the PPM record may indicate presence of magnetic anomalies underneath the subsurface of the prescribed survey sites. These fluctuations in magnetic intensity may be related to some buried structures, as during the geophysical survey any structure that can generate the cultural noise has been taken care of.

VLF pseudosections of real anomaly readings present high limits, which tend to distort the models. The VLF survey may indicate that the zones of higher current density appear to orient with the water stagnated, muddy, areas of the site. Further, current density variation might be factored by the prevalent anthropogenic activities, such as involvement of sophisticated iron based equipments towards containing the blowout and ongoing activities in the reverie port, etc.

Significant variations in all the geophysical parameters were observed during various stages of surveys. The temporal variations in the geophysical parameters may however, be influenced by incessant rain and subsequent flooding during the survey period. It is well known that ground resistivity PPM and VLF readings are greatly influenced by water saturation in the subsurface strata.

The strong motion accelerograph (SMA) also recorded several local, regional and very local events during the study period. The maximum ground motion in terms of peak ground acceleration (PGA) recorded is 0.0027g due to a local earthquake occurred on 23.06.2020. The PGA is not significant to cause any damage to the dwellings.

Interferometric synthetic-aperture radar (InSAR) data were analyzed to detect any surface deformation at the vicinity of the blowout site. Several sets of acquired InSAR data processed and analyzed. The InSAR data does not show any surface deformation so far the incident is concerned.

Date: 21.08.2020

Place: CSIR-NEIST, Jorhat

A concise report on seismological and geophysical investigations in Baghjan and its vicinity *(Submitted earlier)*

Since 18th June, 2020, a network of 5 broadband seismic stations and a strong motion accelerograph station were under operation. Simultaneously a geophysical survey is being carried out periodically. The 3rd phase of survey is going on. The instruments used for geophysical survey are (i) Proton precision seismometer (ii) Resistivity meter and (iii) VLF (very low frequency) instrument.
In addition, InSAR (Interferometric synthetic aperture radar) studies are being carried out as well from band C SENTINEL satellite data.
Daily reports are being sent to Hon. CM's Office and OIL

Observation:

a) A number of small magnitude tremors are observed originating from the nearby region of Baghjan within the radial distance of 5-6 km. These events are of very small magnitude, probably less than 1.0. Although magnitudes of the events are small, being shallowermost in depth, events might have been felt.

b) The Peak ground acceleration due to shaking of the events is found to be around 0.049 g and lower which is negligible towards damage potential to nearby habitat. The preliminary processing indicates that the PGA value for local earthquake from Baghjan area is very low

c) Analysis and processing of InSAR satellite data from two different passes of satellite after the blow out indicates no ground subsidence presently.

d) The Electro Magnetic density variation could be influenced by the prevalent anthropogenic activities involving sophisticated iron based equipments towards containing the fire.

e) The resistivity values decreases significantly, and may infer presence of conductive clay layer with high water saturation in Baghjan region.

f) There was an interruption of two days in seismic data acquisition as four out of five seismographic stations suffered from flood water. These seismograph stations had to be shifted from their original positions. All the seismic stations are currently working fine.

g) The noise spectrum at BJN5 seismic station, indicates two strong oscillations around 5Hz and 35Hz. The strong 5Hz continuous oscillation may be directly originating from the blowout site and basically a ground vibration.

h) Temporal changes of magnetic field intensity in the vicinity of Baghjan area are observed.

i) In addition to local events the seismic network has also recorded regional and teleseismic events.

j) The seismological investigations are being carried out 24x&7. Geophysical survey party are available at site with their investigations. Final report will be submitted after the completion of the duration of the survey.

I. Seismic Investigation

1.1 Broadband Seismic Stations:

Following request from Oil India Ltd. (OIL), Duliajan to conduct a seismic study of the Baghjan well blowout site a team of scientists visited the site on 14th of June 2020 accompanied by OIL officials. The team went to Early Production Set-up (EPS), Baghjan and had a discussion with OIL officials, where the requirements for putting seismographs at five different sites were fixed. OIL agreed to prepare the sites for seismograph installation, which include erection of piers and construction of temporary housing for equipments. It was also decided to put the equipment at sites with adequate safety/security for personnel and equipment. The team also visited the blowout site and tentatively fixed the locations to install the equipment. It was decided that OIL authority will create the infrastructure within 2 days and then CSIR-NEIST would install the equipments.

Apart from the seismic observation, it was decided to conduct thorough geophysical surveys at the vicinity of the blowout site involving Ground Electrical Resistivity, Proton Precession Magnetometer (PPM) and Very Low Frequency (VLF) electromagnetic equipment. It was decided to conduct the field surveys by deploying two teams.

Installation of Seismographs:

A four member CSIR-NEIST team lead by Dr. Manoj Kr Phukan, Sr. Scientist arrived at Tinsukia with 5 (five) 3D broadband seismographs and a Strong Motion Accelerographs (SMA) on 17th June 2020. The other members were Dr. Bijit Kr Choudhury, Sr. Scientist, Mr. Sausthov M Bhattacharyya, Technical Officer and Mr Ashim Gogoi, Project Asst.

18th June 2020: The CSIR-NEIST team was led by an OIL team for installation of equipment at the sites. The teams first visited the Guijan area for installation of the first equipment, which was planned at the campus of an Eco Resort. However, it was found that the area where the pier was constructed had already water logged and hence not suitable for putting the equipment. On the other hand, CSIR-NGRI was offered to put their seismograph at another previously selected site. Therefore, we had to find alternative suitable sites to put the equipment. With able supports of district administration of Tinsukia district, two new sites at Dhelakhat T.E. and at Barekuri Police station were selected for seismograph installation. OIL officials had taken responsibility to urgently construct the sites, so that equipments could be installed as soon as possible. Later the team moved to another location where there is an operational OIL rig at Limbuguri. The site was ready and a set of broadband seismograph was successfully installed there.

19th June 2020: The team visited the Baghjan area to an OIL installation EPS Baghjan, where a broadband seismograph and an SMA were planned to install. However, the site was not ready for installation of equipment as it was water logged and housing was not ready. After discussion with OIL officials, they agreed to make necessary modification of the site as early as possible. Thereafter, the team proceeded to the blowout site at Baghjan. The pier was ready at this site, but there was no housing to place the equipment safely. OIL officials immediately deployed workers, who prepared the facility within a short time. Then, a broadband seismograph was successfully installed at this site.

After completing installation at the Baghjan site team proceeded to the Limbuguri site to inspect the station there.

20th June 2020: The team visited the Dhelakhat T.E. site. Though the pier and the shed was ready the whole premises was muddy due to heavy rains. The local contractor with the help of officials from Dhelakhat T.E. took initiative to make the site ready for installation of equipment, and later a set of broadband seismograph was successfully installed at the site. After initiation of data acquisition, the team moved to the Barekuri Police Station site. The site was ready and necessary installation was done promptly. After completion of work at Barekuri P.S. the field party proceeded to the Baghjan EPS site. At EPS site they made necessary modification of the pier as suggested and the housing for the equipment was also ready, though not very satisfactory. With the help of few workers, the site was finally ready for installation. The SMA was installed inside a storage space and initiated data acquisition. However, the pier was not solid enough to put broadband sensor on that day itself. Therefore, all necessary arrangements were made for installation in the next day and the broadband sensor was temporarily installed with the SMA inside the same enclosure.

21st June 2020: It was intended to have an initial inspection of the data from all the running sensors to check the data quality. Therefore, the team visited the 3 sites at Guijan-Barekuri area and retrieved some data from all the sites and then proceeded to the Baghjan EPS site. At this site also the team could retrieve some preliminary data from both the SMA and BB sensor for inspection and then shifted the BB seismograph to its proper location on the pier, installed it and started data acquisition. After completing the works at EPS site initial data was also retrieved from the Baghjan blowout site. After this, the first phase of field study was over for the seismic party and the team returned to Jorhat.

Photographs of the seismic sensors deployed at different locations are given in the figs. 1-5. Also a map showing location of the seismic stations is given in fig. 6.

Site details & equipment installed:

Site 01: BJN1 (Limbuguri)

Location: Lat. 27°33.7131N, Lon. 95°21.6070E

Date of Installation & Initiation of data acquisition: 18.06.2020, Time: 10:00:58 UTC

Sensor: Nanomatrics Trillium 3D Broadband Seismometer

Data Logger: Reftek Data Acquisition System

GPS Receiver: Reftek GPS

Accessories: 12V SMF battery, Solar panel, CF memory Card.



Fig. 1: Seismic station at Limbuguri (BJN1)

Site 02: BJN2 (Dhelakhat T.E.)

Location: Lat. 27°33.3986N, Lon. 95°23.5631E

Date of Installation & Initiation of data acquisition: 20.06.2020, Time: 06:44:38 UTC

Sensor: Nanomatrics Trillium 3D Broadband Seismometer

Data Logger: Reftek Data Acquisition System

GPS Receiver: Reftek GPS

Accessories: 12V SMF battery, Solar panel, CF memory Card.



Fig. 2: Seismic station at Dhelakhat T.E. (BJN2)

Site 03: BJN3 (Barekuri P.S.)

Location: Lat. 27°33.8658N, Lon. 95°23.9540E

Date of Installation & Initiation of data acquisition: 20.06.2020, Time: 08:29:24 UTC

Sensor: Nanomatrics Trillium 3D Broadband Seismometer

Data Logger: Reftek Data Acquisition System

GPS Receiver: Reftek GPS

Accessories: 12V SMF battery, Solar panel, CF memory Card.




Fig. 3: Seismic station at Barekuri Police Station (BJN3)

Site 04: BJN4 (Baghjan EPS)

Location: Lat. 27°36.2223N, Lon. 95°24.3728E

Date of Installation & Initiation of data acquisition: 20.06.2020, Time: 13:45:48 UTC

Sensor: Nanomatrics Trillium 3D Broadband Seismometer (1 No.) and Nanomatrics TITAN SMA (1 No.)

Data Logger: Reftek Data Acquisition System (1 No.)

GPS Receiver: Reftek GPS (2 Nos.)

Accessories: 12V SMF battery (2 Nos.), Solar panel (2 Nos.), CF memory Card (2Nos).


A

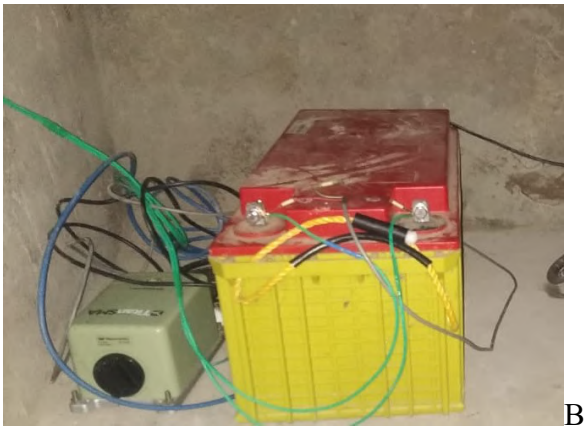

B

Fig. 4: Seismic station at Baghjan EPS (BJN4), A. Broadband sensor, B. Accelerometer

Site 05: BJN5 (Baghjan Blowout Site)

Location: Lat. 27°35.6941N, Lon. 95°23.0927E

Date of Installation & Initiation of data acquisition: 19.06.2020, Time: 10:03:13 UTC

Sensor: Nanomatrics Trillium 3D Broadband Seismometer

Data Logger: Reftek Data Acquisition System

GPS Receiver: Reftek GPS

Accessories: 12V SMF battery, Solar panel, CF memory Card.





Fig. 5: Seismic station at Baghjan (BJN5)



Fig. 6: Map of the Baghjan Local Seismic Network

1.2 Initial records of Baghjan local seismic network:

After successful installation of the seismic stations we could retrieve small amount of preliminary data from all the stations. The data was later processed and analyzed to check the data quality of each station. The same has been presented in the following section:

Waveform and spectrum of the initial data:

BJN1 (Limbuguri):

The station BJN1 is located at the Limbuguri wellsite, which was not in operational state during the installation of the seismic station. Though the well was not in operational state, there is frequent high frequency noise due to generator operation. Completely quite period at the site was very less. At the site two generators were alternatively ran - a smaller one and a large one. During the operation of the smaller generator the seismograph records were acceptable, but during operation of the large generator there were continuous high frequency noise and seismograph data quality rapidly deteriorated. We basically analyzed the data when the station was either quite or when they ran only the smaller generator. A waveform of the seismic station and the spectra derived from the same is given in the fig. 7 & 8.

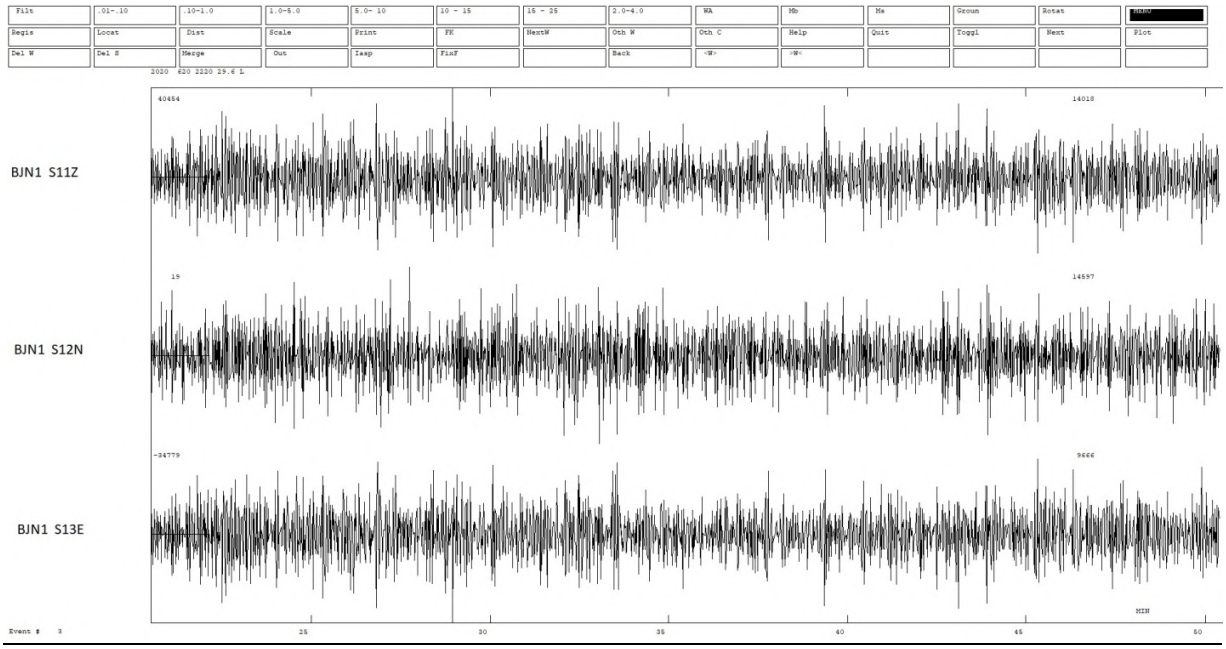


Fig. 7: Waveform record at the BJN1 station

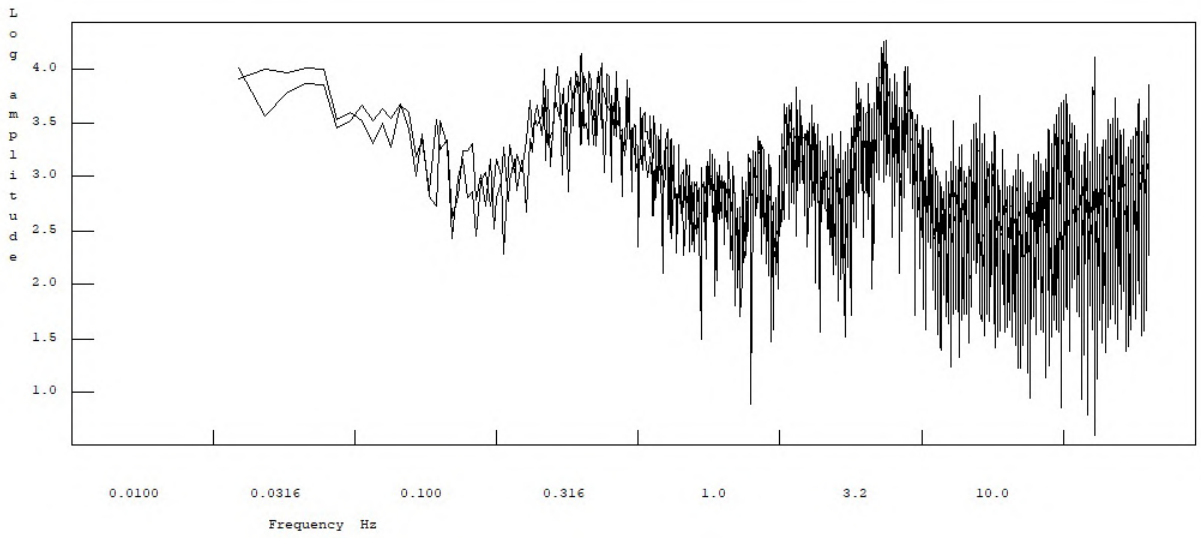


Fig. 8: FFT spectrum of the waveform at site BJN1

BJN2 (Dhelakhat T.E.):

The station BJN2 was located at the proximity of a residential quarter of Dhelakhat T.E. The data quality at the station was quite good, especially at night time. During day frequent disturbances were observed mainly due to nearby man-made activities. Further, vehicular movement at the adjusting road also caused some disturbances. Though sensor was placed over a newly constructed noise isolating pier, due to soft soil condition the pier could not prevent the anthropogenic noise from

reaching the seismometer. Example of data recorded at the station and derived spectra is presented in the fig. 9 & 10.

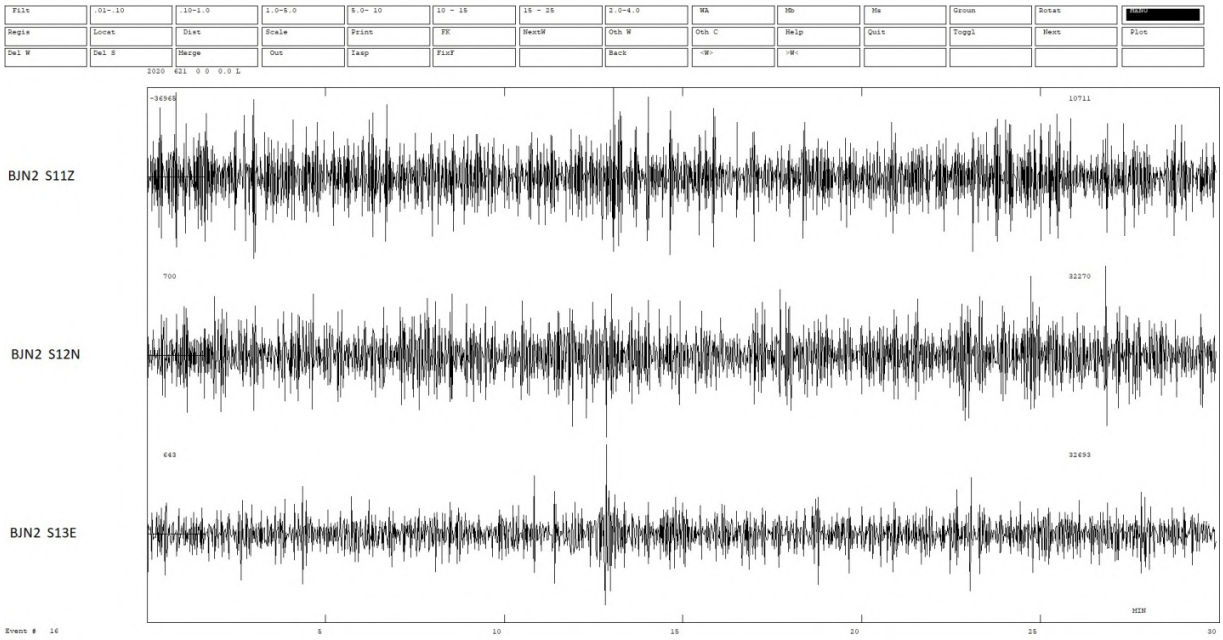


Fig. 9: Waveform record at the BJN2 station

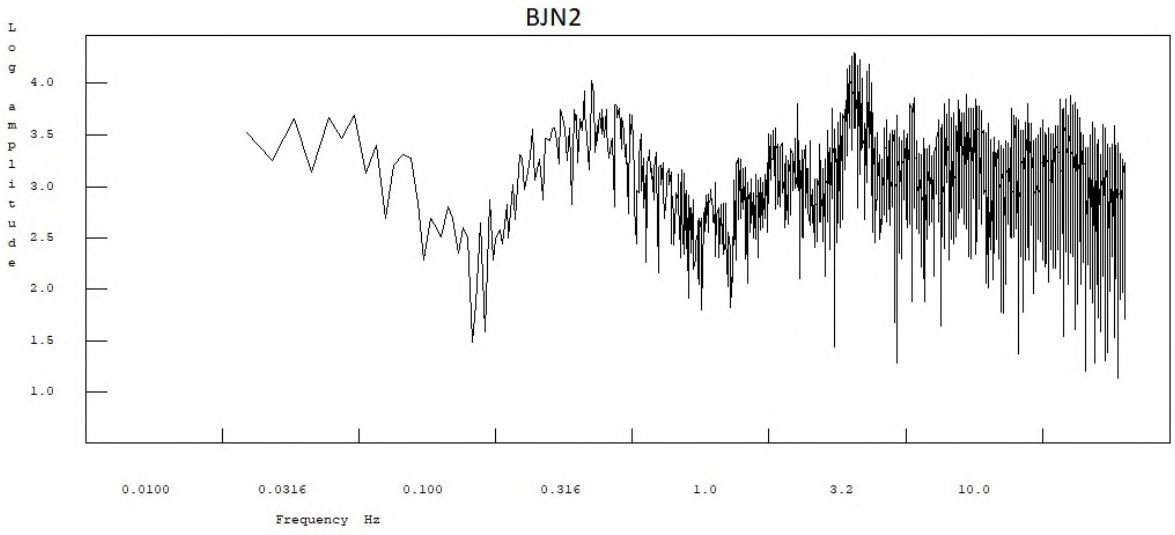


Fig. 10: FFT spectrum of the waveform at site BJN2

BJN3 (Barekuri P.S.):

The station BJN3 was located at the Barekuri police station and the sensor was placed on a newly constructed pier. The record of the station was quite good, except for the period when a generator was run during occasional power-cut, mainly in the evening. Example of recorded data and derived spectra is given in fig. 11 & 12.

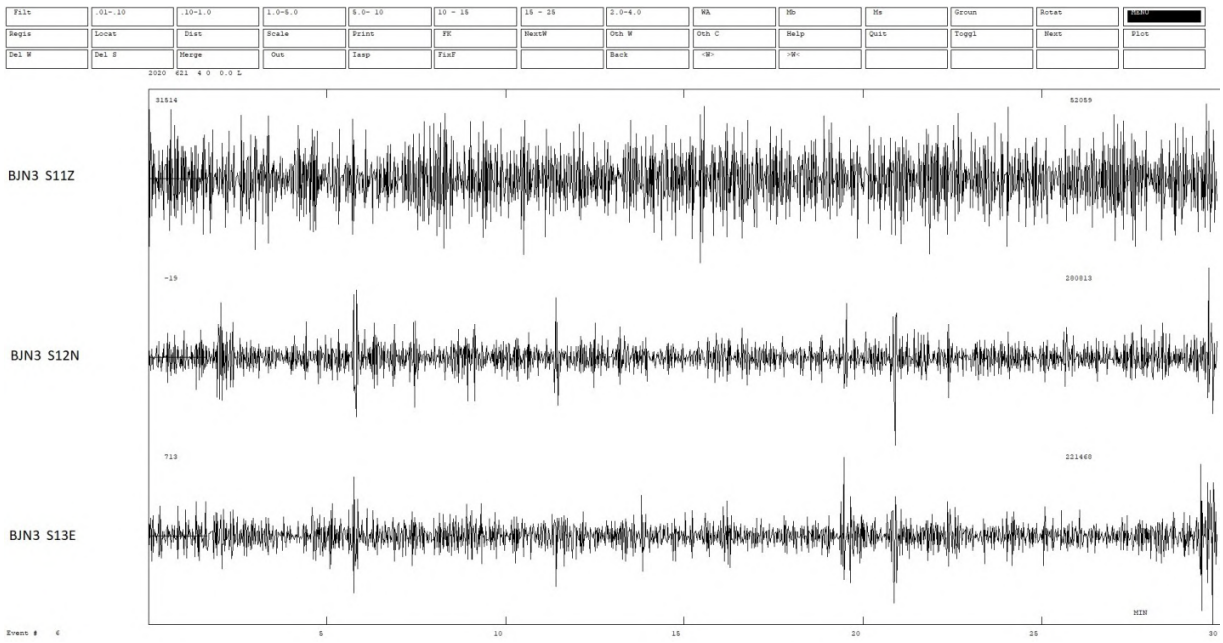


Fig. 11: Waveform record at the BJN3 station

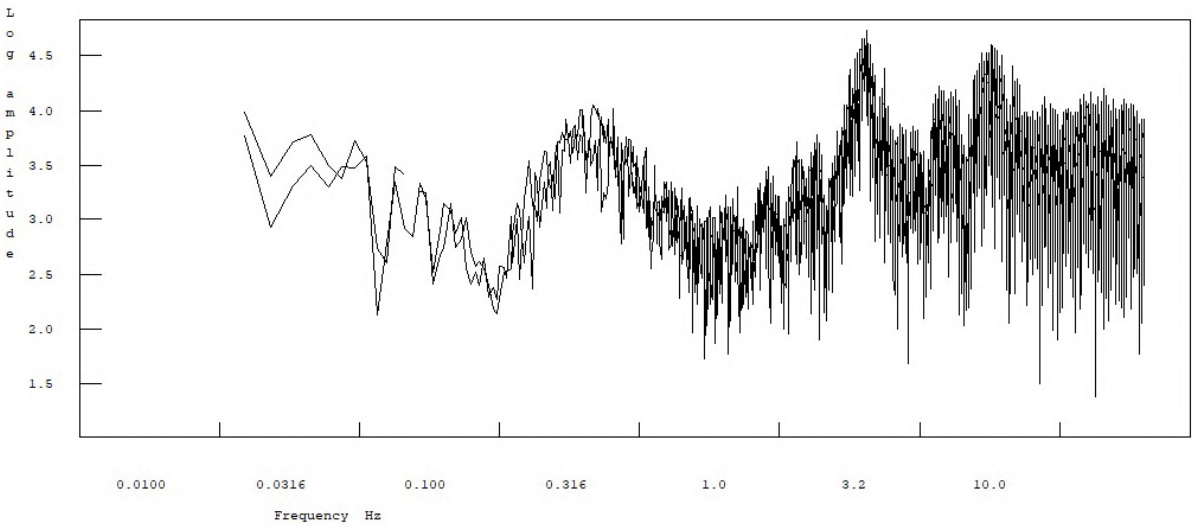


Fig. 12: FFT spectrum of the waveform at site BJN3

Flood water entered the seismic station installed at Barekuri police station on 25th June 2020. With the help of the staff at the police station we could recover the equipment and same was shifted to a convenient relatively quiet room of the police station. The data quality was good at this new site and the station performed fine during the rest of the period.

BJN4 (Baghjan EPS):

The seismic station BJN4 was initially installed at the OIL's Early Production Set-up (EPS) located at Baghjan about 2km away from the blowout site. Though the sensor was placed on a newly constructed pier, the noise level at this site was very high due to the ongoing activities at the EPS. The continuous high frequency noise at the site makes it difficult to recognize any other recorded event. Though, the distant earthquake activities could still be well identified when the data is passed through high-cut filter, identifying very local high frequency events was very difficult, and nearly impossible from the prevailing noise. An example of the seismograph record and derived spectrum is given in fig. 13 & 14.

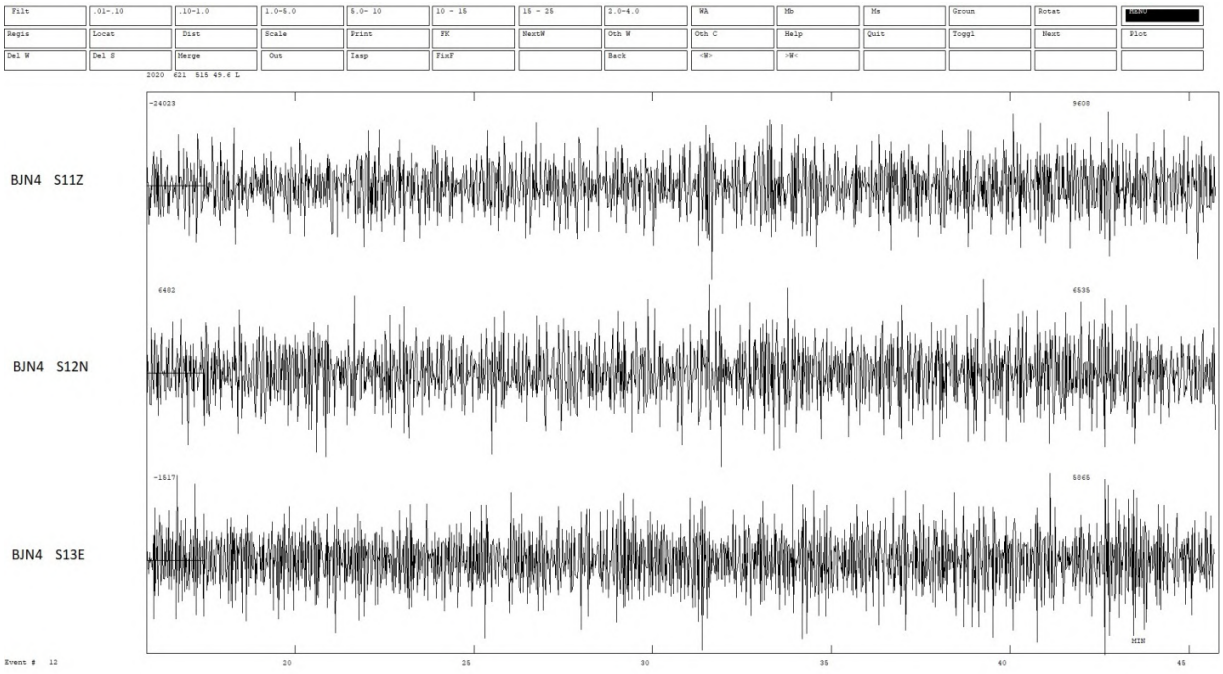


Fig. 13: Waveform record at the BJN4 station

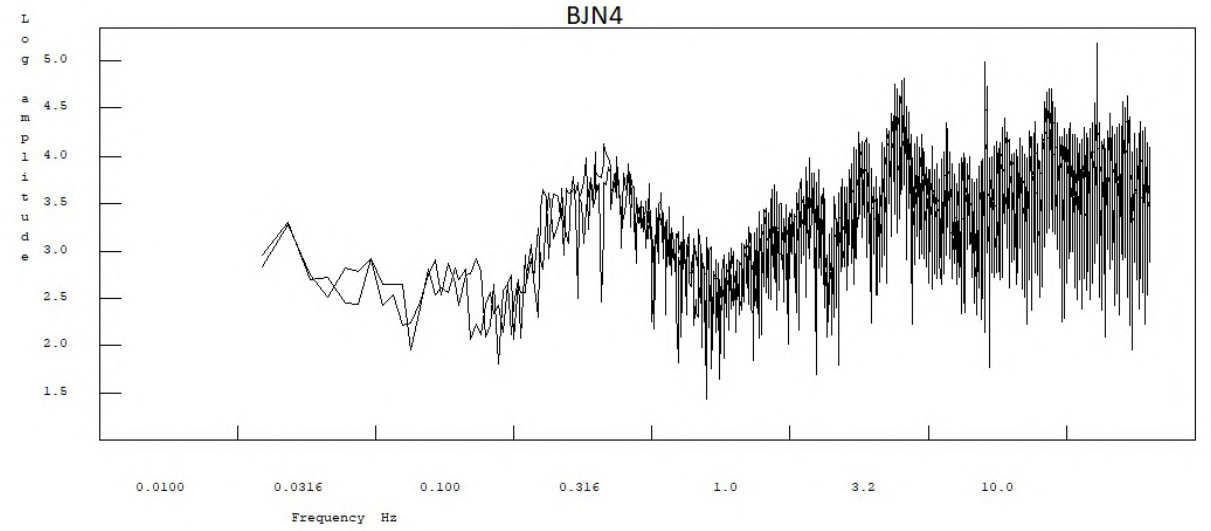


Fig. 14: FFT spectrum of the waveform at site BJN4

Due to the very disturbing continuous that prevailed at the EPS and also due to water logging problem, the station was later shifted to the campus of a private resident at a distance of about 0.5km from the EPS. Even without the concrete pier the data quality improved significantly in the new location except for the intermittent man-made disturbances. Any event, local/distant could be readily recognized at the new site.

BJN5 (Baghjan Blowout Site):

The seismic station BJN5 was installed just about 420m away from the blowout site at Baghjan gaon. This station was supposed to act as the reference station for the high level of local vibration observed. Intense high frequency disturbance coming from the blowout site is dominant in the records of this station. Example of data recorded at this station with derived spectrum is given in fig. 15 & 16.

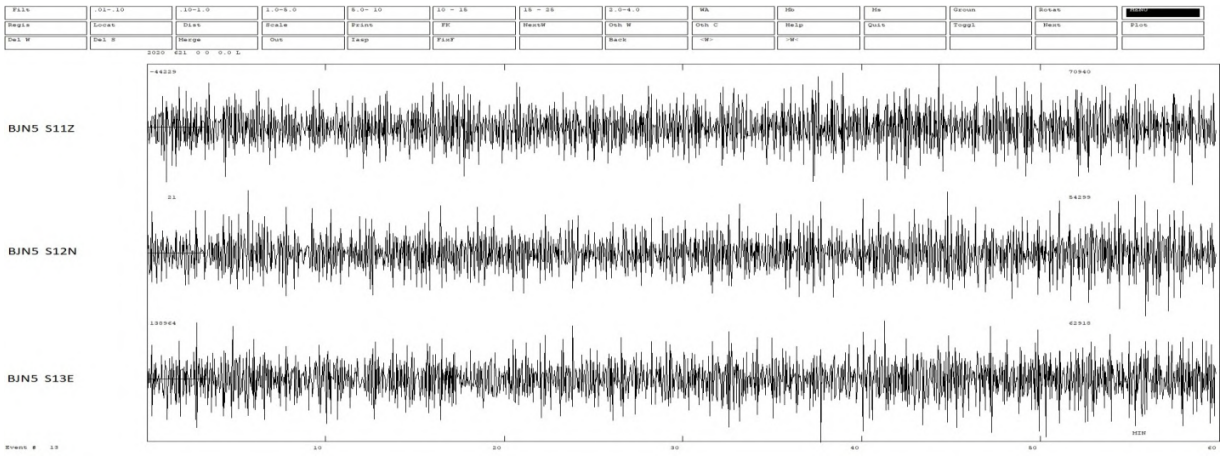


Fig. 15: Waveform record at the BJN5 station

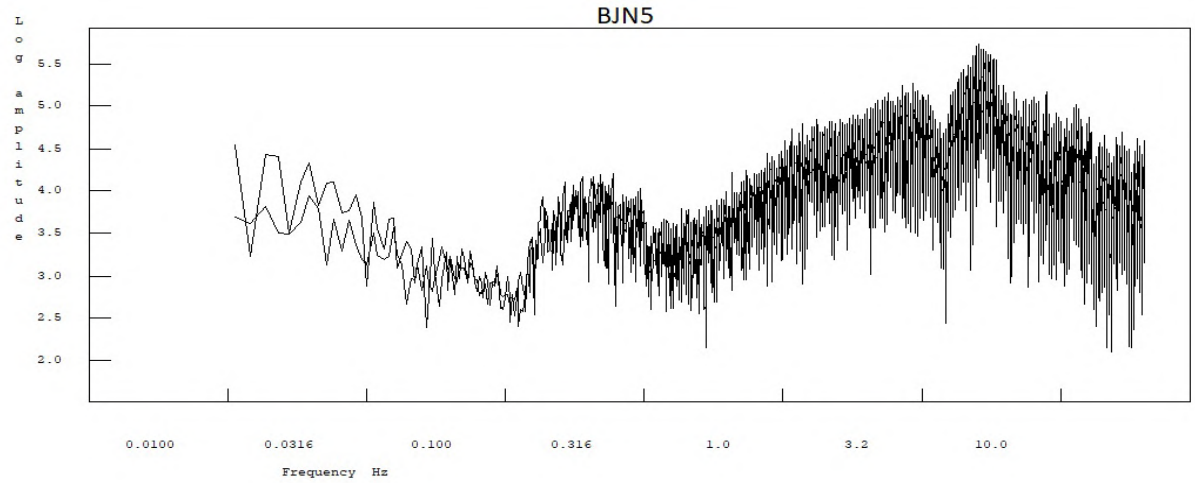


Fig. 16: FFT spectrum of the waveform at site BJN5

During the data recording period there were disturbances at the seismic station BJN5 as the sensor was submerged under flood water. It was under water for about three days and we were informed quite late. However, we reached the site on the evening of 26th June 2020 and fortunately the station was still active and data recording was going on. Due to the flooding condition, we shifted the station to about 1.1km away from the blowout site to a convenient location (private residence). Thereafter, the seismic station performed without any further disturbance. During first period of record, i.e. from 16-17 June to 26th June, 2020 the data recording was done at 100SPS. However, as we observed that the very local events are mainly of high frequency content, we later changed the recording frequency to 200 SPS in the second phase to record the event at a higher resolution.

The updated location details of the seismic stations are given in table -1 and fig. 17.

Table -1: Updated station locations of Baghjan temporary seismic network

Station Code	**Lat (^{o}N)**	**Lon (^{o}E)**	**Locality**	**Distance from blowout site (km)**	**Direction to blowout site**
BJN1	27:33:37.56	95:21:35.84	LIMBUGURI	4.455	27^o (NNE)
BJN2	27:33:23.84	95:23:33.76	DHELAKHAT T.E.	4.448	345^o (NNW)
BJN3	27:33:52.87	95:23:58.53	BAREKURI P. S.	3.877	332^o (NW)
BJN4	27:36:09.05	95:24:06.17	NEAR BAGHJAN E.P.S.	2.175	255^o (SW)
BJN5	27:36:00.96	095:23:29.54	BAGHJAN GAON	1.125	251^o (SW)



Fig. 17: Updated seismic station map of the Baghjan local seismic network

1.3 Types of seismic records

The Baghjan local seismic network ran smoothly and all the significant local, regional and teleseismic events reported by different national and international agencies had been recorded beautifully by the local seismic network. The records of the seismic network consist of:

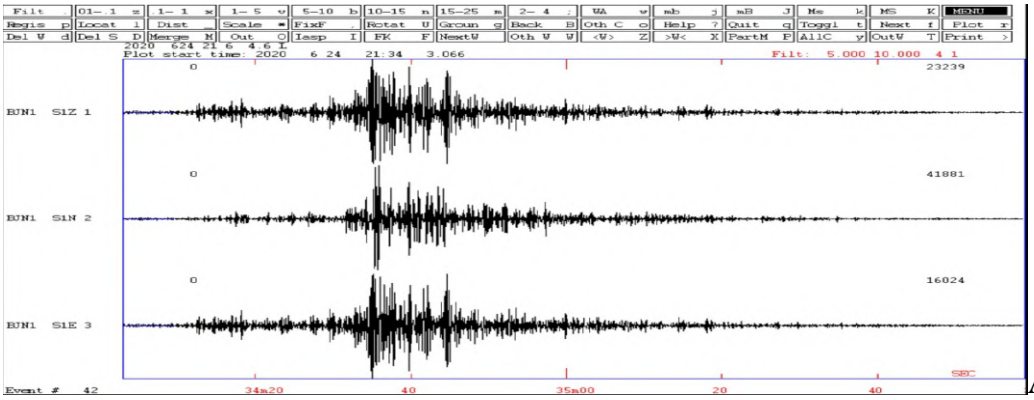
1. Local earthquakes occurred in the NE India and adjoining areas
2. Regional and teleseismic earthquakes
3. Very local events occurred near the seismic network and
4. High frequency continuous vibration coming from the blowout site.

1.3.1 Local earthquake occurring in the NE India and adjoining region:

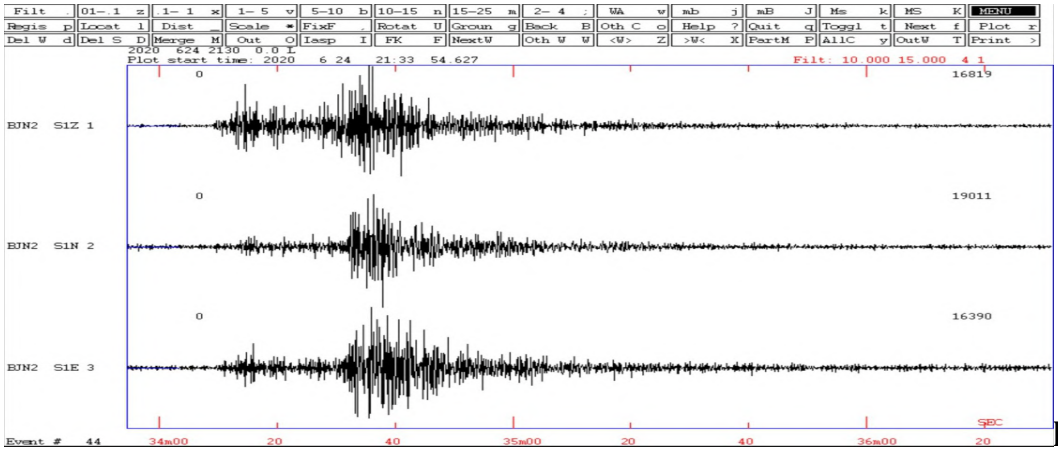
The Baghjan local seismic network recorded a number of local earthquakes occurring in the NE India and adjoining areas during the period of operation. The nearest event apart from the very local event of Baghjan area occurred at a distance of about 90km from Baghjan. Majority of the distant but still local events occurred near the Indo-Burma border area. A list of the local earthquakes recorded during the time of operation of the seismic network is given below in table 2.

Table 2: Local earthquakes occurring in the NE India and adjoining region recorded by the Baghjan local seismic network

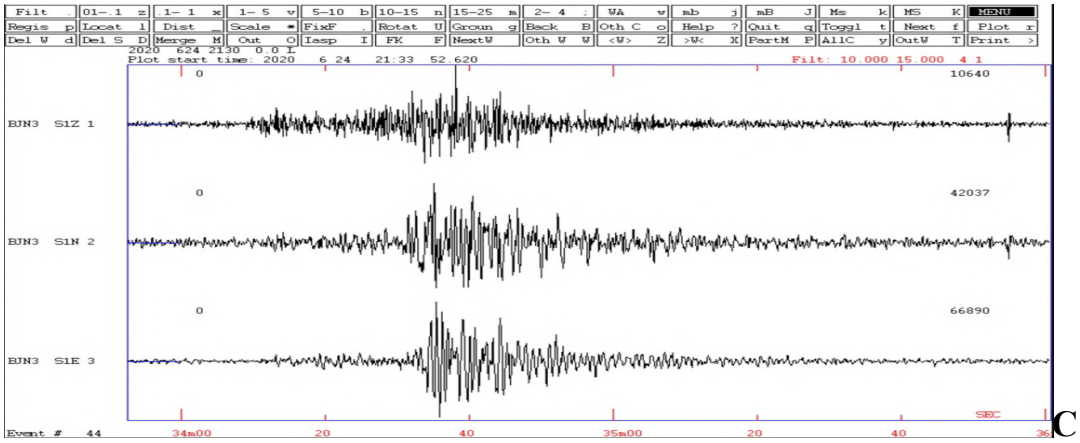
Sl No	Date	Origin Time (UTC)	Lat (^{o}N)	Lon (^{o}E)	Magnitide	Depth (km)	Locality
1	24.06.2020	21:33:41	26.17	94.24	3.8	6	Nagaland
2	24.06.2020	01:48:54.5	28.424	95.297	2.7	15	35 km WNW of Dambuk, Arunachal Pradesh
3	26.06.2020	17:27:10	26.81	93.74	2.6	-	Gohpur, Assam
4	28.06.2020	05:54:35	24.20	93.66	3.8	-	Manipur
5	28.06.2020	05:55:37	24.74	94.40	4.0	60	Manipur
6	14.07.2020	03:02:59	26.56	94.87	3.5	10	Longleng, Nagaland
7	19.07.2020	21:00:47	24.98	94.63	3.5	10	Ukhrul, Manipur
8	06.07.2020	20:23:32	Location parameter not estimated				
9	06.07.2020	20:03:16	28.36	92.12	3.1	170	Arunachal Pradesh



A



B



C

Fig: 18. M3.8 event recorded by BJN3 station originating at Nagaland on 24th June 2020, which is more than 220km from the blowout site. The event is recorded by the stations BJN1 (A), BJN2 (B) and BJN3 (C) respectively.

Another local earthquake originating in the Arunachal Pradesh, which is located about 90km towards north of the blowout site was nicely recorded (Fig.19). The hypocentral parameters of the event was estimated and given below:

Date	Origin time	Latitude o N	Longitude o E	Mag (Mc)	Depth (km)	Locality
24.06.2020	01:48:54.5 (UTC)	28.424	95.297	2.7	15	35 km WNW of Dambuk, Arunachal Pradesh

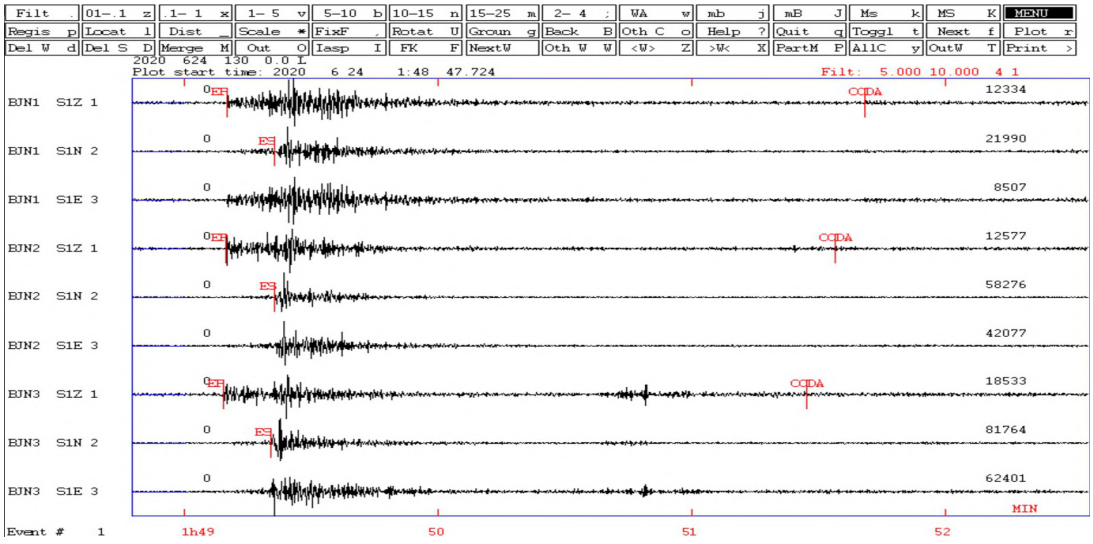


Fig. 19: A local earthquake recorded by Baghjan temporary seismic network. Distance from blowout site is about 90km due north.

An earthquake of M4.0 occurred at Ukhrul, Manipur has been nicely recorded by the local seismic network. This event has been reported by National Centre for Seismology, which occurred on 28th June 2020 at around 05:55:37 (UTC). This local event occurred at about 320km SSW of Baghjan. Waveforms of the event have been presented in fig.20.

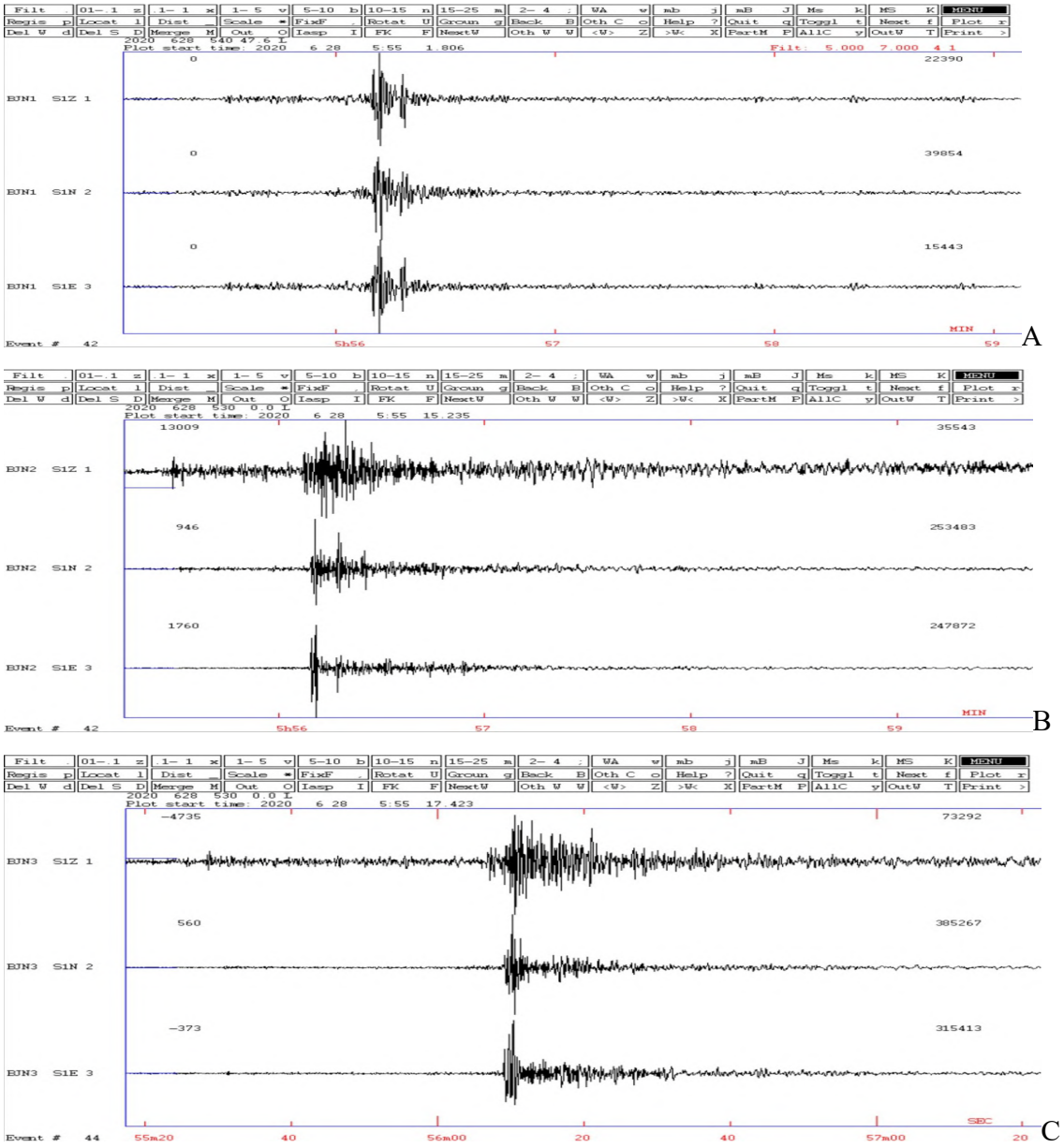


Fig. 20: Waveforms of local M4.0 event occurring at Ukhrul (Manipur) on 28th June 2020 as recorded by Baghjan local seismic network. The event is recorded by the stations BJN1 (A), BJN2 (B) and BJN3 (C) respectively.

The local seismic network at Baghjan recorded two local events on 26 June and 28 June, 2020 (Fig. 21 and Fig. 22). The 26 June event was recorded by three seismic stations of the local network and though azimuth coverage is poor, we tried to locate the event. As per our estimation, the first event is an M2.6 earthquake occurred near Gohpur, Assam. Epicentral distance from Baghjan is about 180km. The 28 June event, on the other hand, originated at southern Manipur at an epicentral distance of about 410km from Baghjan. The duration magnitude of the event is estimated at M3.8. The depth of the events could not be estimated with confidence. The hypocentral parameters of the events are given below:

Date	OT (UTC)	Lat (^{o}N)	Lon (^{o}E)	Depth (km)	Mag (Mc)
26.06.2020	17:27:10	26.81	93.74	-	2.6
28.06.2020	05:54:35	24.20	93.66	-	3.8

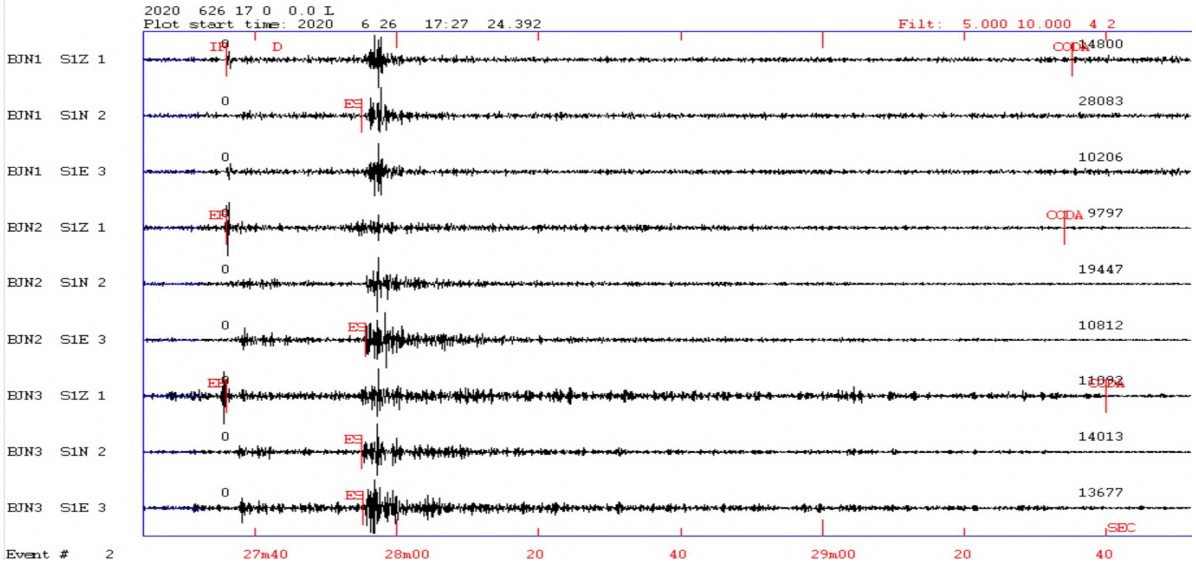


Fig. 21: M2.6 local event occurred near Narayanpur of Assam on 26th June 2020.

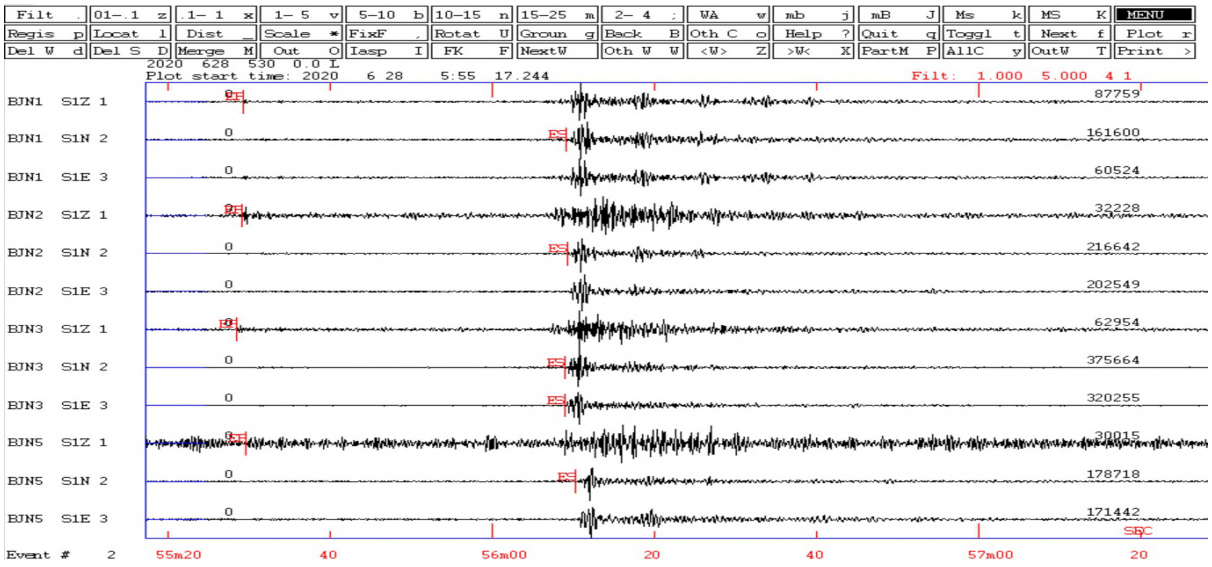


Fig. 22: M3.8 local event occurred in southern Manipur on 28th June 2020.

An earthquake of magnitude M3.5 occurred at Longleng, Nagaland on 14th July 2020 at 03:02:59 (UTC). The waveform of the event is given in fig. 23 and hypocentral parameter is given in table - 2. Similarly an event occurred in Manipur on 19th July 2020 at 21:00:47 (UTC) is also nicely recorded by the network. The waveform of the recorded event is given in fig. 24 and hypocentral parameter is presented in table -2.

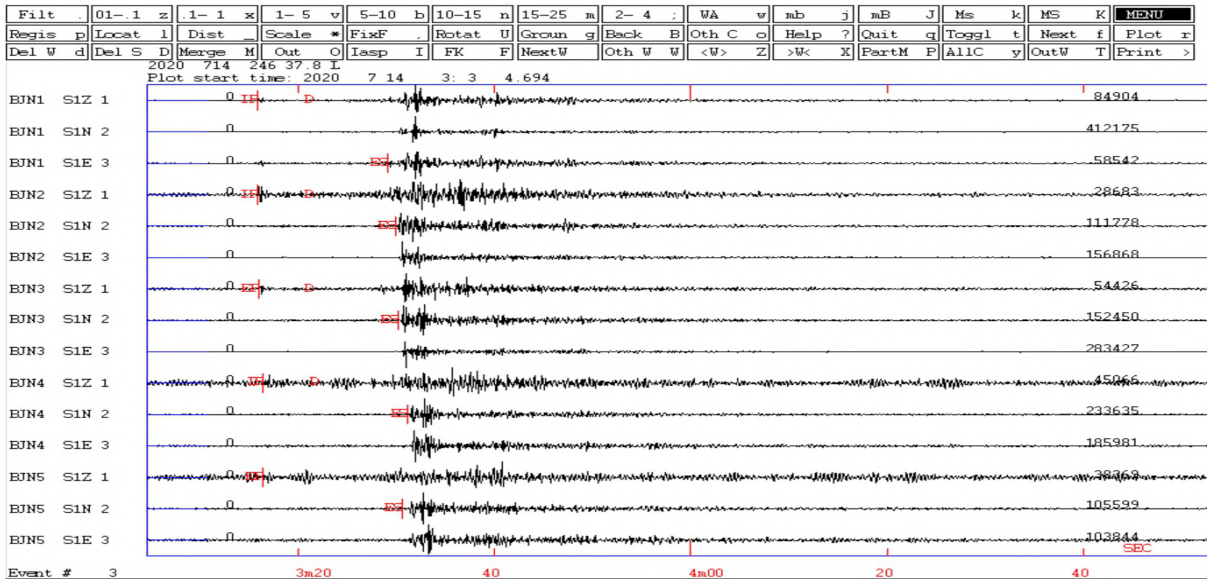


Fig. 23: Earthquake of M3.5 originating near Longleng, Nagaland on 14.07.2020 at 03:02:59 (UTC) as recorded by the Baghjan local seismic network.

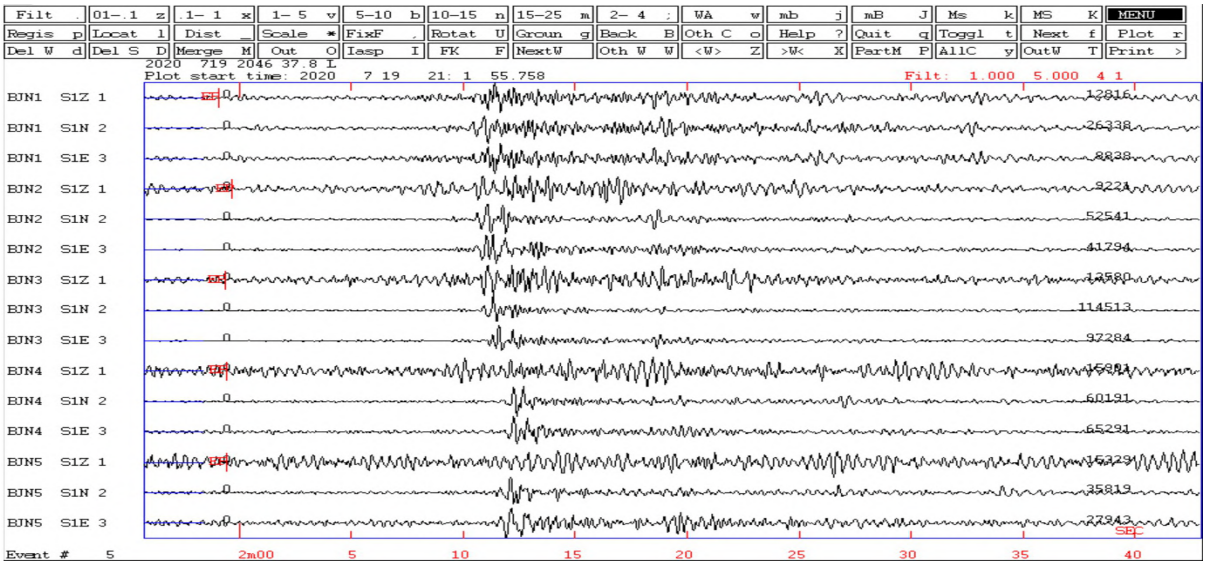
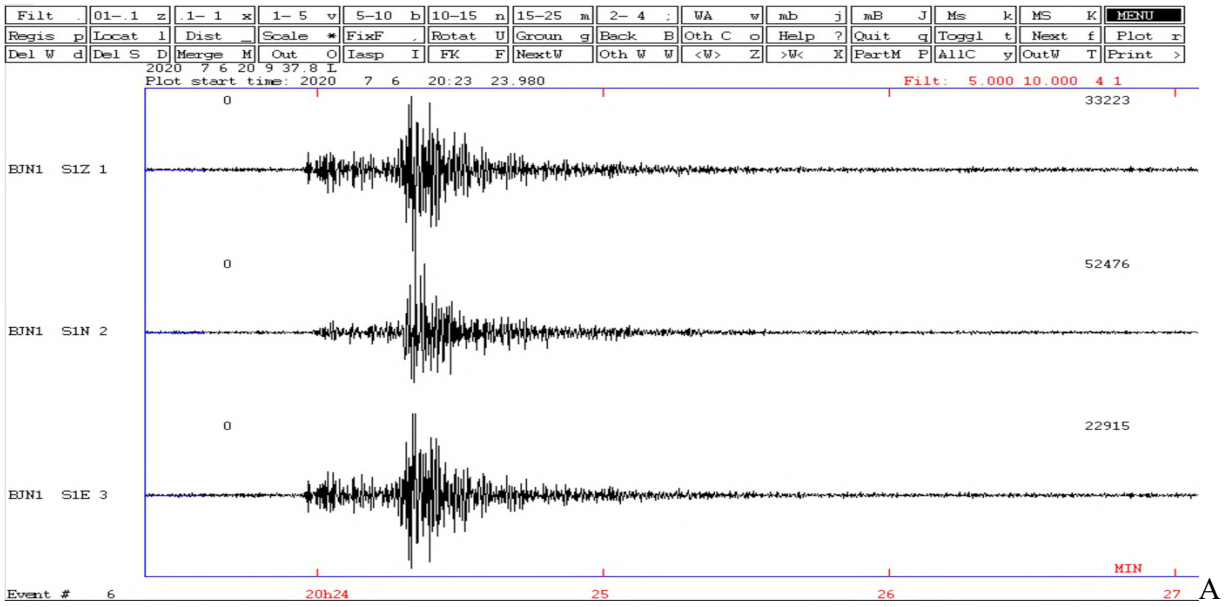


Fig. 24: An M3.5 earthquake originating near Ukhrul, Manipur on 19.07.2020 at 21:00:47 (UTC) as recorded by the Baghjan local seismic network.

An event recorded by the Baghjan local seismic network (Fig.25 A, B) on 6th July 2020 at 20:23:32 (UTC). As the event was recorded clearly by only two stations (BJN1 & BJN2), the hypocentral parameters could not be confidently estimated. Single station location was attempted and it was found that the event probably occurred in Arunachal Pradesh at a distance of about 175km NNE of Baghjan. The magnitude of the event is estimated at M3.1.



A

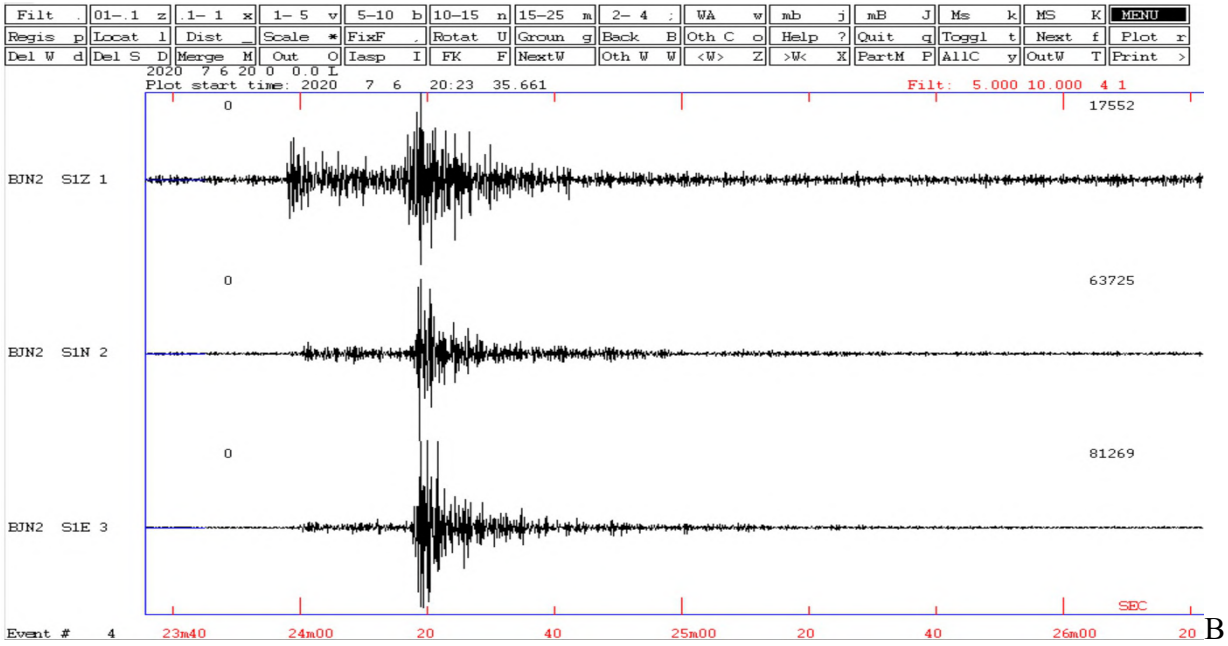


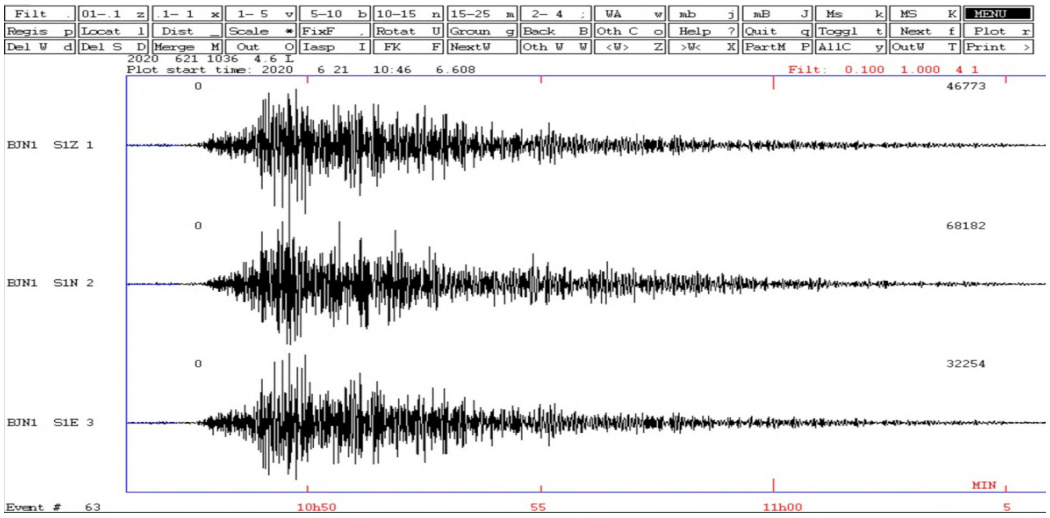
Fig. 25 (A,B) A local earthquake occurring in Arunachal Pradesh on 6th July 2020 as recorded by the Baghjan local seismic network.

1.3.2 Regional/Teleseismic events:

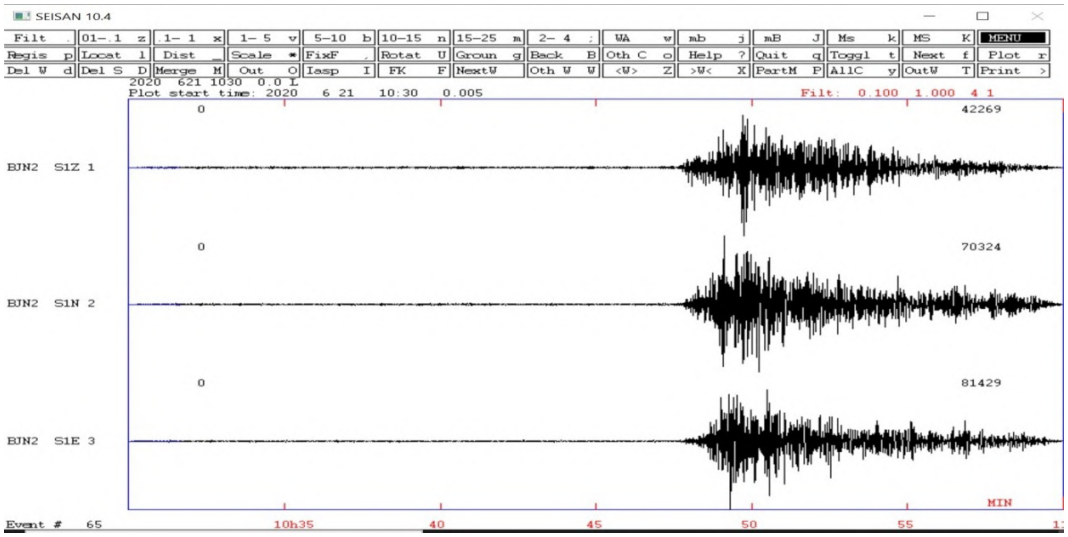
Apart from the local earthquakes the Baghjan local seismic network successfully recorded a few earthquakes originating at regional/teleseismic distance. Most of these events are a sequence of earthquakes occurred at southern Mizoram in the Indo-Burma border region. A list of distant/teleseismic events recorded by the Baghjan seismic network during its operation is presented in table -3.

Table 3: List of a few distant/teleseismic events recorded by the Baghjan local seismic network during its operation.

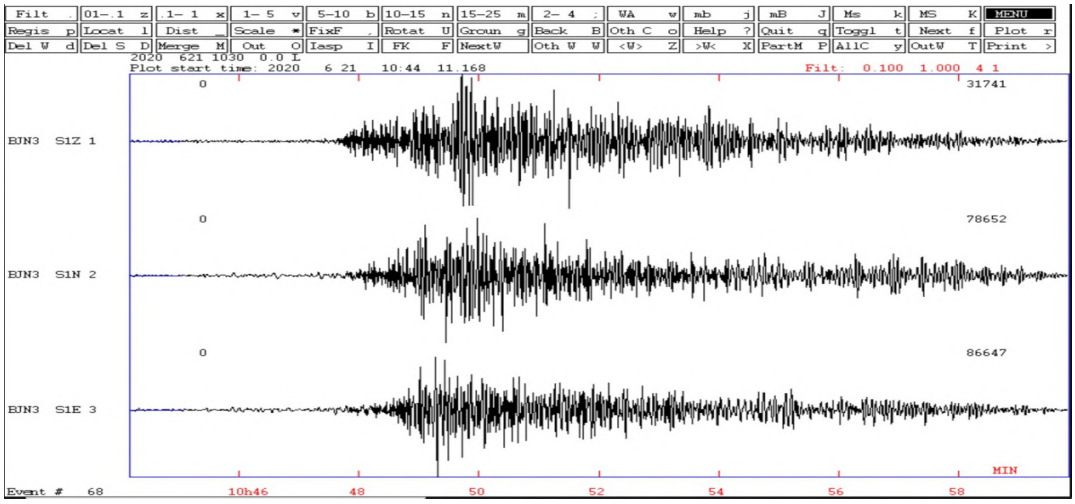
Sl No	Date	Origin Time (UTC)	Lat (°N)	Lon (°E)	Magnitide	Depth (km)	Locality
1	21.06.2020	10:46:24	23.88	93.09	5.1	30	Mizoram
2	21.06.2020	22:40:52.63	23.145	93.286	5.6	10.8	Mizoram
3	25.06.2020	21:05:18	26.81	93.74	6.3	10.0	China
4	17.07.2020	16:33:58	23.29	93.35	5.1	78.0	Mizoram
5	03.07.2020	09:05:41	23.02	93.53	4.6	25.0	Mizoram (Indo-Burma Border)


Filt 01– 1 z 1– 1 x 1– 5 v 5–10 b 10–15 n 15–25 m 2– 4 ; WA w mb j mB J Ms k MS K MENU
Regis p Locat l Dist _ Scale * FixF . Rotat U Groun g Back B Oth C o Help ? Quit q Toggl t Next f Plot r
Del W d Del S D Merge M Out O Iasp I FK F NextW Oth W W <W> Z >W< X PartM P AllC y OutW T Print >
2020 621 1036 4.6 L
Plot start time: 2020 6 21 10:46 6.608
Filt: 0.100 1.000 4 1
0
46773
BJN1 S1Z 1
0
68182
BJN1 S1N 2
0
32254
BJN1 S1E 3
MIN
Event # 63
10h50
55
11h00
5

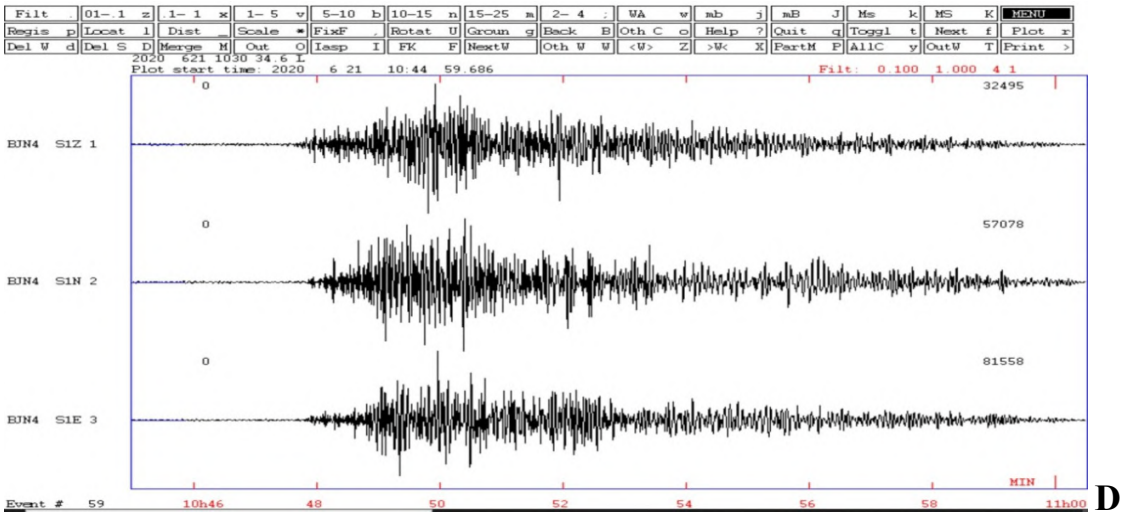
A


SEISAN 10.4
Filt 01– 1 z 1– 1 x 1– 5 v 5–10 b 10–15 n 15–25 m 2– 4 ; WA w mb j mB J Ms k MS K MENU
Regis p Locat l Dist _ Scale * FixF . Rotat U Groun g Back B Oth C o Help ? Quit q Toggl t Next f Plot r
Del W d Del S D Merge M Out O Iasp I FK F NextW Oth W W <W> Z >W< X PartM P AllC y OutW T Print >
2020 621 1030 0.0 L
Plot start time: 2020 6 21 10:30 0.005
Filt: 0.100 1.000 4 1
0
42269
BJN2 S1Z 1
0
70324
BJN2 S1N 2
0
81429
BJN2 S1E 3
MIN
Event # 65
10h35
40
45
50
55

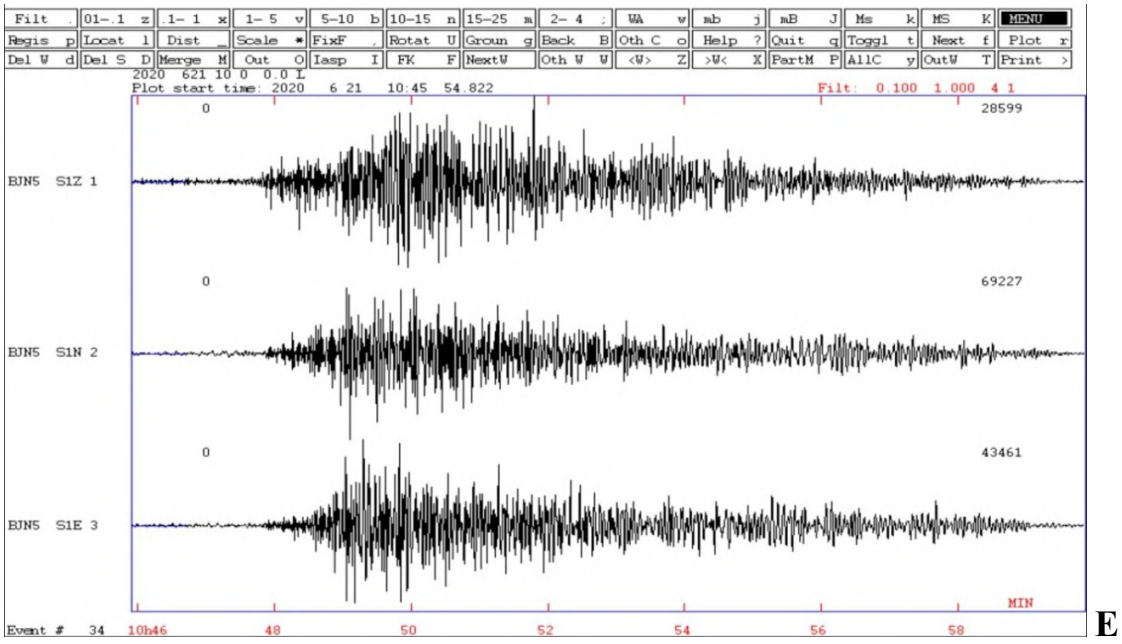
B


Filt
Regis p
Del W d
01-.1 z
Locat l
Del S D
1- 1 x
Dist _
Merge M
1- 5 v
Scale *
Out O
5-10 b
FixF ,
Iasp I
10-15 n
Rotat U
FK F
15-25 m
Groun g
NextW
2- 4 ;
Back B
Oth W W
WA w
Oth C o
<W> Z
mb j
Help ?
>W< X
mB J
Quit q
PartM P
Ms k
Toggl t
AllC y
MS K
Next f
OutW T
MENU
Plot r
Print >
2020 621 1030 0.0 L
Plot start time: 2020 6 21 10:44 11.168
Filt: 0.100 1.000 4 1
BJN3 S1Z 1
BJN3 S1N 2
BJN3 S1E 3
31741
78652
86647
MIN
Event # 68
10h46
48
50
52
54
56
58

C


Filt
Regis p
Del W d
01-.1 z
Locat l
Del S D
1- 1 x
Dist _
Merge M
1- 5 v
Scale *
Out O
5-10 b
FixF ,
Iasp I
10-15 n
Rotat U
FK F
15-25 m
Groun g
NextW
2- 4 ;
Back B
Oth W W
WA w
Oth C o
<W> Z
mb j
Help ?
>W< X
mB J
Quit q
PartM P
Ms k
Toggl t
AllC y
MS K
Next f
OutW T
MENU
Plot r
Print >
2020 621 1030 34.6 L
Plot start time: 2020 6 21 10:44 59.686
Filt: 0.100 1.000 4 1
BJN4 S1Z 1
BJN4 S1N 2
BJN4 S1E 3
32495
57078
81558
MIN
Event # 59
10h46
48
50
52
54
56
58
11h00

D


Filt
Regis p
Del W d
01-.1 z
Locat l
Del S D
1- 1 x
Dist _
Merge M
1- 5 v
Scale *
Out O
5-10 b
FixF ,
Iasp I
10-15 n
Rotat U
FK F
15-25 m
Groun g
NextW
2- 4 ;
Back B
Oth W W
WA w
Oth C o
<W> Z
mb j
Help ?
>W< X
mB J
Quit q
PartM P
Ms k
Toggl t
AllC y
MS K
Next f
OutW T
MENU
Plot r
Print >
2020 621 10 0 0.0 L
Plot start time: 2020 6 21 10:45 54.822
Filt: 0.100 1.000 4 1
BJN5 S1Z 1
BJN5 S1N 2
BJN5 S1E 3
28599
69227
43461
MIN
Event # 34
10h46
48
50
52
54
56
58

E

Fig. 26: Record of M5.1 earthquake occurred at Mizoram on 21st June 2020 as recorded by A) BJN1, B) BJN2, C) BJN3, D) BJN4 and E) BJN5.

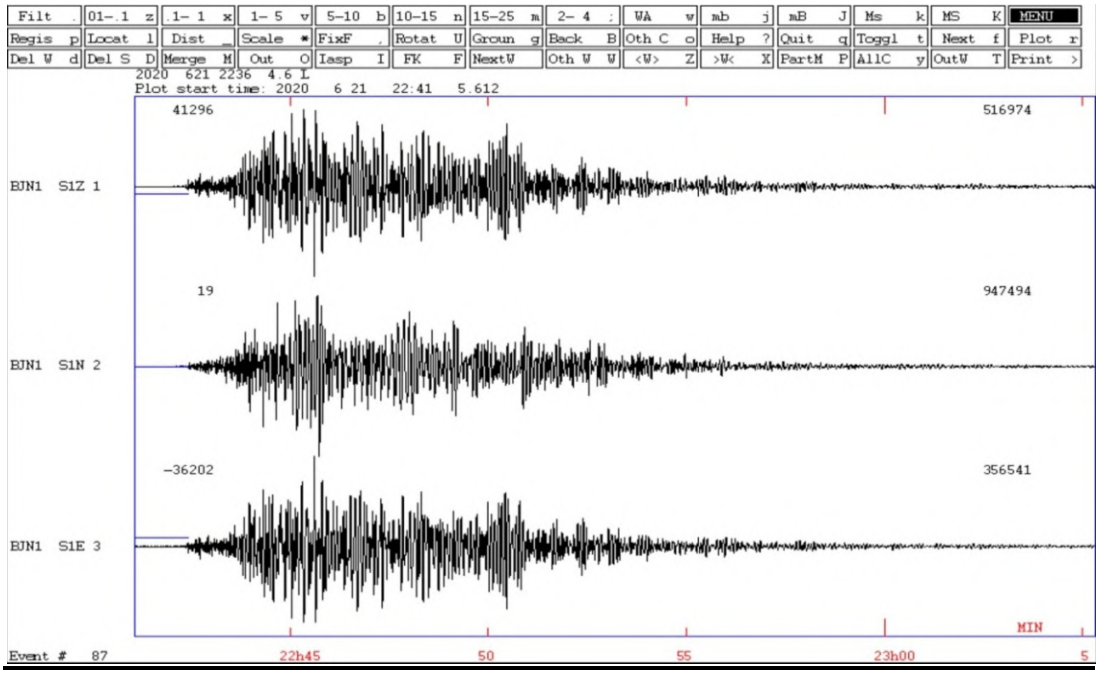
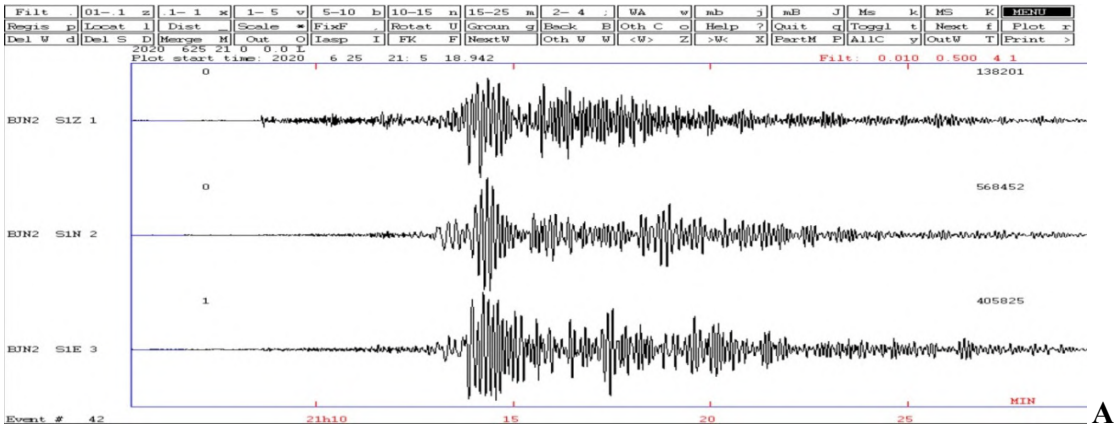


Fig. 27: M5.6 event recorded by BJN3 station originating at Mizoram on 21st June 2020.



A

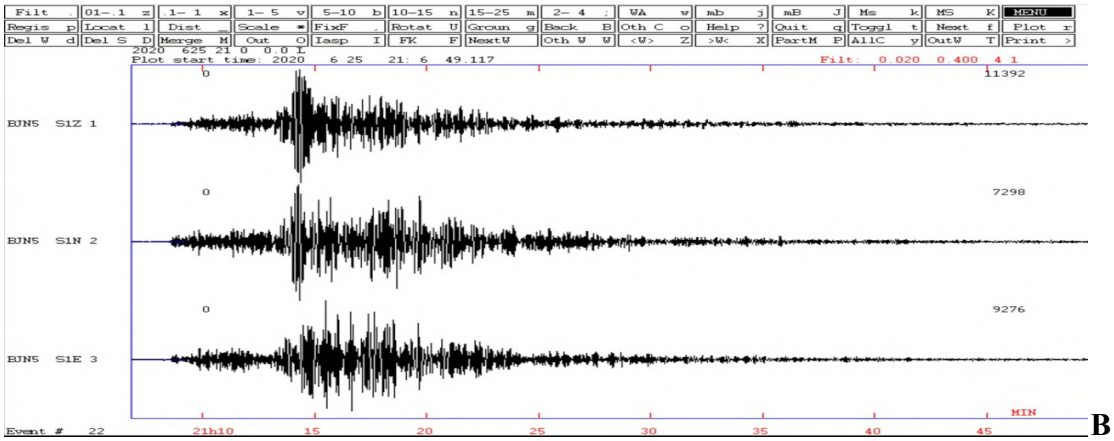


Fig. 28: M6.3 earthquake recorded by the seismic stations, A) BJN2 and B) BJN5 at Baghjan with more than 1500km epicentral distance originating in China on 25th June 2020 (21:05:18 UTC).

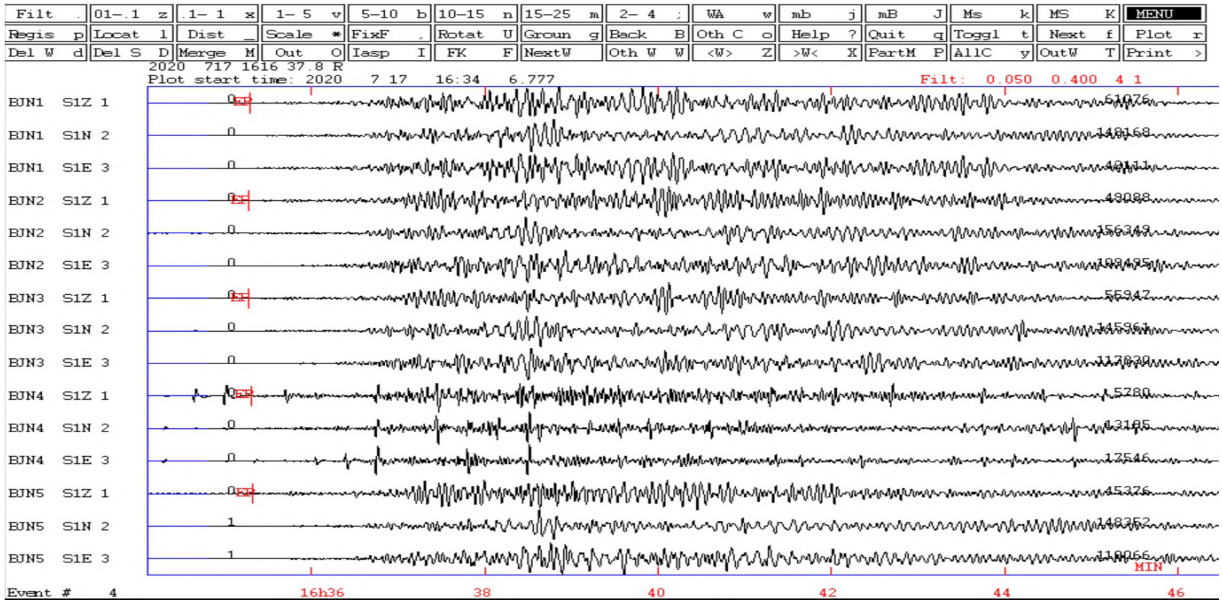


Fig. 29: Records of M5.1 earthquake occurred in Mizoram on 17.07.20 at 16:33:58 UTC.

The seismic network at Baghjan has recorded a distant M4.6 earthquake (regional) occurring in the Indo-Myanmar border area of Mizoram on 03.07.2020 at 09:05:43 (UTC). The waveforms of the event as recorded by the seismic stations are given in fig. 30 (A, B & C).

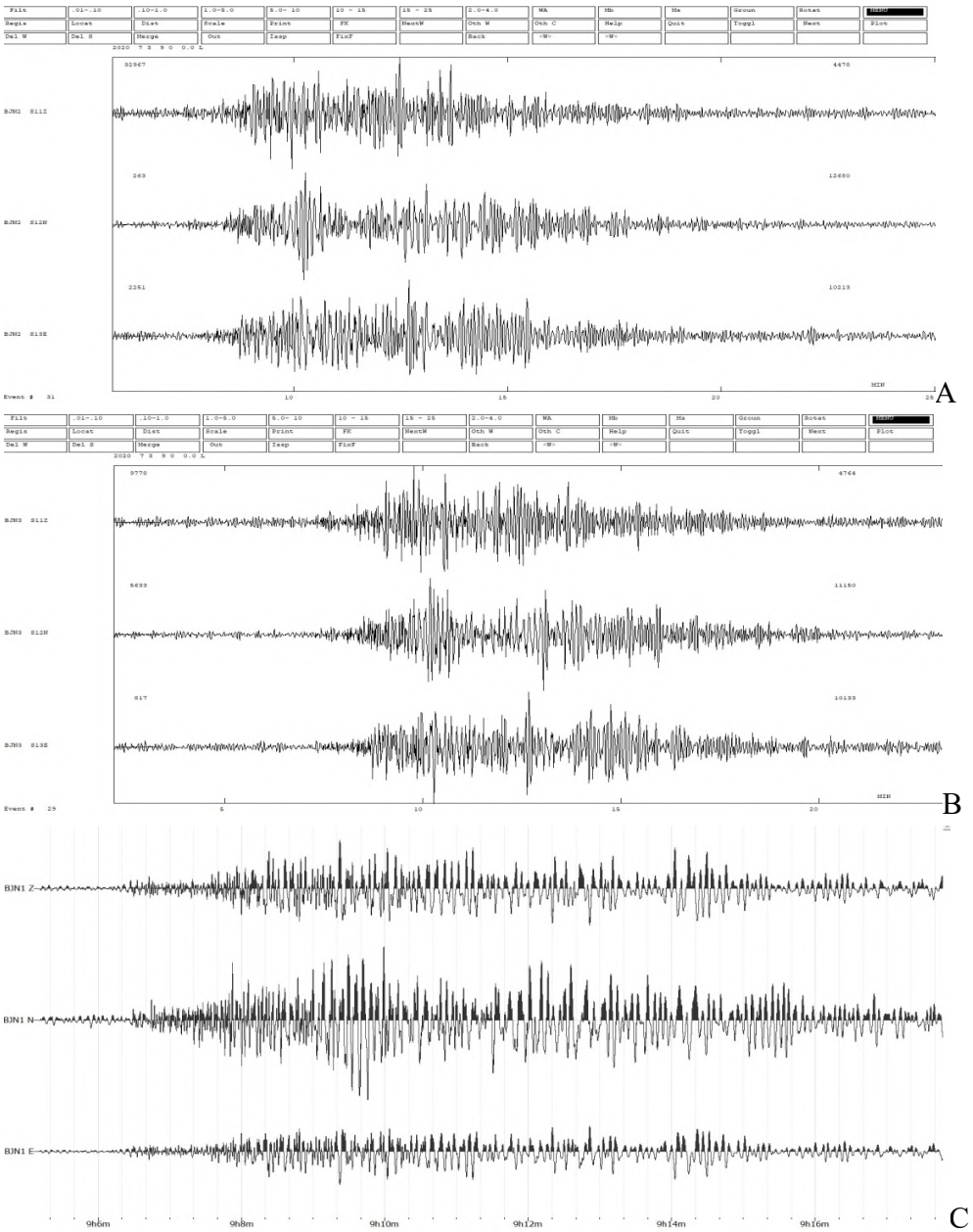


Fig. 30: A distant M4.6 earthquake originated in Mizoram (Indo-Myanmar border area) on 03.07.2020 at 09:05:43 (UTC) as recorded by the local seismic network at Baghjan.

1.3.3 Very Local Earthquakes (Near Baghjan)

The Baghjan local seismic network had been operational during 16th June to 21st July, 2020 to record any probable earthquake activity in the vicinity of the Baghjan well blowout site. Apart from the local earthquakes occurring in the NE India and adjoining areas, a few distant/teleseismic events the seismic network also recorded some very local micro earthquakes that occurred at Baghjan area and its neighborhoods during the operation. All the events are characterized by high frequency content and very minute, probably all are less than magnitude 1.0. Only one micro-earthquake was recorded

by multiple stations and we could locate the event. The said event occurred on 5th July 2020 at around 10:28:22 (UTC) and was nearest to BJN2. The estimated location parameters show that the event occurred at more than 5km away from the blowout site and the duration magnitude is about 0.8. Except this event there are several very local minute earthquakes recorded only by single station, and hence not located. However, the events are located at 1.5km to 12 km away from the recording stations, and obviously very shallow, which is quite evident from the travel time difference of S-wave and P-wave (S-P), which range from 0.34 sec to 2.5 sec only. We could not recognize any local earthquake occurring at Baghjan area in the records of BJN5, which is the nearest station to the incident site. The records of BJN5 are full of high frequency noise coming from the blowout site, and since the events are also of high frequency in nature, it was almost impossible to filter out the events from the noise. We have also observed maximum number of very local events near BJN1 and BJN4, and both the sites are related to oilfield activities. The station BJN1 is located at a close proximity of a well (Limbuguri well of Oil India Ltd.) that is supposed to start production soon. On the other hand, the station BJN4 is located just near the Baghjan EPS of OIL and next nearest station to the blowout site (about 2 km). Therefore, though cannot be confirmed, it is possible that the events occurring near BJN4 may be related to the blowout incident. The details of the very local micro-earthquakes observed at the neighbourhood of the Baghjan area is given in table -4. Waveforms of the events are presented in the figures 31-39.

Table 4: List of very local micro-earthquakes occurred at and near Baghjan area during the operation of the seismic network.

SL NO	DATE	P-ARRIVAL TIME (UTC)	S-ARRIVAL TIME (UTC)	S-P (s)	RECORDED BY STATION	APPROX. EPICENTRAL DISTANCE (KM)
1	26.06.2020	04:14:24.45	04:14:26.95	2.50	BJN2	10.0-12.0
2	26.06.2020	11:04:36.70	11:04:37.60	0.90	BJN1	3.6-4.5
3	27.06.2020	17:54:43.75	17:54:44.40	0.65	BJN1	2.6-3.25
4	29.06.2020	02:12:12.70	02:12:13.70	1.00	BJN1	4.0-5.0
5	30.06.2020	00:18:05.90	00:18:06.60	0.70	BJN1	2.8-3.5
6	03.07.2020	01:27:10.96	01:27:11.35	0.39	BJN1	1.5-1.9
7	03.07.2020	06:06:08.50	06:06:09.60	1.10	BJN1	4.5-5.5
8	05.07.2020	10:28:22.50	10:28:23.90	1.4	BJN1, BJN2, BJN3	5.6-7.0
9	05.07.2020	10:32:36.90	10:32:38.20	1.30	BJN3	5.2-6.5
10	10.07.2020	13:33:32.25	13:33:32.82	0.57	BJN4	2.5 - 3.0
11	10.07.2020	15:49:17.80	15:49:18.14	0.34	BJN4	1.5 - 2.0
12	11.07.2020	03:09:46.82	03:09:47.75	0.93	BJN4	4.5 - 6.0
13	11.07.2020	08:21:35.53	08:21:35.98	0.45	BJN4	2.0 - 2.5
14	11.07.2020	01:20:47.30	01:20:47.60	0.30	BJN1	1.2-1.5
15	13.07.2020	04:54:11.80	04:54:12.10	0.30	BJN1	1.2-1.5
16	13.07.2020	04:56:03.10	04:56:03.40	0.30	BJN1	1.2-1.5
17	13.07.2020	22:55:48.55	22:55:48.90	0.35	BJN1	1.4-1.75

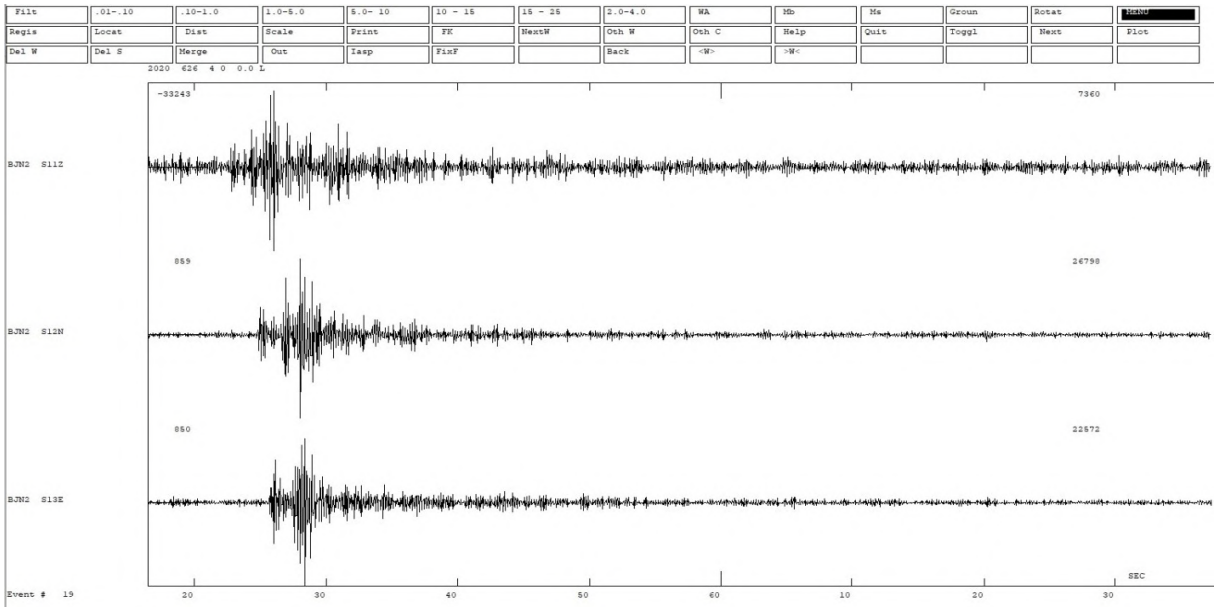


Fig. 31: A local earthquake recorded at BJN2 (Dhelakhat) seismic station. The event was recorded at 04:14:24 UTC (09:34:24 IST) of 26th June 2020 and occurred at an epicentral distance of about 10-12 km from BJN2.

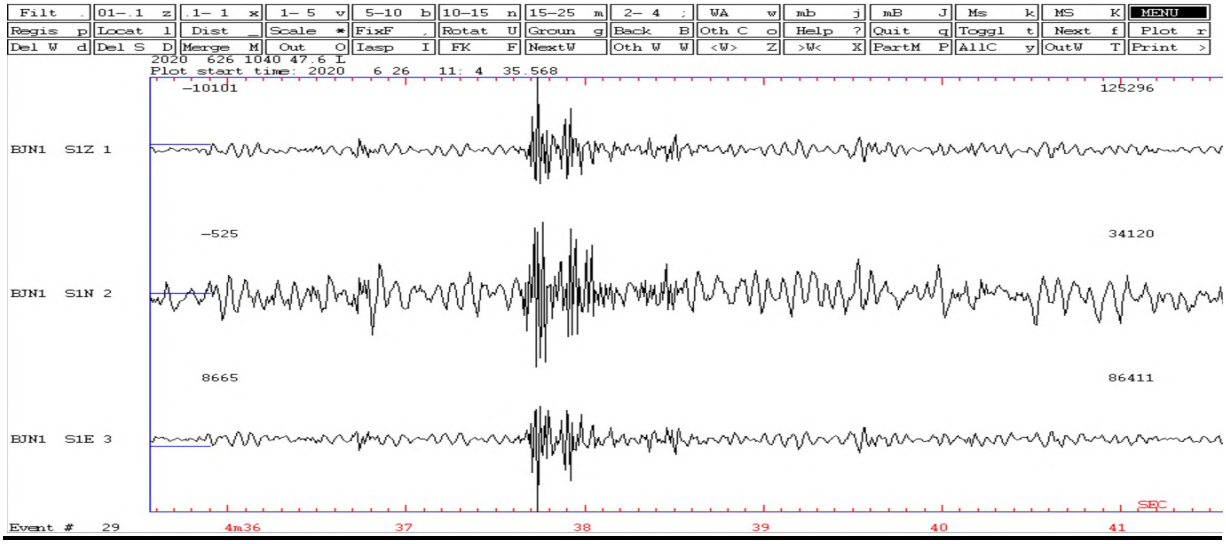


Fig. 32: A probable very local micro earthquake (probably M<1.0) as recorded by the BJN1 station on 26.06.2020 at 11:04:36 (UTC). The epicentral distance of the event should be within 3-4km from BJN1.

Preliminary processing of data has been started. It is observed that the station BJN1 has recorded a probable very local micro earthquake on 26.06.2020 at 11:04:36 (UTC) (Fig.32). The high frequency event may be related to the blowout incident, and probably occurred within 3-4 km distance from BJN1. The event is quite small as it was not recorded by the other stations, and magnitude may not exceed M1.0.

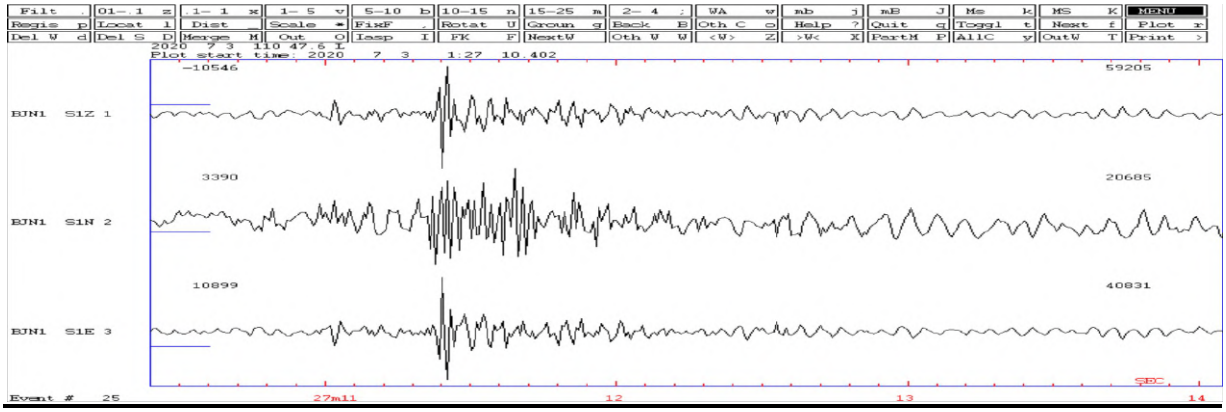


Fig. 33: A probable very local micro earthquake (probably below M1.0) as recorded by the BJN1 station on 03.07.2020 at 01:27:11 (UTC). The epicentral distance of the event should be within a from BJN1.

The station BJN1 has recorded a probable very local micro earthquake on 03.07.2020 at 01:27:11 (UTC) (Fig.33). This is a high frequency event and probably occurred within 1 km radial distance from BJN1 (S-P = 0.5s). The event is very small and was not recorded by the other stations.

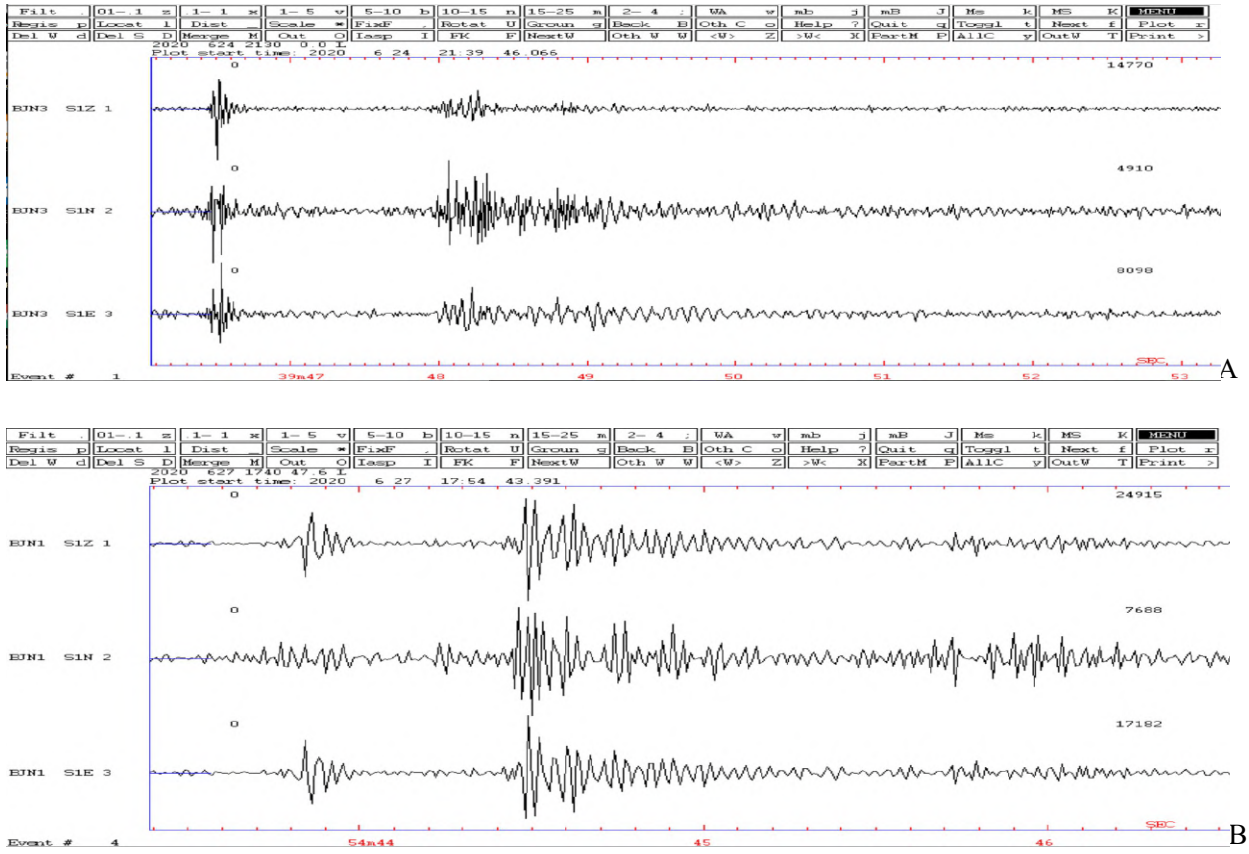


Fig. 34: Two probable micro-earthquakes recorded by single station. (A) recorded by BJN1, epicentral distance ~6-7km, (B) recorded by BJN3, epicentral distance ~3km.

We have identified four probable micro-earthquakes as recorded by the station BJN1 during 29th June to 3rd July 2020. The epicentral distance of the events vary from 1.5 to 4.5km from BJN1 (Limbuguri) with S-P ranging from 0.39sec to 1.1sec. P-wave travel time is considered at 4km/s, since events are probably very shallow. The details of the events are given in table-4 and fig. 35. All are high frequency events and not recognized in the records of any other station. Currently a team is conducting the geophysical surveys at the blowout site and another team is proceeding to Baghjan for data retrieval from the seismic stations and to check the status of the stations.

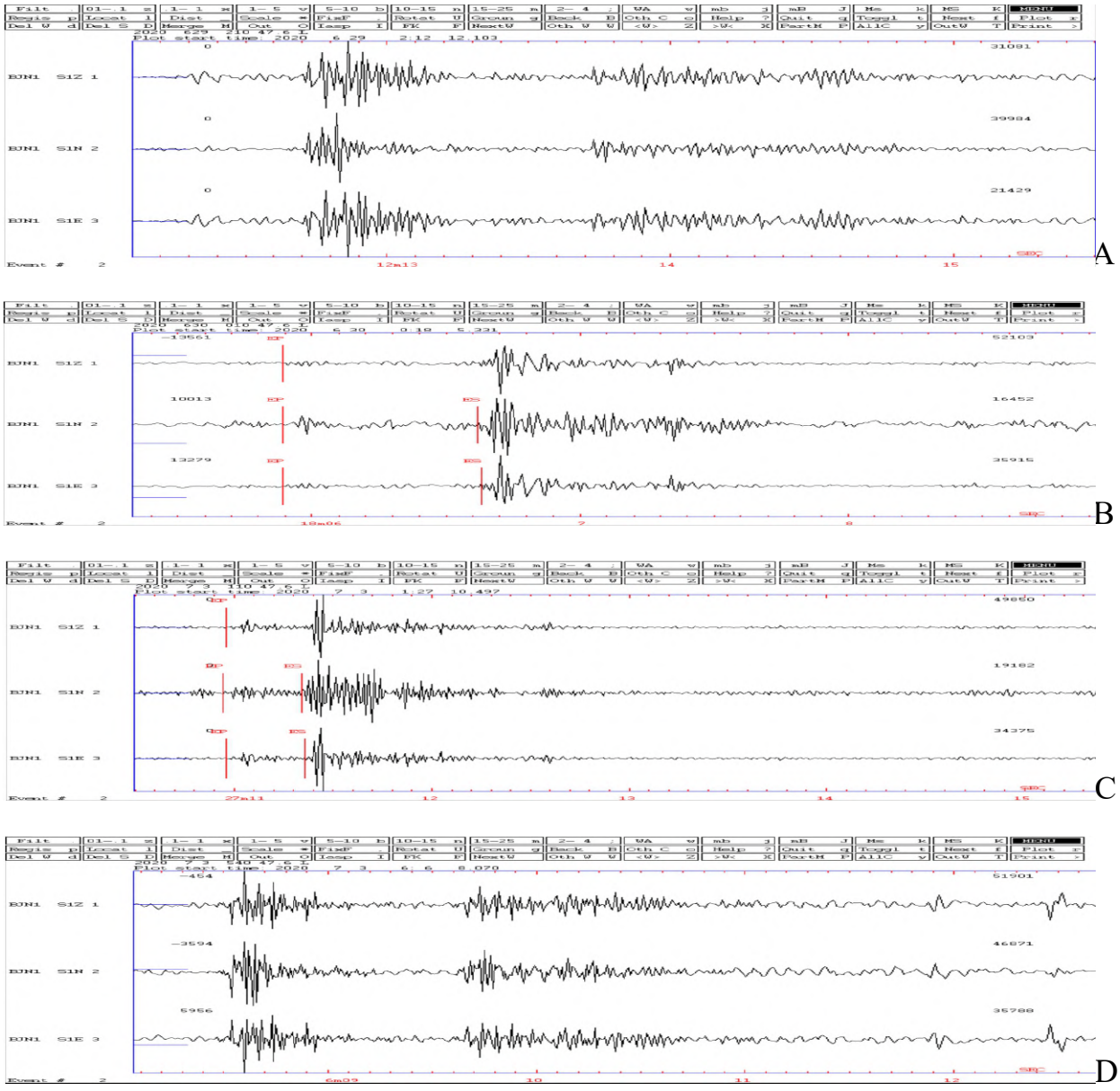


Fig. 35 (A, B, C &D): Probable micro-earthquake recorded by the BJN1 seismic station during 29th June to 3rd July 2020.

A very local micro-earthquake was recorded by three stations occurring on 5th July 2020. The waveform of the event is given in fig. 36.We tried to determine the hypocentral parameters of the event and found that the epicenter is located just near the BJN2 (27.555°N, 95.393°E). However, to accurately locate such very local shallow events we need a precise and detail velocity model of the subsurface.

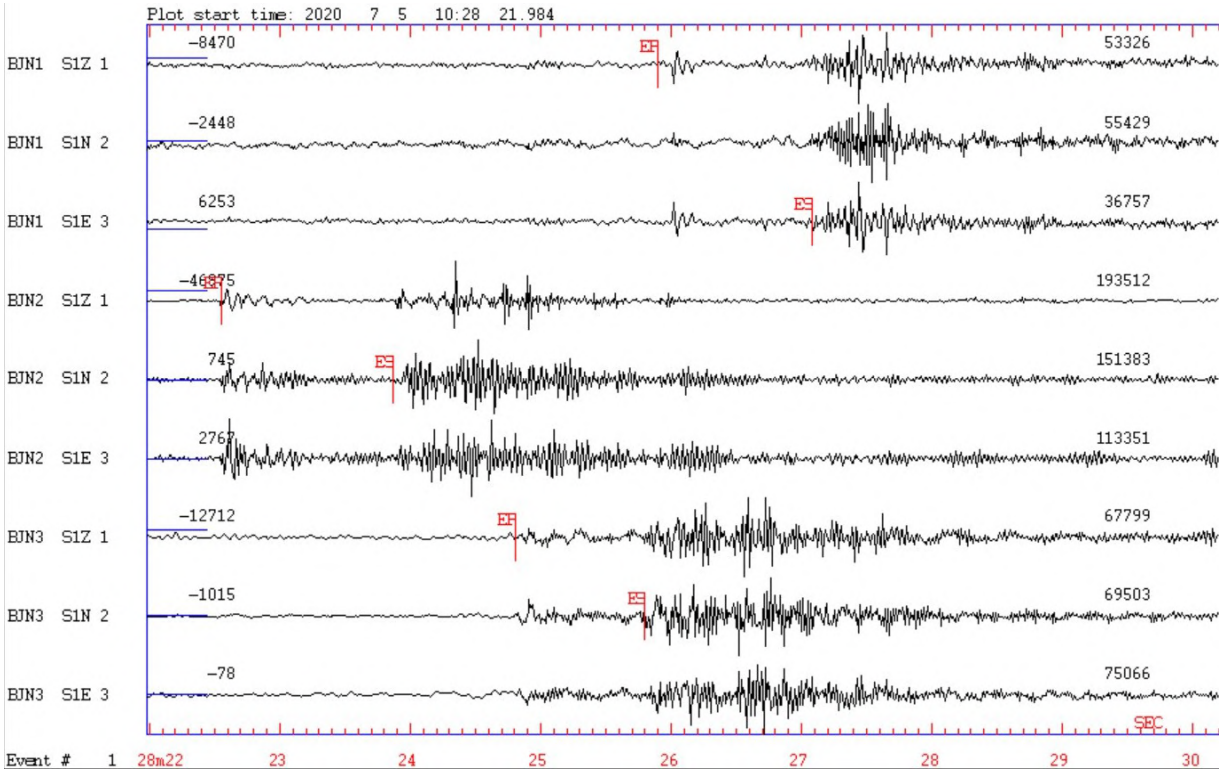


Fig. 36: A local small magnitude event occurred near Baghjan area occurred on 5 July 2020 at 10:28 Hrs (UTC)

A few probable local earthquakes have been observed in the records of BJN4 seismic station. All the events are very local occurring within 1.5-6.0km radius of the seismic station. These medium to high frequency events are very small and not observed in the records of other seismic stations. The nearest seismic station to BJN4 is BJN5, which is closely located to the blowout site. Therefore, seismic record of BJN5 is dominated by high frequency vibration coming from the blowout site, and any other high frequency signal in impossible to filter out. Further processing & analysis of the seismic records is in progress. The details of the events are given in table 4 and waveforms are presented in the fig. 37.

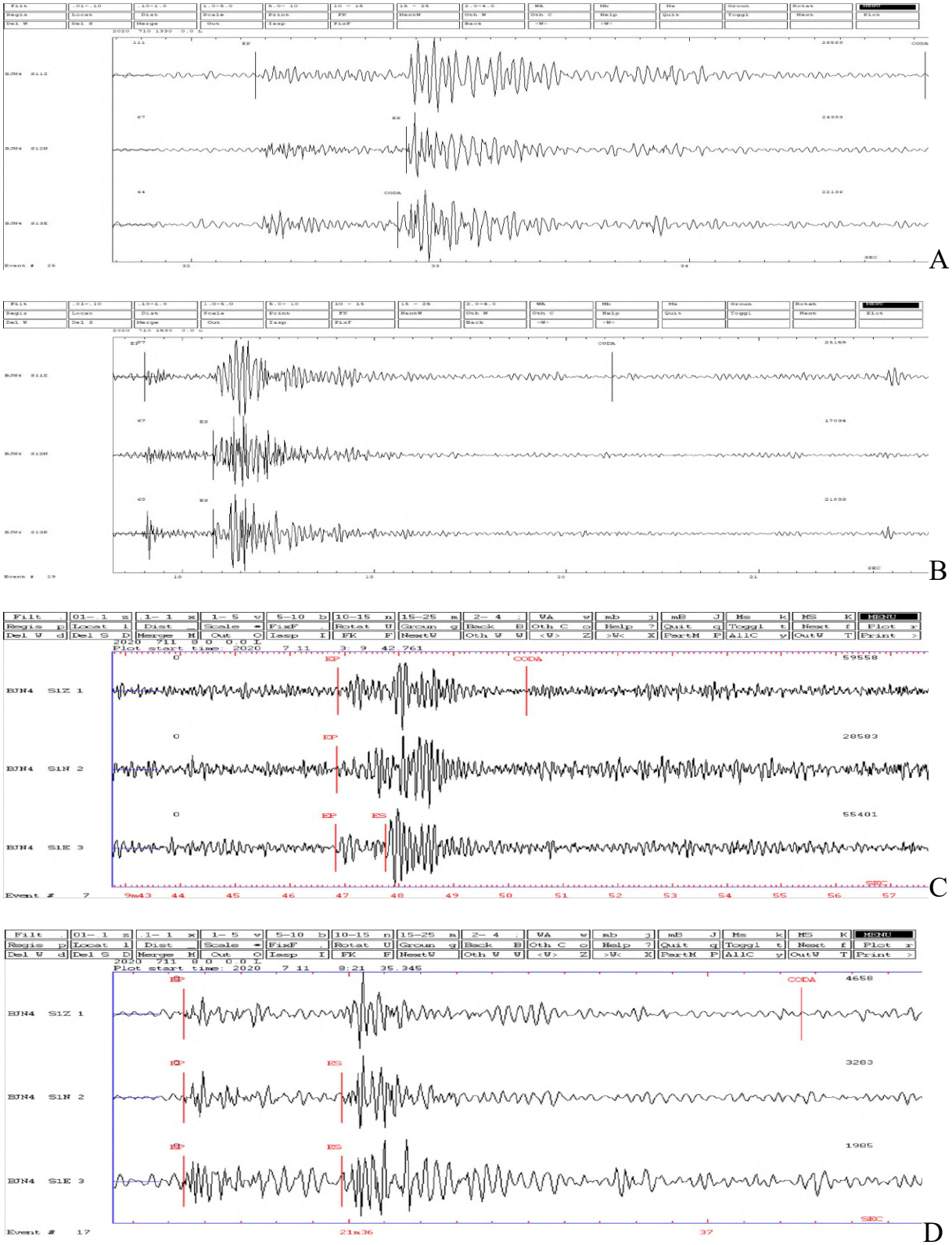


Fig. 37 (A, B, C & D): A few probable micro-earthquakes observed in the records of seismic station BJN4. The events are very small, below magnitude 1.0 and located within 1.5-6.0 km radius of BJN4.

Waveforms of two micro-earthquakes as recorded by the station BJN1 is given in fig. 38 and 39.

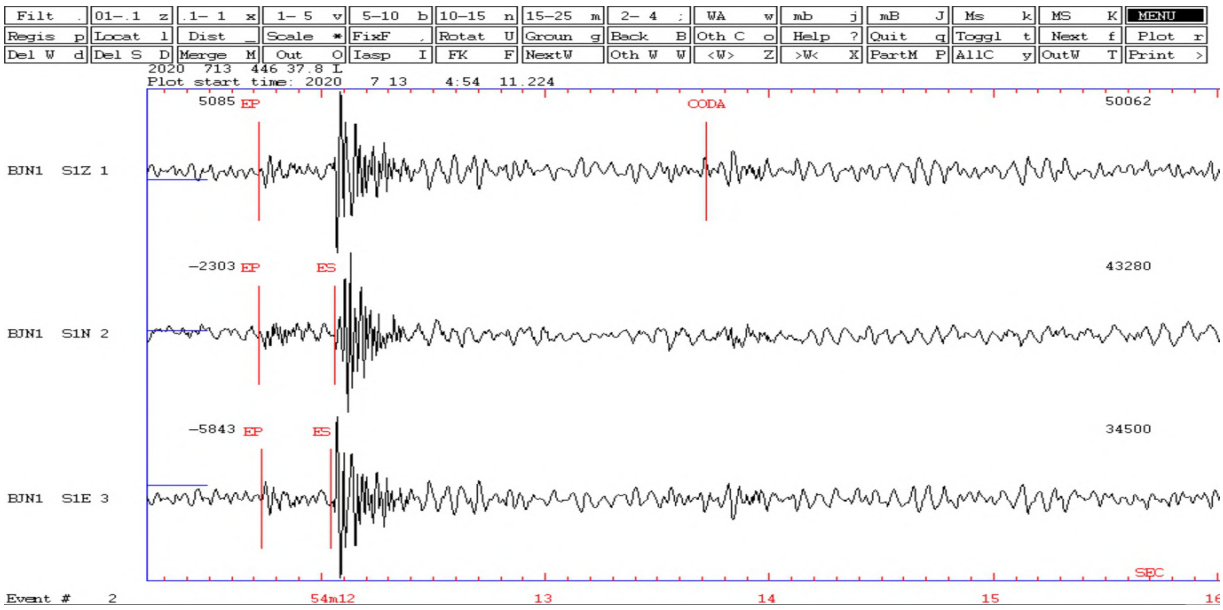


Fig. 38: A probable micro-earthquake observed in the records of seismic station BJN1. The event occurred on 13th July 2020 at 04:54:11 hrs (UTC).

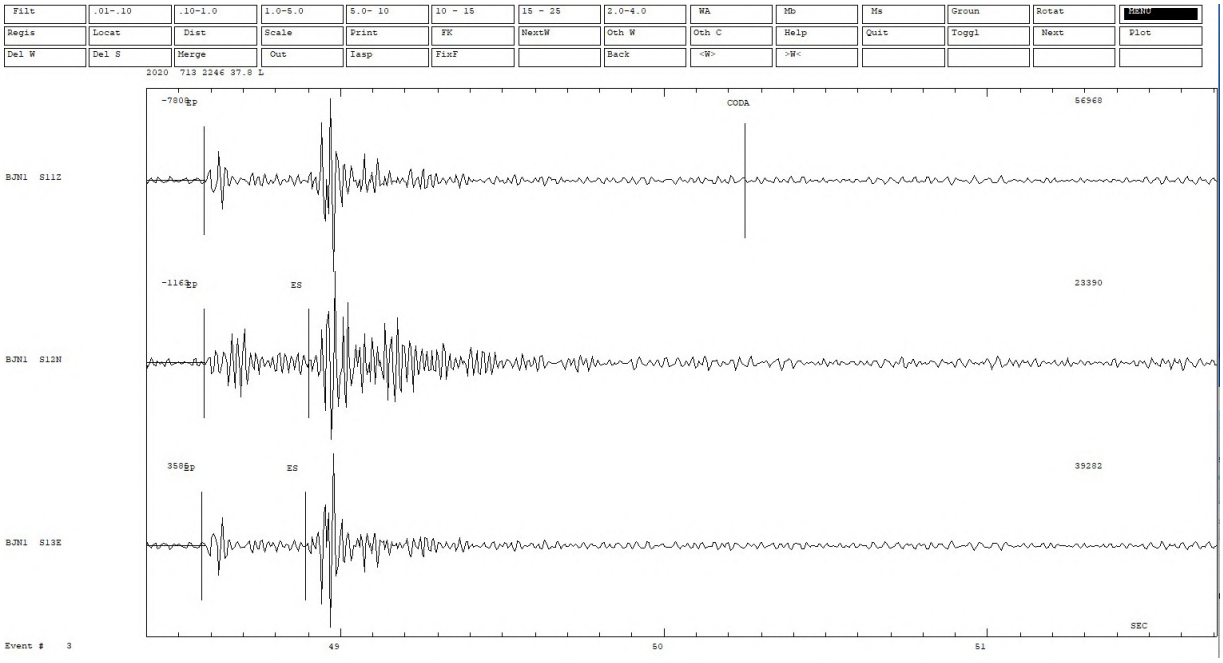


Fig. 39: A probable micro-earthquake recorded by BJN1. The event occurred on 13th July 2020 at 22:55:48.6 (UTC).

The micro-earthquakes recorded by the Baghjan local seismic network are of very small magnitude and in most cases they are very shallow and not more than 3km as evident from the narrow S- and P-wave travel time gaps. Therefore, the events originating near the stations BJN4 and BJN5 may be

related to the blowout incident and subsequent activities for controlling the accident. Considering the very micro nature of the events it is very unlikely to inflict any kind of damage to houses or other structures. However, at very close proximity to the epicenter some events may be lightly felt.

1.3.4 Noise data

Analysis of continuous vibration recorded by the seismic stations at Baghjan local seismic network

Types of noise recorded by the seismic stations at Baghjan

The Baghjan local seismic network recorded different types of noises during the deployment. Apart from the Earth's natural ambient noise field and some local, regional and teleseismic events the network also recorded the noise generated by different anthropogenic activities, mainly industrial. In this investigation we are only considering the ground vibration, the continuous high frequency audible noise is beyond the scope of our investigation. The anthropogenic noise recorded by the seismic network can be divided into:

a. Continuous vibration,
b. Transient vibration,
c. Intermittent vibration and
d. Pseudo steady state

We observe continuous ground vibrations, which are cyclic in amplitude and keeps on repeating (Fig. 40). Such vibration is very prominent near the industrial setup of OIL, such as Early Production Set-up (EPS) and Limbuguri wellsite. Such high frequency continuous vibration is also very prevalent near the blowout site and in the other distant stations too, though frequency of oscillation significantly reduces with increasing distance. Apart from the continuous oscillation, sequence of transient vibration is also very common near the industrial set-ups. The sequence of transient vibration often leads to pseudo steady stage, where transient vibration are so closely spaced that the coda of each event overlaps with the arrival of the next event (Fig. 41). A comparison of transient vibration generated due to machine operation and records at the same site when it is quieter is presented in fig.42.

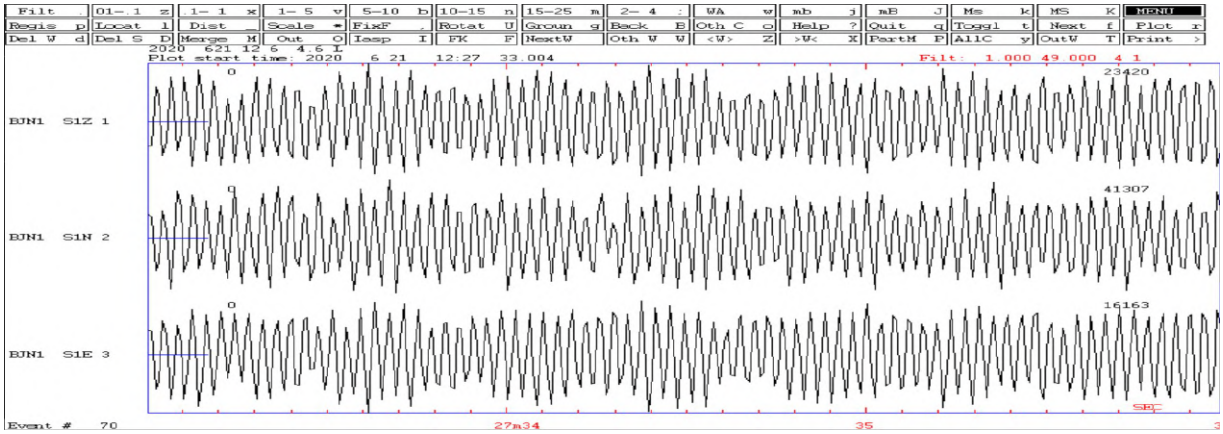


Fig. 40: Continuous oscillation at BJN1 (Limbuguri wellsite) due to running of generator.

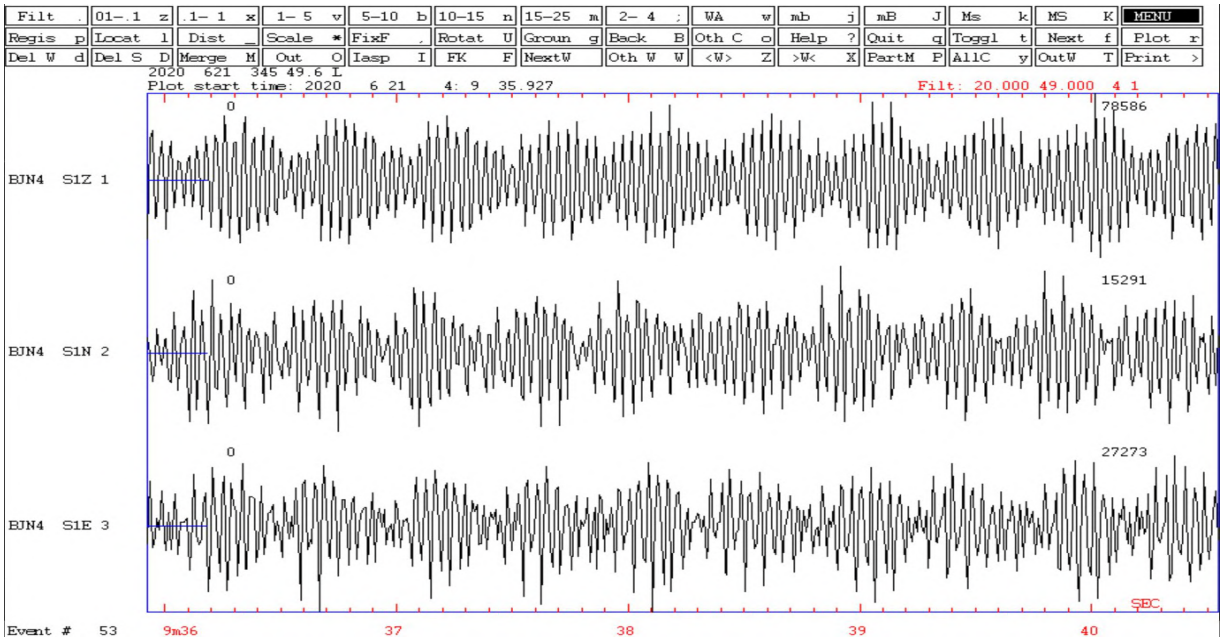


Fig. 41: Sequence of transient vibration generated from the activities of Baghjan Early Production Setup (EPS) at BJN4. This vibration is in a pseudo steady state, where transient vibration are so closely spaced that the coda of each event overlaps with the arrival of the next event.

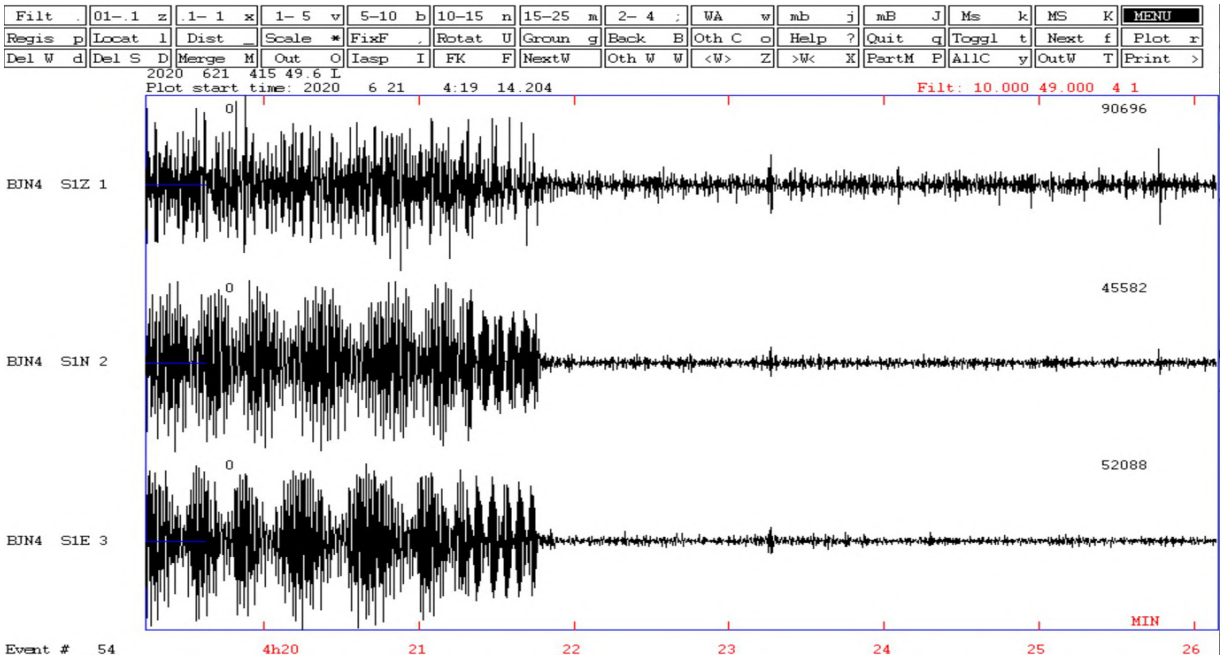


Fig. 42: Comparison machine induced transient vibration and normal ground vibration at BJN4 (inside the EPS)

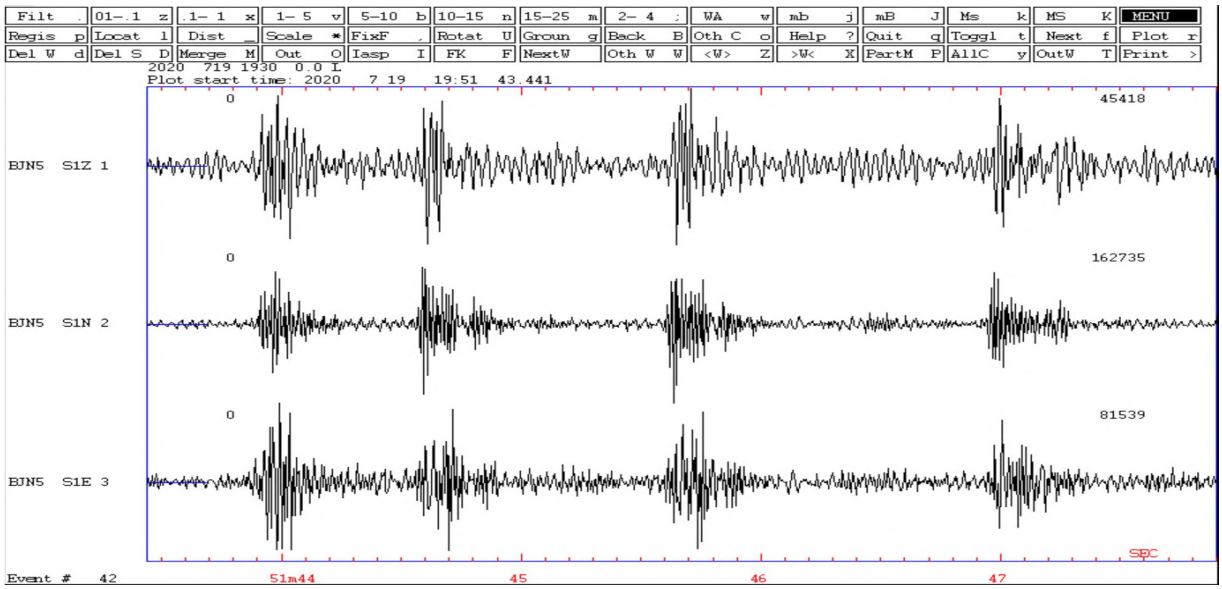


Fig. 43: Intermittent vibration recorded at the station BJN5, nearest to the blowout site, probably due to anthropogenic activity. In case of intermittent vibration there is sufficient time between events so that the amplitude decays to an insignificant level.

Day-to-day anthropogenic activities near the seismic stations are also recorded as intermittent vibrations, which is common in the records of all the seismic stations. These vibrations are more prevalent during the day-time than the quieter night time. In case of intermittent vibration there is sufficient time between events so that the amplitude decays to an insignificant level (Fig. 43). These

high frequency vibrations often get mixed up with the local earthquake events and causes difficulty in analyzing the records.

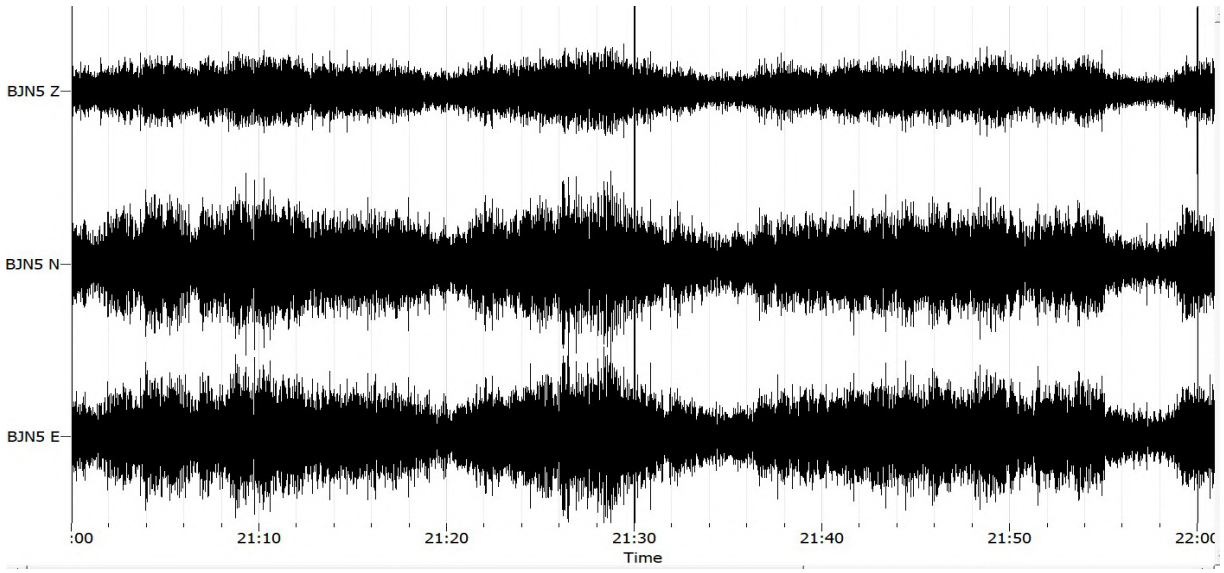
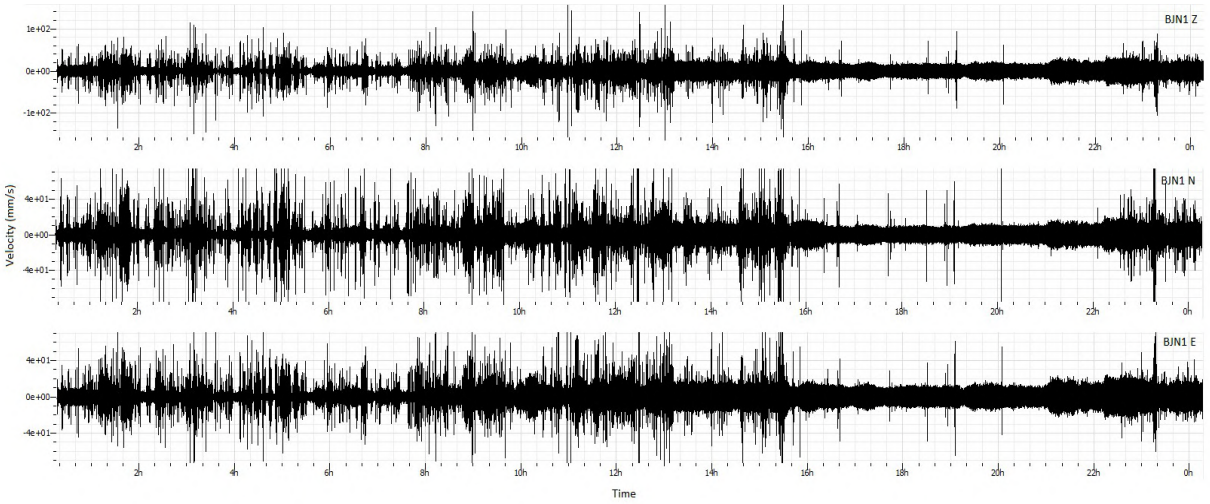


Fig. 44: A record of BJN5 with a band-pass filter of 90-100Hz. It confirms that the continuous oscillation is prevailing even at higher frequency.

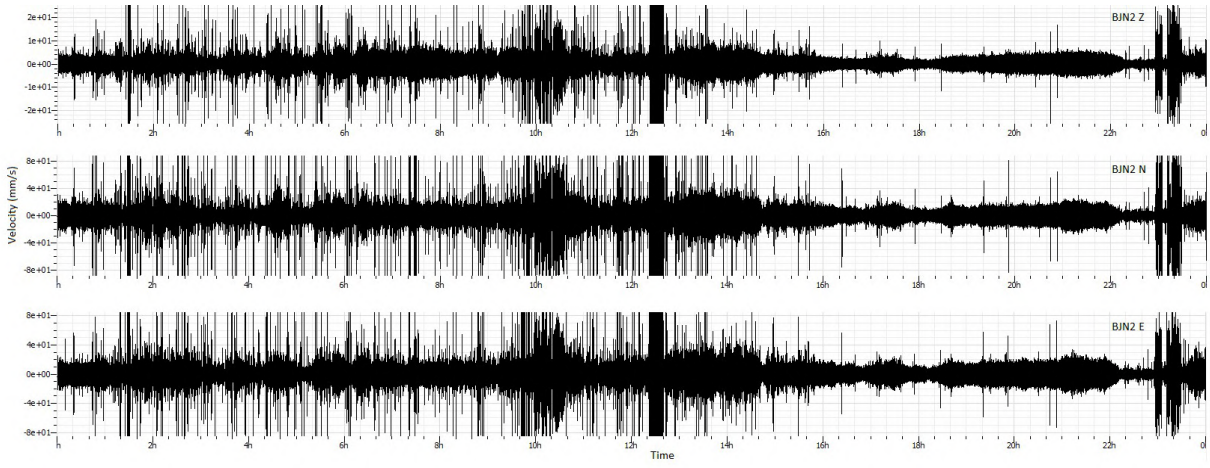
In all the seismic stations deployed at Baghjan we could observe periods of highly disturbing noises followed up by relatively calm periods. The phenomenon is more dominant in the stations nearer to the blowout site (BJN4 and BJN5) than the distant stations. In the fig 44 we present such vibration as recorded by the station BJN5, which is nearest to the blowout site. The noise data is filtered using a band-pass filter of 90-100Hz. It indicates that the sequence of high and low vibrations is mainly predominant in the higher frequency component of the records.

Analysis of noise records

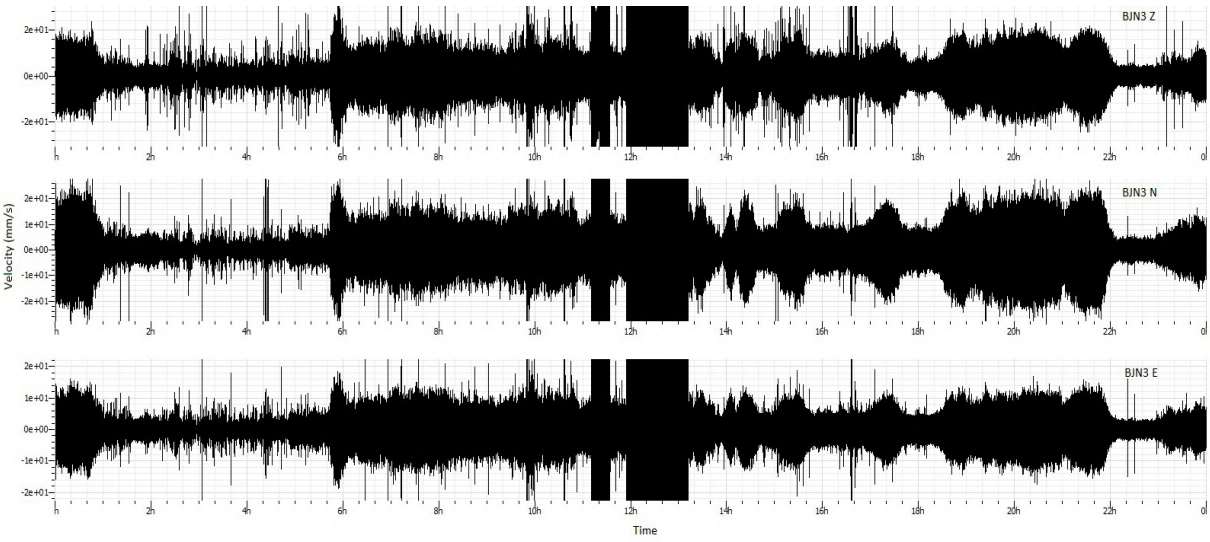
The Baghjan local seismic network recorded continuous high frequency vibration. The vibration can easily be felt at more than 4.5km from the blowout site. Unverified reports claim that the vibration as well the sound from the blowout site could be felt and heard as far as 12km. We established seismic stations from nearest of 0.45km to a maximum distance of about 4.5km from the incident site, and at all these stations the continuous vibration was quite prevalent. Just by visual inspection of the vibration records one can verify the high level of oscillation being felt by the seismic stations. The vibration recorded by the seismic stations on 14th of July has been presented in the fig. 45 (A, B, C, D & E). The significantly high level of disturbances is not uniform throughout the day as evident from the records. Further, the ground oscillation clearly attenuates with increasing distance from the blowout site.


BJN1 Z
BJN1 N
BJN1 E
Velocity (mm/s)
Time

A


BJN2 Z
BJN2 N
BJN2 E
Velocity (mm/s)
Time

B


BJN3 Z
BJN3 N
BJN3 E
Velocity (mm/s)
Time

C

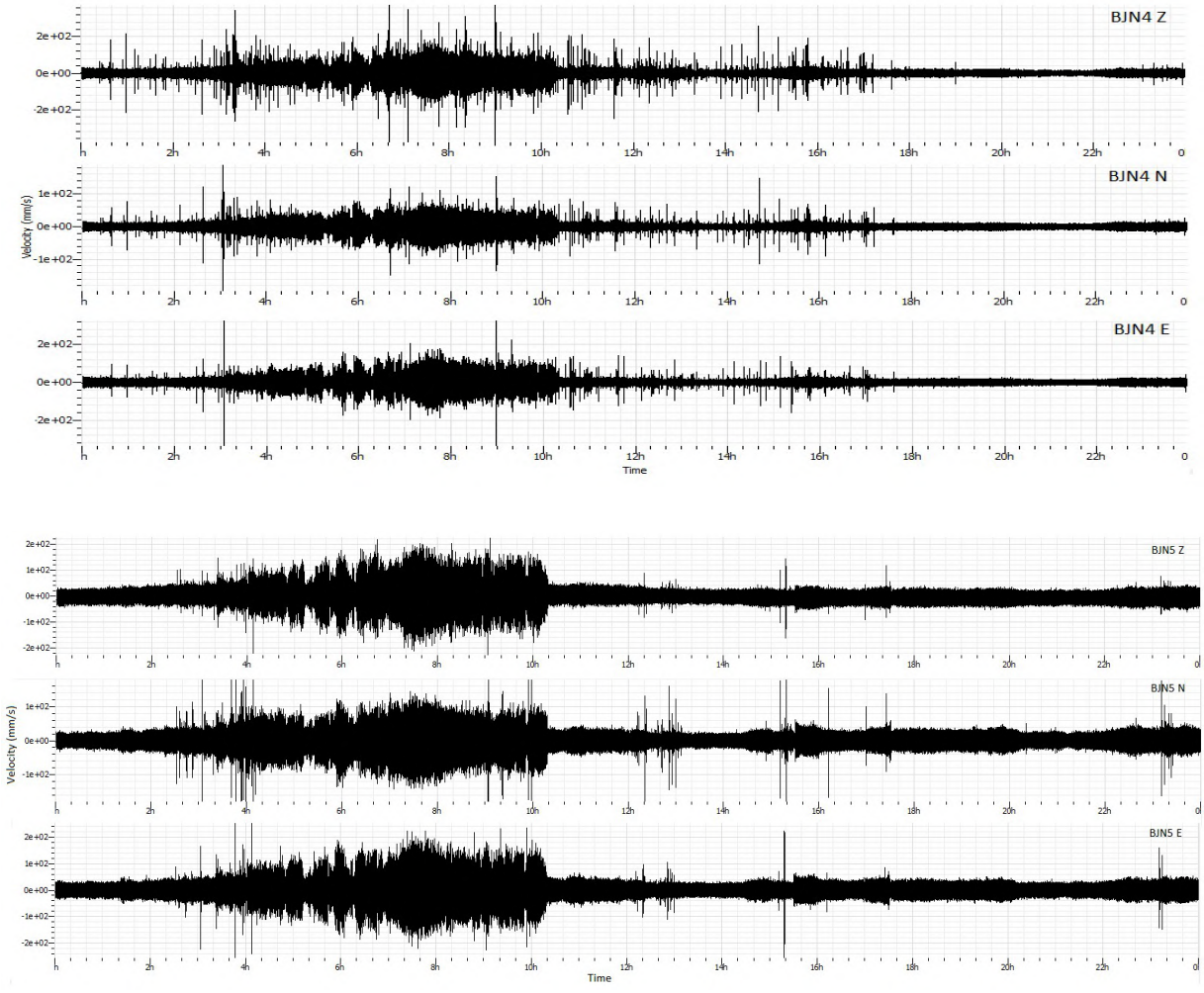


Fig. 45: Full one day records of vibration recorded by the seismic stations A) BJN1, B) BJN2, C) BJN3, D) BJN4 and E) BJN5 on 14th July 2020. High level of high frequency ground vibration is very common in all the stations.

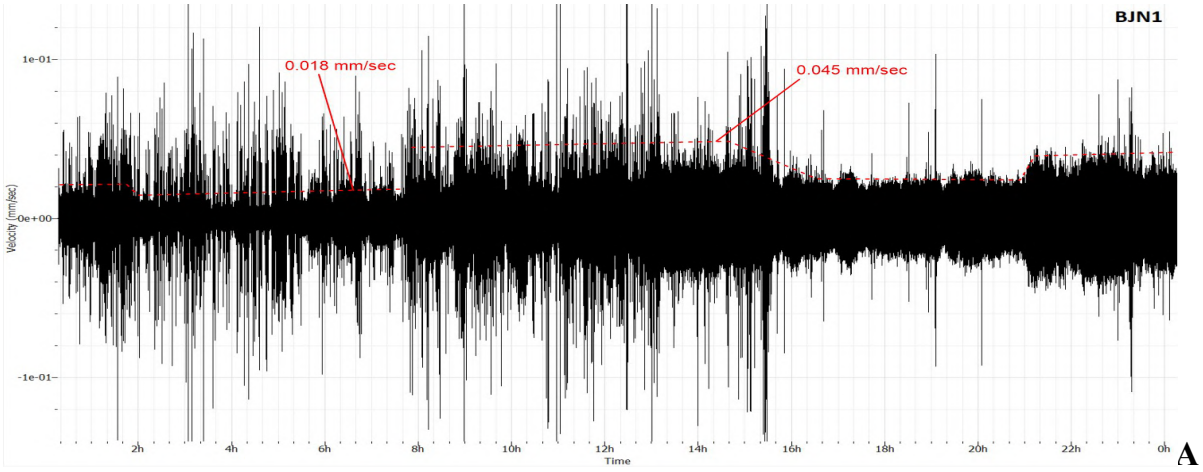
1.3.5 Peak particle Velocity (PPV)

Noise data

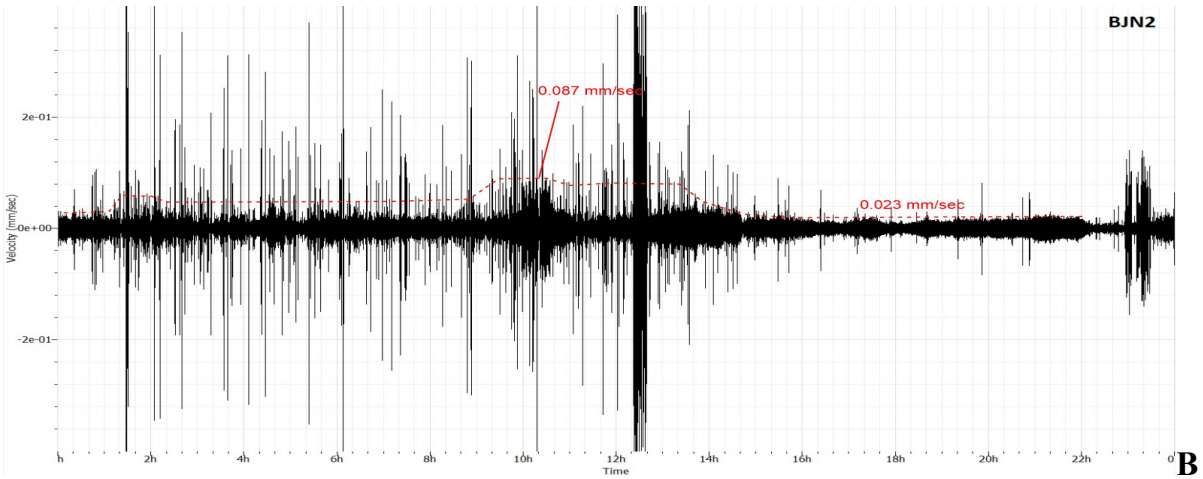
We have converted the amplitude count of the records to ground velocity for all stations in terms of. The ground velocity of the records on 14th July 2020 has been shown in the fig. 46 (A, B, C, D & E) and table-5. An average maximum particle velocity of 0.175mm/sec was recorded by the station BJN5, which is nearest to the blowout site (1.125km), whereas the average maximum particle velocity of 0.0456mm/sec was recorded by the station BJN2 at a distance of 4.4km from the blowout site. The station BJN4 at a distance of 2.2km from the blowout site also shows higher average particle velocity of 0.16mm/sec.

Table-5: Peak Particle Velocity of noise recorded by the seismic stations

Station Code	Lat (°N)	Lon (°E)	Locality	Distance from blowout site (km)	PPV (mm/sec)	Average maximum particle velocity (mm/sec)
BJN1	27:33:37.56	95:21:35.84	Limbuguri	4.455	0.115	0.045
BJN2	27:33:23.84	95:23:33.76	Dhelakhat T.E.	4.448	0.202	0.087
BJN3	27:33:52.87	95:23:58.53	Barekuri P. S.	3.877	0.095	0.052
BJN4	27:36:09.05	95:24:06.17	Near Baghjan E.P.S.	2.175	0.200	0.160
BJN5	27:36:00.96	095:23:29.54	Baghjan Gaon	1.125	0.220	0.175



A



B

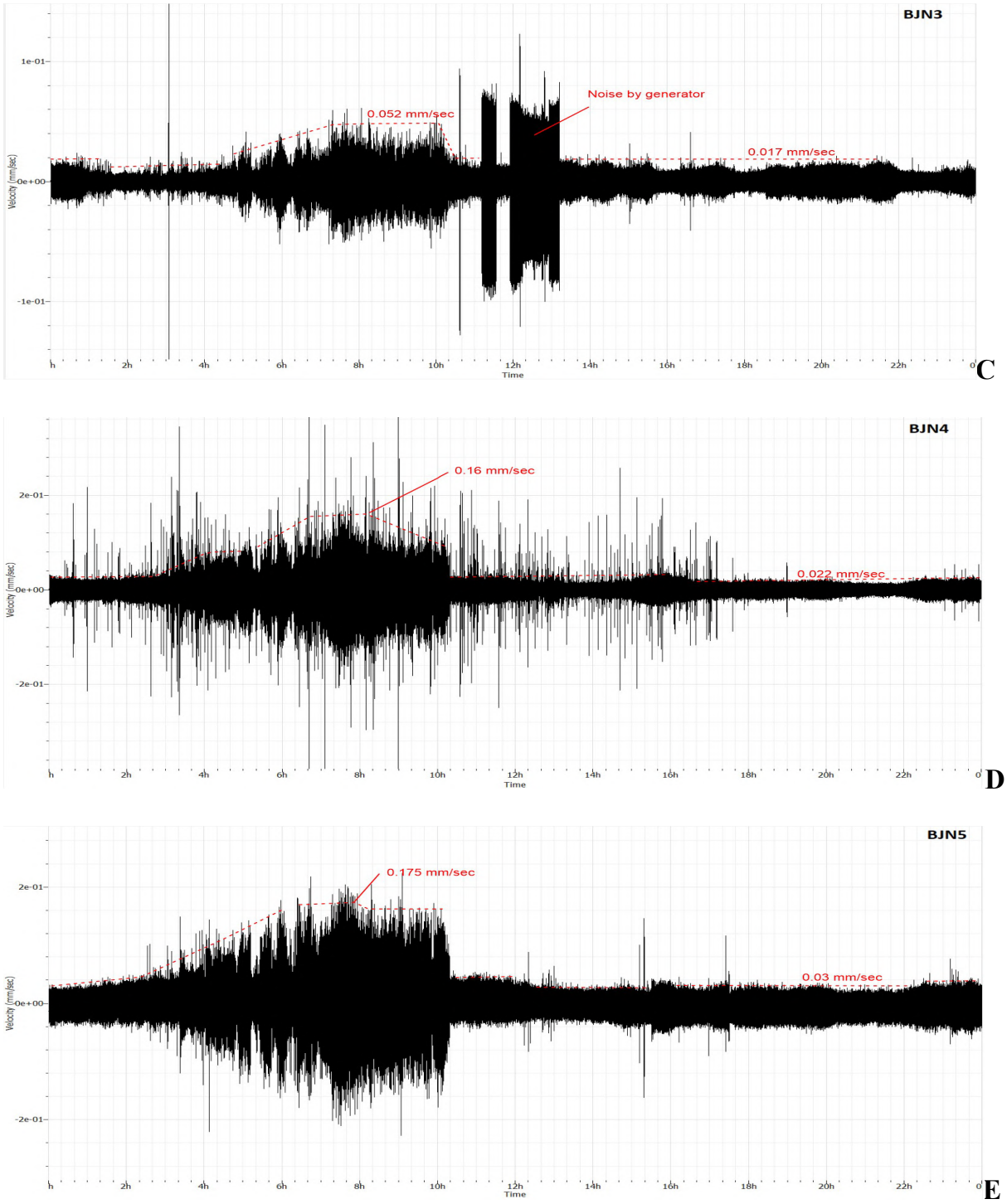
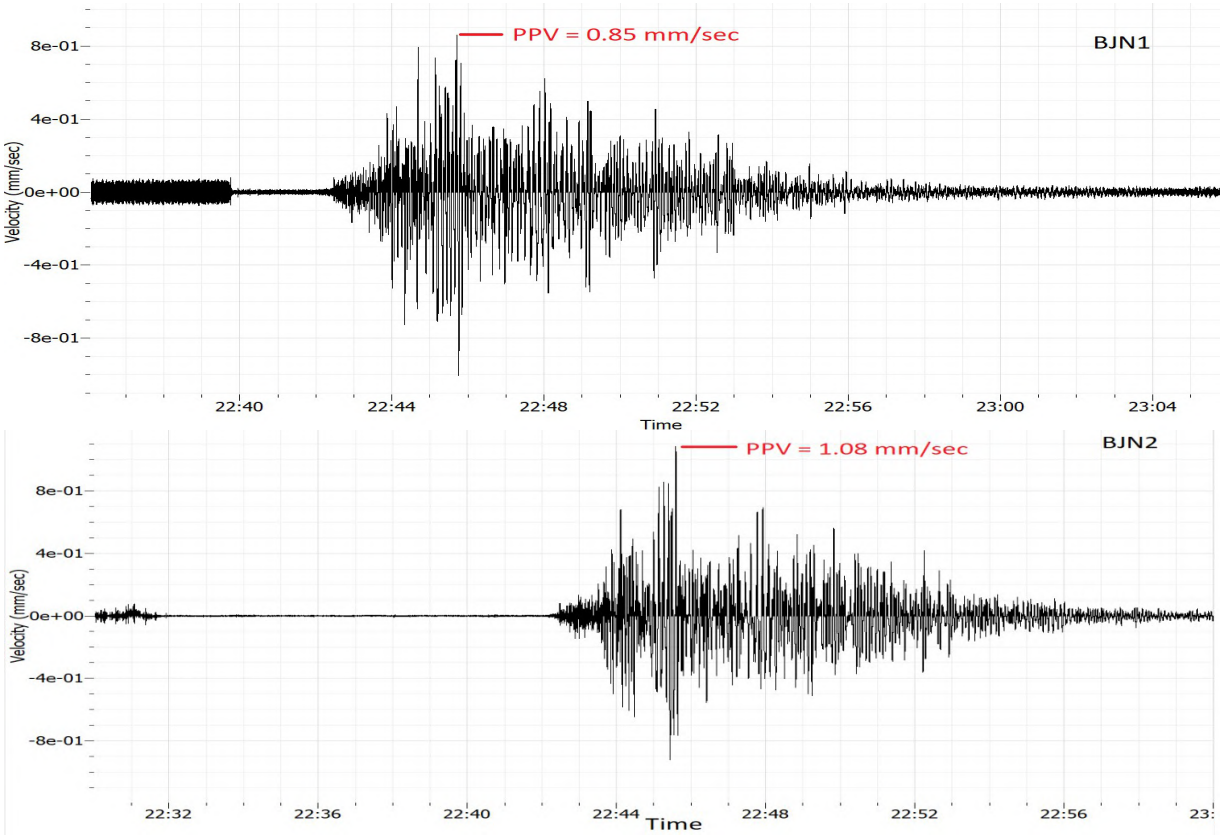


Fig. 46: Particle velocity as recorded by all the seismic stations A) BJN1, B) BJN2, C) BJN3, D) BJN4 and E) BJN5 on 14th July 2020. The maximum PPV recorded by the nearest station BJN5 (0.175mm/sec) and the minimum PPV by station BJN2 (0.016mm/sec) at a distance of 1.1km and 4.4km respectively from the blowout site.

In terms of Peak Particle Velocity (PPV), the maximum value was 0.22 mm/sec recorded by BJN5 and the minimum PPV was 0.095 mm/sec observed at BJN3. Despite, located further from the blowout site the stations BJN1 and BJN2 showed higher PPV values than BJN3, which may be attributed to local site effects.

PPV of earthquake record

The PPV recorded during the 21st June 2020 earthquake of magnitude M5.6 occurred at Mizoram was the highest ground motion record at Baghjan area during the operation of the local seismic network . This PPV value far exceeds the ground motion originating from the disturbance in the Baghjan blowout site. The PPV recorded at BJN4 was highest for the earthquake at 1.14 mm/sec followed by BJN2 = 1.08 mm/sec, BJN3 = 0.95 mm/sec, BJN5 = 0.9 mm/sec and BJN1 = 0.85mm/sec (fig. 47). However, there are basic differences between the ground motion generated by the earthquake and the disturbances from the blowout site. First, ground motion generated by the earthquake lasted only for a few minutes (about 10 minutes), whereas the disturbances from the well site is almost continuous and consistent high level of noise occasionally lasts for 6-8 hours. Secondly, the ground motion by the earthquake was of low frequency content, whereas the disturbances from the wellsite are of higher frequency, often exceeding 25Hz.



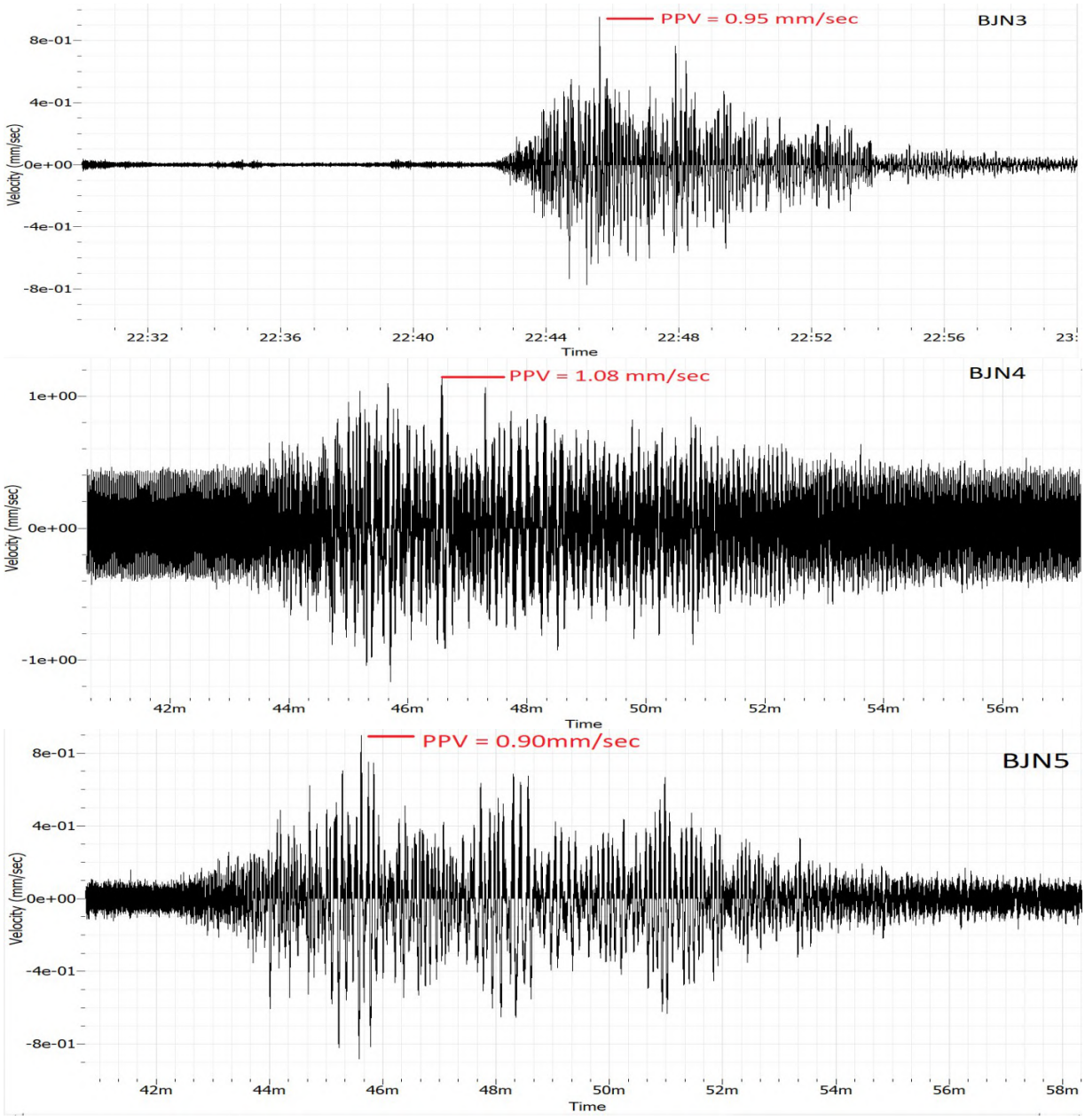


Fig. 47: Peak Particle Velocity (PPV) recorded during the 21 June 2020 M5.6 earthquake was the highest ground motion recorded during the operation of the Baghjan local seismic network.

Frequency of ground vibration often plays an important role with respect to damage to building and other structures. Low frequency ground vibration can travel quite far through the upper layer of the subsurface and when the frequency matches with the fundamental frequency of buildings/structure, may cause extensive damage due to resonance.

1.4 Effects of vibration on human and buildings:

Effect of industrial vibration has been studied extensively by many authors (Konon, 1985; Siskind et al., 1980; Reiher, H., and F. J. Meister, 1931; Wiss, 1974; Whiffen, A. C. 1971; California Department of Transportation, 2013, etc.). We try to analyze the effect of the continuous vibration on people and probable effects on building based on the established observations. Whiffen (1971) related continuous vibration to human response and found that peak particle velocity (PPV) value of 0.4-0.6 inch/sec (10.16-15.25mm/sec) is very unpleasant for human. Whiffen's observation of human response to continuous vibration is presented in table-1. Any continuous vibration is readily perceptible above PPV value of 2.0mm/sec. Similarly Wiss (1974) studied the effect of transient vibration on human and concluded that above PPV of 22.86mm/sec the vibration is strongly perceptible to human, whereas at 50.8mm/sec it becomes severe. Wiss's study of human response to transient vibration is given in table-2. Way back in 1931, Reiher analyzed the response of human to steady state vibration, where he found that PPV value of more than 91mm/sec at 2Hz is very disturbing to human, and even PPV value of as small as 10mm/sec at 20Hz is equally disturbing. Results of Reiher's study on the human response to steady state (continuous) vibration is shown in table-3.

Table 1: Human response to continuous vibration (Whiffen 1971)

PPV (in/sec)	PPV (mm/sec)	Human Response
0.4 - 0.6	10.16 - 15.24	Unpleasant
0.2	5.08	Annoying
0.1	2.54	Begins to annoy
0.08	2.032	Readily perceptible
0.006 - 0.019	0.1524 - 0.4826	Threshold of perception

Table 2: Human response to transient vibration (Wiss 1974)

PPV (in/sec)	PPV (mm/sec)	Human Response
2.0	50.8	Severe
0.9	22.86	Strongly perceptible
0.24	6.096	Distinctly perceptible
0.035	0.889	Barely perceptible

Table 3. Human Response to Steady State Vibration (Reiher 1931)

PPV (in/sec)	PPV (mm/sec)	Human Response
3.6 (at 2Hz)-0.4 (at 20Hz)	91.44 (at 2Hz)-10.16 (at 20Hz)	Very disturbing
0.7 (at 2Hz)-0.17 (at 20Hz)	17.78 (at 2Hz)-4.318 (at 20Hz)	Disturbing
0.1	2.54	Strongly perceptible
0.035	0.889	Distinctly perceptible
0.012	0.3048	Slightly perceptible

In the case of Baghjan different nature of vibrations are observed ranging from transient, intermittent, steady state and continuous vibrations. We have observed high level of continuous vibration of up to 10 hours, which is very disturbing. PPV value of 100-130mm/sec is observed at a distance of 1-2km from the blowout site at high frequency. We have also observed PPV value of as high as 29mm/sec at a distance of about 4.5km from the blowout site, which is also disturbing. Therefore, it may be convincingly concluded that the continuous high frequency vibration felt by the residents as far as 2-3km from the blowout site is detrimental to the physical as well as mental health of the residents.

Response of buildings to vibration has also been studied extensively. The Swiss Association of Standardization has developed a series of vibration damage criteria that differentiates between single-event sources (blasting) and continuous sources (machines and traffic) (Wiss 1981). They had differentiated the criteria based on the frequency of oscillation. They considered the frequency range of vibration mainly for construction and traffic and capped it at 10–30 Hz. Table 4 shows criteria for 10–30 Hz as considered by the Swiss agency.

Table 4. Swiss Association of Standardization Vibration Damage Criteria (vibration at 10-30 Hz)

Building Class	Continuous Source PPV		Single-Event PPV	
	(in/sec)	(mm/sec)	(in/sec)	(mm/sec)
Class I: buildings in steel or reinforced concrete, such as factories, retaining walls, bridges, steel towers, open channels, underground chambers and tunnels with and without concrete alignment	0.5	12.7	1.2	30.48
Class II: buildings with foundation walls and floors in concrete, walls in concrete or masonry, stone masonry retaining walls, underground chambers and tunnels with masonry alignments, conduits in loose material	0.3	7.62	0.7	17.78
Class III: buildings as mentioned above but with wooden ceilings and walls in masonry	0.2	5.08	0.5	12.7
Class IV: construction very sensitive to vibration; objects of historic interest	0.12	3.048	0.3	7.62

Many studies were conducted on historical monuments and other sensitive buildings as how these may be affected by industrial ground vibration. During 1985 Konan studied the response of several types of buildings to ground vibration and reviewed numerous vibration criteria. His study was mainly confined to historic and sensitive buildings, where he developed a recommended set of vibration criteria for transient (single-event) and steady-state (continuous) sources. Konan recommended that criteria for transient sources should be about double the amplitude of continuous vibration sources. Konan's observation is presented in table 5.

Table 5. Konan Vibration Criteria for Historic and Sensitive Buildings

Frequency Range (Hz)	Transient Vibration PPV		Steady State Vibration PPV	
	(in/sec)	(mm/sec)	(in/sec)	(mm/sec)
1 - 10	0.25	6.35	0.12	3.048
10 - 40	0.25-0.5	6.35-12.7	0.12-0.25	3.048-6.35
40 - 100	0.5	12.7	0.25	6.35

According to Whiffen (1971) when buildings are subjected to continuous vibration they may suffer architectural damage and even possibly structural damage when PPV goes beyond 0.4-0.6in/sec (10-15mm/sec). He found that threshold of architectural damage to normal dwelling houses may be as low as PPV of 0.2 in/sec (5.08mm/sec) when subjected to continuous vibration. Whiffen's observations of response of buildings to continuous vibration are summarized in Table 6.

Table 6. Whiffen Vibration Criteria for Continuous Vibration

PPV		Effect on Buildings
(in/sec)	(mm/sec)	
0.4-0.6	10.16-15.24	Architectural damage and possible minor structural damage
0.2	5.08	Threshold at which there is a risk of architectural damage to normal dwelling houses (houses with plastered walls and ceilings)
0.1	2.54	Virtually no risk of architectural damage to normal buildings
0.08	2.032	Recommended upper limit of vibration to which ruins and ancient monuments should be subjected
0.006-0.019	0.1524-0.4826	Vibration unlikely to cause damage of any type

Siskind et al. (1980) have studied the response of buildings to vibration caused by blasting. They had applied probabilistic methods in this approach. In the study they had identified three damage thresholds in terms of PPV for probabilities of 5, 10, 50, and 90%. They observed that in case of PPV due to blasting vibration exceeding 430mm/sec, there will be 90% probability that a building may suffer severe damage. It may weaken the structure and even there may be fall of masonry buildings. There is 50% probability of similar damage criteria when PPV due to blasting exceeds 150mm/sec. Further, there is 50% probability of loosening of paints, plaster cracks at joints in normal dwelling houses at PPV of 64mm/sec, but at the same time there is 5% probability of major damage to buildings for similar level of small ground vibration. If PPV exceeds 76mm/sec the probability of a building to suffer heavy damage is 10%. The observations of Siskind on response of building to vibration due to blasting are summarized in table -7.

Table 7. Siskind Vibration Damage Thresholds

Damage Type	PPV							
	5 % Probability		10 % Probability		50 % Probability		90 % Probability	
	(in/sec)	(mm/sec)	(in/sec)	(mm/sec)	(in/sec)	(mm/sec)	(in/sec)	(mm/sec)
Threshold damage: loosening of paint, small plaster cracks at joints between construction elements	0.5	12.7	0.7	17.78	2.5	63.5	9.0	228.6
Minor damage: loosening and falling of plaster, cracks in masonry around openings near partitions, hairline to 3-mm (0–1/8-in.) cracks, fall of loose mortar	1.8	45.72	2.2	55.88	5.0	127	16.0	406.4
Major damage: cracks of several mm in walls, rupture of opening vaults, structural weakening, fall of masonry, load support ability affected	2.5	63.5	3.0	76.2	6.0	152.4	17.0	431.8

Whiffen and Leonard (1971) studied the response of people and buildings to continuous vibration induced by traffic. They observed that though there is no likelihood

Table 8. Response of people and buildings to continuous vibration

Vibration Amplitude (Peak Particle Velocity)*			
mm/s	in/sec	Human Reaction	Effect on Buildings
0.15-0.30	0.006-0.019	Threshold of perception; possibility of intrusion	Vibrations unlikely to cause damage of any type
2.0	0.08	Vibrations readily perceptible	Recommended upper amplitude of the vibration to which ruins and ancient monuments should be subjected
2.5	0.10	Amplitude at which continuous vibrations begin to annoy people	Virtually no risk of "architectural" damage to normal buildings
5.0	0.20	Vibrations annoying to people in buildings (this agrees with the amplitudes established for people standing on bridges and subjected to relative short periods of vibrations)	Threshold at which there is a risk of "architectural" damage to normal dwelling - houses with plastered walls and ceilings Special types of finish such as lining of walls, flexible ceiling treatment, etc., would minimize "architectural" damage
10-15	0.4-0.6	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater amplitude than normally expected from traffic, but would cause "architectural" damage and possibly minor structural damage.

** The vibration amplitudes are based on peak particle velocity in the vertical direction. Where human reactions are concerned, the value is at the point at which the person is situated. For buildings, the value refers to the ground motion. No allowance is included for the amplifying effect, if any, of structural components.*

Source: "A Survey of Traffic-induced Vibrations" by Whiffen and Leonard, Transport and Road Research Laboratory, RRL Report LR418, Crowthorne, Berkshire, England, 1971.

1.4.1 Frequency component of ground vibration

Though intensity of the vibration and distance from the source are the most important factors for assessment of damage potential of building/structures due to vibration, the frequency component of ground motion and the attenuation of the wave train also plays significant role. Therefore, we highlight here the frequency components of the vibration recorded at the seismic stations and how they behaved with increasing distance from the source, i.e. the blowout site. Frequency component of records for each seismic station installed at Baghjan area are given in the figure fig 48. In all the seismic station there is clear amplitude peak in the frequency range of about 2.0-3.0Hz. The nearest station BJN5 shows the peak at 2.8Hz, whereas the lowest frequency of 2.0Hz is displayed by BJN2 and BJN3. The stations BJN3 show another amplitude peak 5.4Hz, whereas the second peak can be observed at 7.3Hz and 8.1Hz for stations BHJ4 and BJN5 respectively. High frequency peaks observed at 14.2Hz and 28.7Hz for stations BJN1 and BJN2 respectively may be generated by other sources. The peak at 5-8Hz observed in the other stations is not seen at BJN1 and BJN2.

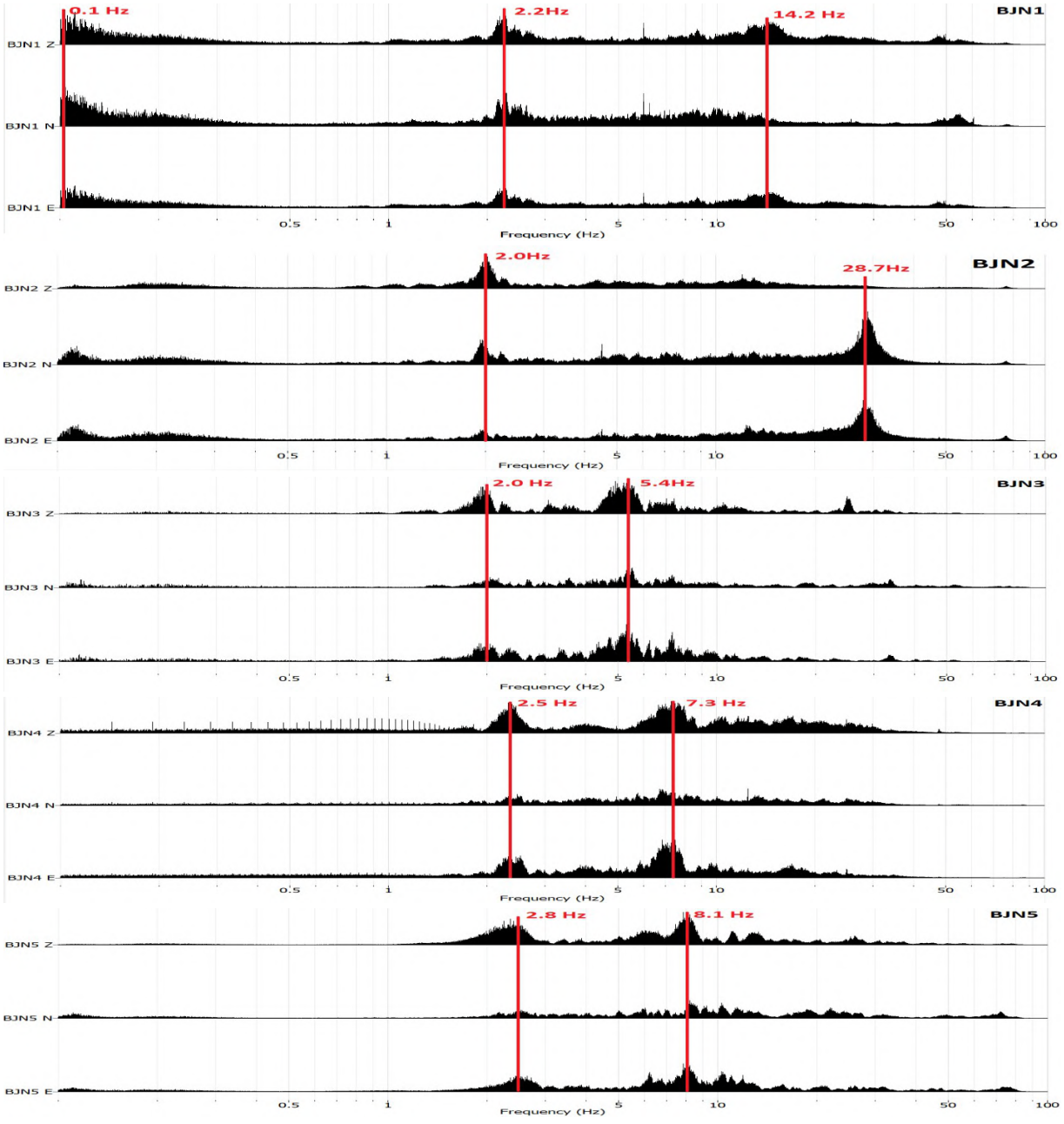


Fig. 48: Frequency component of vibration recorded by the seismic stations installed at Baghjan and adjoining areas.

Near the blowout site of Baghjan area and as far as 4.5km from the incident site continuous ground vibration could be felt to different degrees by the sensors. We have observed the rattling of doors & windows, metal roofs and even of household paraphernalia at several locations. Further, in the area wherever we went to put seismograph stations local people complaint about continuous annoying ground vibration as well as disturbing sound. However, our works does not include surveying of building/dwelling houses for assessment of vibration damage, if any. The study was mainly confined to

investigate the complaints regarding earthquake activities related to the blowout incident and to conduct a sets of other geophysical investigations such as: geomagnetic survey, ground electrical resistivity survey, very low frequency electromagnetic survey, etc. apart from InSAR data analysis to detect any possible ground deformation. Therefore, it is beyond the scope of the investigation to comment directly on actual damage that may have incurred to residential houses and other buildings as well as the impact on human health by the continuous ground vibration the incident have induced. Nevertheless, we try to relate our observations on continuous vibration felt in the area to the already established literature on response of human and buildings to continuous ground vibration.

The maximum ground vibration in terms of PPV observed at BJN5 is about 0.22 mm/sec, which is continuous in nature and sometime exceeds several hours. Apart from the intermittent spikes the average ground velocity recorded due to the continuous vibration is about 0.03mm/s, which is slightly higher than a normally quiet site. The maximum level of recorded PPV at BJN5 comes within the limit of human perception and may be disturbing (refer table 1, 6 and 8) at station BJN2, BJN4 and BJN5. However, the ground vibration at other two stations (BJN1 and BJN3) are quite less in terms of PPV and should not be very disturbing, expect for the occasional spikes. We also observe intermittent spikes of transient vibration in all the stations. The intermittent transient vibration also comes as series of spikes, sometimes lasting for hours and may cause some degree of disturbances.

The damage criteria of normal residential houses start at a minimum PPV of around 5.0 mm/sec, and some historical monuments/ruins may suffer minor architectural damage if PPV exceeds 3.0 mm/sec. PPV observed in and around Baghjan area, up to an average radial distance of 4.5km from the blowout site is much below the threshold value that may cause damage to normal residential houses. The rattling of window pans, metal sheets, etc. of houses as observed in the nearby areas may probably be caused by continuous high intensity sound emanating from the blowout site rather than ground motion. However, immision of predominantly low frequency sound components may cause considerable disturbances to dwellings (Findeis & Peters, 20040). Sometimes such noise may become intolerable to certain individuals. Such low frequency vibrations even at considerable distance may be observed on buildings and on objects inside the dwelling. There are several unconfirmed reports, media coverage etc. mentioning felt vibration to a distance of more than 10km from the incident site, which we could not verified, as our investigation was limited to a radial distance of 4.5km only from the blowout site. It is evident from observations through several studies that ground motion, though may not be felt near the source the same may be felt at far away due to site effects. It has been proved that when wave travel through subsurface they slows down while interacting with unconsolidated layers resulting in amplification of the wave train. If the predominant period of oscillation matches with the natural period of a building/structure it may suffer some degree of damage. Similar situation may cause felt vibration on houses located at a distance from the blowout site, while the houses situated nearby the source may not feel any.

1.5 Directivity analysis of noise data:

The property of ambient seismic noise showing strong directivity towards nearby noise source is very well known. In this regard, we attempt to find out whether the constant high frequency noise recorded in the all the seismographs installed in and around Baghjan shows any directivity and if the noise has originated from the blowout site. Previously many authors such as, Poli et. al. (2013), Yang and Ritzwoller (2008), Gouédard et. al. (2008), Lehujeur et. al. (2015), etc. have studied directivity of earth's ambient noise and showed that ambient noise field shows strong directivity to the nearby noise sources. The details of the seismic stations with the direction of the blowout site from each station are tabulated below:

Station Code	Lat (^{o}N)	Lon (^{o}E)	Locality	Distance from blowout site (km)	Direction to blowout site
BJN1	27:33:37.56	95:21:35.84	LIMBUGURI	4.455	27^o (NNE)
BJN2	27:33:23.84	95:23:33.76	DHELAKHAT T.E.	4.448	345^o (NNW)
BJN3	27:33:52.87	95:23:58.53	BAREKURI P. S.	3.877	332^o (NW)
BJN4	27:36:09.05	95:24:06.17	NEAR BAGHJAN E.P.S.	2.175	255^o (SW)
BJN5	27:36:00.96	095:23:29.54	BAGHJAN GAON	1.125	251^o (SW)

Station BJN1

The seismic station BJN1 was first installed at the premise of a wellsite at Limbuguri about 4.5km away from the blowout site. Though there were no ongoing major activity at the wellsite during the data recording period, high capacity pumps and generators were frequently ran for some routine works. The high frequency (~25Hz) noise source is oriented NNE-SSW. Though the blowout is site also situated towards NNE from BJN4 it is more likely that the source of the noise is the Limbuguri well site and not the blowout site considering high frequency content of the vibration (fig 49).

Due to flooding and also considering the disturbances from the wellsite we later shifted the seismograph to a nearby convenient location. The directivity analysis of the noise data at this new location is given in the fig 50. The blowout site is located at an azimuth of 20^o (NNE) from the new BJN1 location. A clear orientation of the noise towards NNE is seen at about 2.3Hz pointing to the blowout site. Another peak at 15Hz is oriented towards ESE (118^o) is probably due to the noise coming from a nearby busy road.

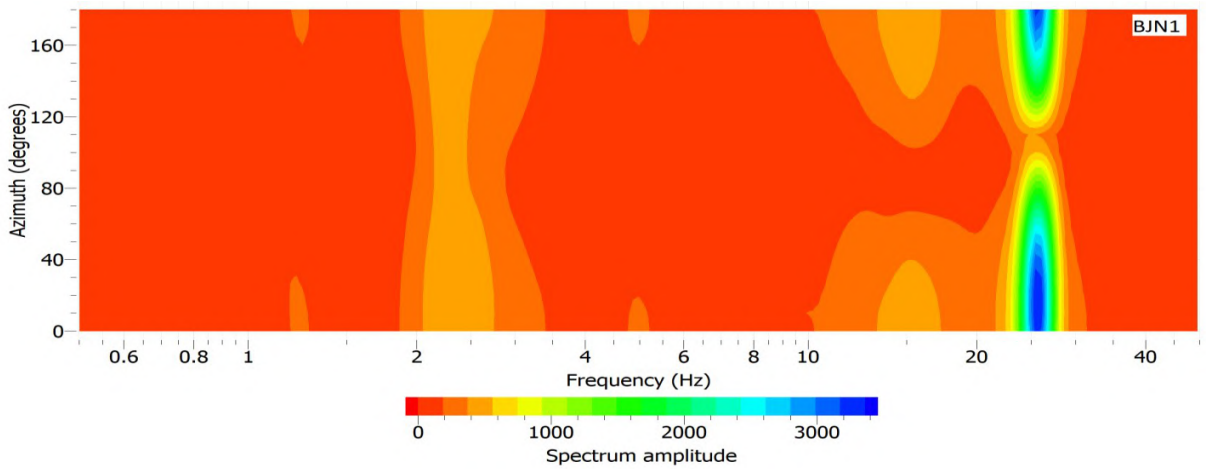


Fig. 49: Azimuth variation of spectrum amplitude for BJN1 (Limbuguri) station at the original location. The almost NNE-SSW oriented high-frequency (~25Hz) noise probably came from the generator set operating at the well site.

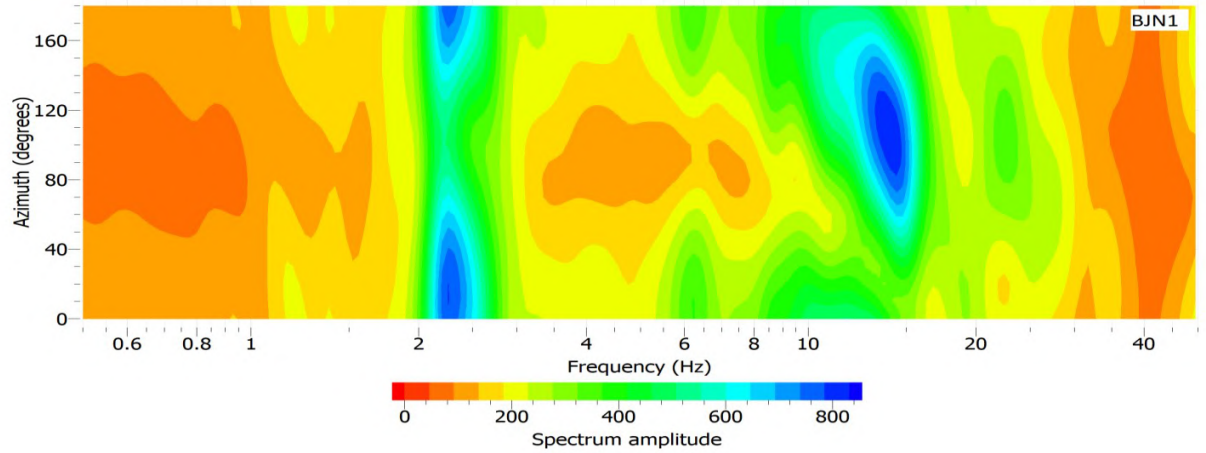


Fig. 50: Azimuth variation of spectrum amplitude for BJN1 (Limbuguri) after shifting of the seismograph from the well site to a new location. The blowout site is located at about 20° from BJN1 new location. A high frequency noise at about 15Hz oriented towards 118° from BJN1, just towards the nearby road. Another prominent frequency peak at ~2.3Hz now directed 20° orienting towards the blowout site.

Station BJN2

The station BJN2 was established at a workers' residential colony of Dhelakhat T.E. The peak amplitude observed at this site is at a frequency of ~23Hz, but without any directivity (Fig. 51). However, there is a clear low frequency peak directing NNW-SSE (about 335°), which is towards the direction of the blowout site. The high frequency noise at 23Hz probably comes from a nearby busy road.

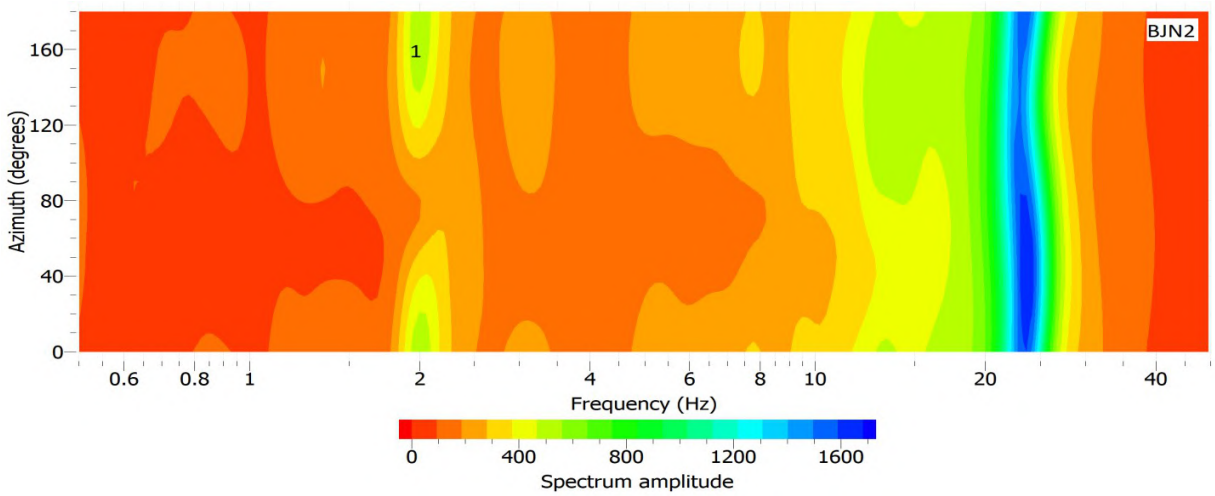


Fig. 51: Azimuth variation of spectrum amplitude for BJN2 (Dhelakhat T.E.). The peak frequency at ~23Hz is not showing any directivity. But another prominent peak at ~2Hz orienting NNW-SSE (about 335°) is directed towards the blowout site. The blowout site is located at about 137° from BJN2.

Station BJN3

The station BJN3 was first installed at a newly constructed pier in the Barekuri Police Station premise. It ran smoothly for a few days, but due to flood water inundating the station we had to shift the equipment to an isolated room inside the police station. The record quality of the station was quite good, except for occasional disturbances from a generator operated during power-cuts. A peak directing towards NE at 12Hz is probably originated due to the running of the generator (fig. 52). Two significant amplitude peaks are observed at 2.1Hz and 5.5Hz directing towards NW. The bearing of the blowout site from BJN3 is about 332°, i.e. towards NW, similar to the directivity of the noise data.

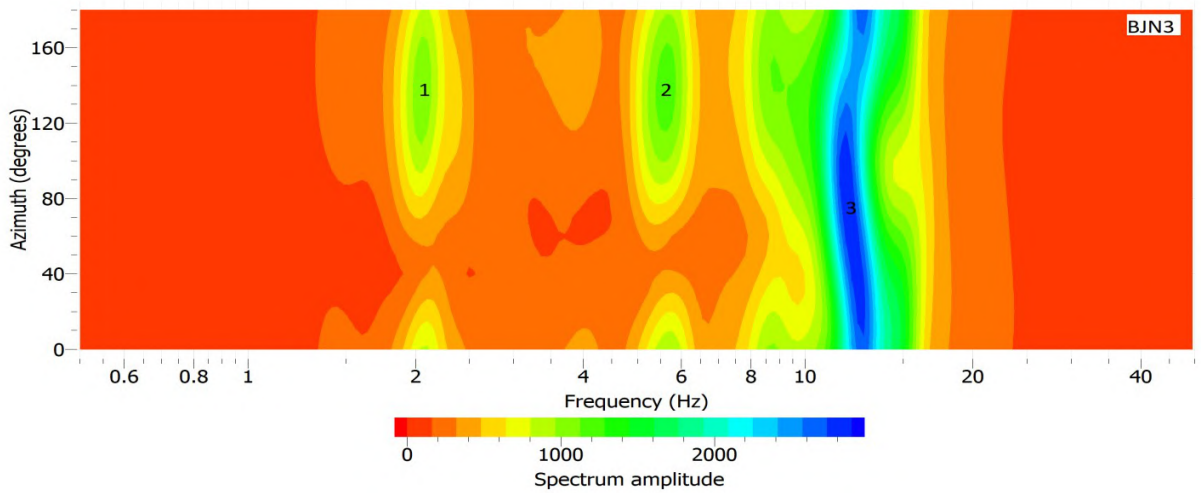


Fig. 52: Azimuth variation of spectrum amplitude for BJN3 (Barekuri P.S.). The peak frequency at ~15Hz has no directivity. However, the other prominent frequency peaks at ~2Hz and ~6Hz show directivity of about ~138° directing towards the blowout site. The bearing of the blowout site is about 325° from BJN3.

Station BJN4

The seismic station BJN4 was first installed at the premise of the Baghjan Early Production Set-up (EPS) of OIL. The site was very noisy due to constant operation of machineries at the EPS and also vehicular movement. Nevertheless, we could record a few distant earthquakes in this location. The directivity of noise in this site shows clear orientation of NE-SW at 12Hz (fig. 53), which probably originated from the generator and other machine operation noises at the EPS. However, a low frequency peak at 2.5Hz also appears directing NE-SW. The blowout site is also located towards SW from BJN4 and hence, the origin of this noise is probably from the incident site.

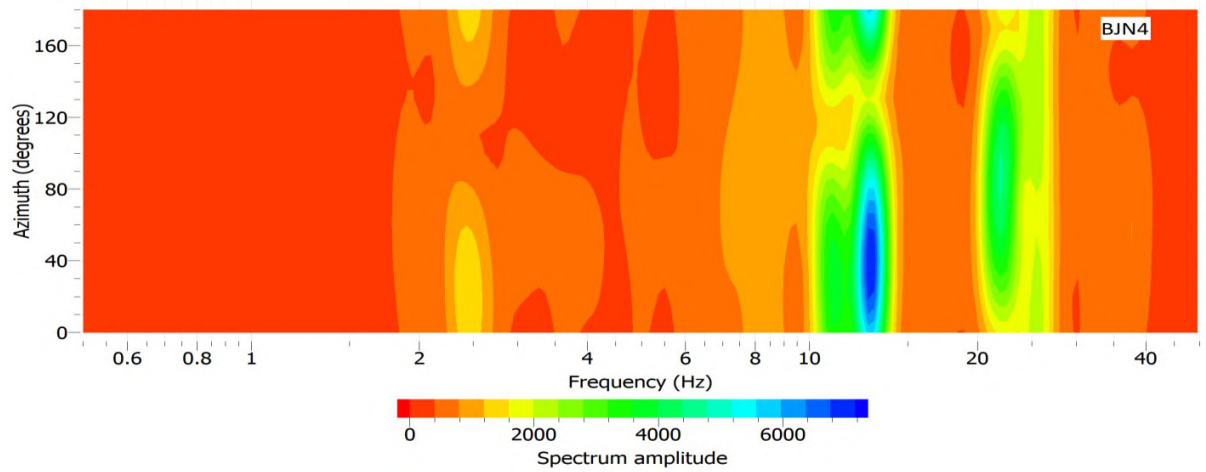


Fig. 53: Azimuth variation of spectrum amplitude for BJN4 (EPS Baghjan, original location). The peak frequency ~12Hz is orienting NE-SW (about 48°) directing towards most probably nearby generator at the Baghjan EPS, OIL. Another low frequency peak at ~2.5Hz bearing ~40° is roughly directed towards blowout site.

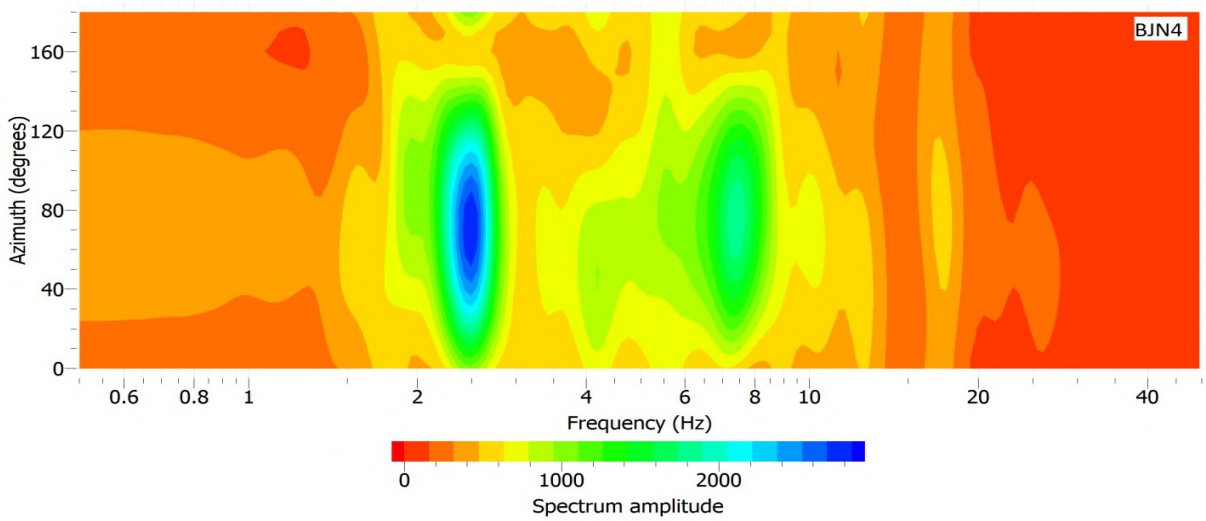


Fig. 54: Azimuth variation of spectrum amplitude for BJN4 (EPS Baghjan, after shifting). The peak frequency at ~2.5Hz is now orienting almost ENE-WSW (about 68°) directing towards the blowout site. The bearing of the blowout site from BJN4 new location is 245° (i.e. WSW).

After operating the station BJN4 at EPS for a few days there were problem of water logging at the site. Further, due to the machinery noise the data quality was not satisfactory. Therefore we shifted the station to a nearby convenient location. The bearing to the blowout site from this new site was 255° (WSW). We analyzed the directivity of the noise data from the new site and found that there is a prominent amplitude peak at about 2.5Hz directing WSW (68°), i.e. towards the blowout site (Fig. 54).

Station BJN5

The seismic station BJN5 was established at Baghjan village at about 450m from the blowout site. The station was very noisy due to ongoing activities to manage the crisis. However, despite this disturbance the station recorded continuous high frequency vibration coming from the incident site. The direction of the blowout site from this station was towards WNW (118°, almost west). The directivity plot of the noise record also shows clear peak at 5.8Hz directing to the blowout site (fig. 55). Another high frequency peak at 35Hz directing NNW-SSE may be coming from the other machine sources operating at the site.

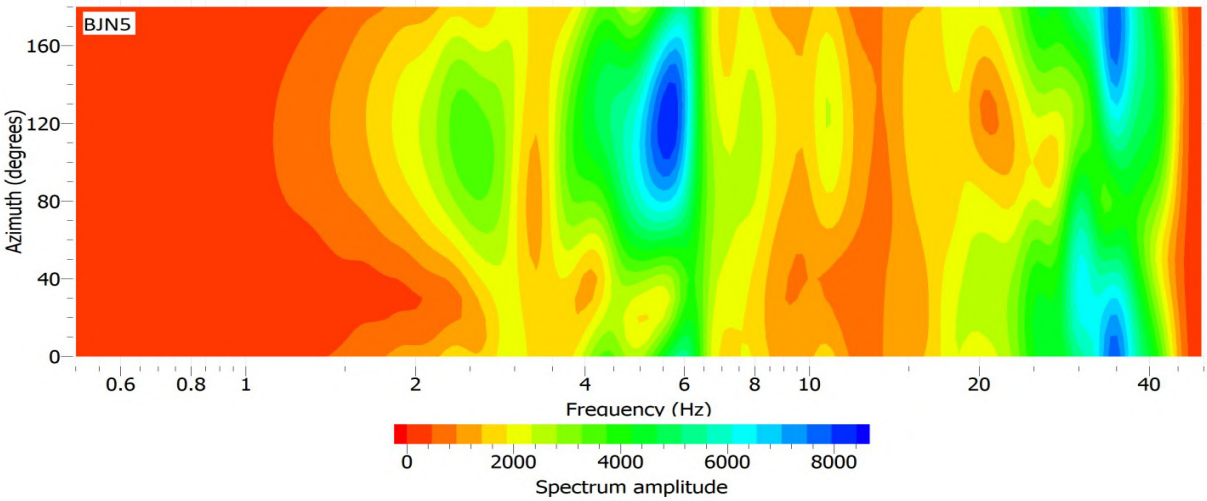


Fig. 55: Azimuth variation of spectrum amplitude for BJN5 (Baghjan gaon), 450m from the blowout site. The dominant peak frequency ~5.8Hz is directed towards ESE-WNW (~118°). The blowout site was located at WNW of BJN5 (original location), indicating noise source mainly from the blowout site. A high frequency peak at ~35Hz with a directivity bearing towards NNW-SSE may be coming from other machinery sources at the well site.

After operating the station at this site for week, flood water entered the seismic station inundating our equipment, and we were forced to shift the station to another location situated about 1.2km away from the blowout site. The azimuth of to the blowout site from the new location was 251°, i.e. towards SW. We again analyzed the noise directivity for the new site and found that a prominent peak appears at 2.5Hz directing ENE-WSW pointing its source to be the blowout site. Another peak at 8Hz also shows similar directivity (fig. 56).

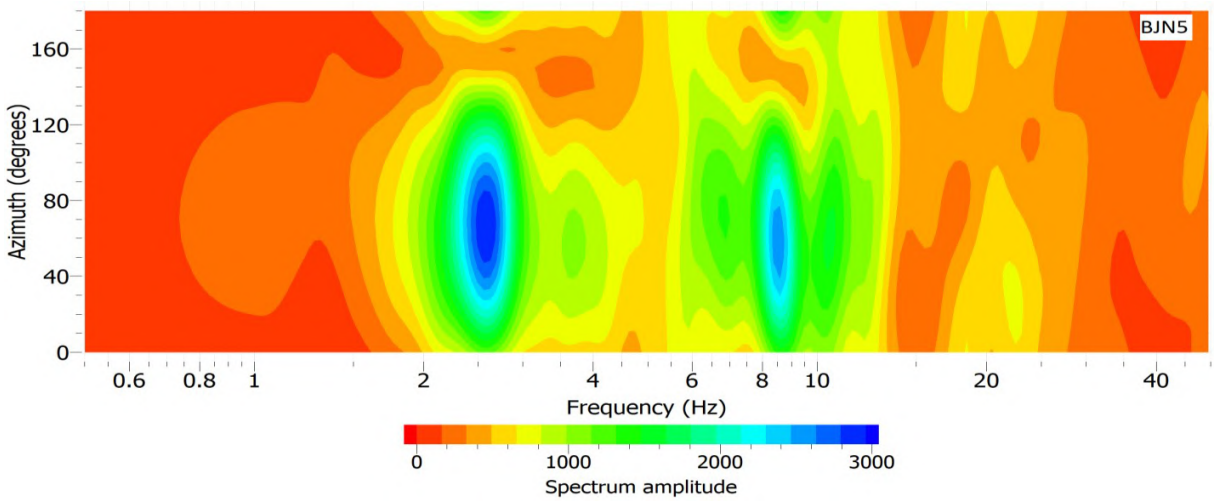


Fig. 56: Azimuth variation of spectrum amplitude for BJN5 (Baghjan gaon), 1100m from blowout site at the new location. The dominant peak frequency ~2.5Hz is now directed towards ENE-WSW (65^{o}) . The blowout site is located at WSW of the station, indicating noise source mainly from the blowout site. Another peak frequency at ~8.5Hz also shows similar directivity.

The directivity analysis of the noise records by all the seismic stations was carried out and each station shows directivity towards the blowout site. Therefore, it can be concluded that the continuous high frequency ground vibration observed in the records of each station of Baghjan local seismic network have its origin at the blowout site. However, though there is continuous ground vibration, the intensity is not significant as has been mentioned earlier and may not cause serious damage to dwelling houses in the investigated areas. Nevertheless, in the two nearby sites, (BJN4 and BJN5) the continuous ground vibration exceeds the human perceptible limit and may be quite disturbing.

II. Report on Geophysical Investigation at Baghjan Blow-out site

The geophysical survey team consisting of Dr. Santanu Baruah, Senior Scientist (Team leader) along with the members Dr. Goutam Kashyap Boruah, PhD, Timangshu Chetia, PhD(Thesis Submitted), Chandan Dey PhD(Pursuing) and Prasurjyo Borthakur MSc (Final Results awaited) reached Baghjan blowout site on 20th June, 2020. The situation of blowout in Baghjan, oil field is uncertain and unprecedented. The temperature in the vicinity of blowout was high enough to be felt at a distance of 1-1.5 km radically from the blowout. The whizzing sound was too loud which could be heard from a distance of approximately 22 Km during night time (Tinsukia). The scenario of the blowout site was heart wrenching as the live severity of burnt location was observed by us. On surveying with the oil field workers we came to know some of the facts that at night time vibrations due to the pressure of the flow of gas could be felt which resembled like to that of earthquakes.

1. Sites of geophysical surveys

We have selected 5 sites in and around the blowout covering the East, West and South direction of the investigation site depending on the feasibility of investigation. The north direction to blowout site was not feasible as it was covered entirely with water masses (Dibru River/Brahmaputra River) where detailed geophysical investigation is impossible. The details of the five sites along with some photographs are emphasized below:

Table 10: Geophysical survey sites in and around Baghjan Blowout Site

Sites	Name of the place	Distance to the Blow out site	Latitude	Longitude	Direction from the blow-out site
A	Baghjan oil field pathar	~800 m	27.590034^0 N	95.376503^0 E	SSW
B	Guijan (bank of River Dibru)	~5km	27.578969^0 N	95.359290^0 E	WSW
C	Baghjan gaon (very near the blow-out site)	~350m	27.595603^0 N	95.384038^0 E	ESE
D	Baghjan Tea Estate 6 no line(at the Run-way)	~5km	27.606803^0 N	95.438438^0 E	East
E	Dhelakhat 14 No	~4km	27.559843^0 N	95.391626^0 E	SSE



Figure 57: Locations of the Geophysical Survey sites (diamond) along with the blow-out well (red star).

General field photographs

Site A: Baghjan oil field pathar

~800 m	27.590034^0 N	95.376503^0 E



Figure 58: Images of survey site A

Site B: Guijan (bank of River Bibru)

~5km	27.5789690 N	95.3592900 E



Figure 59: Images of survey site B

Site C: Baghjan gaon (very near the blow-out site)

~350m	**27.5956030 N**	**95.3840380 E**



Figure 60: Images of survey site C

Site D: Baghjan Tea Estate 6 no line(at the Run-way)

~5km	**27.6068030 N**	**95.4384380 E**



Figure 61: Images of survey site D

Site E: Dhelakhat 14 No

~4km	**27.5598430 N**	**95.3916260 E**



Figure 62: Images of survey site E

2. Ground Electrical Resistivity Survey

Table 11: Details of Resistivity survey conducted in the vicinity of Baghjan Blowout SIte

Phase → / Site↓	I	II	III	IV
A	20/6/20			28/7/20 30/7/20
B	21/6/20	30/6/20	7/7/20	30/7/20
C	21/6/20			
D	21/6/20		8/7/20	
E	22/6/20			

There are altogether 11 geoelectric sounding surveys have been conducted at the proposed sites in the vicinity of Baghjan OIL Blowout site. The number of surveys has been constrained to such a value due to the extreme weather condition and water logging in the sites. Resistivity survey, conducted at the water logged sites may have ended up with erroneous results. Following are the comparison of the results of each site, where the survey has been conducted atleast twice.

2.1 Site A

Phase → / Site↓	I	II	III	IV
A	20/6/20			28/7/20 30/7/20

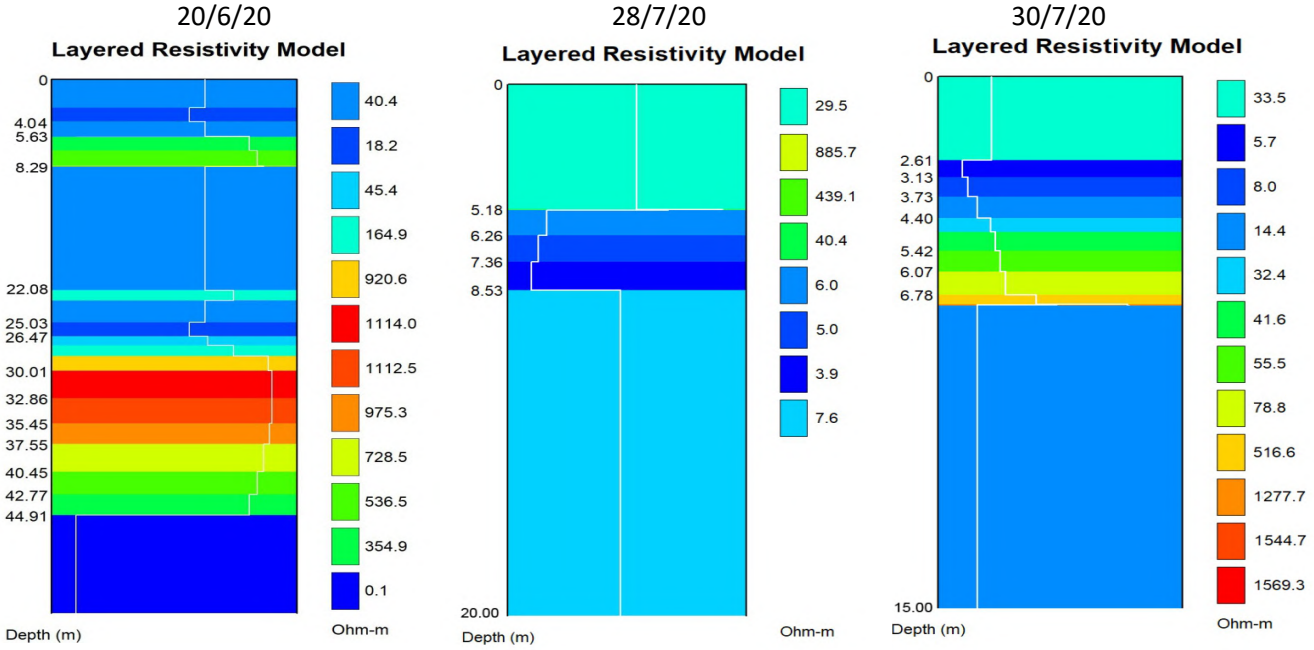


Figure 63: Resistivity profiles derived from geoelectric sounding performed at Site A

Three numbers of ground electrical resistivity sounding surveys had been conducted at the site A of Baghjan Blowout vicinity using Schlumberger's array. In comparison to the first phase survey, where the depth could be resolved to 55m, the later surveys could resolve subsurface resistivity variation to much lesser depths of 20m and 15m only. The surveys were conducted with a gap period of 38 days and 2 days respectively. It is also to mention that there had been significant amount of rains and water logging at the survey site in between the date of conduction of surveys. Due to water logging problem & logistic issues, uniform lengths of electrode separation could not be maintained, which influenced the depth resolution of resistivity survey. Also, the depth of penetration of current was probably influenced by water saturation. In all of the surveys, low resistivity layers (30-40Ωm) have been observed at the top soil covering. In the first profile uniform resistivity of 40Ωm is observed from 8-22m, whereas in the second profile and third profile the resistivity decreased to 7.6Ωm and 14Ωm respectively for the same depth. This might have directly influenced by the heavy rains and consequent water saturation that occurred after the first survey. Significant variation of resistivity values could be observed in all the profiles above 8m indicating presence of multiple thin layers. *However, no significantly high resistivity observed in the shallow depth*. In the first profile highly resistive multiple layers are observed below 29m and anomalous low resistivity (0.1 Ωm) is observed below 45m.

2.2 Site B

Phase → / Site↓	I	II	III	IV
B	21/6/20	30/6/20	7/7/20	30/7/20

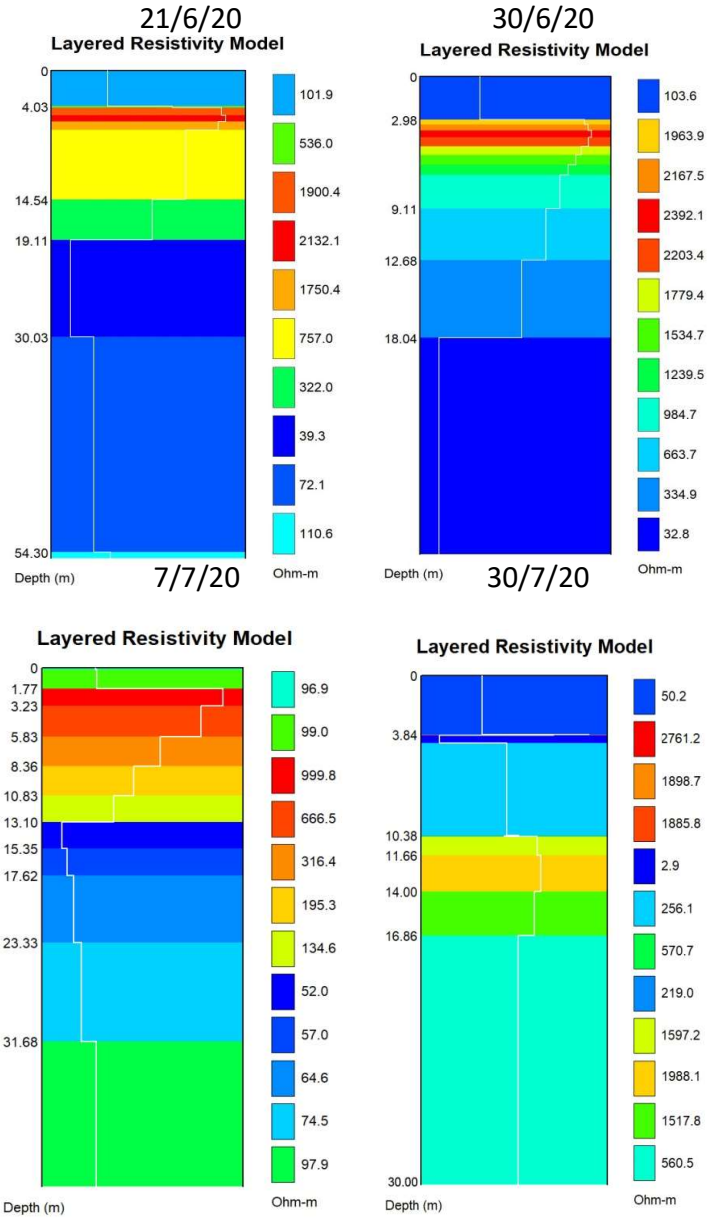


Figure 64: Resistivity profiles derived from geoelectric sounding performed at Site B

Guijan is the only site, where the geoelectric sounding has been conducted four times, although the depth of investigation has been varied as compared to the first survey depending upon the length of electrode array. The depths of investigation in the surveys of different phases are respectively 55m, 33m, 44m and 30m.

The survey site is adjacent to the river bank, because of which a significant change of resistivity values have been observed during the surveys as depicted in the figures. There has been a varying gap of 7-23 days between each of the surveys. High variations of resistivity are observed down to a depth of 16-20m in all the profiles, which indicates presence of multiple thin layers of alternating sand and clay. The several periods of heavy rains that occurred in between the surveys might have periodically influenced the water saturation, thereby changing the electrical resistivity of the layers. Very high resistivity (~2000Ωm) that could be observed at 3-5m depth in the first two layers disappeared in the subsequent profiles.

2.3 Site C

Site Code	Name of the place	Distance to the Blow out site	Latitude	Longitude	Direction from the blow-out site
C	Baghjan Gaon	~350 m	27.5956030 N	95.3840380 E	ESE

The survey site is very near to the blowout site (~350m) and contains the debris of the fire incident. Most of the places are covered by oil residuals and ashes of burnt out elements. Due to the constraints faced, the survey length is limited to 60m only (AB/2=30m). Following are the observations from the field.

Geoelectric sounding had been conducted using Schlumberger Array with a total array length of 60m. A total of 16 readings have been taken by increasing the electrode spacing. The site is directed to the blowout site with an azimuth of 110^{o} and the array is heading towards the blowout point. The site is mostly covered by muddy remains containing water and oil elements. The resistivity value up to a depth of 8.7m is very uniform (~250Ωm) and no sub-layer could be differentiated. There is possibility that the site may be contaminated to this depth. Clear variations of resistivity below 8.7m are observed between ranging from 495-591Ωm, indicating presence of several thin layers. Ground resistivity could be resolved only upto 16.5m only in this location.

Only one survey could be conducted at this site as the area was inundated by flood water during the later phases of surveys.

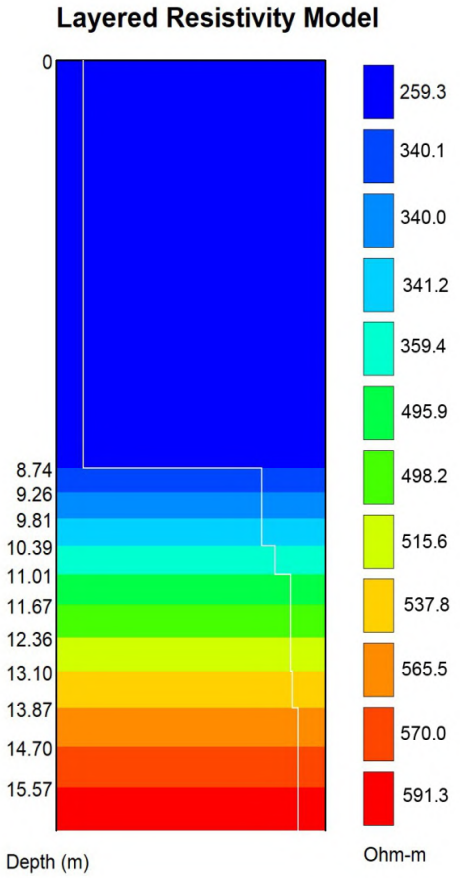


Figure 65: Resistivity profile derived from geoelectric sounding performed at Site C

2.4 Site D

Phase →	I	II	III	IV
Site↓				
D	21/6/20		8/7/20	

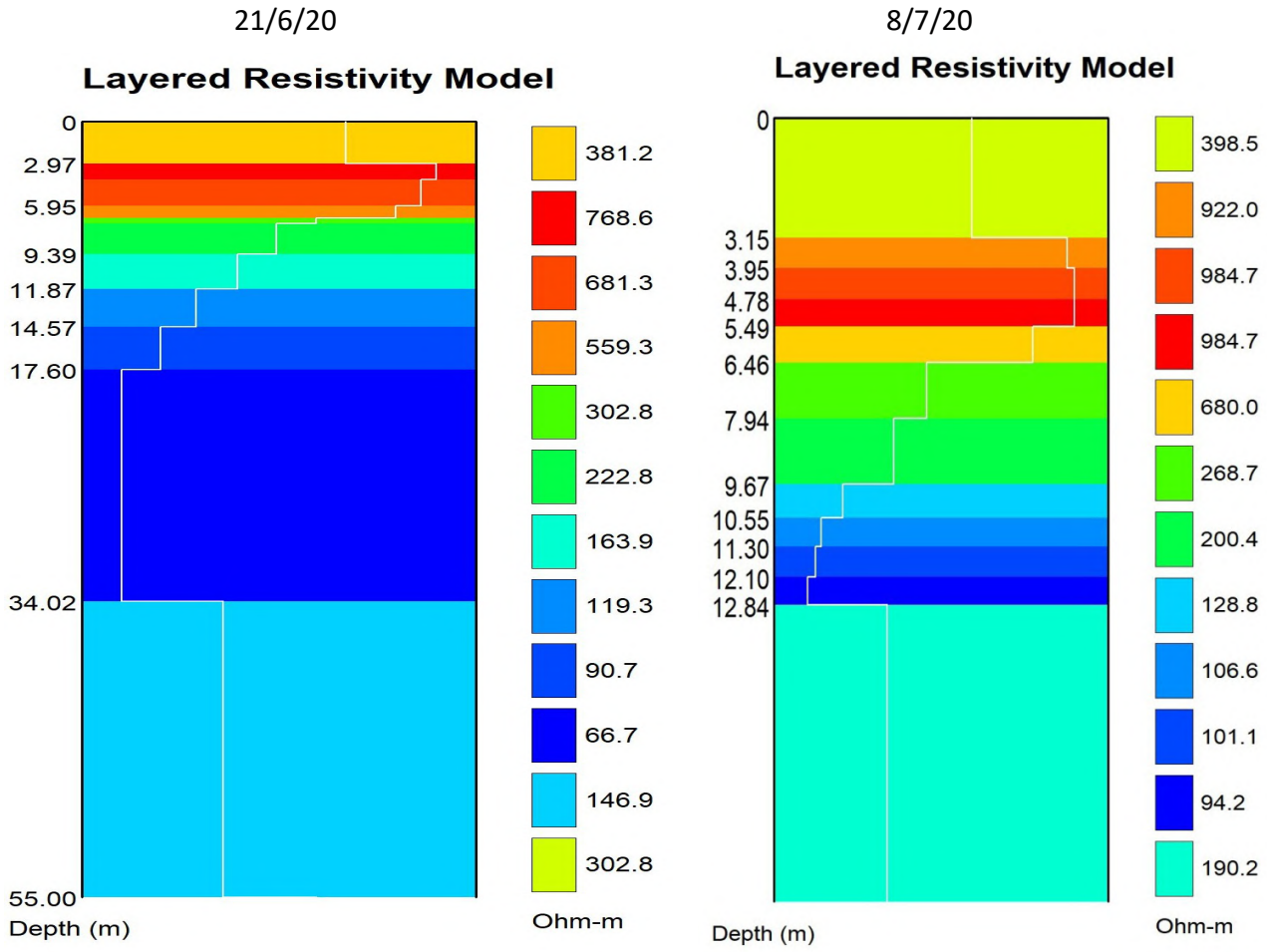


Figure 66: Resistivity profiles derived from geoelectric sounding performed at Site D

The survey site is a grass land which was earlier used as an active runway. Two surveys had been conducted within a gap period of 17days. Due to the excessive water logging, this site was skipped during other two phase (2 and 4). Due to the unavailability of dry places, the array length was restricted to 60m in the second survey as compared to 200m in the first survey. The array length restriction reduced the depth of investigation from 55m in the first survey to 18m in the second survey. In the first phase survey, significant variation is observed in the depth up to 17.6m, where resistivity value ranges from 90-770Ωm. In the later survey, the variation could be observed only to 12.18m depth. The top layers in both the case are found to be of 380-400Ωm.

2.5 Site E

Site Code	Name of the place	Distance to the Blow out site	Latitude	Longitude	Direction from the blow-out site
E	Dhelakhat Tea Estate	~4km	27.5598430N	95.3916260E	SSE

Dhelkhat Tea Estate is situated from the blowout site at a distance of ~4km of radial distance. The site is a football ground near to a tea garden. Due to the limitations of the field dimensions, the survey array had to be also limited to a lower length as usual (120m)

Geoelectric sounding has been conducted using Schlumberger Array with a total array length of 120m. A total of 20 readings have been taken by increasing the electrode spacing. The site is directed to the blowout site with an azimuth of 160^{o} and the array was heading towards the blowout point. The top layers are consists of highly resistive elements having resistivity values in the range of ~300-700Ωm till a depth of ~15m. The site was covered during the first survey after a dry spell, and probably indicates presence of a thick dry sand layer. Below this depth, resistivity value indicates presence of multiple layers with gradually decreasing resistivity values (minimum around ~120Ωm). Resistivity values could be obtained up to 28m depth.

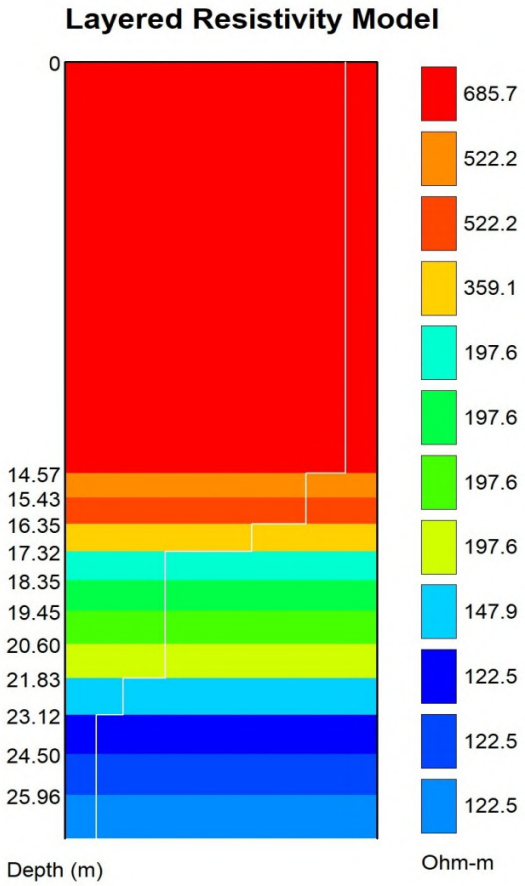


Figure 67: Resistivity profiles derived from geoelectric sounding performed at Site E

3. ANALYSIS AND INTERPRETATION OF MAGNETIC DATA IN AND AROUND BAGHJAN WELL BLOWOUT

A geophysical survey is done in and around the Baghjan Well Blowout Site. Magnetic data is acquired using, a Geometrics G-857 portable proton precession magnetometer .The magnetic method of geophysical survey is a useful technique than the expensive seismic methods. In this work, the objective is to study of the blowout site and study the magnetic susceptibility contrast of the targeted site.

Data was acquired in four phases, each phases consisting of 5 survey sites. A layout consisting of N-S lines is planned on the survey site. The spacing between each station is taken 5m apart. In each observation point each data set is recorded. The real data is been processed for diurnal variation and regional distorting effects. Further these data are reduced to pole (RTP), Euler deconvolution and inversion were employed to characterised the site. The Euler deconvolution applied to the RTP data with different structural index vales interpret the dyke, sill, contact and fault structures. This magnetic survey also helps in the interpretation of the magnetic minerals that presents in the rocks in terms of magnetic susceptibility.

3.1 INSTRUMENTATION:

PROTON PRECESSION MAGNETOMETER:

A PPM is a device that measures tiny change in the earth magnetic field with most accuracy.PPM is based on the simple concept that each proton has its own tiny magnetic field. The frequency at which the proton spins (or precess) is directly related to the ambient magnetic field.



Figure 68: Proton Precession Magnetometer at CSIR-NEIST

3.2 DATA ACQUISITION:

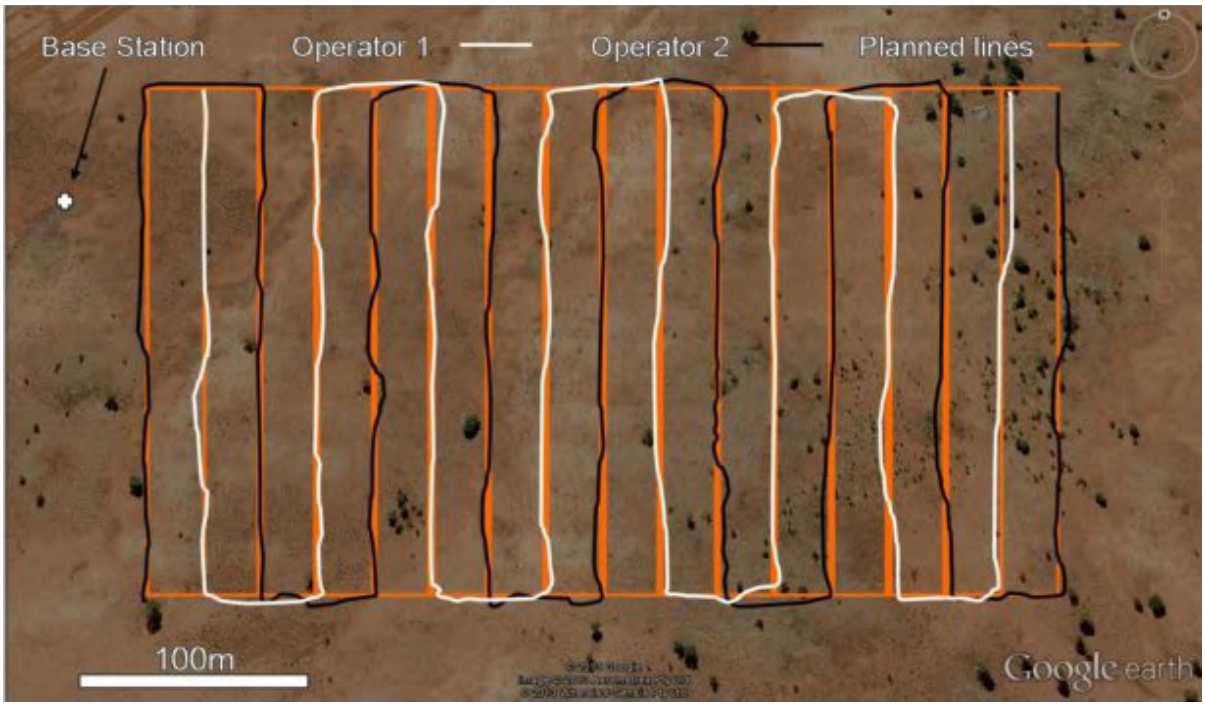


Fig-69: Above is a graphical representation of the layout of one of the survey site.

3.3 METHODOLOGY:

When an atom or nucleus possesses a resultant angular momentum G, it has an associated magnetic dipole moment, $\mu=\gamma$ G, where is the magneto-gyric ratio. If such a dipole is placed in an external magnetic field H, it experiences a torque and the equation is,

$$dG/dt= \mu\times H$$

$$dG/dt= \gamma\ G \times H$$

Thus the motion of μ or G is uniform precession about H with angular frequency,

$$\omega_{L=}\ \gamma\ G$$

A PPM operates essentially as follows. About 300—500 cm' of water is subjected to a strong (—100 G) magnetic field roughly at right angles to the earth's field for a few seconds. This application partially polarizes the proton magnetic moments in the direction of the net magnetic field. When the polarizing field is removed, the proton magnetic moment precesses about the remaining (earth's)

magnetic field. Since γ is a constant, a measurement of the precession frequency can be used to determine **F**

If the earth's magnetic field is given by at a point, the precession frequency, $\omega_{L=} \gamma F$

of the proton will determine the magnitude of the field vector F. Now suppose the PPM is moved along a traverse and encounters an anomaly of magnetic field vector T as shown in Fig. 3. For, T≤F, angle and the proton magnetic moment will precess about OC with frequency,

$$\omega_{L=} \gamma(T+F)$$

Thus a change in the precessional frequency, $\Delta \omega_L = \omega_L^{/} - \omega_L$, will yield information on the component of the anomaly field along the earth's magnetic field vector. The approximation ~|F+T|. F+T cos Θ breaks down when |T| is comparable to |F| as it is in the vicinity of iron ore deposits or other large anomalies.

STEPS FOR DATA PROCESSING:

Diurnal Correction:

Due to the current flowing in the in the ionosphere and magnetosphere there is temporal variation in the geomagnetic field in a period less than a day. This is known as Diurnal variation. Solar wind creates a variation in the magnetic field of about 10nT. Therefore magnetic survey is advised to conduct in the mornings and evenings where the heat is relatively low. Another variation is due to the geomagnetic storms which are very unpredictable with magnitude up to thousands of n T. Base station readings are used to correct for these temporal variations.

Three readings have been taken for base station before and after the survey. The average of these values is taken and subtracted from the measured field. That gives a diurnally corrected field value.

Regional Corrections:

Instrument such as G-857 PPM measures the strength of magnetic field $\mathbf{B_{obs}}$ due to all the magnetic substance present at that specific observation point. Therefore the observed field strength will be the sum of the ambient field $\mathbf{B_E}$ and the targeted field $\mathbf{B_T}$. We can easily get the background anomaly field due to the buried source and to do that we have to remove the background field strength B_E. The total field anomaly can be define as,

$$T=|B_{obs}|-F \quad (1)$$

In the above equation, $|B_{obs}|$ is the field measured by the proton precession magnetometer and F (background anomaly) can be taken from IGRF magnetic field model. We have obtained the value of F from an online calculator based on IGRF-2020 available on National Oceanic and Atmospheric Administration (USA) website.Using the above mentioned calculator, (https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml#igrfwmm).

Further that specific amount of regional magnetic field value is subtracted from the acquired field by the magnetometer at each observation point.

3.4 SITE INFORMATION

SITE A: BAGHJAN OIL FIELD PATHAR

DISTANCE FROM BLOWOUT SITE: 800 m (approx)

DIRECTION FROM BLOWOUT: SSW

SITE B: GUIJAN GHAT

DISTANCE FROM BLOWOUT SITE: 5KM

DIRECTION FROM BLOWOUT: WSW

SITE C: BAGHJAN GAON

DISTANCE FROM BLOWOUT SITE: 350m (approx)

DIRECTION FROM BLOWOUT: SSW

SITE D: BAGHJAN TEA ESTATE

DISTANCE FROM BLOWOUT SITE:5KM

DIRECTION FROM BLOWOUT: EAST

SITE E: DHELAKHAT

DISTANCE FROM BLOWOUT SITE:4KM

DIRECTION FROM BLOWOUT: SSE

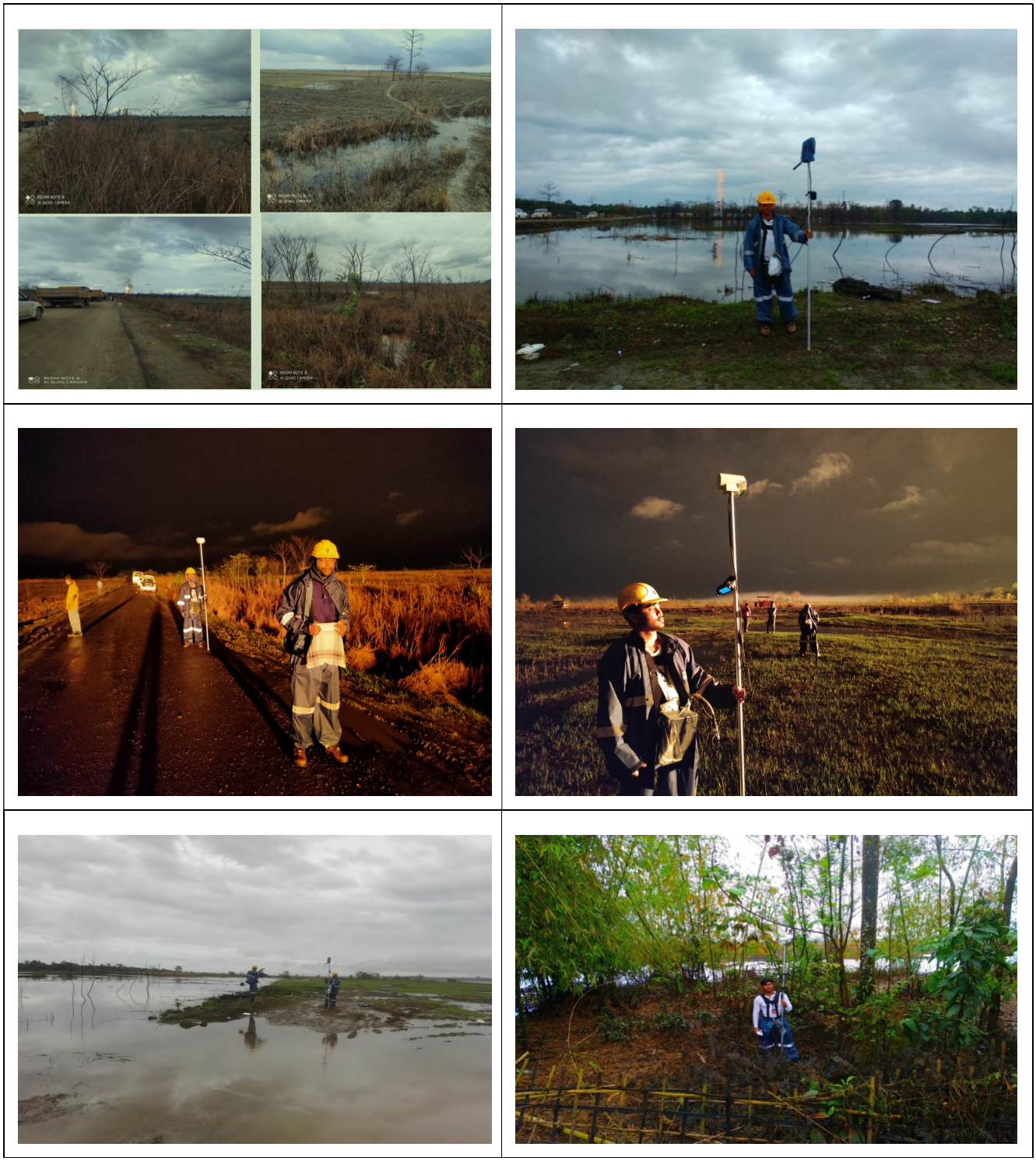


Figure 70: Picture taken while the GSTD team is conducting the geophysical survey of the blowout site.

3.5 Phases of PPM surveys

PHASE 1

DATE: 20/06/2020

MODEL USED: IGRF 2020

LATITUDE: 27.590034 **N**

LONGITUDE: 95.376503 **E**

Elevation: 124.0 m Mean Sea Level

DATE	Inclination	Declination	Horizontal component	Vertical Component	Total Field
20th June,2020	43.45170	-0.72520	35,768.0 nT	33,888.2 nT	49,274.4 nT

PHASE 2

DATE:1/07/2020

MODEL USED: IGRF 2020

LATITUDE: 27.590034 **N**

LONGITUDE: 95.376503 **E**

Elevation: 124.0 m Mean Sea Level

DATE	Inclination	Declination	Horizontal component	Vertical Component	Total Field
1st July,2020	43.4550°	-0.7267°	35,770.9 nT	33,891.9 nT	49,276.9nT

PHASE 3

DATE: 10/07/2020

MODEL USED: IGRF 2020

LATITUDE: 27.590034 **N**

LONGITUDE: 95.376503 **E**

Elevation: 124.0 m Mean Sea Level

DATE	Inclination	Declination	Horizontal component	Vertical Component	Total Field
10th July,2020	43.4577°	-0.7278°	35,770.7 nT	33,895.0 nT	49,279.0 nT

PHASE 4

DATE: 28/07/2020

MODEL USED: IGRF 2020

LATITUDE: 27.590034 **N**

LONGITUDE: 95.376503 **E**

Elevation: 124.0 m Mean Sea Level

DATE	Inclination	Declination	Horizontal component	Vertical Component	Total Field
28th July,2020	43.4630°	-0.7301°	35,770.5 nT	33,901.1 nT	49,283.0 nT

DATE: 30/07/2020

MODEL USED: IGRF 2020 LATITUDE: 27.590034 **N** LONGITUDE: 95.376503 **E** Elevation: 124.0 m Mean Sea Level

DATE	Inclination	Declination	Horizontal component	Vertical Component	Total Field
30th July,2020	43.4630°	-0.7301°	35,770.5 nT	33,901.1 nT	49,283.5 nT

Reduction to pole (RTP) filter:

Before interpretation of the data it is been processed many times. In conventional practice magnetic data reduction includes regional correction where any regional effect is removed by subtracting from each measured value an average of the total magnetic intensity over the study area. Reduction to pole filter is a tool that makes the interpretation of data much easier. RTP is a technique of converting the magnetic data that had been acquired at latitude where the Earth's field is inclined to that would have been acquired at a magnetic pole i.e. at inclination 90^0.

Euler Deconvolution:

Magnetic survey data are evaluated by the identification of source or estimation of depth. Euler method can be used for estimating depth to source regarding magnetic poles, point mass and sphere distributions. This technique can also be used for other type of geometrical pattern of the source body such as edges of long flat objects, vertical and horizontal cylinder etc.

3.6 Processing of PPM data

PROCESSED DATA OF SITE A (BAGHJAN OIL FIELD PATHAR)

PHASE 1 (SITE A)

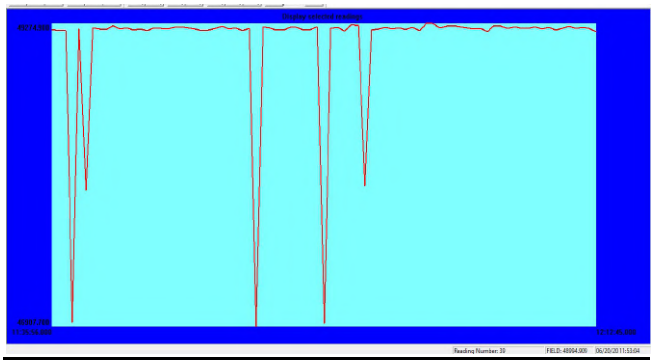


Fig: Anomaly peaks are observed in three different positions.

PHASE 2 (SITE A)

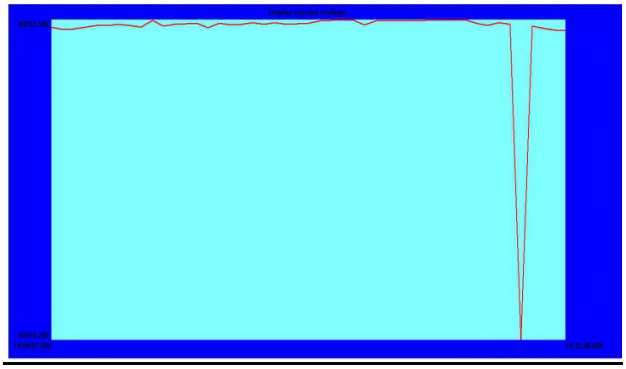


Fig: Anomaly peak is observed at one position.

PHASE 3 (SITE A)

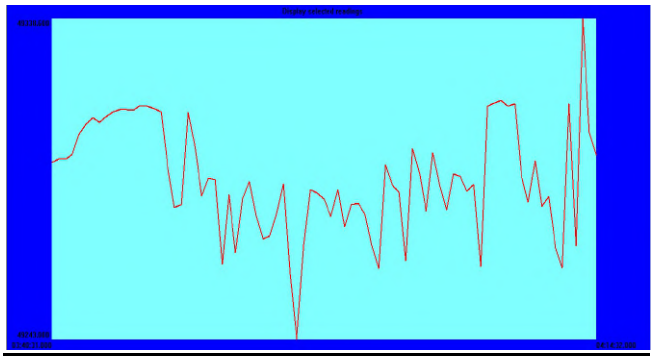


Fig: The variation is uniform with some minor peak values.

PHASE 4 (SITE A)

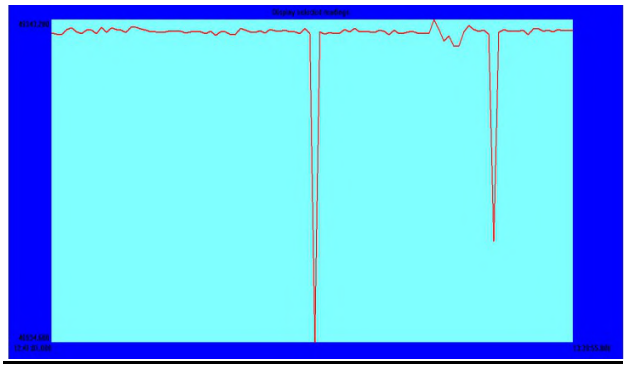


Fig: Anomaly peaks are observed at two positions.

PHASE 4(SITE A)

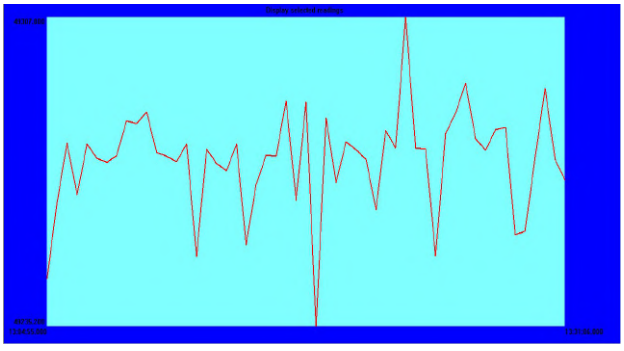
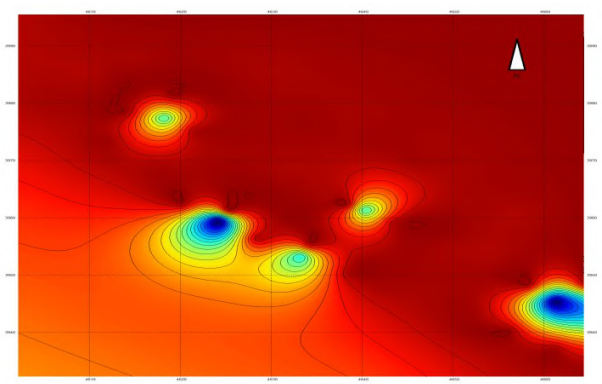


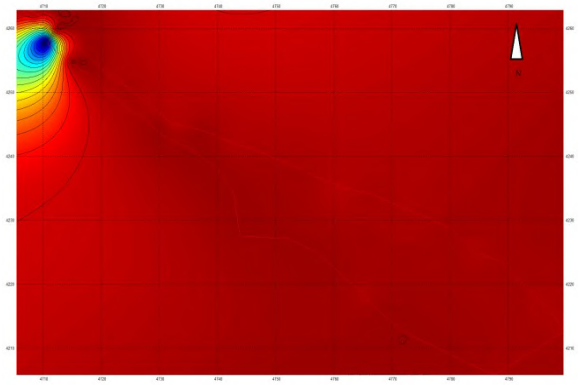
Figure 71: Processed Data at Site A

SITE A (BAGHJAN OIL FIELD PATHAR)

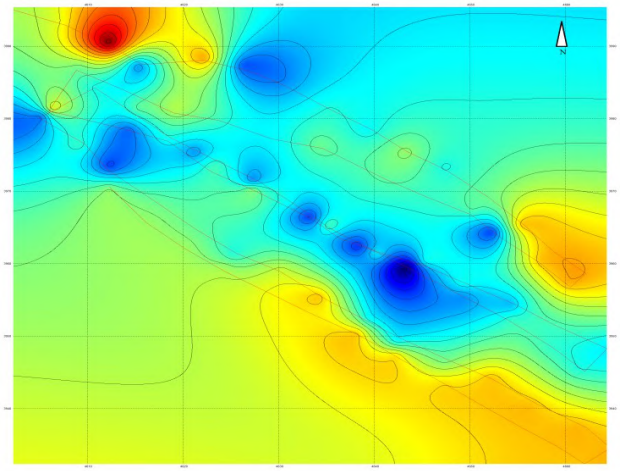
PHASE 1 (SITE A)



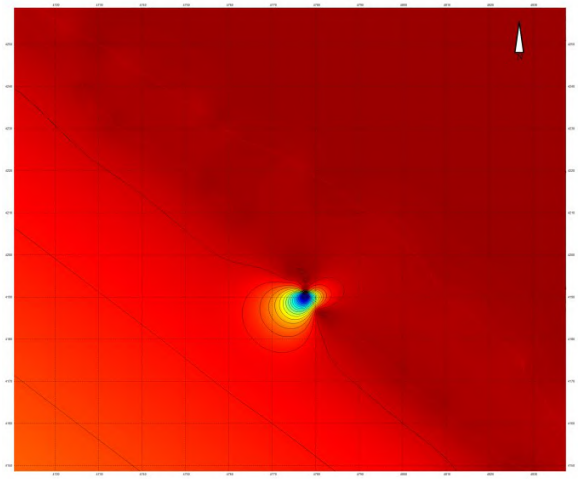
PHASE 2 (SITE A)



PHASE 3 (SITE A)



PHASE 4 (SITE A)



PHASE 4 (SITE A)

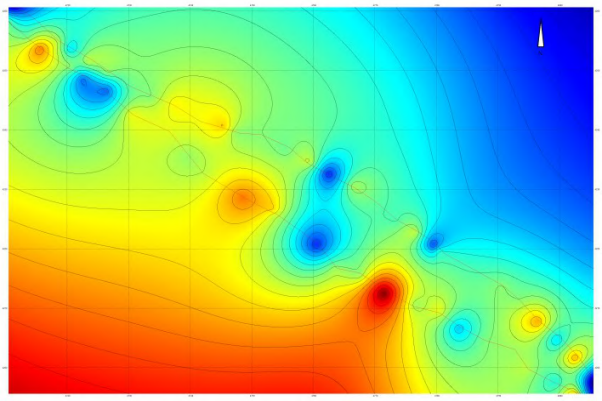
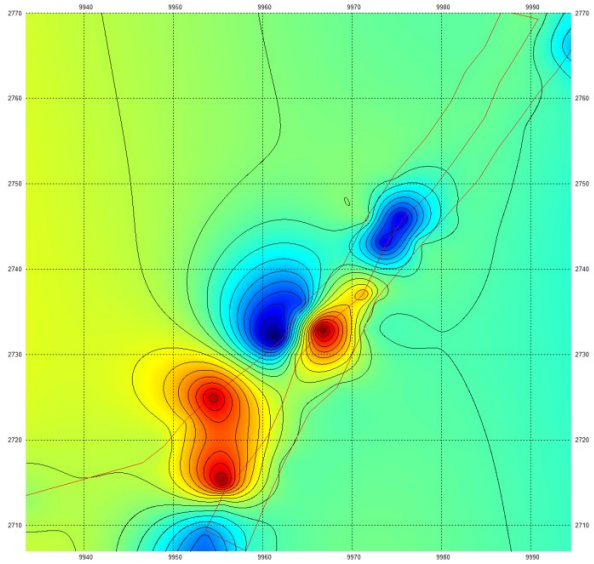
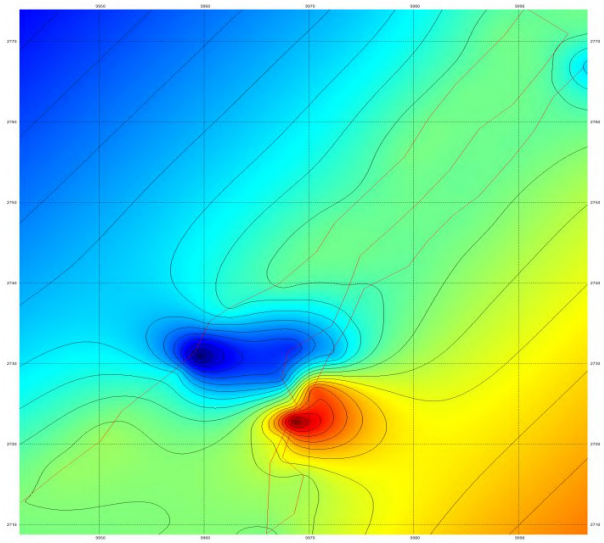


Figure 72: Contour maps produced at Site A

SITE B (GUIJAN GHAT)

PHASE 1	PHASE 2
	

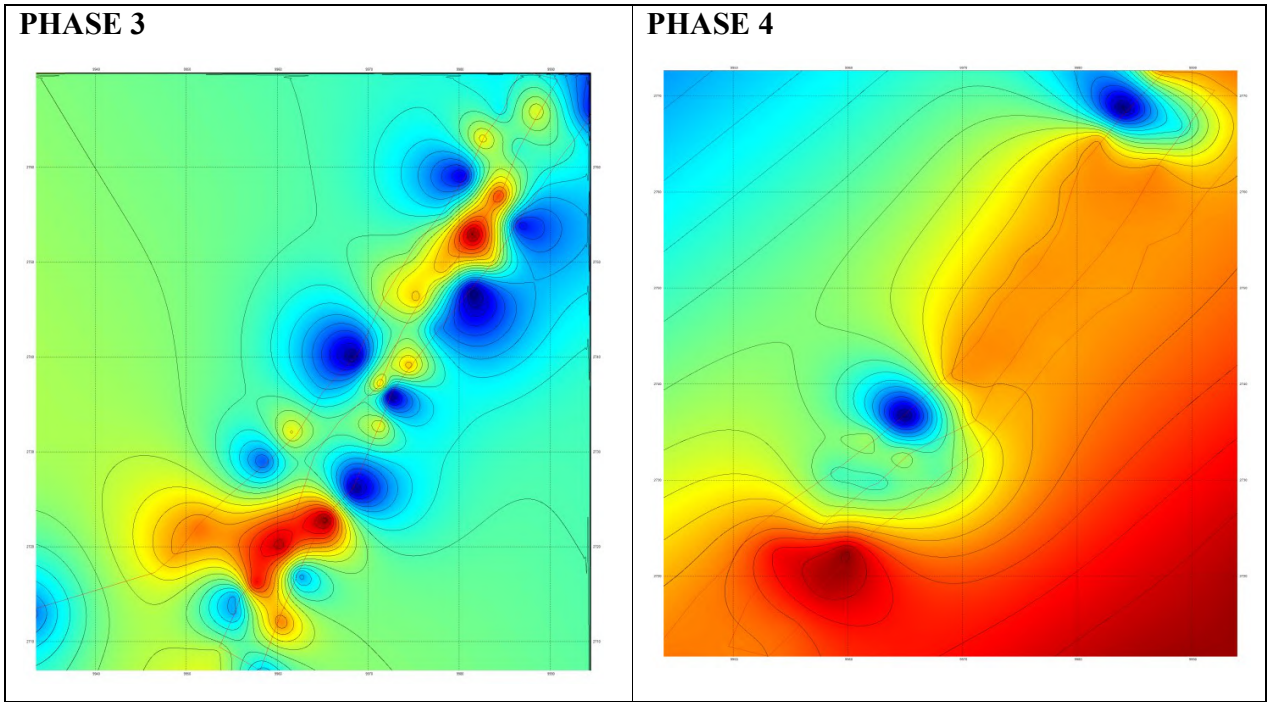


Figure 73: Contour maps produced at Site B

SITE C (BAGHJAN GAON)

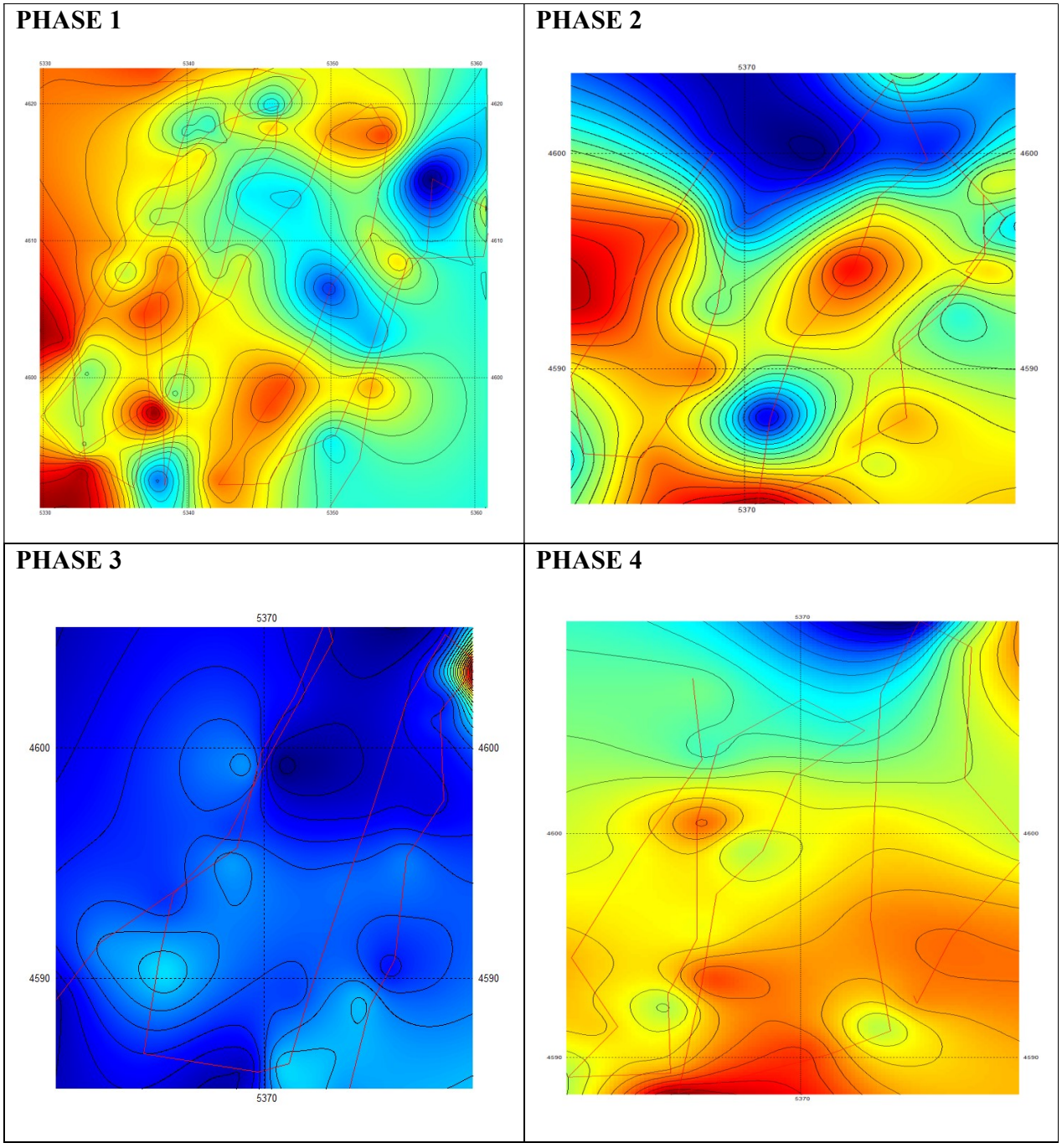
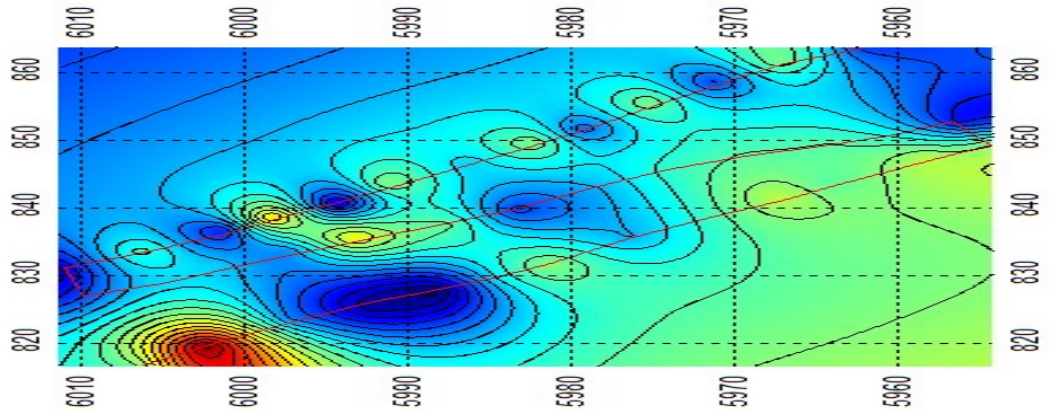


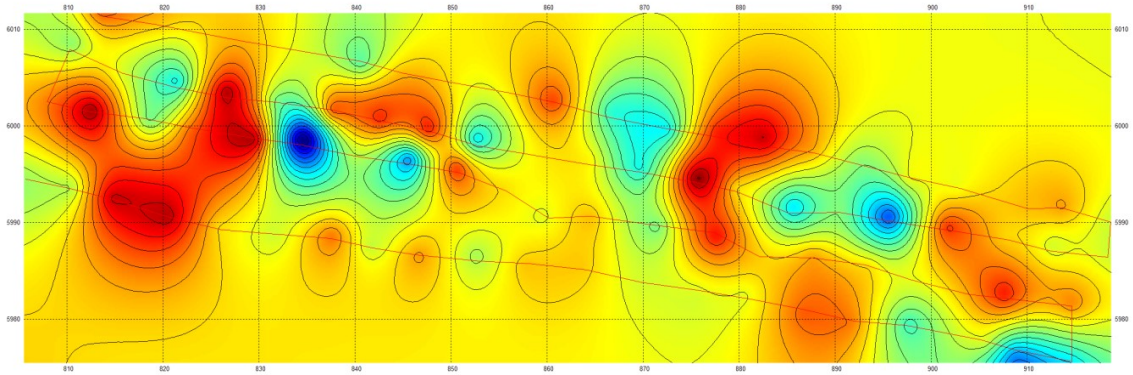
Figure 73: Contour maps produced at Site C

SITE D (BAGHJAN TEA ESTATE)

PHASE 1



PHASE 1



PHASE 2

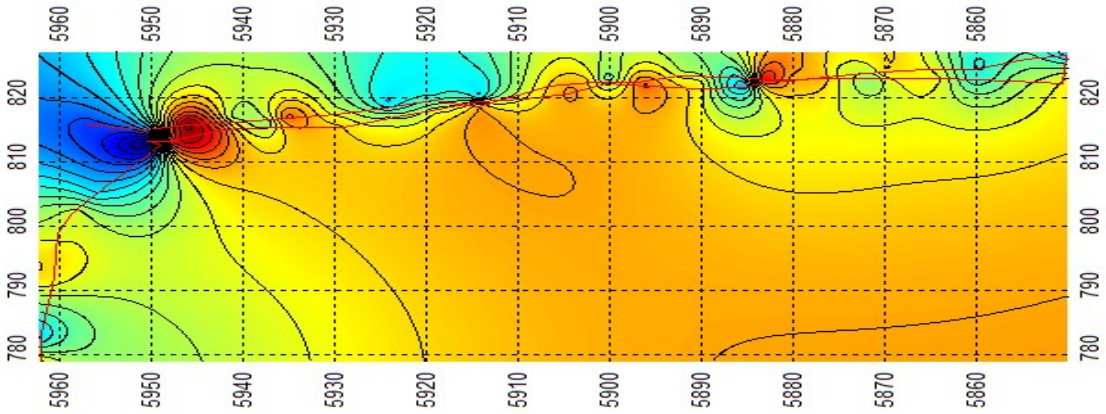
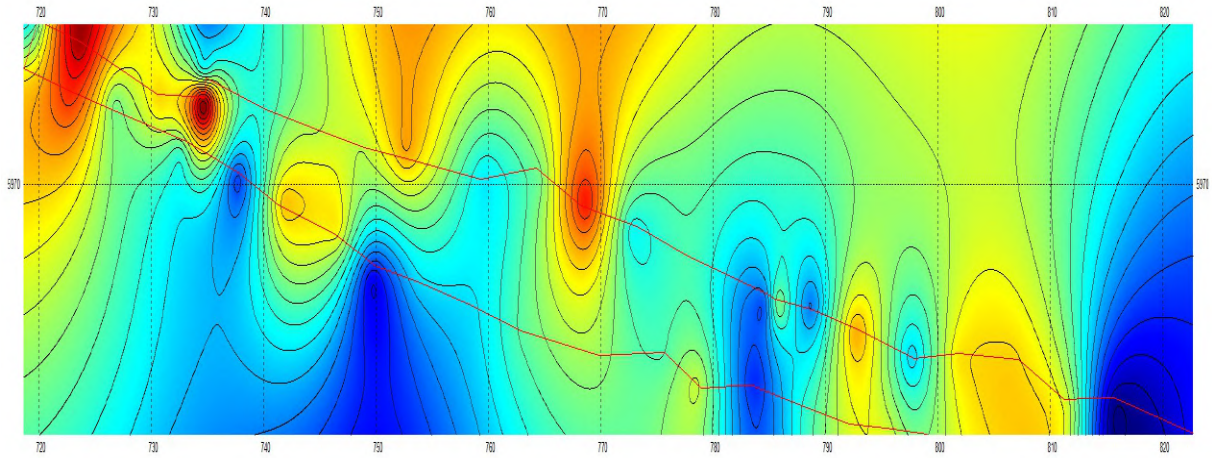


Figure 74: Contour maps produced at Site D

PHASE 2



PHASE 3

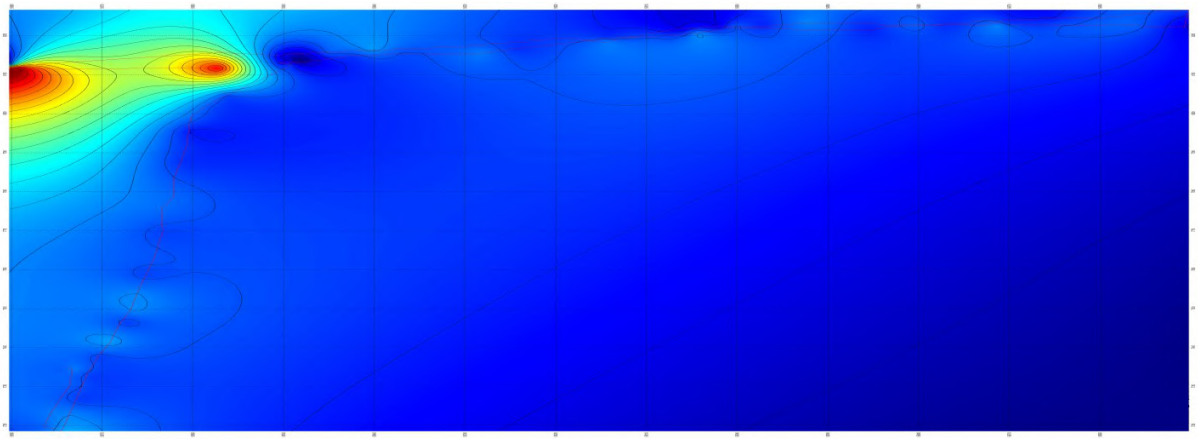
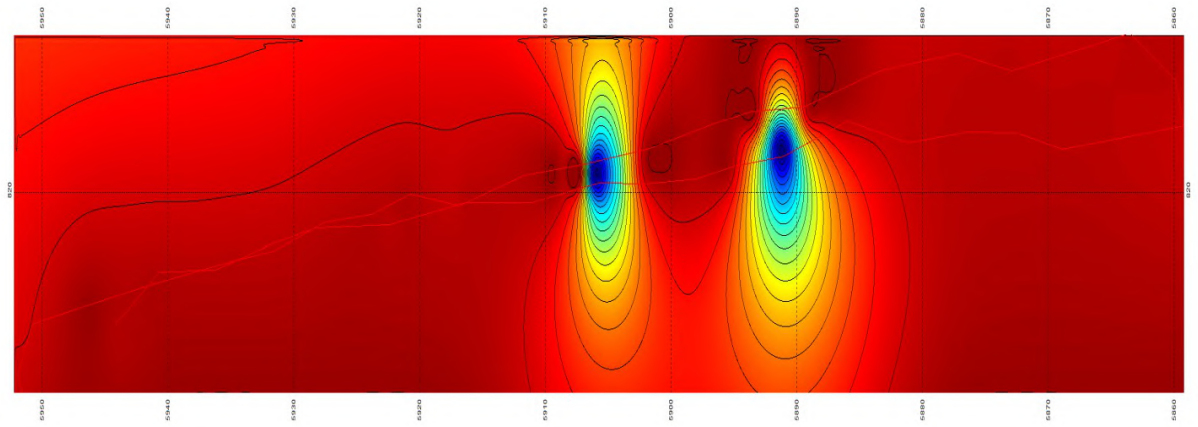


Figure 75: Contour maps produced at Site D

PHASE 4



PHASE 2

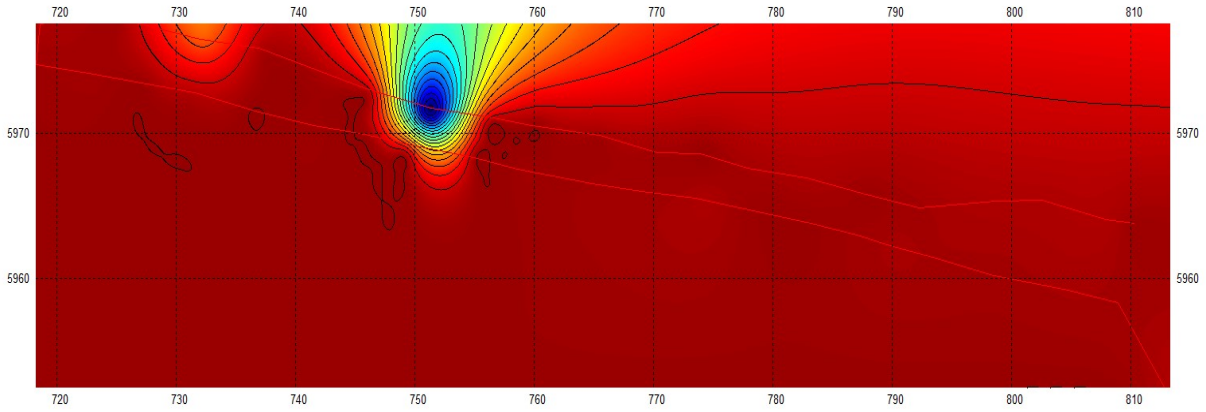


Figure 76: Contour maps produced at Site D

SITE E (DHELAKHAT)

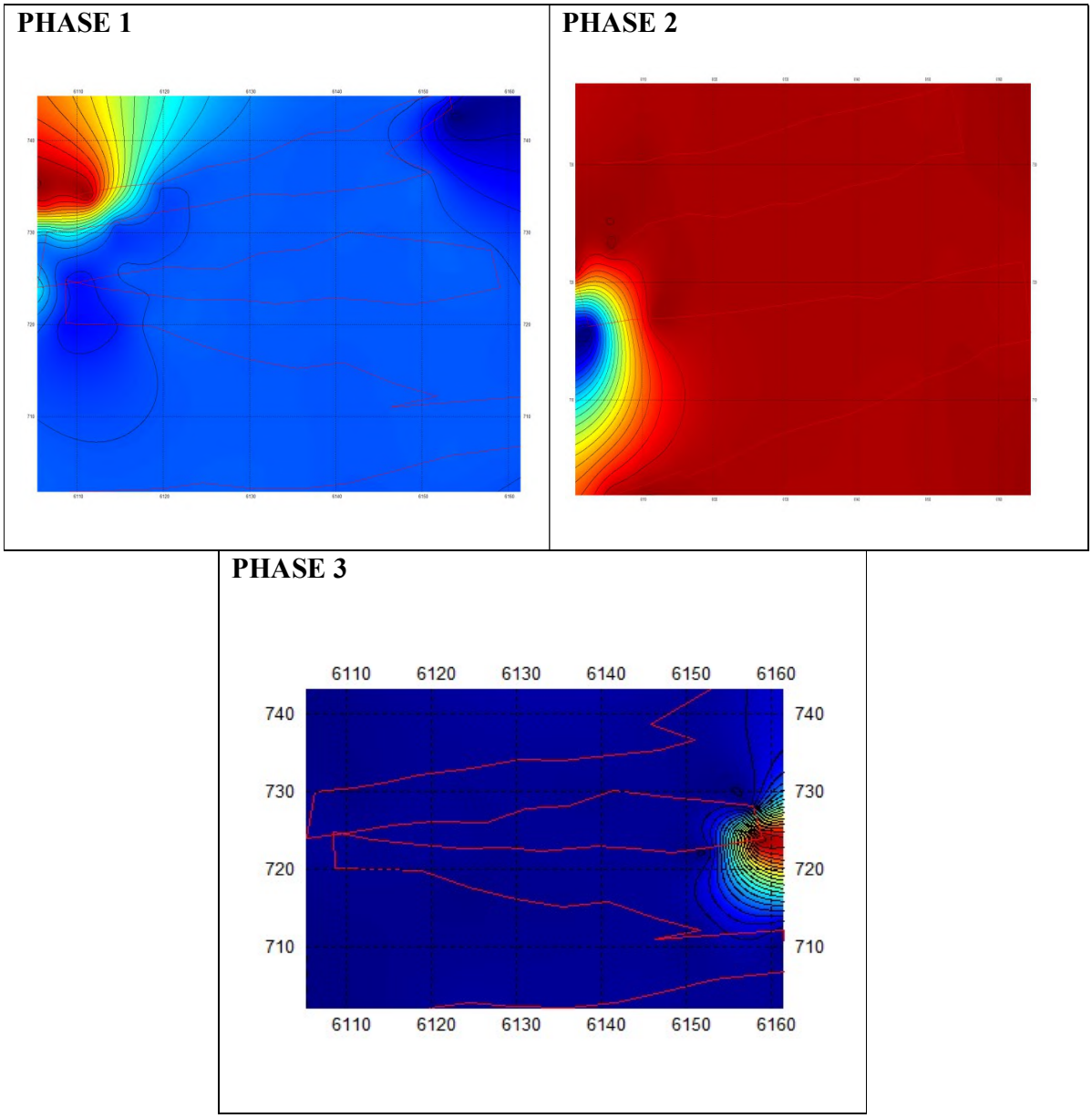


Figure 77: Above the first figure is the intensity graph of the SITE A throughout the four (04) phases of the Geophysical survey conducted in and around the Baghjan Blowout site. The second figure shows the contour maps of the survey site representing the magnetic field intensity at the time of the geophysical survey is conducted.

3.7 Results

As observed from figure there is an obvious variation in magnetic anomalies over the five (05) sites during the course of time. Throughout the four phases of the survey, the site is subjected to fluctuation of magnetic field intensity. In PHASE 1 and PHASE 2 the variation profiles are quite similar while PHASE 3 and PHASE 4 the profiles are different. In the first three phases there are some anomalous change in the magnitude of the magnetic anomaly value of about 1500-2000 nT. This maybe an indication towards some geological patterns that are present underneath the prescribed survey site. While in the other two surveys (in phase 4) the variation is uniform in the sense that there is no distinct peak values are observed, just a continuous variation of the magnetic anomaly value. The contour maps obtained for PHASE 1 and PHASE 2 are somehow similar. There is a huge deviation of the measured intensity from the IGRF total magnetic field value at some certain coordinates. Therefore in the contour maps of the specific site, more high intensity zones are observed (red colour) while that is not the case in PHASE 3 and PHASE 4 as there are no such anomaly peaks are been observed in those phases. So overall, there is a continuous variation in the magnetic anomaly throughout the four phases. Due to the heavy rains, there were some variations, which intercept the contouring of some sites. Because of this rainy season in some of the sites, appropriate measures could not be taken.

3.8 Conclusions

The contour maps developed from the measured intensity by the PPM magnetometer tells us that, there is variation in magnetic anomalies present underneath the subsurface of the prescribed survey site. The red colour of the contour map shows high value of magnetic anomaly and the blue colour shows lower intensity of magnetic anomaly. These fluctuations in magnetic intensity are maybe due to some buried structure that is there underneath the subsurface. As during the geophysical survey any structure that can give the cultural noise has been taken care of; that is why, and this variation is solely due to some geological structures. The resulting large magnetic mass will give rise to large magnetic field gradients making the PPM readings somewhat less reliable. This problem of large magnetic field gradient can be overcome to some extent by raising the magnetometer probe. It may still be difficult to estimate the depth of burial. However, the boundaries of such a site can be located easily with the PPM. The magnitude and shape of an anomaly will depend on several considerations. For example, the direction of the induced dipole moment will

depend on the direction of the earth's magnetic field at the location of the buried object. This in turn will determine the shape of the magnetic field anomaly for a given traverse. The shape and magnitude of an anomaly can be further modified if the buried object has a permanent moment (i.e. magnetic moment in the absence of any applied magnetic field). For example, an anomaly will be greatly reduced if the permanent magnetic moment is of about the same magnitude but oppositely directed to the induced moment.

The detection of buried objects by a PPM depends on the anomaly arising from the magnetic contrast created by the different magnetic properties of the buried object and the surrounding medium. The object detected need not be ferromagnetic, although the detection is easier when such is the case. From the range of problems in the hazardous material spill area, we foresee the use of PPM mostly in the detection of buried ferromagnetic containers, pipelines, etc. One cannot overemphasize, however, that when applicable, the technique is one of the most reliable, sensitive, and cost-effective techniques available for the detection of buried containers. It is obvious that in any successful systematic approach toward the solution of a hazardous materials spill problem the use of more than one technique may not only be desirable but necessary.

4. VLF EM DATA PROCESSING AND ANALYSIS

VLF EM surveys were carried out at two sites, Site A was located about 800m WSW, whereas the Site B was located 5km away WSW of the blowout site. Multiple observations were made at the same site to detect any temporal variation in the recorded parameters.

4.1 Site A

Site Code	Name of the place	Distance to the Blow out site	Latitude	Longitude	Direction from the blow-out site
A	Baghjan oil field pathar	~800 m	27.5900340^0N	95.3765030^0E	WSW

Very Low Frequency (VLF) electromagnetic survey was carried out at site A, located about 800 west-southwest of the Baghjan well blow out site on 20/06/2020 to assess subsurface variability along with other geophysical parameters with multiple observations over the same site. This was the first survey for the proposed geophysical study. The survey was carried out using Gem System built VLF EM system.

4.1.1 Site Characteristic: Site A constituted alluvium soil, which received light rain shower about 3 hours before the survey. The site was already contaminated with oil condensate spills with about 30% of the vegetation, mainly wild grass, being burnt. An abandoned house hold build up was also present near the site. The condition was not optimum for VLF EM survey, however, to accrue time varying database the area was surveyed. Due to intermittent monsoon rain and paralyzed accessibility

due to precaution measures near the site, the selected site was found to be most suitable for survey operation.

4.1.2 Data acquisition: Data was collected from six profiles in the site with the first profile trending at an azimuth of 130^{O} SE. Spacing of 5 m was maintained; minimum profile length is 60m and again the profile spacing is 5 m too.

4.1.3 Processing: Data processing was carried out in Microsoft visual studio under Fortran environment. Initially, the data is segregated based on profile line and anomaly category. Thereafter, spline interpolation was carried out for smooth representation of the acquired information. It is observed that profile line 1, 3 and 5 holds better information. Figure 78, 79 and 80 presents the Real and Imaginary anomaly against the profile length for the three profiles. The output derived is further processed to apply KarousadHjelt (1983) filter to create subsurface pseudosection of real and imaginary components as shown in figure 81 and 82, respectively for the three profiles with an arrow pointing towards the well blowout site upto a depth of 10m.

4.1.4 Interpretation: The real and imaginary components show analogous variation with difference in total perception. Therefore, either of the real or imaginary pseudosection is considered valid for further study. However, for the sake of better elucidation both the pseudosections have been prepared. Considering the limits of the anomaly values, the profiles appear to show nearly conformant variation. However, current density variation could be factored by the prevalent anthropogenic activities involving sophisticated iron based equipments towards containing the fire. Inferences on pressure variation or alteration in subsurface characteristic can be made upon studying multiple data frames from the same site.

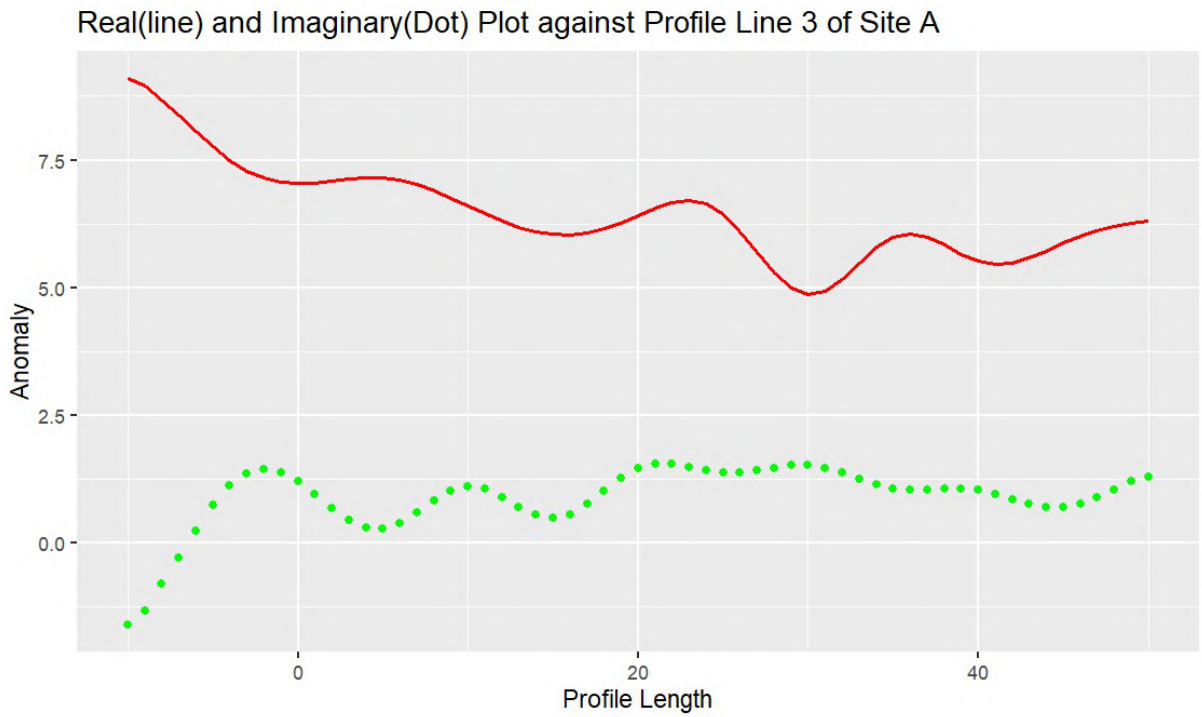


Figure 78: Real (line) and Imaginary (dot) anomaly recorded in percentage against profile line 1.

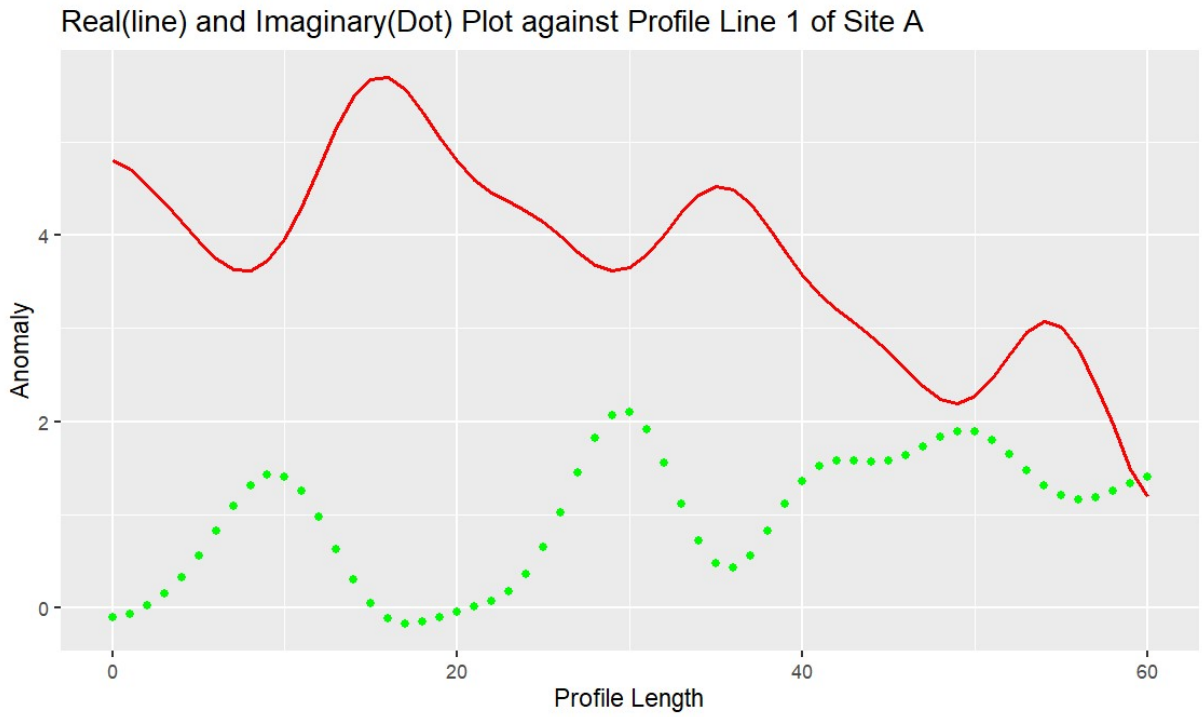


Figure 79: Real (line) and Imaginary (dot) anomaly recorded in percentage against profile line 3.

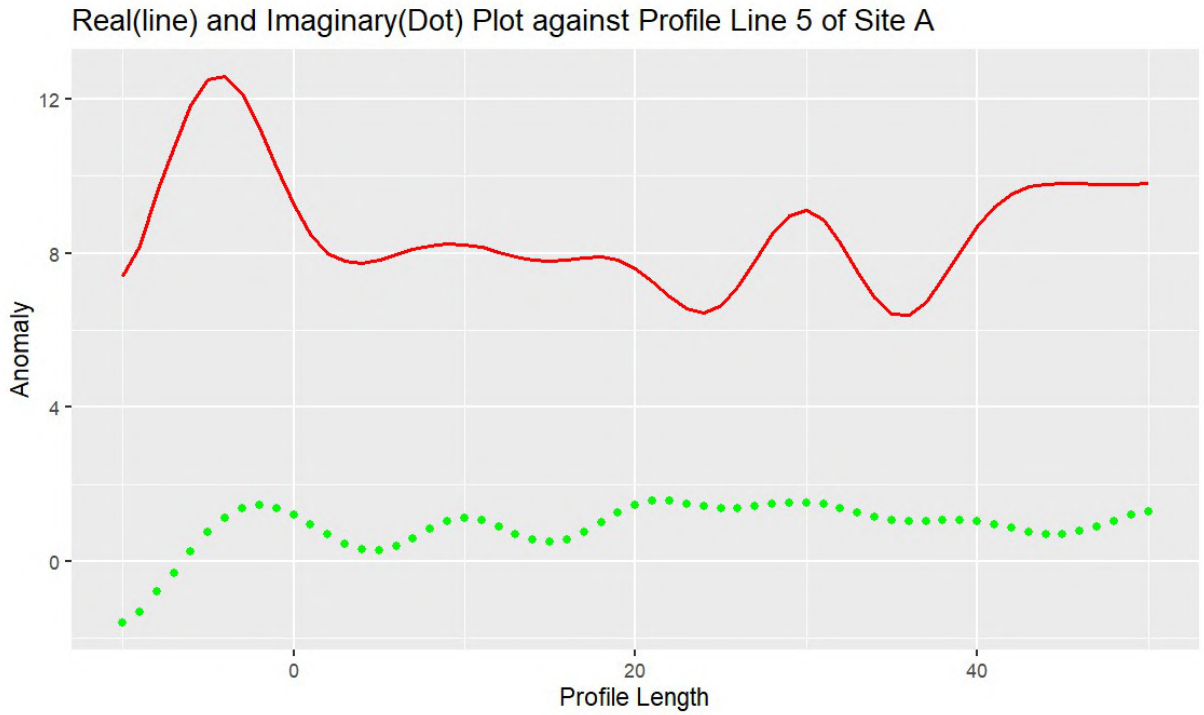


Figure 80: Real (line) and Imaginary (dot) anomaly recorded in percentage against profile line 5.

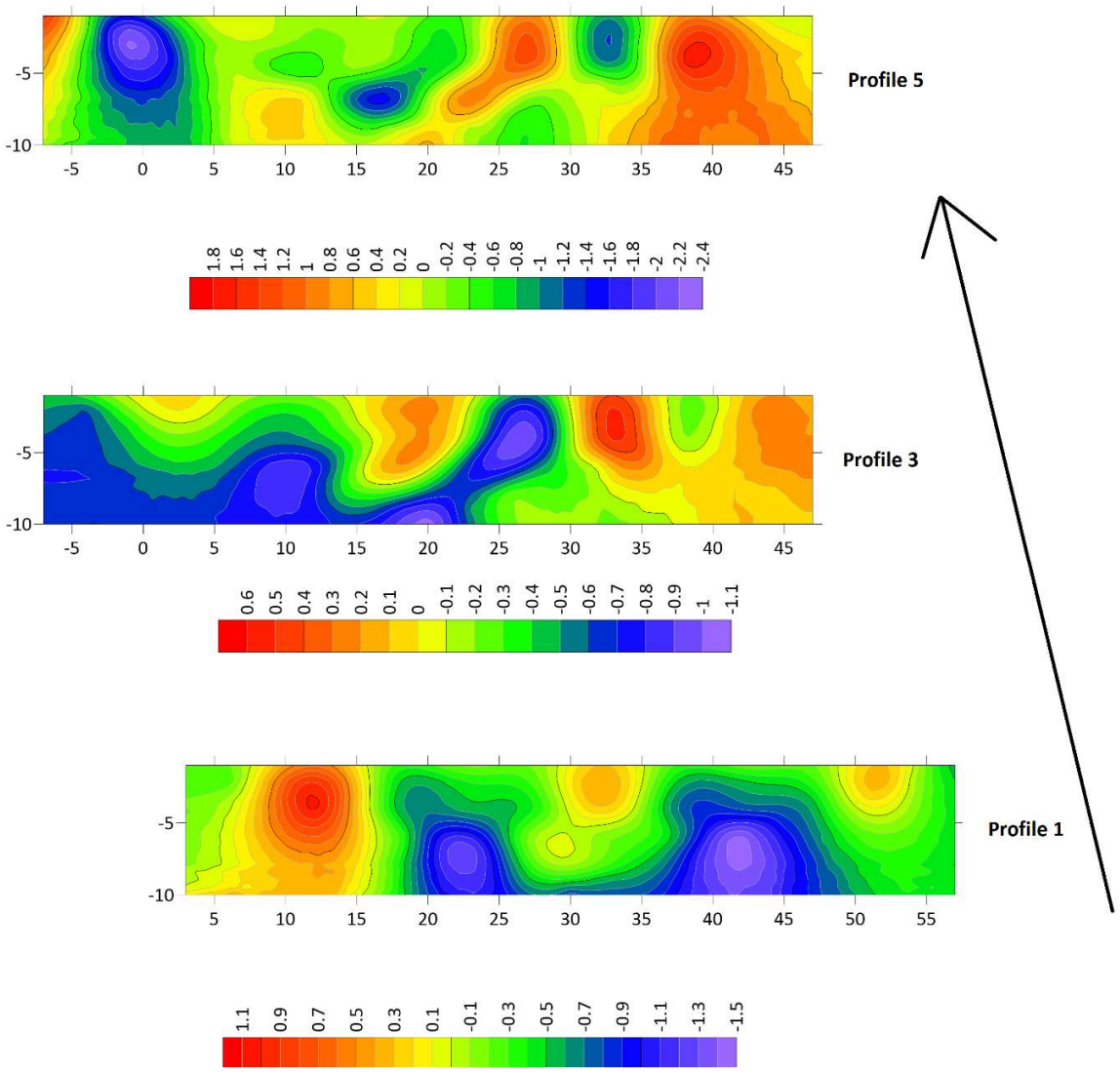


Figure 81. Pseudosection plots of real anomaly component of Profile 1, 3 and 5 respectively with the arrow facing towards the blowout site. The x axis represents profile length while the y axis represents depth and the contouring represent current density variation in %.

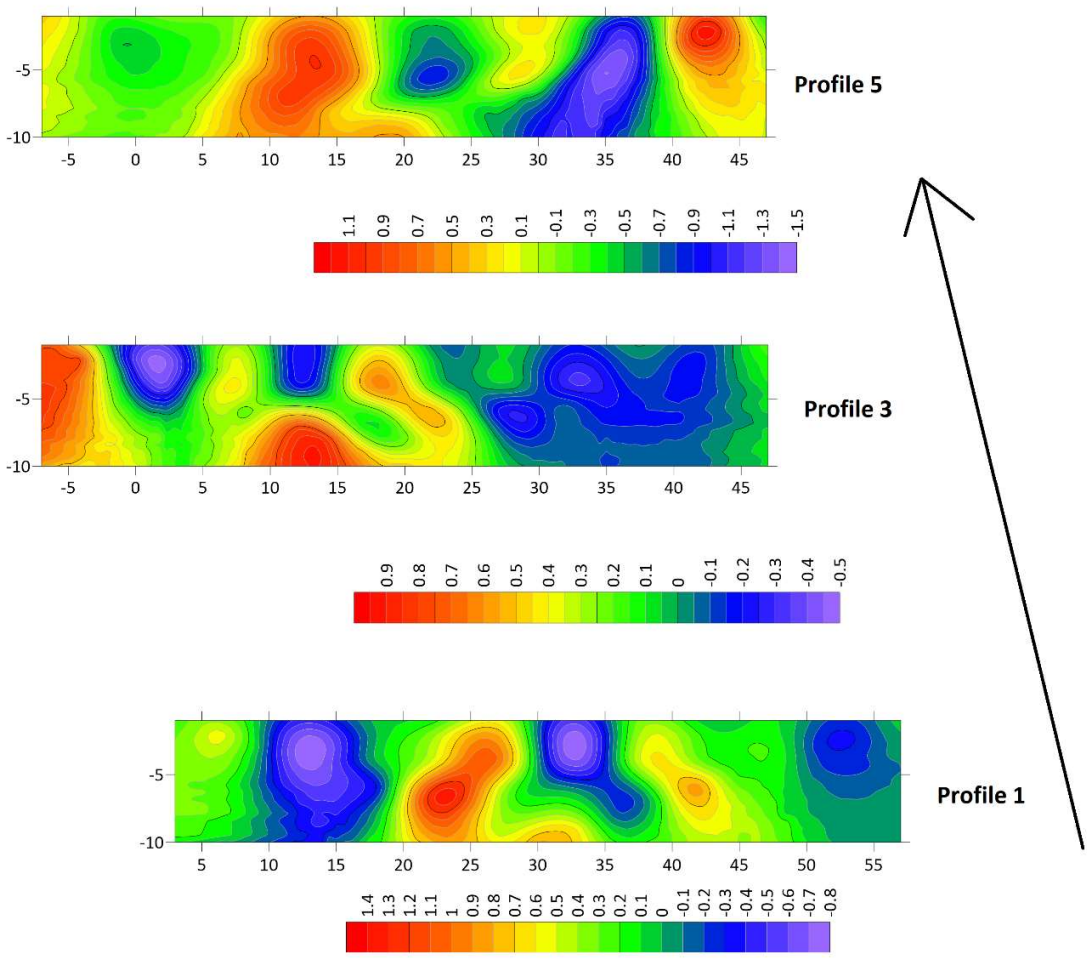


Figure 82. Pseudosection plots of imaginary anomaly component of Profile 1, 3 and 5 respectively with the arrow facing towards the blowout site. The x axis represents profile length while the y axis represents depth and the contouring represent current density variation in %.

4.2 Site B

Site Code	Name of the place	Distance to the Blow out site	Latitude	Longitude	Direction from the blow-out site
B	Guijan (bank of River Bibru)	~5km	27.5789690 °N	95.3592900 °E	WSW

Very Low Frequency (VLF) electromagnetic survey was carried out at site B, located about 5 km west-southwest of the Baghjan well blow out site on 21/06/2020, as a component of the first phase of geophysical study in and around Baghjan well blow out site, to assess subsurface variability along with other geophysical parameters with multiple observations over the same site. This was the first survey for the proposed geophysical study. The survey was carried out using Gem System built VLF EM system.

Site Characteristic: Site A constituted loosely compacted placer sand and silt deposits. Light rain shower occurred concurrently while acquiring data. The site was located at the bank of River Dibru which, considering the prevalent monsoon activities, was flowing with maximum water holding capacity. A turbulently flowing, small stream, traversed survey profile in the middle. The site also served as a port for riverine travel to DibruSaikhowa forest and therefore presence of ferry steamers and motor vehicles should be noted. The condition was not optimum for VLF EM survey, however, to accrue time varying database the area was surveyed. Due to intermittent monsoon rain and paralyzed accessibility considering precaution measures near the site, the selected site was found to be most suitable for survey operation.

Data acquisition: Data was collected from five profiles in the site with the first profile trending at an azimuth of 26° NE. Spacing of 5 m was maintained; minimum profile length is 60m and again the profile spacing is 5 m too.

Processing: Data processing was carried out in Microsoft visual studio under Fortran environment. Initially, the data is segregated based on profile line and anomaly category. Thereafter, spline interpolation was carried out for smooth representation of the acquired information. It is observed that profile line 1, 3 and 5 holds better information. Figure 83, 84 and 85 presents the Real and Imaginary anomaly against the profile length for the three profiles. The output derived is further processed to apply KarousadHjelt (1983) filter to create subsurface pseudosection of real and imaginary components as shown in figure 86 and 87, respectively for the three profiles with an arrow pointing towards the well blowout site upto a depth of 10m. Thereafter, the pseudosection and observed Real and Imaginary anomalies are plotted using Surfer and R.

Interpretation: The real and imaginary components show analogous variation as shown in Figure 84, however, with sectoral variation (Figure 83 and Figure 85). Based on observed anomalies, imaginary readings show better correlation with the site and adjacent profiles. However, for the sake of better elucidation both the pseudosections have been prepared. Considering the limits of the anomaly values, the profiles of imaginary pseudosections (Figure 87) presents a clear picture of underlying current density. The zones of higher current density appear to orient with the water stagnated, muddy, areas of the site. Further, current density variation could be factored by the prevalent anthropogenic activities emanating from the riverine port activities. Pseudosections of real anomaly readings present high limits which tend to distort the models. Inferences on pressure variation or alteration in subsurface characteristic can be made upon studying multiple data frames from the same site.

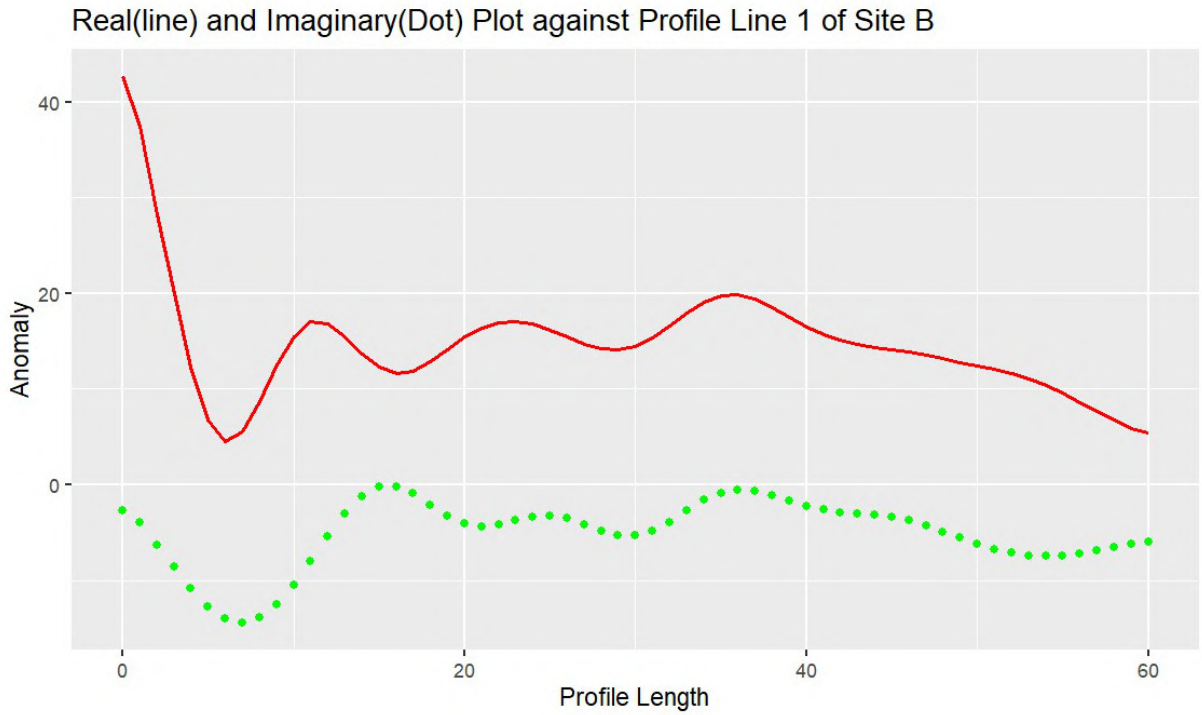


Figure 83. Real (line) and Imaginary (dot) anomaly recorded in percentage against profile line 1.

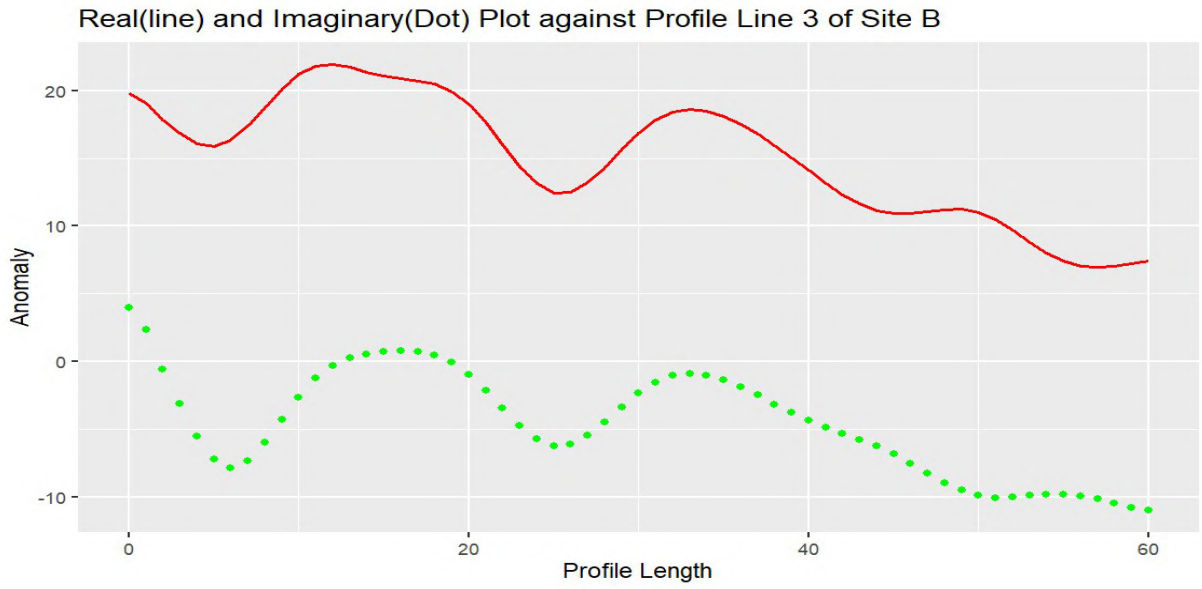


Figure 84. Real (line) and Imaginary (dot) anomaly recorded in percentage against profile line 3.

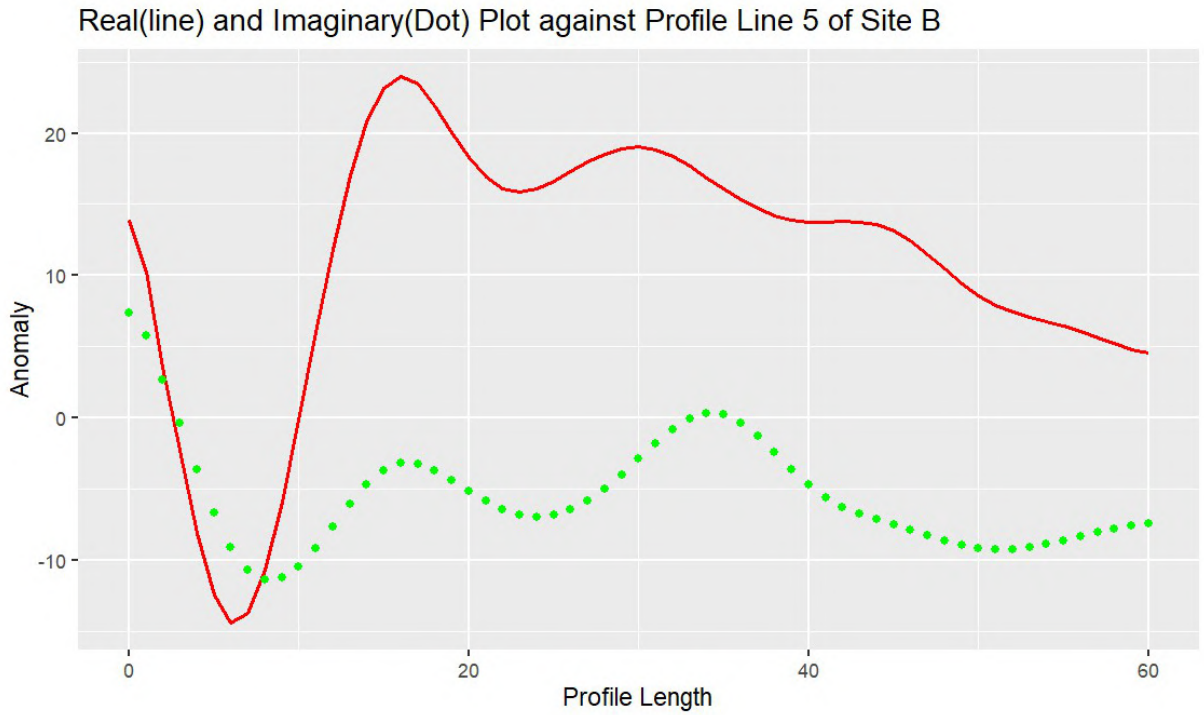


Figure 85. Real (line) and Imaginary (dot) anomaly recorded in percentage against profile line 5.

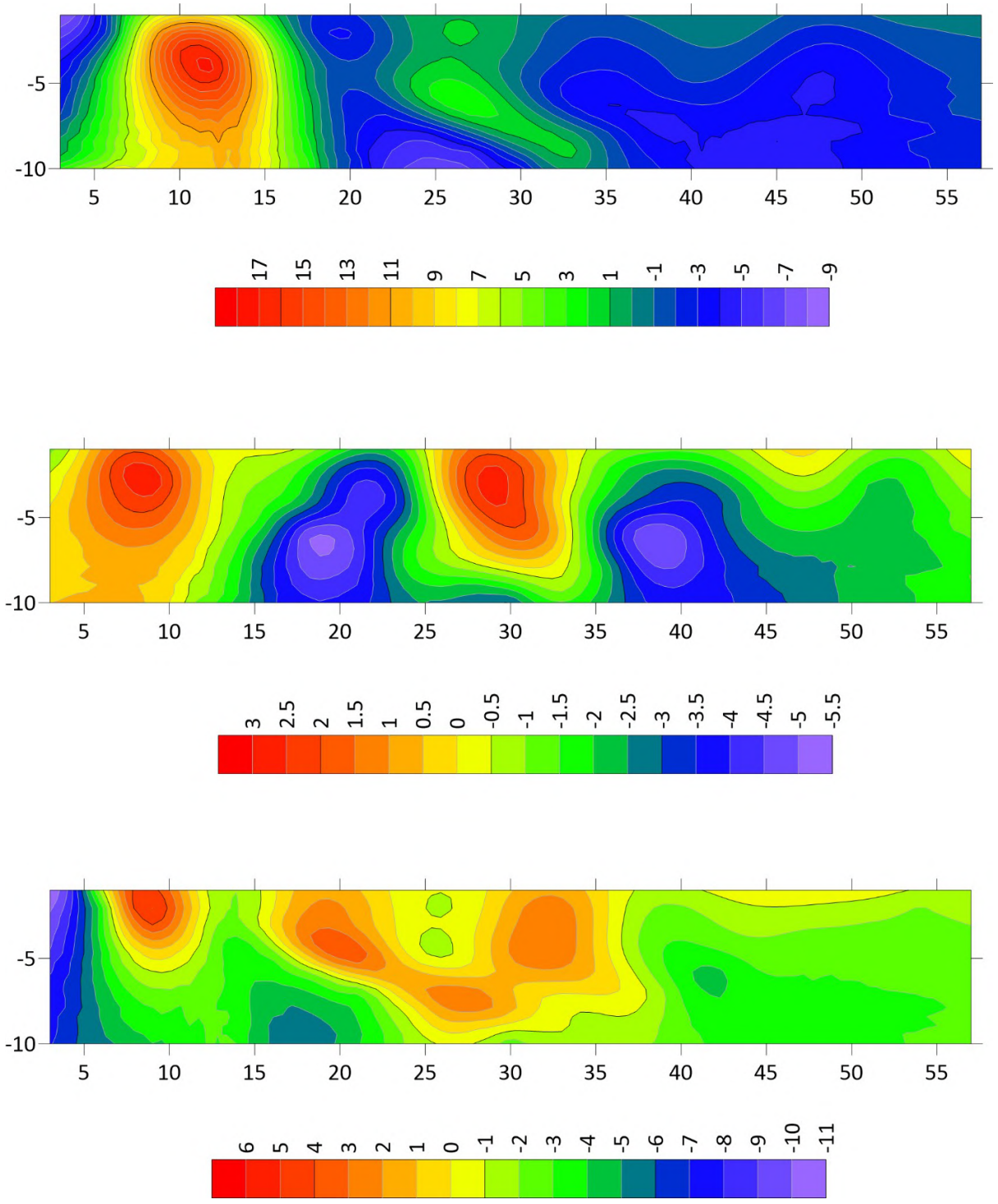


Figure 86. Pseudosection plots of real anomaly component of Profile 1, 3 and 5 from bottom to top, respectively. The x axis represents profile length while the y axis represents depth and the contouring represent current density variation in %.

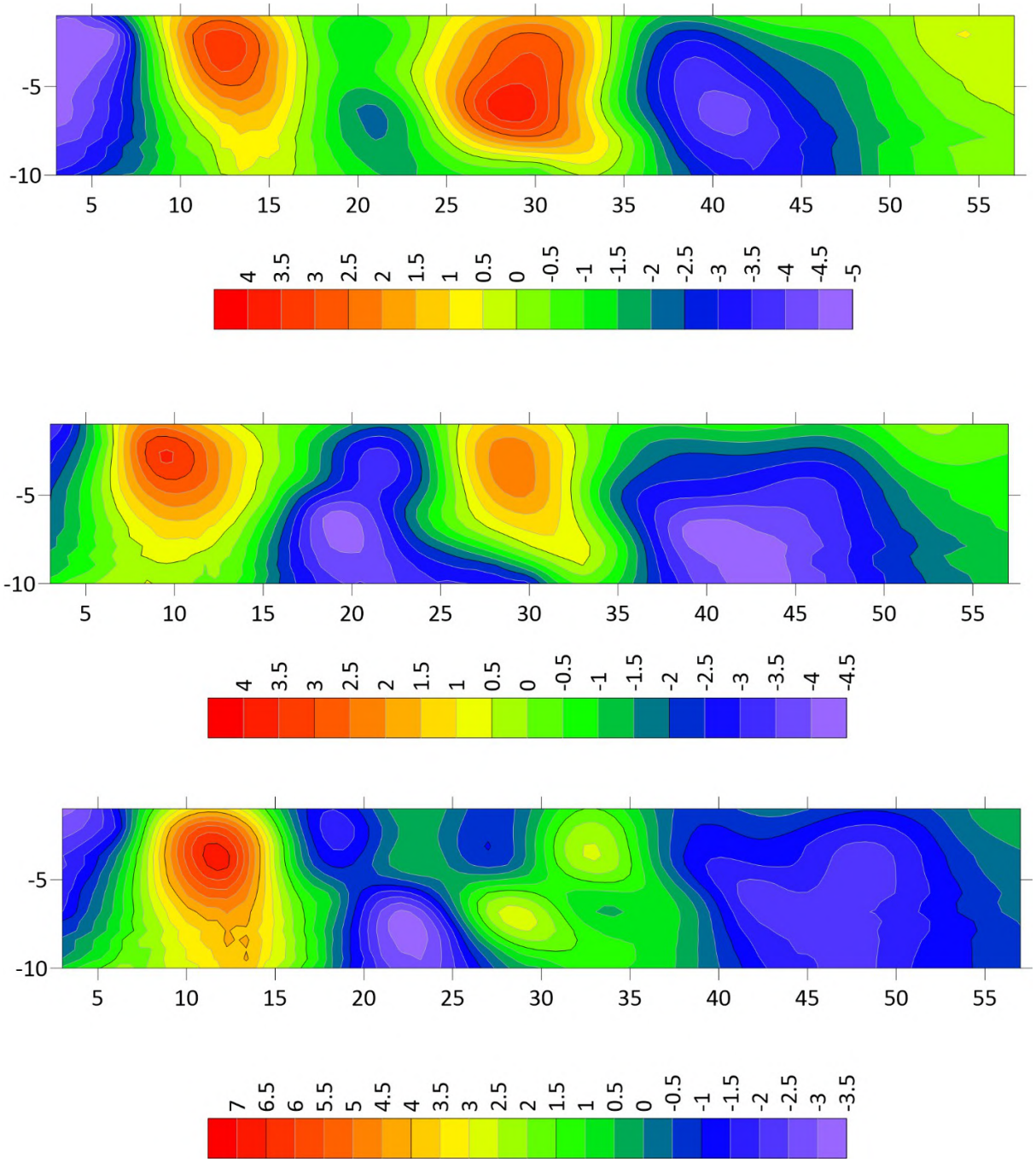


Figure 87. Pseudosection plots of imaginary anomaly component of Profile 1, 3 and 5 from bottom to top, respectively. The x axis represents profile length while the y axis represents depth and the contouring represent current density variation in %.

5. INVESTIGATION ON PROBABILITY OF OCCURRENCE OF FUTURE EARTHQUAKES IN AND AROUND BAGHJAN BLOW OUT SITE

5.1 INTRODUCTION

Seismic data for 90 years (1929-2020) are analyzed for probabilistic analysis towards risk assessment and forecast of next probable earthquake in the vicinity ($\geq$ 400 km) of Baghjan Blowout site, NE-India. The Kolmogorov-Smirnov statistics is applied to establish the recurrence time having the proper distribution for the earthquakes of magnitude Mw $\geq$ 3.0 in the vicinity ($\geq$ 400 km) of Blowout site at Baghjan, NE-India since 1929 to 2020. This particular study is an approach towards assessment of seismic hazard and probable future earthquake risk in which seismic recurrence time has been estimated in a probabilistic framework. The theory of probability can be applied in everyday life for assessment of risk and modeling based on the population with the specific distribution. The earthquake recurrence time for earthquakes in the investigation area indicate stationary condition. It is established that Weibull distribution satisfies the analysis and fits the observed recurrence time well to fit an appropriate time series model towards long term as well short term successful assessment of earthquake risk in the area. The earthquakes (Mw$\geq$3) and its recurrence time is represented in Figure 1. The seismic data accrued for the probabilistic analysis pertain to the earthquakes of magnitude Mw $\geq$ 3 for 90 years during the period 1st January, 1929 to 31st July, 2020. A catalogue is prepared from seismological bulletins of CSIR-NEIST, Jorhat, ISC, USGS, GEM. The fundamental assumption about earthquake catalogue, which is to be utilized for data analysis, should follow a stationary Poisson process and thus occurs independent of each other. The catalogue should consist only of main shocks, whereas fore- and aftershocks are rejected. We have adopted declustering method by Reasenberg which is governed by cluster method. After declustering of the database, we have used the maximum likelihood algorithm provided by ZMAP to

perform a Gutenberg-Richter regression. Here, the magnitude range of earthquakes catalog indicate relatively high magnitude of completeness (M_C = 4.7) for the region. Most of these data are carefully chosen that only the magnitude (Mw > 3.0) earthquakes are considered for the probabilistic analysis towards estimation a suitable time frame for the occurrence of next probable earthquake ,having Mw ≥ 3, in NE-India region. The magnitude (Mw) and depth (km) of the earthquakes during 1929-2020 which occurred in the vicinity within about 400 km radically from the Blowout site and the series of recurrence time of the earthquake is represented in Figure 88.

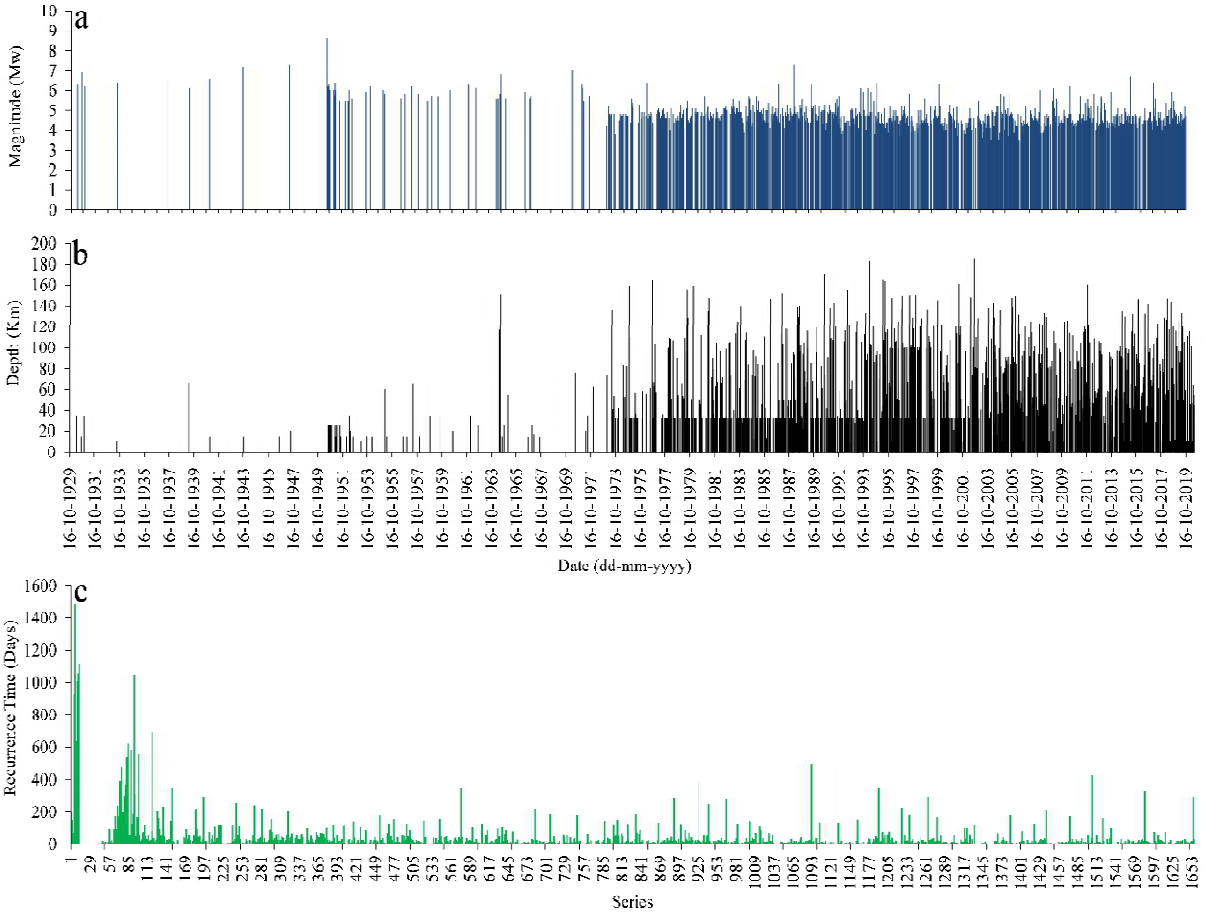


Figure 88. The plot illustrates the (a) magnitude (Mw) of the earthquakes, (b) depth of the earthquakes during 1929-2019 which occurred in the vicinity within about 400 km radically from the Blowout site and (c) series of recurrence time of the earthquakes in days.

5.2 RESULTS

Earthquakes in of Mw ≥ 3 for 90 years (1929 to 2020) are considered here for the probabilistic analysis and forecast from seismic recurrence time frame for next seismic risk within about 400 km from Baghjan Blowout site in NE, India region. The depth of the events are mostly shallower (74.6%) to intermediate (25.4%) earthquakes which ranged from 4 to 185 Km. Earthquake of minimum and maximum magnitude (Mw) observed is 3.4 and 8.6 respectively. In order to find the best fit among widely used distribution, Kolmogorov-Smirnov test statistics was applied to seismic recurrence time data of the earthquakes within about 400 km from the Baghjan Blowout, site. The calculated Kolmogorov-Smirnov test statistics and the best fits are listed rank wise in Table 1. It is observed that the Weibull distribution fits best for earthquake data set utilized (Figure 89). The parameters of α (continuous scale parameter) and β (continuous shape parameter) estimated using maximum likelihood estimation (MLE) are 16.25, 0.63 respectively. Substituting the values of α and β in equation (1) below, the earthquake data set are best modeled by Weibull Distribution as follows (equation (2)):

$$f(t;\alpha,\beta) = \beta\,\alpha^{-\beta} t^{\beta-1} exp(-\alpha^{-\beta} t^{\beta}) \;.\; 0 < t < \infty,\ \alpha > 0,\ \beta > 0 \qquad (1)$$

$$f(t;\alpha,\beta) = (0.63)(16.25)^{0.63} t^{(0.63-1)} exp(-16.25^{-0.63} t^{0.63}) \qquad (2)$$

It is observed that by applying Dickey Fuller statistic to the time series of recurrence time, it is estimated as alpha=0.05, p value 0.01 during 1929-2020. The computed p-value as observed to be lower than the significance level alpha=0.05, we discard the null hypothesis and accept the hypothesis that there is no unit root for the series and the series is stationary. The mean occurrence period $E(t)$ is estimated using equation (3) as below

$$E(t) = \alpha\ \Gamma(1 + 1/\beta) \qquad 16.25,\ 0.63\ \ 2.587 \qquad (3)$$

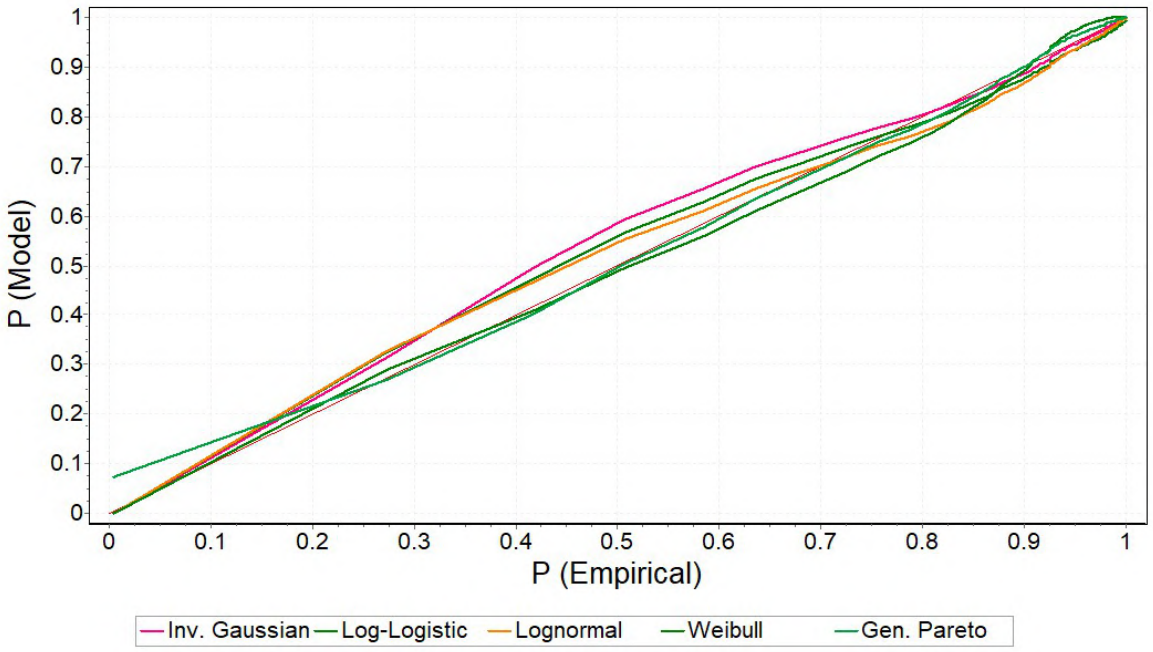


Figure 89: Plot showing the analyzed probability function of some of the widespread distributions which are considered in general to have the best fit nature for analysis of random phenomena. It is discernible that Weibull distribution has the best fit for the earthquake data set.

Table 12: Kolmogorov- Smirnov test statistics calculated values for establishment of the proper distribution for the earthquake data:

Rank	Distribution	Kolmogorov Smirnov Statistic
1	Weibull	0.04591
2	Lognormal	0.05839
3	Log-Logistic	0.05926
4	Gen. Pareto	0.07366
5	Inv. Gaussian	0.08889

The mean occurrence period (E(t)) is estimated to be 23 days for earthquake with Mw ≥ 3.0 within about 400 km radially from Baghjan blowout site and is represented in cumulative distribution

function graph (Figure 90). Similarly, while estimating the mean occurrence period $E(t)$ the cumulative probability function indicate a time period of 23 days with 40% probability for an earthquake of Mw ≥3.0 to recur following the occurrence of last earthquake within about 400 km radically from Baghjan Blowout site. Alternatively, 125 days to 250 days of recurrence time period is observed with >90% probability respectively for an earthquake of Mw ≥ 3.0 to recur following the occurrence of last earthquake (Figure 90). The validation of these estimates is constrained by estimation of reliability function. The reliability function graph (Figure 91) indicate the probability of occurrence of an earthquake having magnitude Mw ≥ 3 within about 400 km radically from Baghjan Blowout site in an interval of "*t*" days after the occurrence of last earthquake having magnitude Mw ≥ 3.0 within about 400 km radically from Baghjan Blowout site.

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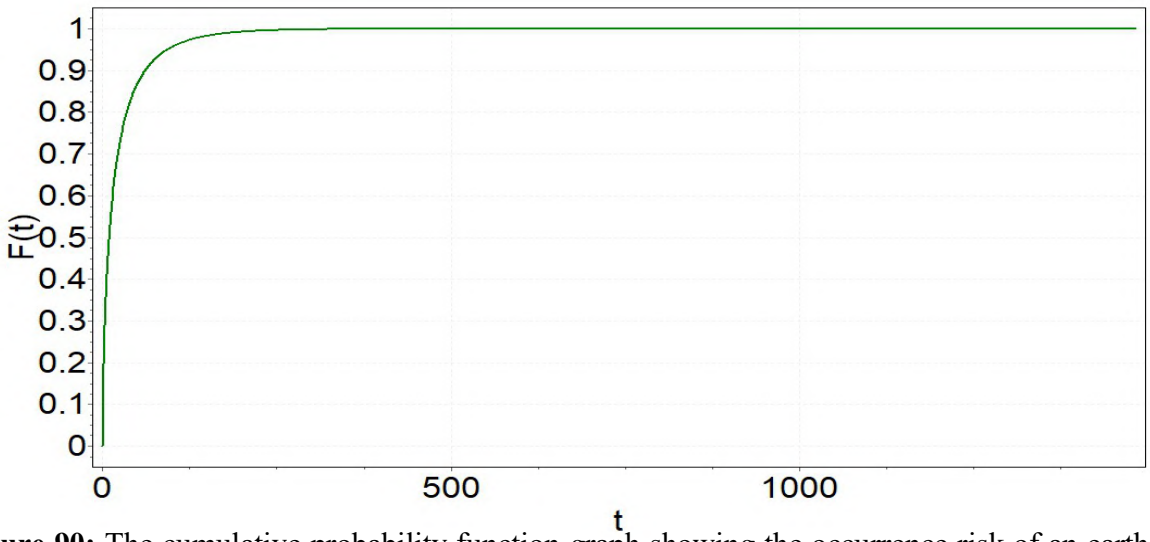


Figure 90: The cumulative probability function graph showing the occurrence risk of an earthquake with Mw ≥ 3 within about 400 km radically from Baghjan Blowout site. The probability that an earthquake (Mw ≥ 3) to occur preceding the last earthquake within about 400 km radically from Baghjan Blowout site with Mw~3 or above in 125 days is estimated to be 90%.

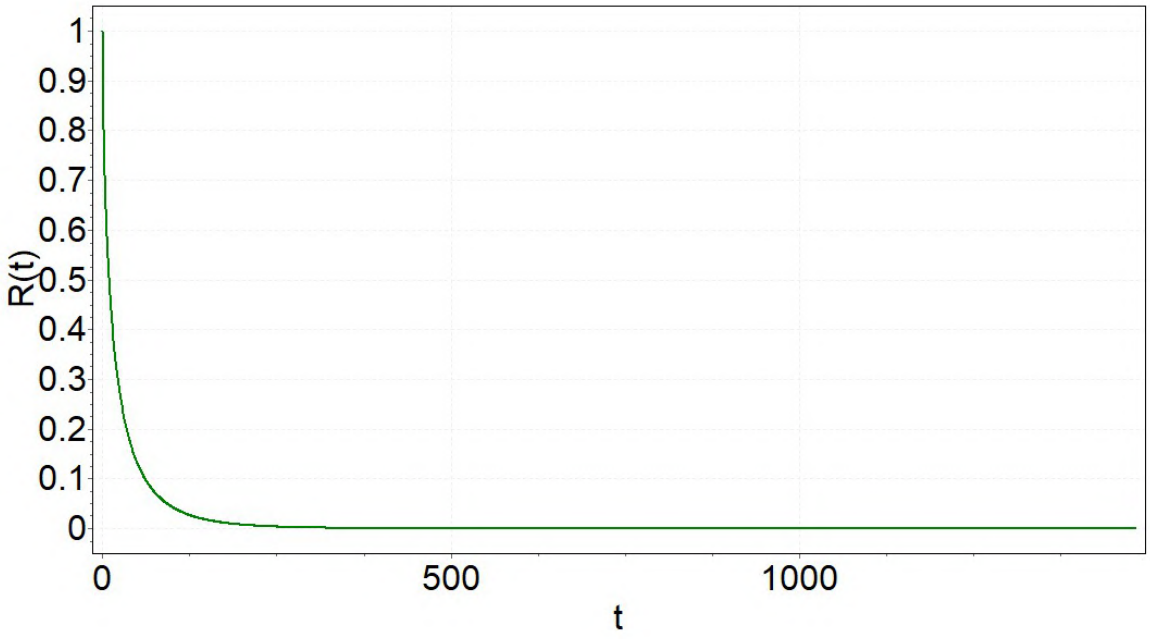


Figure 91: The plot showing the reliabilty function (*R(t)*) graph for earthquake within about 400 km radically from Baghjan Blowout site.

Moreover, 25 days to 100 days of recurrence time period is observed with 85- 100% probability respectively for an earthquake of $3 \leq Mw < 5.0$ to recur following the occurrence of last earthquake within 400 km radically from the Baghjan Blowout, site (Figure 92). Similarly, 125 days to 500 days of recurrence time period is observed with 75 – 90 % probability respectively for an earthquake of $Mw \geq 5.0$ to recur following the occurrence of last earthquake within 400 km radically from the Baghjan Blowout, site (Figure 93). This clearly discern that the occurrence period of earthquakes of $Mw \geq 5$ is longer than $3 \leq Mw < 5$. Furthermore, 100 days to 600 days of recurrence time period is observed with 55- 100% probability respectively for an earthquake of $3 \leq Mw < 5.0$ to recur following the occurrence of last earthquake within 200 km radically from the Baghjan Blowout, site (Figure 94). Similarly, 125 days to 1000 days of recurrence time period is observed with 65 – 90 % probability respectively for an earthquake of $Mw \geq 5.0$ to recur following the occurrence of last earthquake within 400 km radically from the Baghjan Blowout, site (Figure 95).

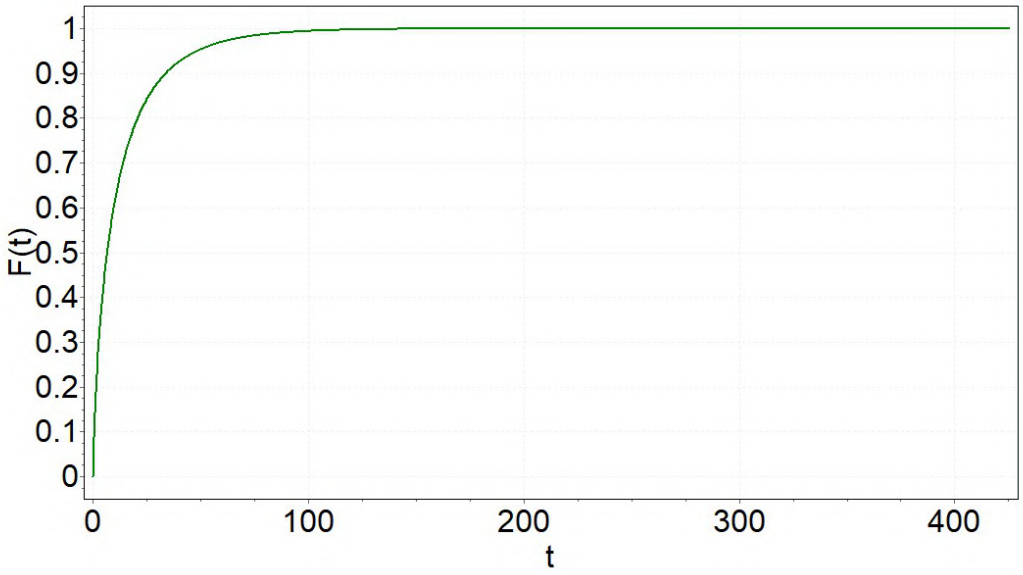


Figure 92: The cumulative probability function graph showing the occurrence risk of an earthquake with 3 ≤ Mw < 5 within about 400 km radically from Baghjan Blowout site. The probability that an earthquake (3 ≤ Mw < 5) to occur preceding the last earthquake within about 400 km radically from Baghjan Blowout site with 3 ≤ Mw <5 in 25 days is estimated to be 85%.

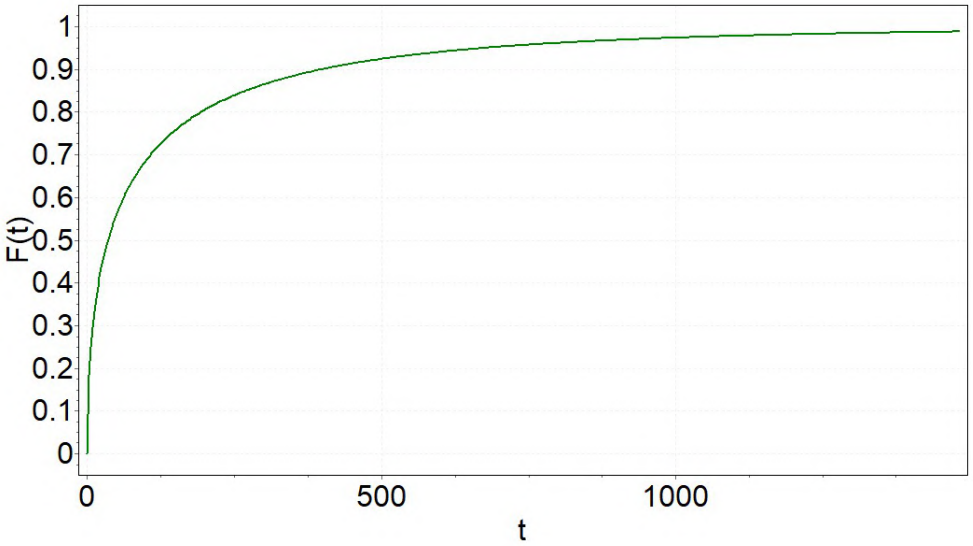


Figure 93: The cumulative probability function graph showing the occurrence risk of an earthquake with Mw ≥ 5 within about 400 km radically from Baghjan Blowout site. The probability that an earthquake (Mw ≥ 5) to occur preceding the last earthquake within about 400 km radically from Baghjan Blowout site with Mw ≥ 5 in 125 days is estimated to be 75%.

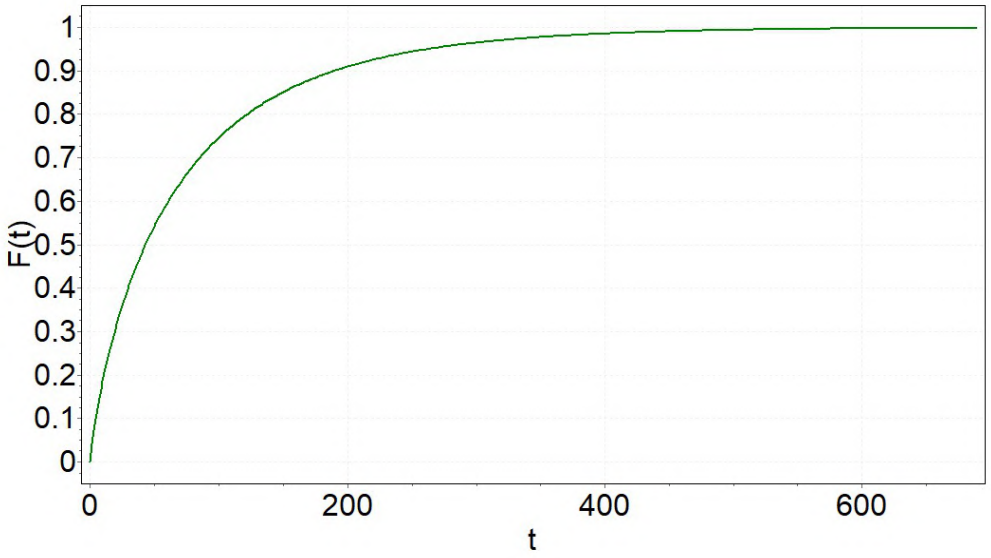


Figure 94: The cumulative probability function graph showing the occurrence risk of an earthquake with 3 ≤ Mw < 5 within about 200 km radically from Baghjan Blowout site. The probability that an earthquake (3 ≤ Mw < 5) to occur preceding the last earthquake within about 200 km radically from Baghjan Blowout site with 3 ≤ Mw <5 in 100 days is estimated to be 55%.

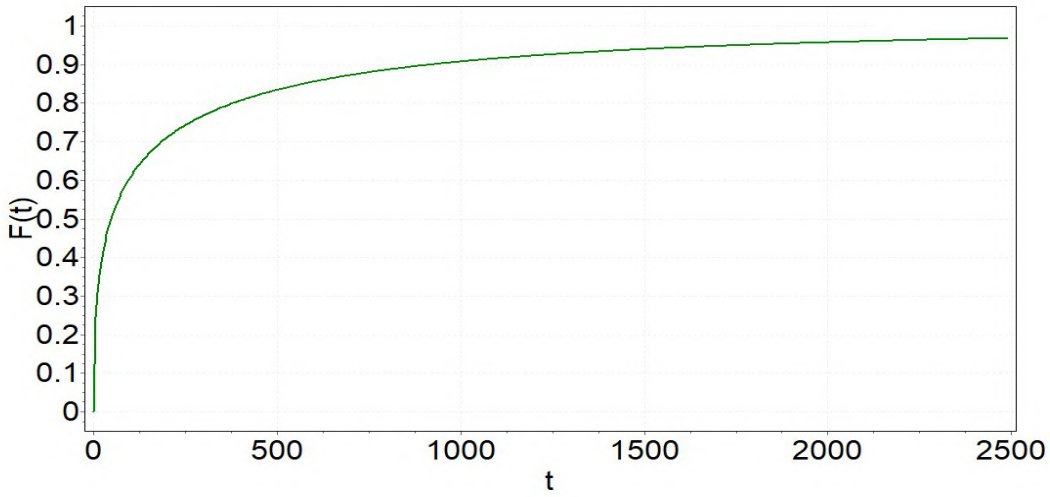


Figure 95: The cumulative probability function graph showing the occurrence risk of an earthquake with Mw ≥ 5 within about 200 km radically from Baghjan Blowout site. The probability that an earthquake (Mw ≥ 5) to occur preceding the last earthquake within about 200 km radically from Baghjan Blowout site with Mw ≥ 5 in 125 days is estimated to be 65%.

It is observed that there were only 18 earthquakes of 3 ≤ Mw. The minimum and maximum magnitude (Mw) earthquake observed is 3.7 and 6.2 respectively. Recurrence time of 2000 days to 4500 days of recurrence time period is observed with 75 – 90 % probability respectively for an

earthquake of Mw $\geq$ 3.0 to recur following the occurrence of last earthquake within 400 km radically from the Baghjan Blowout, site (Figure 96). The region within about 100 km radically from Baghjan Blowout site was found to be the least risky.

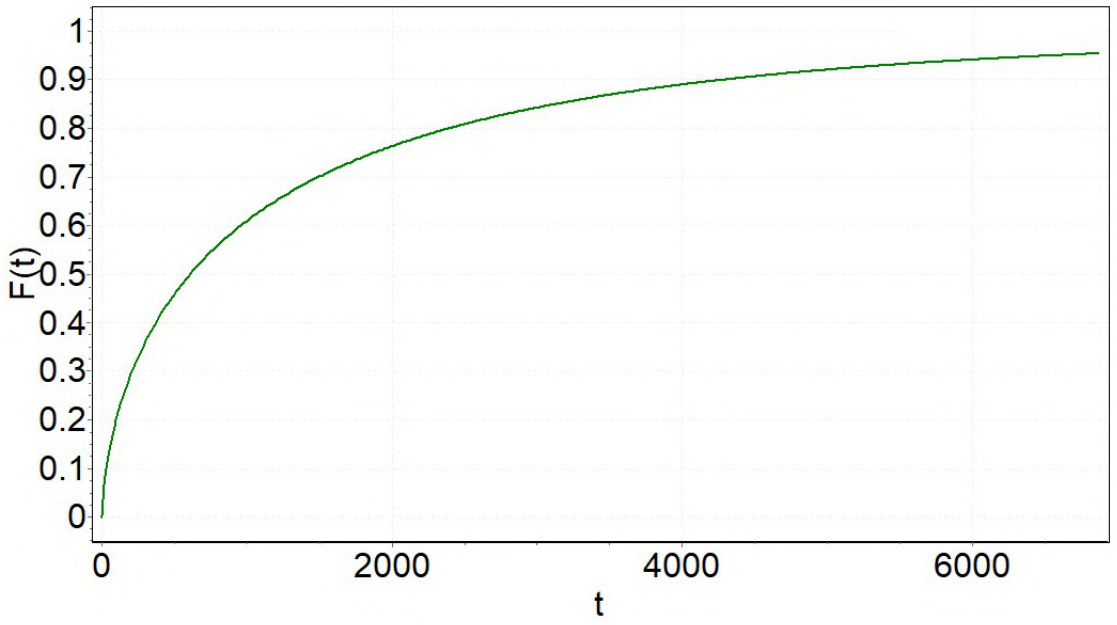


Figure 96: The cumulative probability function graph showing the occurrence risk of an earthquake with Mw $\geq$ 3 within about 100 km radically from Baghjan Blowout site. The probability that an earthquake (Mw $\geq$ 3) to occur preceding the last earthquake within about 100 km radically from Baghjan Blowout site with Mw $\geq$ 3 in 2000 days is estimated to be 75%.

III. Strong Motion Acclerograph

1. Introduction:

A strong motion Accelerograph (SMA) instrument have been installed at Baghjan, Assam on 20/06/2020, to observed seismic activities of that site. At first SMA instrument installed at EPS (Early production setup) site of Baghjan of latitude 27.36 N and longitude 95.24 E. SMA recorded ground motion data for the period of 20/06/2020 to 27/06/2020 at EPS site. Later the SMA instrument shifted to different site of latitude 27.6 N and longtitude 95.40 E on 27/06/2020, which is located an around of 200 m away from the early site. Ground motion data recorded at new site from 27/06/2020 to 21/07/2020.

2. Methodology

The SMA instrument records ground motion or seismic activities. The seismic records recorded by the SMA instrument are collected for the study area.Seismic records collected are observed keenly to study the seismic activities of the region. The local earthquake events occurred in the region are extracted for processing. The acceleration time histories of local events occurred in Baghjan are used for estimation of various ground motion parameters e.g PGA, PGV, PGD etc.

3. Details of strong ground motion parameters of local earthquakes

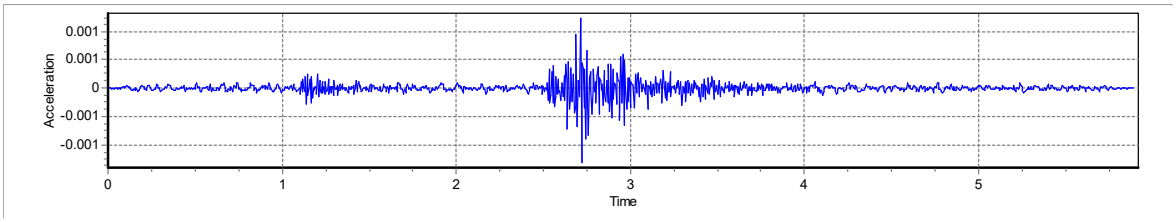
Table 13: List of earthquakes recorded by the SMA

Serial No.	Date	Time (UST)	P arrival (second)	S arrival (second)	S-P (second)	Coda (TIME)
1	21-06-2020	5:49:21	5:49:21.90	5:49:22.55	0.65 s	5:49:24.6
2	21-06-2020	09:15:42.05	09:15:42.15	9:15:42.76	0.61 s	9:15:44.9
3	21-06-2020	09:16:18.2	09:16:18.32	09:16:18.92	0.60 s	09:16:20.4
4	21-06-2020	09:32:51	09:32:51.52	09:32:51.86	0.34 s	09:32:52.95
5	21-06-2020	11:15:54.81	11:15:54.81	11:15:55.29	0.48 s	11:15:57.1
6	21-06-2020	11:28:20.5	11:28:20.51	11:28:21.13	0.62 s	11:28:21.9
7	22-06-2020	8:41:51	8:41:51.65	8:41:53.31	1.66 s	8:41:55.5
8	22-06-2020	9:42:14	9:42:14.32	9:42:15.18	0.86 s	9:42:16.4
9	23-06-2020	8:48:11	8:48:12.1	8:48:13.54	1.44 s	8:48:14.9
10	23-06-2020	09:32:28	9:32:28.22	9:32:29.34	1.12 s	9:32:30.6
11	26-06-2020	08:08:34	8:08:34.15	8:08:34.62	0.47 s	08:08:35.5
12	26-06-2020	10:06:2.20	10:06:02.19	10:06:02.95	0.76 s	10:06:04.4
13	01-07-2020	10:33:27	10:33:27.94	10:33:28.86	0.92 s	10:33:29.45
14	02-07-2020	02:03:16	02:03:16.45	02:03:16.86	0.41	02:03:17.21
15	05-07-2020	06:03:17	06:03:17.73	06:03:18.48	0.75	06:03:19.51
16	10-07-2020	15:49:17	15:49:17.76	15:49:18.12	0.36	15:49:19.15
17	11-07-2020	17:38:54	17:38:54.01	17:38:54.39	0.38	17:38:54.94
18	11-07-2020	12:13:13	12:13:13.29	12:13:14	0.71	12:13:14.75
19	18-07-2020	14:10:55	14:10:55.oo	14:10:55.75	0.75	14:10:55.56.77

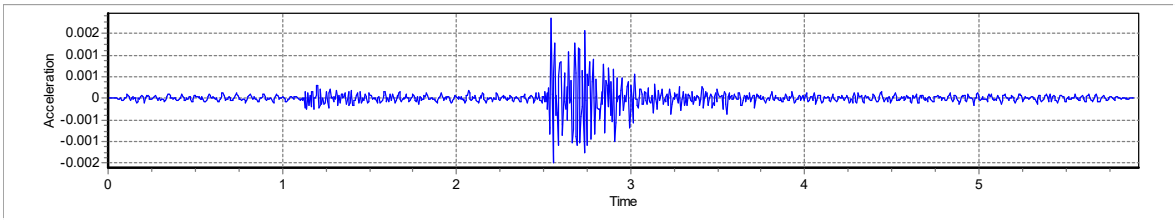
The ground motion parameters of a few local events recorded by accelerometer in the Baghjan area are given below:

i. Date: 23/06/2020 Time: 08:48:11.00 GMT

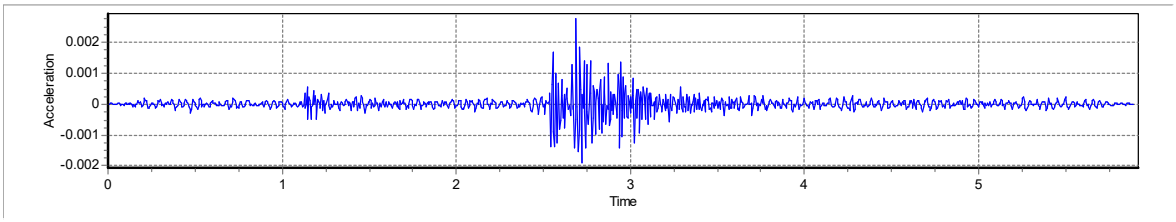
EW



NS



VT



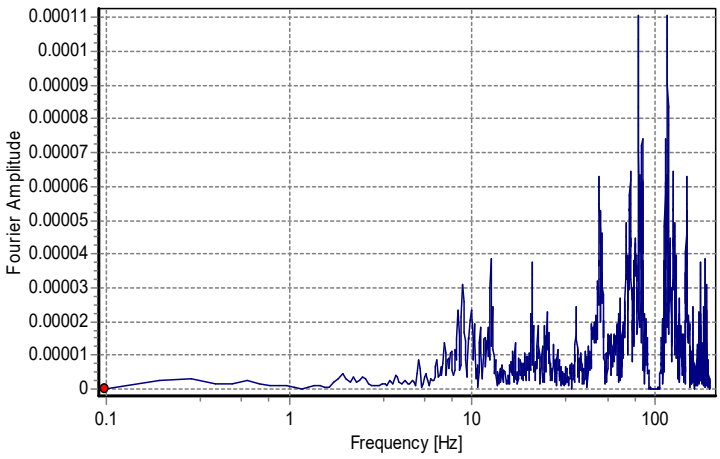


Fig. 97: Fourier amplitude spectra of EW component

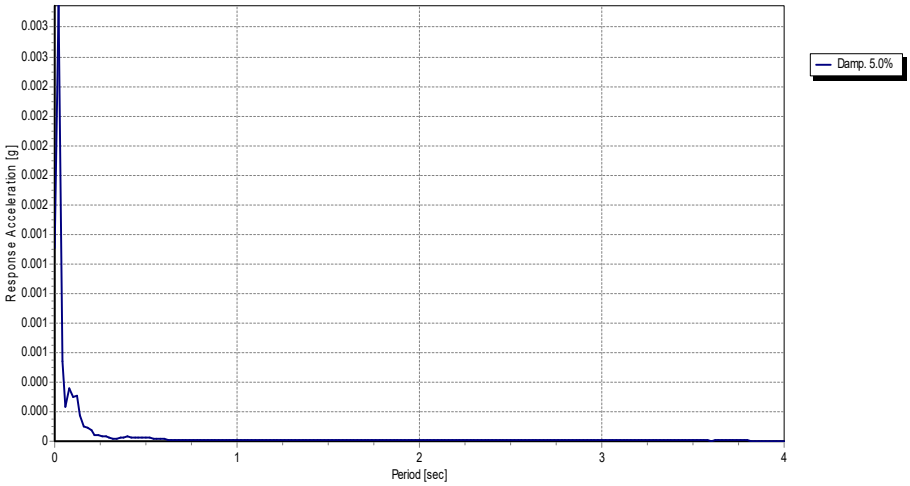
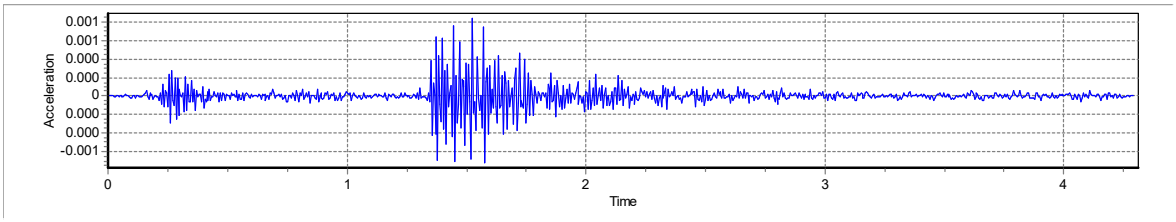


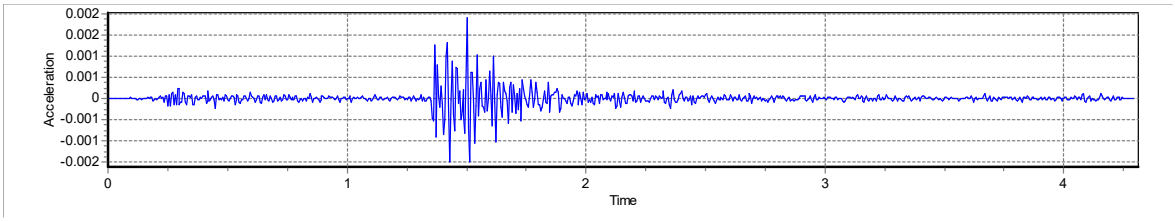
Fig. 98: Response spectra of the EW component at 5% damping

ii. Date: 23/06/2020 Time: 09:32:27.00 GMT

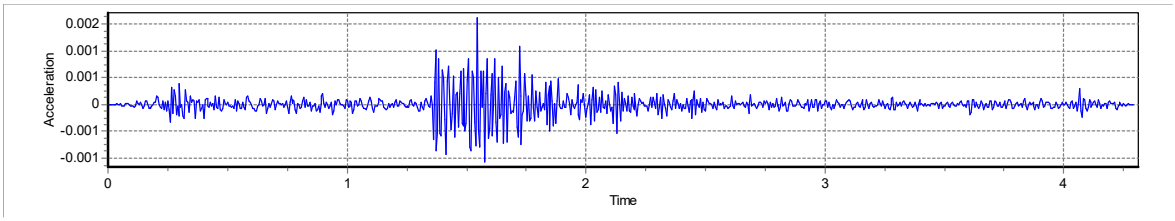
EW



NS



VT



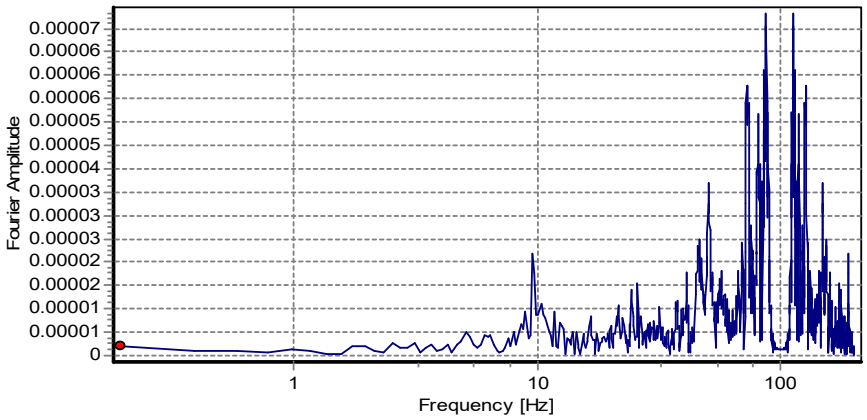


Fig. 99: Fourier amplitude spectra of EW component

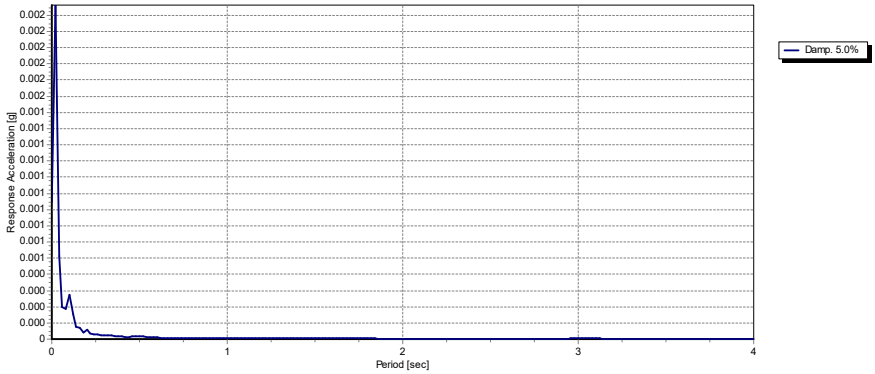


Fig. 100: Response spectra of the EW component at 5% damping

Table 14. Ground motion parameters of the three components of the two above earthquakes

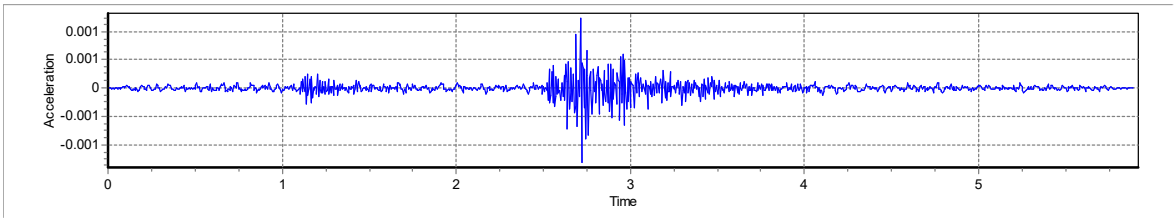
Ground Motion Parameters	EW 08:48:11	NS 08:48:11	VT 08:48:11	EW 09:32:27	NS 09:32:27	VT 09:32:27
Max Acceleration (g)	0.0013	0.00185	0.00277	0.00085	0.0019	0.00163
Max Velocity (cm/sec)	0.00303	0.00551	0.00662	0.00277	0.00562	0.00353
Max Displacement (cm)	0.00466	0.00183	0.00388	0.00349	0.00128	0.00146
Vmax/Amax (sec)	0.00237	0.00304	0.00244	0.00334	0.00301	0.00221
Acceleration RMS (g)	0.00012	0.0002	0.00027	0.00012	0.0002	0.0002
Velocity RMS (cm/sec)	0.00104	0.00093	0.00119	0.001	0.00079	0.00072
Displacement RMS (cm)	0.00247	0.00124	0.00167	0.00196	0.00057	0.00073
Arias Intensity (m/sec)	0	0	0.00001	0	0	0
Characteristic Intensity	0	0.00001	0.00001	0	0.00001	0.00001
Specific Energy Density (cm2/sec)	0.00001	0.00001	0.00001	0	0	0
Cum. Abs. Velocity (cm/sec)	0.35969	0.55009	0.81045	0.24764	0.3656	0.47329
Acc Spectrum Intensity	0.00003	0.00004	0.00002	0.00002	0.00003	0.00002

(g*sec)						
Vel Spectrum Intensity (cm)	0.00669	0.01327	0.0156	0.00501	0.01265	0.0087
Housner Intensity (cm)	0.00372	0.00386	0.00256	0.00234	0.0021	0.00233
Sustained Max.Acceleration (g)	0.00036	0.00101	0.0014	0.0003	0.00024	0.00102
Sustained Max.Velocity (cm/sec)	0.00235	0.00314	0.00448	0.00226	0.00157	0.00242
Effective Design Acceleration (g)	0.00004	0.00008	0.00004	0.00002	0.00005	0.00003
A95 parameter (g)	0.0013	0.00185	0.00276	0.00084	0.0019	0.00162
Predominant Period (sec)	0.02	0.02	0.02	0.02	0.02	0.02

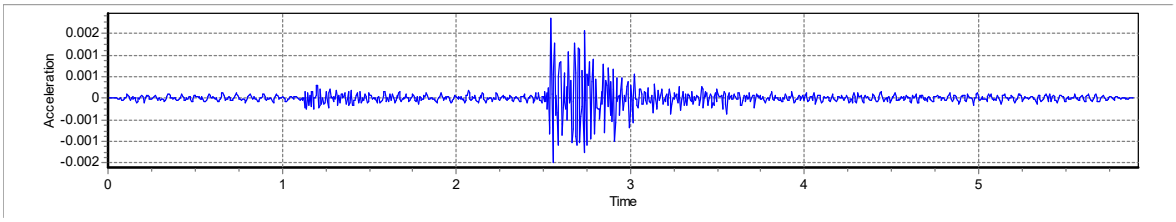
The maximum peak ground acceleration (PGA) is 0.0027 g for a local earthquake occurred on 23.06.2020. The other parameters of the ground motion are given in table-2.

iii. Date: 23/06/2020 Time: 08:48:11.00 GMT

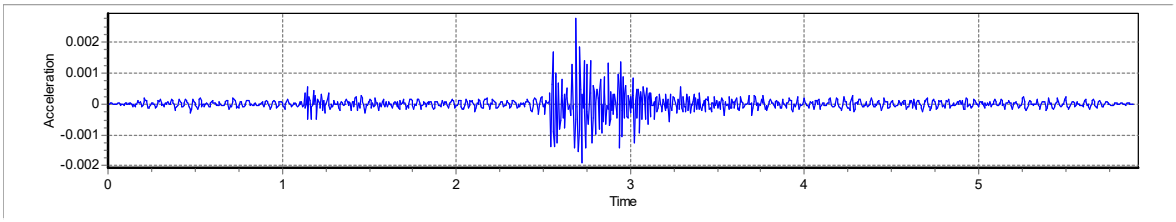
EW



NS



VT



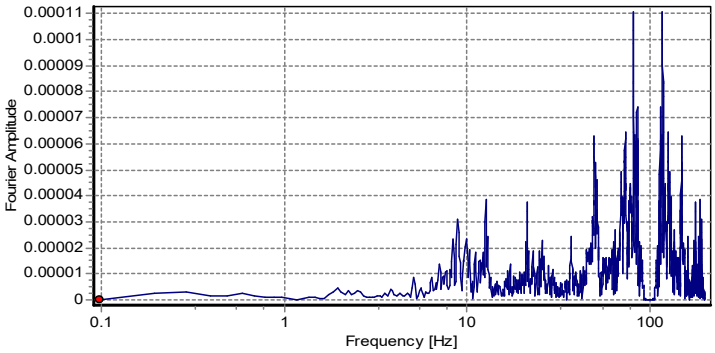


Fig. 101: Fourier amplitude spectra of EW component

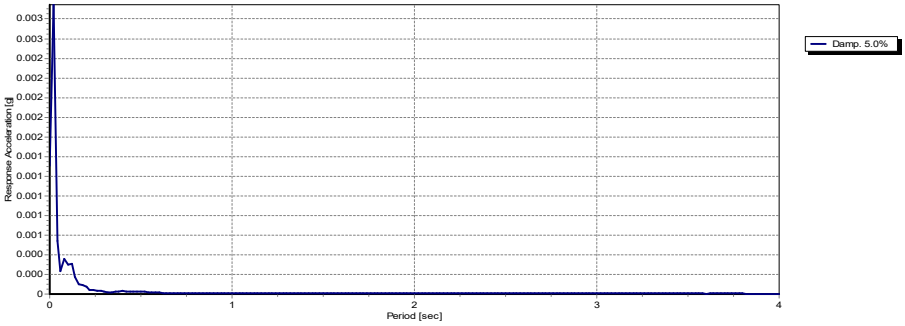
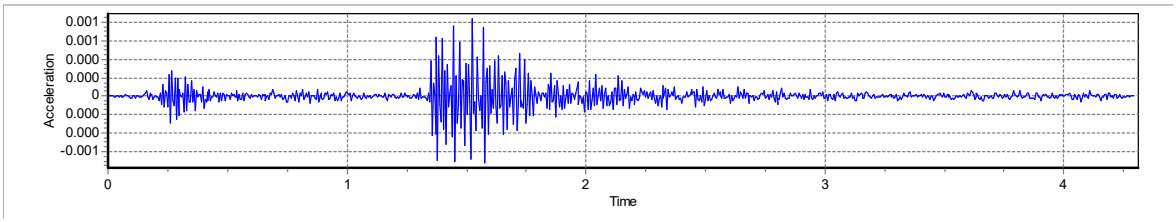


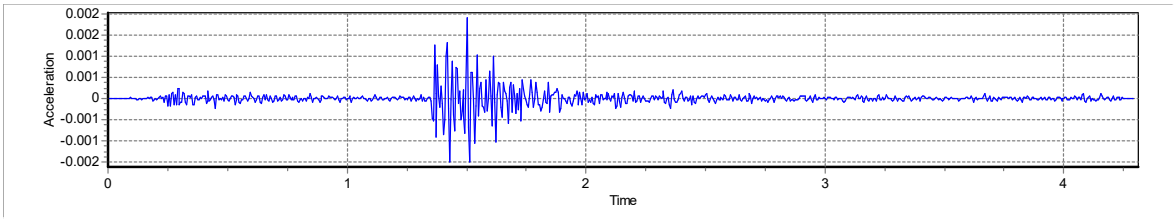
Fig. 102: Response spectra of the EW component at 5% damping

iv. Date: 23/06/2020 Time: 09:32:27.00 GMT

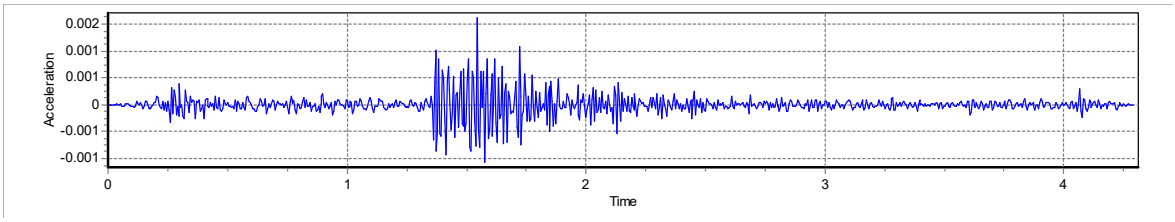
EW



NS



VT



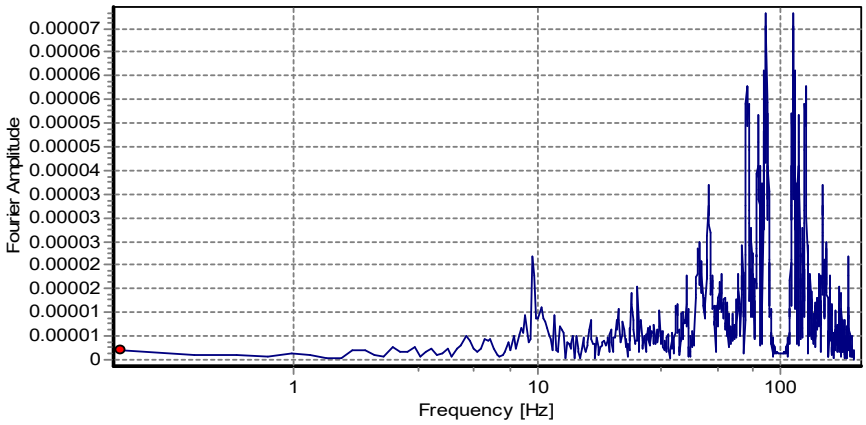


Fig. 103: Fourier amplitude spectra of EW component

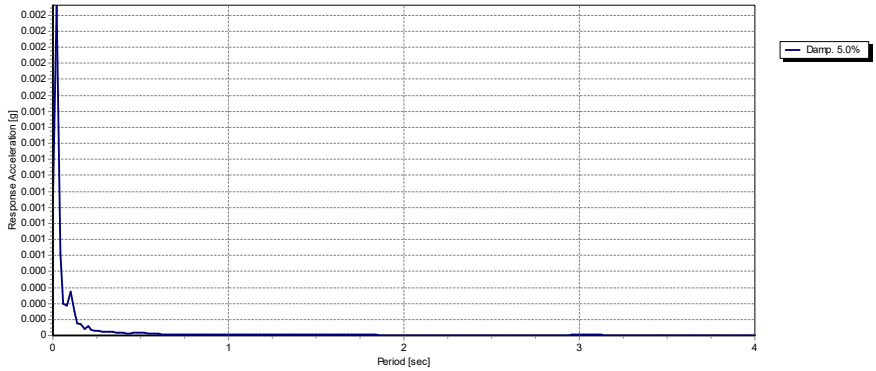


Fig. 104: Response spectra of the EW component at 5% damping

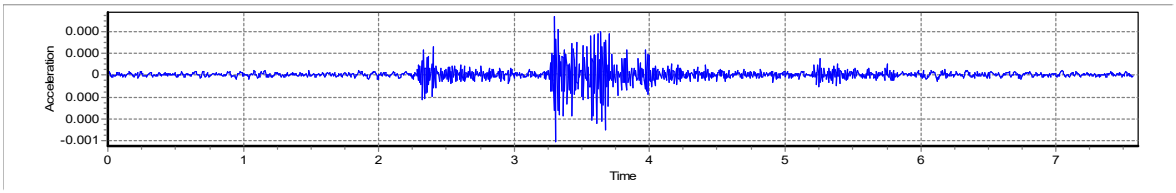
Table 15: Ground motion parameters of the three components of the two above earthquakes

Ground Motion Parameters	EW 08:48:11	NS 08:48:11	VT 08:48:11	EW 09:32:27	NS 09:32:27	VT 09:32:27
Max Acceleration (g)	0.0013	0.00185	0.00277	0.00085	0.0019	0.00163
Max Velocity (cm/sec)	0.00303	0.00551	0.00662	0.00277	0.00562	0.00353
Max Displacement (cm)	0.00466	0.00183	0.00388	0.00349	0.00128	0.00146
Vmax/Amax (sec)	0.00237	0.00304	0.00244	0.00334	0.00301	0.00221
Acceleration RMS (g)	0.00012	0.0002	0.00027	0.00012	0.0002	0.0002
Velocity RMS (cm/sec)	0.00104	0.00093	0.00119	0.001	0.00079	0.00072
Displacement RMS (cm)	0.00247	0.00124	0.00167	0.00196	0.00057	0.00073
Arias Intensity (m/sec)	0	0	0.00001	0	0	0
Characteristic Intensity	0	0.00001	0.00001	0	0.00001	0.00001
Specific Energy Density (cm2/sec)	0.00001	0.00001	0.00001	0	0	0
Cum. Abs. Velocity (cm/sec)	0.35969	0.55009	0.81045	0.24764	0.3656	0.47329

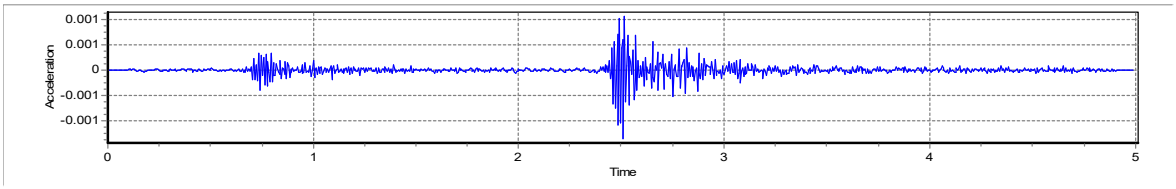
Acc Spectrum Intensity (g*sec)	0.00003	0.00004	0.00002	0.00002	0.00003	0.00002
Vel Spectrum Intensity (cm)	0.00669	0.01327	0.0156	0.00501	0.01265	0.0087
Housner Intensity (cm)	0.00372	0.00386	0.00256	0.00234	0.0021	0.00233
Sustained Max.Acceleration (g)	0.00036	0.00101	0.0014	0.0003	0.00024	0.00102
Sustained Max.Velocity (cm/sec)	0.00235	0.00314	0.00448	0.00226	0.00157	0.00242
Effective Design Acceleration (g)	0.00004	0.00008	0.00004	0.00002	0.00005	0.00003
A95 parameter (g)	0.0013	0.00185	0.00276	0.00084	0.0019	0.00162
Predominant Period (sec)	0.02	0.02	0.02	0.02	0.02	0.02

v. Some local events:

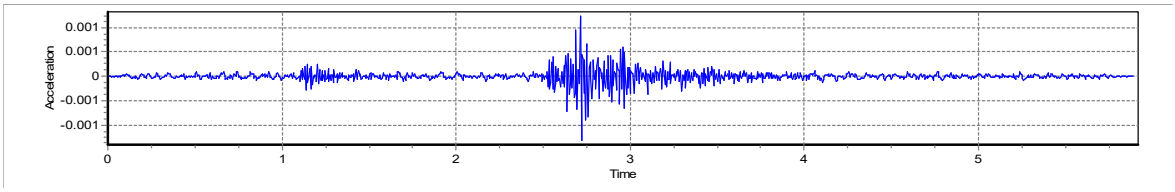
21/6/2020

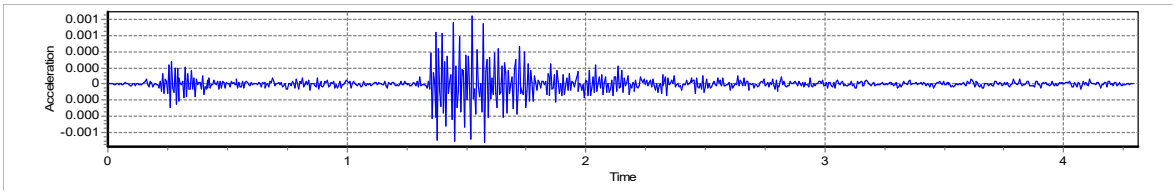


22/06/2020



23/06/2020





26/06/2020

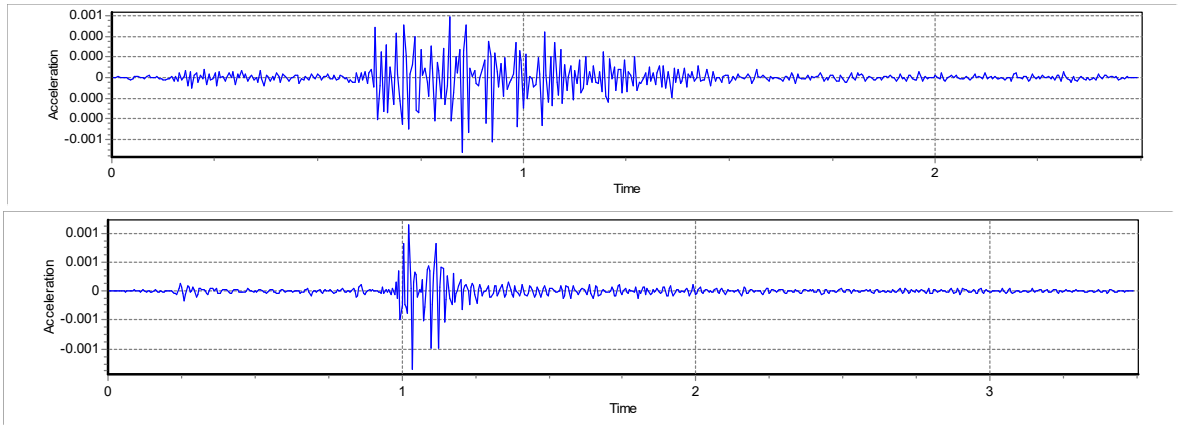


Fig. 105: Accelerograms of a few local events

Table -16: The details of these events are given in the following table:

Date	Time (GMT)
21-06-2020	5:49:21
22-06-2020	8:41:51
23-06-2020	8:48:11
	09:32:28
26-06-2020	08:08:34
	10:06:2.20

Table-17: The Ground motion parameters of these events are:

Ground motion parameters	21/06/2020	22/06/2020	23/06/2020	23/06/2020	26/06/2020	26/06/2020
Max Acceleration (g)	0.00061	0.00135	0.0013	0.00085	0.00072	0.00135
Max Velocity (cm/sec)	0.04078	0.00264	0.00303	0.00277	0.0015	0.00332
Max Displacement (cm)	0.15354	0.00142	0.00466	0.00349	0.00033	0.00215
Vmax/Amax (sec)	0.06804	0.002	0.00237	0.00334	0.00212	0.00251
Acceleration RMS (g)	0.00007	0.00013	0.00012	0.00012	0.00013	0.00012
Velocity RMS (cm/sec)	0.02351	0.00059	0.00104	0.001	0.00044	0.00084
Displacement RMS (cm)	0.06846	0.00092	0.00247	0.00196	0.0002	0.00099
Arias Intensity (m/sec)	0	0	0	0	0	0
Characteristic Intensity	0	0	0	0	0	0
Specific Energy Density (cm2/sec)	0.00419	0	0.00001	0	0	0
Cum. Abs. Velocity (cm/sec)	0.24625	0.2827	0.35969	0.24764	0.16619	0.16596
Acc Spectrum Intensity (g*sec)	0.00001	0.00003	0.00003	0.00002	0.00001	0.00001
Vel Spectrum Intensity (cm)	0.00359	0.00596	0.00669	0.00501	0.00403	0.0078
Housner Intensity (cm)	0.00522	0.00325	0.00372	0.00234	0.00244	0.00203
Sustained Max.Acceleration (g)	0.00037	0.00025	0.00036	0.0003	0.00025	0.00016
Sustained Max.Velocity (cm/sec)	0	0.00163	0.00235	0.00226	0.00132	0.00139
Effective Design	0.00002	0.00005	0.00004	0.00002	0.00001	0.00001

Acceleration (g)						
A95 parameter (g)	0.00061	0.00134	0.0013	0.00084	0.00072	0.00135
Predominant Period (sec)	0.02	0.02	0.02	0.02	0.02	0.02

4. Observations

Since these kind of local events are observed on a daily basis, we have picked up a few and analysed in detail (the results of which are shown above). These events indicate low PGA value <0.00135g. As per the USGS Instrumental Intensity scale, which maps peak ground acceleration and peak ground velocity on an intensity scale similar to the felt Mercalli scale, the values show Instrumental Intensity of I which indicates that the shaking may be perceptible by people with no potential damage.

IV. Interferometric synthetic-aperture radar (InSAR)

1. Objective:

- Preliminary assessment of surface deformation.
- Preliminary damage assessment.
- Details analysis of affected area.

2. Method:

- InSAR and D-InSAR for surface deformation.
- Coherence based change detection.

3. Data used:

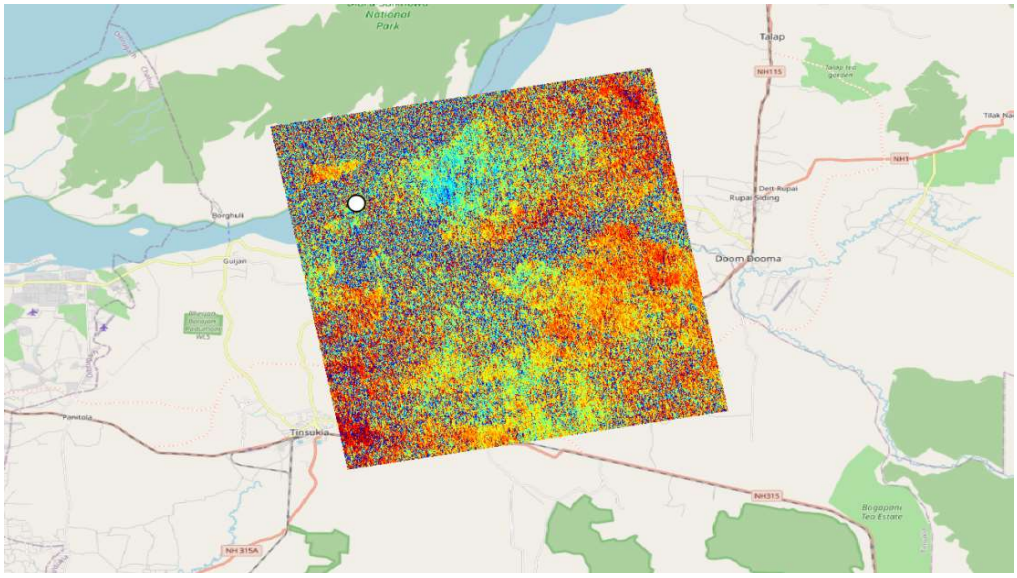
Sentinel-1 SAR data provided by ESA.

Three images used as following.

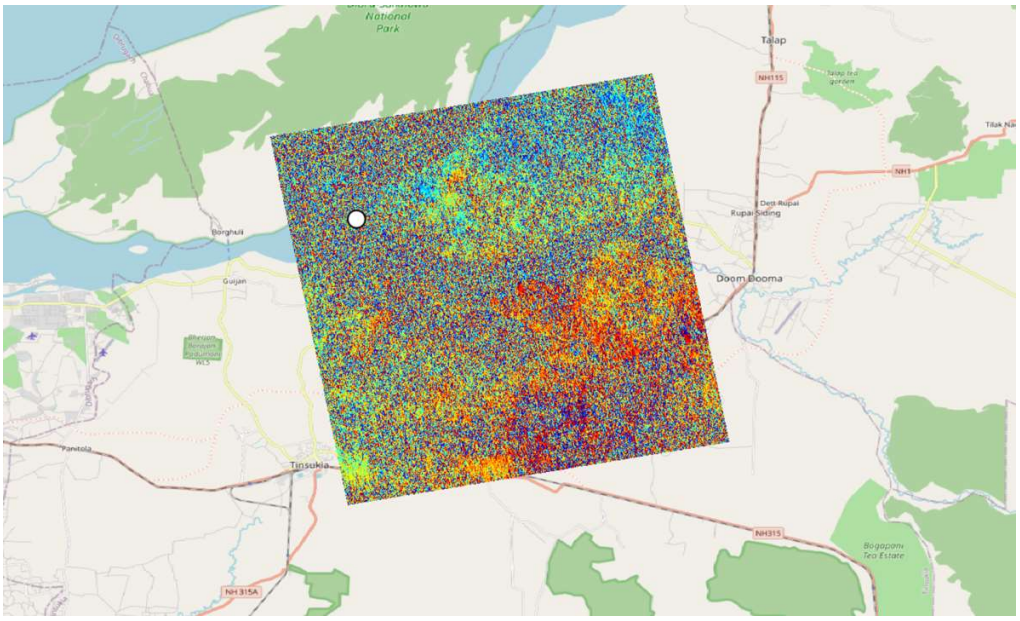
One before the event acquired on 4th June 2020 to 10th July 2020

S1A_IW_SLC__1SDV_20200604T114101_20200604T114129_032867_03CE93_03E8.SAFE	17-06-2020 17:22
S1A_IW_SLC__1SDV_20200616T114102_20200616T114130_033042_03D3D4_E834.SAFE	17-06-2020 17:25
S1A_IW_SLC__1SDV_20200628T114103_20200628T114131_033217_03D925_F7AB.SAFE	28-06-2020 16:50
S1A_IW_SLC__1SDV_20200710T114103_20200710T114131_033392_03DE73_3ADA.SAFE	19-07-2020 18:04

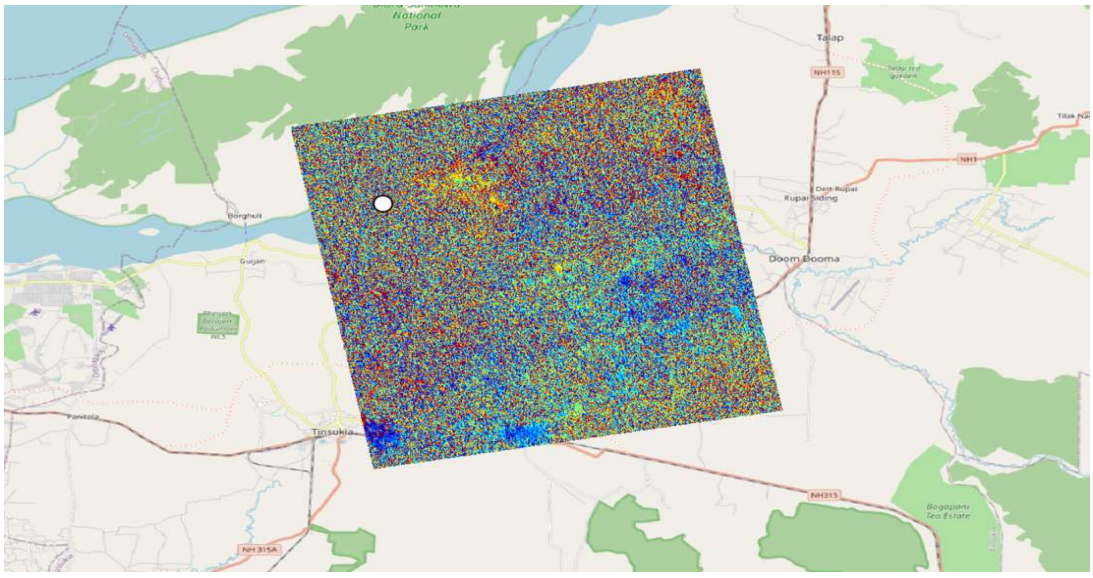
20200604-20200616_phase_ortho



20200628-20200604_phase_ortho



20200710-20200604_phase_ortho



Change detection: 20200604-20200616

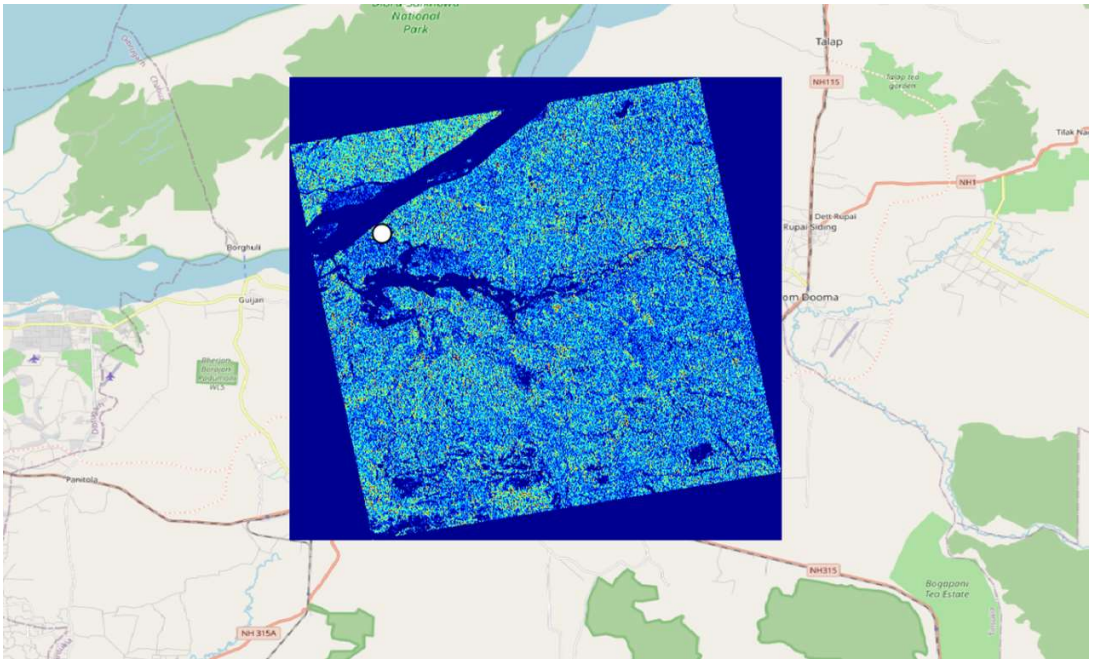


Fig. 106: InSAR images used in the study

4. **Conclusion:** No surface deformation is observed in this dataset in three different interferogram generated.

Concluding remarks:

CSIR-NEIST, Jorhat was entrusted to investigate the reported earthquake activities in an around Baghjan area aftermath of the unfortunate gaswell blowout incident at Baghjan well No. 5 of OIL. In this regard, seismic as well as several other geophysical investigations were carried out at Baghjan and adjoining areas deploying broadband seismometer, strong motion accelerometer, proton precession magnetometer, ground resistivity meter. Apart from these surveys, InSAR data were also analyzed to identify any possible surface deformation at the vicinity of the incident site. The findings of the investigation are summarized below:

1. During the investigation period, the network of five seismograph stations recorded several, local, distant/teleseismic earthquakes occurring in the NE India and its neighbourhood.
2. A number of very local and shallow micro-earthquake activities are also detected, and some of these events may be related to the well blowout incident. However, such micro-earthquakes are reported globally near producing hydrocarbon reservoir due to disturbance of hydrostatic balance inside the reservoir during production activities. These micro-earthquakes are very small and are usually not felt unless extremely close to the epicenter.
3. High frequency ground motion as continuous oscillation is observed in the records of all the seismic sensors as far as 4.5km from the blowout site. These noises are not uniform and sudden spikes are observed, which sometime lasted for several hours.
4. The Peak Particle Velocity (PPV) observed due to the noise ranges from 0.095 mm/sec to 0.22 mm/sec. However, the maximum PPV recorded during the study period was 1.08 mm/sec, which was due to an M5.6 earthquake that occurred in Mizoram on 21 June, 2020. The PPV due to this earthquake far exceeds the highest PPV generated by the continuous noise.
5. Directivity study of the noise spectrum indicates that the source of the high frequency disturbances observed at the seismic stations is the Baghjan Blowout site.
6. Ground vibration at seismic stations BJN2, BJN4 and BJN5 reaches the human perceptible limit and sometime may be quite disturbing to people. However, the continuous ground vibration does not always reach human perceptible limit.
7. The recorded PPV is much lesser as compared to damage threshold of a normal house or even sensitive historical monuments. Therefore, it is highly unlikely to cause any structural or even architectural damage of dwellings. The maximum Peak Ground Acceleration (PGA) recorded by the accelerometer is 0.0027g, which is also quite insignificant from any structural damage potential.
8. Reported felt vibrations on dwellings as far as 10-12km from the blowout site could not be verified as the investigation was restricted to a radial distance of 4.5km only.

9. Significant variation of recorded geophysical parameters has been observed for different survey episodes. The survey period was much rainy with subsequent flooding. The measured geophysical parameters are highly sensitive to variation of water saturation in the subsurface layers. Hence, influence of water saturation in observed variation of the geophysical parameters cannot be ruled out.
10. Temporal variations in ground resistivity value are observed at several sites. The resistivity readings of the nearest site to the blowout incident, probably, influenced by contamination in the upper layer.
11. Large variation in measured magnetic intensities by the PPM record may indicate presence of magnetic anomalies underneath the subsurface of the prescribed survey sites. VLF pseudosections of real anomaly readings present high limits, which tend to distort the models. The VLF survey may indicate that the zones of higher current density orient with the water stagnated, muddy, areas of the site.
12. InSAR data analysis does not show any surface deformation at the vicinity of the blowout site.
13. There is scope to investigate the reported vibration effects, if any, on dwellings located beyond the covered 4.5km radial distance from the incident site. Such study should be very useful in hazard mitigation in case unfortunate incidents like the Baghjan well blowout recurs in the near future.

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Photograph of the field party: standing from right Mr. Sausthov M. Bhattacharyya, Dr. Santanu Baruah, Mr. Chandan Dey, Mr. Prachurjya Borthakur, Dr. Bijit Kr. Choudhury, Dr. Goutam K Boruah, Mr. Timangshu Chetia and Dr. M K Phukan



Photograph of the field party: standing from right Dr. M K Phukan, Dr. Santanu Baruah, Mr. Chandan Dey, Mr. Prachurjya Borthakur, Dr. Bijit Kr. Choudhury, Mr. Ashim Gogoi, Dr. Goutam K Boruah and Mr. Timangshu Chetia

IN THE SUPREME COURT OF INDIA
(CIVIL APPELLATE JURISDICTION)
CIVIL APPEAL NO. 2201 OF 2021

IN THE MATTER OF:

Bonani Kakkar ...Appellant

Versus

Oil India Limited & Ors. ...Respondents

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22.	**Annexure R21** A Copy of the Letter of Award dated 29.09.2020 bearing number OIL/CONT/LOA/S/394/2020-21 issued by the Answering Respondent to M/s Balmer Lawrie & Co. Ltd.	448 – 449	
23.	**Annexure R22** A copy of the report dated 10.11.2021 of the Effluent Pit Water Sample Analysis near Baghjan Well No. 5	450	
24.	**Annexure R23** Copy of the letter dated 15.11.2021 bearing number AFT-9/2021-22/289 from the District Fishery Development Officer (DFDO), Tinsukia, Government of Assam, to the Answering Respondent.	451	
25.	**Annexure R24** Copy of the letter dated 13.11.2021 bearing number DVOT/G-9/Baghjan/2021-22/638 from the District Animal Husbandry & Veterinary Officer, Tinsukia, Government of Assam, to the Answering Respondent.	452 – 454	
26.	**Annexure R25** A copy of the LOA dated 16.11.2021 bearing number OIL/62/7/LOA-323 issued by the Answering Respondent to M/s TERI.	455 – 456	

27.	**Annexure R26** A copy of the Report of M/s The Energy and Resources Institute for the Assessment of Environmental Quality of Soil and Vegetation in the vicinity of Baghjan Well No. 5.	457 – 495	

Filed by

TRUST LEGAL
Advocate for Respondent No 1
Trust Legal House C-224,
Defence Colony, New Delhi 11024
(Computer Code: 2725, Mob No.:9899545281)
Email: gaichangadvocate@gmail.com

New Delhi

Date: 09.05.2022

2760 ANNEXURE – R7 296

Oil India Limited
(A Govt. of India Enterprise)
P.O. DULIAJAN, DIST. DIBRUGARH,
ASSAM, INDIA, PIN-786 602

CONTRACTS DEPARTMENT
TEL: (91) 374-2800548
E-mail: contracts@oilindia.in
Website: www.oil-india.com
FAX: (91) 374-2803549

Ref. No. OIL/CONT/LOA/G/189/2020-21 **Date: 06.07.2020**

M/s IIT GUWAHATI,
Department of Civil Engineering,
North Guwahati -781 039, Assam
Email: shrishi@iitg.ac.in

Sub: Letter of Award (LOA) for Measurement of Thermal Mapping of structure and Sonic Boom in Baghjan.

Dear Sir,

With reference to Techno-commercial Proposal dated 05.07.2020, we have the pleasure in awarding you our LOA/Work Order no. **LOA/G/189** for Hiring of services for **Measurement of Thermal Mapping of structure and Sonic Boom in Baghjan** of Oil India Limited, Duliajan.

2.0 Mobilisation of your Professionals are to be done on urgent basis so as to reach the Well Site at the eariest. Towards the services, the rates applicable are as under:

	Description/Particulars	Qty.	UOM	Total INR
Phase -1	Thermal imaging of the Structure(s) using thermal camera near Blowout Site of Baghjan#5 in Upper Assam (minimum 3 working days including damage reconnaissance) including logistic and travel expenses. Minimum of 15 structures to be thermally scanned.	1	Lump sum	9,00,000.00
Phase -2	Noise level measurement and recording as per the mentioned scope (for minimum 3 days) including logistic and travel expenses.	1	Lump sum	6,00,000.00
Phase -3	Data processing and data inference to assess damage to the structure. Interpretation and analysis of data, report compilation and submission of thermal and Sonic Boom data to analyses correlation to formation of crack.	1	Lump sum	8,00,000.00
			Total Expenditure exclusive of GST	**23,00,000.00**

Other Terms:

a) GST extra as applicable.
b) Payment term: 20% amount will be paid on completion of mobilization. Balance 80% will be paid on submission of final report.
c) Detailed scope of work as per the offer dated 05.07.2020

3.0 Considering the Urgency of the requirement of the services, please do coordinate and ensure that Services are provided within 48 Hours.

4.0 Kindly confirm acceptance of this LOA and complete the mobilization at the earliest.

Thanking you,

Yours faithfully,
Oil India Limited

(A J Sarmah)
GM-CONTRACTS
For RESIDENT CHIEF EXECUTIVE

Dr. H. Sharma
Assistant Professor

Indian Institute of Technology, Guwahati,
North Guwahati, Guwahati-781 039, Assam, India.

Phone : +91-361-258- 3326
Fax : +91-361-258-2440
email : shrishi@iitg.ac.in

Date: 28th August 2020

To,

Dr. Neeraj Mathur

Chief General Manager (R&D)

Oil India Limited

Duliajan 786 602 Assam

The detailed report is attached along. Kindly let me know in case you need additional information.



Dr. Hrishikesh Sharma and Dr. Amit Shelke

Department of Civil Engineering

Indian Institute of Technology, Guwahati

Guwahati-781 039, Assam, India

Email id:shrishi@iitg.ernet.in, Ph No: +91-9435321894

Measurement of Thermal Mapping of Structure and Sonic Boom in Baghjan in Upper Assam

SUBMITTED TO
OIL INDIA LIMITED

Submitted by

Department of Civil Engineering
INDIAN INSTITUTE OF TECHNOLOGY, GUWAHATI
GUWAHATI, ASSAM, INDIA, 781039

August 28, 2020

.

DISCLAIMER

- The blowout incident occurred on 27 May 2020 and followed by an explosion on 9 June 2020 at Oil Well in Bhagjan in Tinsukia district, Assam. During the transient thermal radiation period which occurs in the time period just after the blowout, no measurements could be conducted due to unexpected conditions which couldn't be predicted, inaccessibility to the site condition, fire hazard and COVID restrictions, and numerous other reasons which are beyond human control.

  The conclusion from the scientific study are based on the thermal mapping and sound measurement conducted between 16 July 2020 and 21 July 2020 after the blowout incident. These measurements are conducted upon attaining steady state temperature and sound pressure in the Bhagjan area. Therefore, the conclusions are limited only to the steady state duration of the measurement. Under no conditions, the scientific measurements and associated conclusions should not be extended or extrapolated to earlier period of blowout incident and subsequent explosion. Moreover, the sonic measurements and thermal mapping are representative data set collected at critical location agreed upon with mutual discussion with District Administration and Oil India Limited. Our study cannot differentiate between any new cracks formed or the or any pre-defects, pre-existing cracks, etc. which were present earlier. The scope of the report covers only the structural components.

- This report is submitted to OIL India limited by IIT Guwahati as per the results and conclusions obtained from the thermal mapping and sound measurement study. IIT Guwahati will not be liable for any legal, social, economical, and financial implications arising out of the effects of this report. All the matters and issues relating to the outcome based on this report are sole responsibility of OIL India Limited.

LIST OF ABBREVIATIONS

GPS	Global Positioning System
Hz	Hertz
dB	Decibel
ms	milliseconds
LAeq	Time averaged equivalent continuous sound level (Leq) expressed in dB, for frequency weightings A symbols
Lmax	The highest time weighted sound level (Max) expressed in dB, within a stated time interval, for frequency weightings
Lmin	The lowest time weighted sound level (Min) expressed in dB, within a stated time interval, for frequency weightings
SPL	Statistical Plot of Level
IR	Infrared
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MP	Megapixel

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Chapter 1. EXECUTIVE SUMMARY

1.1. BACKGROUND

The gas well Baghjan 5 of Oil India Limited in Upper Assam caught fire, following a blowout, on 9th June 2020. The fire is confined only to the wellhead. Local villagers in the area who have been evacuated safely by Oil India Limited with the help of Local Administration have reportedly alleged having observed shaking of ground which have been claimed to have caused certain cracks in their houses in the area. A seismological study has already been initiated by Oil India Limited through CSIR-NEIST, Jorhat.

In response to your email dated 15th June 2020, an expert team of IIT Guwahati was formed. Based on the discussions with Director (HR&BD), Oil India Limited final proposal was submitted on address following task. The scope of the work as agreed upon was as follows:

1.2. SCOPE OF PROPOSAL

The present proposal is prepared based on the requirement of investigation into the fact whether the fire in the well Baghjan 5 is any way related to the above observations by studying the following:

A. Whether the Sonic boom, as perceived by the locals, has caused the cracks, if at all?

B. Whether thermal currents due to the fire can in any way can lead to the above phenomena?

1.3. FIELD OBSERVATIONS

The field observations were made in the area surrounding the Bhagjan well no 5. The locations has been shown in the Figure 1.1 to 1.4. The locations were marked using the commercially available applications. The exactness of the locations as per the location accuracy provided by the applications, the international laws dictating the sharing of GPS data for civilian usage and the signal available at the site. Firstly, data in the form of photography and visual inspection at random places were done to access the line of sight from the Bhagjan well No 5, distribution of the dwellings at the site, and other factors to efficiently choose the points for random data collection. Upon examining, the observations were made for collecting data for sonic measurements as well as Thermal measurements.



Fig. 1.1 Field Observations taken on Day 16/07/2020

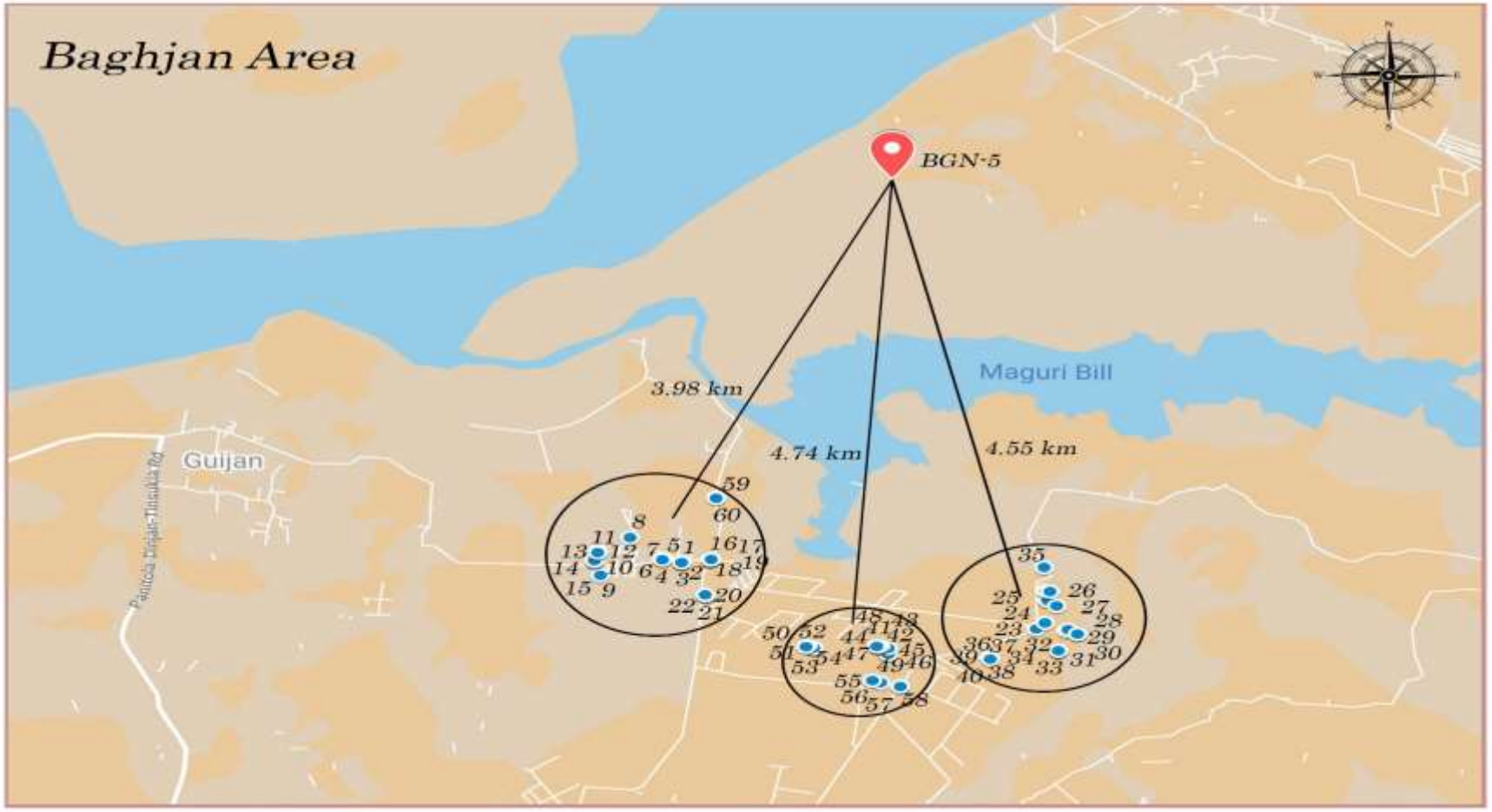


Fig. 1.2 Field Observations taken on Day 17/07/2020

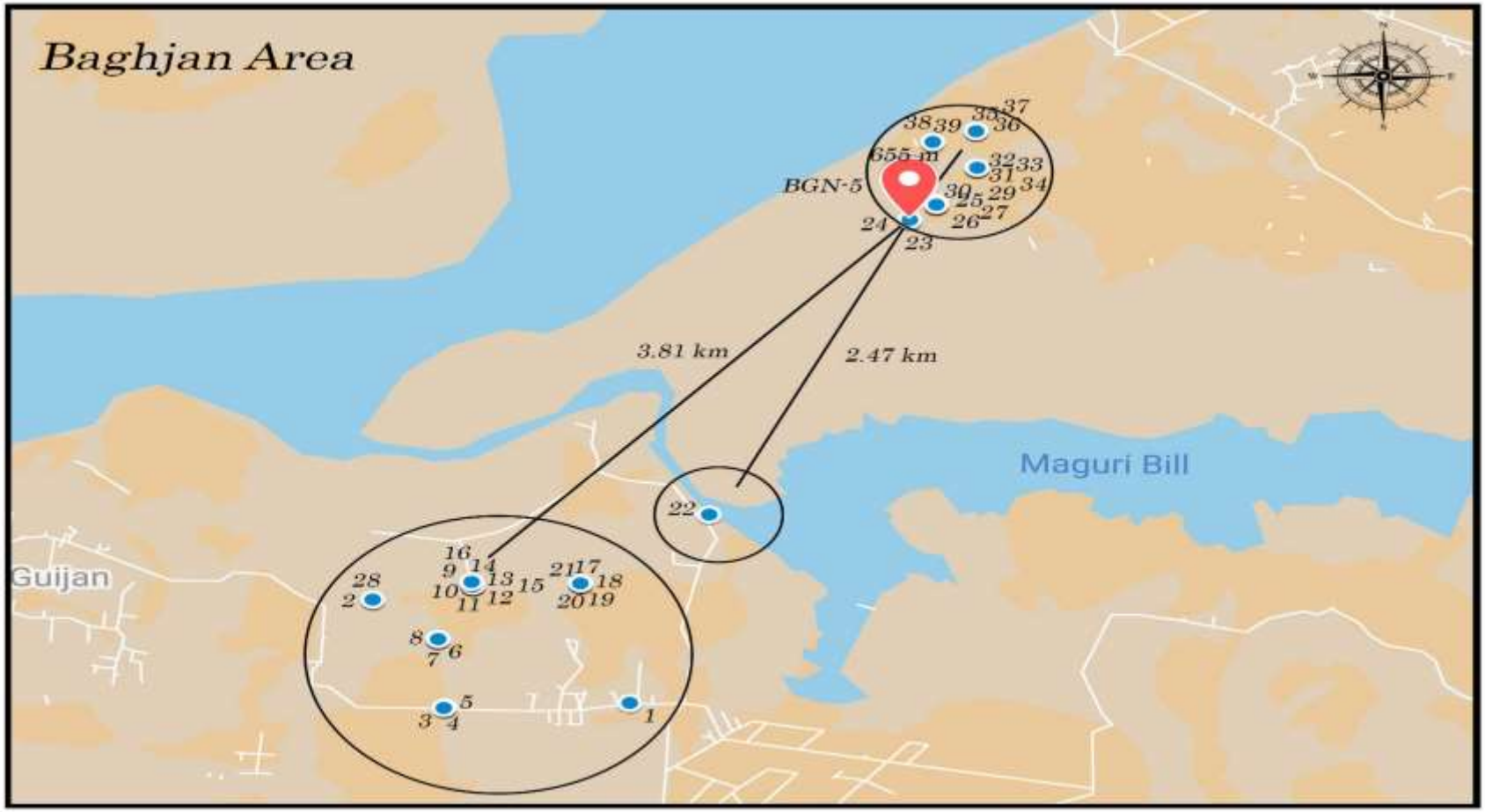


Fig. 1.3 Field Observations taken on Day 20/07/2020

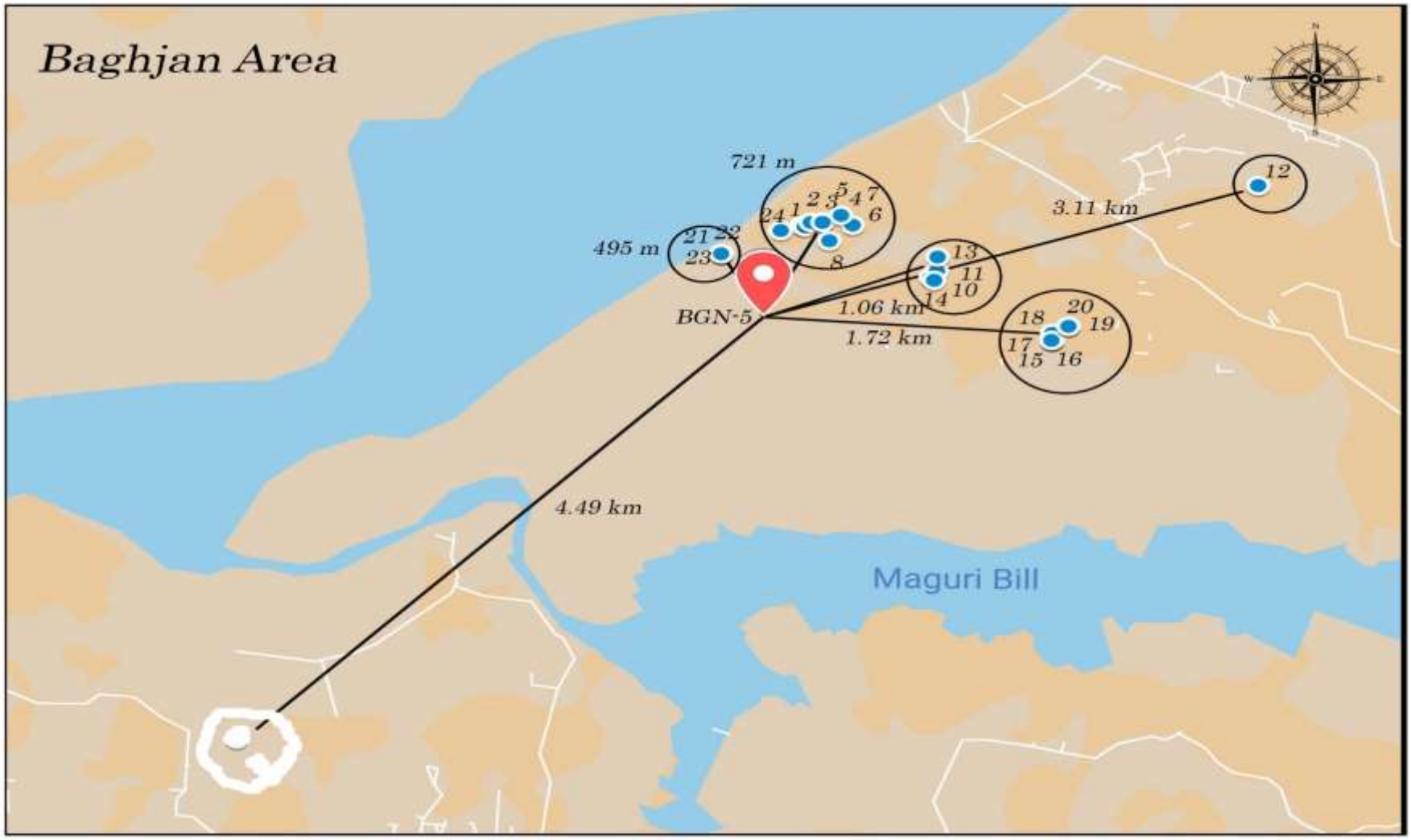


Fig. 1.4 Field Observations taken on Day 21/07/2020

1.4. SUMMARY OF FINDINGS

The detailed study carried out is presented in the subsequent Chapters. The detailed conclusions are presented in Chapter 4. Following is the summary of the findings which has to be read in conjunction with the details presented in Chapter 4.

- **Sound Intensity Measurement Inference:** The sound time history with high pressure intensity in dB emitting at low occurrence rate is not detrimental to the structural integrity.

- **Spectral Energy Inference:** Overall, the sound intensity is not too intense to cause any detrimental effect on structural integrity.

- **Frequency Inference:** The sound pressure intensities from the gas blowout has no significant influence on formation of cracks in the buildings.

- **Thermal Measurement Inference:** Based on the thermal maps, we conclude that there is no significant effect of fire in blowout well in Bhagjan well 5 on the formation of crack in the structures.

Chapter 2. STUDY OF THE SONIC BOOM OCCURING AT THE SITE

2.1. INVESTIGATIVE METHODOLOGY

The measurement of sonic boom occurring at the site was acquired using state-of-art microphone/sound level meter in the radius from vicinity of the blowout site to approximately 4.75 km of the affected area. The pressure of sound intensity with respect to time was measured during the event of sonic boom. The sonic boom intensity and frequency was evaluated using the spectral analysis of the time domain signal. Moreover, continuous real time measurements were acquired for evaluating occurrence rate and progression in changes in sonic intensities.

For this purpose, SVAN 971 Class 1, sound level meter which is capable of measuring sound intensity in the range of 20 Hz to 20KHz was used. The time history of sound intensity was recorded in real time. Data processing of the time histories was performed to obtain 1/3 octave results. Our focus is on measurement of spectral information of the sound and its influence on structures which shall be useful for the study.

2.2. SCOPE OF WORK

A. In this study, SVAN 971 Class 1 sound meter which is capable of measuring sound in the range of 20 Hz to 20KHz was used. In all the measurements, instrument was placed at the free field condition. The noise amplitude vs frequency plot (1/3 octave plot) at each measurement location was evaluated.
B. Sound measurement at 23 different locations in a 4.75 km area around the gas well of Oil India Limited was conducted.

2.3. DATA INTERPRETATION FORMAT

A. Tabulated summary of the sound time history is provided comprising of time stamp, maximum and minimum sound intensity, average energy in logarithm scale over period of measurement.
B. Time history of Acoustic pressure in dB. The logger time step was 800 ms. Time domain signal gives information about the Time vs Amplitude data, which can be used to analyse Noise trend/pattern followed by the DUT/Application Area.
C. 1/3 octave in terms of LAeq (dB) over frequency of 20 Hz till 20 kHz. Octave Analysis is widely used frequency domain analysis technique. Octave data provides information about amplitude level at particular Central frequencies defined as per the IEC 61260.
D. Sound statistic of occurrence rate (%) of maximum sound levels (dB). The plot signifies the frequency of occurrence in percentage for sound pressure that has highest occurrence rate.

2.4. DATA ANALYSIS

2.4.1. DATA DETAILS AT COORDINATE: 27.55848797, 95.36369117

Table 2.1 Parameters and Peak Values at **Coordinate: 27.55848797, 95.36369117**

Day dd-MM-yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	13:27:18	P1	A, Lpeak C	Fast	00:15:04	0	0	dB	107.98	98.67	45.91	55.45	67.4
20-07-2020	13:27:18	P2	C, Lpeak C	Fast	00:15:04	0	0	dB	107.98	97.12	62.77	80.85	78.86
20-07-2020	13:27:18	P3	Z, Lpeak Z	Fast	00:15:04	0	0	dB	108.9	99.99	72.17	90.12	88.19

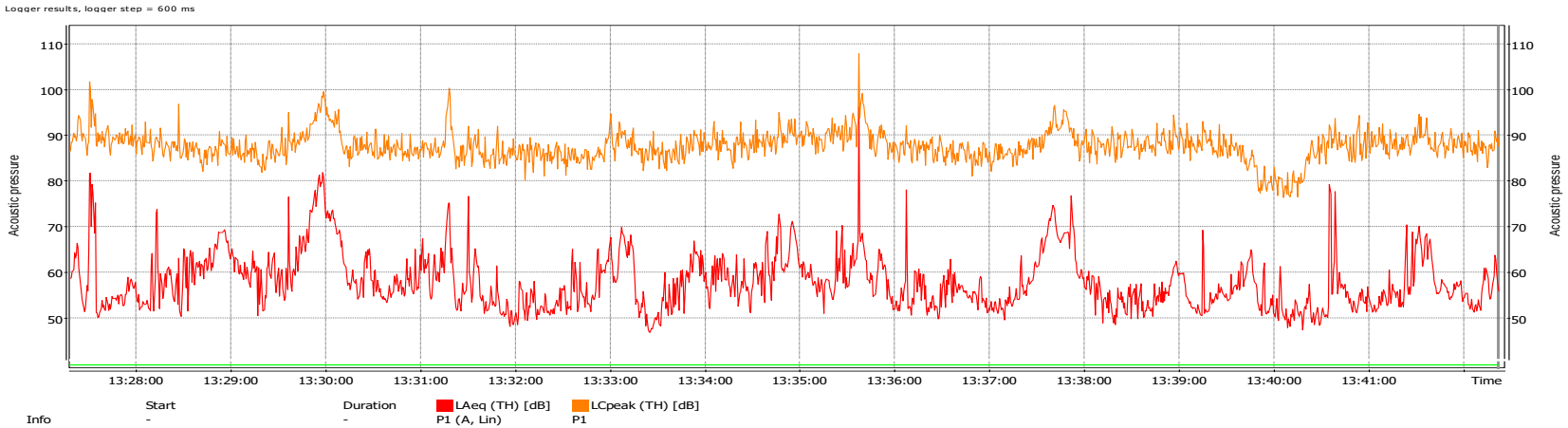


Fig. 2.1 Time Domain Signal/Data at coordinate **27.55848797, 95.36369117**

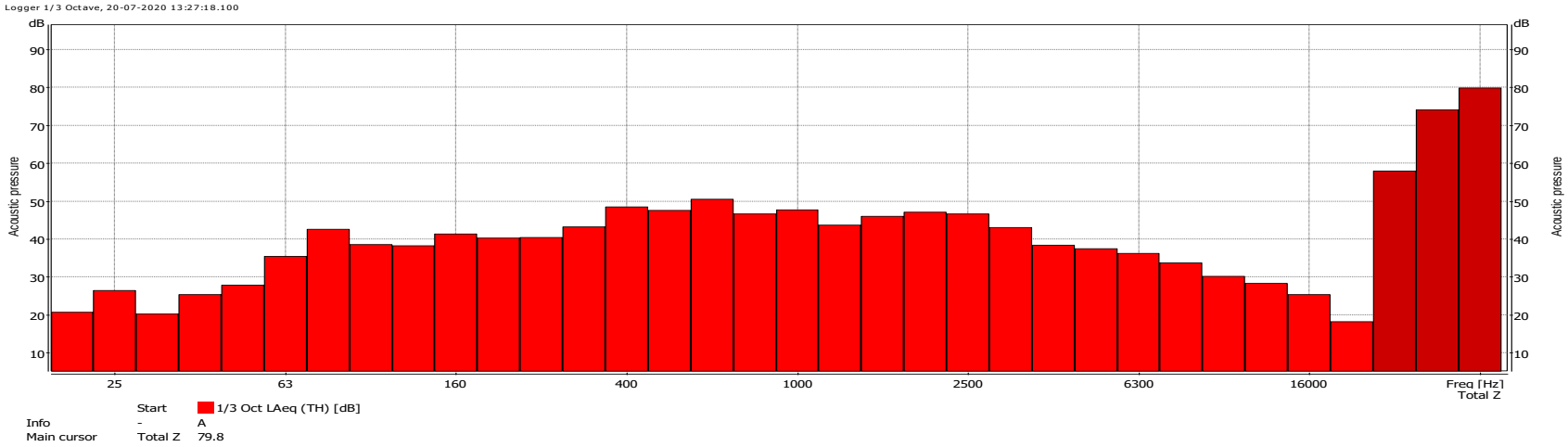


Fig. 2.2 Frequency domain data at coordinate **27.55848797, 95.36369117**

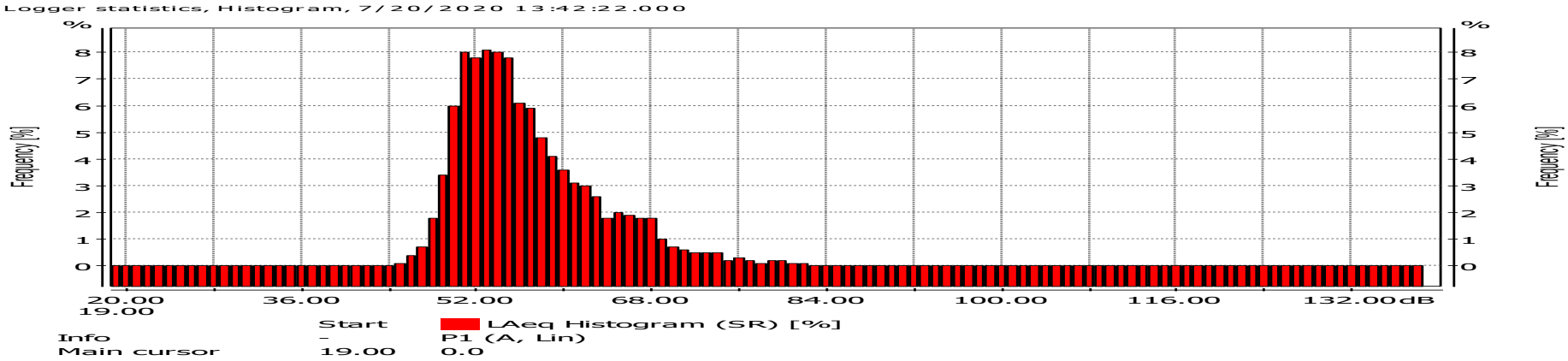


Fig. 2.3: 1/3 Octave result summary at coordinate **27.55848797, 95.36369117**

2.4.2. DATA DETAILS AT COORDINATE 27.5662653, 95.34787

Table 2.2 Parameters and Peak Values at Coordinate: 27.5662653, 95.34787

Day dd-MM-yyyy	Hour HH:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	13:48:04	P1	A, Lpeak C	Fast	00:15:03	dB	102.88	80.43	43.95	55.87	56.37
20-07-2020	13:48:04	P2	C, Lpeak C	Fast	00:15:03	dB	102.88	92.58	62.67	78.03	77.39
20-07-2020	13:48:04	P3	Z, Lpeak Z	Fast	00:15:03	dB	107.34	100.87	71.23	87.15	87.61

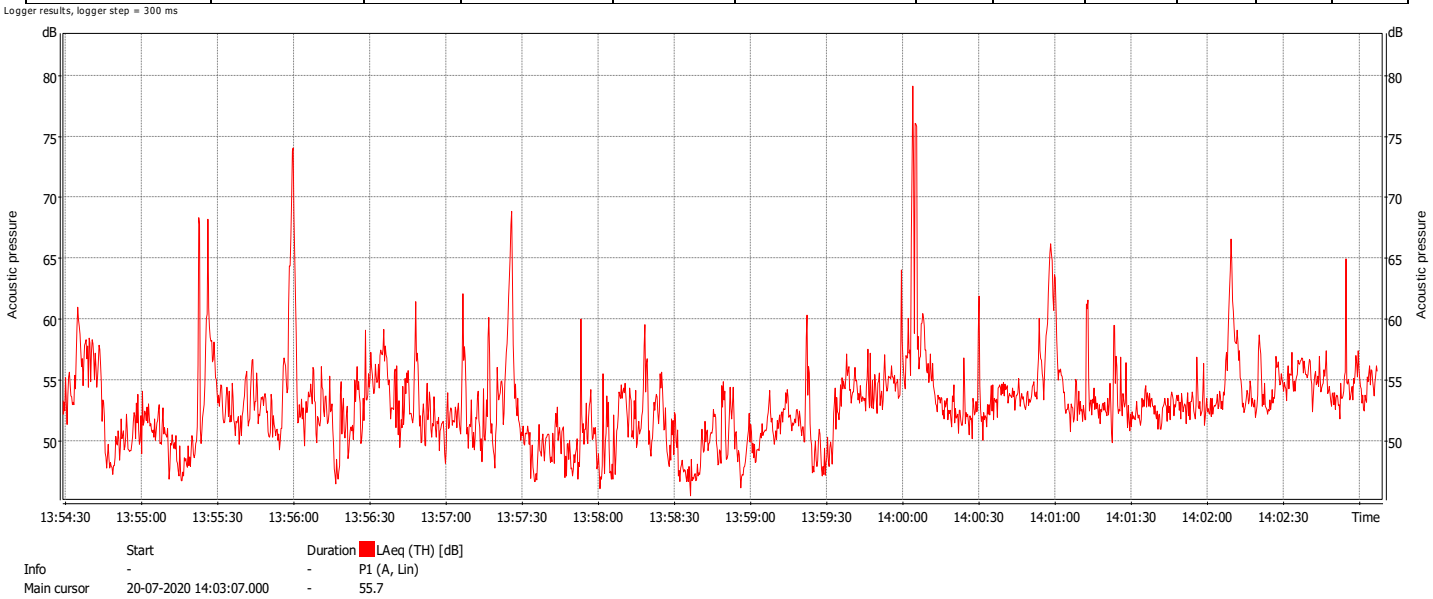


Fig. 2.4: Time Domain Signal/Data at coordinate 27.5662653, 95.34787

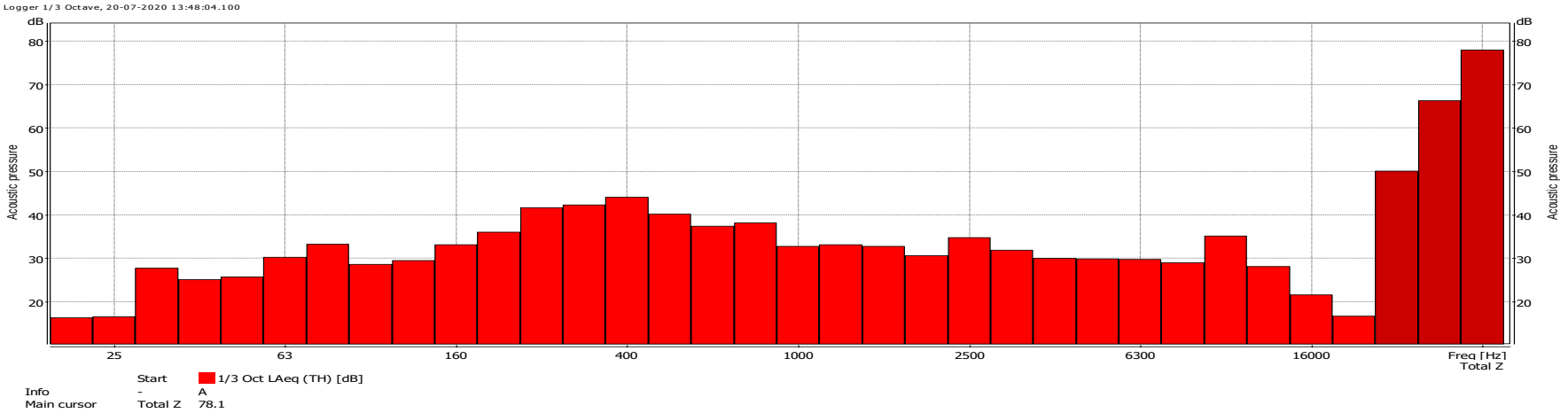


Fig. 2.5::Frequency domain data at coordinate 27.5662653,95.34787

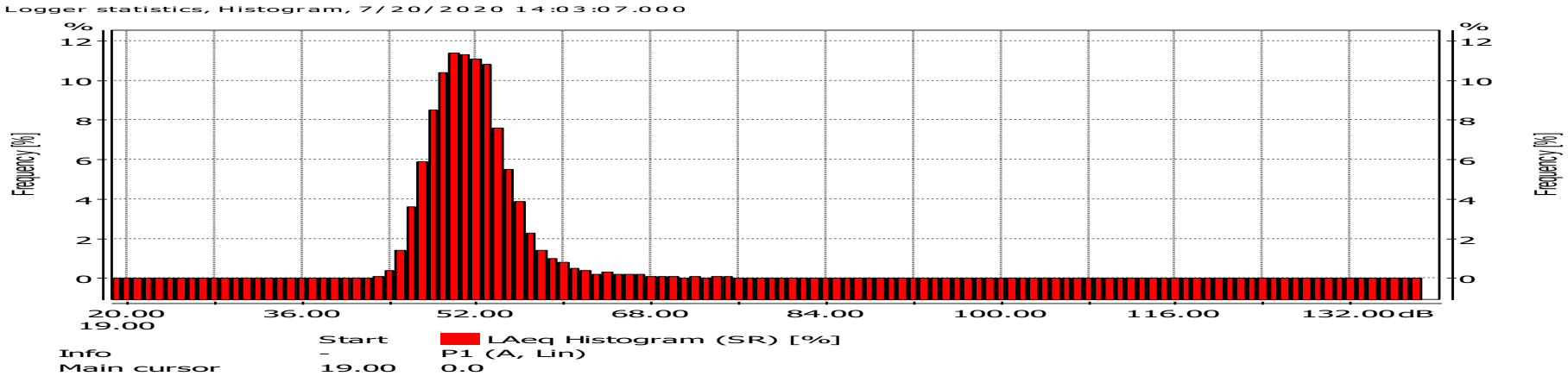


Fig. 2.6:: 1/3 Octave result summary at coordinate 27.5662653, 95.34787

2.4.3. DATA DETAILS AT COORDINATE 27.55815066,95.35231103

Table 2.3 Parameters and Peak Values at Coordinate: 27.55815066,95.35231103

Day dd-MM-yyyy	Hour HH:mm:ss	Profile	Filter	Detector	Elapsed time HH:mm:ss	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	14:06:52	P1	A, Lpeak C	Fast	00:15:07	dB	99.06	82.5	45.79	54.6	57.67
20-07-2020	14:06:52	P2	C, Lpeak C	Fast	00:15:07	dB	99.06	85.33	65.06	72.45	73.81
20-07-2020	14:06:52	P3	Z, Lpeak Z	Fast	00:15:07	dB	103.23	97.35	74.36	82.5	85.69

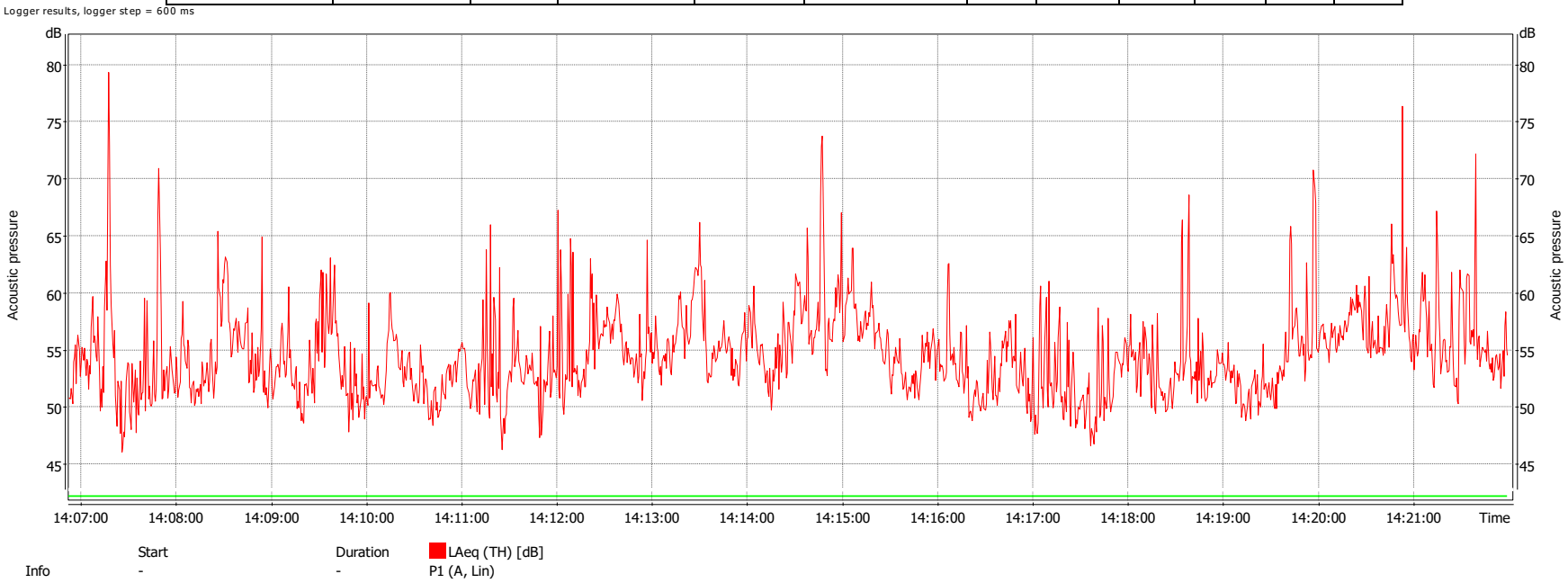


Fig. 2.7: Time Domain Signal/Data at coordinate 27.55815066,95.35231103

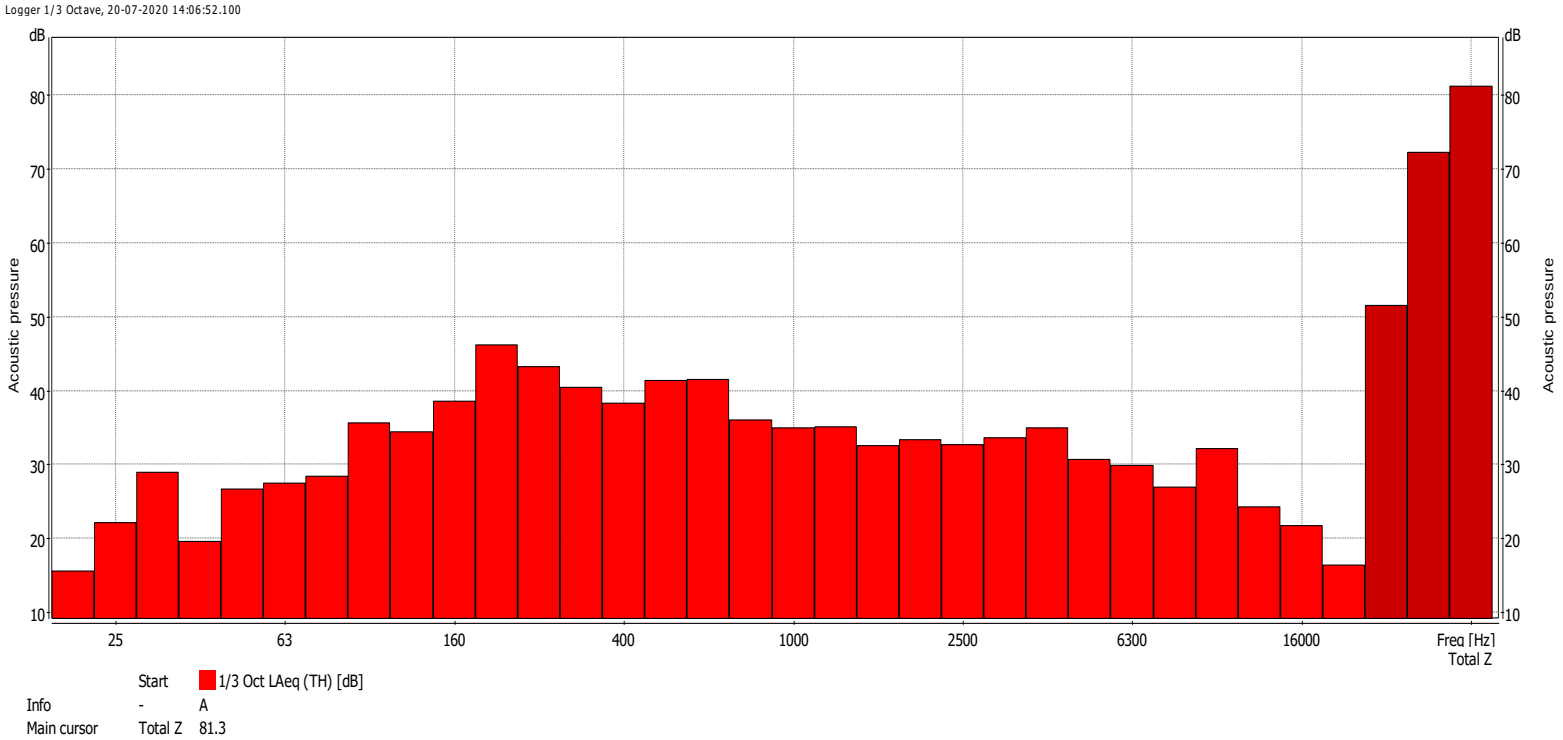


Fig. 2.8:Frequency domain data at coordinate 27.55815066,95.35231103

2.4.4. DATA DETAILS AT COORDINATE 27.55814049,95.35223708

Table 2.4 Parameters and Peak Values at Coordinate: 27.55814049,95.35223708

Day M/d/yyyy	Hour h:mm:ss	Profile	Filter	Detector	Elapsed time h:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	14:25:58	P1	A, Lpeak C	Fast	00:15:08	0	0	dB	97.4	80.19	41.55	46.18	56.31
20-07-2020	14:25:58	P2	C, Lpeak C	Fast	00:15:08	0	0	dB	97.4	90.4	69.01	80.34	79.8
20-07-2020	14:25:58	P3	Z, Lpeak Z	Fast	00:15:08	0	0	dB	108.54	102.02	77.18	94	89.83

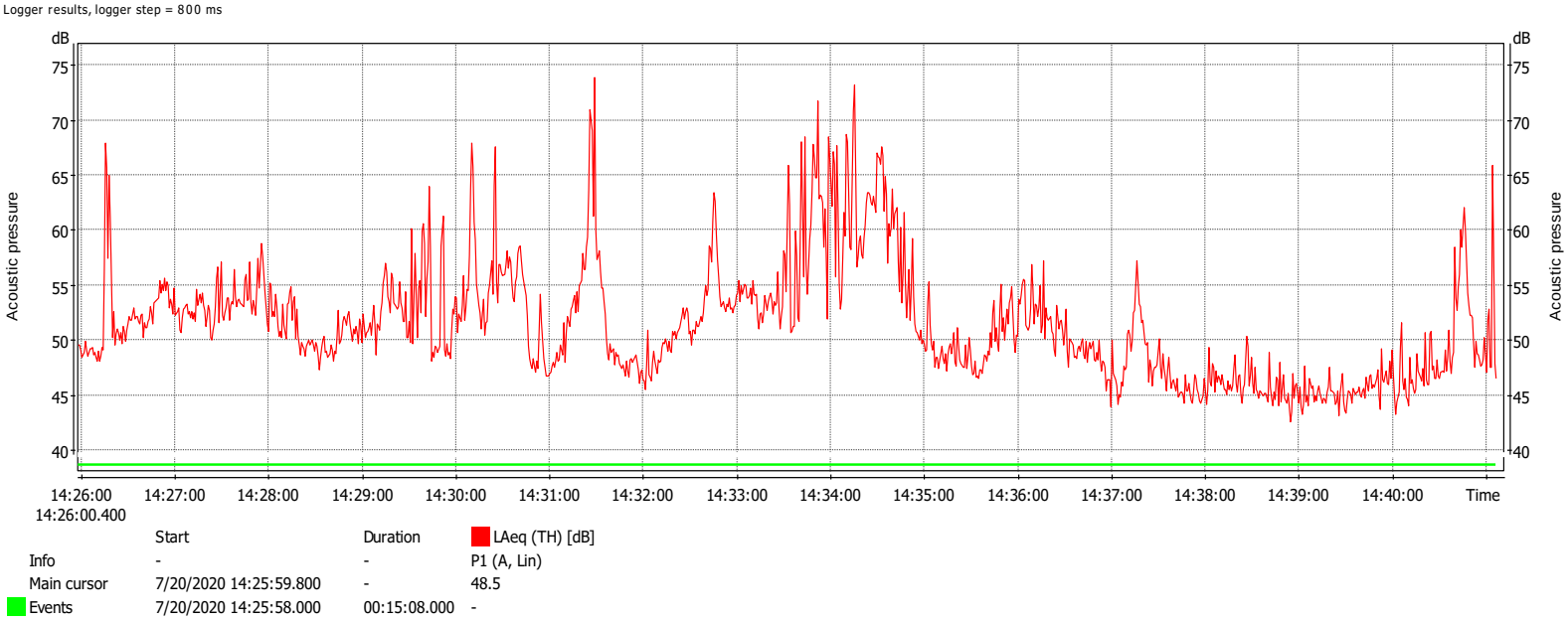


Fig. 2.9:Time Domain Signal/Data at coordinate 27.55814049,95.35223708

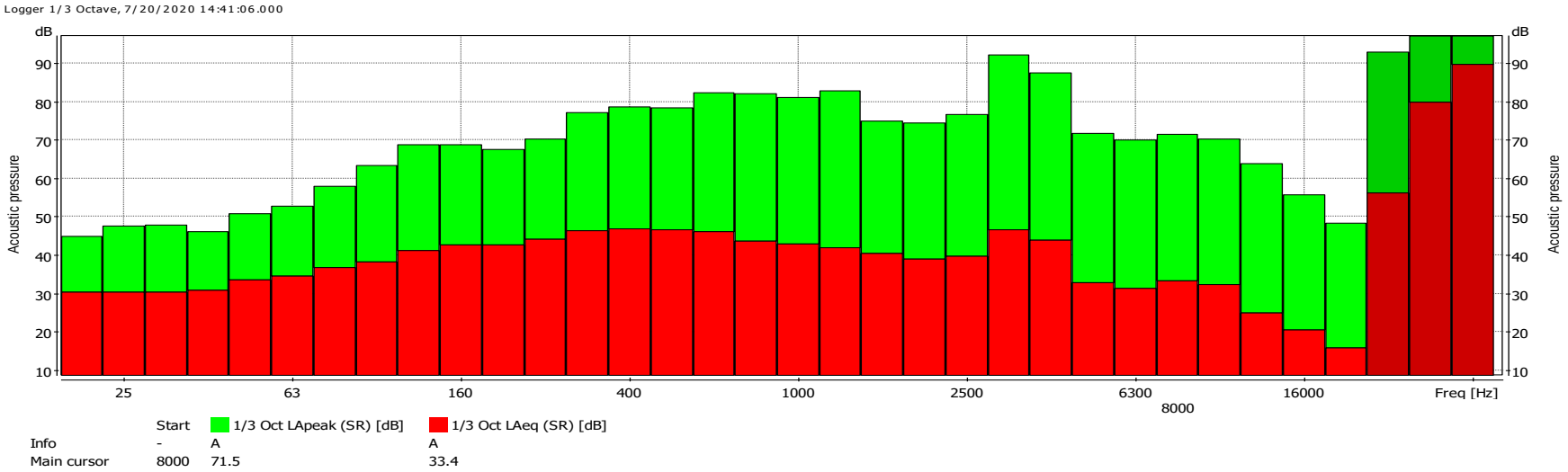


Fig. 2.10 Frequency domain data at coordinate 27.55814049,95.35223708

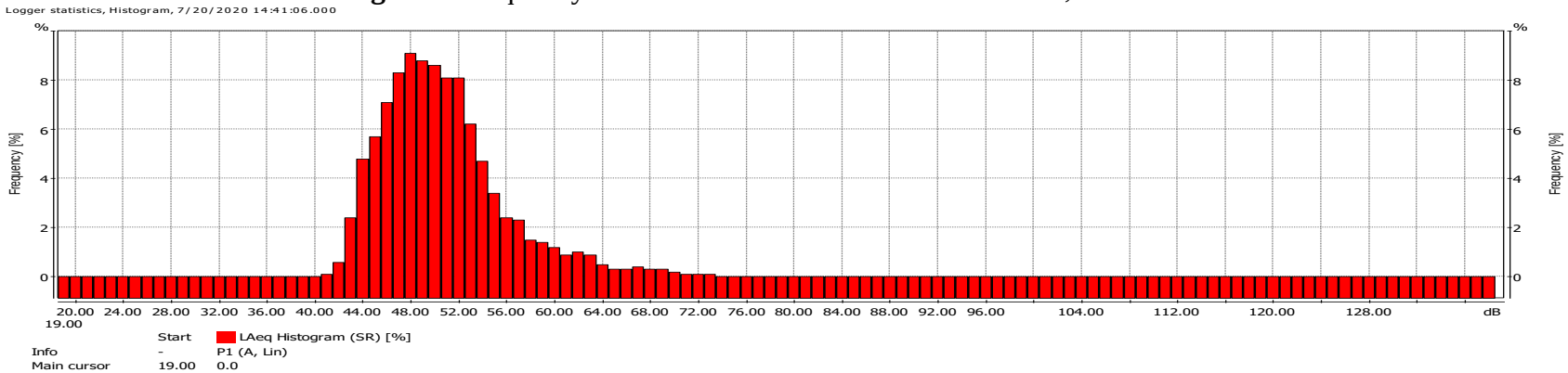


Fig. 2.11 1/3 Octave result summary at coordinate 27.55814049,95.35223708

2.4.5. DATA DETAILS AT COORDINATE 27.56328188,95.35186403

Table 2.5 Parameters and Peak Values at Coordinate: 27.56328188,95.35186403

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	14:49:40	P1	A, Lpeak C	Fast	00:15:03	0	0	dB	126.81	87.42	44.54	64.9	62.01
20-07-2020	14:49:40	P2	C, Lpeak C	Fast	00:15:03	0	0	dB	126.81	116.2	74.86	85.52	85.53
20-07-2020	14:49:40	P3	Z, Lpeak Z	Fast	00:15:03	0	0	dB	132.28	122.63	83.98	96.26	96.24

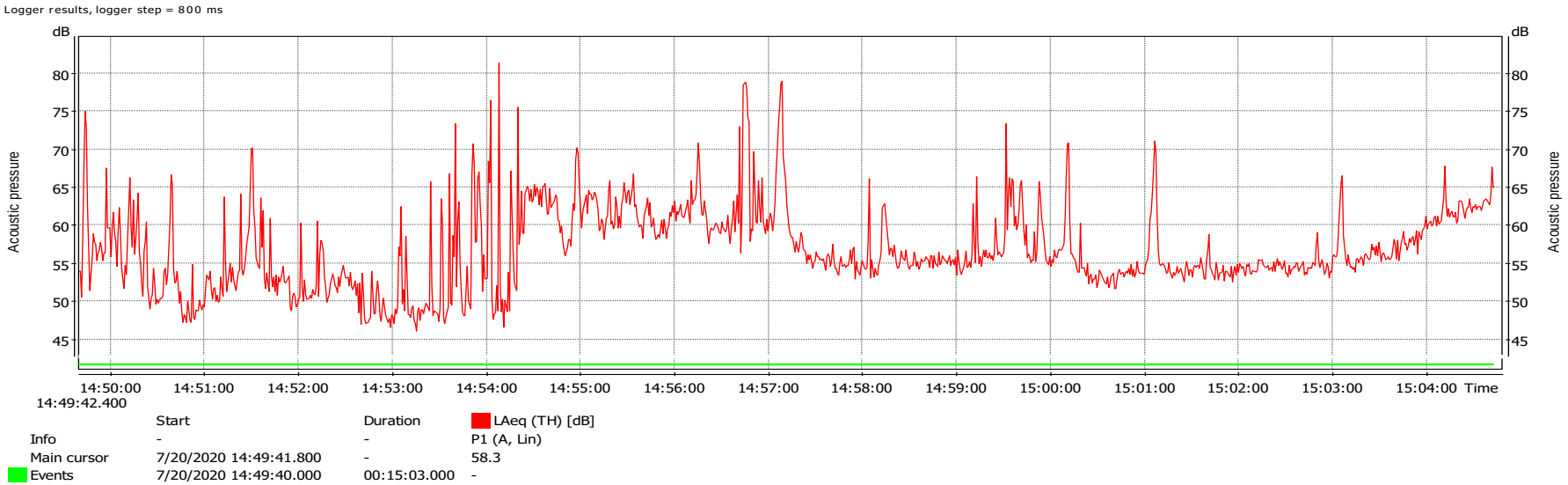


Fig. 2.12: Time Domain Signal/Data at coordinate 27.56328188,95.35186403

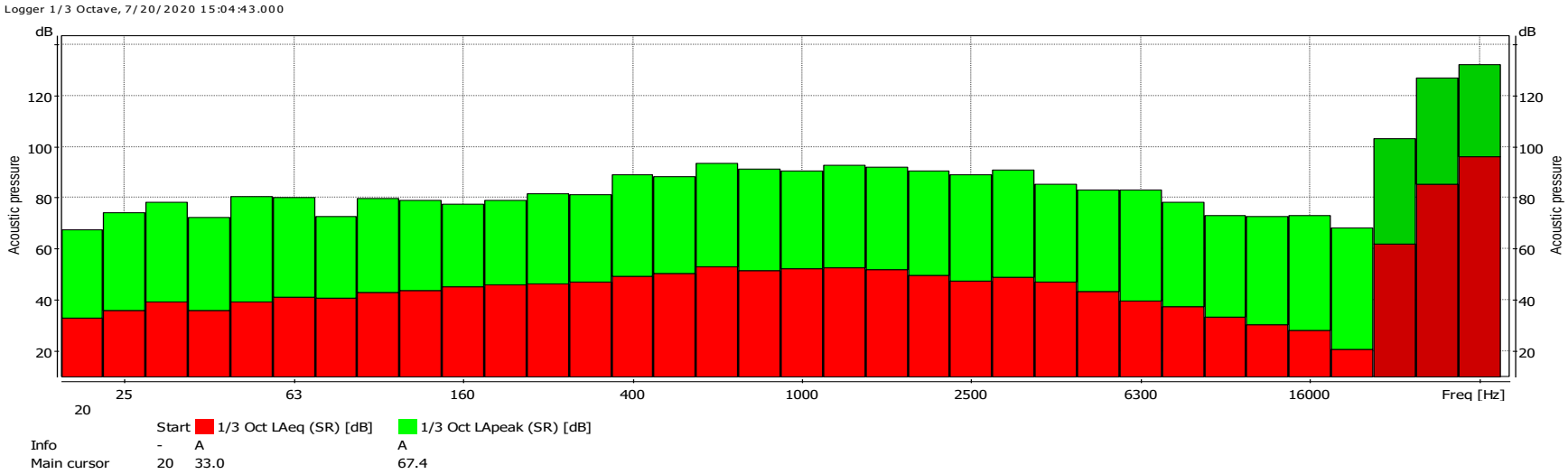


Fig. 2.13:Frequency domain data at coordinate 27.56328188,95.35186403

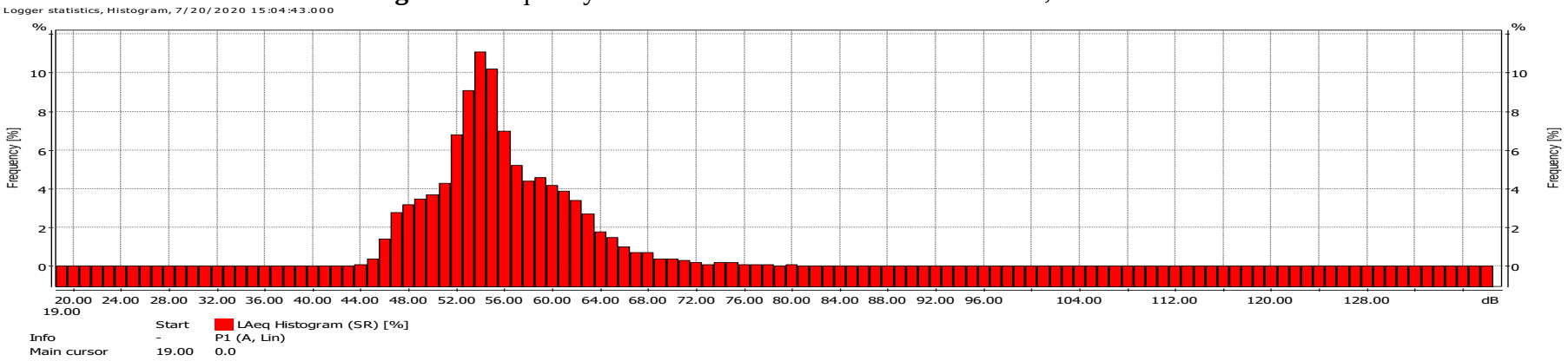


Fig. 2.14 1/3 Octave result summary at coordinate 27.56328188,95.35186403

2.4.6. DATA DETAILS AT COORDINATE 27.56732275,95.35401515

Table 2.6 Parameters and Peak Values at Coordinate: 27.56732275,95.35401515

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	15:11:38	P1	A, Lpeak C	Fast	00:15:05	0	0	dB	104.46	93.2	58.57	67.13	66.86
20-07-2020	15:11:38	P2	C, Lpeak C	Fast	00:15:05	0	0	dB	104.46	95.36	75.59	84.58	85.05
20-07-2020	15:11:38	P3	Z, Lpeak Z	Fast	00:15:05	0	0	dB	110.61	103.53	84.95	94.08	94.91

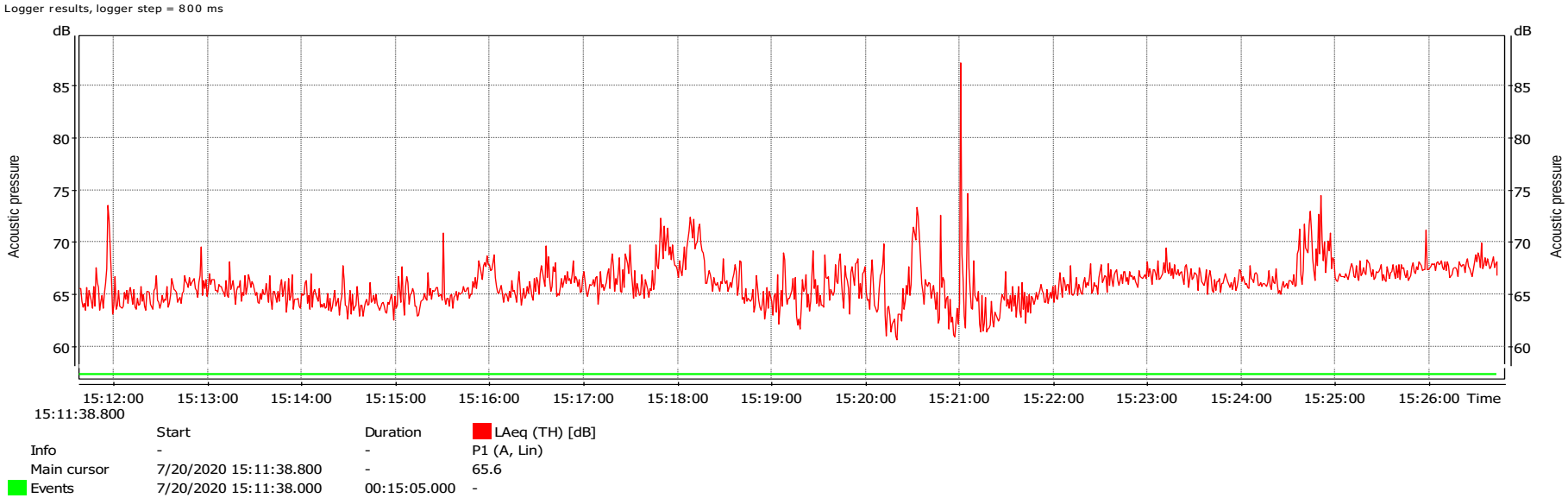


Fig. 2.15 Time Domain Signal/Data at coordinate 27.56732275,95.35401515

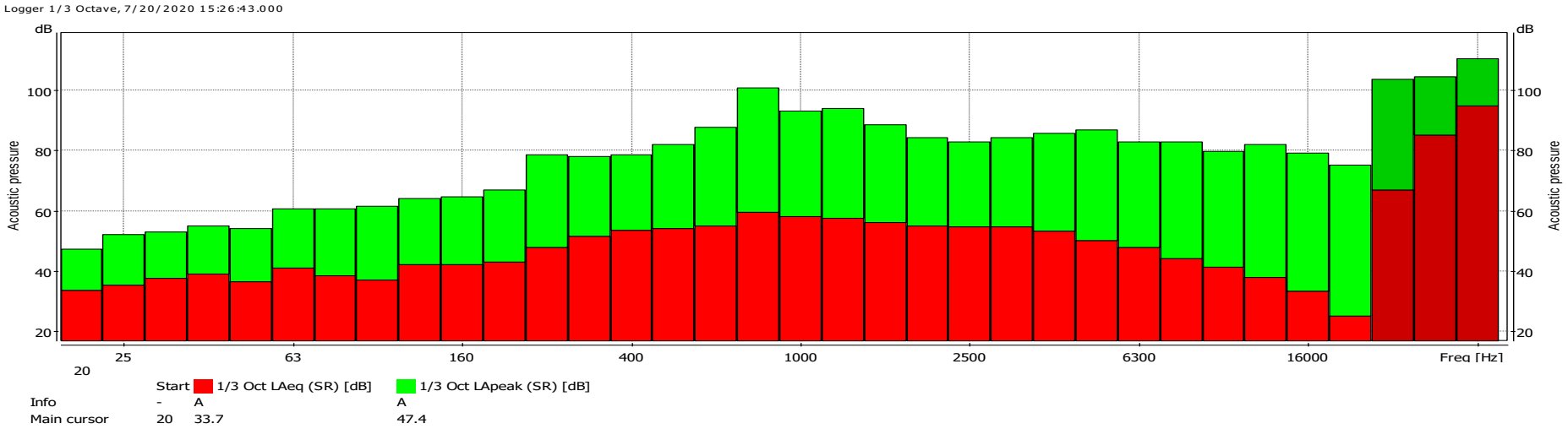


Fig. 2.16:Frequency domain data at coordinate 27.56732275,95.35401515

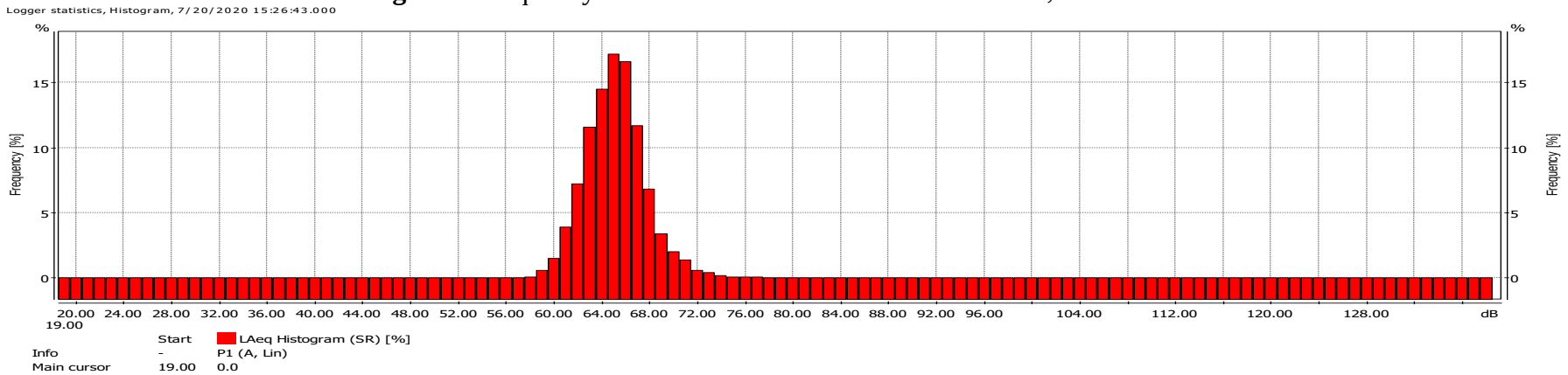


Fig. 2.17 1/3 Octave result summary at coordinate 27.56732275,95.35401515

2.4.7. DATA DETAILS AT COORDINATE 27.56734212,95.35404362

Table 2.7 Parameters and Peak Values at Coordinate: 27.56734212,95.35404362

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	15:35:42	P1	A, Lpeak C	Fast	00:15:04	0	0	dB	104.6	92.2	60.4	66.8	81.3
20-07-2020	15:35:42	P2	C, Lpeak C	Fast	00:15:04	0	0	dB	104.6	93.6	66.2	71.8	82.9
20-07-2020	15:35:42	P3	Z, Lpeak Z	Fast	00:15:04	0	0	dB	106.8	98.2	70.3	77.5	87

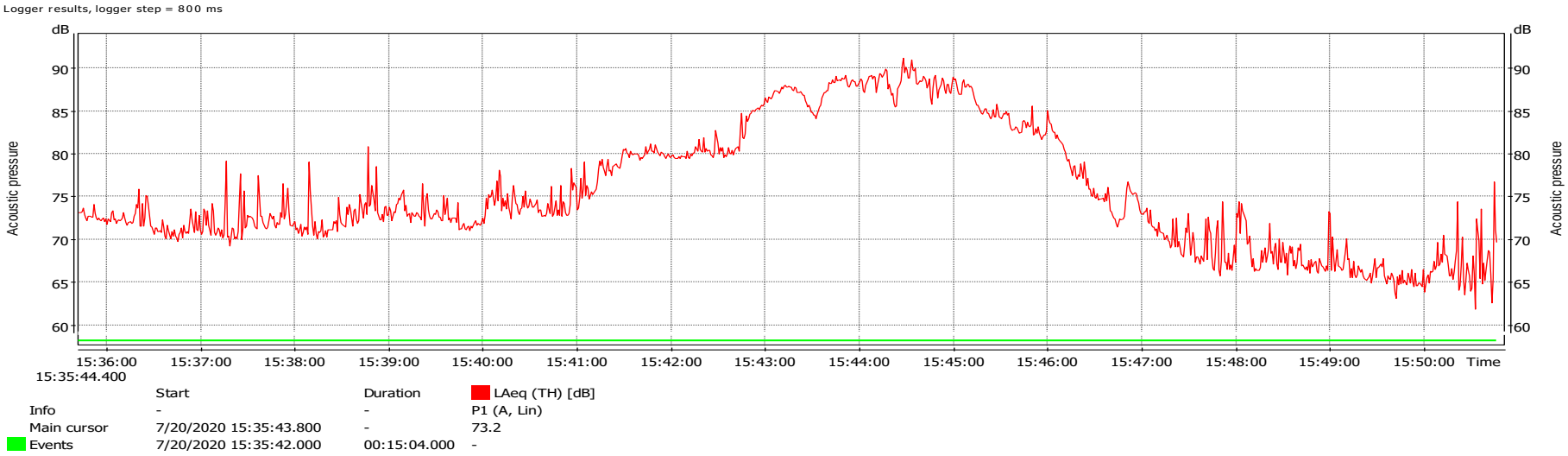


Fig. 2.18 Time Domain Signal/Data at coordinate 27.56734212,95.35404362

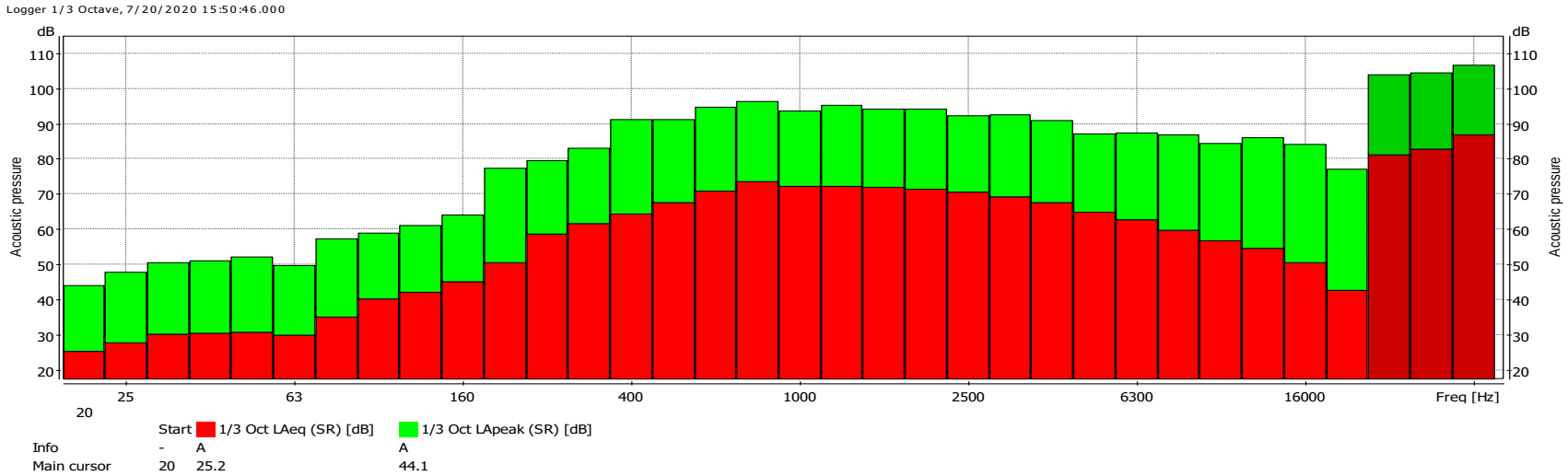


Fig. 2.19:Frequency domain data at coordinate 27.56734212,95.35404362

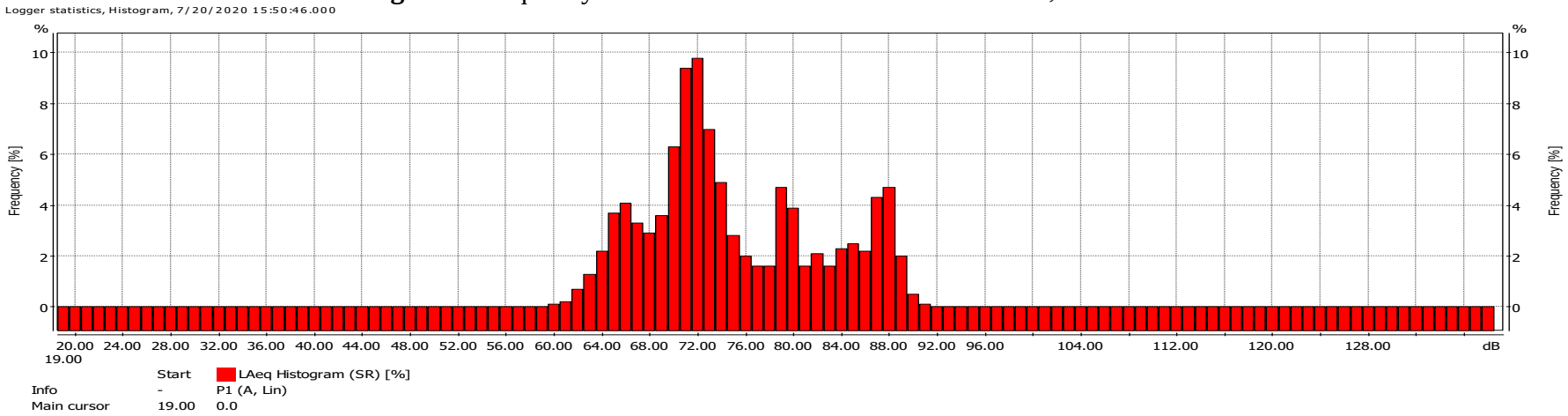


Fig. 2.20 1/3 Octave result summary at coordinate 27.56734212,95.35404362

2.4.8. DATA DETAILS AT COORDINATE 27.56749357,95.36067654

Table 2.8 Parameters and Peak Values at Coordinate: 27.56749357,95.36067654

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	16:07:52	P1	A, Lpeak C	Fast	00:15:05	0	0	dB	101.5	85.7	61.7	67.7	67.5
20-07-2020	16:07:52	P2	C, Lpeak C	Fast	00:15:05	0	0	dB	101.5	91.8	73.7	77.9	81.9
20-07-2020	16:07:52	P3	Z, Lpeak Z	Fast	00:15:05	0	0	dB	109.5	100.3	80.7	87.6	90.9

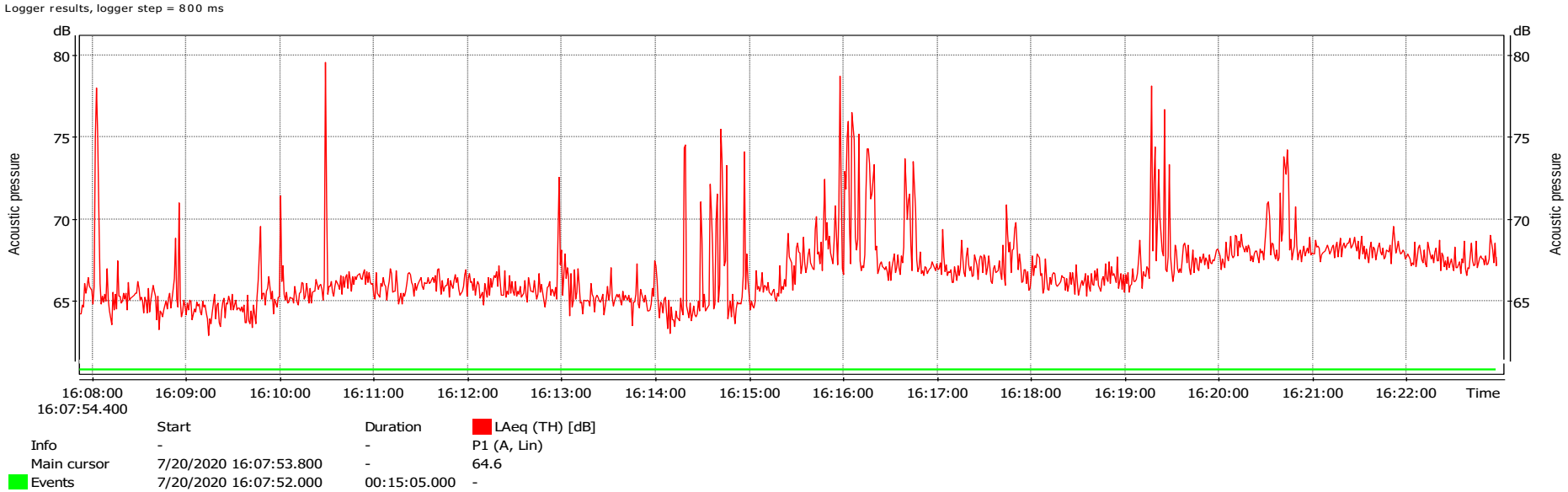


Fig. 2.21 Time Domain Signal/Data at coordinate 27.56749357,95.36067654

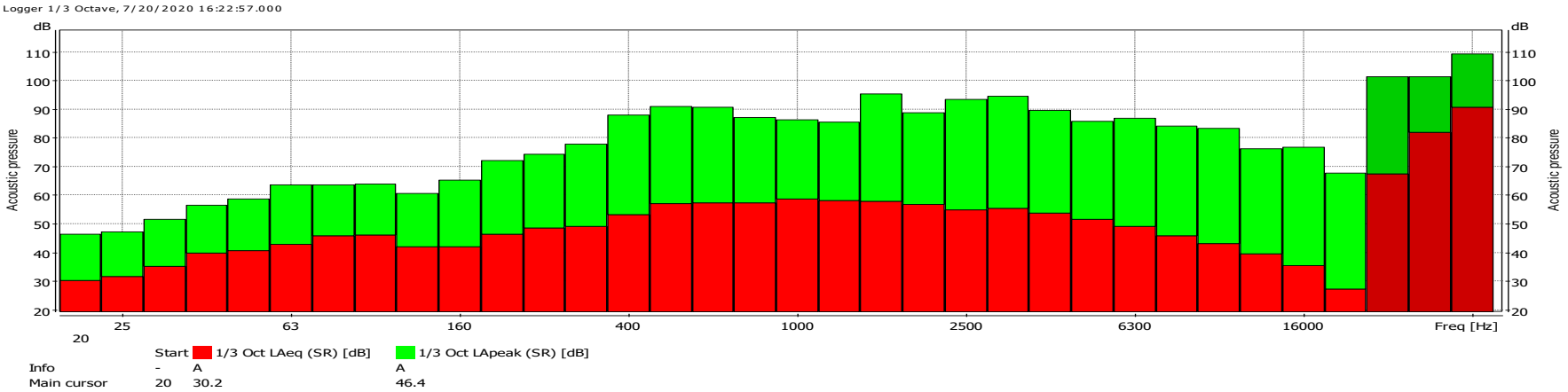


Fig. 2.22:Frequency domain data at coordinate 27.56749357,95.36067654

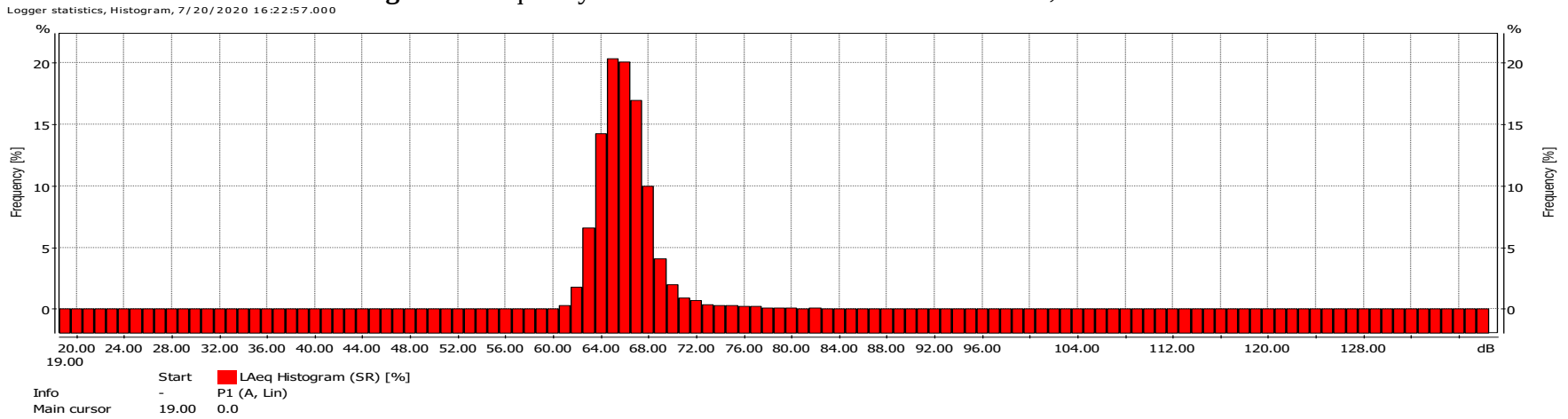


Fig. 2.23 1/3 Octave result summary at coordinate 27.56749357,95.36067654

2.4.9. DATA DETAILS AT COORDINATE 27.59478334,95.38095694

Table 2.9 Parameters and Peak Values at Coordinate: 27.59478334,95.38095694

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	16:44:34	P1	A, Lpeak C	Fast	00:15:08	0	0	dB	112	84.6	50.6	62.8	62.8
20-07-2020	16:44:34	P2	C, Lpeak C	Fast	00:15:08	0	0	dB	112	93.2	75.4	84.8	82.5
20-07-2020	16:44:34	P3	Z, Lpeak Z	Fast	00:15:08	0	0	dB	113.5	96.2	80.8	89.7	88.2

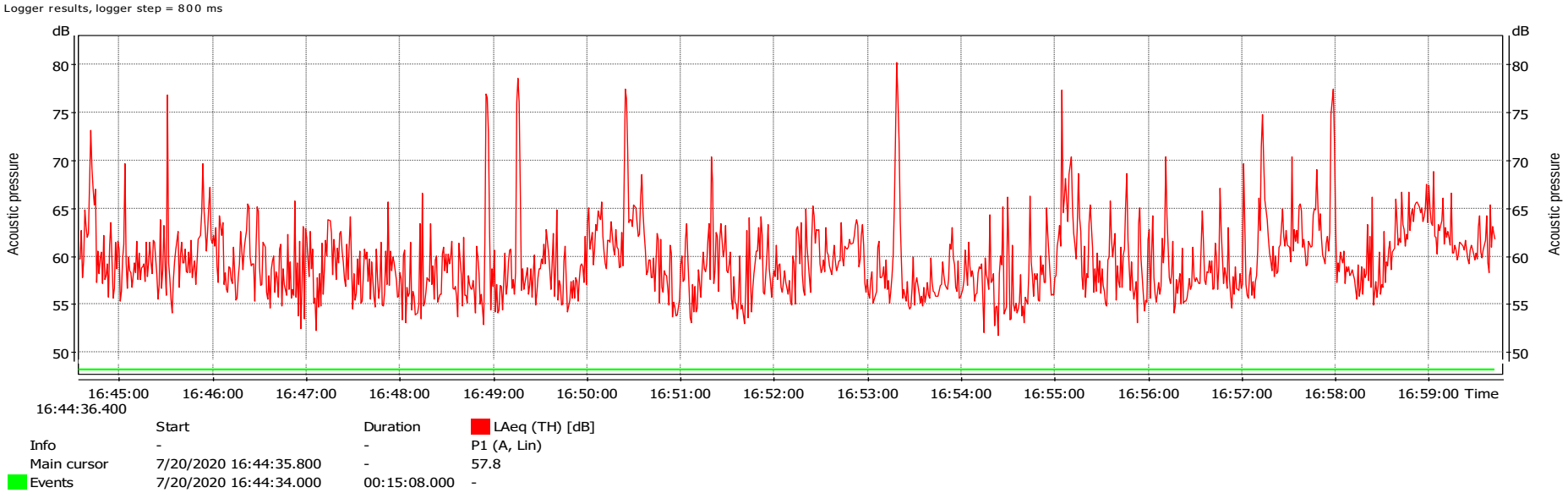


Fig. 2.24: Time Domain Signal/Data at coordinate 27.59478334,95.38095694

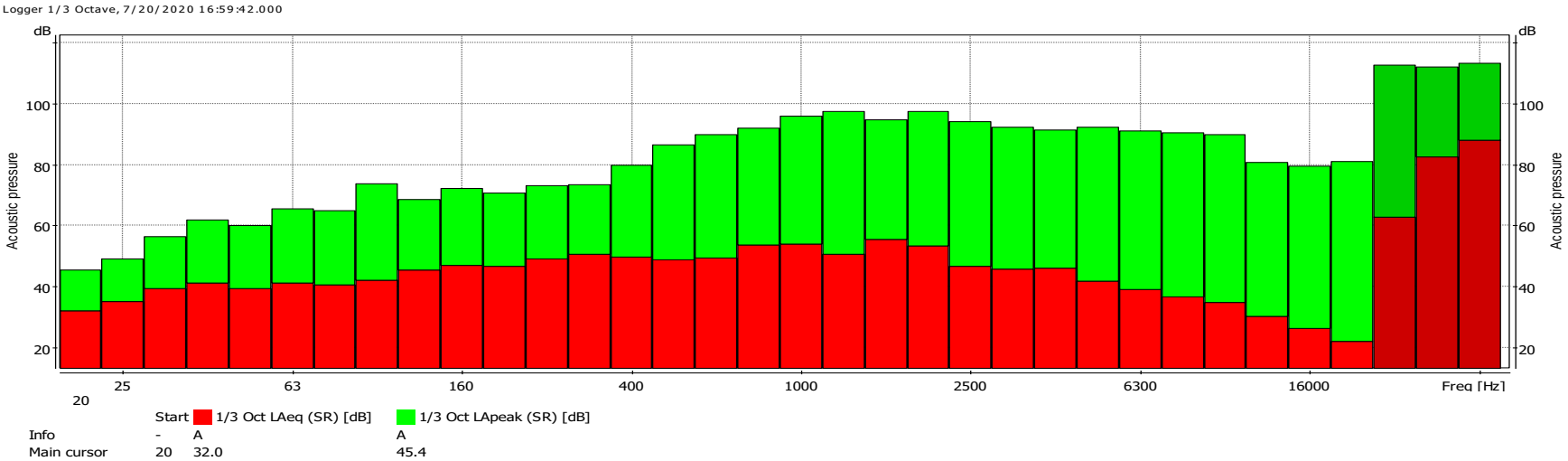


Fig. 2.25:Frequency domain data at coordinate 27.59478334,95.38095694

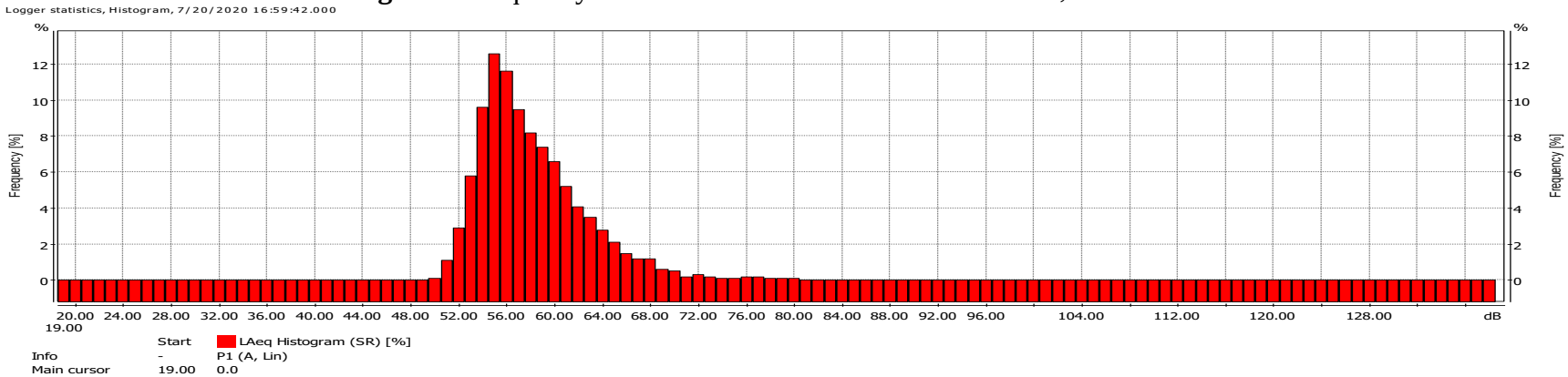


Fig. 2.26: 1/3 Octave result summary at coordinate 27.59478334,95.38095694

2.4.10. DATA DETAILS AT COORDINATE 27.59591043,95.38257916

Table 2.10 Parameters and Peak Values at Coordinate: 27.59591043,95.38257916

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	17:03:36	P1	A, Lpeak C	Fast	00:15:12	0	0	dB	107.2	95.3	55.9	73	67.9
20-07-2020	17:03:36	P2	C, Lpeak C	Fast	00:15:12	0	0	dB	107.2	94.6	79.8	89.2	86.3
20-07-2020	17:03:36	P3	Z, Lpeak Z	Fast	00:15:12	0	0	dB	107.9	96.7	83.5	92.7	90.4

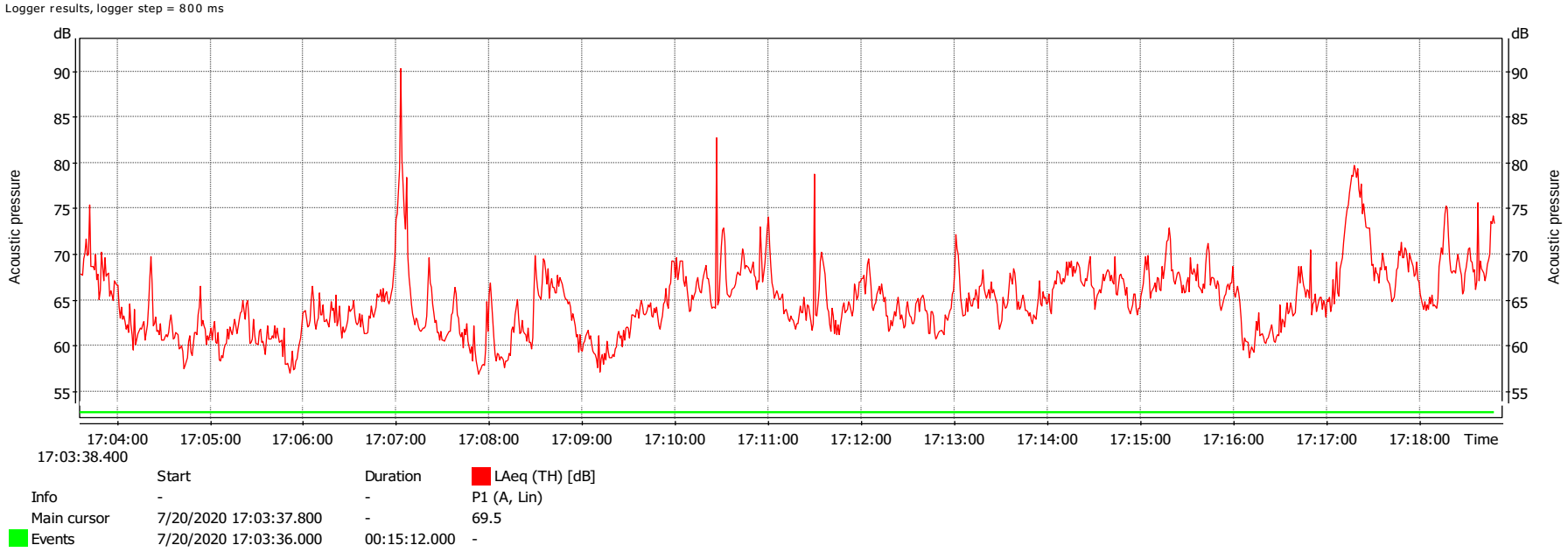


Fig. 2.27: Time Domain Signal/Data at coordinate 27.59591043,95.38257916

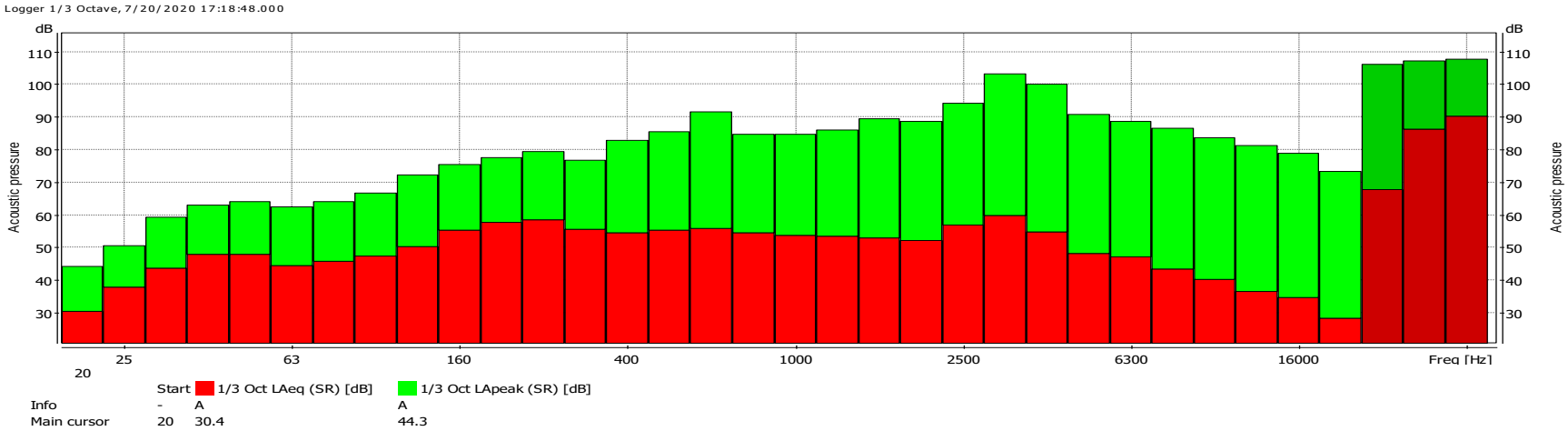


Fig. 2.28:Frequency domain data at coordinate 27.59591043,95.38257916

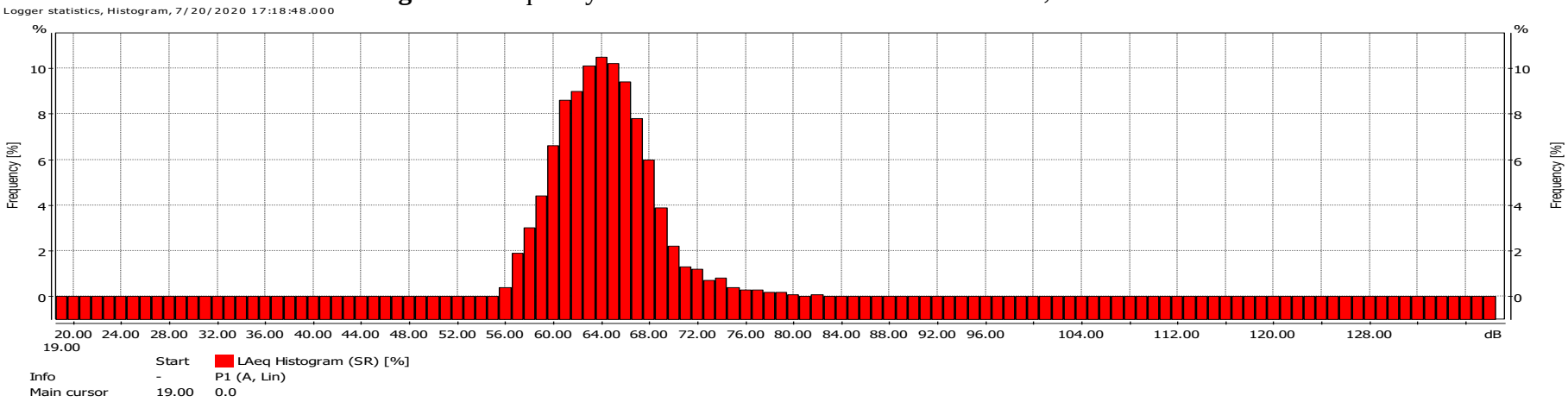


Fig. 2.29: 1/3 Octave result summary at coordinate 27.59591043,95.38257916

2.4.11. DATA DETAILS AT COORDINATE 27.59591873,95.38258025

Table 2.11 Parameters and Peak Values at Coordinate: 27.59591873,95.38258025

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	17:25:54	P1	A, Lpeak C	Fast	00:15:14	0	0	dB	107.9	93.1	67.7	71.8	76.3
20-07-2020	17:25:54	P2	C, Lpeak C	Fast	00:15:14	0	0	dB	107.9	97.9	84.8	90.3	90.7
20-07-2020	17:25:54	P3	Z, Lpeak Z	Fast	00:15:14	0	0	dB	110	100.1	88.7	95.3	94.3

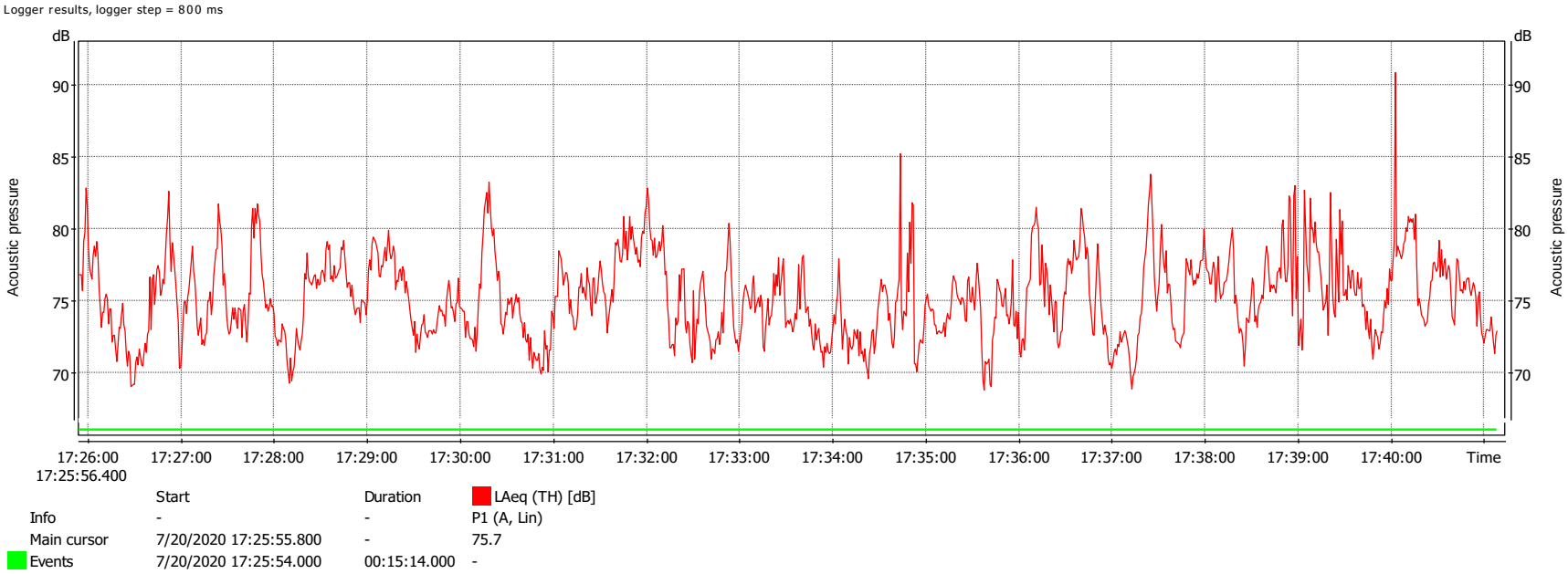


Fig. 2.30: Time Domain Signal/Data at coordinate 27.59591873,95.38258025

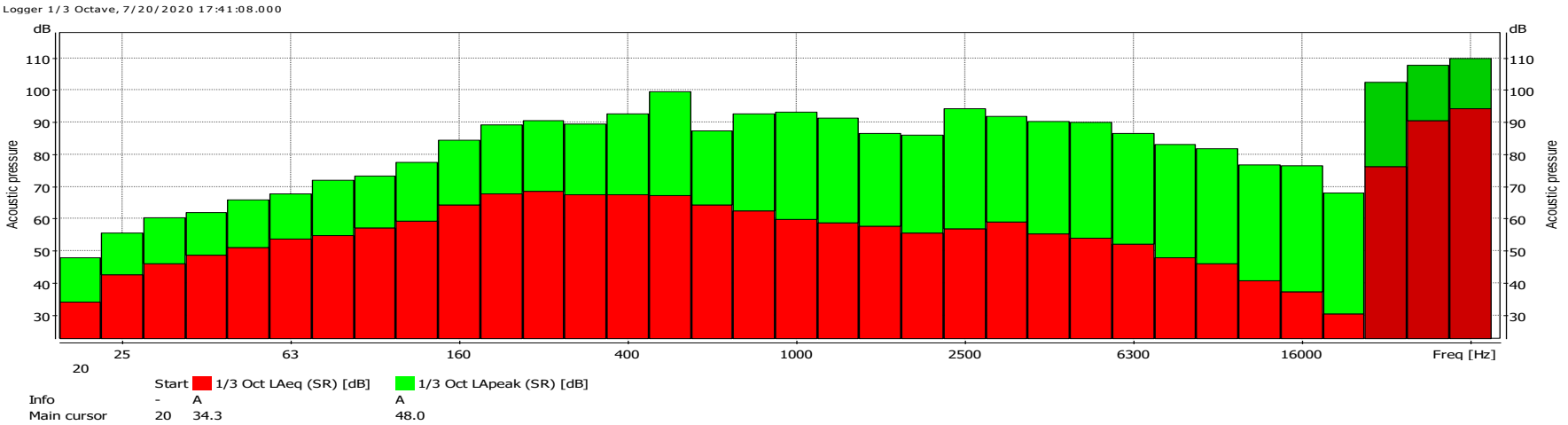


Fig. 2.31:Frequency domain data at coordinate 27.59591873,95.38258025

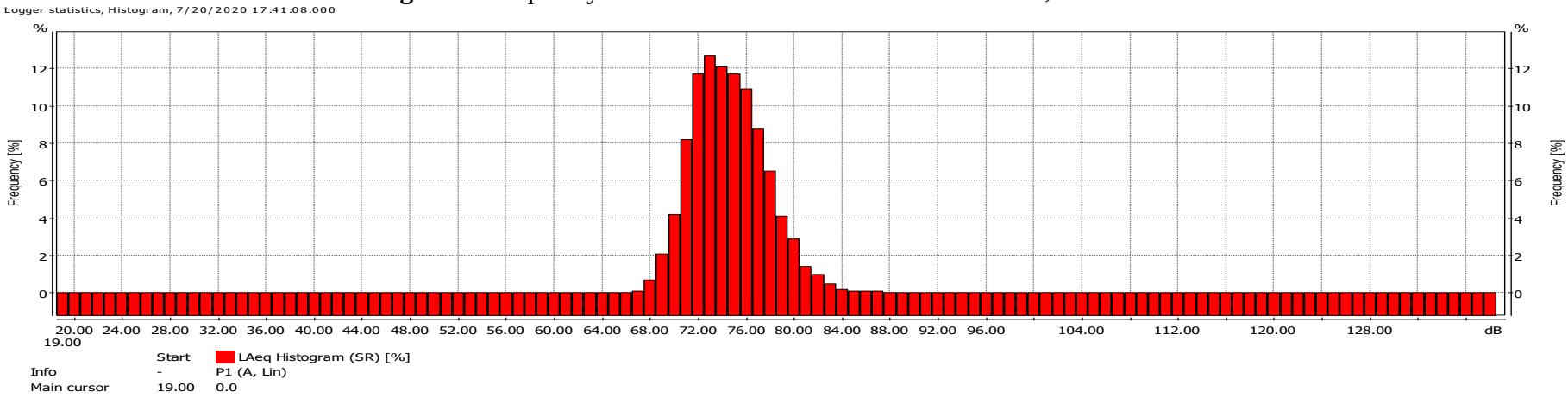


Fig. 2.32: 1/3 Octave result summary at coordinate 27.59591873,95.38258025

2.4.12. DATA DETAILS AT COORDINATE 27.5662653,95.34787

Table 2.12 Parameters and Peak Values at Coordinate: 27.5662653,95.34787

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	17:48:50	P1	A, Lpeak C	Fast	00:15:09	0	0	dB	107	89.5	69.6	81.1	77.3
20-07-2020	17:48:50	P2	C, Lpeak C	Fast	00:15:09	0	0	dB	107	96.7	82.9	87.3	90.9
20-07-2020	17:48:50	P3	Z, Lpeak Z	Fast	00:15:09	0	0	dB	109.7	99.9	87.5	89.9	94.2

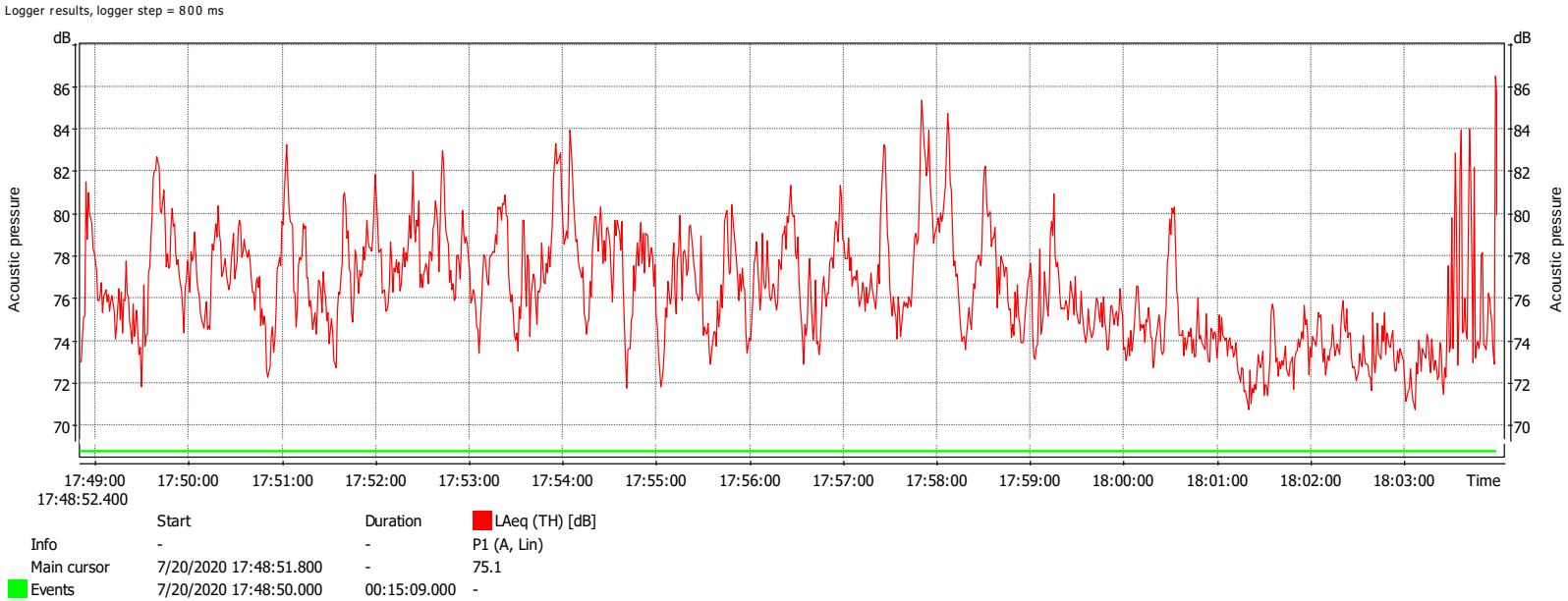


Fig. 2.33: Time Domain Signal/Data at coordinate 27.5662653,95.34787

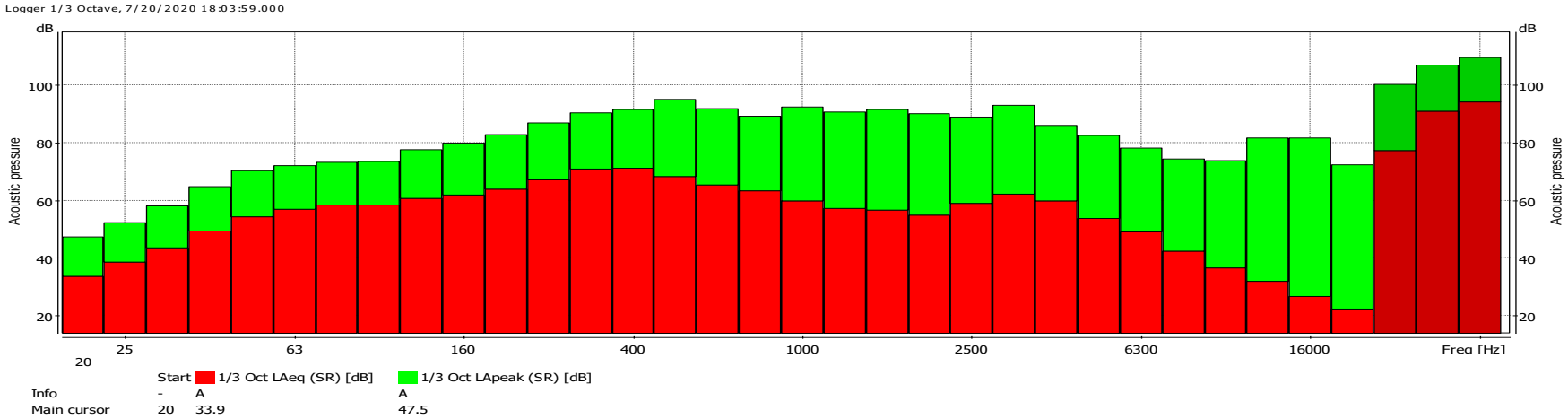


Fig. 2.34:Frequency domain data at coordinate 27.5662653,95.34787

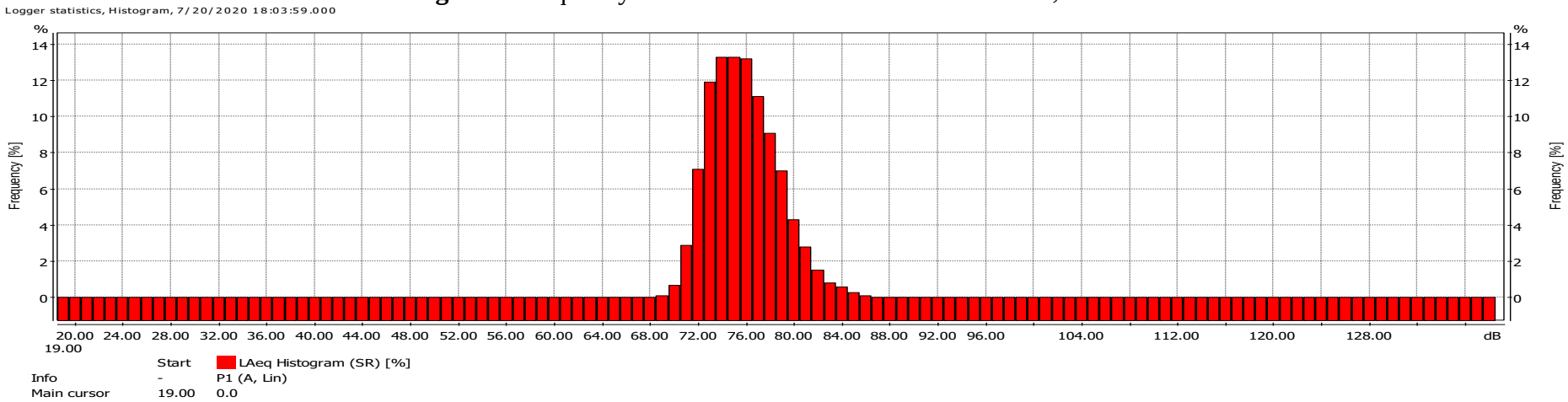


Fig. 2.35: 1/3 Octave result summary at coordinate 27.5662653,95.34787

2.4.13. DATA DETAILS AT COORDINATE 27.59608902,95.38257255

Table 2.13 Parameters and Peak Values at Coordinate: 27.59608902,95.38257255

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	18:25:34	P1	A, Lpeak C	Fast	00:15:18	0	0	dB	123.1	100.6	93.9	96.5	96.6
20-07-2020	18:25:34	P2	C, Lpeak C	Fast	00:15:18	0	0	dB	123.1	111.6	103.7	107	107.2
20-07-2020	18:25:34	P3	Z, Lpeak Z	Fast	00:15:18	0	0	dB	125.3	117	107.4	111.6	111.9

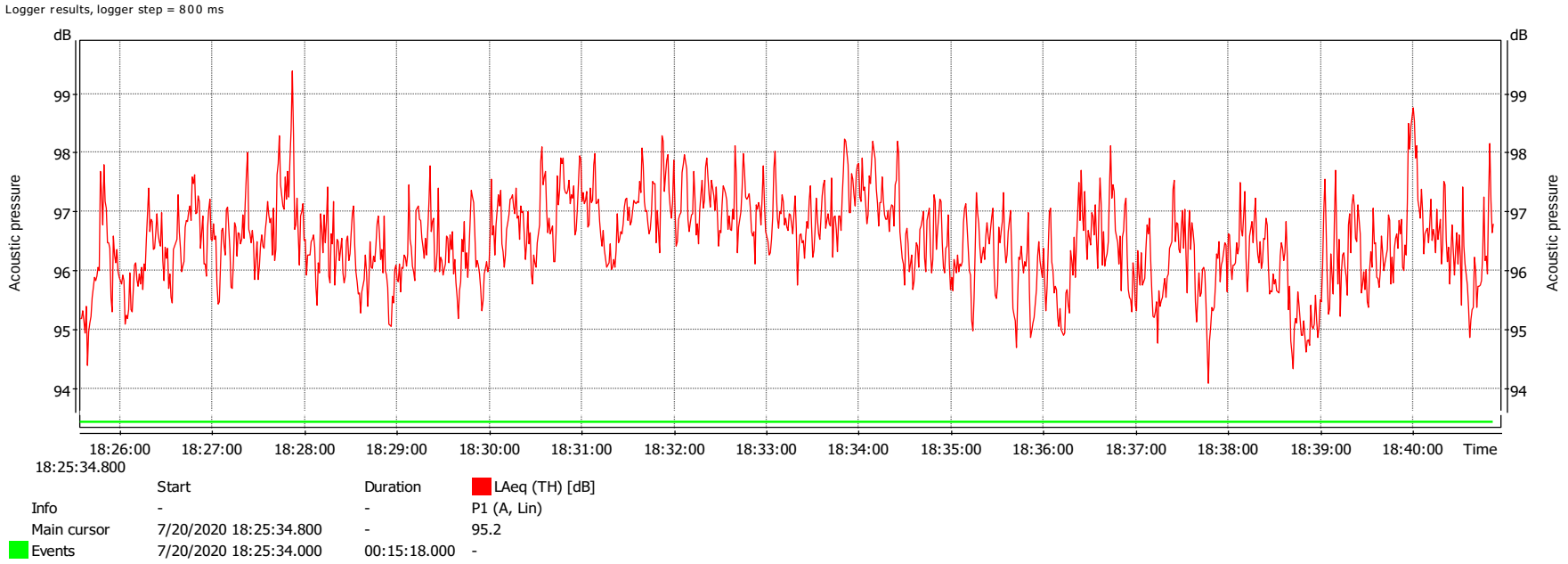


Fig. 2.36: Time Domain Signal/Data at coordinate 27.59608902,95.38257255

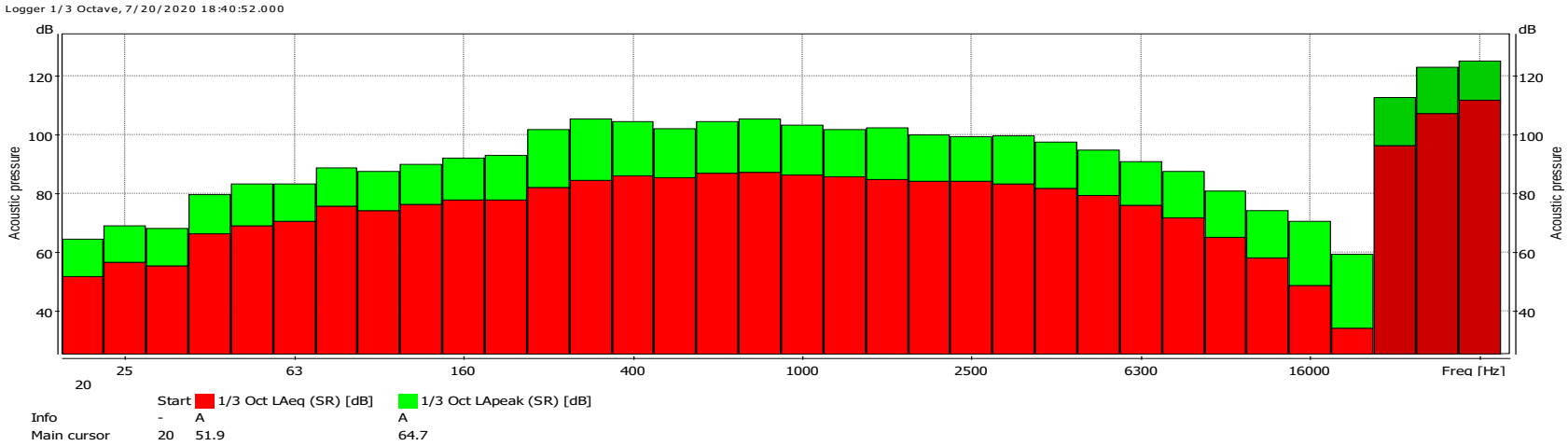


Fig. 2.37:Frequency domain data at coordinate 27.59608902,95.38257255

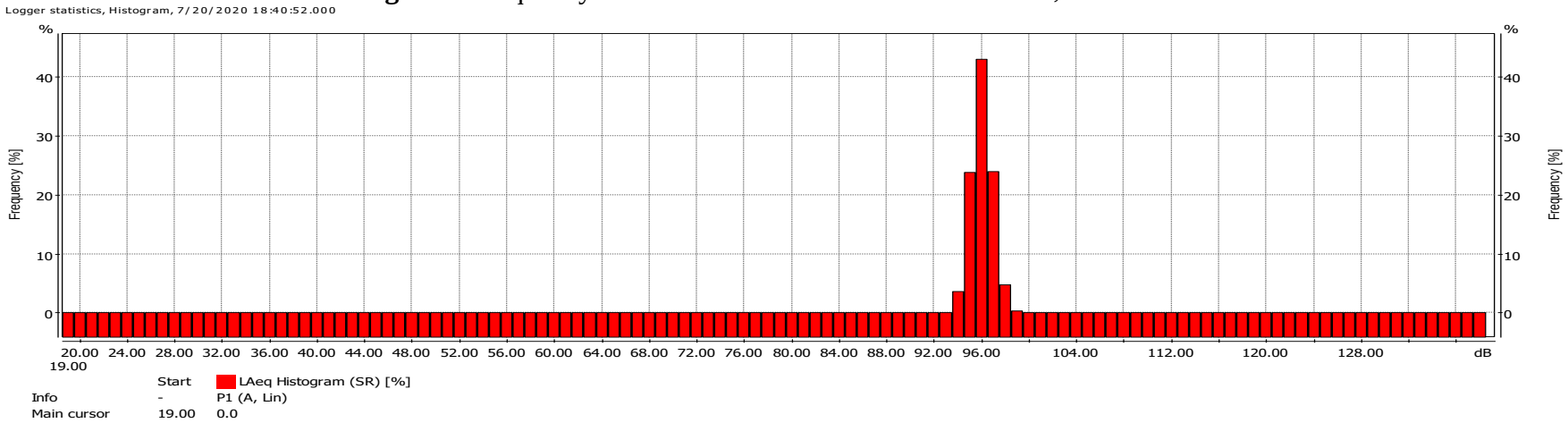


Fig. 2.38: 1/3 Octave result summary at coordinate 27.59608902,95.38257255

2.4.14. DATA DETAILS AT COORDINATE 27.59591873,95.38258025

Table 2.14 Parameters and Peak Values at Coordinate: 27.59591873,95.38258025

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	18:46:56	P1	A, Lpeak C	Fast	00:15:08	0	0	dB	126.1	109.6	98.3	103.6	103
20-07-2020	18:46:56	P2	C, Lpeak C	Fast	00:15:08	0	0	dB	126.1	113.1	105.8	109.5	109.5
20-07-2020	18:46:56	P3	Z, Lpeak Z	Fast	00:15:08	0	0	dB	127.2	116.3	108	112.5	112

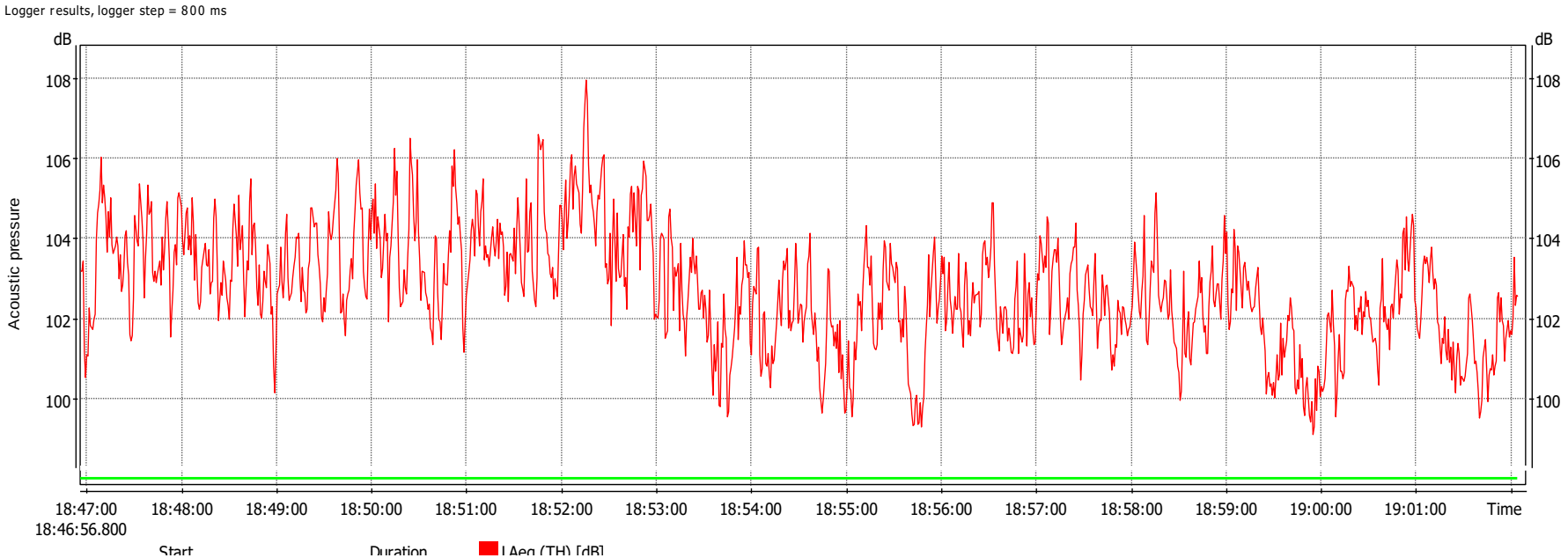


Fig. 2.39: Time Domain Signal/Data at coordinate 27.59591873,95.38258025

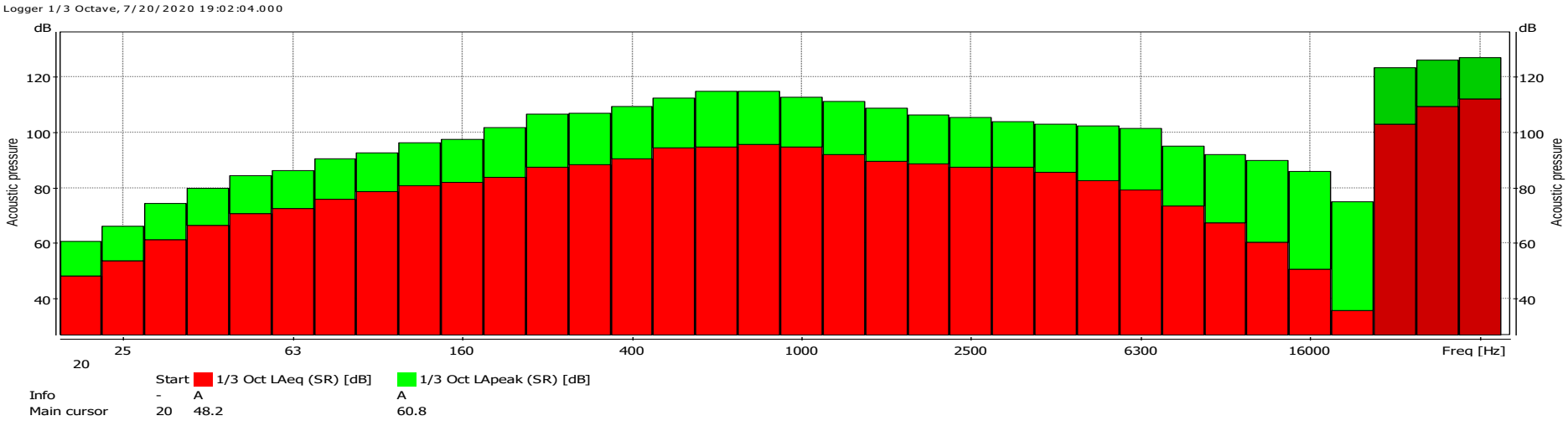


Fig. 2.40:Frequency domain data at coordinate 27.59591873,95.38258025

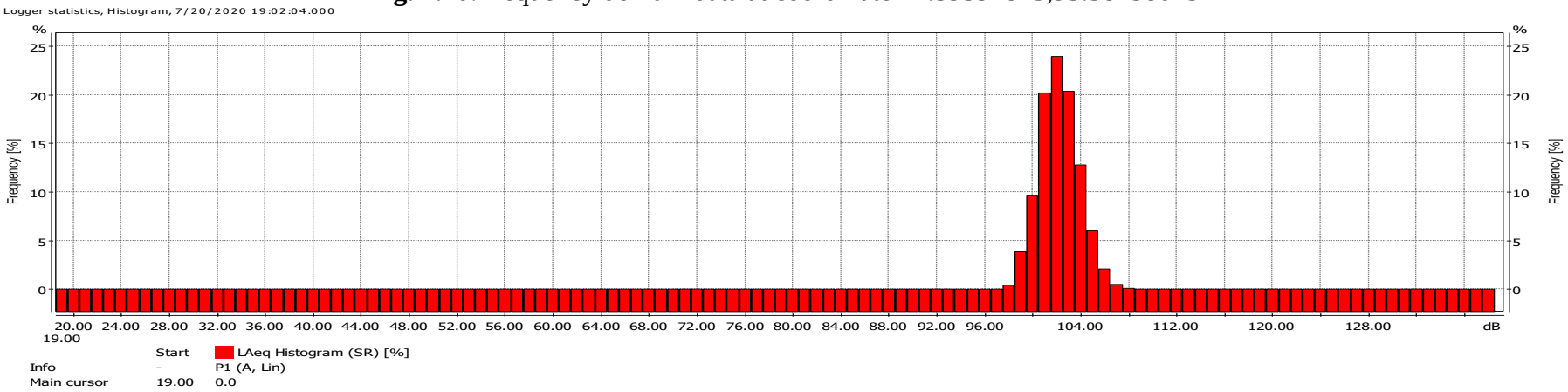


Fig. 2.41: 1/3 Octave result summary at coordinate 27.59591873,95.38258025

2.4.15. DATA DETAILS AT COORDINATE 27.5662653,95.34787

Table 2.15 Parameters and Peak Values at Coordinate: 27.5662653,95.34787

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	19:12:34	P1	A, Lpeak C	Fast	00:15:05	0	0	dB	112.1	82.3	74.1	76.3	78.3
20-07-2020	19:12:34	P2	C, Lpeak C	Fast	00:15:05	0	0	dB	112.1	101.6	91.7	97.8	96.6
20-07-2020	19:12:34	P3	Z, Lpeak Z	Fast	00:15:05	0	0	dB	115.5	106	95.5	102.1	100.7

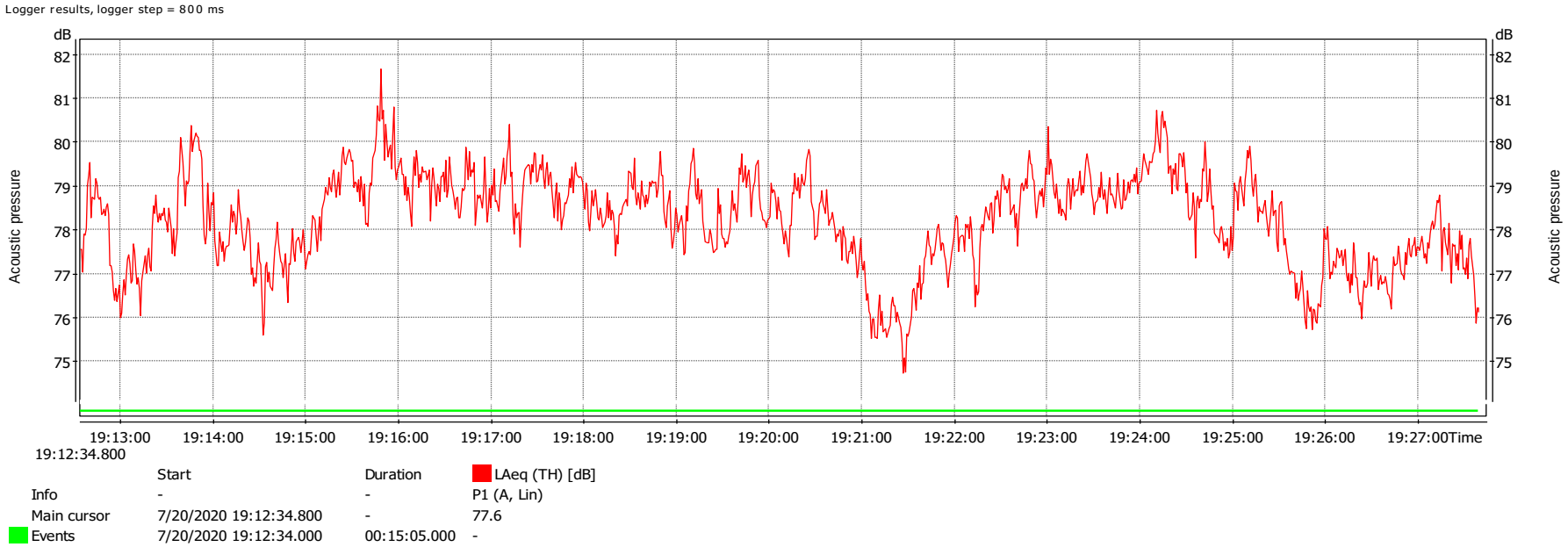


Fig. 2.42: Time Domain Signal/Data at coordinate 27.5662653,95.34787

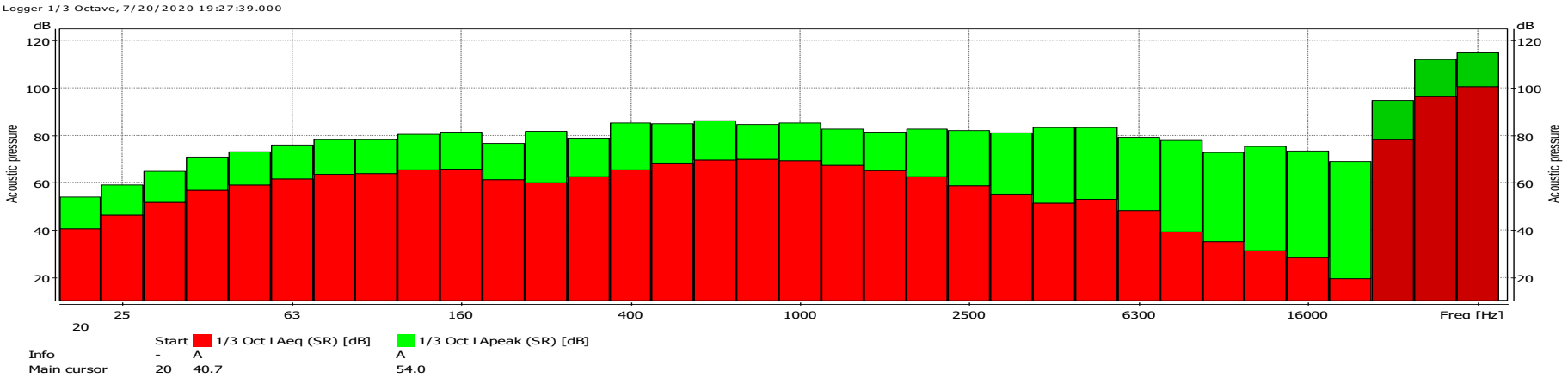


Fig. 2.43:Frequency domain data at coordinate 27.5662653,95.34787

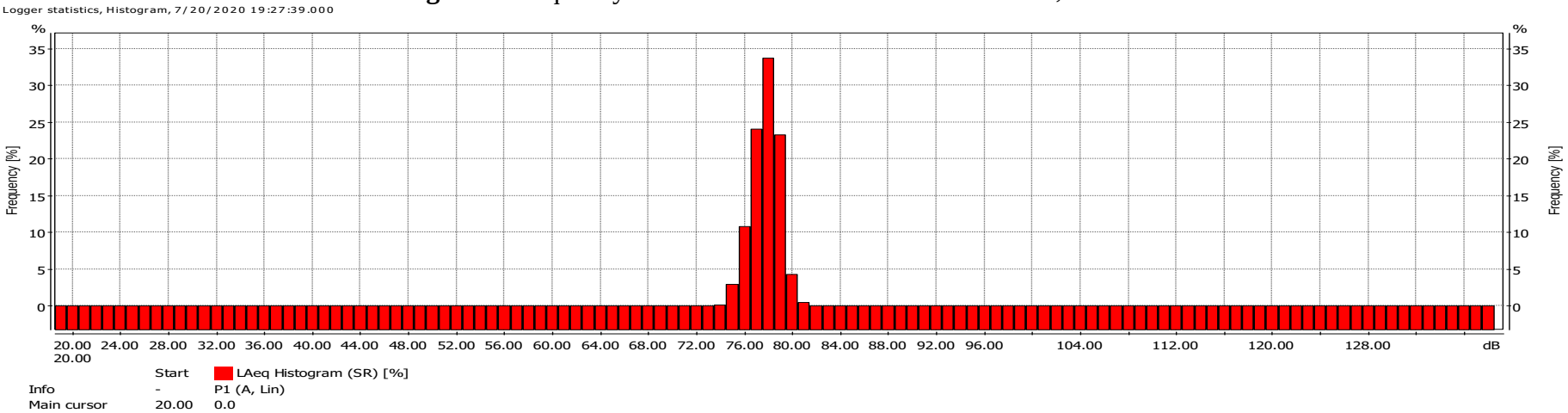


Fig. 2.44: 1/3 Octave result summary at coordinate 27.5662653,95.34787

2.4.16. DATA DETAILS AT COORDINATE 27.5959434,95.38258096

Table 2.16 Parameters and Peak Values at Coordinate: 27.5959434,95.38258096

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	19:33:24	P1	A, Lpeak C	Fast	00:15:03	0	0	dB	103.7	79.8	66.6	73.3	71.5
20-07-2020	19:33:24	P2	C, Lpeak C	Fast	00:15:03	0	0	dB	103.7	93.9	83.1	89.7	89.3
20-07-2020	19:33:24	P3	Z, Lpeak Z	Fast	00:15:03	0	0	dB	110.4	101.6	89.7	93.6	95.7

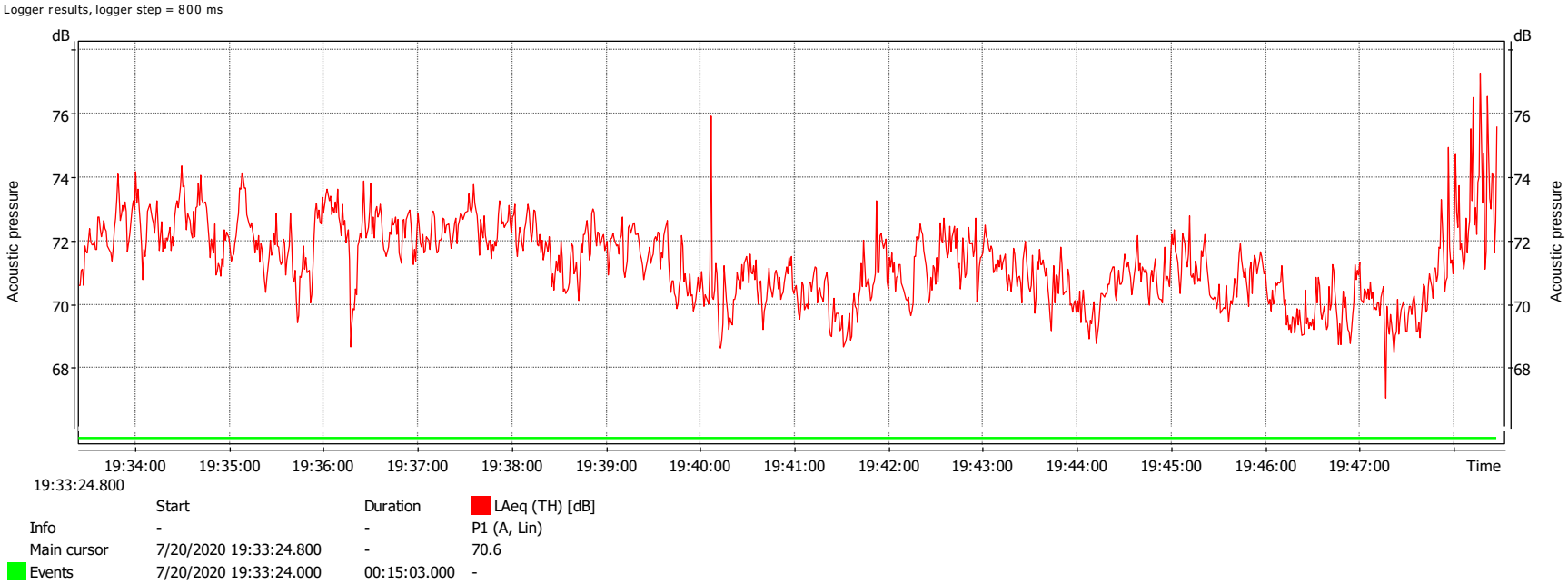


Fig. 2.45: Time Domain Signal/Data at coordinate 27.5959434,95.38258096

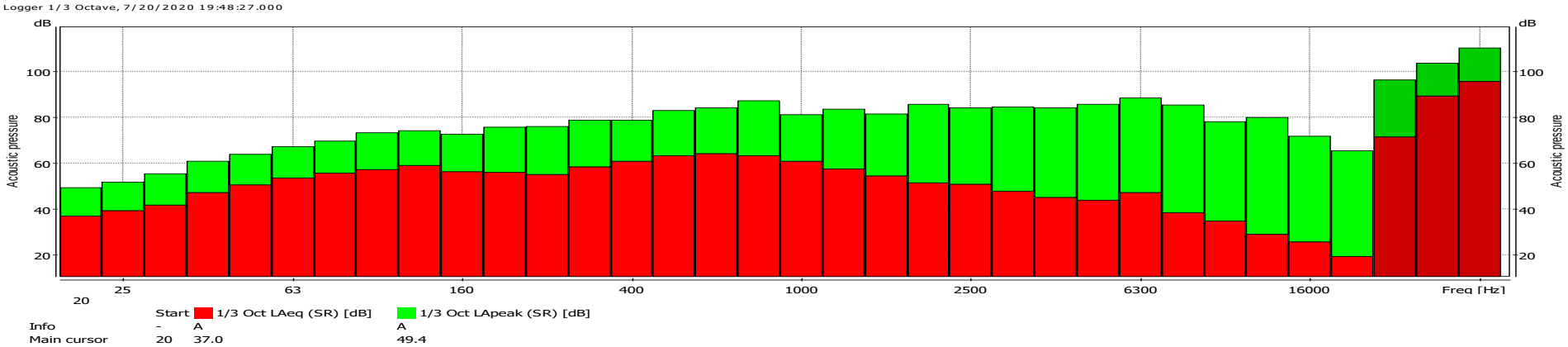


Fig. 2.46:Frequency domain data at coordinate 27.5959434,95.38258096

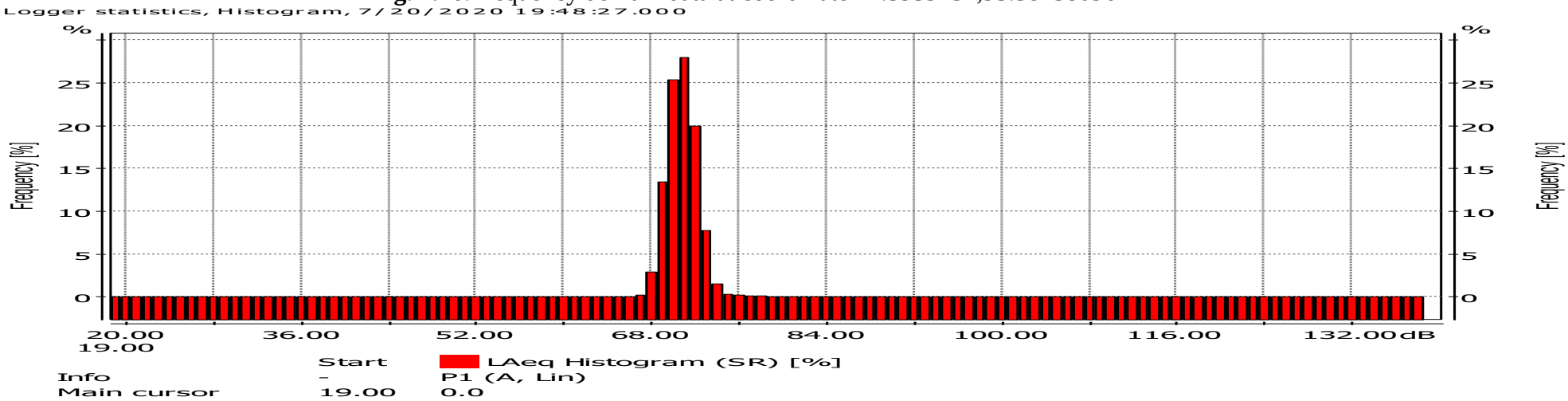


Fig. 2.47: 1/3 Octave result summary at coordinate 27.5959434,95.38258096

2.4.17. DATA DETAILS AT COORDINATE 27.59871847,95.38508162

Table 2.17 Parameters and Peak Values at Coordinate: 27.59871847,95.38508162

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
20-07-2020	19:56:42	P1	A, Lpeak C	Fast	00:15:34	0	0	dB	110.8	80.5	71	76.8	76
20-07-2020	19:56:42	P2	C, Lpeak C	Fast	00:15:34	0	0	dB	110.8	101.6	89.6	96.8	95.8
20-07-2020	19:56:42	P3	Z, Lpeak Z	Fast	00:15:34	0	0	dB	116.5	107.1	94.6	102.6	101.4

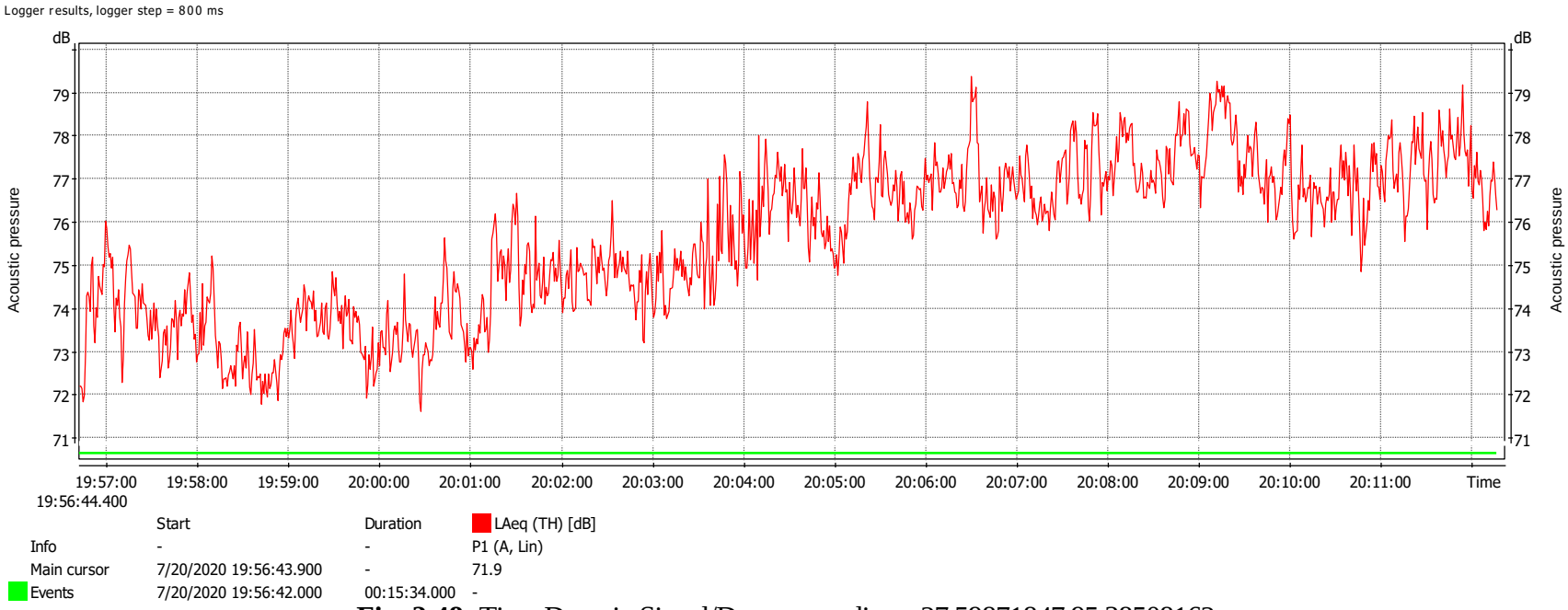


Fig. 2.48: Time Domain Signal/Data at coordinate 27.59871847,95.38508162

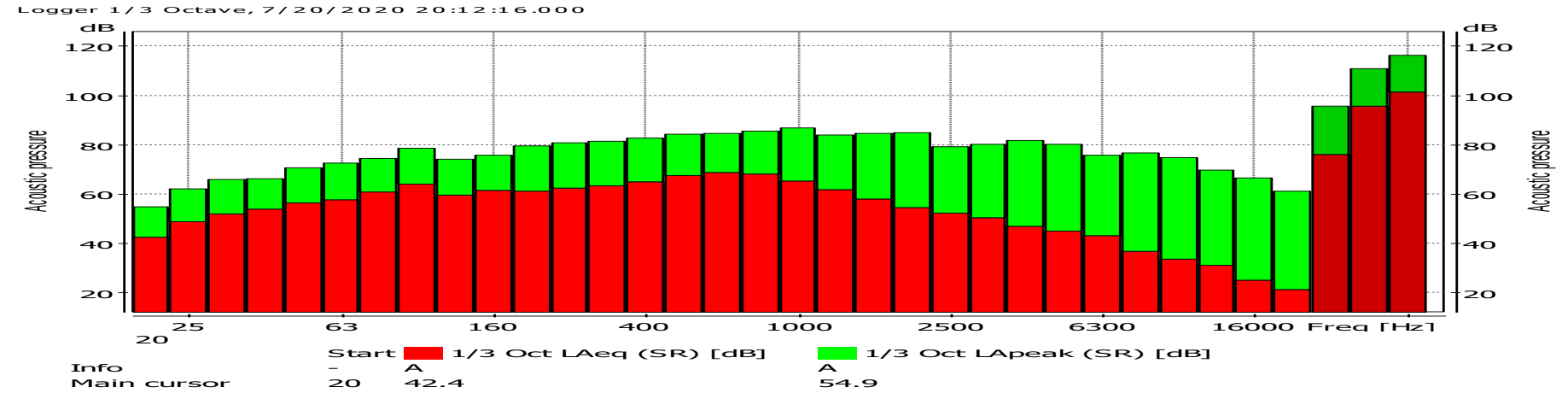


Fig. 2.49:Frequency domain data at coordinate 27.59871847,95.38508162

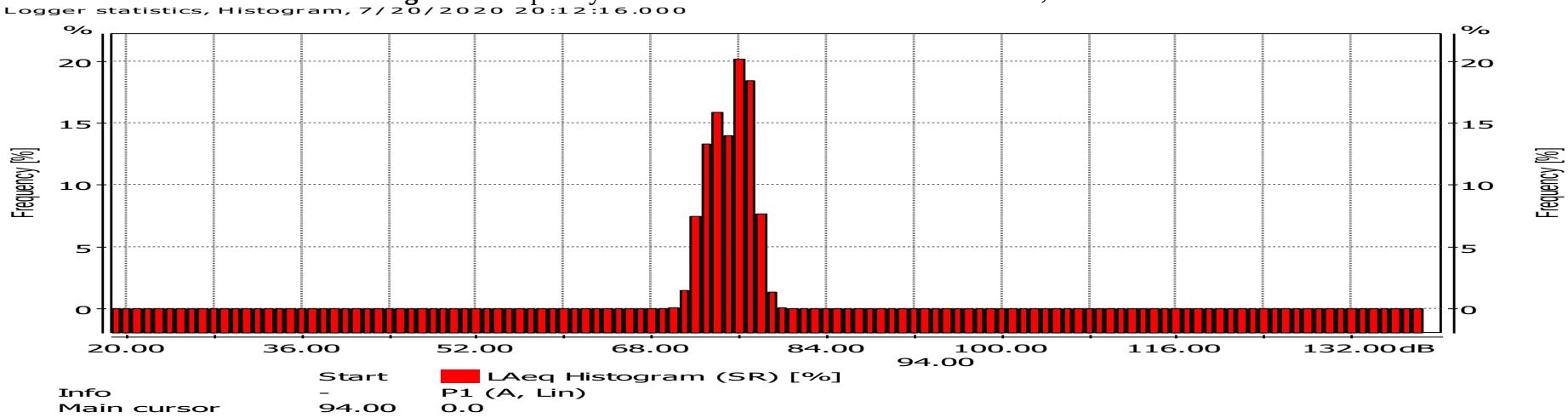


Fig. 2.50: 1/3 Octave result summary at coordinate 27.59871847,95.38508162

2.4.18. DATA DETAILS AT COORDINATE 27.60130352,95.38647372

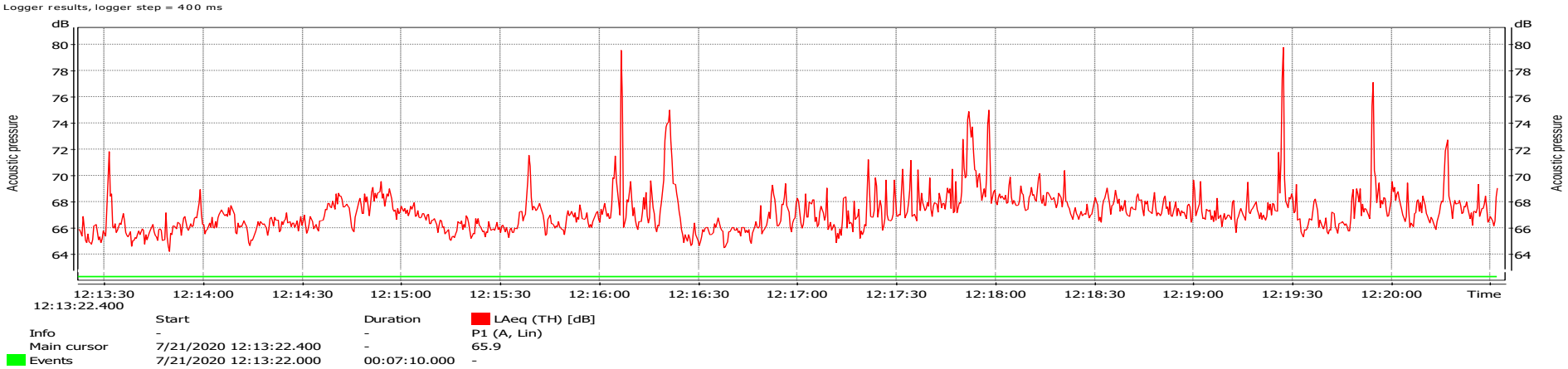


Fig. 2.51: Time Domain Signal/Data at coordinate 27.60130352,95.38647372

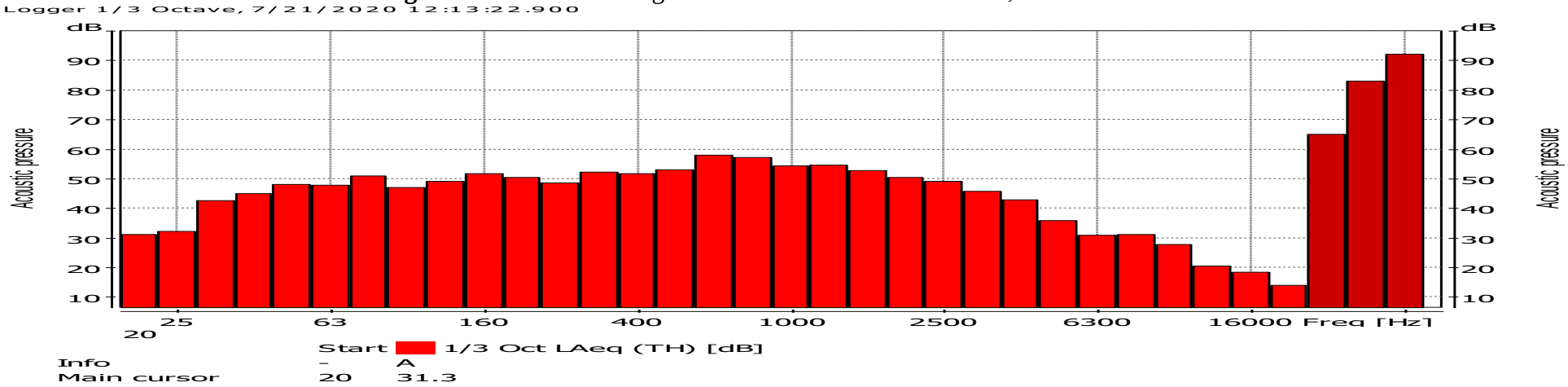


Fig. 2.52:Frequency domain data at coordinate 27.60130352,95.38647372

2.4.19. DATA DETAILS AT COORDINATE 27.60198671,95.38574775

Table 2.18 Parameters and Peak Values at Coordinate: 27.60198671,95.38574775

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
21-07-2020	12:22:20	P1	A, Lpeak C	Fast	00:15:17	0	0	dB	104.1	92.4	63.8	71	68.8
21-07-2020	12:22:20	P2	C, Lpeak C	Fast	00:15:17	0	0	dB	104.1	94.6	81.5	88	87.5
21-07-2020	12:22:20	P3	Z, Lpeak Z	Fast	00:15:17	0	0	dB	109.3	101	87.5	94.7	94.3

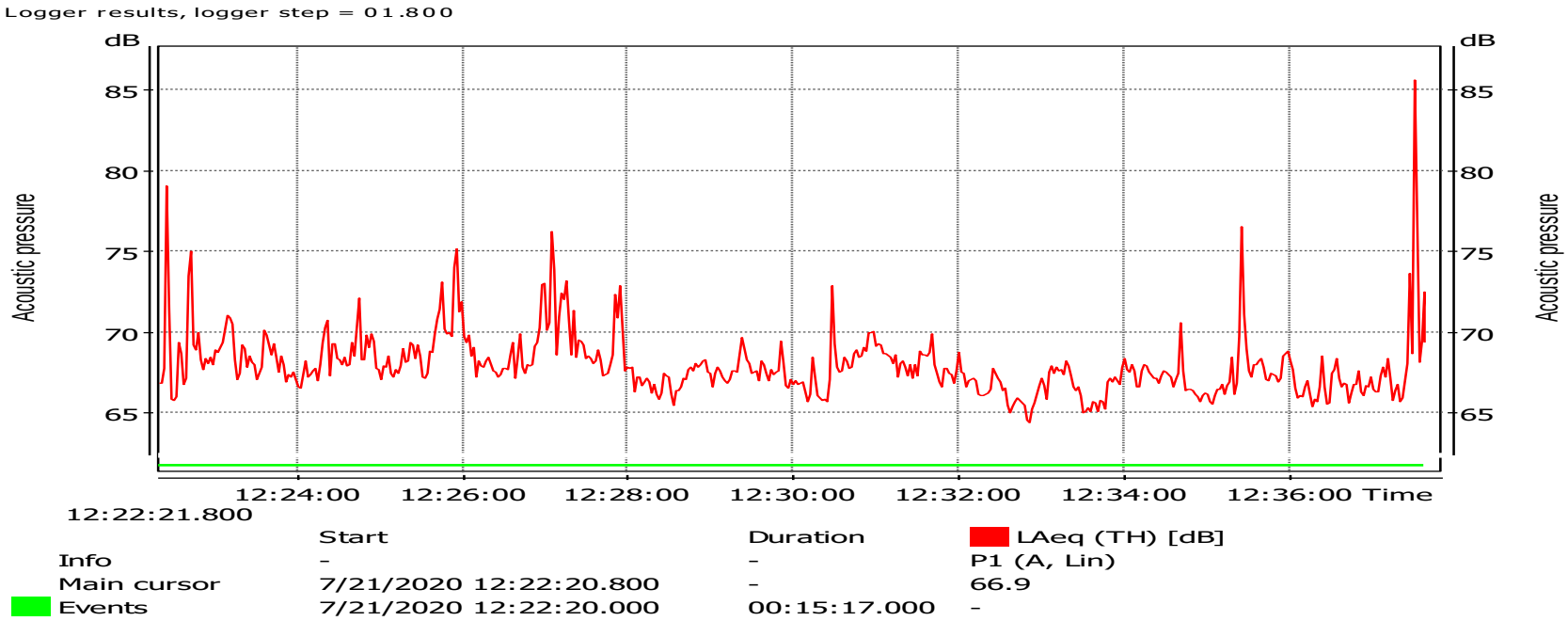


Fig. 2.53 Time Domain Signal/Data at coordinate 27.60198671,95.38574775

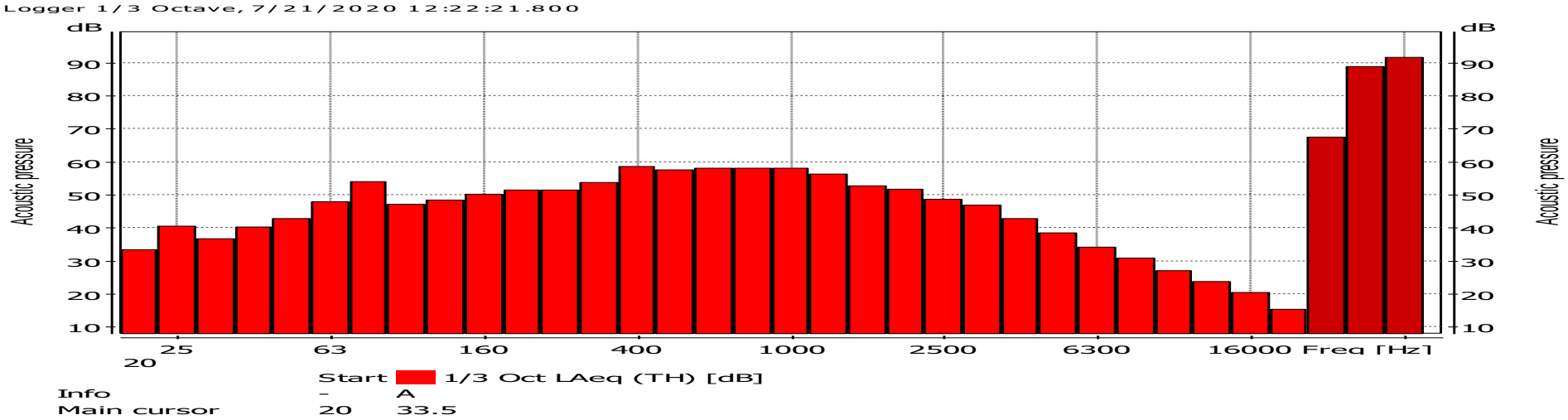


Fig. 2.54:Frequency domain data at coordinate 27.60198671,95.38574775

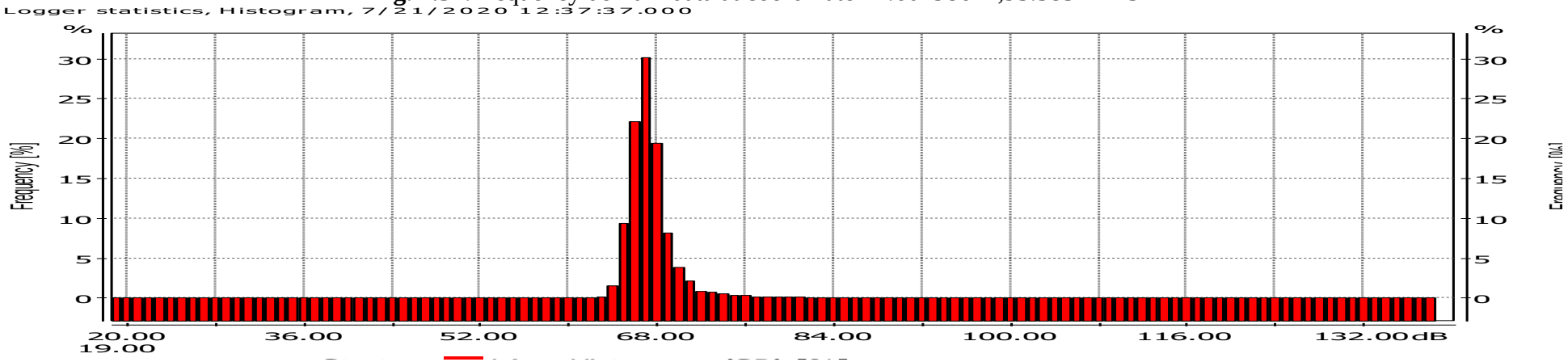


Fig. 2.55 1/3 Octave result summary at coordinate 27.60198671,95.38574775

2.4.20. DATA DETAILS AT COORDINATE 27.59764506,95.39137965

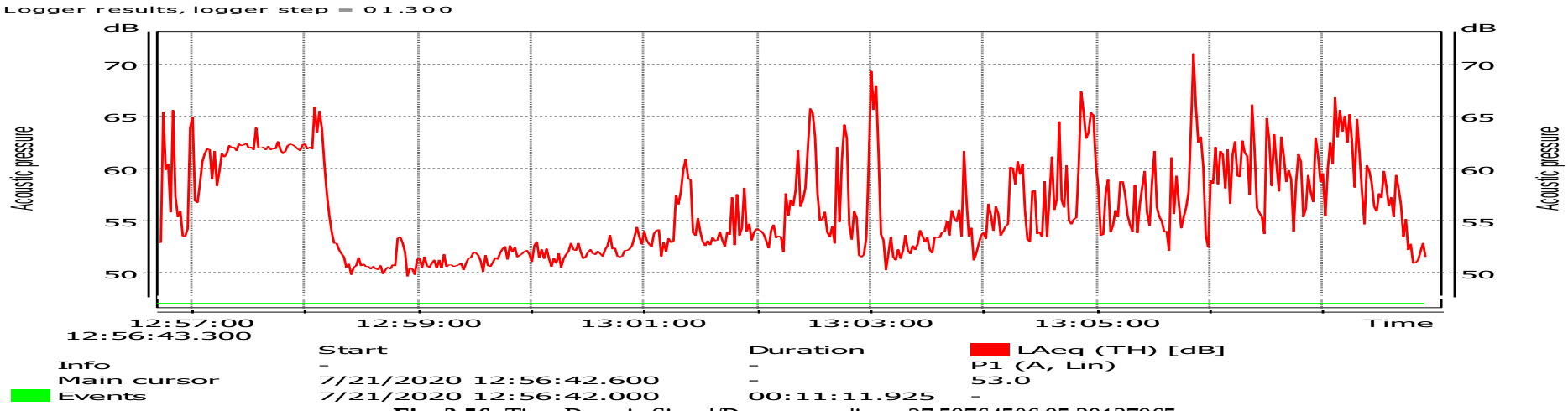


Fig. 2.56: Time Domain Signal/Data at coordinate 27.59764506,95.39137965

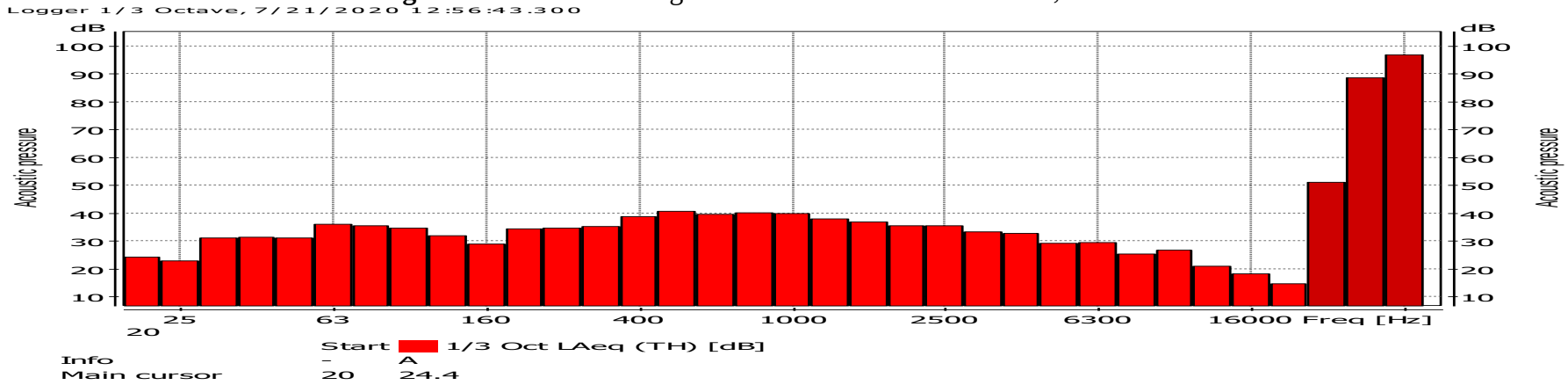


Fig. 2.57:Frequency domain data at coordinate 27.59764506,95.39137965

2.4.21. DATA DETAILS AT COORDINATE 27.59740903,95.39159112

Table 2.19 Parameters and Peak Values at Coordinate: 27.59740903,95.39159112

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
21-07-2020	13:12:54	P1	A, Lpeak C	Fast	00:15:02	0	0	dB	104.3	79.3	49.8	52.6	56.8
21-07-2020	13:12:54	P2	C, Lpeak C	Fast	00:15:02	0	0	dB	104.3	95.7	77.4	85.1	86.5
21-07-2020	13:12:54	P3	Z, Lpeak Z	Fast	00:15:02	0	0	dB	114.1	108.6	85.3	97.2	98

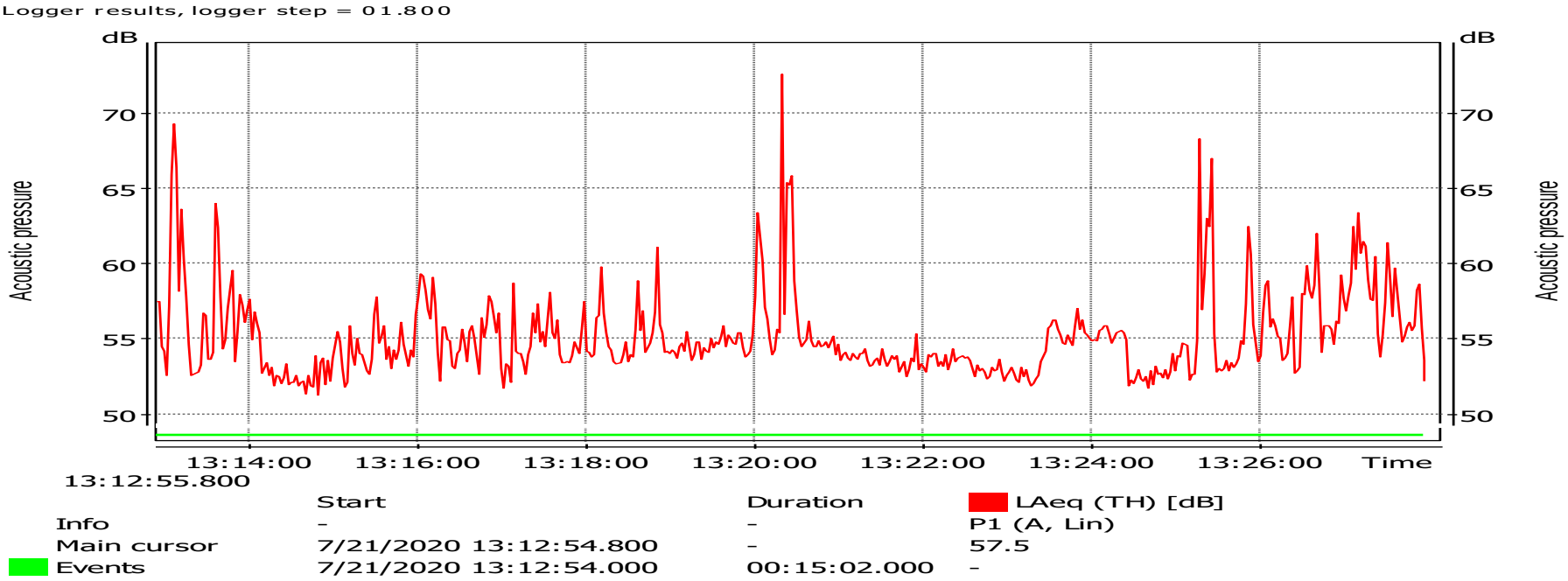


Fig. 2.58: Time Domain Signal/Data at coordinate 27.59740903,95.39159112

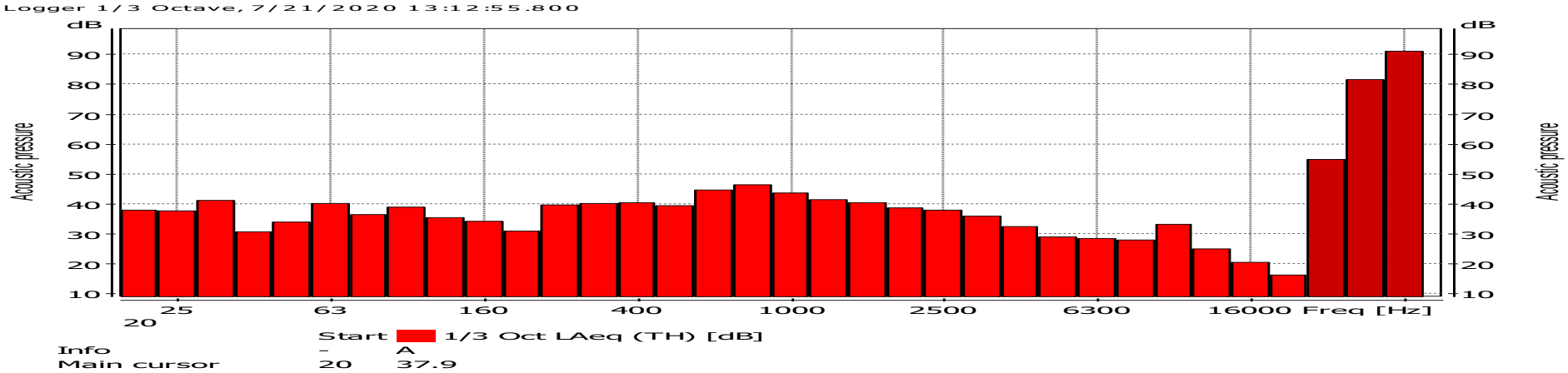


Fig. 2.59:Frequency domain data at coordinate 27.59740903,95.39159112

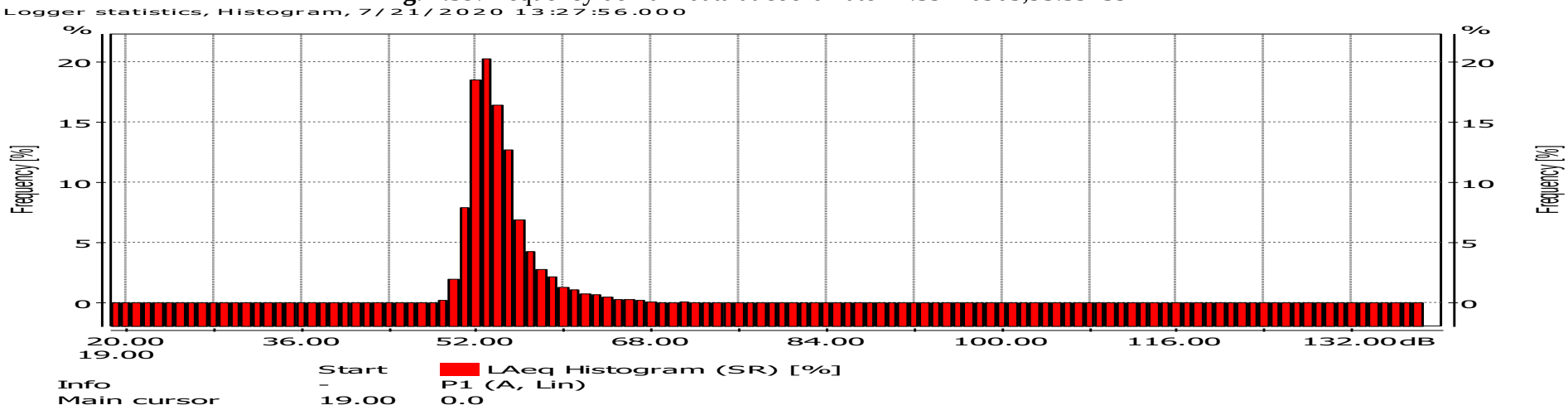


Fig. 2.60: 1/3 Octave result summary at coordinate 27.59740903,95.39159112

2.4.22. DATA DETAILS AT COORDINATE 27.5932051,95.39897968

Table 2.20 Parameters and Peak Values at Coordinate: 27.5932051,95.39897968

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
21-07-2020	13:52:14	P1	A, Lpeak C	Fast	00:19:32	0	0	dB	104.6	85.3	45.5	56	60.6
21-07-2020	13:52:14	P2	C, Lpeak C	Fast	00:19:32	0	0	dB	104.6	93.7	72.4	83.4	82.9
21-07-2020	13:52:14	P3	Z, Lpeak Z	Fast	00:19:32	0	0	dB	110.3	104	81.6	94.3	93.1

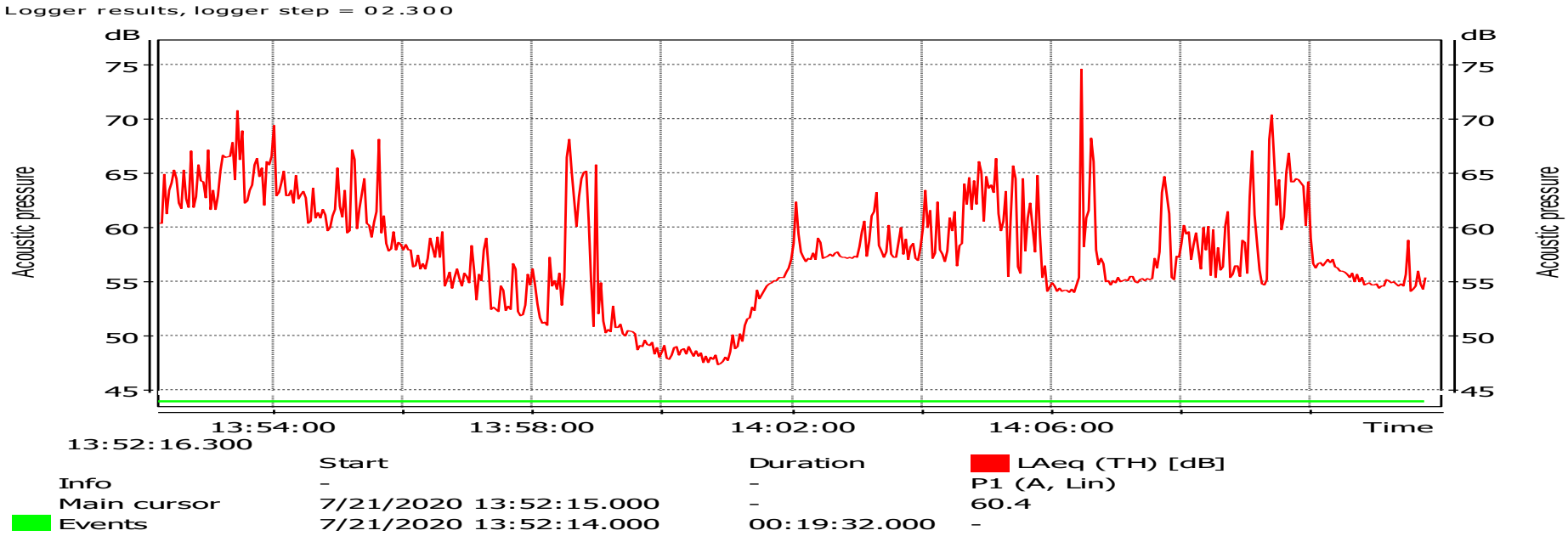


Fig. 2.61: Time Domain Signal/Data at coordinate 27.5932051,95.39897968

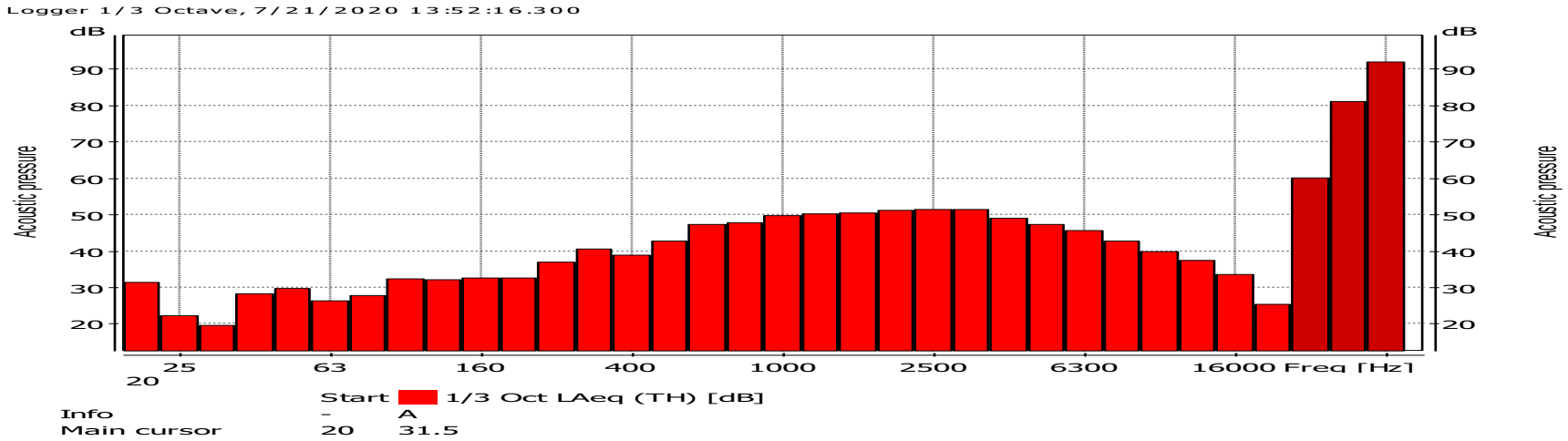


Fig. 2.62::Frequency domain data at coordinate 27.5932051,95.39897968

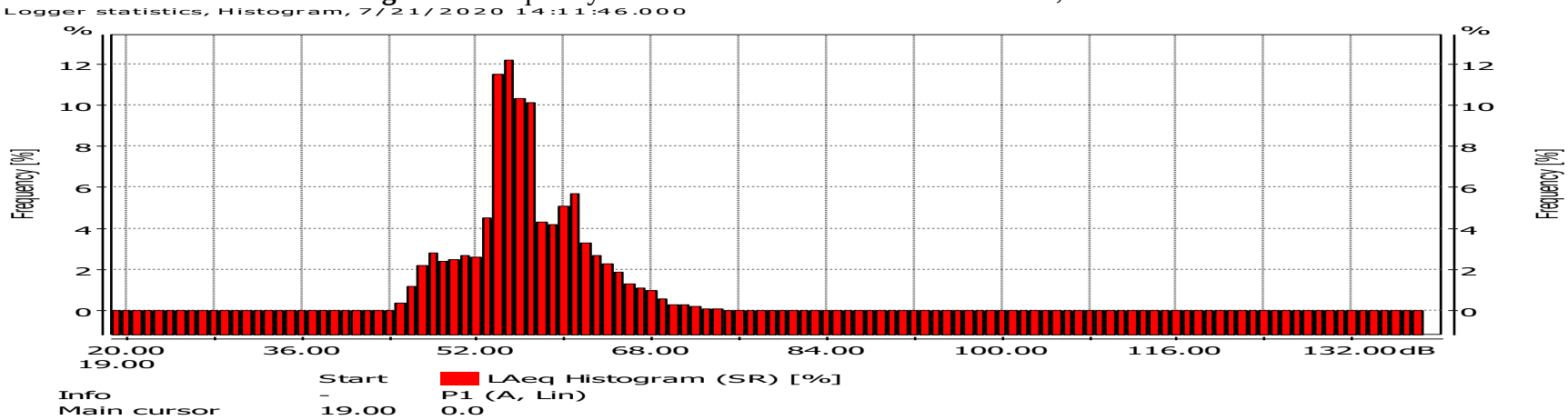


Fig. 2.63:1/3 Octave result summary at coordinate 27.5932051,95.39897968

2.4.23. DATA DETAILS AT COORDINATE 27.59927099,95.37829372

Table 2.21 Parameters and Peak Values at Coordinate: 27.59927099,95.37829372

Day M/d/yyyy	Hour hh:mm:ss	Profile	Filter	Detector	Elapsed time hh:mm:ss	OvlT %	Underrange	Units	Lpeak	Lmax	Lmin	SPL	Leq
21-07-2020	15:34:30	P1	A, Lpeak C	Fast	00:15:05	0	0	dB	120	88.7	76.8	87	82.9
21-07-2020	15:34:30	P2	C, Lpeak C	Fast	00:15:05	0	0	dB	120	112.3	94.8	104.6	102.5
21-07-2020	15:34:30	P3	Z, Lpeak Z	Fast	00:15:05	0	0	dB	128.6	121.3	103	114	112.1

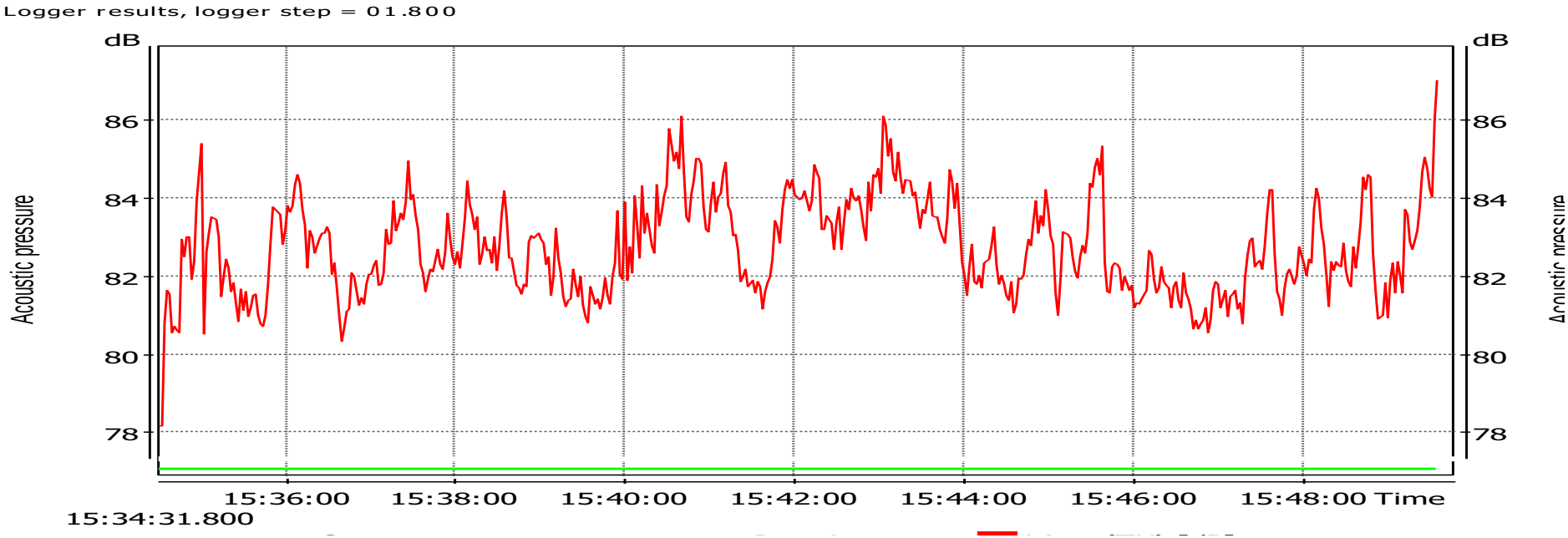


Fig. 2.64:Time Domain Signal/Data at coordinate 27.59927099,95.37829372

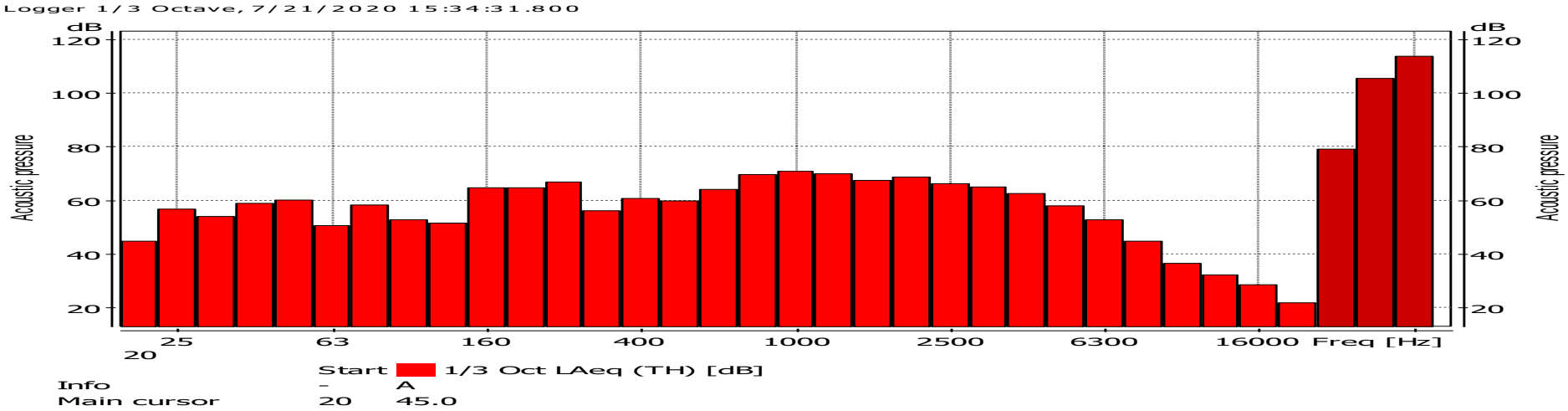


Fig. 2.65:Frequency domain data at coordinate 27.59927099,95.37829372

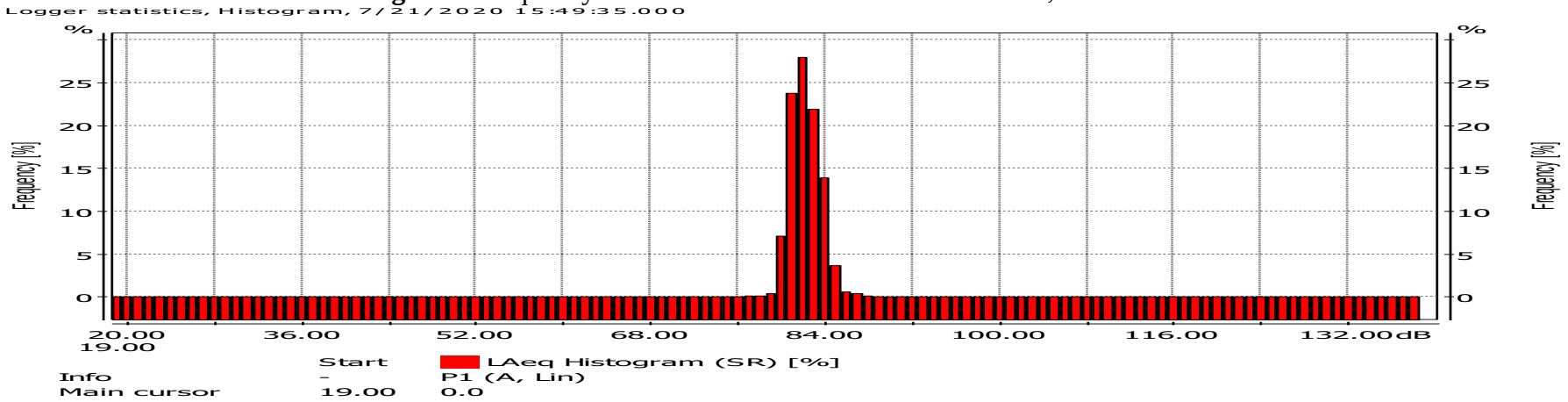


Fig. 2.66: 1/3 Octave result summary at coordinate 27.59927099,95.37829372

Chapter 3. THERMAL MAPPING OF STRUCTURE USING THERMAL IMAGER CAMERA

3.1. INTRODUCTION

A survey of the affected structure(s) was conducted to assess the development of any cracks. Based on the initial structural assessment, thermal imaging was conducted for the hot spot location in the structure namely location such as beam-column joint, shear and flexure crack in beams, different wall locations etc. Thermal Imager camera is suitable to measure the surface temperature of any object from where infrared wave emits shall be deployed for the survey. Based on the thermal maps, pixelated thermal images are overlayed on the optical images to correlate existence of the any cracks or voids. The thermal images are capable to measure temperature in range -20 ^{o}C to 650 ^{o} C. To enhance the accuracy, mode with capability to measure -20 ^{o}C to +150 ^{o}C was selected. The accuracy of thermal maps is -/+0.5 ^{o}C. The working distance of the operation and acquisition of the thermal maps is 1-5 m.

The technical highlight of the thermal camera are:

a. IR Resolution : 320 x 240

b. Object Temperature Range : -20°C to to 650°C

c. Thermal Sensitivity :<30 mK@30^{o}C

d. Display : 4”, 640 x 480 pixel touchscreen LCD with auto-rotation

e. Digital Camera : 5 MP, with built-in LED photo/video lamp

f. Color Palettes : Iron, Gray, Rainbow, Arctic, Lava, Rainbow HC

g. Image Mode : Infrared, visual, MSX, Picture-in-Picture

h. Accuracy : ±2°C (±3.6°F) or ±2% of reading

i. Spot meter and Area : 3 in live mode.

j. Measurement Presets : No measurement, center spot, hot spot, cold spot, User Preset 1, User Preset 2 Laser Pointer : Yes

k. Storage Media : Removable SD card

l. Image File Format : Standard JPEG with measurement data included

m. Working Temperature : -15°C to 50°C

3.2. DATA ANALYSIS

The thermal images and optical image of the structure having cracks/damage measured at the nearby area of Baghjan, Upper Assam blowout site.



Fig. 3.1: Thermal and Optical observation of the structure as per Figure 1.1

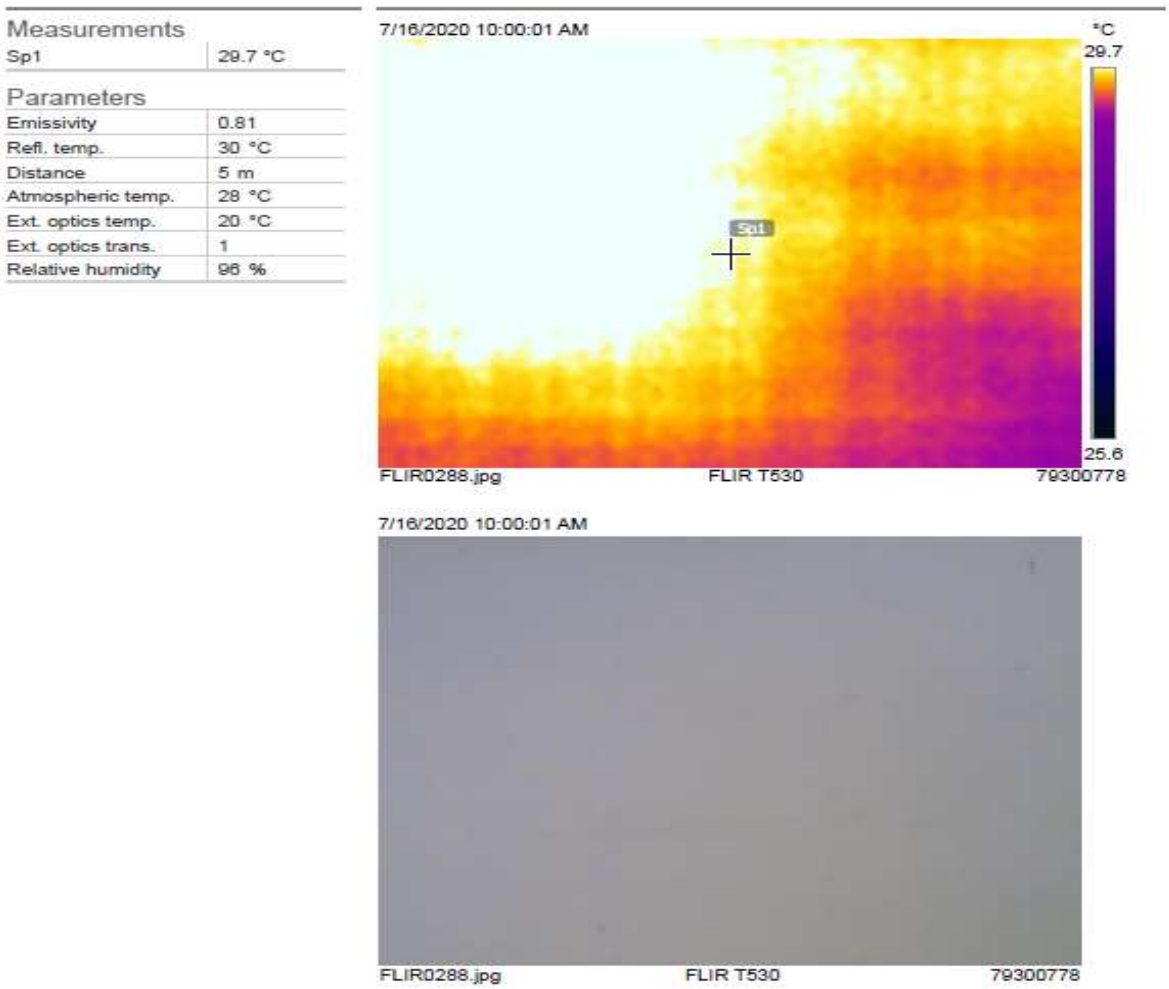


Fig. 3.2: Thermal and Optical observation of the structure as per Figure 1.1

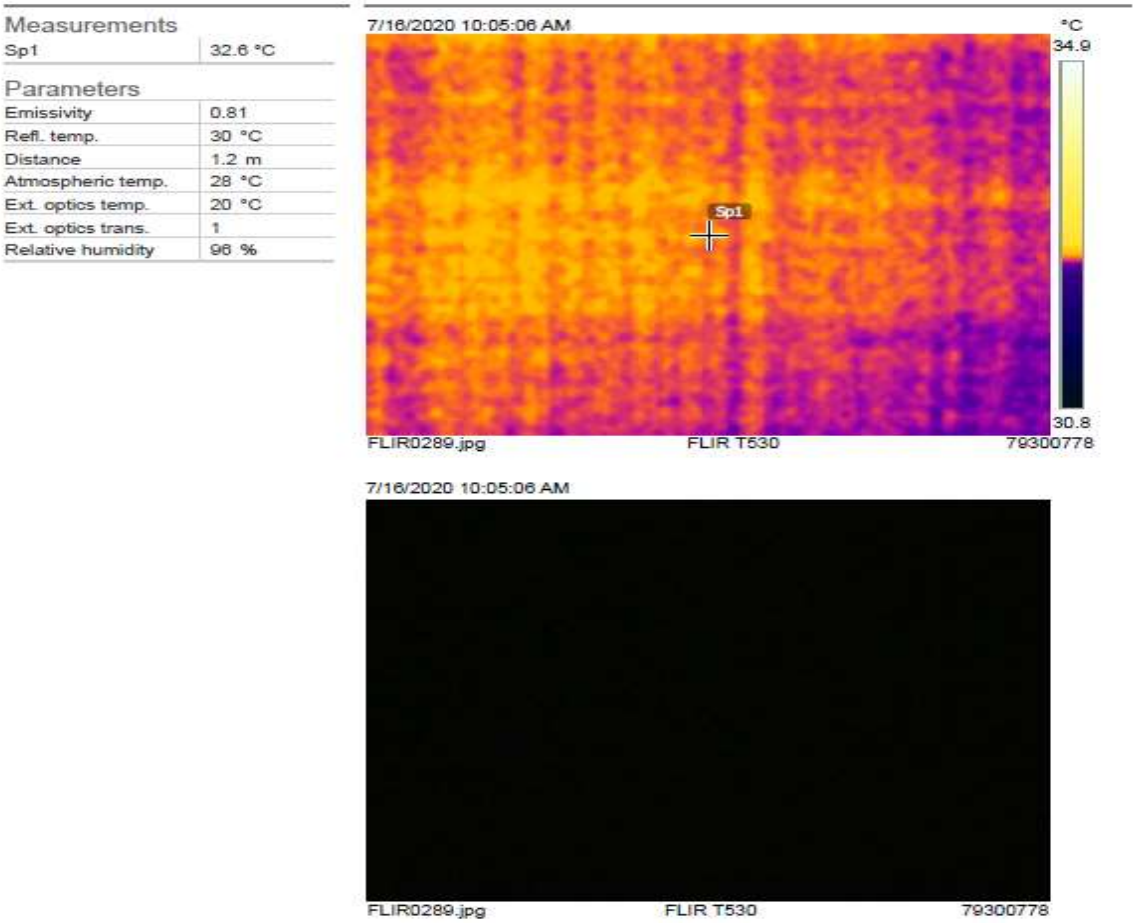


Fig. 3.3: Thermal and Optical observation of the structure as per Figure 1.1

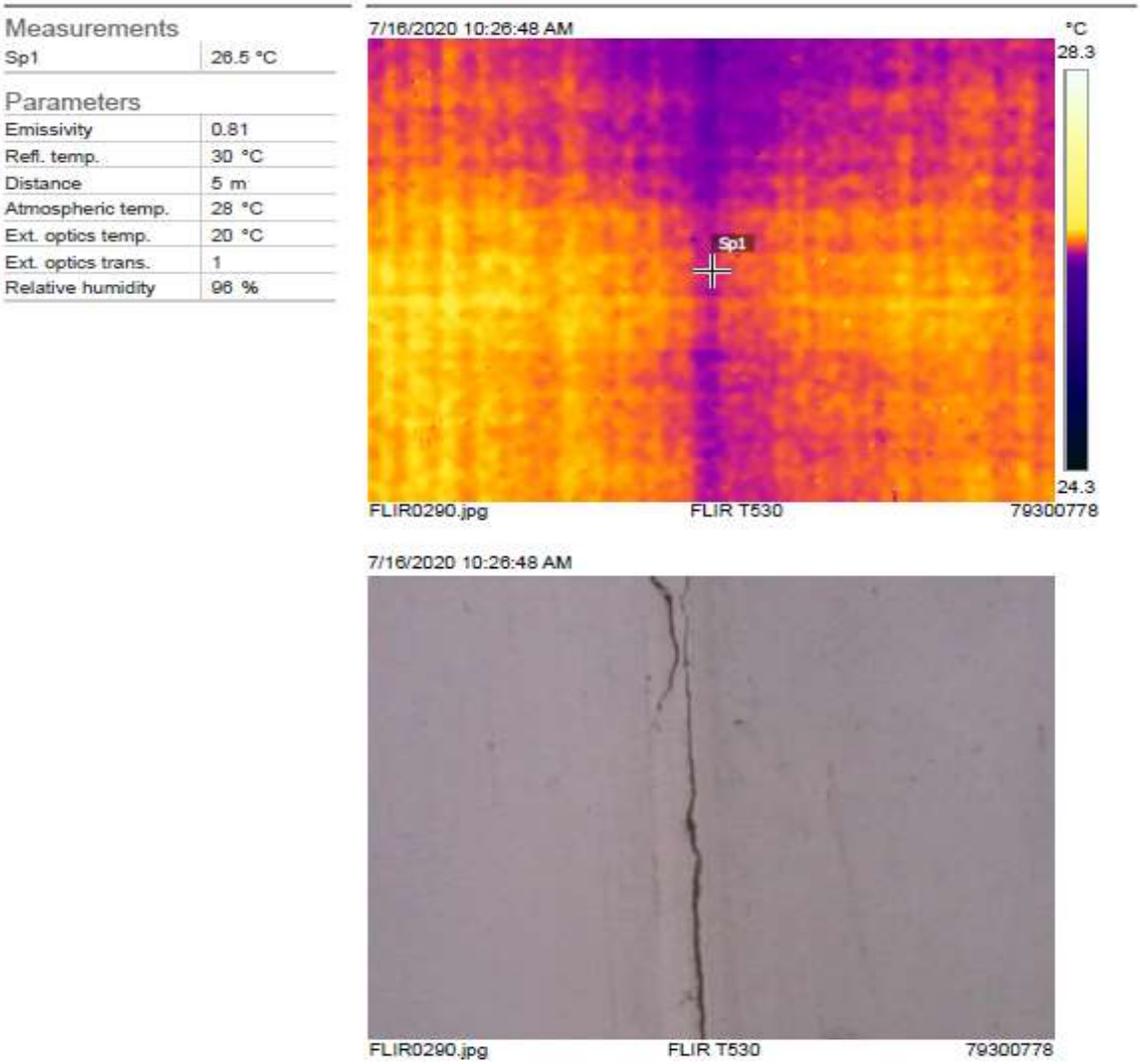


Fig. 3.4: Thermal and Optical observation of the structure as per Figure 1.1

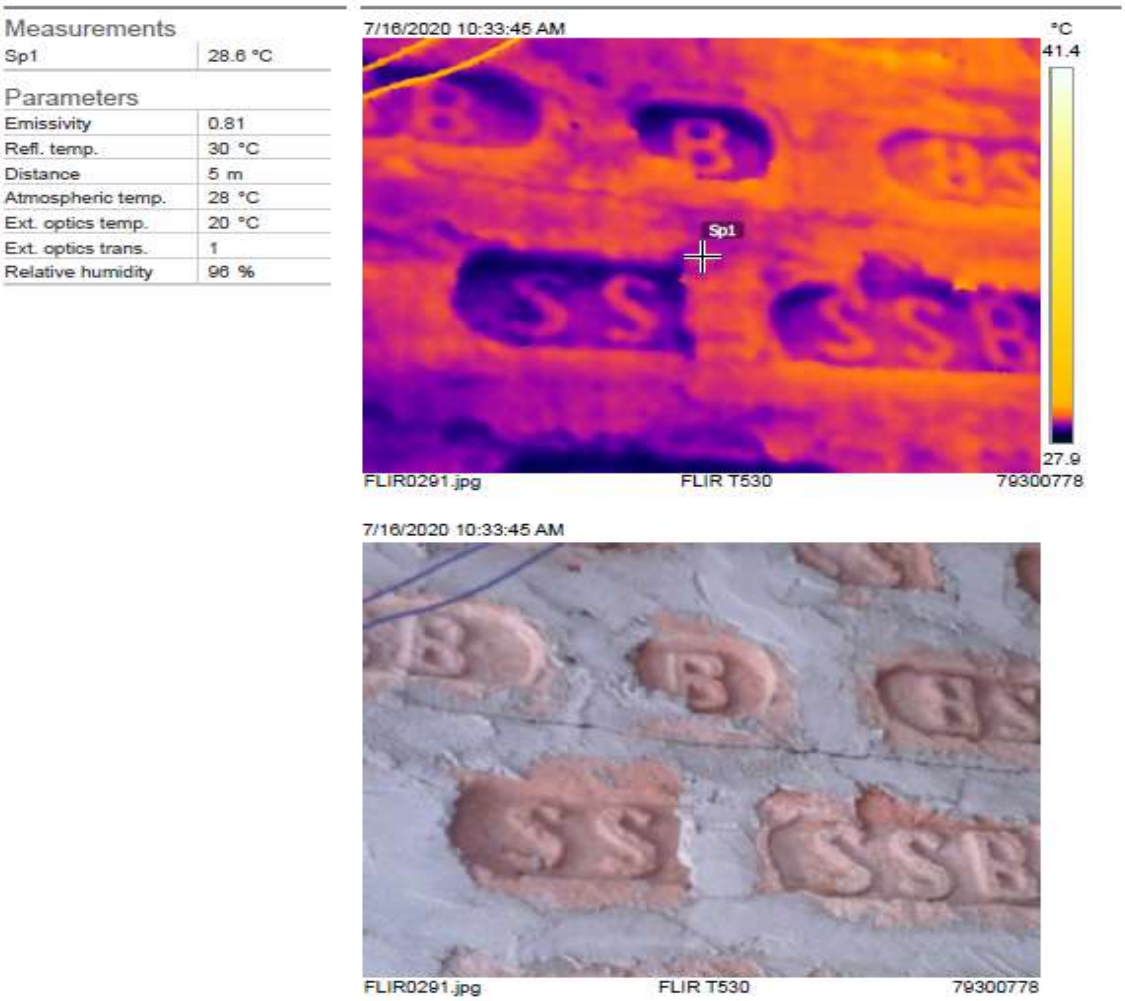


Fig. 3.5: Thermal and Optical observation of the structure as per Figure 1.1

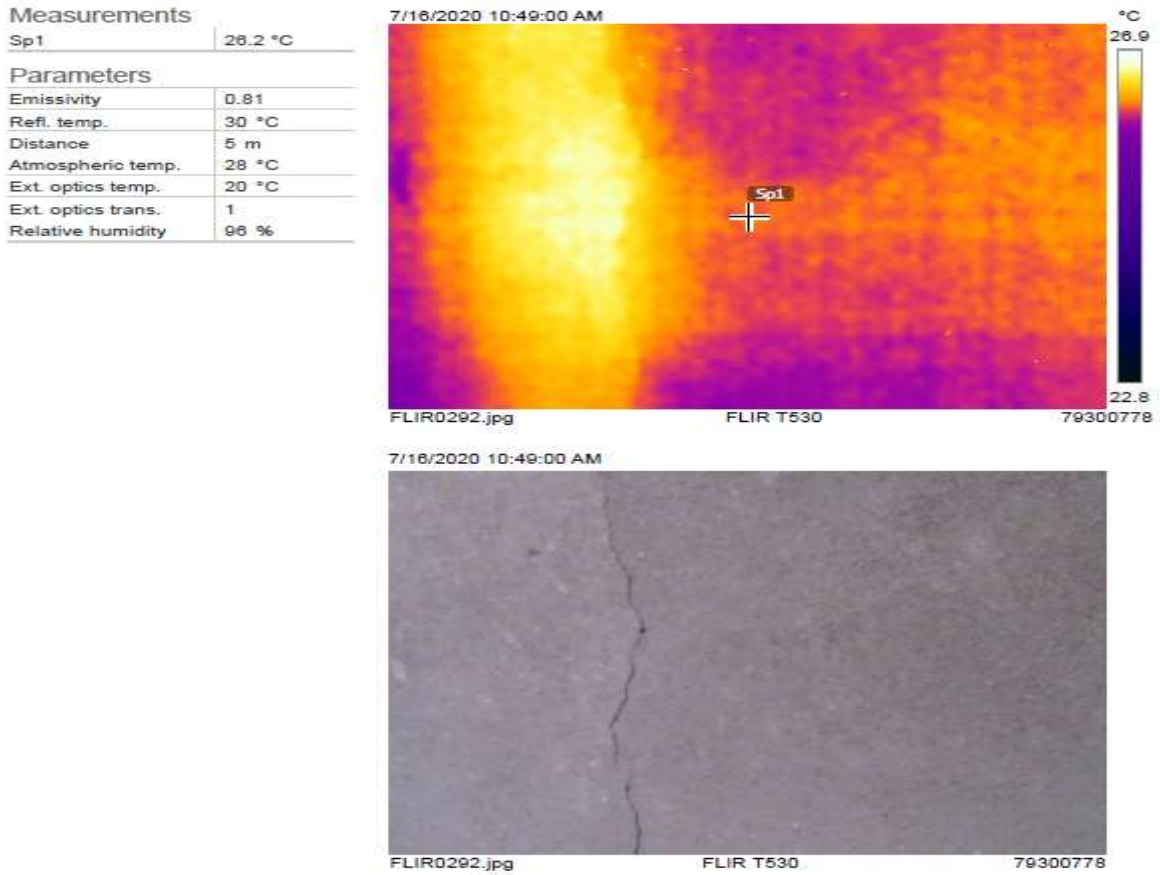


Fig. 3.6: Thermal and Optical observation of the structure as per Figure 1.1

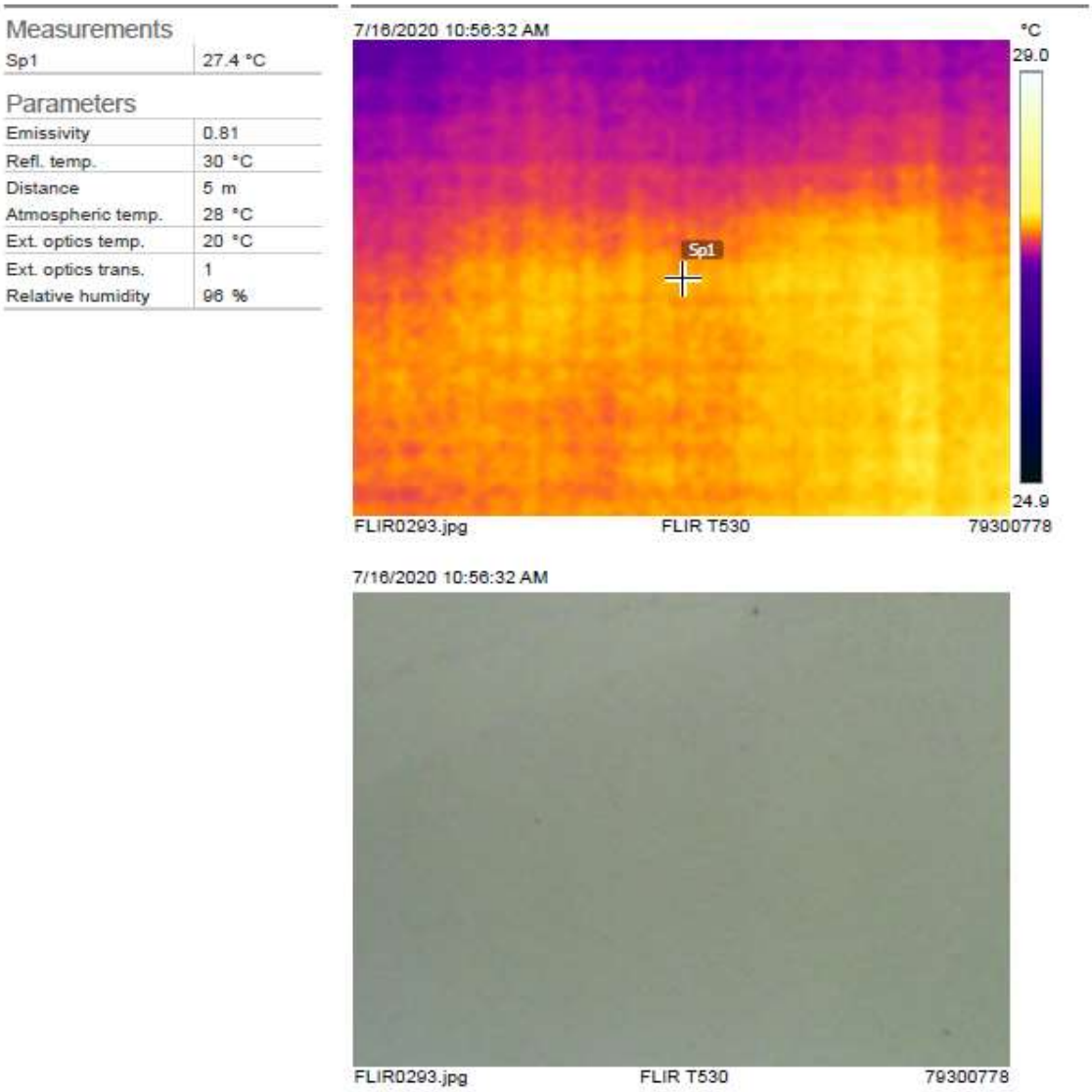


Fig. 3.7: Thermal and Optical observation of the structure as per Figure 1.1

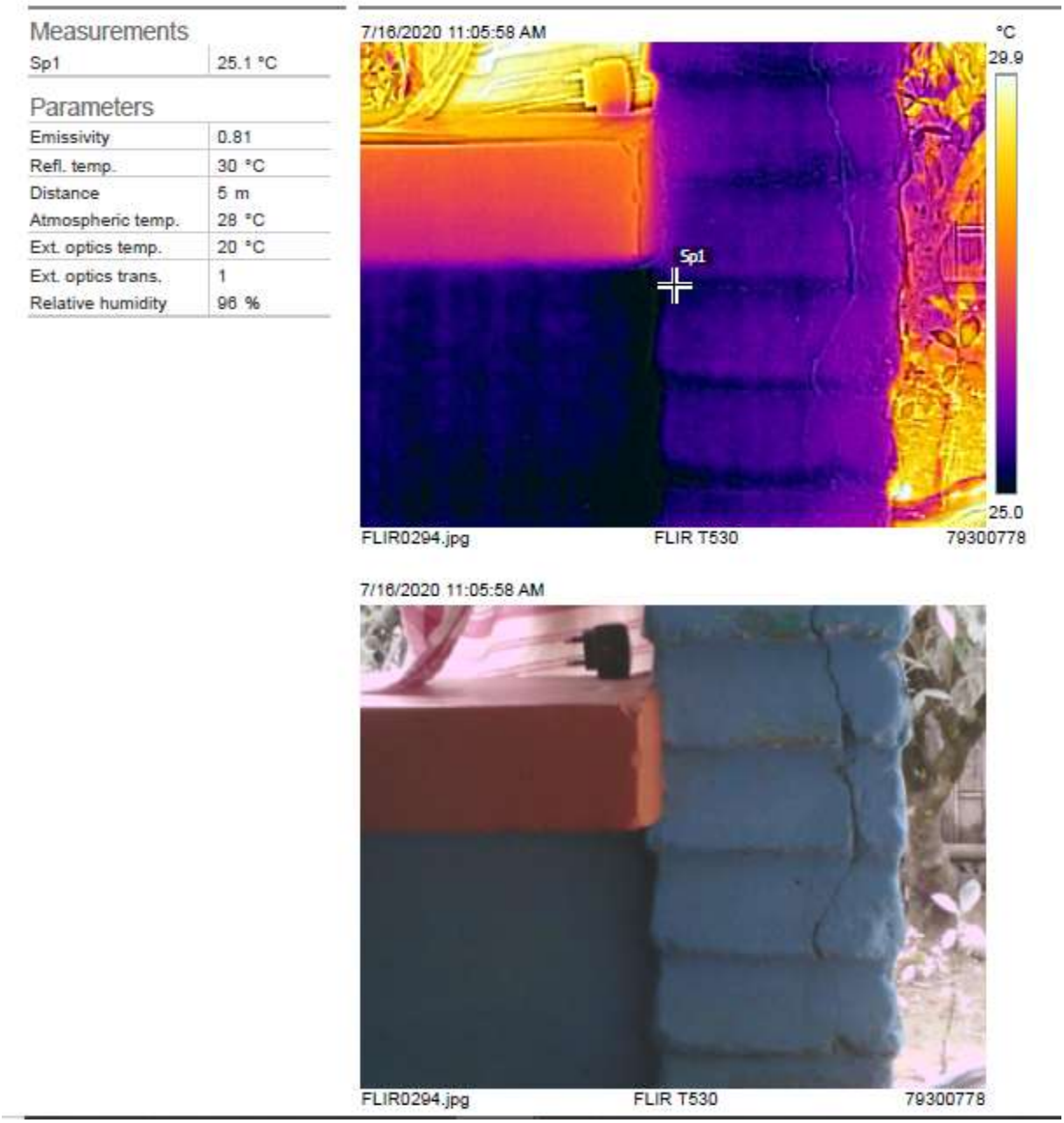


Fig. 3.8: Thermal and Optical observation of the structure as per Figure 1.1

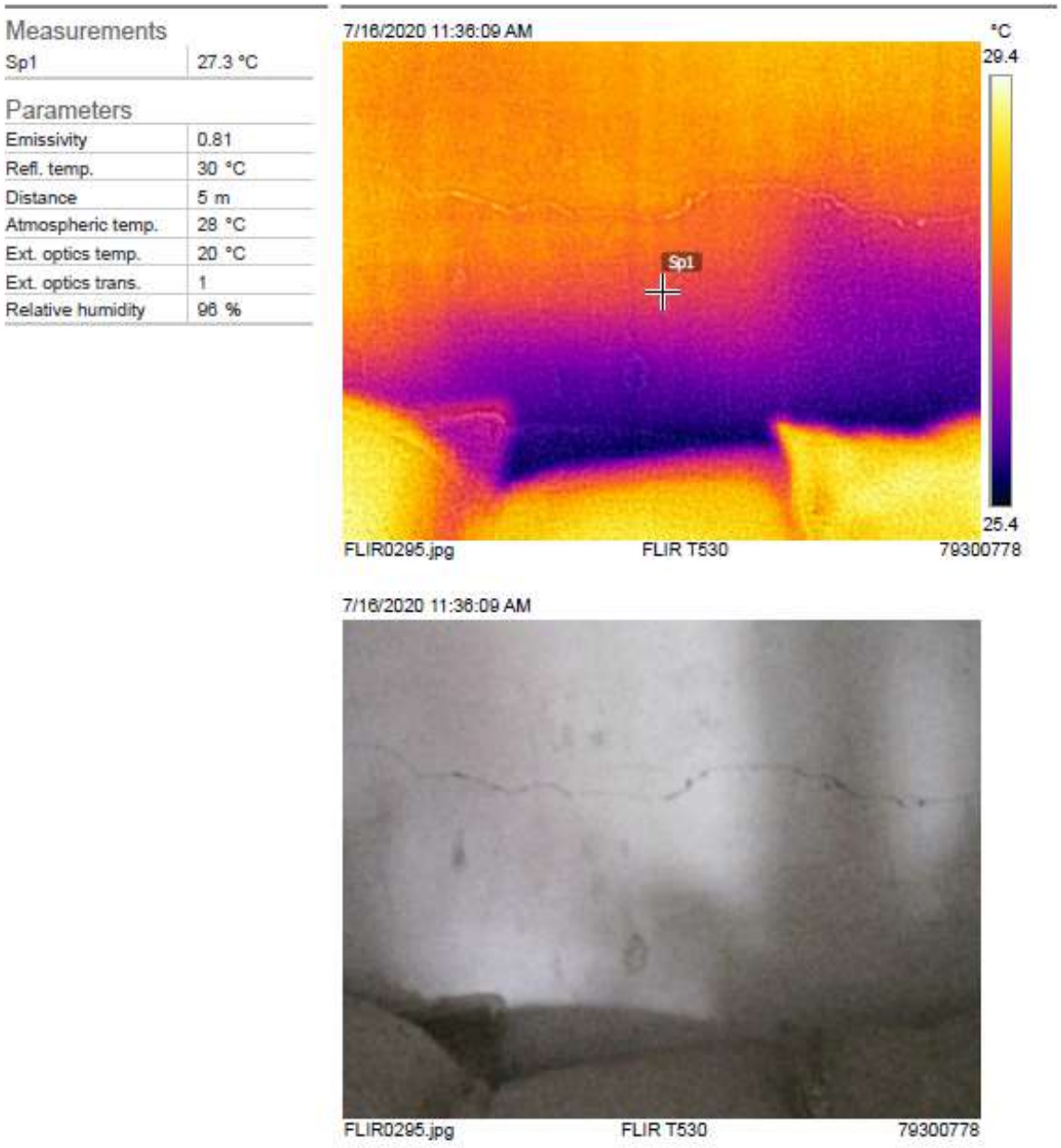


Fig. 3.9: Thermal and Optical observation of the structure as per Figure 1.1

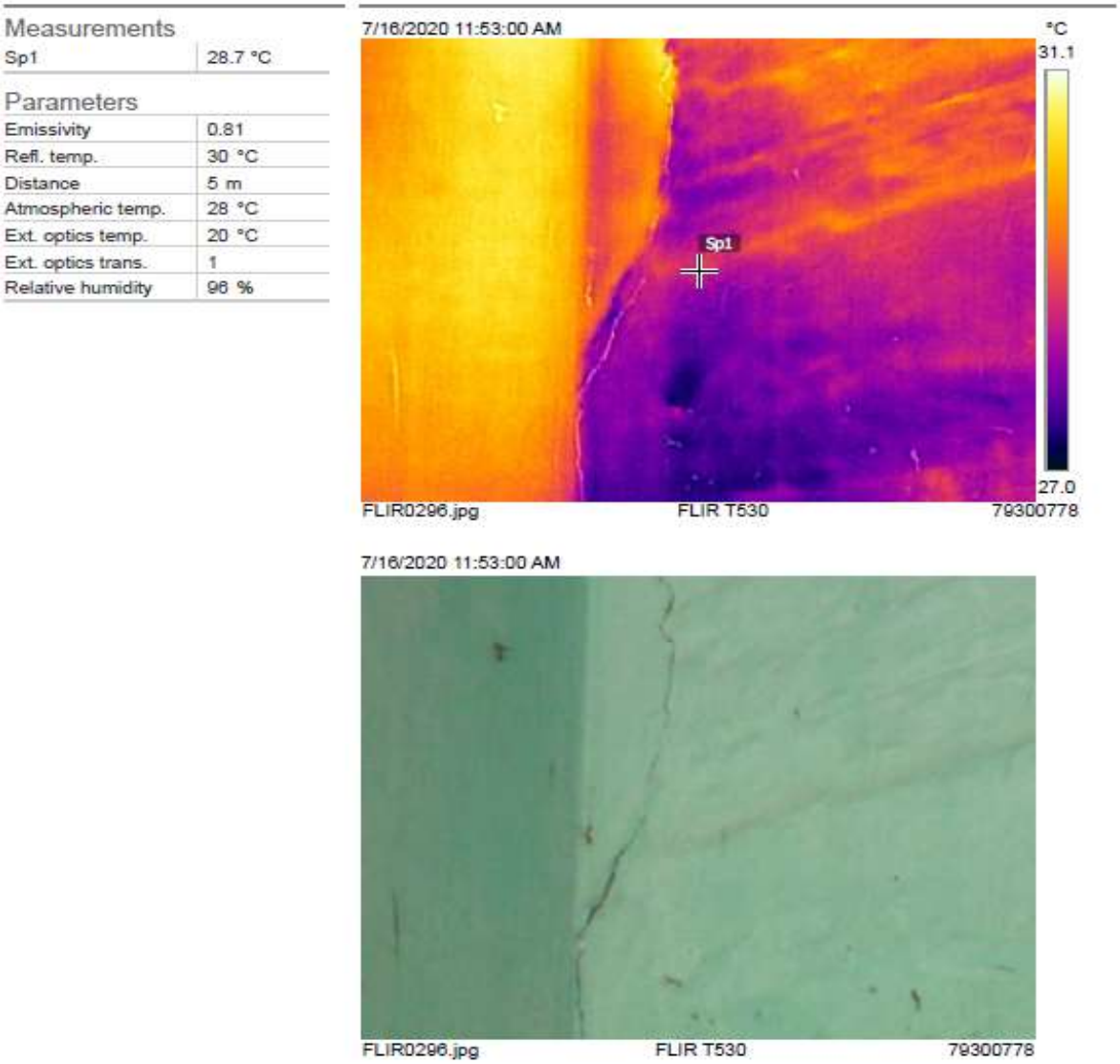


Fig. 3.10: Thermal and Optical observation of the structure as per Figure 1.1

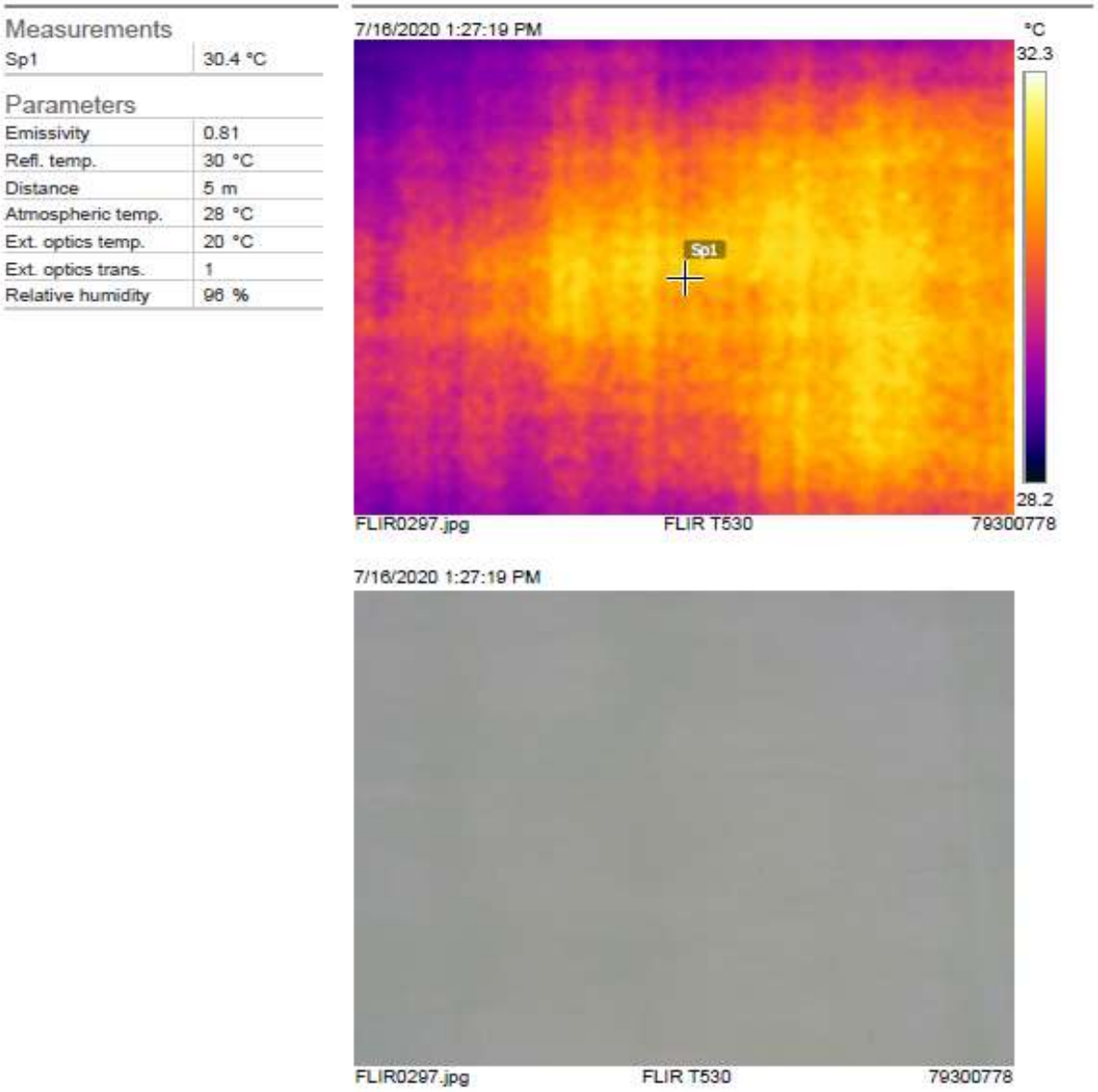


Fig. 3.11: Thermal and Optical observation of the structure as per Figure 1.1

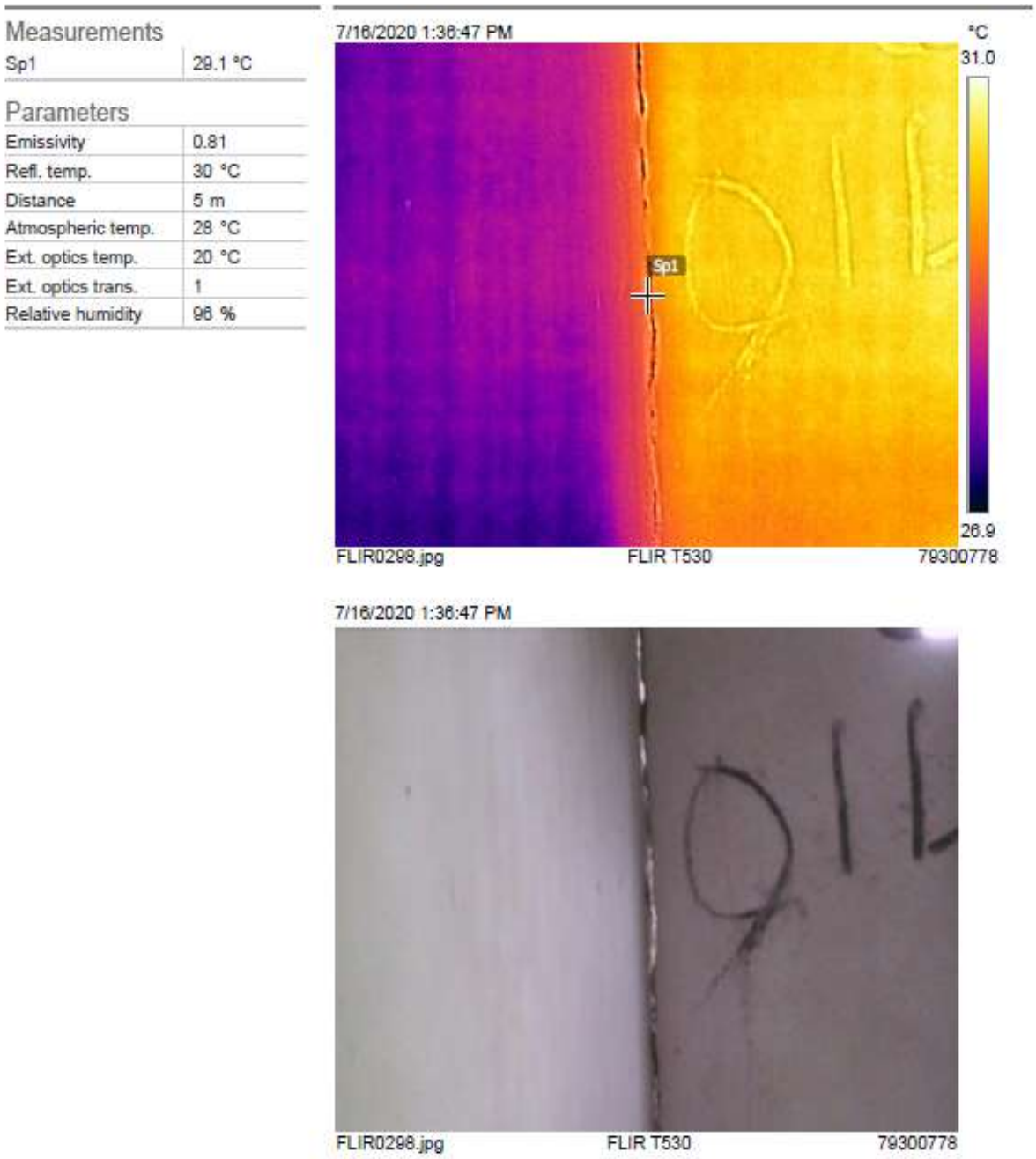


Fig. 3.12: Thermal and Optical observation of the structure as per Figure 1.1

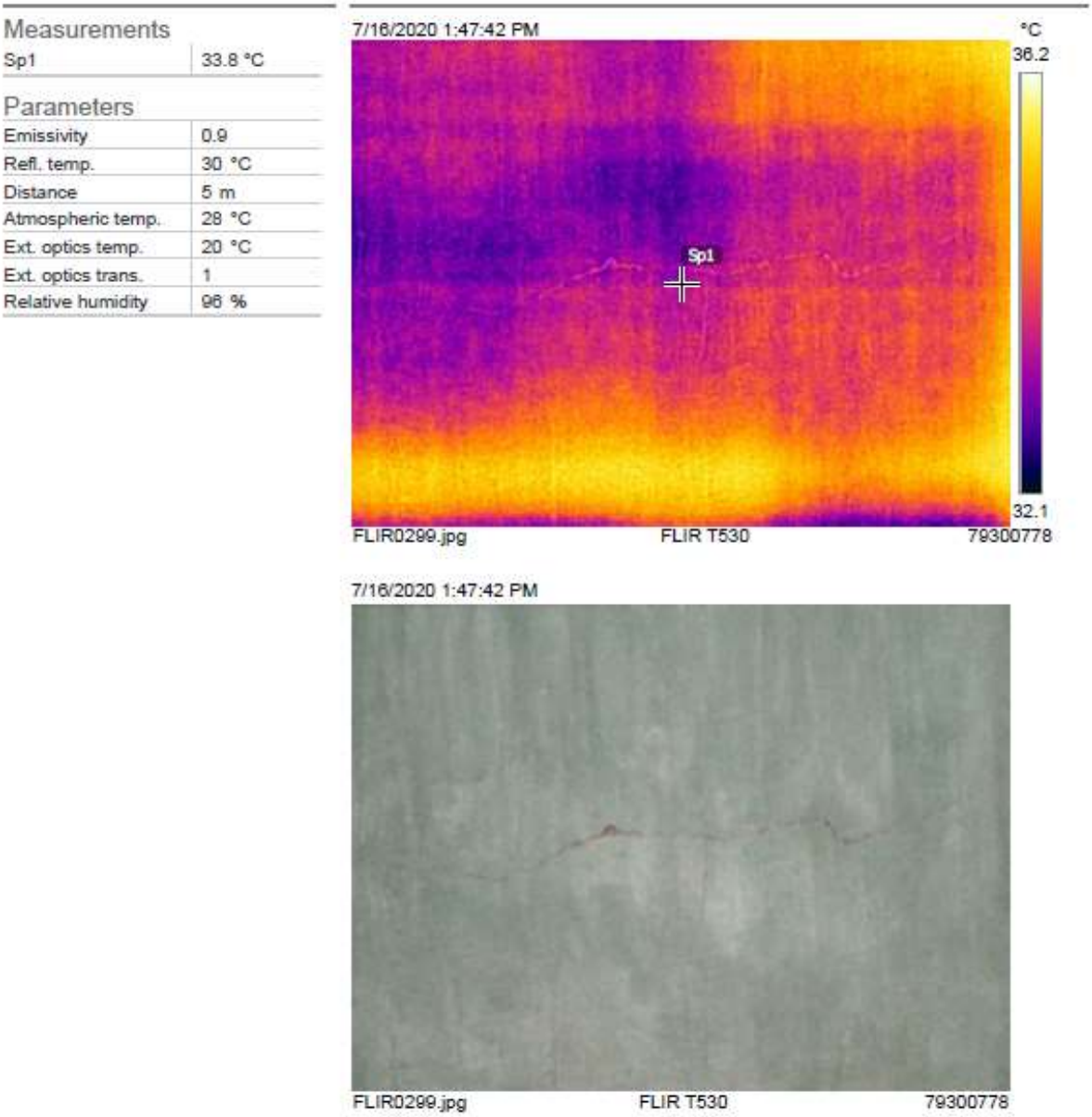


Fig. 3.13: Thermal and Optical observation of the structure as per Figure 1.1

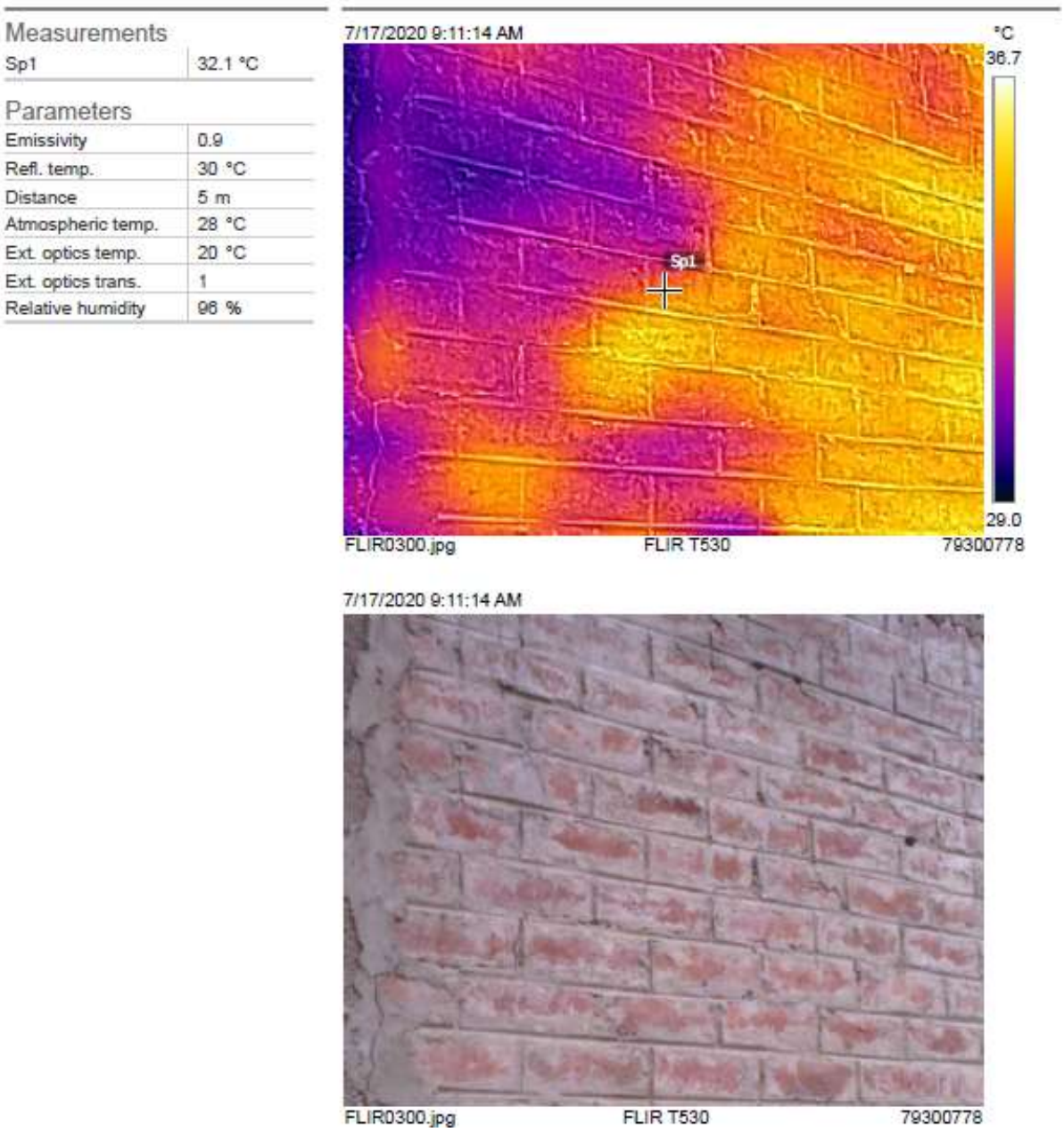


Fig. 3.14: Thermal and Optical observation of the structure as per Figure 1.2

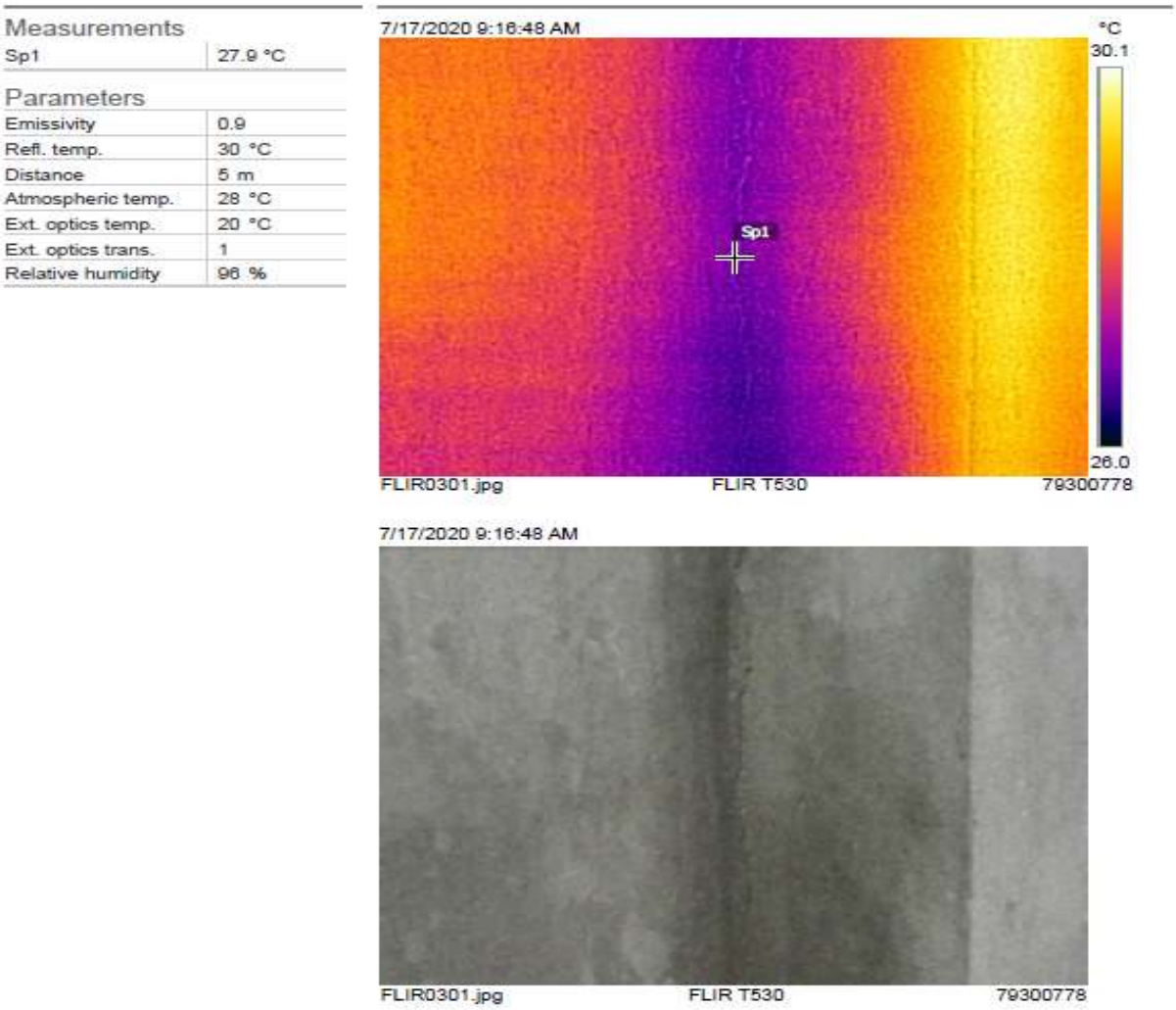


Fig. 3.15: Thermal and Optical observation of the structure as per Figure 1.2

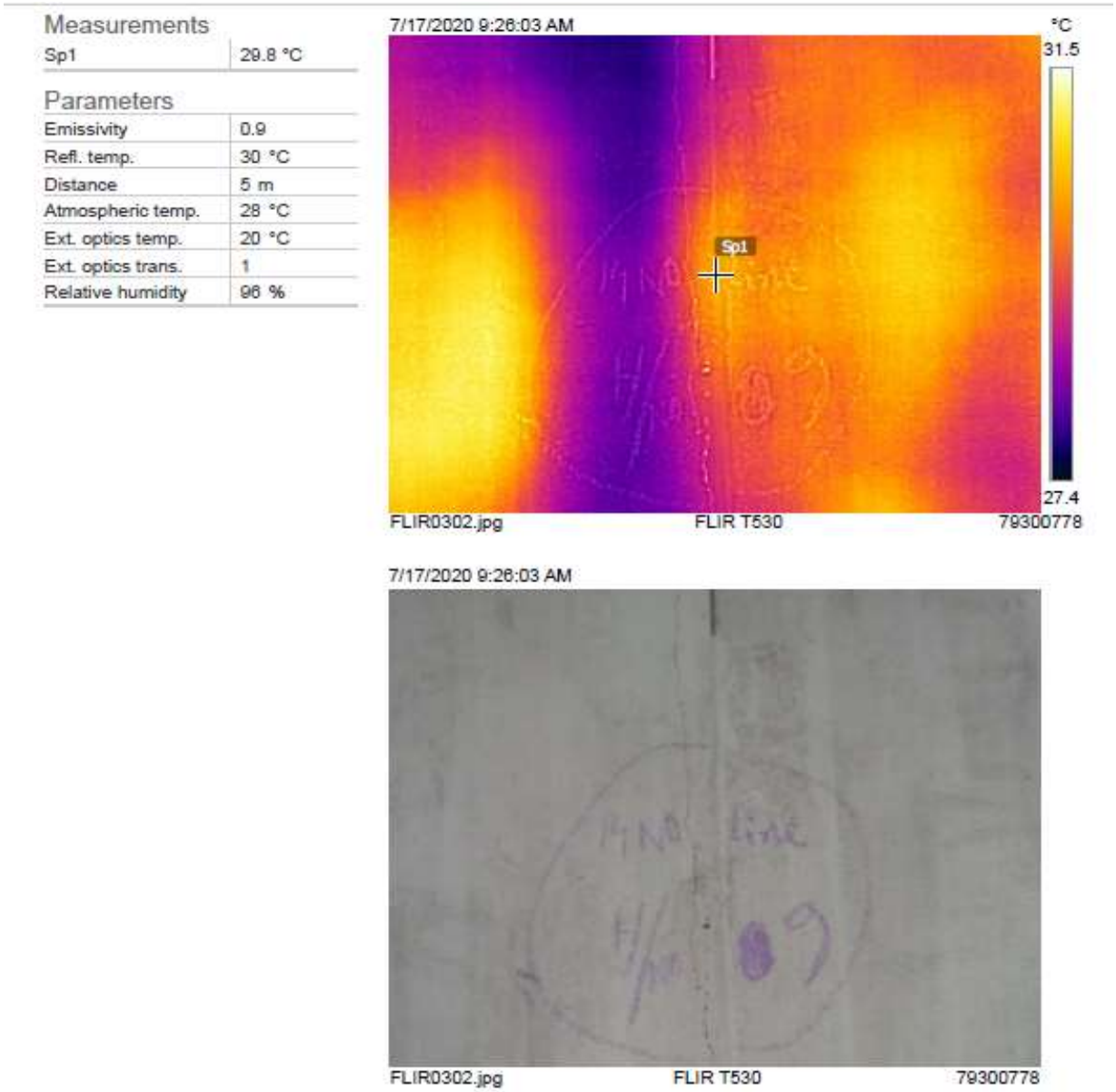


Fig. 3.16: Thermal and Optical observation of the structure as per Figure 1.2

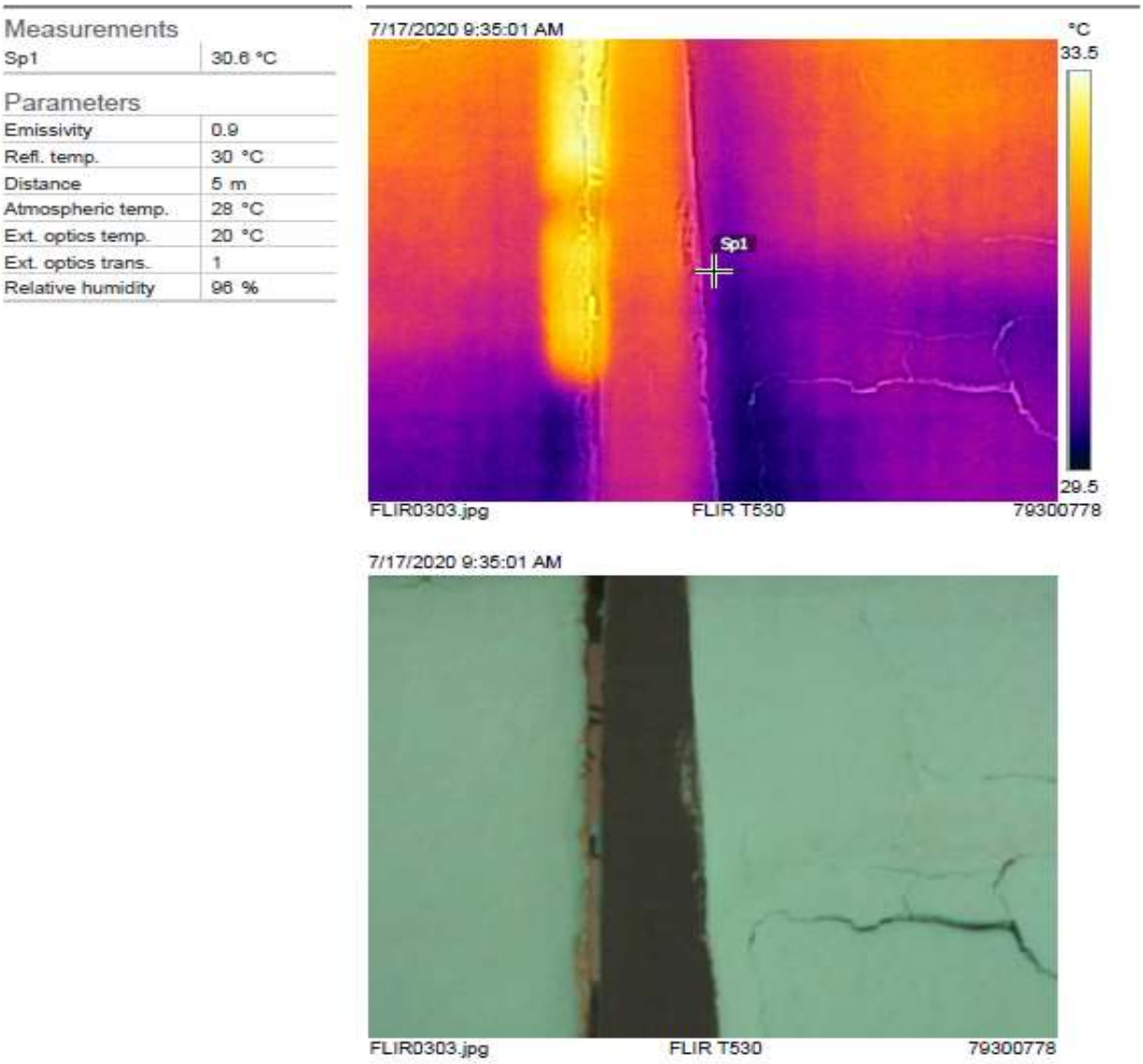


Fig. 3.17: Thermal and Optical observation of the structure as per Figure 1.2

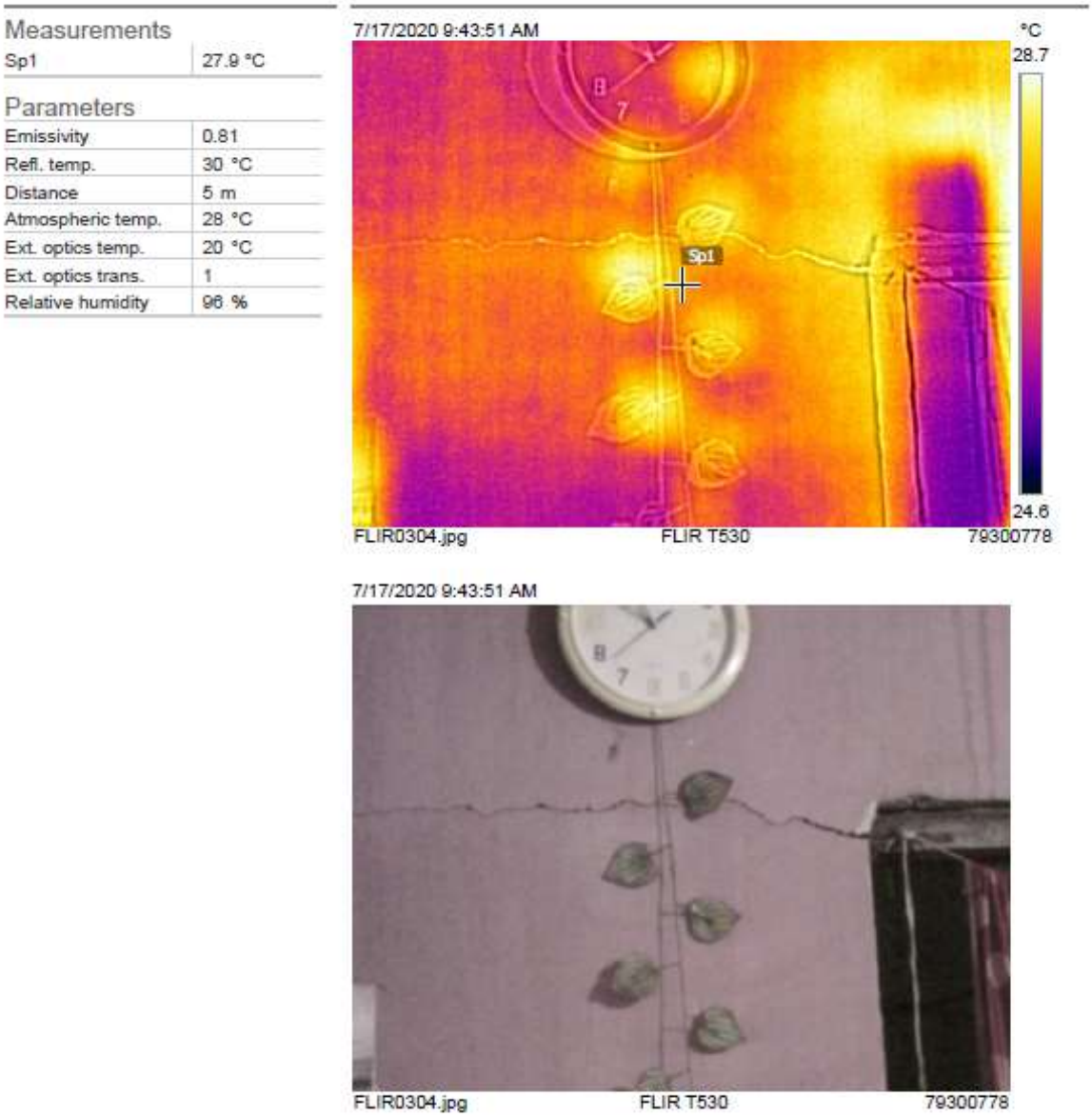


Fig. 3.18: Thermal and Optical observation of the structure as per Figure 1.2

Measurements	
Sp1	31.0 °C

Parameters	
Emissivity	0.81
Refl. temp.	30 °C
Distance	5 m
Atmospheric temp.	28 °C
Ext. optics temp.	20 °C
Ext. optics trans.	1
Relative humidity	96 %



Fig. 3.19: Thermal and Optical observation of the structure as per Figure 1.2

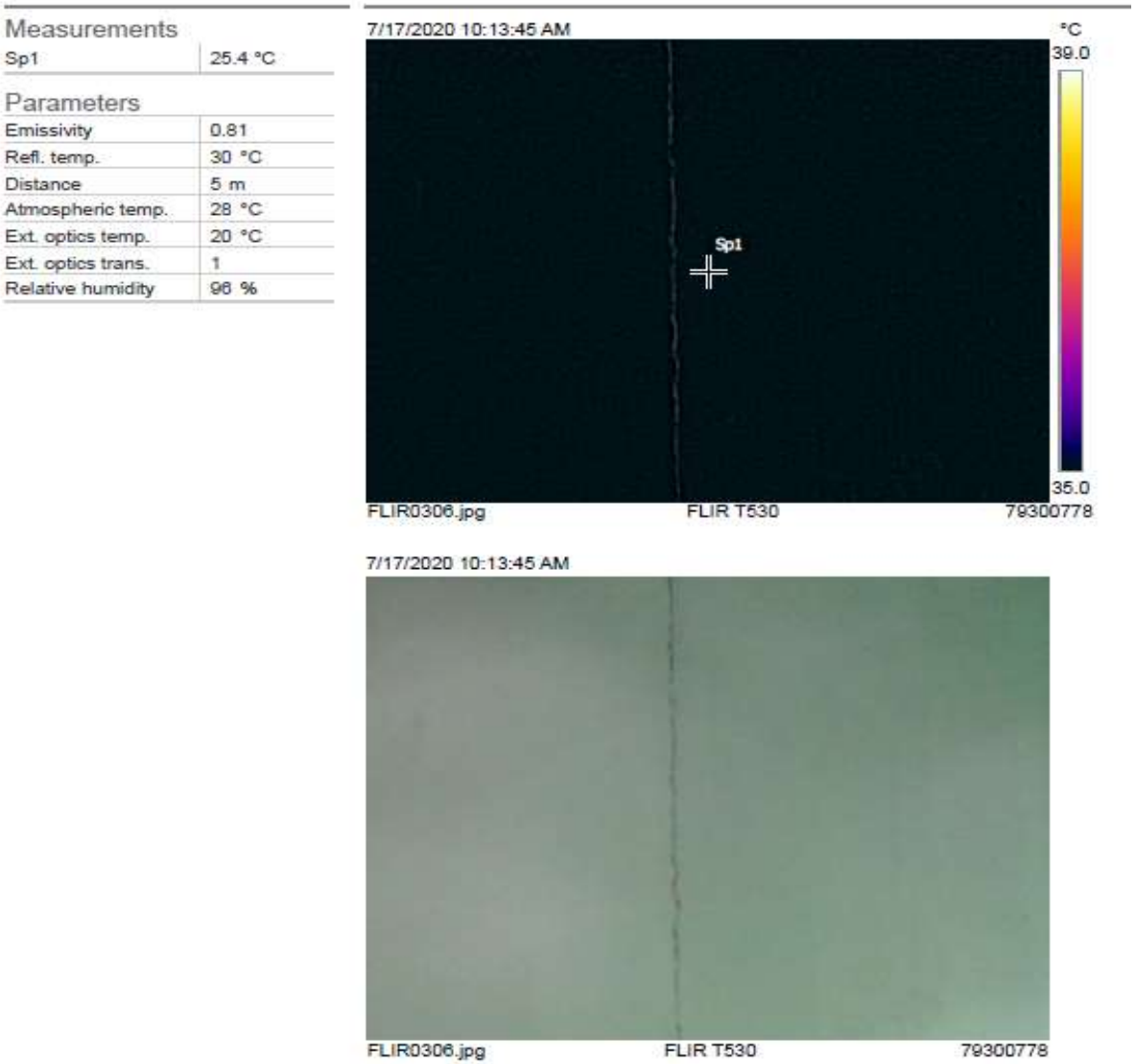


Fig. 3.20: Thermal and Optical observation of the structure as per Figure 1.2

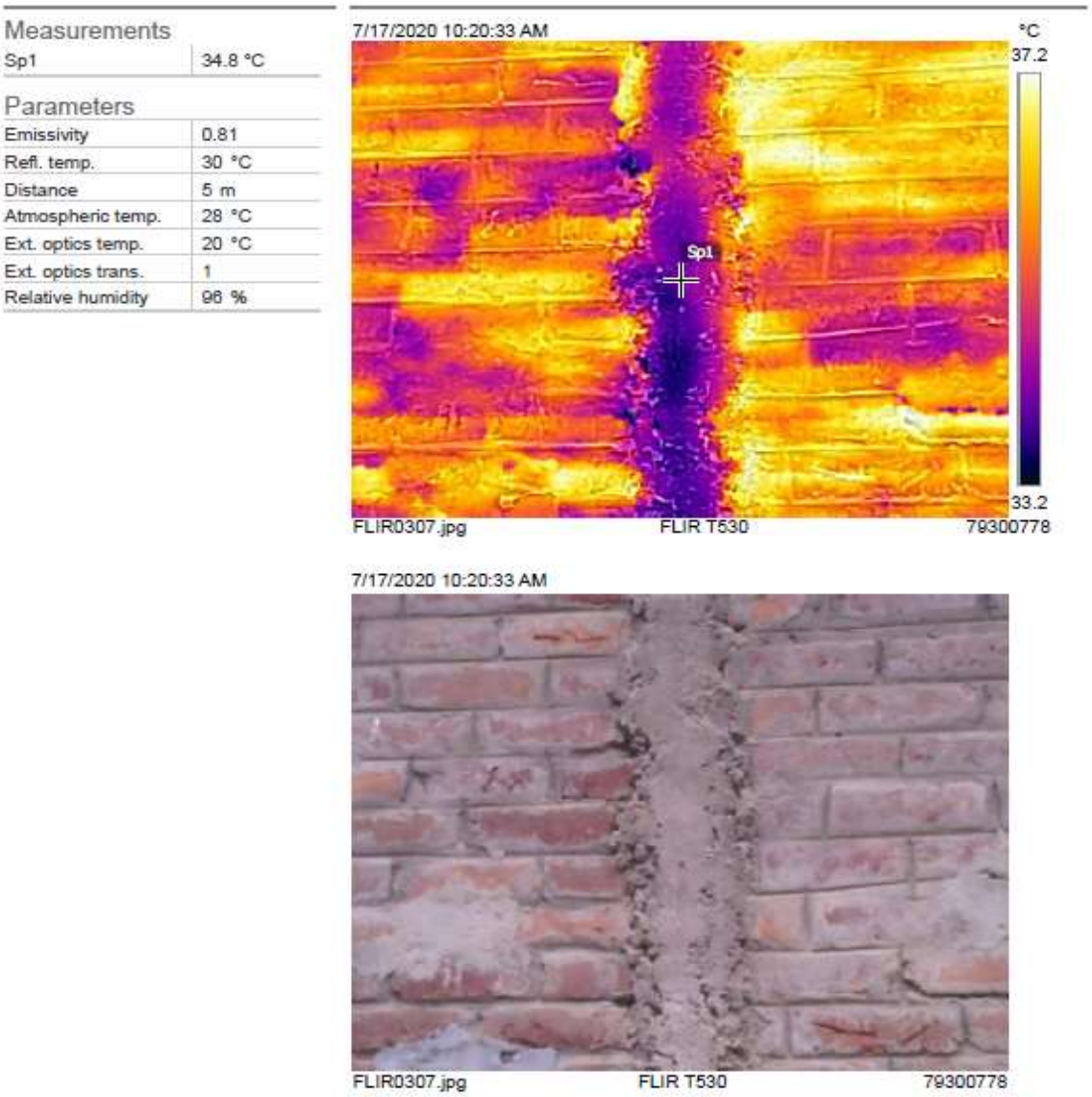


Fig. 3.21: Thermal and Optical observation of the structure as per Figure 1.2

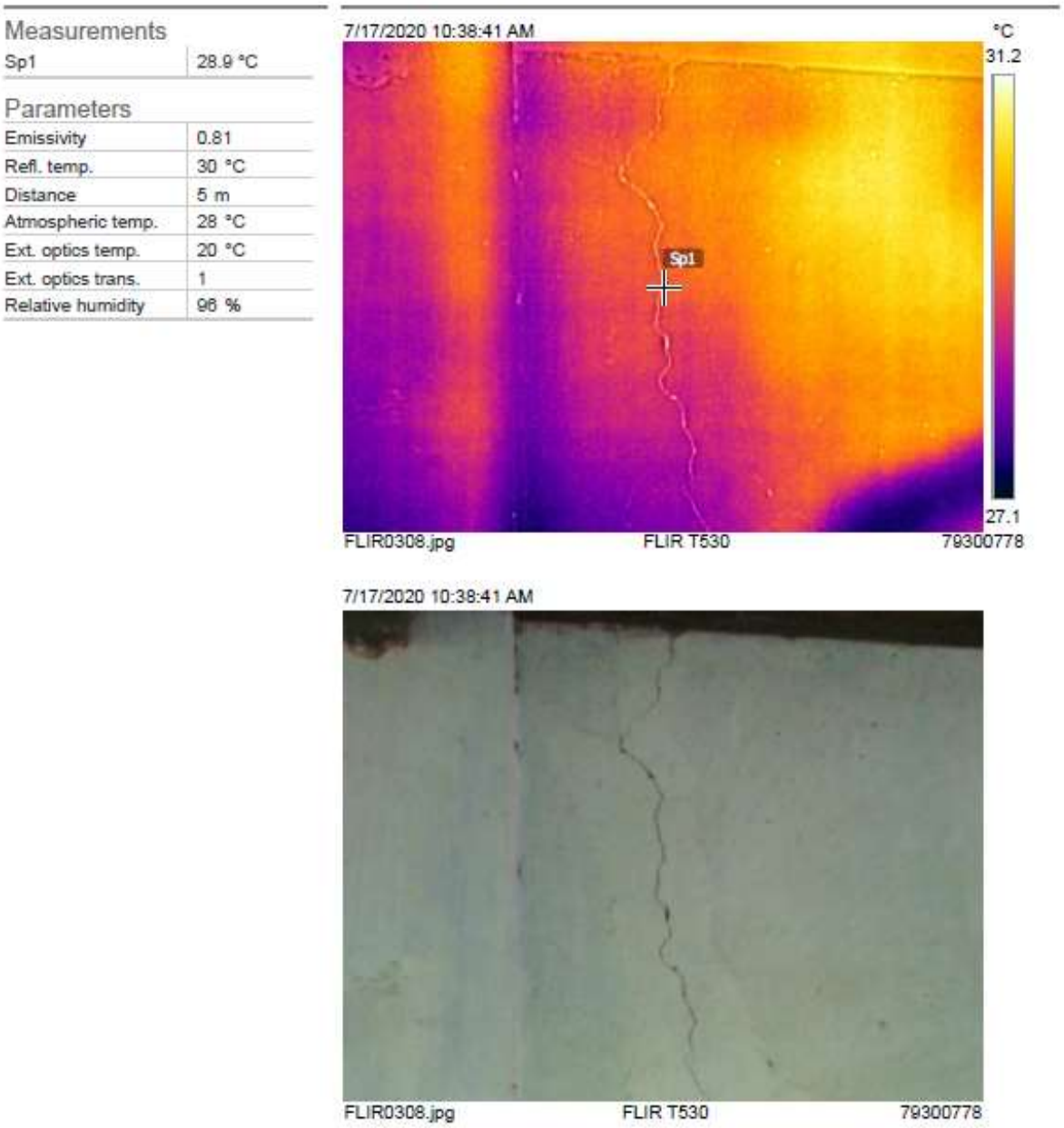


Fig. 3.22: Thermal and Optical observation of the structure as per Figure 1.2

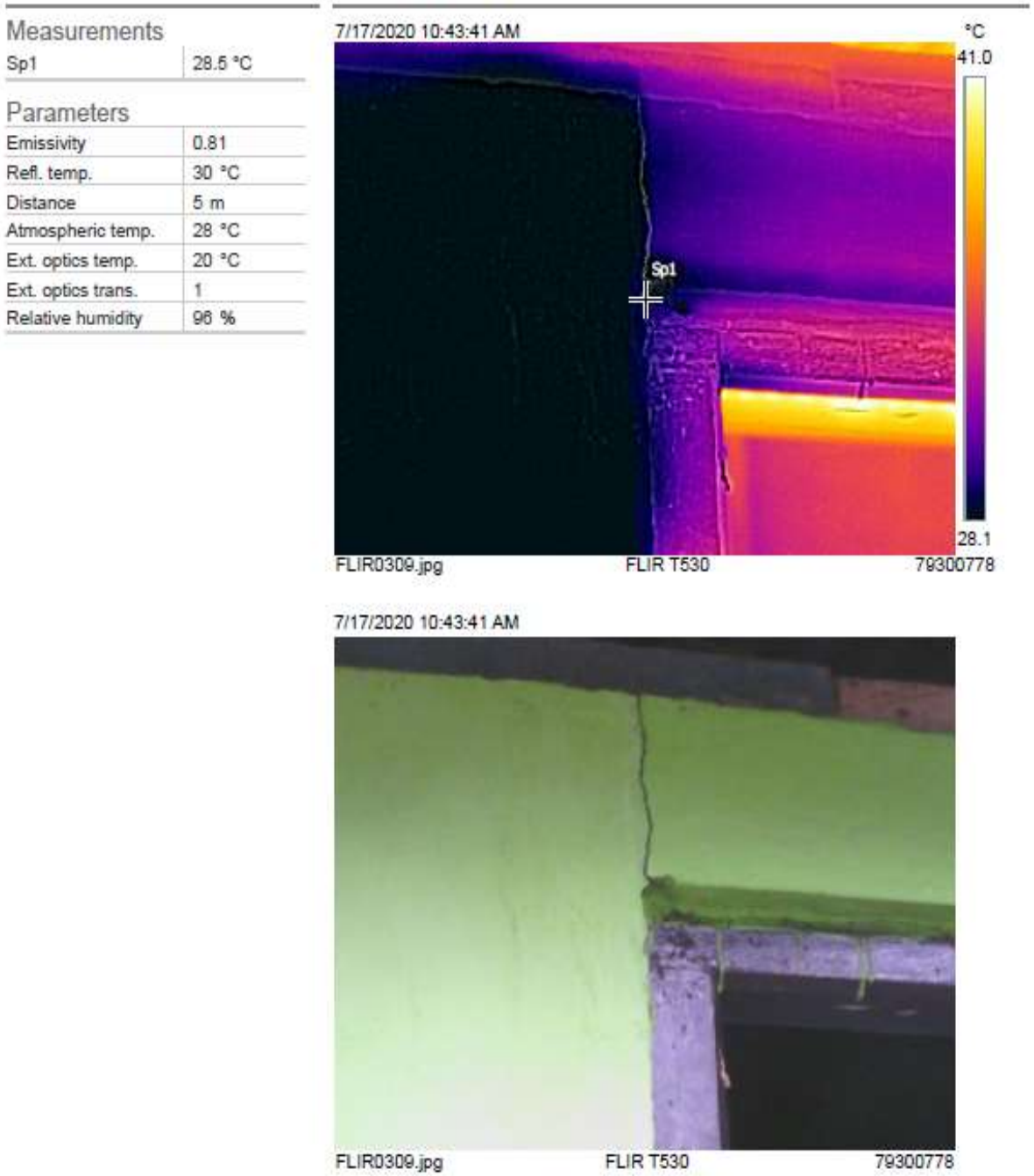


Fig. 3.23: Thermal and Optical observation of the structure as per Figure 1.2

Measurements	
Sp1	32.4 °C

Parameters	
Emissivity	0.81
Refl. temp.	30 °C
Distance	5 m
Atmospheric temp.	28 °C
Ext. optics temp.	20 °C
Ext. optics trans.	1
Relative humidity	98 %

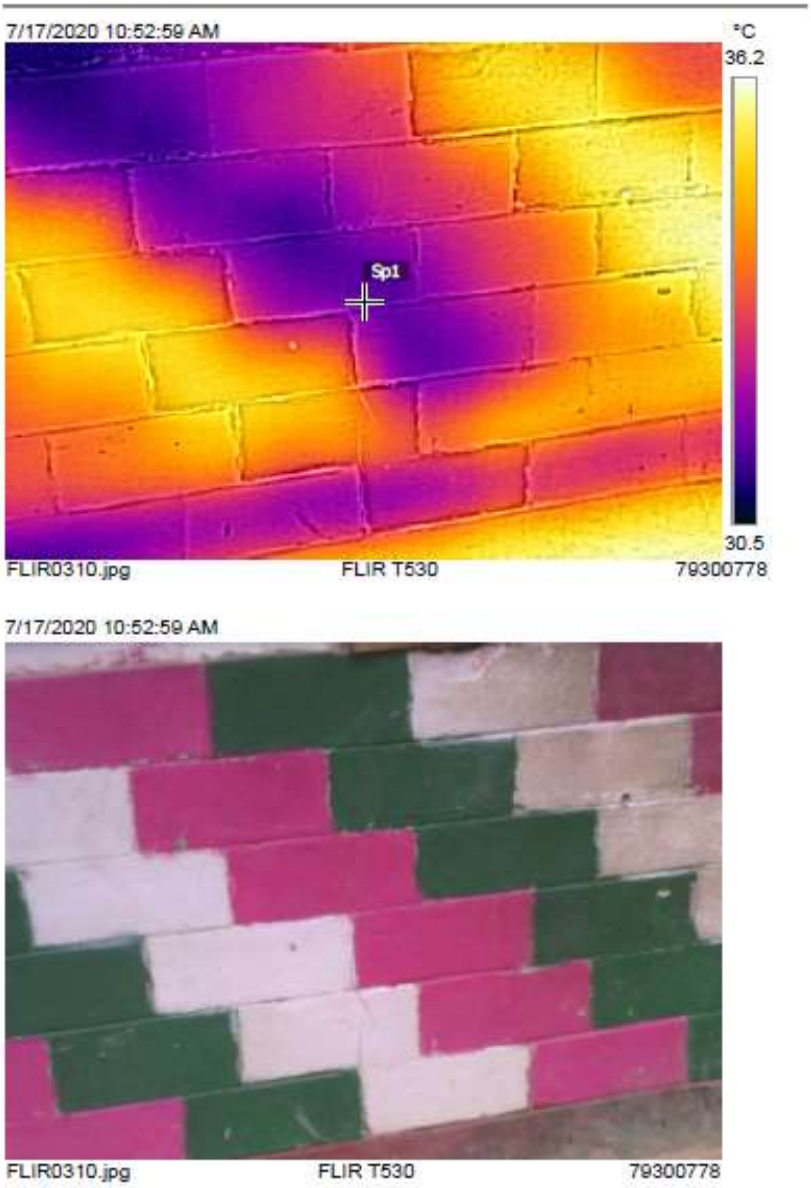


Fig. 3.24: Thermal and Optical observation of the structure as per Figure 1.2

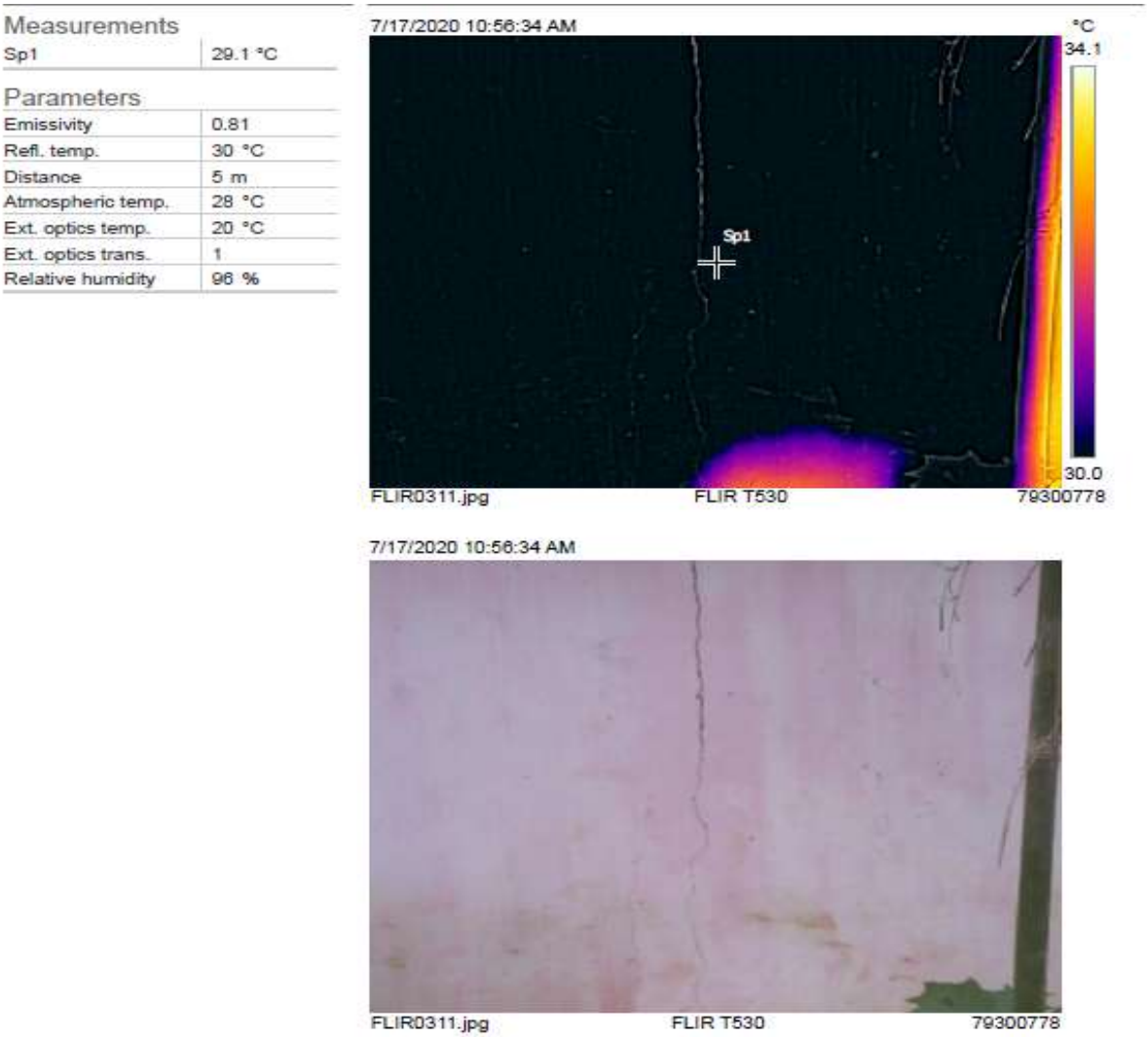


Fig. 3.25: Thermal and Optical observation of the structure as per Figure 1.2

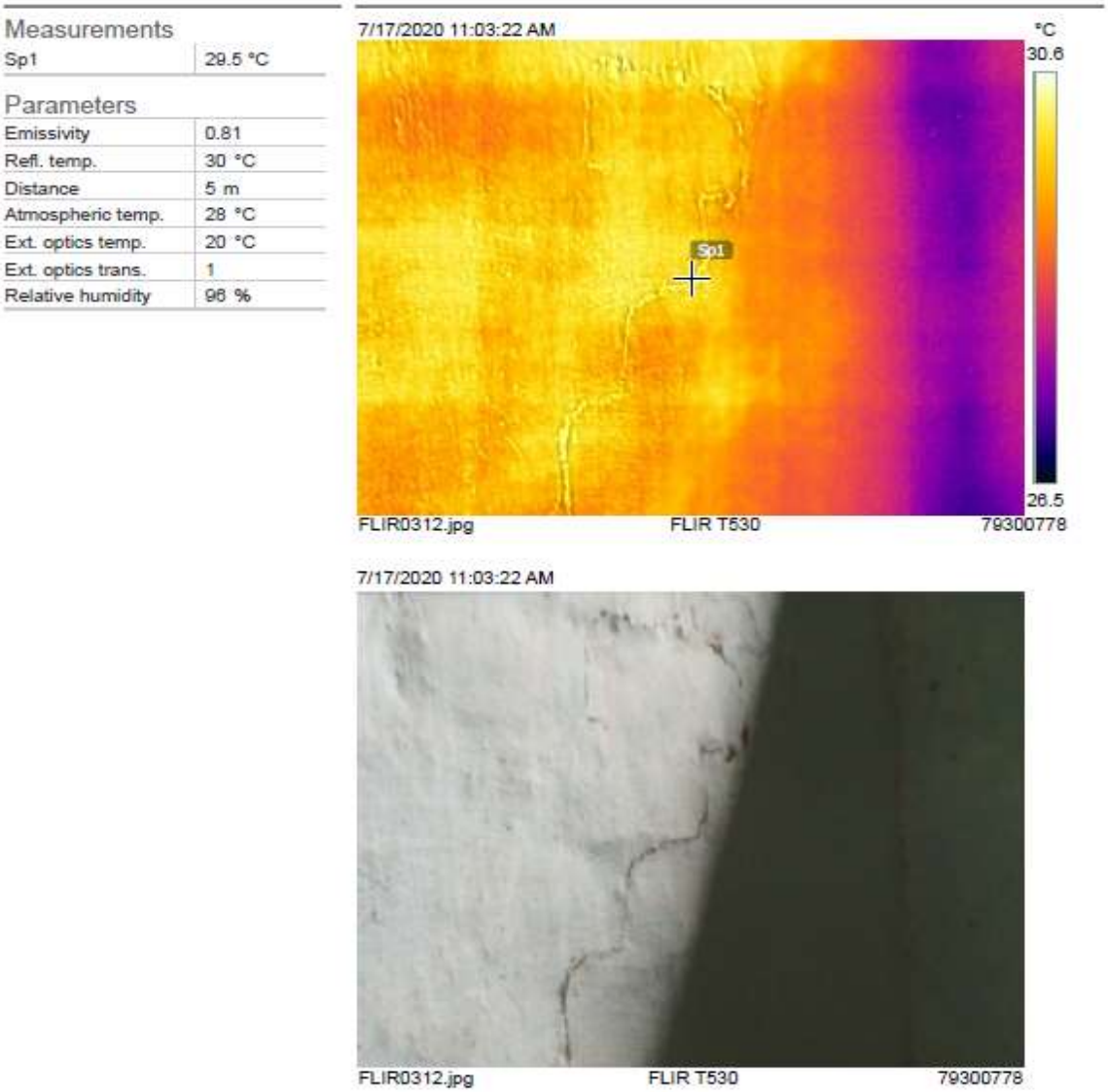


Fig. 3.26: Thermal and Optical observation of the structure as per Figure 1.2

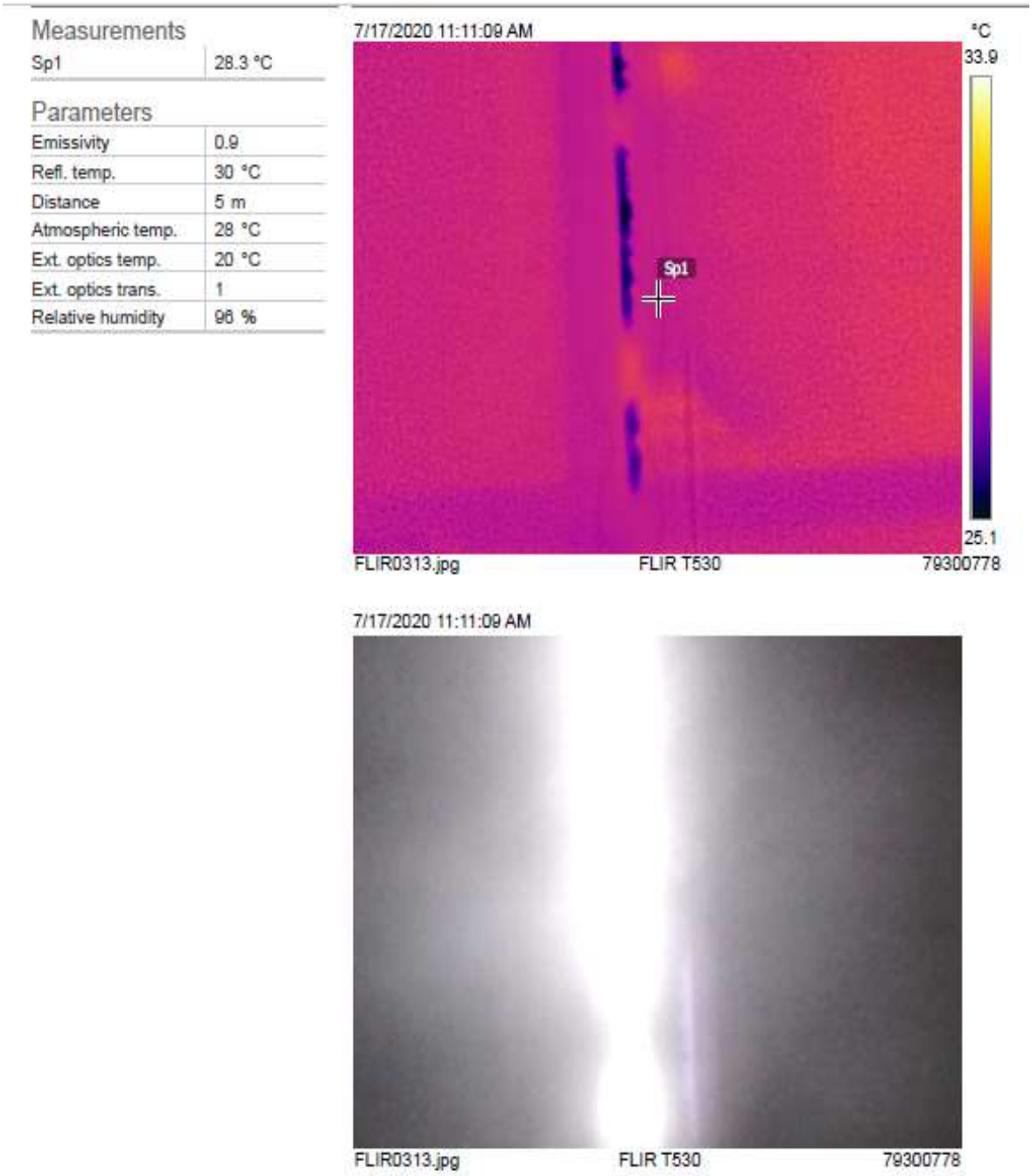


Fig. 3.27: Thermal and Optical observation of the structure as per Figure 1.2

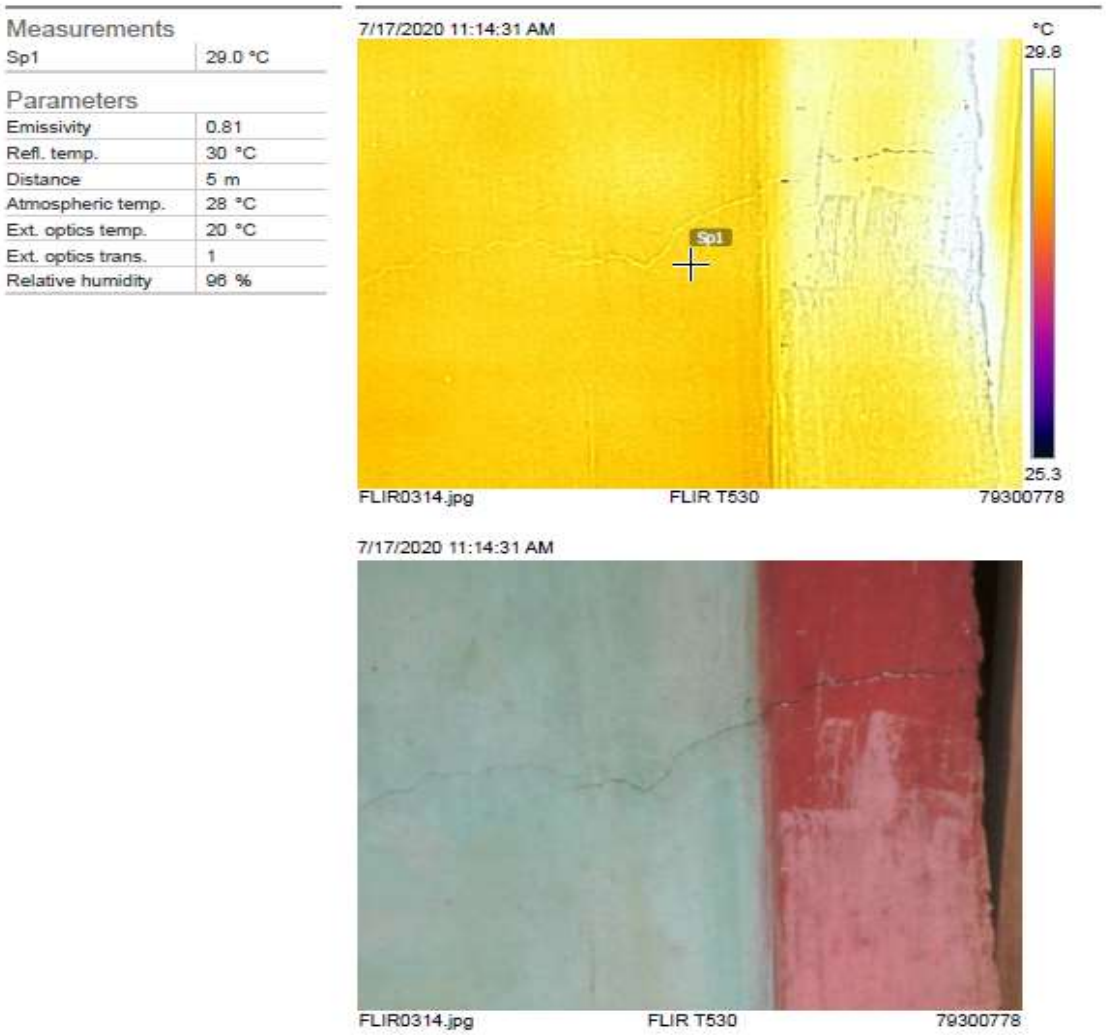


Fig. 3.28: Thermal and Optical observation of the structure as per Figure 1.2

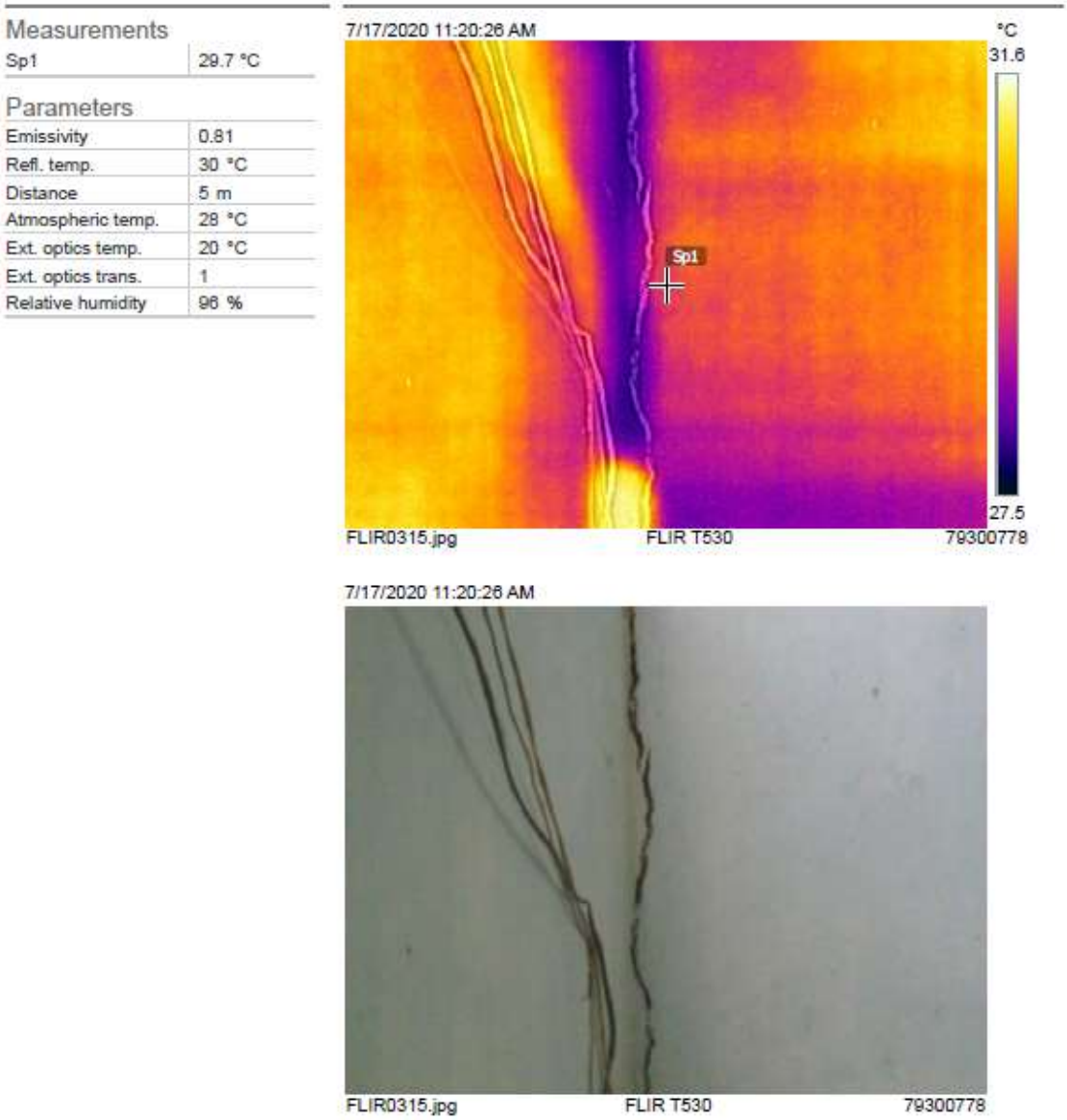


Fig. 3.29: Thermal and Optical observation of the structure as per Figure 1.2

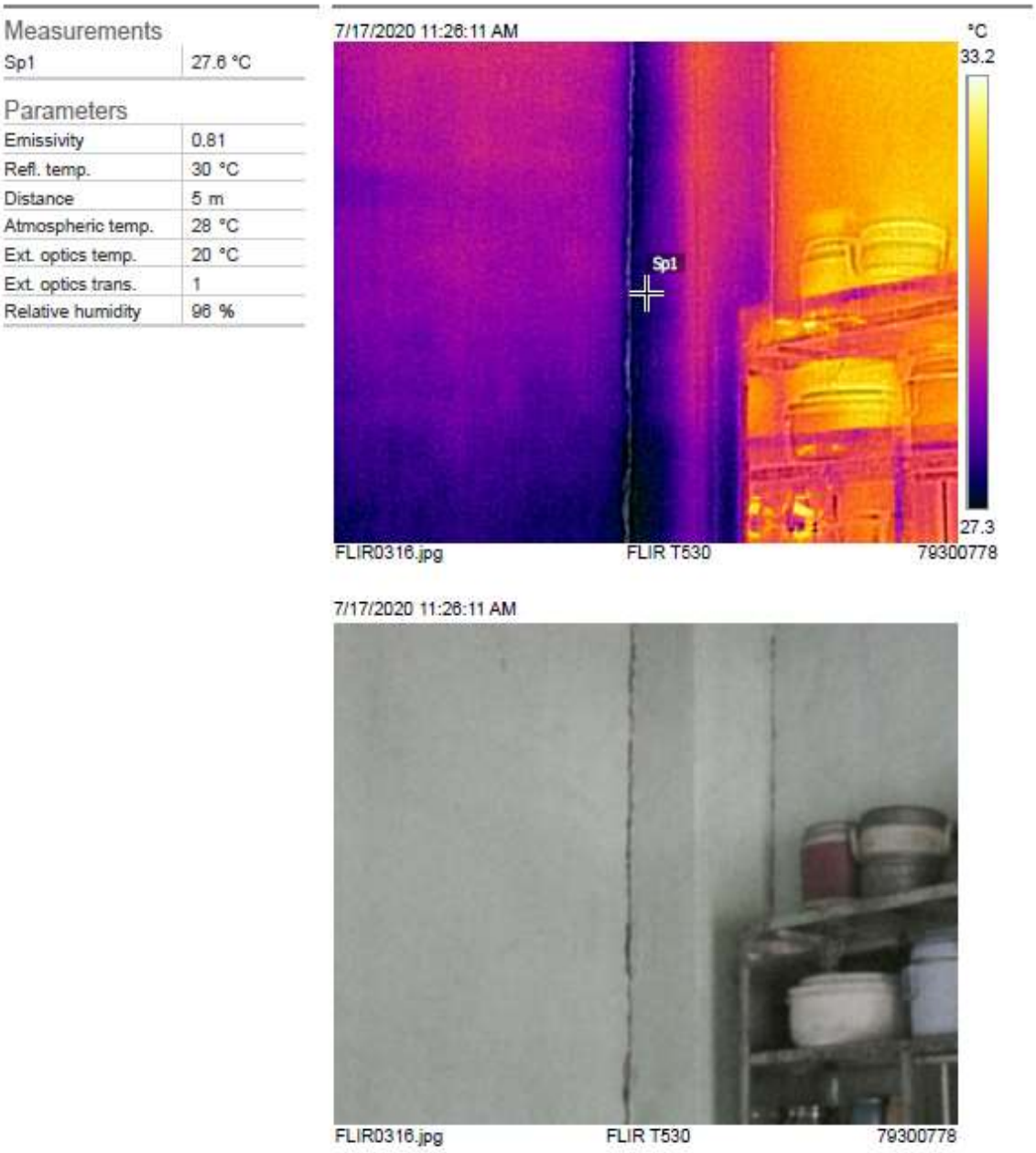


Fig. 3.30: Thermal and Optical observation of the structure as per Figure 1.2

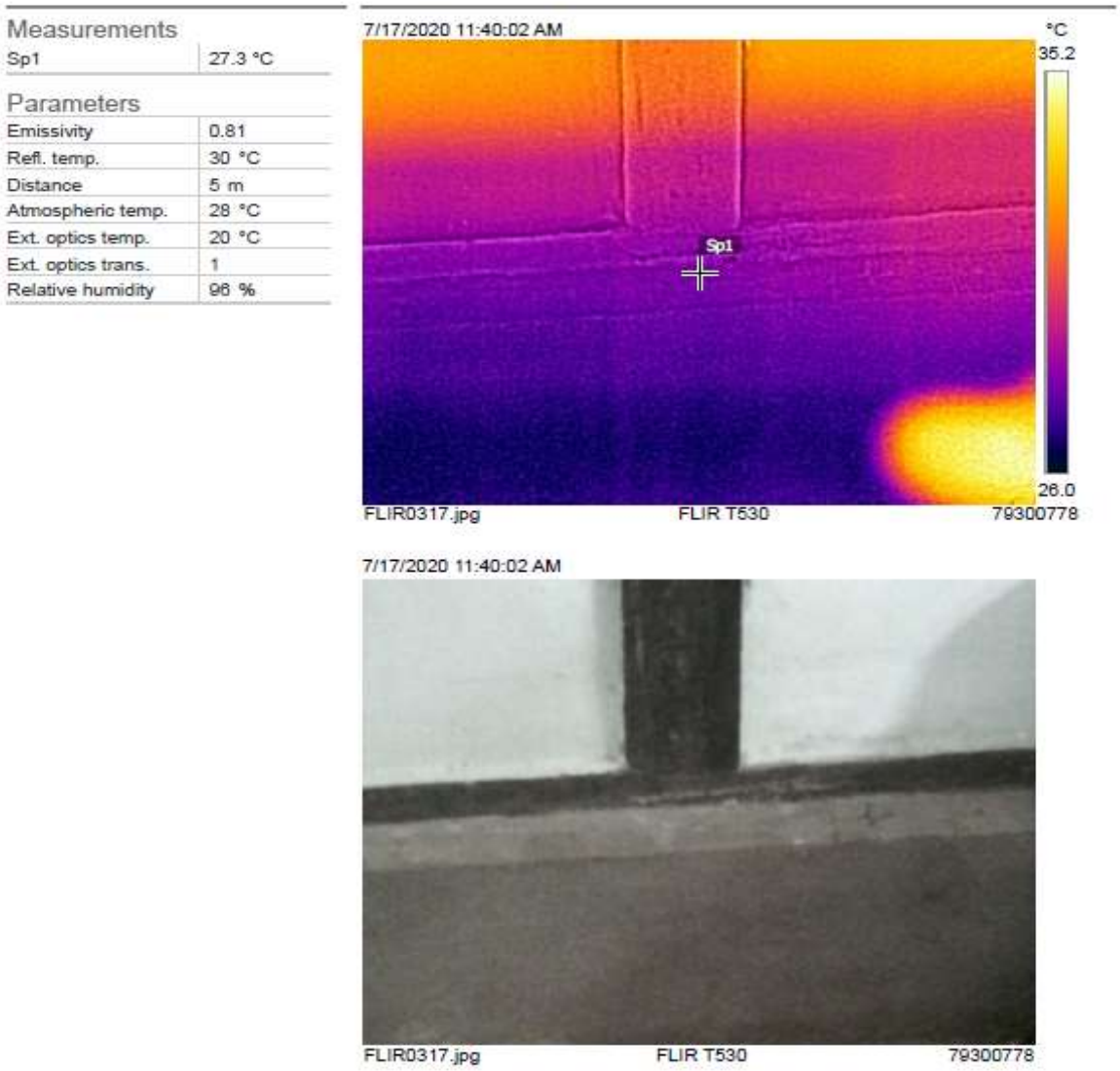


Fig. 3.31: Thermal and Optical observation of the structure as per Figure 1.2

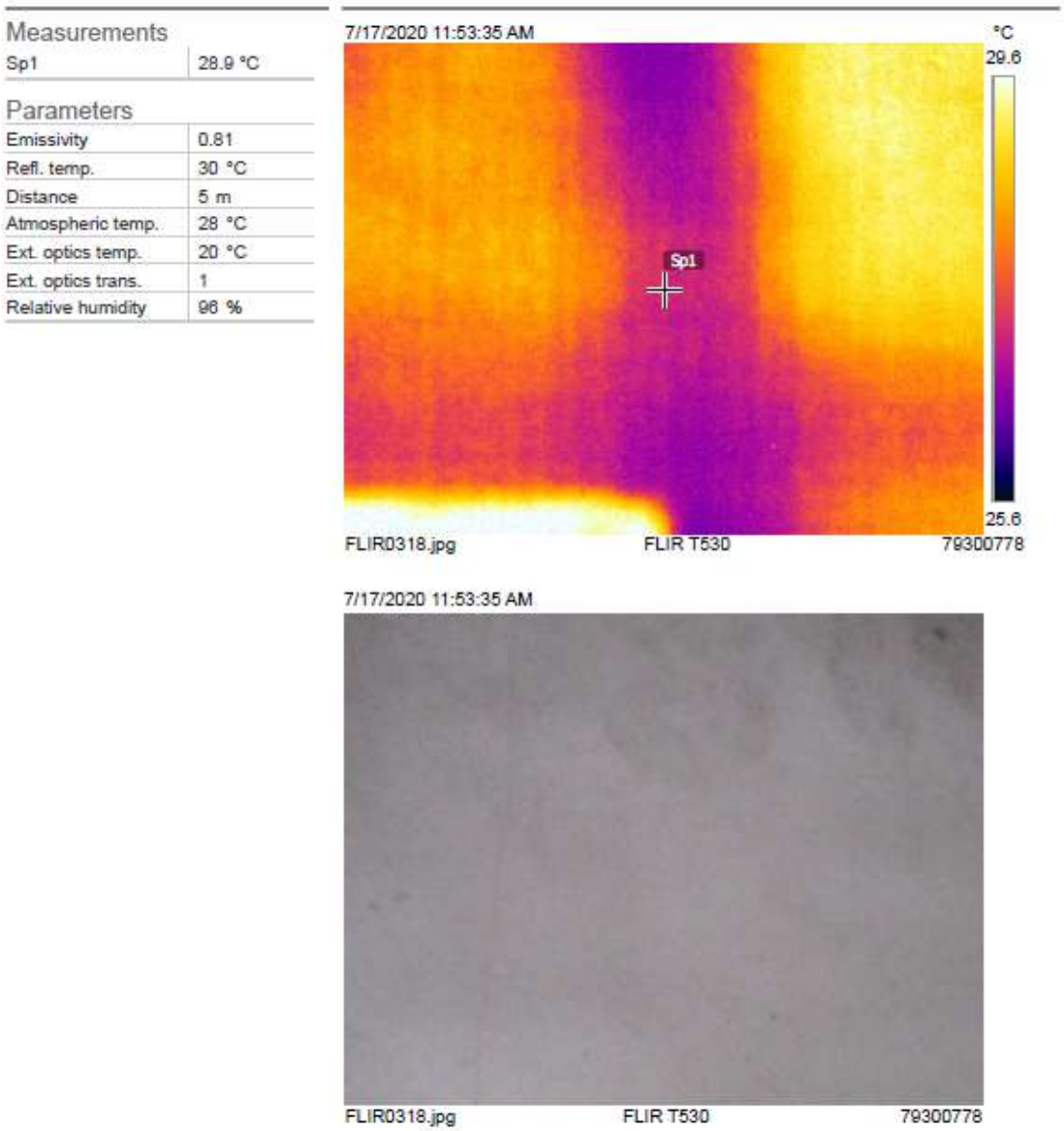


Fig. 3.32: Thermal and Optical observation of the structure as per Figure 1.2

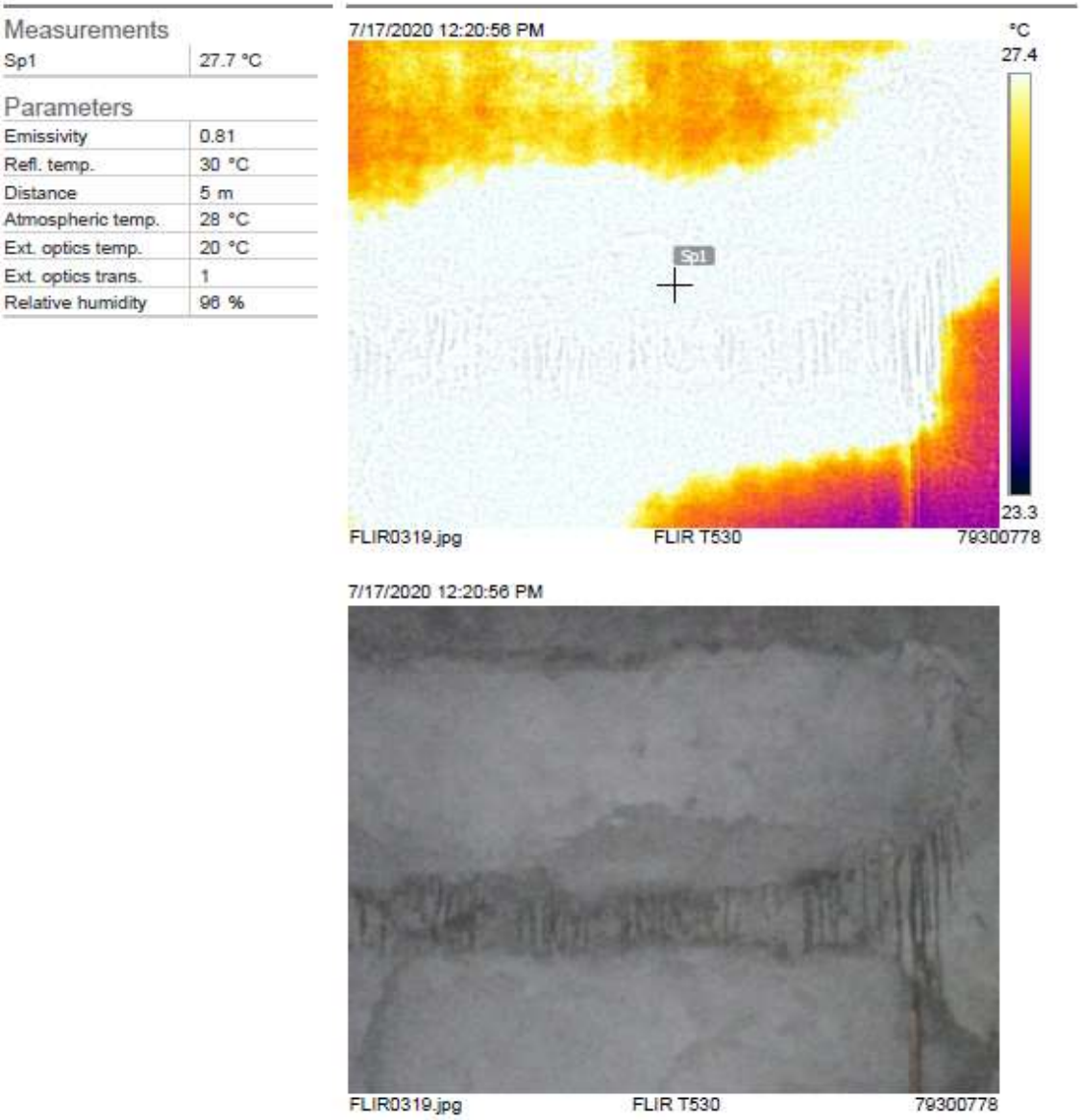


Fig. 3.33: Thermal and Optical observation of the structure as per Figure 1.2

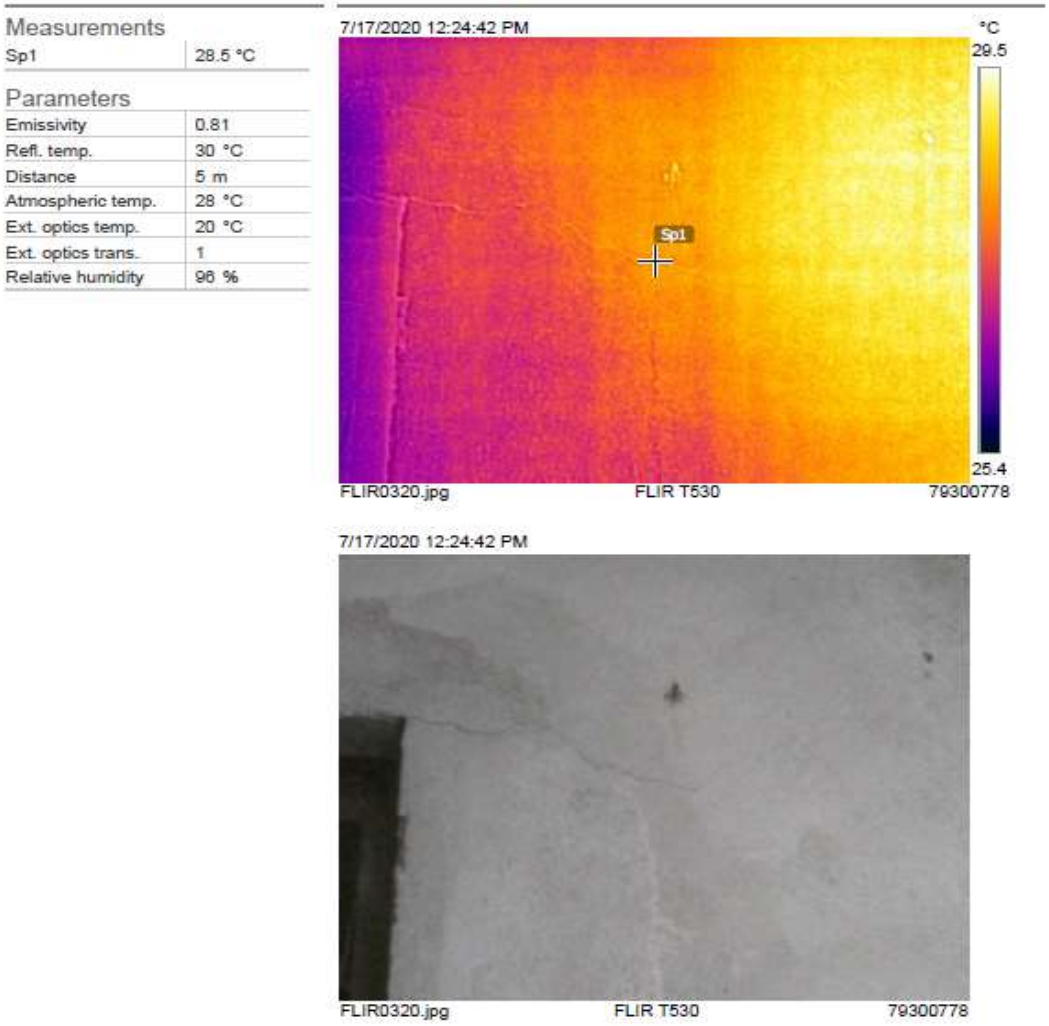


Fig. 3.34: Thermal and Optical observation of the structure as per Figure 1.2

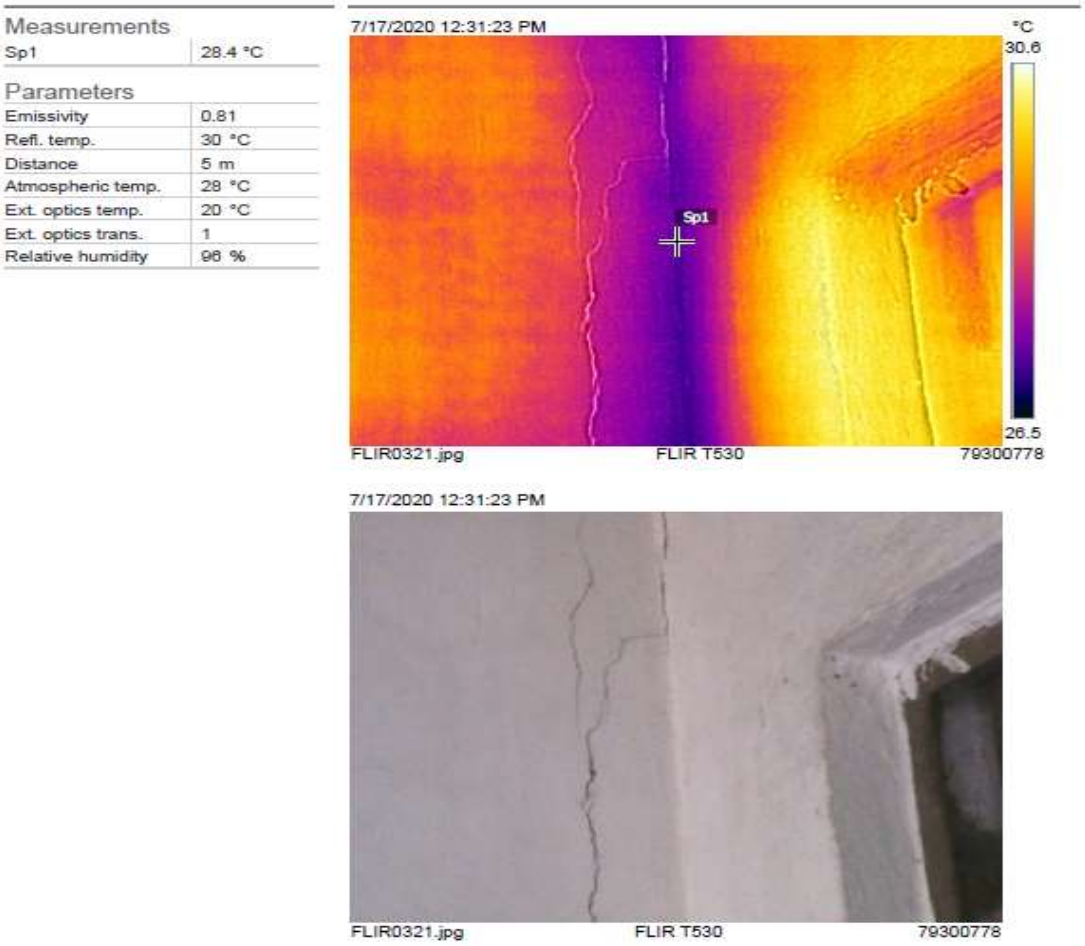


Fig. 3.35: Thermal and Optical observation of the structure as per Figure 1.2



Fig. 3.36: Thermal and Optical observation of the structure as per Figure 1.2



Fig. 3.37: Thermal and Optical observation of the structure as per Figure 1.2



Fig. 3.38: Thermal and Optical observation of the structure as per Figure 1.2



Fig. 3.39: Thermal and Optical observation of the structure as per Figure 1.2

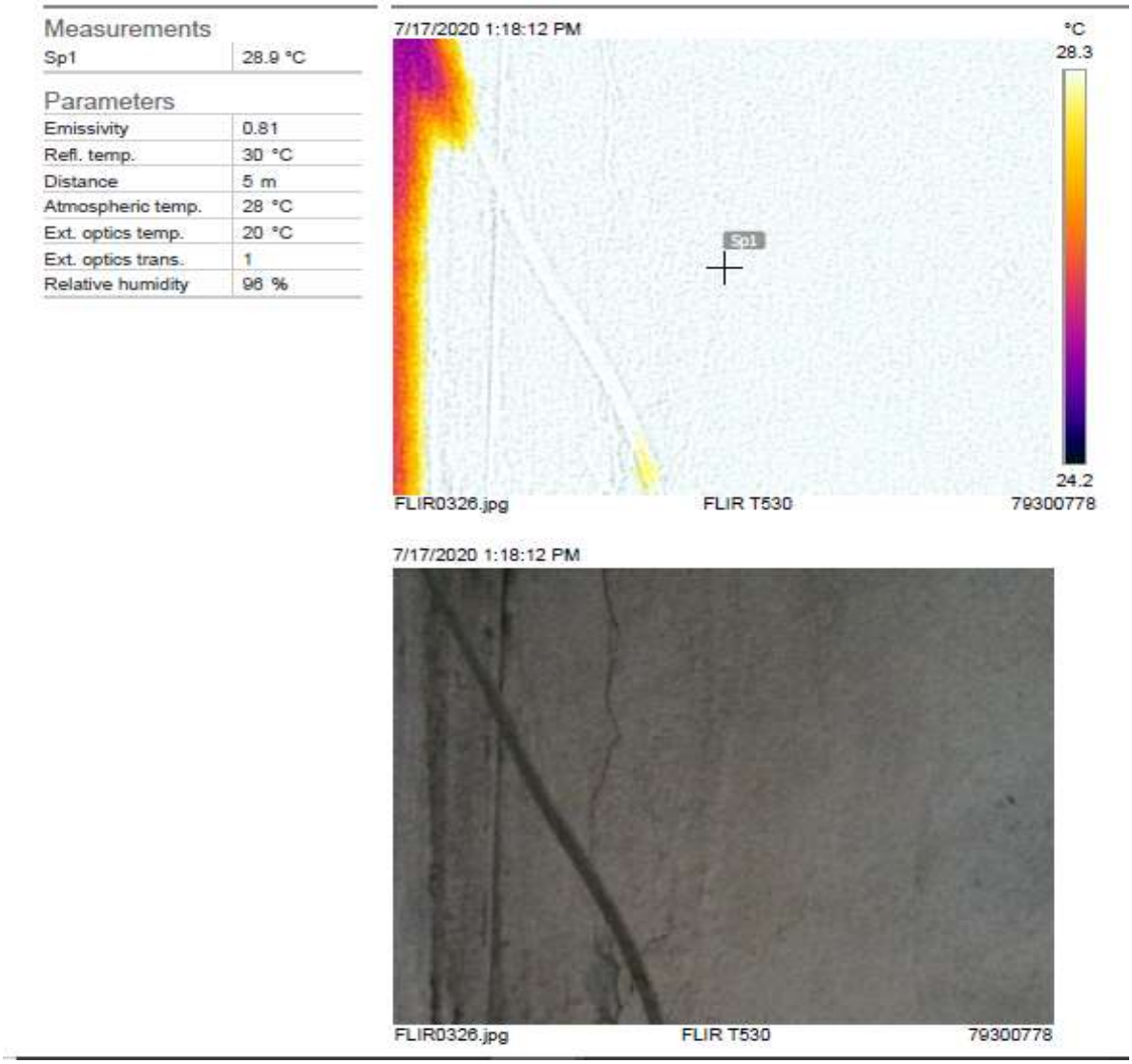


Fig. 3.40: Thermal and Optical observation of the structure as per Figure 1.2

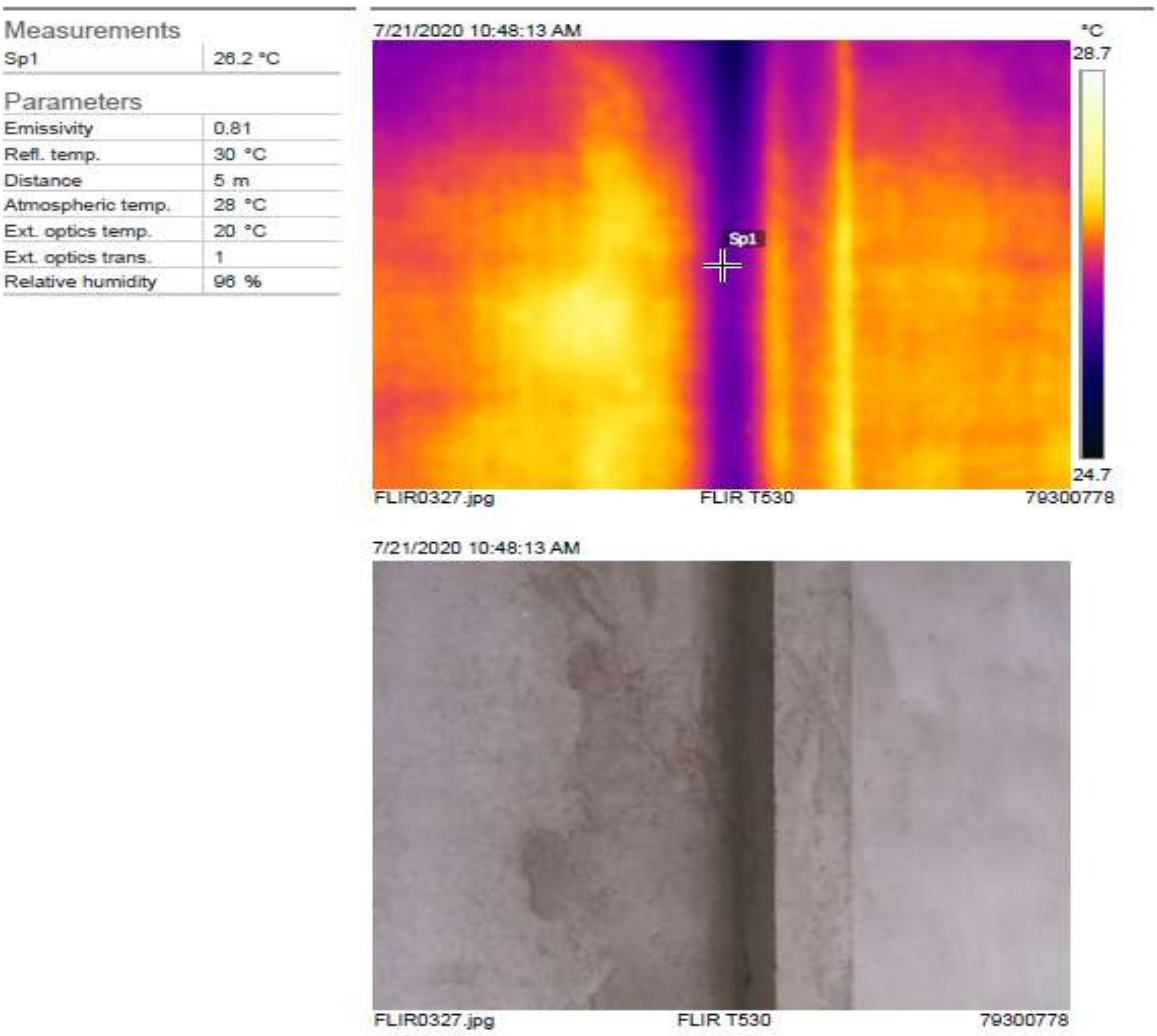


Fig. 3.41: Thermal and Optical observation of the structure as per Figure 1.4

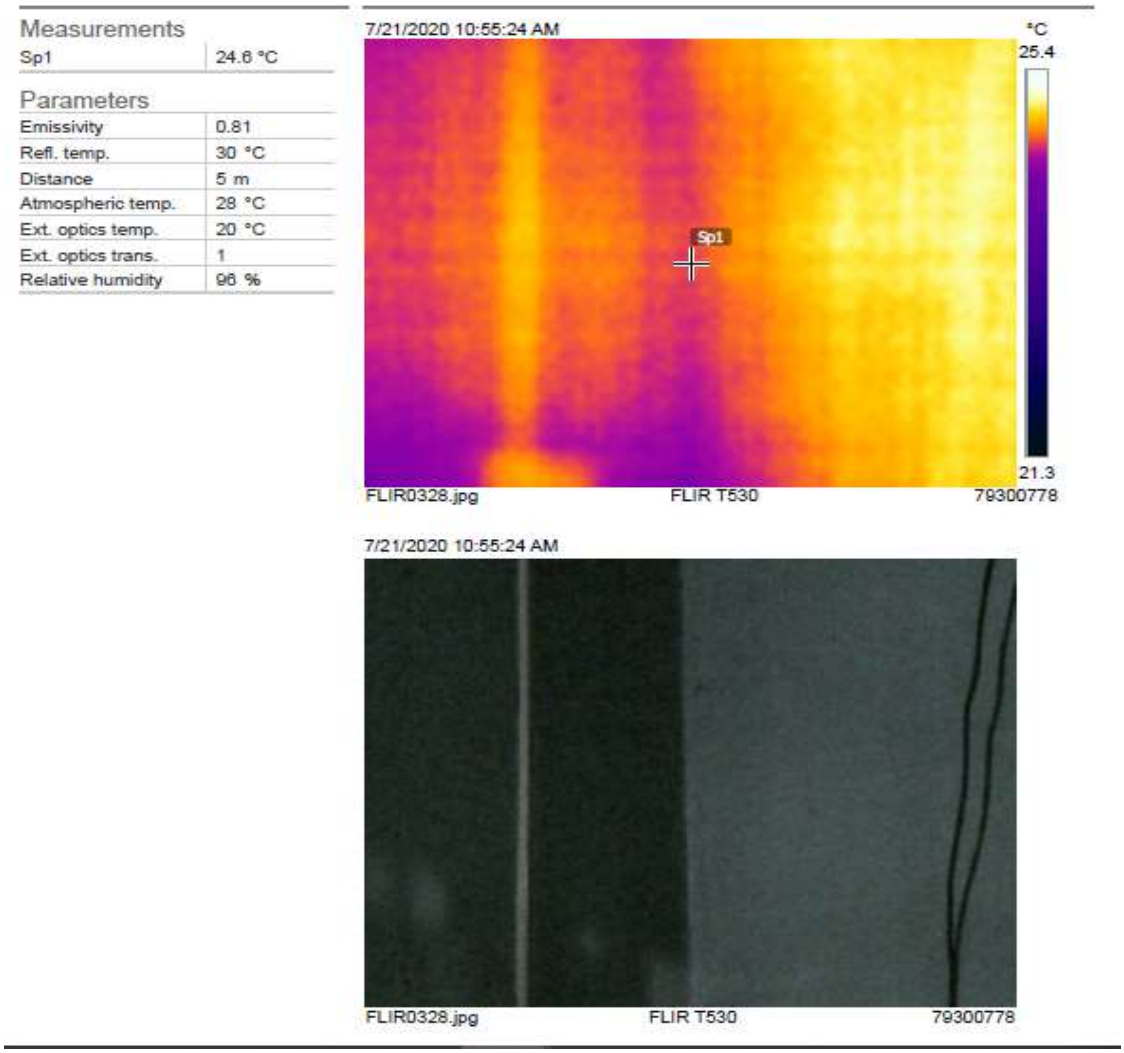


Fig. 3.42: Thermal and Optical observation of the structure as per Figure 1.4

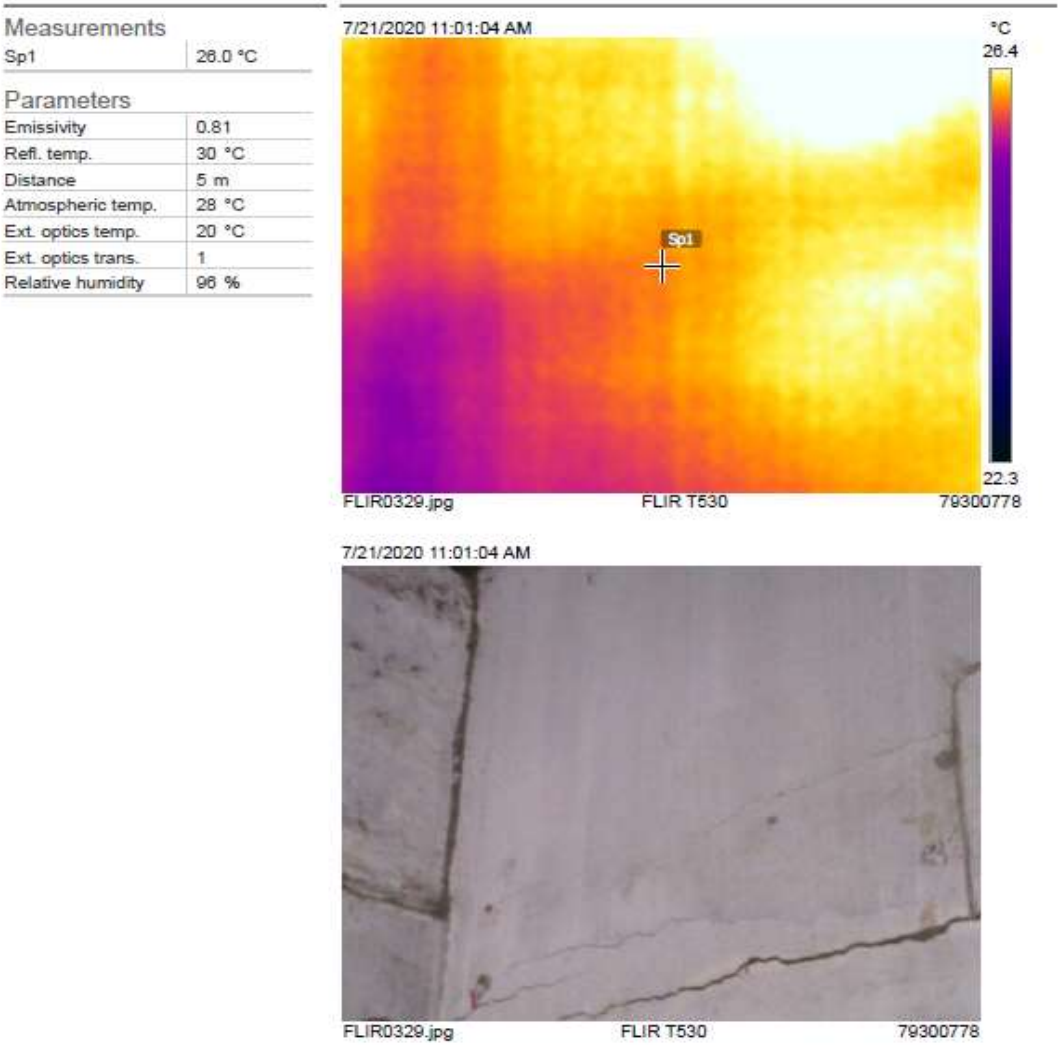


Fig. 3.43: Thermal and Optical observation of the structure as per Figure 1.4

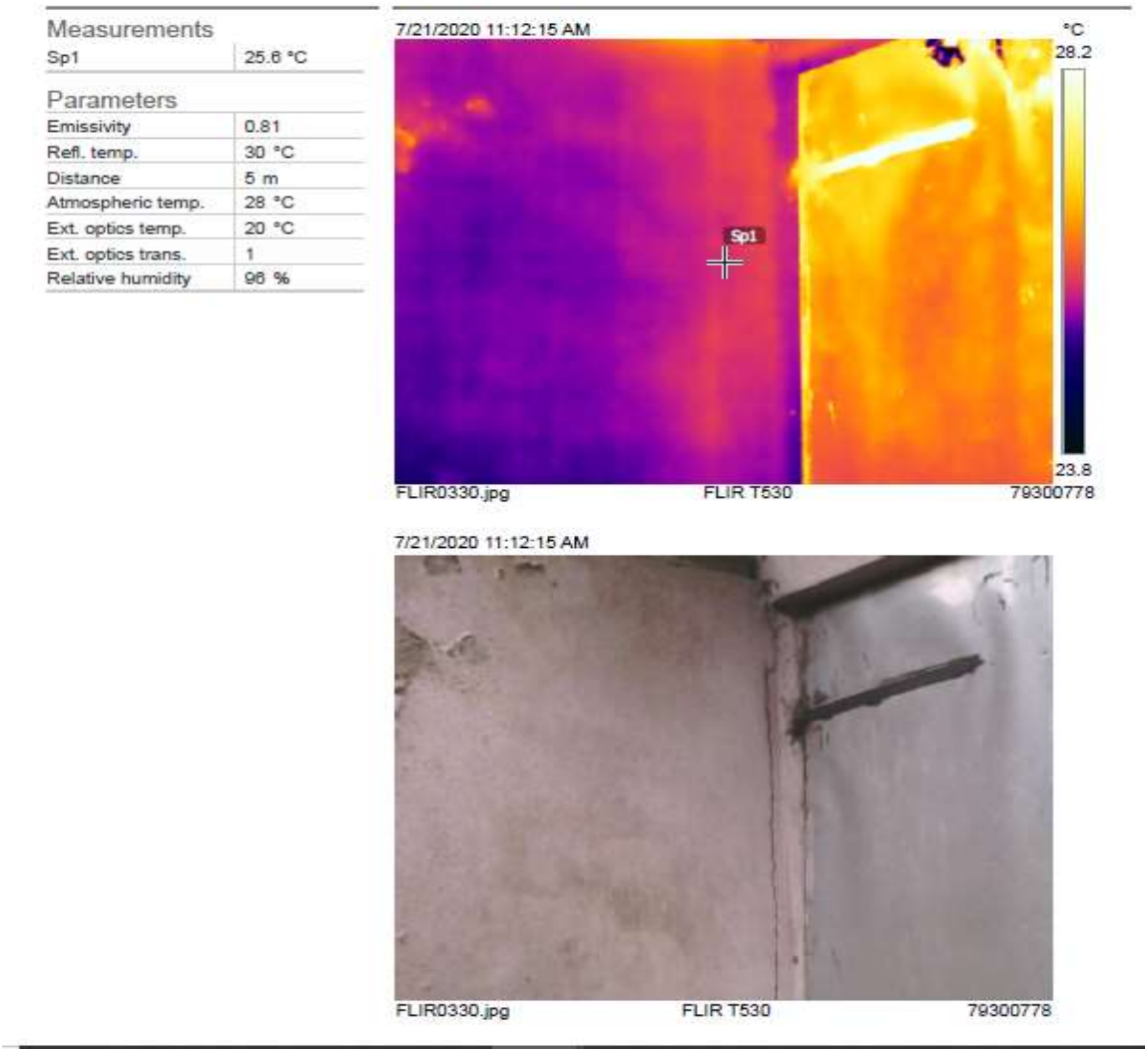


Fig. 3.44: Thermal and Optical observation of the structure as per Figure 1.4

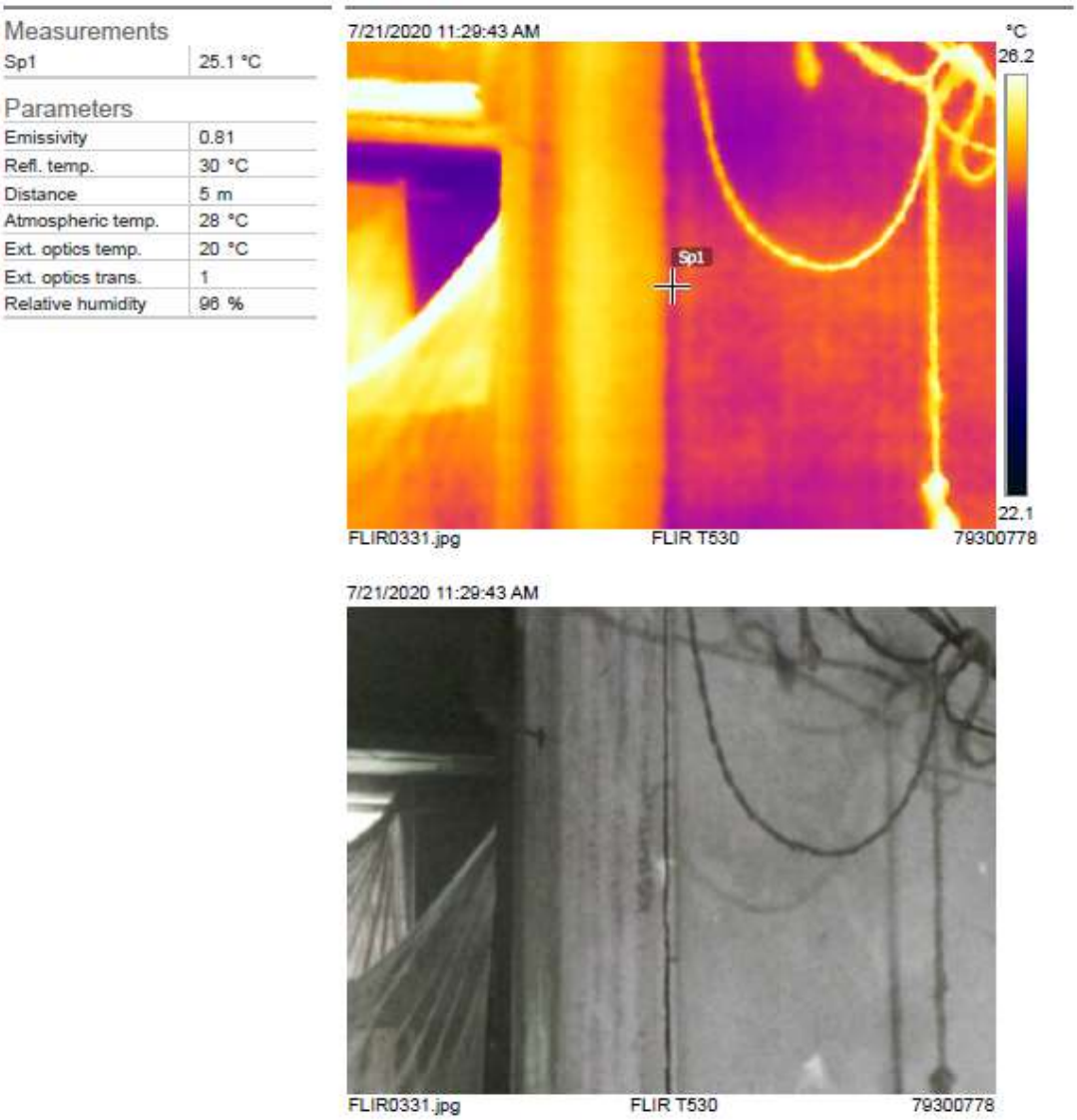


Fig. 3.45: Thermal and Optical observation of the structure as per Figure 1.4

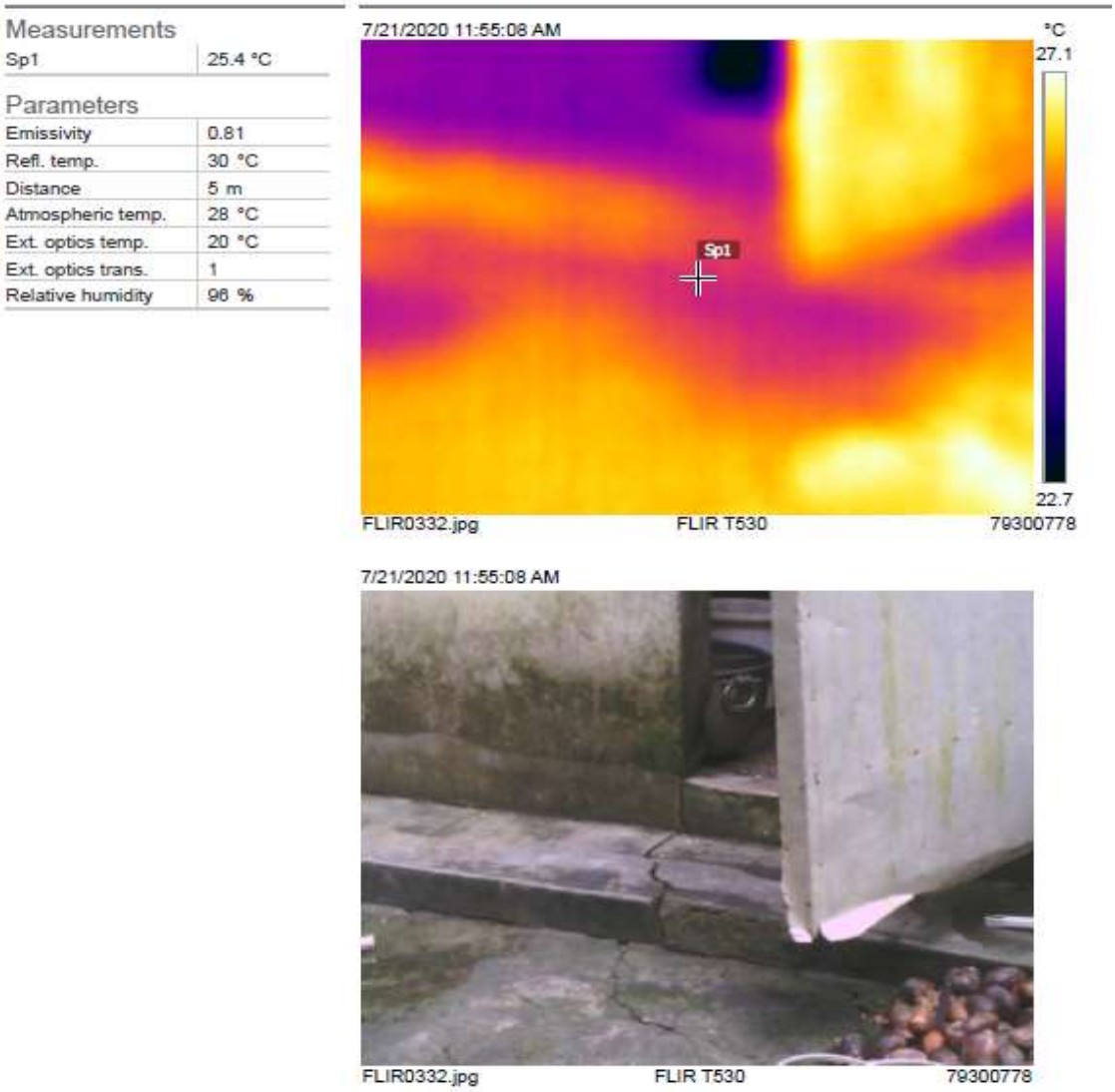


Fig. 3.46: Thermal and Optical observation of the structure as per Figure 1.4

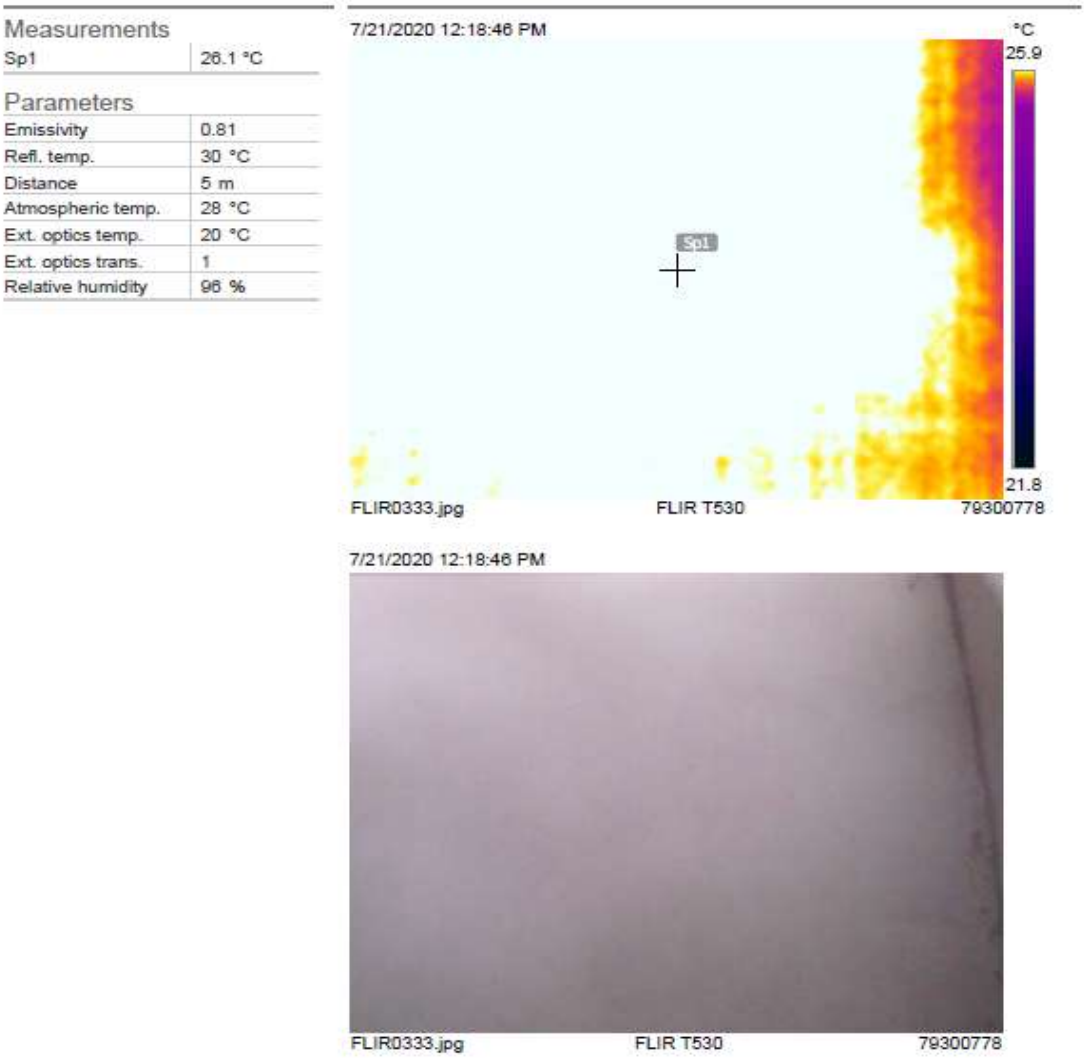


Fig. 3.47: Thermal and Optical observation of the structure as per Figure 1.4

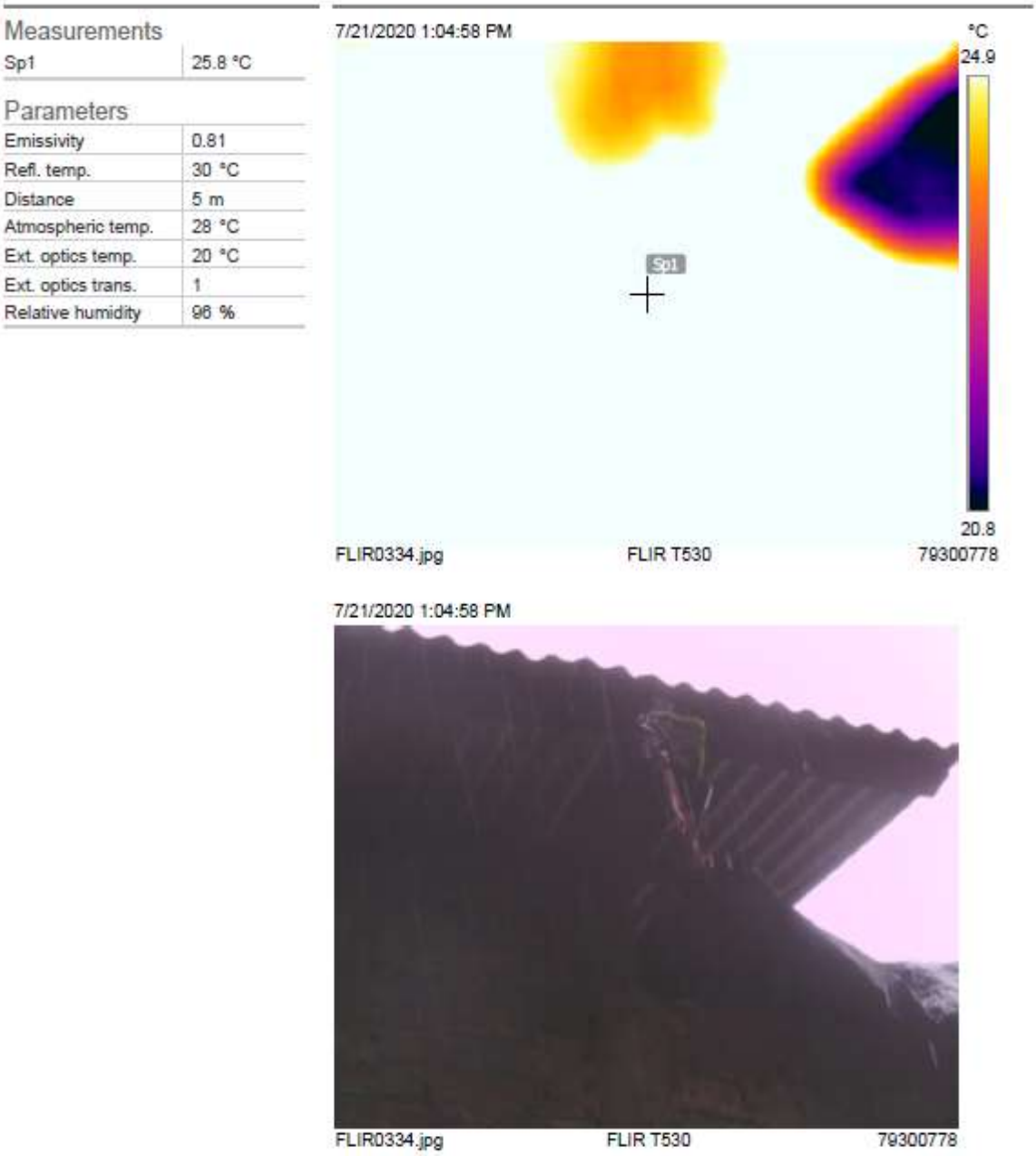


Fig. 3.48: Thermal and Optical observation of the structure as per Figure 1.4

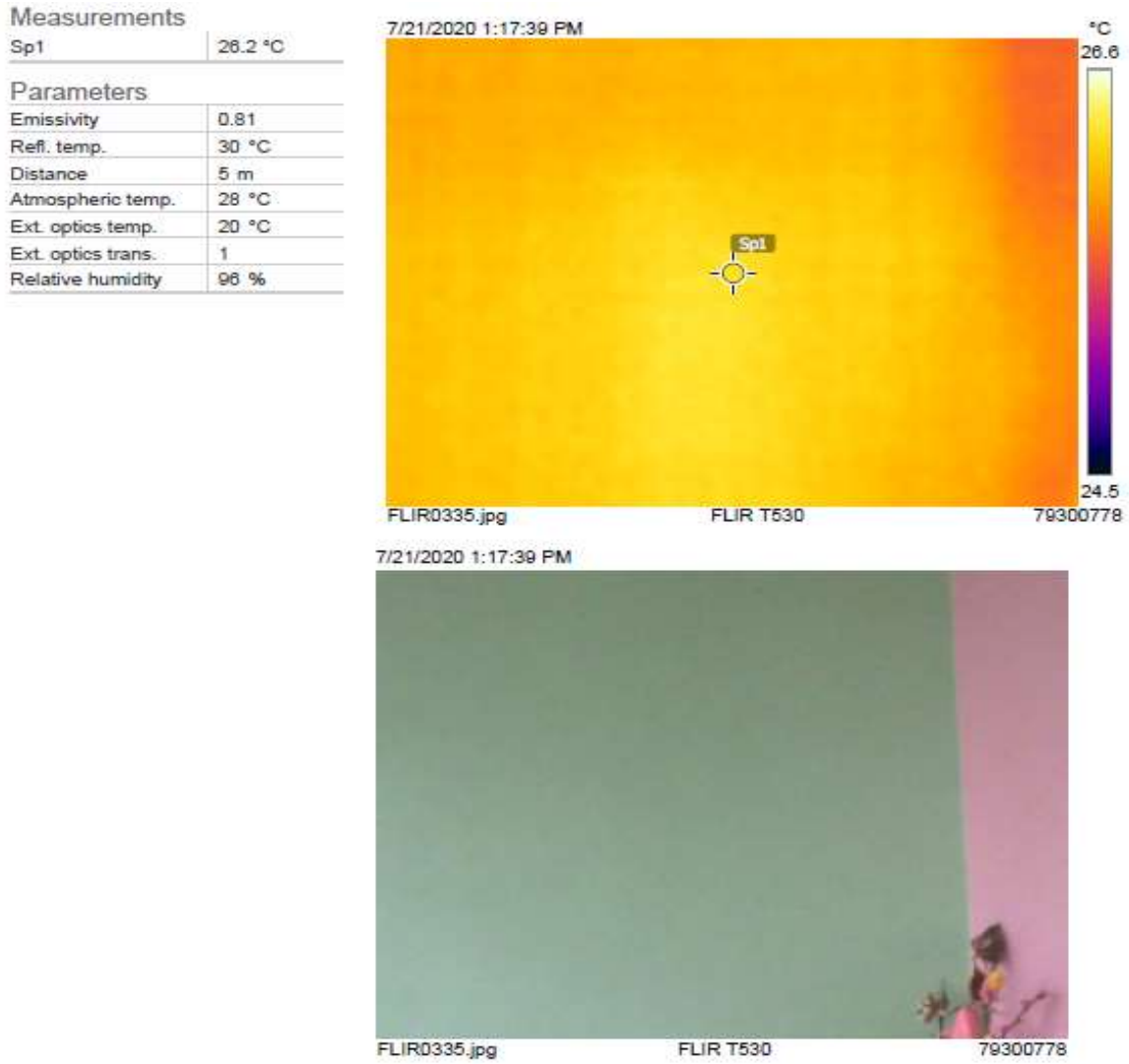


Fig. 3.49: Thermal and Optical observation of the structure as per Figure 1.4

Table 3.1 Thermal image statistic of the heat map of the structure

Thermal Image No.	Maximum Temperature ^{o}C	Minimum Temperature ^{o}C	Average Temperature ^{o}C
288	29.9	29.0	29.5
289	32.6	32.4	32.5
290	26.8	26.2	26.5
291	29.7	28.0	28.6
292	26.9	25.7	26.2
293	27.5	26.9	27.3
294	31.3	24.9	25.9
295	28.4	26.1	27.3
296	29.8	27.9	28.8
297	30.4	29.8	30.2
298	29.6	28.0	28.8
299	34.4	33.7	33.9
300	32.4	31.0	31.9
301	28.83	27.6	28.1
302	30.2	28.5	29.4
303	32.8	30.1	30.9
304	28.5	27.1	27.7
305	40.9	30.2	33.0
306	26.0	24.8	25.5
307	37.2	32.8	35.8
308	29.5	28.0	28.9
309	41.3	27.5	28.9
310	35.4	31.8	33.5
311	31.4	27.9	29.0
312	29.5	28.3	29.2
313	29.3	24.7	28.5
314	30.0	28.6	29.1
315	30.7	28.9	29.7
316	31.3	27.1	28.2
317	33.6	26.6	27.9
318	30.1	28.5	29.0

319	27.7	26.8	27.4
320	28.8	27.7	28.5
321	29.6	28.1	29.0
322	31.0	27.6	28.2
323	31.8	26.1	29.6
324	28.3	27.5	27.9
325	27.9	24.8	26.1
326	29.0	27.7	28.7
327	27.6	25.5	26.9
328	25.0	24.2	24.7
329	26.5	25.3	26.1
330	28.8	23.7	25.8
331	26.8	24.1	25.2
332	27.0	22.4	25.7
333	26.1	25.5	25.9
334	26.5	20.5	25.4
335	26.2	25.6	26.0

Chapter 4. CONCLUSIONS

4.1. SOUND INTENSITY MEASUREMENT INFERENCE

The maximum and minimum peak sound intensity recorded on 20th and 21st July 2020,was 132.2 dB and 103.2 dB respectively. As per IS 1950 (1962, R 2006) code of practise for sound insulation of non-industrial buildings, typical sound levels of 130 dB corresponds to aeroplane noise, pneumatic drill (refer Table 2.3.3). These high sound intensities are occurring sparsely and not throughout the measurement duration (refer spectral representation plots). Moreover, in most of the sound measurements, the high pressure intensity is observed at frequency of 16 kHz and above. At high frequency, the sound intensity is attenuated along the path propagation as compared to low frequency sound. Also, for acoustic free-far field condition, there is 6 dB decrease per doubling of distance for high frequency sound waves. The 1/3 Octave result summary at any given coordinate shows the percentage of occurrence of the peak sound intensities. It is observed that peak sound intensity in the sound time history is occurred at very low occurrence rate (in percentage). Therefore, the sound time history with high pressure intensity in dB emitting at low occurrence rate is not detrimental to the structural integrity.

4.2. SPECTRAL ENERGY INFERENCE

From the spectral representation of the acoustic pressure intensity, it is observed that the maximum energy content of the sound is localized in frequency range of 160 Hz to 6300 Hz. However, in the maximum energy content region, the acoustic pressure intensity is well below 100 dB. Therefore, overall the sound intensity is not too intense to cause any detrimental effect on structural integrity.

4.3. FREQUENCY INFERENCE

As per IS 1893 (part I) 2016, the time period of the structure is approximated as $T_a = \frac{0.09h}{\sqrt{d}}$, where h=height of the structure and d=base dimension of the building at the plinth level along the considered direction of the earthquake shaking. For, all the investigated structures, the time period will be below 5 s and natural frequency will be in well below 20 Hz. As the sound frequency from the gas blow out is much higher than the natural frequency of the structure, the resonance of the structure is not possible. Therefore, we conclude that the sound pressure intensities from the gas blowout has no significant influence on formation of cracks in the buildings.

4.4. THERMAL MEASUREMENT INFERENCE

On the date of thermal mapping measurements i.e 16 July 2020, the maximum and minimum temperature recorded in the heat maps for all the structures under consideration was 41.3 ^{o}C and 20.5 ^{o}C, respectively. The temperature at the location of crack was within the range of 20.5 ^{o}C to 41.3 ^{o}C. The brick, mortar and concrete contained certain amount of trapped liquid water. In fire loading, the water being vaporises only when temperature exceed 100 ^{o}C, usually causing build up of pressure within the mortar and concrete (as per standard BS 8110 (3)),. In practise, boiling temperature of trapped water extend to 140 ^{o}C due to entrapment. In concrete, only above 400 ^{o}C calcium hydroxide in the cement will begin to hydrate, generating more water vapour causing significant reduction in the physical strength of the material. However, in the all the investigated structure, the surface temperature on brick, mortar, plaster and concrete was below 50^{o}C. As per Eurocode 6-Design of Masonry Structure-Part 1-2 General Rule-Structural fire design, the moderate temperature below 50 ^{o}C will have no significant influence on the degradation of strength or stiffness of the structure. Therefore, based on the thermal maps, we conclude that there is no significant effect of fire in blowout well in Bhagjan well 5 on the formation of crack in the structures.

Chapter 5. REFERENCE

IS 1893 (Part 1) :2002. Indian Standard. CRITERIA FOR EARTHQUAKE RESISTANT. DESIGN OF STRUCTURES. PART 1 GENERAL. PROVISIONS.

IS 1950: Code of practice for sound insulation of non-industrial buildings.

Eurocode 6-Design of Masonry Structure-Part 1-2 General Rule-Structural fire design

"ANNEXUR- R9"

417

DISTRICT LABORATORY
Tinsukia (PHE) Division,Tinsukia,Assam
Water Analysis Report

Name of Block : Hapjan
Name of GP : Baghjan
Name of Village: Baghjan Gaon
Name of Habitations: Baghjan No. 1
Date of Collection: 06/04/2020
Date of Examination: 06/04/2020-08/04/2020

Sl No	Pin Point	Source	TURBIDITY	TDS	PH	IRON	ALKALINITY	CHLORIDE	CA-HARDNESS	HARDNESS	FLUORIDE	Bacterla	Remarks
			1 – 5	500-2000	6.5-8.5	0.3-1.00	200-600	250-1000	75-200	200-600	1-1.5		
1	Kali Mondir	HP	0.83	81.6	7.08	0.32	138	64	58	126	0.32	Not Found	Safe for drinking
2	Niranjan Tanti	HP	3.80	68.70	6.91	1.37	120	56	62	128	0.39	Not Found	Fe Contamination
3	Taman Urang	HP	1.85	83.60	7.03	0.92	136	68	54	120	0.31	Not Found	Safe for drinking
4	Brojesh Gupta	HP	2.91	73.6	6.97	0.87	124	52	66	112	0.29	Not Found	Safe for drinking
5	Raju Lakra	HP	3.86	71.6	6.94	1.28	118	58	62	124	0.35	Not Found	Fe Contamination
6	Mukul Deka	HP	3.28	61.7	6.94	0.83	128	68	54	110	0.35	Not Found	Safe for drinking
7	Monoj Lakra	HP	1.64	46.9	7.03	0.68	126	54	66	118	0.31	Not Found	Safe for drinking
8	Baghjan Dighaltarang High School	HP	1.75	64.3	6.92	0.10	138	66	54	112	0.26	Not Found	Safe for drinking
9	Bhagawati Gupta	HP	2.37	59.3	6.94	0.78	122	50	60	116	0.27	Not Found	Safe for drinking
10	Pulok Gogoi	HP	2.67	72.5	7.06	0.31	134	54	66	128	0.31	Not Found	Safe for drinking

Signature of tester
DLL (PHE) Tinsukia Division
Tinsukia

Asst. Chemist
DLL (PHE) Tinsukia Division
Tinsukia

Executive Enginner (PHE)
Tinsukia Division, Tinsukia

"ANNEXURE - R10"

ऑयल इंडिया लिमिटेड
(भारत सरकार का सस्थान) पंजीकृत कार्यालय : दुलियाजान, आसाम
Oil India Limited
(A Government of India Enterprise) Registered Office : Duliajan, Assam

CHEMICAL LABORATORY
(An ISO 9001 : 2015 Certified Laboratory)
CHEMICAL DEPARTMENT, DULIAJAN 786 602, ASSAM, INDIA
(Phone : 91-374-2800439, Fax : 91-374-2801680/2800633,
Email : chemical@oilindia.in)

(FOR INTERNAL USE ONLY)

Ref. No :- ChemLab/Gas/Rep/Condensate//01/2020 Date : 08.06.2020

Chromatographic Analysis of Condensate Sample Extract From Water Sample of BGN # 05 .

Source	BGN # 05	
Collection date	31.05.2020	
Collection time	-	
Date received at Lab.	06.06.2020	
Date of analysis	06.06.2020	

Components	Composition (Mole%)	
C5	0.17	
C6	0.10	
C7	1.45	
C8	0.43	
C9	0.55	
C10	0.63	
C12	20.26	
C13	29.53	
C14	24.20	
C15+	22.68	

Remarks : The sample was collected by personnel's of S&E Department.

N.B. : It may be noted that the Pit water sample was collected from nearby pit of well BGN # 05 and above oil sample was extracted from the pit water. Since, the above sample extracted from water, therefore lighter hydrocarbon may loss / evaporate during the extraction process.

Analyzed By : AKS/LND

Distribution : File-Gas section.
Format: ChemLab/Gas/Rep/Cond/03.

Mrs. D. Bora.
Sr. Chemist (Lab)
Dy.Chief Chemist (Lab)
For- **GM CHEMICAL (Lab)**

"ANNEXURE – R 11"

Central Pollution Control Board
Regional Directorate North East
Lower Motinagar, Shillong-14

Date: 29-10-2020

Report on Ambient Air and Water Quality Monitoring in and around the Well No 5 of OIL, Baghjan, Tinsukia, Assam

As directed by the **Committee of Experts Constituted by Hon'ble NGT,** O. A. No. 43/2020/EZ and O.A No. 44/2020/EZ on Oil India Limited gas accident, the Central Pollution Control Board (CPCB), Regional Directorate North East (RDNE) conducted monitoring/assessment of Ambient Air quality and Water Quality in and around the Well No. 5 of Oil India Limited (OIL) at Baghjan, Tinsukia District, Assam during 09-10-2020 to 13-10-2020.

A. Ambient Air Quality Monitoring:

Ambient Air Quality Monitoring was conducted at four locations in and around the Well No. 5 of OIL Baghjan:

1. **Station 1:** 100 meters from accident site to the North West
2. **Station 2:** 150 meters from accident site to the West
3. **Station 3:** 300 meters from accident site to the West
4. **Station 4:** 500 meters from accident site to the South East

As the wind moves towards West and North West with an average speed of 5 Km per hour; Ambient Air quality monitoring were conducted at one location in the North West (Station-1) and two locations in the west (Station 2 & 3) as downstream of wind, while one location in the South (Station- 4) as upstream of wind but near damaged and old metallic road public road. The Ambient Air Quality Monitoring results are within the National Ambient Air Quality Standard (NAAQS). Monitoring results/Data in **Annexure-1**

B. Water Quality Monitoring:

Water samples were collected from the receiving water bodies around the Well No. 5 (accident site) from the locations given below:

1. Station 1: Dibru river at about 150m away from oil fire towards the west
2. Station 2: Pond adjacent to the oil fire (Accident site)
3. Station 3: Baghjan stagnant water 500 m away from fire
4. Station 4: Maguri Wetland near bridge about 500 m away from accident site
5. Station 5: Maguri Wetland stagnant water 150 m away from fire

Water samples are collected from the nearby water bodies, both from flowing and stagnant water, which are expected to receive the pollution from the accident site. Water samples are analyse in three laboratories SPCB Assam (EPA recognised Laboratory), SPCB Meghalaya (NABL Accredited laboratory) and CPCB RDNE Shillong laboratory. Compiled results given in Annexure-II. The results provided are the highest among the three test results. Except Lead in station-2 all other tested parameters are found within the Discharge Standard for "Oil Drilling and Gas Extraction Industry".

29/10/2020

(Z. Changsan)
Regional Director

Annexure-I

CENTRAL POLLUTION CONTROL BOARD,
REGIONAL DIRECTORATE – SHILLONG
LOWER MOTINAGAR, SHILLONG-793014

REPORT ON AMBIENT AIR QUALITY MONITORING
(In and around Well No 5 in Oil India Limited, Baghjan)

Monitoring Period: 6.00AM 11-10-2020 to 6.00AM 12-10-2020
Parameters=SO_2, NO_2, PM_{10} and $PM_{2.5}$

Parameters ▼	Location/Station ▶	Station No. 1: North West about 100m from accident site	Station No. 2: West about 150m from accident site	Station No. 3: West about 300m from accident site	Station No. 4: South East about 500m from accident site
	NAAQS Standard ▼				
SO_2 Time weighted Average (24 hours) **(µg/m³)**	80	**6**	**BDL**	**BDL**	**BDL**
NO_2 Time weighted Average (24 hours) **(µg/m³)**	80	**9**	**14**	**10**	**BDL**
PM_{10} Time weighted Average (24 hours) **(µg/m³)**	100	**40**	**66**	**35**	**39**
$PM_{2.5}$ Time weighted Average (24 hours) **(µg/m³)**	60			**21**	**4**

Note: 1. BDL= Below Detectable Limit
2. NAAQS= National Ambient Air Quality Standards
3. All tested parameters are within the National Ambient Air Quality Standards

29/10/2020

Dr. Z. Changsan
Regional Director

Annexure-II

421

CENTRAL POLLUTION CONTROL BOARD
REGIONAL DIRECTORATE NORTH EAST
LOWER MOTINAGAR, SHILLONG-793014

Water Quality Analysis Report

Source of water Sample : BAGHJAN OIL WELL FIRE SITE, DULIAJAN, TINSUKIA, ASSAM
Date of collection : October 12, 2020

Sl. No.	Parameters ▼	Discharge Standard ▼	Level of Pollution parameters in 5 locations				
			Station-1: Dibru river approx. 150 m away from oil fire.	**Station-2** Pond adjacent to oil fire	**Station-3** stagnant water 500 m away from fire	**Station-4** Wetland near bridge about 500 m away from fire site	**Station-5** Wetland water, 150 m away from fire
1	pH	5.5-9.0	8.3	7.6	6.7	7.5	7.7
2	Temperature	40 °C	25.6 °C	31 °C	29 °C	34.5 °C	36.2° C
3	Suspended Solids	100 mg/L	74	4	1	5	15.00
4	Zinc	2 mg/L	0.033	0.018	BDL	0.021	0.005
5	BOD	30 mg/L	4.60	2.80	3.40	8.60	7.20
6	COD	100 mg/L	16.2	16	12.10	28.40	24.20
7	Chlorides	600 mg/L	10.0	12.0	16.00	14.00	16.20
8	Sulphate	1000 mg/L	270.9	74.2	69.96	77.38	86.92
9	TDS	2100 mg/L	100.00	77.00	45.00	156.00	320.00
10	% sodium	60 mg/L	X	X	X	X	X
11	Oil & Grease	10 mg/L	4.6	0.251	0.002	0.40	0.026
12	Phenolics	1.2 mg/L	BDL	BDL	BDL	BDL	BDL
13	Cyanides	0.2 mg/L	X	X	X	X	X
14	Flourides	1.5 mg/L	0.20	0.08	0.08	0.10	0.10
15	Sulphides	2.0 Mg/L	0.039	0.026	BDL	0.12	0.04
16	Chromium (Cr+6)	0.1 mg/L	BDL	BDL	BDL	BDL	BDL

17	Chromium (Total)	1.0 mg/L	BDL	BDL	BDL	BDL	BDL
18	Copper	0.2 mg/L	BDL	BDL	BDL	BDL	BDL
19	Lead	0.1 mg/L	0.04	0.121	BDL	0.041	0.041
20	Mercury	0.01 mg/L	BDL	BDL	BDL	BDL	BDL
21	Nickel	3.0 mg/L	BDL	BDL	BDL	BDL	BDL

Note: 1. BDL= Below Detectable Limit

2. X= Not Analyse
3. Standard for Discharge is given while the samples are collected from receiving water bodies
4. Except Lead in station-2 all other tested parameters are found within the Discharge Standard for "Oil Drilling and Gas Extraction Industry".

29/10/2020

(Dr. Z. Changsan)
Regional Director

T.C

"ANNEXURE – R12"

DISTRICT LABORATORY
Tinsukia (PHE) Division,Tinsukia,Assam
Water Analysis Report

Name of Block : Hapjan
Name of GP : Baghjan
Name of Village: Baghjan Gaon
Name of Habitations: Baghjan No. 1
Date of Collection: 03/11/2020
Date of Examination: 03/11/2020-05/11/2020

Sl No	Pin Point	Source	TURBIDITY	TDS	PH	IRON	ALKALINITY	CHLORIDE	CA-HARDNESS	HARDNESS	FLUORIDE	Bacteria	Remarks
			1 -- 5	500-2000	6.5-8.5	0.3-1.00	200-600	250-1000	75-200	200-600	1-1.5		
1	Rubeen Nagbongshhi	HP	3.7	73.41	7.05	1.16	136	68	74	146	0.33	Not Found	Fe Contamination
2	Sukon Moran	HP	0.58	37.16	7.06	1.53	122	60	54	126	0.27	Not Found	Fe Contamination
3	Taman Urang	HP	2.58	77.40	6.98	0.91	140	74	66	126	0.37	Not Found	Safe for drinking
4	Prokash Gupta	HP	3.4	70.52	6.93	1.26	148	68	74	150	0.28	Not Found	Fe Contamination
5	Raju Lakra	HP	3.86	71.6	6.94	1.33	118	58	62	124	0.35	Not Found	Fe Contamination
6	Mukul Deka	HP	2.37	61.5	7.05	0.75	134	64	58	122	0.29	Not Found	Safe for drinking
7	Monoj Lakra	HP	3.57	70.4	6.98	0.77	146	64	70	130	0.35	Not Found	Safe for drinking
8	Baghjan Dighaltarang High School	HP	2.27	77.5	7.08	0.27	144	76	64	128	0.28	Not Found	Safe for drinking
9	Bhagawati Gupta	HP	3.58	64.7	6.98	0.82	134	64	52	108	0.25	Not Found	Safe for drinking
10	Pulok Gogoi	HP	1.87	75.3	7.02	0.47	128	74	62	114	0.28	Not Found	Safe for drinking

Signature of Tester
DLL (PHE) Tinsukia Division
Tinsukia

Asstt. Chemist
DLL (PHE) Tinsukia Division
Tinsukia

Executive Enginner (PHE)
Tinsukia Division, Tinsukia

T-C
8/

2888 "ANNEXURE-13 (Colly)"

424

OIL INDIA LIMITED

SAFETY AND ENVIRONMENT DEPARTMENT

DULIAJAN

Ref.No: S&E/E/09/727 Date:04.06.2020

TO,
DIRECTOR OF RESEARCH (AGRICULTURE)
ASSAM AGRICULTURE UNIVERSITY
JORHAT-13
ASSAM
Fax No.: 0376-2310831

Sub: Assessment of damage to Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) due to OIL's operation.

Dear Sir,

This is to inform you that Oil India Limited (OIL) was carrying out workover operations in its well No Baghjan-5 (Natural Gas Well), Tinsukia District, Assam. During the operations, at around 10.30 AM on 27-05-2020, the well became active and a blowout occurred which led to uncontrolled flow of gas. Due to the aforesaid incident, some damage to Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) has been occurred.

View above, we request you to kindly depute your experts to assess damage to the Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) if any in the said area on urgent basis.

We shall make necessary arrangement for transportation and accommodation of the experts. The details of the experts being deputed may be communicated to us for making necessary arrangements.

Thanking you,

Yours faithfully
OIL INDIA LIMITED

(S.Basumatary)
General Manager (HSE)
For Chief General Manager (HSE)
For **RESIDENT CHIEF EXECUTIVE**

Copy : Vice-chancellor
Assam Agricultural University
Jorhat -785013 ASSAM

OIL INDIA LIMITED

SAFETY AND ENVIRONMENT DEPARTMENT

DULIAJAN

Ref.No: S&E/E/09/771 Date:13.06.2020

TO,
DIRECTOR OF RESEARCH (AGRICULTURE)
ASSAM AGRICULTURE UNIVERSITY
JORHAT-13
ASSAM
Fax No.: 0376-2310831

Sub: Assessment of damage to Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) due to OIL's operation.

Ref: Our earlier letter no. S&E/E/09/727 dated 04.06.2020

Dear Sir,

With reference to our above referred letter, thank you for sending a team of 3(three) experts from your institution. The team reached Duliajan on 08.06.2020(Evening) and made a site visit partially on 09.06.2020 and returned on the same day evening. Unfortunately, on 09.06.2020 at around 01.15PM, the blowout well caught fire and a part of the surrounding areas vegetation got damaged.

View above, we request you to kindly depute your experts again to assess damage to the Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) in the said area on urgent basis.

We shall make necessary arrangement for transportation and accommodation of the experts. The details of the experts being deputed may be communicated to us for making necessary arrangements.

Thanking you,

Yours faithfully
OIL INDIA LIMITED

(S.Majumder)
Chief General Manager (HSE)
For **RESIDENT CHIEF EXECUTIVE**

Copy : Vice-chancellor
Assam Agricultural University
Jorhat -785013 ASSAM

DIRECTORATE OF RESEARCH (AGRI.)
ASSAM AGRICULTURAL UNIVERSITY:: JORHAT-13, ASSAM

No. 7(15)/13/DRA(T)/Pt/2020-21/ 2381 **Dated** 17.06.2020

To

S. Majumder
Chief General Manager (HSE)
For Resident Chief Executive
Safety and Environment Department
Oil India Ltd., Duliajan

Sub: Deputation of experts for assessment of damage of Crops/ Tree/ Plants (Paddy/Tea/Fruit/Vegetation) – reg.

Ref: No. S & E/E/09/771 Dtd. 13.06.2020

Sir,

In inviting a reference to above, the undernoted Scientists from Assam Agricultural University, Jorhat are deputed for assessment of damage of Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) in the surrounding areas of the blowout well at Baghjan – 5 (Natural Gas Well), Tinsukia District, Assam. You may please contact the below mentioned Scientists and finalize the date of their visit.

1. Dr. S. Gogoi, Pr. Scientist, AICRP on Vegetable Crops, Dept. of Horticulture, AAU, Jorhat **(9435514466)**
2. Dr. M. Deka, Professor, Dept. of Tea Husbandry & Technology, AAU, Jorhat **(9435052196)**
3. Dr. Bhabesh Gogoi, Jr. Scientist, AICRP on Integrated Farming System, AAU, Jorhat **(9435352867)**

Yours faithfully,

18/6/2020

Director of Research (Agri.)
Assam Agricultural University
Jorhat-13

Copy to :

1. Mr. G. G. Rasu, Dy. General Manager (S&E), Safety and Environment Department, OIL, Duliajan
2. The Chief Agronomist, AICRP on Integrated Farming System, AAU, Jorhat
3. The Prof. & Head, Dept. of Tea Husbandry & Technology/Horticulture, AAU, Jorhat
4. Dr. S. Gogoi, Pr. Scientist, AICRP on Vegetable Crops, Dept. of Horticulture, AAU, Jorhat
5. Dr. M. Deka, Prof., Dept. of Tea Husbandry & Technology, AAU, Jorhat
6. Dr. Bhabesh Gogoi, Jr. Scientist, AICRP on Integrated Farming System, AAU, Jorhat

DIRECTORATE OF RESEARCH (AGRI.)
ASSAM AGRICULTURAL UNIVERSITY:: JORHAT-13, ASSAM

No. 7(15)/13/DRA(T)/Pt/2020-21/ 2602 **Dated** 22.06.2020

To

S. Majumder
Chief General Manager (HSE)
For Resident Chief Executive
Safety and Environment Department
Oil India Ltd., Duliajan

Sub: Deputation of experts for assessment of damage of Crops/ Tree/ Plants (Paddy/Tea/Fruit/Vegetation) – reg.

Ref: No. S & E/E/09/771 Dtd. 13.06.2020

Sir,

In inviting a reference to the subject cited above, the undersigned is pleased to allow Dr. Karuna Kanta Sharma, Chief Agronomist, AICRP on Integrated Farming System, AAU, Jorhat **(Mobile: 6000208171)** for field visit duty to assess the damages on the crops/ trees/ plants in the surrounding area of Baghjan-5 (Natural gas Well) Blowout at Duliajan due to OIL's operation instead of Dr. Bhabesh Gogoi, Scientist (Soils) Stage – II, AICRP-IFS, AAU, Jorhat vide office letter *No. 7(15)/13/DRA(T)/Pt/2020-21/2381 Dated17.06.2020*

Yours faithfully,

22/06/2020

Director of Research (Agri.)
Assam Agricultural University
Jorhat-13

Copy to :

1. Mr. G. G. Rasu, Dy. General Manager (S&E), Safety and Environment Department, OIL,Duliajan
2. Dr. Karuna Kanta Sharma, Chief Agronomist, AICRP on IFS, AAU, Jorhat
3. The Prof. & Head, Dept. of Tea Husbandry & Technology/Horticulture, AAU, Jorhat
4. Dr. S. Gogoi, Pr. Scientist, AICRP on Vegetable Crops, Dept. of Horticulture, AAU, Jorhat
5. Dr. M. Deka, Prof., Dept. of Tea Husbandry & Technology, AAU, Jorhat
6. Dr. Bhabesh Gogoi, Scientist (Soils) Stage – II, AICRP on IFS, AAU, Jorhat

OIL INDIA LIMITED

SAFETY AND ENVIRONMENT DEPARTMENT

DULIAJAN

Ref.No: S&E/E/09/1581 Date:23.11.2020

TO,
DIRECTOR OF RESEARCH (AGRICULTURE)
ASSAM AGRICULTURE UNIVERSITY
JORHAT-13
ASSAM
Fax No.: 0376-2310831

Sub: Assessment of damage to Soil/Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) due to OIL's operation.
Ref: Our earlier letter no. : S&E/E/09/771 dated:13.06.2020

Dear Sir,

With reference to our above referred letter, we thank you for sending a team of 3(three) experts from your institution. The team reached Duliajan on 08.06.2020(Evening) and made a site visit (partially) on 09.06.2020 and returned on the same day evening as the blowout well caught fire at around 01.15PM. Some part of the vegetation in the surrounding areas of the blowout well Baghjan-5 in Tinsukia district got damaged due to the fire incident. Again, on our request, your experts visited the site on 25.06.2020, but due to the prevailing condition/situation and flood due to heavy rain, assessment could not be carried out. Now, the fire in the well is completely doused off and the well has been killed successfully.

View above, we once again request you to kindly depute the same experts sent earlier to continue their assessment/study damage to the Soil/Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) in the said area on urgent basis. We shall make necessary arrangement for transportation and accommodation of the experts.

Thanking you,

Yours faithfully
OIL INDIA LIMITED

23/11/2020

(G.G.Rasu)
Deputy General Manager (S&E)
For Chief General Manager (HSE)
For **RESIDENT CHIEF EXECUTIVE**

Copy : Vice-chancellor
Assam Agricultural University
Jorhat -785013 ASSAM

DIRECTORATE OF RESEARCH (AGRI.)
ASSAM AGRICULTURAL UNIVERSITY:: JORHAT-13, ASSAM

No. 7(15)/13/DRA(T)/Pt/2020-21/ 11887-92 Dated 28/11/2020

To

Mr. G. G. Rasu
Dy. General Manager (S&E)
For Chief General Manager (HSE)
For Resident Chief Executive
Safety and Environment Department
Oil India Ltd., Duliajan

Sub: Deputation of experts for assessment of damage of Crops/ Tree/ Plants (Paddy/Tea/Fruit/Vegetation) – reg.

Ref: No. 1) S & E/E/09/771 Dtd. 13.06.2020
2) S & E/E/09/1581 Dtd. 23.11.2020

Sir,

In inviting a reference to above, the undernoted Scientists from Assam Agricultural University, Jorhat are deputed for assessment of damage of Crops/Tree/Plants (Paddy/Tea/Fruit/Vegetation) in the surrounding areas of the blowout well at Baghjan – 5 (Natural Gas Well), Tinsukia District, Assam. You may please contact the below mentioned Scientists and finalize the date of their visit.

1. Dr. Karuna Kanta Sharma, Chief Agronomist, AICRP on Integrated Farming System, AAU, Jorhat **(6000208171)**
2. Dr. S. Gogoi, Pr. Scientist, AICRP on Vegetable Crops, Dept. of Horticulture, AAU, Jorhat **(9435514466)**
3. Dr. M. Deka, Professor, Dept. of Tea Husbandry & Technology, AAU, Jorhat **(9435052196)**

Yours faithfully,

28/11/2020

Director of Research (Agri.)
Assam Agricultural University
Jorhat-13

Copy to :

1. Dr. Karuna Kanta Sharma, Chief Agronomist, AICRP on IFS, AAU, Jorhat
2. The Prof. & Head, Dept. of Horticulture/ Tea Husbandry & Technology, AAU, Jorhat
3. Dr. S. Gogoi, Pr. Scientist, AICRP on Vegetable Crops, Dept. of Horticulture, AAU, Jorhat
4. Dr. M. Deka, Prof., Dept. of Tea Husbandry & Technology, AAU, Jorhat

REPORT OF THE TEAM

OF EXPERTS

ASSAM AGRICULTURAL UNIVERSITY

VISITED TO

Baghjan Gas Blowout area (OIL Field Area), Duliajan

(YEAR 2021)

Submitted by

Dr. K.K. Sharma, Chief Agronomist
Dr. M. Deka, Professor, Department of THT
Dr. S. Gogoi, Professor, Department of Horticulture

Assam Agricultural University
Jorhat, Assam -785 013 (INDIA)

REPORT OF THE TEAM OF EXPERT FROM ASSAM AGRICULTURAL UNIVERSITY, JORHAT ON GAS BLOWOUT AREA OF BAGHJAN, DISTRICT: TINSUKIA, ASSAM

A team of Scientists constituted by the Director of Research (Agri.), Assam Agricultural University, Jorhat Vide No. 7 (15) / 13 / DRA(T) / Pt / 2020-21 / 11887- 92 dtd. 28 / 11 / 2020 to assess the damage due to Gas blowout area of Baghjan under OIL, Duliajan. The team constituted by the following members –

1. Dr. K.K. Sharma, Chief Agronomist, AAU, Jorhat
2. Dr. M. Deka, Professor, Department of THT, AAU, Jorhat
3. Dr. S. Gogoi, Professor, Department of Horticulture AAU, Jorhat

The team visited the affected sites during 27-28 January, 2021. The team was accompanied by officials of Safety & Environment Deptt., along with other OIL officials, Duliajan and visited the Baghjan sites. The details report followed below:

1. The team visited Baghjan Gaon and interacted with the inhabitant of the area within 500 m radius. The team noticed the affect of the gas blowout in crops, soil and water body of the site of visit.
2. Collected the soil and water samples from the sites for further necessary analysis. The crop field includes both paddy fields and homestead gardens accommodating tea, arecanut, pepper and others of the farmers.
3. The soil sample collected from the North, South, East and West direction within 500 m radius of the Baghjan (B N 5.) on 28 / 01 / 2021 were analyzed in the Laboratory, at AAU, Jorhat. From these soil test reports, interpretations/ inferences were made on the soil health status of the *flare broke-out* area (Table 1).

   Data (Table 1) revealed that the physico-chemical properties such as porosity, alkalinity, pH and electrical conductivity (EC) were in the safe limit. Soil pH ranged between minimum 5.33 (acidic) and maximum 7.64 (slightly saline). In general, Assam soil is acidic in nature. Therefore, neutral pH or slightly saline pH (in the case of some of the soil samples) indicated the after-effects due to oil contamination (salt content high) from the Baghjan Blowout incident.

   The soil carbon (WBC) data ranged from 0.97 to 2.27% (Table 1). High content of soil carbon might be due to the fact that the soil was affected by the oil contaminants

(having high content of hydrocarbons). Soil available nitrogen was found to be in the lower range (Table 1). This indicated wider C:N ratio in the soil which may affect the microbial activity. Data also indicated lower range of available phosphorus and potassium in the soils. Besides, water analysis report (Table 2) showed safe limit of the parameters.

Over all, for improving the fertility/ productivity status of the soils, following measures have been suggested:

a) Application of well decomposed organic matter @ 7-10 ton/ha (compost/ FYM/ Vermicompost etc.).
b) Green manuring with Dhaincha/ Sunhemp (seed rate: 60 kg/ha) could enhance the soil health.
c) Cultivation of fodder crops/ agroforestry is advisable in the homestead gardens.
d) In case of acidic soils, liming and in case of near neutral pH Gypsum or Aluminum sulphate application could be done as correction of the soil pH.
e) Cultivation of crops/ trees with balanced fertilization. A 25% increase over the recommended dose of fertilizers may be followed for each crop.
f) Application of 5 kg/ha Biofertilizers such as *Rhizobium*, *Azotobacter*, Phospahe solubilizing bacteria etc. are recommended (through root dip/ seed treatment method) for the crops.
g) Referred Report on 'Soil Reclamation Process (cost involvement) at Gas Blowout Area (based on our visit dtd. 09 / 06 / 2020) which has been already submitted to Department of Safety & Environment, OIL, Duliajan.

Improvement of Livelihood of the farmers :

We have observed different components in the homestead we have visited. The enterprises were homestead garden with diversified tree species like areca nut and other fruit trees, tea cultivation, vegetable garden, other useful species. The damaged plants should be replanted with selected variety and with adoption of scientific production techniques. Combining all the components including livestock incentives may be given to the farmers for developing their farming into integrated farming system mode so that their income and productivity can be improved with the existing resources as well as with some priming with financial assistant to make it a integrated farming system model for achieving the objective of self sustaining systems. For achieving this details of

resources of individual farmers will be needed for finding out the list of intervention required for individual farmers.

Table 1: STATUS OF CHEMICAL PROPERTIES OF THE SOIL SAMPLES OF VARIOUS SITES OF BAGHJAN, DULIAJAN

Sr No	Sample No	Site name/ detail	Porosity	Alkalinity	pH (1:2.5)	EC (µs/cm)	TDS (ppm)	WBC (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)
1.	2	S-E Phote Murah water tube well, D-1 (R3) Baghjaan village	Safe	Safe	5.79 (acidic)	-- (Safe)	--	2.17 (very high)	147 (low)	6.0 (low)	72 (low)
2.	3	East- Ratneswar Hazarika water (pond) (veg. crop)	Safe	-	-- (acidic)	-- (Safe)	--	2.00 (very high)	167 (low)	6.5 (low)	75 (low)
3.	4	Bagh- 5, Dipali Orang tube well D-5	Safe	Safe	6.54 (acidic)	227	--	1.90 (very high)	155 (low)	7.6 (low)	77 (low)
4.	5	Bh-5, 28-01-21, D-1 (5)	Safe	Safe	7.43 (~ neutral/ weakly acidic)	391 (Safe)	--	1.81 (very high)	175 (low)	6.4 (low)	97 (low)
5.	6	Control soil sample near Bridge	Safe	Safe	6.89 (~ neutral)	251 (Safe)	--	0.97 (high)	217 (low)	8.5 (low)	121 (low)
6.	8	Bagh -5, water D (3)-R-1	Safe	Safe	7.66 (~ neutral/ weakly acidic)	-- (Safe)	--	1.67 (very high)	178 (low)	7.7 (low)	85 (low)
7.	9	Bagh -5, water tube well F- Akheswar Chetia, D-R (R-1)	Safe	Low	5.33 (acidic)	-- (Safe)	--	1.54 (very high)	166 (low)	7.0 (low)	81 (low)
8.	10	Bagh -5, 28-01-21, Soil-D- Z (R1)	Safe	Safe	5.88 (acidic)	257 (Safe)	--	(very high)	(low)	(low)	(low)
9.	11	East –Bagh-5, Debendra Neog Soil → Tea + Arecanut (D-1) R2	Safe	Safe	5.05 (acidic)	-- (Safe)	--	2.27 (very high)	175 (low)	6.7 (low)	78 (low)
10.	12	South Fallow land, D-3 (R3) soil	Safe	Safe	7.64 (~ neutral/ weakly acidic)	423 (Safe)	--	1.87 (very high)	193 (low)	7.7 (low)	85 (low)
11.	13	East – Bagh-5, Tube well water Debandand Musa, D-3 (R-2)	Safe	Safe	6.23 (acidic)	-- (Safe)	--	(very high)	(low)	(low)	(low)
12.	14	South Tea Garden, D-3 (soil)	Safe	Safe	5.70 (acidic)	337 (Safe)	--	2.21 (very high)	177 (low)	6.8 (low)	77 (low)

TDS, Total Dissolve Solid; WBC, Walkley & Black C

Table 2: STATUS OF CHEMICAL PROPERTIES OF THE WATER SAMPLES OF VARIOUS SITES OF BAGHJAN, DULIAJAN

Sample No.	Site details	Physical look / Colour etc.	pH (1:2.5)	EC (µs/cm)	TDS (ppm)	Calcium (meq/L)	Magnesium (meq/L)	Carbonate (meq/L)	Bicarbonate (meq/L)	Remarks
1	West Magari Motapms bill water sample, Koliapam, Near Bridge.	Looks clean/ dirt-free	7.45	138.4	95.3	0.8	2.0	Trace amount	2.0	All the parameters are within the safe limit.
2	S-E Phote Murah water tube well, D-1 (R3) Baghjaan village	Looks clean/ dirt-free	6.06	81.5	156.9	0.2	0.2	Trace amount	3.2	
3	East- Ratneswar Hazarika water (pond) (veg. crop)	Very slightly reddish in colour on shaking	6.33	110.1	72.3	0.6	1.0	Trace amount	3.2	
4	Bagh- 5, Dipali Orang tube well D-5	Looks clean	6.51	155.8	108	0.3	0.4	Trace amount	2.0	
7	East- Jolim Bora, Water tube well, D-2(R_1)	Looks clean	6.15	46.9	35	0.2	0.3	Trace amount	0.8	
8	Bagh -5, water D (3)-R-1	Reddish in colour on shaking	6.13	122.5	85.6	1.2	1.4	Trace amount	1.6	
9	Bagh -5, water tube well F-Akheswar Chariali, D-R (R-1)	Looks clean/ dirt-free	6.28	72.4	53.4	0.8	Trace amount	Trace amount	0.8	
10	Bagh -5, water D -2-R_1	Slightly reddish in colour on shaking	6.32	227	162	0.4	1.0	Trace amount	2.4	
12	Sample No.12	Looks clean	7.16	352	253	2.6	3.2	Trace amount	5.6	
13	East – Bagh-5, Tube well water Debandand Musa, D-3 (R-2)	Slightly reddish in colour on shaking	6.04	116.9	82.8	1.6	1.0	Trace amount	3.2	

Prepared & submitted by:

Name of the Expert	Designation & Address	Signature
1. Dr. K.K. Sharma	Chief Agronomist, AICRP on IFS, AAU, Jorhat	
2. Dr.M. Deka	Professor, Department of Tea Husbandry & Technology, AAU, Jorhat	
3. Dr.S. Gogoi	Professor, Department of Horticulture, AAU, Jorhat	

Date : 20.07.2021, AAU,Jorahat

Oil India Limited
(A Govt. of India Enterprise)
P.O. DULIAJAN, DIST. DIBRUGARH,
ASSAM, INDIA, PIN-786 602

CONTRACTS DEPARTMENT
TEL: (91) 374-2800548
E-mail: contracts@oilindia.in
Website: www.oil-india.com
FAX: (91) 374-2803549

Ref. No. OIL/CONT/LOA/G/98/2020-21 **Date: 31.5.2020**

M/s DEEP CONSTRUCTION,
CENTRAL NAMGHAR ROAD,
DULIAJAN, Assam

Sub: Letter of Award (LOA) for Hiring of various Misc. Services at well no.: BGN#05 for management to Blowout Control Operation

Dear Sir,

With reference to your offer dated 31.05.2020 and various discussion on the requirement of the multiple services, we have the pleasure in awarding you our Work Order no. LOA/G/150-A for Hiring of various Misc. Services at well no.: BGN#05 for management to Blowout Control Operation.

2.0 The various rates applicable against each of the lump-sum services are as under:

Srl	Description	Unit of Measurement	Rate
1	Cleaning Services of Oil Spillage from Roof, Wall, Trees, Ground Surface etc.	Lump Sum	5,80,000.00
2	Fixing and Replacement of Roof, Painting of Roof and Wall	Lump Sum	6,50,000.00
3	Oil Pickup, carriage, Transpiration, Storage etc.	Lump Sum	6,20,000.00
4	Supply of Gravel, spreading, Levelling including Excavator Services	Lump Sum	4,12,500.00
5	Supply, erection of boundary Fencing	Lump Sum	4,31,000.00
6	Earth cutting, Filling, Dressing, Levelling etc.	Lump Sum	5,30,000.00
7	Development of various village Roads, sand begging etc.	Lump Sum	5,91,250.00
8	Cutting, trimming and uprooting of Trees	Lump Sum	60,000.00
9	Service of Boat for oil pickup & manpower including supply of Diesel etc.	Lump Sum	5,40,000.00
10	Mitigation of Any other contingencies	Lump Sum	6,00,000.00

Other Terms:

a) GST extra as applicable
b) Payment term : Please submit the Invoice duly certified by the user assigned the Job for processing the Payment

3.0 Kindly confirm acceptance of this LOA and start the jobs as assigned.

Thanking you,

Yours faithfully,
Oil India Limited

(A J Sarmah)
GM-CONTRACTS
For RESIDENT CHIEF EXECUTIVE

"ANNEXURE - R16"

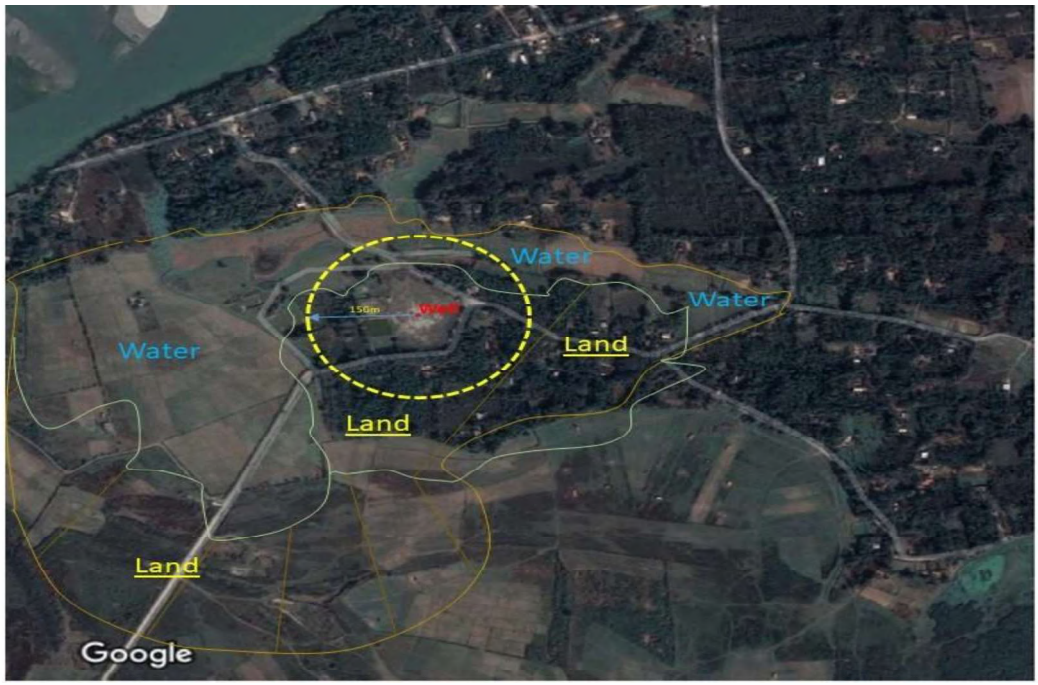





Baghjan Well No. 5 Site
26.08.2021


Baghjan Well No. 5 Site
26.08.2021

Ariel View based on the joint Site Recce by M/s. OIL & M/s. TERI (19.06.20)



Contamination area calculation details:

- Total area divided into 2 zones- Land & Water.
- Based on observation average depth of contamination for Land :10cm
- Based on observation average depth of contamination considered for Water including exposed lands:03cm

Sl No	Area Detail	Area in m^2 (Approx)	Average Depth of contamination	Quantity of contamination (m^3)
*	Total Area as provided by M/s. TERI	1, 60,0000	-	-
1	Water Part	70000	03 cm (0.03m)	70000 X 0.03=2100
2	Land Part	90000	10 cm (0.1m)	90000 X 0.10= 9000
Total				**11, 100 m3**

Now considering the Maguri Beel patches of spillage if traced as indicated by M/s. TERI and additional job involvement during the physical job execution and additional tentative volume (+8.2%) of 900m3, the total volume may be estimated to 12,000.00m3 turnkey (spillage area/s from well BGN#05-source to the Maguri-Motapung Bridge-Baghjan EPS both land and water bodies).

OIL's Representative(s) **M/s. TERI**

Representative(s)

Fig.-3. Both parties signed the joint volume assessment of contaminated area.

"ANNEXURE – R18"

OIL INDIA LIMITED
(A GOVT. OF INDIA ENTERPRISE)
CERTIFICATE OF PAYMENT - Contract/Civil Service

Bill Tracking Reference: 440596 dated 20.08.2021

SES NO : 1000754265
DATE : 20.08.2021
Posting Date : 20.08.2021

NAME OF CONTRACTOR : THE ENERGY AND RESOURCES INSTITUTE
CONTRACTOR'S CODE NO : 402439
Details of Work Done/Service Rendered :
Work Done During the Period : 21.06.2020 to 07.09.2020
Physical Progress of Works/Services : 97.42 %

CONTRACT NO. : 6114478
Tracking No : BLOWOUT-9
Total Contract value : 19,348,000.00
Contract valid upto : 05.12.2020
This payment is : Part Payment

Item Sl No.	Short Text	Job No.	Cont. Item No.	Extnl Service No	Contract Quantity	Cum. COP Qty	COP Quantity	Contract Rate (Rs.)	Amount (Rs.)
10	Collection of Oily Sludge	SR.20ASCM.003.02	40		3,000.000	3,000.000	3,000.000	140.00	420,000.00
20	Transportation of Contaminated Sludge wi	SR.20ASCM.003.02	50		3,000.000	3,000.000	3,000.000	95.00	285,000.00
30	Refilling & Reclamation	SR.20ASCM.003.02	70		3,000.000	3,000.000	3,000.000	132.00	396,000.00

COP Summary

Parameters	Total Value of SES No.**1000754265** (Rs.)	Cummulative Value for Contract (Rs.)
A. Work Done	1,101,000.00	18,849,000.00
B. Escalation		
C. Penalty	-0.00	-0.00
D. Additonal Work	0.00	0.00
E. Total (A + B + C + D)	1,101,000.00	18,849,000.00
F. Service Tax (IN:- SGST+ CGST 18% ND)	198,180.00	3,392,820.00
G. Total (E + F)	1,299,180.00	22241,820.00
H. Retention money		

Total Service Entry Sheet value:Rs. 1,299,180.00 (RUPEES TWELVE LAKH NINETY-NINE THOUSAND ONE HUNDRED EIGHTY ONLY)

CGM-F&A
Respected Sir,
This SES is being prepared with reference to the Tax Invoice no: 2020MarOLTAX0059 date: 26.03.2021. Also the certified measurement sheet and supporting documents are enclosed

T.S.

OIL INDIA LIMITED
(A GOVT. OF INDIA ENTERPRISE)
CERTIFICATE OF PAYMENT - Contract/Civil Service

SES NO : 1000754265
DATE : 20.08.2021

Bill Tracking Reference: 440596 dated 20.08.2021

herewith.

M.Book No. :	Measurement taken by :	Calculation By :	COP Prepared by :
Page From :	Measure Checked By :	Calculation Checked By :	COP Verified by :

Certified that the amount stated on this certificate is the correct statement of amount due to me/us for the work done/services rendered under the above contract and that I/we no further claim om M/s Oil India Limited in the aforesaid respect.

Payment Certified By

Contractor Date :

Sec.Head - User Dept.

Head-User Deptt.

For Accounts Department Only

Checked By :

Voucher Prepared By :

Date :

Manager(F&A)

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Protesters clash with police at site of Baghjan fire in Assam's Tinsukia; several injured

Several people were injured in a clash between protesters and police near the Baghjan fire in Tinsukia, Assam on Saturday.

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Guwahati July 24, 2021 UPDATED: July 24, 2021 23:52 IST



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File photo of the Baghjan oil field engulfed in fire in Tinsukia, Assam (Photo: PTI)

Listen to this article now

-02:35 1.0×

Several people, including cops, were injured in a clash on Saturday between protesters and the police in Assam's Tinsukia district. A lathi-charge by the police to disperse the crowd preventing Oil India Limited (OIL) from clearing materials from its now-closed Baghjan oil well site is believed to have triggered the clash.

Earlier in the day, the Tinsukia district administration imposed section 144 of the CrPC in light of the Covid-19 situation and directed protesters to vacate the area.

However, the police resorted to lathi-charge after some irate protesters began pelting stones at security personnel. They even damaged a fire service vehicle deployed in the area.

Tear gas shells were also fired by the police in a bid to disperse the crowd.

Three protesters and four police officers were injured during the clash. They were rushed to Tinsukia civil hospital, said a top police officer.

What are the protesters' demands?

Hundreds of protesters protesting in Tinsukia demanded compensation for losses they incurred last year during the oil well blowout at Baghjan oil field.

Bollywood's political correctness killed it, one hero at a time



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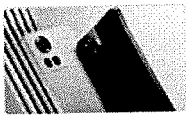
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Oil India Limited (OIL) has been trying to move out materials from its now-closed Baghjan oil well, but a section of the local people are resisting the move. These locals maintain that they will allow the site to be cleared only after the publicly-owned OIL pays the entire compensation due to them.

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Tinsukia district Superintendent of Police (SP) Debojit Deuri told India Today over the phone that OIL has already paid the compensation amount to affected families following the NGT's directives.

"When the OIL authorities had been trying to move out the materials, vehicles from the site, a group of people blocked them," Debojit Deuri said.

Baghjan oil field fire

A gas well at the Baghjan oil field blew out during a workover operation on May 27, last year, and caught fire again on June 9, 2020. The fire at the gas well killed two firefighters. The tragic incident also forced many villagers living in nearby areas to flee their homes.

On September 9, an OIL electrical engineer died as a result of a high voltage electric shock while attempting to extinguish the fire at the Baghjan oil field.

The fire at the damaged gas well was brought under control only after a five-month-long effort on November 15 of last year.

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Posted by
Nandini Singh

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T.C.
R

आँयल इंडिया लिमिटेड
(भारत सरकार का उद्यम) पंजीकृत कार्यालय : दुलियाजान, असम
Oil India Limited
(A Government of India Enterprise) Registered Office:Duliajan, Assam

CONTRACTS DEPARTMENT
Fax : (91) 374-2803549
Tel : (91) 374-2800548
e-mail : contracts@oilindia.in
Website : www.oil-india.com

संविदा विभाग
फैक्स : (९१) ३७४-२८०३५४९
दूरभाष : (९१) ३७४-२८००५४८
ई-मेल : contracts@oilindia.in
वेबसाइट : www.oil-india.com

Ref. No. OIL/CONT/V/G/1964/2020-21 **Date: 23.03.2021**

Amendment No. 1 to Contract No. 6114478/PDNO/2020 for 'Hiring of services for bioremediation services of contaminated soil/water bodies due to oil spillage resulting from blowout of well no. BGN#05' is issued to revise quantities against the line items of the contract as per the following cost details:

Item No.	Description of Services	UOM	Revised Contract Quantity	Contract Rate (Rs.)	Revised Contract Amount (Rs.)
10	In-Situ Bioremediation	M3	12000	1,479.00	17748000
20	Ex- Situ Bioremediation	M3	0	1,479.00	0
30	HDPL lined Bio-remediation pits	NO	0	7,00,000.00	0
40	Collection of oily sludge	M3	3000	140	420000
50	Transportation of contaminated sludge within 25km	M3	3000	95	285000
60	Transportation of contaminated sludge beyond 25km	M3	0	121	0
70	Refilling & Reclamation	M3	3000	132	396000
				TOTAL(Rs.) (Exclusive of GST)	**1,88,49,000.00**
				TOTAL(Rs.) (Inclusive of GST @18%)	**2,22,41,820.00**

Thus, the revised total estimated contract cost now stands at Rs. 1,88,49,000.00 (Excluding GST).

2.0 The other terms and conditions of the original contract remains unchanged.

IN WITNESS thereof, each party has executed this amendment to contract at Duliajan, Assam as of the date shown above.

Signed, Sealed and Delivered,

For and on behalf of Company
(OIL INDIA LIMITED)

Signature: _____

Name: A. J. Sarmah

Status: GM (Contracts-HoD)

In Presence of:

1. _____

2. _____

For and on behalf of Contractor
(M/S THE ENERGY AND RESOURCES INSTITUTE)

Signature: _____

Name: K. Rajagopal

Status: General Manager
The Energy and Resources Institute
Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi-110 003

In Presence of:

1. _____

2. _____

ऑयल इंडिया लिमिटेड
(भारत सरकार का उद्यम) पंजीकृत कार्यालय : दुलियाजान, असम
Oil India Limited
(A Government of India Enterprise) Registered Office: Duliajan, Assam

CONTRACTS DEPARTMENT
Fax : (91) 374-2803549
Tel : (91) 374-2800548
e-mail : contracts@oilindia.in
Website : www.oil-india.com

Ref. No.: OIL/CONT/LOA/S/394/2020-21 Date: 29.09.2020

M/s BALMER LAWRIE & CO. LTD.
21, NETAJI SUBHAS ROAD
Kolkata- 700001
Email: rofs.marketing@balmerlawrie.com
Vendor Code: 407566

Sub.: Letter of Award (LOA) towards "HIRING SERVICES OF HANDLING AND PROCESSING OF OILY SLUDGE."

Dear Sir,

With reference to your offer vide Response No. 60086885 against IFB No. CDI3901P20, we have the pleasure in awarding you our firm **Contract No. 6114629** at a total estimated contract cost of ₹ **24,98,37,860.00 (Rupees Twenty-Four Crore Ninety-Eight Lakh Thirty-Seven Thousand Eight Hundred Sixty)** inclusive of 18% GST.

2.0 **Duration of Contract: 24 (twenty-four) months** from the commencement of the contract i.e after completion of mobilization. The Contract shall have a provision of extension for another 12 (twelve) months at the mutually agreed rates limited to original contract rates, same terms and conditions, at the discretion of OIL. The mobilization period is **60 (sixty)** days from the date of issue of LOA. All statutory formalities required for commencement of work must be completed within the mobilisation period.

3.0 Please arrange to furnish Performance Security for an amount of ₹ **1,05,87,000.00 (Rupees One Crore Five Lakh Eighty-Seven Thousand)** in any of the following ways:

i. Irrevocable Bank Guarantee (Format as per PROFORMA-VI of NIT) issued by any Scheduled Bank in India
ii. Bank Draft or Cashier's Cheque or Banker's Cheque favouring OIL INDIA LIMITED and payable at DULIAJAN
iii. Fixed Deposit Receipt (Account OIL INDIA LIMITED)
iv. Irrevocable Letter of Credit;
v. NEFT or RTGS

The Performance Security amount shall be refunded to you after satisfactory completion of the above-mentioned work but part or whole of which shall be used by the Company in realization of liquidated damage or claims, if any, or for adjustment of compensation or loss due to the Company for any reasons. The security money shall not earn any interest.

***Note: In case your company is furnishing BG as performance security, your BG should be valid up to 28.02.2023 and a duly filled undertaking in the prescribed format (enclosed herewith) must be submitted along with the BG.**

05/10/2020

ए. बंद्योपाध्याय / A. BANDYOPADHYAY
प्रधान (आर ओ एफ एस) / Head (ROFS)
Balmer Lawrie & Co. Ltd.
(A Govt. of India Enterprise)
21, N. S. Road, Kolkata-700 001

TRUE COPY

4.0 On receipt of this LOA, please report to **GM-FIELD ENGINEERING (I/C)** immediately for obtaining necessary information and advice regarding statutory formalities, mobilisation and commencement of work. Please attend the office of the **CGM-CONTRACTS** on or before **13.10.2020** after depositing the Performance Security for signing the formal contract.

5.0 Please confirm acceptance of this LOA and arrange to submit Performance Security at the earliest.

Thanking you.

Yours faithfully
OIL INDIA LIMITED

(U. N. JENA)
CGM – CONTRACTS
For RESIDENT CHIEF EXECUTIVE

Noo:cc:

ED (F&A) For MFA (AP)

GM-FE(I/C)

} This has reference to the approved TCR No. A/327/2020-21 dated 10.08.2020 and PR No. 2226022

30/09/20

CGM – CONTRACTS

Accepted 05/10/2020

ए. बंद्योपाध्याय / A. BANDYOPADHYAY
प्रधान (आर ओ एफ एस) / Head (ROFS)
Balmer Lawrie & Co. Ltd.
(A Govt. of India Enterprise)
21, N. S. Road, Kolkata-700 001

ऑयल इंडिया लिमिटेड
(भारत सरकार का उपक्रम) पंजीकृत कार्यालय : दुलियाजान, आसाम
Oil India Limited
(A Government of India Enterprise) Registered Office : Duliajan, Assam

CHEMICAL LABORATORY
(An ISO 9001 : 2015 Certified Laboratory)
CHEMICAL DEPARTMENT, DULIAJAN 786 602, ASSAM, INDIA
(Phone : 91-374-2800439, Fax : 91-374-2801680/2800633,
Email: chemical@oilindia.in)

For internal use only

Ref. No.: Chem/Ana/PW/1602/DJN/21 Date: 10.11.2021

CGM - HSE

Through : CGM - Chemical (HoD)

Sub: EFFLUENT PIT WATER SAMPLE ANALYSIS REPORT NEAR BAGHJAN WELL NO. 05

Ref. No.: S&E/E/15/1456, dated :- 03.11.2021

Reference above, please find below the test results of the pit water samples forwarded to us from your end for laboratory testing.

Characteristics	Unit	Tolerance limit as per State Pollution Control Board of Assam.	**Effluent pit water near Baghjan Well No. 05**				Test method/ Instrument Used
			70 mtrs	**100mtrs**	**40mtrs**	**45mtrs**	
pH	-	5.5 - 9.0	7.5	7.3	8.5	8.8	Metrohm pH meter
Chloride (as Cl^-)	mg/l	600 (max.)	9	6	5	6	Titration with Silver nitrate
Phenolic compounds as C_6H_5OH	mg/l	1.2 (max)	0.02	0.109	0.088	0.099	Spectrophotometer
Sulphate (as SO_4^{--})	mg/l	1000 (max)	27	6	1	1	Spectrophotometer
Chromium (as Cr^{+6})	mg/l	0.1 (max)	0.006	**BDL**	**BDL**	0.001	Spectrophotometer
Total Dissolved Solids	mg/l	2100 (max)	108	90	75	109	HACH water checker
Suspended Solids	mg/l	100 (max)	**104***	**136***	13	67	Gravimetric method
Oil and grease	mg/l	10 (max)	Nil	Nil	Nil	Nil	Horiba oil content Analyser

Sample Details:-

All the Effluent pit water samples were collected from the above mentioned sources of Baghjan well No # 05 on 03.11.2021 and received at Analytical & Environmental lab. on 03.11.2021 for necessary testing.

BDL:- Below Detectable Limit

Note: *Not within acceptable limit

Tested by :- AAM/UB/SB

Pranab Jyoti Das
Supptdg. Chemist (Lab)

For DGM - Chemical (Lab)

Copy : Analytical & Environmental sec. file

ChemLab/Ana/Report/Water/02

ANNEXURE - R23

GOVERNMENT OF ASSAM
OFFICE OF THE DISTRICT FISHERY DEVELOPMENT OFFICER,
TINSUKIA.

No. AFT-9/2021-22/289 Dated Tinsukia the 15th Nov/2021.

From,

The District Fishery Development Officer,
Tinsukia.

To,

The Chief General Manager (HSE),i/c
For Resident Chief Executive (OIL INDIA LIMITED).

Sub: Data regarding fishes in Dibru River & Maguri –Motapung Rivulet.

Reference No.S&E /E/121/1513 Dated 13th November/2021

Sir,

With reference to the subject cited above , this is to inform you that as per the report submitted by the concerned field officials (office of the undersigned) that ,there is no any sign of adverse impact and deterioration of water quality due to OIL's Baghjan Well no.5 at Maguri Motapung beel during the period from 15-11-2020 to till date.

In this regard, it is confirmed that there is no report received of any extinction fish species during the period from 15-11-2020 to till date. Moreover no unnatural death of fish species have been detected or reported from that area during this period.

This is for favour of your kind information.

Yours faithfully,

15/11/2021

District Fishery Development Officer,
Tinsukia

Dist. Fishery Dev. Offic:
Tinsukia

"ANNEXURE – R24"

452

GOVT. OF ASSAM
OFFICE OF THE DISTRICT ANIMAL HUSBANDRY & VETERINARY OFFICER::: TINSUKIA

NO.DVOT/G-9/Baghjan/2021-22/ **638** /Date Tinsukia the 13th November/2021

From: Dr. Debananda Gogoi,
District A.H. & Veterinary Officer,
Tinsukia.

To,

R. J. Sutradhar
CE (HSE), HSE Department,
OIL Dulijan.

Sub: Field report from Baghjan area regarding post blowout situation.

Sir,

Inviting reference to your email dated 13th November,2021 regarding the above mentioned subject, I am pleased to inform you that post blowout in the Baghjan Oil Field area we have been conducting regular disease surveillance through our field workers and during their surveillance and in the interaction with the local headmen and elected representatives no unnatural diseases have been detected or reported from that area amongst livestock and poultry apart from certain seasonal diseases viz. worms infestation etc.

This is for favour of your kind information and further necessary action.

Yours faithfully

District A.H & Veterinary Officer
Tinsukia

Encl: Report from respective V.O.'s of Doomdooma & Hapjan

T.C.

DSVO/ /21-22/ 1155 dtd 13-11-21

To

The District A.H. & Veterinary Officer, Dated the 13th Nov/21

Tinsukia

Sub : Field Visit Report

Ref : Your telephonic & w/app instruction on 13/11/21

Sir ,

With reference to the subject and your instruction cited above , I have visited the periphery of baghjan blowout area i.e. baghjan -Dighaltarang villages with local field staffs , it is found that there is no any unnatural mortality of livestock and poultry or any symtoms of abnormal diseases are observed or reported till date. During my visit I have observed only some worm infested animals which could be well treated with anthelmentics and liver supportive medicines .

This is for your information and necessary action please.

Yours faithfully

Dr A.K.Deka,

Veterinary Officer

State veterinary officer , Doomdooma

T.C.

Vet. Dispensary, Hapjan 83 13/11/2021 Block

GOVT. OF ASSAM

OFFICE OF THE BLOCK VETERINARY OFFICER :: HAPJAN

Memo No : HBV/CDVO-1/OIL/2021-22 / **83** / Dated, 13th Nov'2021

To

The District A.H & Veterinary Officer
Tinsukia

Sub: Field visit report.

Ref: As per telephonic and Whatsapp instruction on 13/11/2021

Sir,

With reference to the subject cited above, I have the honour to inform you that, after field visit in the villages of No. 2 Purani Motapung, No. 1 Purani Motapung and Babejia villages and interaction with villagers no incidences of animals suffering from after effect of Baghjan Oil Blowout has been reported from any quarters. The villagers have reported that some of their animals (Bovines & Goats) are currently found to be suffering from diarrhoea , bloat and debility like symptoms , which may be due to parasitic infestation. So I am of the opinion that the aforementioned problems currently being suffered by the animals of these three villages may be controlled by proper deworming , hepatoprotectives and mineral mixture uses.

This is for favour of your kind information and further necessary action.

Yours faithfully

13/11/2021

(Dr Rabi Sankar Choudhury)
Block Veterinary Officer, Hapjan

Copy to : File

आज़ादी का अमृत महोत्सव

ऑयल इंडिया लिमिटेड
(भारत सरकार का उद्यम) पंजीकृत कार्यालय: दुलियाजान, असम
Oil India Limited
(A Government of India Enterprise) Registered Office "Duliajan, Assam

प्लॉट. न. 19, सेक्टर 16-ए, नोएडा-201 301 उत्तर प्रदेश
Plot No. : 19, Sector 16-A, Noida-201 301, Uttar Pradesh
दूरभाष / Telephone : 0120-2419000 फैक्स / Fax : 0120-2488310
CIN : L11101AS1959GOI001148 ई-मेल / E-mail : oilindia@oilindia.in, वेबसाईट / Website : www.oil-india.com

LETTER OF AWARD (LOA)

REF: OIL/62/7/LOA-323 **DATE: 16.11.2021**

M/s. The Energy and Resources Institute (TERI)
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi-110003
E-mail: veerac@teri.res.in / k.nanthakumar@teri.res.in

Sub: Letter of Award (LOA) for Assessment of Environmental quality of soil and vegetation in the vicinity of well Baghjan 5, Oil India Limited, Duliajan, Assam.

Dear Sir,

With reference to your offer dated 15.11.2021, we are pleased to award our firm Contract for Assessment of Environmental quality of soil and vegetation in the vicinity of well Baghjan 5, Oil India Limited, Duliajan, Assam at an estimated total contract cost of **Rs. 33,81,880.00 (Rupees Thirty-Three Lakh Eighty-One Thousand Eight Hundred and Eighty only)** including GST@18%. The price break-up is as under:

Item	Cost (INR)
Professional cost for 70 days (Technical and field staffs)	7,00,000.00
Soil, plant sample collection and laboratory analysis cost Plant/vegetation and soil sampling cost (20 soil and 15 plant samples) including sampling materials	1,75,000.00
Analysis cost of 20 soil samples for 41 parameters @ Rs. 45,600.00 per sample	9,12,000.00
Analysis cost of 15 plant samples 26 parameters including its speciation analysis @ Rs. 27,600.00 per sample	4,14,000.00
Water sampling cost	75,000.00
Water sample analysis cost 12 samples	3,50,000.00
Travel including local travel, boarding lodging and transportation (based on actuals on production of invoice)	1,90,000.00
Miscellaneous	50,000.00
Total (excluding GST) =	28,66,000.00
GST@18% =	5,15,880.00
Total (including GST) =	**33,81,880.00**

Note: The costs are based on estimated samples to be collected, actual cost will be based on number of samples collected and analyzed.

REF: OIL/62/7/LOA-323 **DATE: 16.11.2021**

2.0 EFFECTIVE DATE, MOBILIZATION TIME, DATE OF COMMENCEMENT OF THE WORK AND DURATION OF CONTRACT:

2.1 EFFECTIVE DATE: The contract shall become effective as of the date Company notifies Contractor in writing (through this Letter of Award i.e. 16.11.2021) that it has been awarded the contract. Such date of notification of award of Contract will be the Effective Date of the Contract. All terms and conditions of the contract shall come into force with the date of issuance of this LOA.

2.2 MOBILISATION TIME & DATE OF COMMENCEMENT OF THE WORK: Contractor must mobilise his / her/ their resources within 15 (fifteen) days from the date of issue of this Letter of Award. The date of completion of mobilization of resources by the Contractor or 15 (fifteen) days from the date of issue of this Letter of Award, whichever is earlier, will be the Date of Commencement of the Work.

2.3 DURATION OF CONTRACT: Duration of this Contract will be for a period of 70 (seventy) days from the Date of Commencement of the Work.

3.0 PAYMENT TERMS:

- ✓ 50% on completion of soil and plant sampling
- ✓ 50% on submission of report

4.0 Detailed contract incorporating the scope of work will be signed between **Oil India Limited (OIL)** and **M/s. The Energy and Resources Institute (TERI)** within 30 (thirty) days from the date of issue of this LOA. For the purpose of signing of the formal contract, you may depute your authorized representative along with Power of Attorney or any other Authority Letter. The detailed terms and conditions shall be mentioned in the contract agreement. Until the Contract is signed, this LOA along with your offer dated 15.11.2021 shall remain binding between the two parties.

Please acknowledge receipt of this Letter of Award by return fax or scan copy of the acknowledgement letter duly signed by you to e-mail id **corp_c&p@oilindia.in**; **rupakkalita@oilindia.in**; **ujjwal_gogoi@oilindia.in**.

Yours faithfully,
OIL INDIA LIMITED

(Rupak Kalita)
General Manager (Materials)
For GM (Contract & Purchase)
For Chairman and Managing Director

...towards global sustainable development

The Energy and Resources Institute



Assessment of environmental quality of soil and vegetation in the vicinity of Well Baghjan#5, Assam.

2022









Prepared for

Oil India Limited, Duliajan, Assam.

ऑयल इंडिया लिमिटेड
(भारत सरकार का उद्यम)
Oil India Limited
(A Government of India Enterprise)

The Energy and Resources Institute
Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi -110003

Report No. 2021BR04 | February 10 2022

FINAL REPORT

Assessment of Environmental quality of soil and vegetation in the vicinity of well Baghjan 5, Oil India Ltd., Duliajan, Assam

Prepared for

Oil India Ltd., Duliajan, Assam

Prepared by

TERI, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi 110 003, India
Tel.: +91 11 2468 2100 or 2468 2111 | **F**ax: +91 11 2468 2144 or 2468 2145
Email: banwaril@teri.res.in | **W**eb: www.teriin.org

THE TEAM TERI

Dr.Banwari Lal
Dr.Suneel Pandy
Dr.Veeranna Channashettar
Dr.K.Nanthakumar
Mr. Tarun Sharma
Mr.Vinod Kumar

FOR CONTACT
TERI, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi 110 003, India
Tel.: +91 11 2468 2100 or 2468 2111 | Fax: +91 11 2468 2144 or 2468 2145
Email: veerac@teri.res.in, k.nanthakumar@teri.res.in | Web: www.teriin.org

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1. Executive Summary

Oil India Limited (OIL) is engaged in the business of exploration, development and production of crude oil and natural gas, transportation of crude oil and production of LPG. The Baghjan Oil & Gas field of Oil India Limited is located in Tinsukia district, Assam. The Baghjan BGN natural gas Well No. 5 is located south-west of Baghjan village and north-west of Dhakuwal in Barekuri where drilling was done up to 4,045 metres for natural gas production. The Baghjan Well-5 (BGN-5) was drilled in the year 2006 and completed in 2007 and actual production of gas and condensate started in September 2015. The work over operation was carried out on BGN-5 to enhance the natural gas production by the drilling subcontractor M/s John Energy Ltd. On 27th May 2020, the gas well blowout was reported with leakage of condensate followed by raging firestorm in gas well no.5 of Baghjan oilfield. Natural gas (NG) and natural gas condensate (NGC) was released from BGN-5 during blowout pre-fire stage the uncontrolled natural gas and condensate were released to the environment. TERI has been invited to undertake the assessment of environmental quality of soil and vegetation in the vicinity of Baghjan well #5, Oil India Ltd., Duliajan.

TERI has undertaken environmental assessment and sampling activities during the period 30th November, 2021 to 4th December, 2021. The initial reconnaissance survey has been conducted on 30th November, 2021 along with Oil India officials to understand the environmental conditions and selection of sampling locations. The soil, sediment, water and vegetation sampling was carried out from 01st December, 2021 to 4th December, 2021.

The standard field log sheet has been used to record the location coordinates and other field conditions. The field survey consists of interaction with stakeholders, farmers and officials to know the physical impact due to BGN gas well blowout incident. The field survey includes information on observation of visible contaminations, type of vegetation, agricultural farming practice, cattle grazing, stagnant, ground water sources sampling, vegetation sampling, soil profile and distance from BGN well#5. The detailed sampling has been carried out from 2 km radius covering BGN well #5, agricultural field, biodiversity hot spots, wet land and National Park. The unique biodiversity hotspot called Dibru Saikhowa National Park (DSNP) and Maguri Motapung Beel also included in this study. TERI has carry out the detailed mapping of environmental impact including impact on vegetation, water and soil environment due to Baghjan#5 incident. The type of samples includes soil, sediment/sludge, water (surface water and ground water), plant/vegetation biomass and fish. All the sampling process has been carried out as per the standard sampling guidelines and analyzed as per the Indian and international standard methods. The soil samples have been collected from 0-30 cm depth using hand augurs. The surface litter at the sampling spot has been removed and soil auger is used to plough the soil up to 30 cm. Each composite sample is a mixture of 8 random grab subsamples at every site selected for sample collection. The collected samples has been preserved and transported to NABL and MOEF & CC accredited laboratory for the analysis. Similarly the representative plant samples are collected from different locations within 2 km radius which includes grass land, agricultural field, aquatic plant species, food crops and vegetables. One representative fish sample also collected and analyzed to assess the accumulation of TPH, heavy metals and PAHs. This report is based on the findings from field visit, sample analysis, baseline details on contaminant of concern, any visible hazardous waste/material and suggest measures to

manage the contamination due to fire event at Baghjan Well #5. As a quality control, the sampling activities and sampling pits have been tagged with photos and videos.

The field survey, sample analysis of soil, sediment, water (groundwater and surface water), vegetation/plant and fish reveled following outcomes. The maximum TPH concentration of 2425.6 mg/kg was reported in the soil sample collected near BGN#5 within 550 m distance. The minimum TPH concentration of 721.1 mg/kg was reported in northwest side of Erakhuil Goan located 6 km away from the BGN well#5. All the collected soil samples showed the TPH concentration within the remediation standard guideline range of <5000 mg/kg given by CPCB. Among 17 soil samples collected from different locations, South west zone of Maguri Beel sample showed trace level of PAH Fluoranthene (0.15 mg/kg) and Pyrene (0.11 mg/kg). Remaining all other samples, the PAH level was below detectable limit. The BTEX concentration was also below detection limit in all tested soil samples. This results revealed that the surrounding soil environment is in free from contamination due to natural process like heavy rainfall during the monsoon.

The **surface and ground water** quality of water samples from selected location within 2 km radios was assessed to know the impact of BGN#5 blowout. The parameters includes colour, odour, pH, Turbidity, Electrical conductivity, total dissolved solids, Total suspended solids, dissolved oxygen, BOD, COD, total hardness, total alkalinity, oil and grease, ammoniacal nitrogen, chloride, calcium, magnesium, fluoride, phenolic compounds, copper, zinc, nickel, iron, total chromium, chromium (as Cr^{6+}), lead, sulphide, sulphate, cadmium and polynuclear aromatic hydrocarbons (as PHA). The oil & grease, PAH and heavy metals concentration were below the detection limit. The pH, electrical conductivity, TDS, TSS, Total hardness, chloride, sulphide and sulphate were within the acceptable limit of IS: 10500, 2012 drinking water standard. The sampling area was rich biodiversity and agricultural field with high groundwater table leads to good quality of water table in the region. The metallic salts and heavy metals such as Zn, Ni, Cr, Cr ($^{6+}$), Pb and Cr were found to be below detection limits in all the tested water sample showed that the absence of pollutants plume in the ground water ecosystem. The parameters like total phenolic compounds found to be more than the permissible limit prescribed in IS 10500:2012 which may be due to peculation from natural sources of phenols to aquatic systems include decomposition of aquatic vegetation.

One representative **fish sample** has been collected from Maguri Motapung Beel and analyzed for the Heavy metals, PAH and BTEX. The analysis results shows that there is no accumulation of PAH, BTEX and tested heavy metals like cadmium, lead, mercury, nickel and hexavalent chromium. There is no accumulation of TPH and total PAH in the analyzed **plant biomass**. It reveals that the affected surrounding environment is free from contamination may be due to post monsoon investigation.

2. INTRODUCTION

2.1 Background

Oil India Limited (OIL) is a premier Indian Oil Company engaged in the business of exploration, development and production of crude oil and natural. The Greater Chandmari Fields, located approximately 25 kilometres northeast of the Naharkatia field covering an aggregate area of 20 square kilometres, the Baghjan oil field along with the Barekuri and South Chandmari fields have been engaged in active oil production. The Baghjan Oil and natural gas field of Oil India Limited is located in Itakhuli Revenue Blocks of Doomdooma sub-district, Tinsukia district, Assam. The Baghjan BGR natural gas Well No. 5 is located south-west of Baghjan village and north-west of Dhakuwal in Barekuri where drilling was done up to 4,045 metres for natural gas. The cumulative production of BGN-5 up to March 2020 was 191.83 million standard cubic meter (MMSCM) of gas and 44,180 m3 of condensate. On April 19, 2020 Oil has carried out the work over to enhance the gas production and during the operation the blowout occurred. On 27th May 2020, the gas well blowout was reported with leakage of condensate followed by raging firestorm in gas well at well no.5 of Baghjan oilfield (Fig.1). The blowout well has been capped and blowout was controlled in December, 2020.

The spread of natural gas, condensate and gaseous pollutants has been released in surrounding environment including land and water bodies around BGN#5. Gas well accidents may leads to loss of vegetation and soil health. Hence, it is important to study the impact of gas well blowout on the land including crop fields, grasslands and swamps vegetation of surrounding vicinity area. The unique biodiversity hotspot called Dibru Saikhowa National Park (DSNP) and Maguri Motapung Beel also located with 1.0 km of Baghjan incident point.



Fig.1 Satellite imagery of oil well site before and after the blow out. The impact area is in red square. Source: Wildlife Institute of India

The present study was undertaken by TERI to assess the Environmental damage caused by OIL's Baghjan#5 Blowout incident. The environmental assessment and monitoring study was focused to study the severity of pollutants release in and around vicinity area of blowout incident site including Dibru Saikhowa National Park and Maguri-Motapung Wetland.

The initial reconnaissance survey was conducted by the study team to understand the study area and sampling requirements. The detailed land, water and biodiversity components has been assessed and analyzed to identify the area of impact and required mitigation measures after blowout and capping of BGN#5. After reconnaissance field visit and discussion with OIL team, the field level assessment and sample collection was carried out during November 30, 2021 to December 4, 2021.

2.2 BGN well # 5

The Baghjan Well # 5 (BGN-5) is located in Baghjan Gaon, Hapjan Block, Doomdooma Sub-District, in Tinsukia District of Assam. The geographical coordinate of the well site is 27°35'46.01"N; 95°22'52.0"E. The region is remained more agrarian with higher share of agriculture in domestic product.

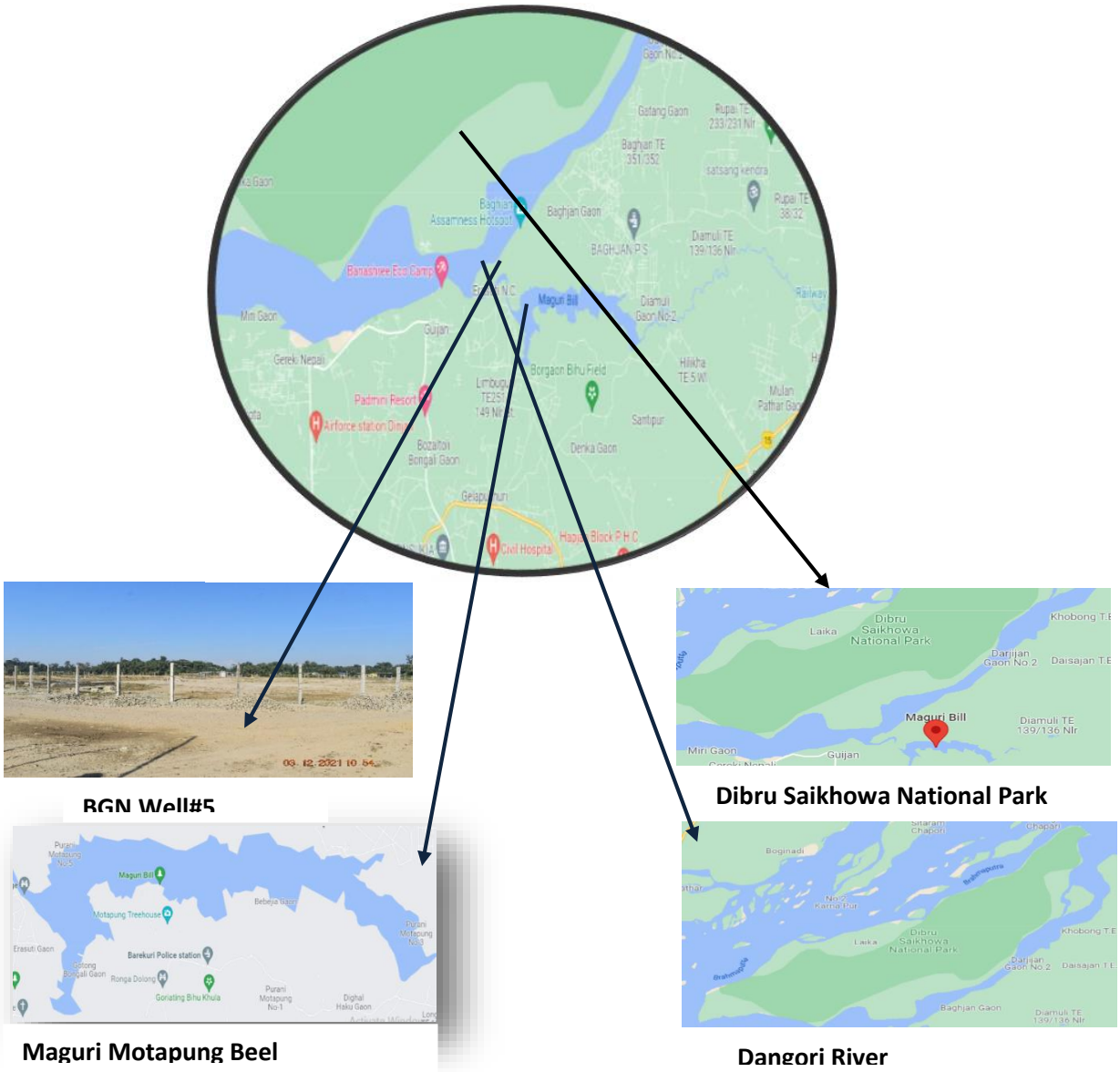


Fig 2: Study area description

2.3 Surrounding area

Abundance of monsoon precipitation in the region and the mountains surrounding enabled the intensive farming activities in the fertile river valleys. The Baghjan oil and gas field is located in the Upper Brahmaputra flood plains covering flood plains, river, wetland including important biodiversity reserve called Dibru-Saikhowa National Park and Biosphere Reserve situated within 1 km radius. The Maguri-Motapung Beel, another important wetland and lake located near Dibru-Saikhowa National Park which serve as natural home to wildlife. The Dangori River which is a habitat for the Gangetic River Dolphin. The tributaries of Bramabuthra rivers including Dangori River and Dibru River situated within 2 km radius. The Baghjan natural gas well surroundings also covered with numerous rich grasslands, tea estates, agricultural fields, homestead tea garden and settlement area. The other ecological habitats Bherjan Borjan Podumoni Wildlife Sanctuary (BBPWLS) is located outside the 5 km radius area of BGN-5.

2.3.1 Dibru-Saikhowa National Park (DSNP)

The Dibru-Saikhowa National Park is designated as Biosphere Reserve in July 1997 with an area of 765 km^2 (295 sq mi), including a core area of 340 km^2 (130 sq mi) and a buffer zone of 425 km^2 (164 sq mi). The BGN-5 well is located within 1.0 km from DSNP and there are 38 revenue villages in the buffer zone. The park is bounded by the Brahmaputra and Lohit Rivers in the north and Dibru River in the south. It mainly consists of moist mixed semi-evergreen forests, mixed deciduous forests, canebrakes and alluvial grasslands. It is the largest salix swamp forest in north-eastern India. Dangori river also part of DSNP which is habitat for Gangetic River Dolphin. The national park is about 35.84% moist mixed forest, 9.50% degraded forest and 21.25% grassland. The DSNP also conserve the habitat of the rare white-winged wood duck, the park is also home to other rare creatures such as water buffalo, black-breasted parrotbill, tiger and capped langur.

2.3.2 Maguri-Motapung Beel (MMB)

Maguri Motapung Beel is 0.8 km from the BGN well #5 on the southern side. MMB is located near Dibru National Park formed from Dibru river from the eastern side. Maguri Motapung Beel is located in the south bank of the Dibru River and it connects Dibru River through a small channel and finally meets Brahmaputra River. There are six villages around the beel such as Baghjan Gaon, Natun Gaon, Gotong Gaon, Purani Motapung, Nya-Motapung Gaon and Dhelakhat Gaon. The MMB consist of a wetland ecosystem and grassland area. Maguri Motapung Beel is a natural habitat to many varieties of birds. The lake is an important habitat for over 110 resident and migratory bird species. The Beel is rich wetland and grassland ecosystem in the region. The wetland is ecologically important with grassland mammals, 283 species of birds8 and 48 species9 of fish10. This is an important habitat for migratory birds including eight listed as threatened on the IUCN Red List, such as the Swamp grass babbler, the ferruginous duck, the white-winged wood duck and the falcated duck.

2.3.3. Agricultural area

Tea is the most important crop in Assam and around 2000 hectors under tea cultivation in Tinsukia circle. Many of the tea estates and homestead tea gardens located near BGN well # 5. There are few tea processing units in the region. Other agricultural crops includes batches of Paddy, vegetable and Betel nut trees were planted in the homestead tea garden areas. Kharif crops like paddy usually sown at the beginning of the first rains during south-west monsoon season, and they are harvested at the end of monsoon season during November. The batches of vegetables are also grown in surrounding area.

2. 3. 4 Aquatic Environment in the surrounding system

River Brahmaputra is main source of water for irrigation in the region. The tributary Dangori River Dibru River are important water body in this area. Doomdooma river meets with Dibru near Doomdooma town and proceeds further towards west. Created a beel named Maguri Beel at the low lying area of Tinsukia district and then falls to Lohit River, which ultimately formed Brahmaputra.

The region is generally high rainfall during monsoon leads to overflowing and flood in every year. Climate and Micro-meteorology of study area experiences a humid and warm sub-tropical climate throughout the year except for cold winter in December to February. The rivers and wetland support a rich biodiversity and agricultural activities. Soil of Brahmaputra valley of which the Field is a part, is characterized by the presence of fertile alluvial soil.

3. Literature Review

Effect of gas well fire accident on Environmental quality of soil, water, vegetation and animals/hum Oil and Gas contamination from drilling processes creates problems that disrupt the lives of people living in close proximity to oil camps, wells, pumping stations, and pipelines. In addition, oil contamination creates hazards to the local environment. People living on oil-rich sites around the world are subjected to contamination of drinking water, top soil, and livestock due to toxic pollution that can result from the oil extraction process. In some contaminated sites, serious illnesses resulting from exposure have been documented. Before the introduction of petrochemical industries, environments around the world that sat upon large oil reserves supported healthy human life and vibrant ecosystems. Oil contamination from drilling processes, however, has adversely affected the people living in these areas by polluting the environment around them. The water, soil and air have been severely tainted by petroleum pollutants. As a result, wildlife, livestock, and humans have been sickened. Oil exploitation can lead to contamination of environments, which can have effects on human/animal health (Whitman, Thyden and Olivia Carol Shepherd, 2010).

In addition to physical effects, economic stress affects the psychological health of the individuals living in polluted areas. A number of investigations have focused on specific ailments noted in particular contaminated sites (Jernelov, San Sebastian *et al*., UNDP). There are many incidents in the past which clearly effects humans/animals and environments surrounding oil and gas wells. Some of the major oil and gas fires are: Deepwater Horizon, Ecuador, Exxon-Valdez, Kuwait, Nigeria and Assam oil gas fire.

The effects of the Kuwaiti oil well fires

At the end of the Gulf War, more than 600 Kuwaiti oil wells and several pools of spilled oil were left burning after being ignited by retreating Iraqi troops. Huge, dramatic plumes of billowing smoke from these fires rose high into the atmosphere.

The health effects believed to be associated with petrochemicals in Kuwait varied greatly due to the wide range in possible exposure (Abramson *et al*, 2004). The oil contamination, occurring in the water, on land, and in air, affected different aspects of people's health. As the crude oil wells burned, they released a host of toxic chemicals into the atmosphere. High levels of particulate matter were found in air samples. Husain, (1994), reveals that chronic and probably irreversible respiratory disorders result from long-term exposure to these contaminants. Kuwait's oil is characterized as sour crude, containing high levels of sulfur. As a result, when ignited, the oil is much more toxic than its low sulfur containing counterpart known as sweet crude. Human health and the vegetation of the area were potentially affected as reported by Husain, (1998), who says that the burning wells produced large amounts of toxic gases including sulfur dioxide (SO2), carbon monoxide (CO), hydrogen sulfide (H2S), carbon dioxide (CO2), along with the oxides of nitrogen (NO(x)) as well as particulates containing partially burned hydrocarbons and metals.

Deepwater Horizon oil spill, environmental disaster, Gulf of Mexico (2010)

Deepwater Horizon oil spill, also called Gulf of Mexico oil spill, largest marine oil spill in history, caused by an April 20, 2010, explosion on the Deepwater Horizon oil rig—located in the Gulf of Mexico, approximately 41 miles (66 km) off the coast of Louisiana—and its subsequent sinking on April 22.

Thousands of birds, mammals, and sea turtles were plastered with leaked oil. There was speculation that a spike in cetacean strandings and deaths that was recorded by NOAA beginning in February 2010 was further exacerbated by the spill. Typical causes of such widespread fatalities, including morbillivirus and toxins from red tides, were ruled out, and there was an unusual incidence of Brucella infection in stranded dolphins, leading researchers to suspect that contaminants from the spill had made cetaceans more vulnerable to other environmental dangers. A December 2013 study of living dolphins in Barataria Bay, Louisiana, found that roughly half were extremely sick; many suffered from lung and adrenal disorders known to be linked to oil exposure. Some 1,400 whales and dolphins had been found stranded by the end of 2015, a figure representing only a tiny percentage of the animals affected. Though the number of dead animals had begun to taper off, substantial decreases in dolphin fertility persisted. It was thought that the strandings represented the largest mortality event to occur in the Gulf of Mexico.

Birds were particularly vulnerable to the oil's effects, and many perished—from ingesting oil as they tried to clean themselves or because the substance interfered with their ability to regulate their body temperatures. The brown pelican, recently delisted as an endangered species, was among the species most affected. A 2014 study projected that perhaps 12 percent of the brown pelicans and more than 30 percent of the laughing gulls in the area hit by the spill had been wiped out. According to another 2014 study, up to 800,000 birds were thought to have died. Even individuals not directly contaminated by oil were affected. A 2012 study determined that white pelicans that had migrated from the gulf to Minnesota to breed were producing eggs that contained discernible amounts of compounds that were traceable to the BP spill. Eggs containing traces of contaminants were found in Iowa and Illinois as well.

Concerns about the offspring of sea turtles that nested on the gulf coasts of Alabama and Florida led wildlife officials to dig up thousands of eggs and hatch them in a warehouse for later release on the Atlantic coast. By late 2012 some 1,700 turtles had been found dead. A long-term satellite tracking study released in May 2013 showed that the endangered Kemp's ridley sea turtle was likely severely affected, as its preferred foraging territory was within the area damaged by the spill. It was estimated that up to 65,000 imperiled turtles had died during 2010 alone, mostly as a result of oil contamination.

The impacts on smaller species were more difficult to determine. Numerous species of fish and invertebrates spawned in the gulf, and it was thought likely that some would succumb to the toxic effects of the oil. A 2014 study showed that the larvae of commercially important fish species, including tuna, likely developed heart defects after exposure to polycyclic aromatic hydrocarbons (PAHs) from the oil. Areas of the seabed that had been coated by by-products of bacteria were essentially dead zones; many sedentary organisms had suffocated or been sickened by the material, and most mobile organisms had fled.

A number of witnesses and reports say that at many locations, contaminated liquids were dumped into rivers and streams without proper sampling and treatment. "Waste pits containing high levels of petroleum were backfilled without removing or treating the oil; crude oil that was removed from waste pits, and contaminated soils and vegetation, were buried in unlined holes in the ground and dumped in the environment, including at locations in nearby forests; crude oil and contaminated vegetation were burned in open fires; toxic chemicals were thrown into waters, polluting water, killing fish; and hazardous for human. Decades later, little has changed for the area's residents. They still suffer from high rates of respiratory illnesses, diabetes,

and other oil-related health conditions, which lately have made them particularly vulnerable to the Covid-19 pandemic.

Six studies assessed the association between cancer and oil extraction, the majority of which were based in the Amazon region of Ecuador. Comparing cancer incidence in a small Ecuadorian community in the Amazon basin impacted by oil extraction to a reference population, San Sebastian and colleagues found an excess of incidence and mortality for all types of cancer (San Sebastián et al. 2001). A subsequent study of 4 counties with at least 20 years of oil extraction also showed excess risk for cancer incidence, including an increase in childhood hematopoietic (blood stem cell) cancer (Hurtig and San Sebastián 2002). The same authors also identified a significantly elevated relative risk for leukemia (RR 3.48, 95% CI 1.25-9.67) among Ecuadorian children less than 14 years of age who lived in an oil extraction region compared to those who did not (Hurtig and San Sebastián 2004).

Several studies identified multiple acute and chronic non-cancer health effects elevated in communities living near oil extraction, typically relying on a cross-sectional design. A study of a New Mexico community near an oil drilling site and an oil waste pit identified elevated prevalence of rheumatic disease, lupus, neurological and respiratory symptoms, and cardiovascular problems compared to a community farther away (Dahlgren et al. 2007). Multiple studies have found suggested evidence of alteration of immunological function in communities near oil extraction which may explain higher rates of lupus (Dahlgren et al. 2007), liver abnormality (Dey et al. 2015) and allergic disease (Yermukhanova et al. 2017). Adults living within 5 km of an oil field had significantly lower levels of 3 liver enzymes—alanine transaminase, aspartate transaminase, and alkaline phosphatase—as measured in blood when compared to adults living in a non-industrial region without oil drilling sites (Dey et al. 2015). School-age children (ages 7-11) in the oil-producing region in Kazakhstan found significant enlargement of thyroid volume in children living in the oil-producing regions, compared to those living in agricultural regions (Kudabayeva et al. 2014) and presence of allergic disease decreased with distance from the oil fields (Yermukhanova et al. 2017). All studies suggest that exposure to oil-related air pollutants may be adversely impacting immunological functions and driving the observed health differences.

4. Study Approach and Objectives

TERI has undertaken environmental assessment and sampling activities during the period 30th November, 2021 to 4th December, 2021 in-order to assess the actual impact of BGN well#5 blowout incidents followed by release of pollutants in surrounding environment. The impact on soil, water and vegetation has been investigated through field visit, sampling and analysis. The initial reconnaissance survey has been conducted on 30th November, 2021 along with Oil India officials to understand the environmental conditions and selection of sampling locations. The following samples has been collected and analyzed.

The main objective of the study is to assess the environmental damage caused by OIL's Baghjan#5 blowout accident. The soil and vegetation health was investigated in the vicinity area. Specific objectives of the study is

- To assess the vegetation stress and soil health in and around fire gas well (up to 2 km radius) from the impacted well head in all the four directions on a rotational basis.
- Collection and analysis of soil and plant samples within 2 km radius of affected area including bioremediation sites
- To submit a report on the vegetation and soil quality status

5. Methodology

5.1. Site description

Location of the each assessment site was designated with GPS coordinates, identification numbers/name and detailed site location. The following section explains water, sediment/sludge and soil sampling procedures.

5.2 Field survey

The field survey consists of interaction with stakeholders, farmers and other public peoples followed to know the impact due to BGN gas well blowout incident. The field survey includes observation of visible contaminations, type of vegetation, agricultural farming practice, cattle grazing, stagnant, ground water sources, soil profile and distance from BGN well#5.

5.3 Sampling locations

The selection of sampling points in the affected area are generally coordinated with sampling points of vegetation to provide a comparable and systematic assessment of the total deposition of pollutants. Soil, sludge, water and plant samples has been collected in and around BGN#5 from 2 km radius covering North, South, West and East from the gas well head. The selection of sampling grid was also based on the specific land cover features of the contaminated environment. In this present study the soil and plant samples has been collected within 2 km radius (North, South, West and East) from the gas well head. Soil samples was collected from 0-30 cm depth using hand augurs. The surface litter at the sampling spot will be removed; auger will be used to plough the soil up to 30 cm. Each composite sample will be a mixture of 8 random grab subsamples at every site selected for sample collection. The soil sampling location was specifically identified in consultation with officials from OIL and stakeholders.

Total 13 water samples consisting of groundwater and surface water, 16 plant/vegetation, 17 soil and 4 sludge samples were collected. The standard soil sampling using grid sampling and zone sampling was carried out. Considering the gas well incident#5, the each field contains different soils with unique soil properties and crop characteristics, and therefore the representative zone has been selected for the random collection of soil and plant samples to assess the environmental impact. The ground water and surface water samples have been collected from different location within the vicinity area. The representative water (surface and ground), soil, sediment/sludge and plant/vegetation samples was collected from surrounding area including in and around BGN well#5, tea garden, settlements, agricultural crop fields and biodiversity parks covering Dibru-Saikhowa National Park and Maguri Motapung Beel.

The summary of soil, sediment/sludge, water sampling locations and analysis details were given in following part.

5.3.1 Soil and Sludge Sampling

Soil and sediment samples have been collected in and around vicinity area of BGN well #5. Total 17 soil and 4 sludge samples were collected from representative zones with specific characteristics consist wet lands, agricultural fields, Residential zones and Dibru National Park. In each selected zones, one composite soil sample consist of 8 grab sub soil samples has been collected from 0 to 30

cm depth and uniformly mixed and designated as one composite sample. The sediment samples have been collected from Maguri Motapung Beel from the South East, North West and South East location of BGN well #5. The GPS coordinates of the each sub-soil location has been recorded in the field data sheet. The soil type, colour, agricultural crop and visible contamination have been recorded. Figure 1 depicts the soil and sediments sampling locations. The each composite sample is mixture of 8 random grab subsamples (Figure 2) at every site selected for sample collection with in single characteristics field. Total 17 composite soil samples and 4 sludge samples have been collected. The soil and sludge sampling has been done in Dibru Saikhowa National Park (DSNP) and Maguri Motapung Beel which located around 2.3 km and 2.5 km distance from BGN well#5 respectively. The sample ID, location latitude, longitude, distance from BGN well #5 has been presented in table 1 and analysis parameters and method has been highlighted in table 2.



Figure 3. Soil and sediments sampling locations



Figure 4. One Composite soil sample: Consist of 8 Grab sample (1 to 8)

Table 1 Soil and Sludge sample location details

S.No.	Sampling Location	GPS Coordinates of sampling Location (Lat, Long)	Distance from BGN#5	Sample ID	Date of sampling
1	S1. SE, Maguri Motapung Beel	27°34'28.0"N 95°22'21.0"E	2.56 km	BSE-S01-34282221	01.12.2021
2	S2. SW, Maguri Crop Field	27°34'48.0"N 95°22'16.0"E	1.98 km	BSW-S02-34472215	01.12.2021
3	S3. SW, Maguri Motapung	27°35'21.0"N 95°22'21.0"E	1.16 km	BSW-S03-35212221	01.12.2021
4	S4. SE, Maguri Motapung area	27°35'24.0"N 95°22'44.0"E	694 m	BSE-S04-35242244	01.12.2021
5	S5. In and around BGN#5 well	27°35'46.0"N 95°22'50.0"E	BGN#5	BGN-S05-35462250	01.12.2021
6	S6. NW,Dibru river-Maguri Motapung Junction	27°34'53.0"N 95°20'21.0"E	4.28 km	BNW-S06-34532021	02.12.2021
7	S7. NW, Dongri River and Motapung Junction	27°35'15.0"N 95°21'43.0"E	2.5 km	BNW-S07-35152143	02.12.2021
8	S8. NW, BNW-S08-35452221	27°35'44.0"N 95°22'21.0"E	800 M	BNW-S08-35452221	02.12.2021
9	S9. North-Dibru National Park	27°36'58.0"N 95°22'57.0"E	2.2	BN-S09-36582257	02.12.2021
10	S10. North-Dibru National Park	27°37'01.0"N 95°23'00.0"E	2.3 km	BN-S010-37012300	02.12.2021
11	S11. East-Near BGN#5	27°35'42.0"N 95°22'52.0"E	125 m	BE-S011-35422252	03.12.2021
12	S12. NW,250 M from BGN#5	27°35'42.0"N 95°22'51.0"E	140 m	BNW-S012-35422251	03.12.2021
13	S13. BN-S013-35582251	27°35'58.0"N 95°22'51.0"E	373 m	BN-S013-35582251	03.12.2021
14	S14. NW-1KM from BGN#5	27°36'13.0"N 95°23'05.0"E	1.0 km	BNE-S014-36112307	03.12.2021
15	S15. NE,Dighastarang, Baghjan Gaon	27°36'15.0"N 95°23'58.0"E	2.07 km	BNE-S015-36152355	03.12.2021
16	S16. SW, Baghjan, End of Maguri Beel	27°35'29.0"N 95°23'33.0"E	1.28 km	BNE-S016-35292333	03.12.2021
17	S17. NW,Erakhuli Gaon	27°35'27.0"N 95°19'06.0"E	6.17 km	BNW-S017-35271906	04.12.2021
18	SL1. SE, Maguri Motapung Beel	27°34'31.0"N 95°22'26.0"E	2.4 km	BSE-SL01-34312226	01.12.2021
19	SL2. NW, Dangri Motapung River Junction	27°35'17.0"N 95°21'41.0"E	2.1 km	BNW-SL02-35172141	02.12.2021
20	SL3. NW, Dibru River	27°36'17.0"N 95°22'29.0"E	1.1 km	BNW-SL03-36172229	02.12.2021
21	SL4. SW, Maguri Motapung Beel	27°35'25.0"N 95°23'33.0"E	1.36 km	BSE-SL04-35252333	03.12.2021

Table 2. Soil and Sludge quality analysis parameters in NABL accredited laboratory

S. No.	Test Parameters	Test Methods
1	pH, Chloride, Sulphate, Alkalinity, Total Organic carbon, Total Nitrogen, Available Nitrogen, Available Phosphorus, Available Potassium, Available Sodium, Specific gravity, Texture, Electrical conductivity, Sodium Adsorption Ratio, Cation Exchange Capacity, Moisture, Acidity, Cadmium, Lead, Mercury, Nickel, Hexavalent Chromium, Zinc, Copper, Permeability, Porosity.	USEPA/IS methods/APHA/Relevant SOP
2	Polynuclear Aromatic Hydrocarbons: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Phenanthrene, Fluoranthene, Pyrene, Benz[A]Anthracene, Chrysene, Benzo[K]Fluoranthene, Benzo[A]Pyrene, Benzo[ghi]Perylene, Dibenz[ah]Anthracene, Indeno[1,2,3-cd]Pyrene and Benzo[B]Fluoranthene.	
3	Total Petroleum Hydrocarbon	
4	BTEX	

5.3. 2 Vegetation/Plant and fish sampling

Analysis of plant quality is important as it show the bioindicator of pollution accumulation. Hence different representative plant samples has been collected from South East, South West, North West and North East direction from BGN well#5 covering 2 km radius. The plant sampling also collected from Dibru Saikhowa National Park (DSNP) and Maguri Motapung Beel which located around 2.3 km and 2.5 km distance from BGN well#5 respectively. One plant sample also collected from North West village Erakhuli Guon which is located from 6.17 km from BGN#5. The single sampling representative zone location is selected based on the specific characteristics consist agricultural fields, wet lands, residential zones and accidental zone BGN#5. Figure 3 shows the plant and fish sampling locations. The sample ID, location latitude, longitude, distance from BGN well #5 has been presented in table 3 and analysis parameters and method has been highlighted in table 4. The analysis reports are enclosed as annexure 1B.

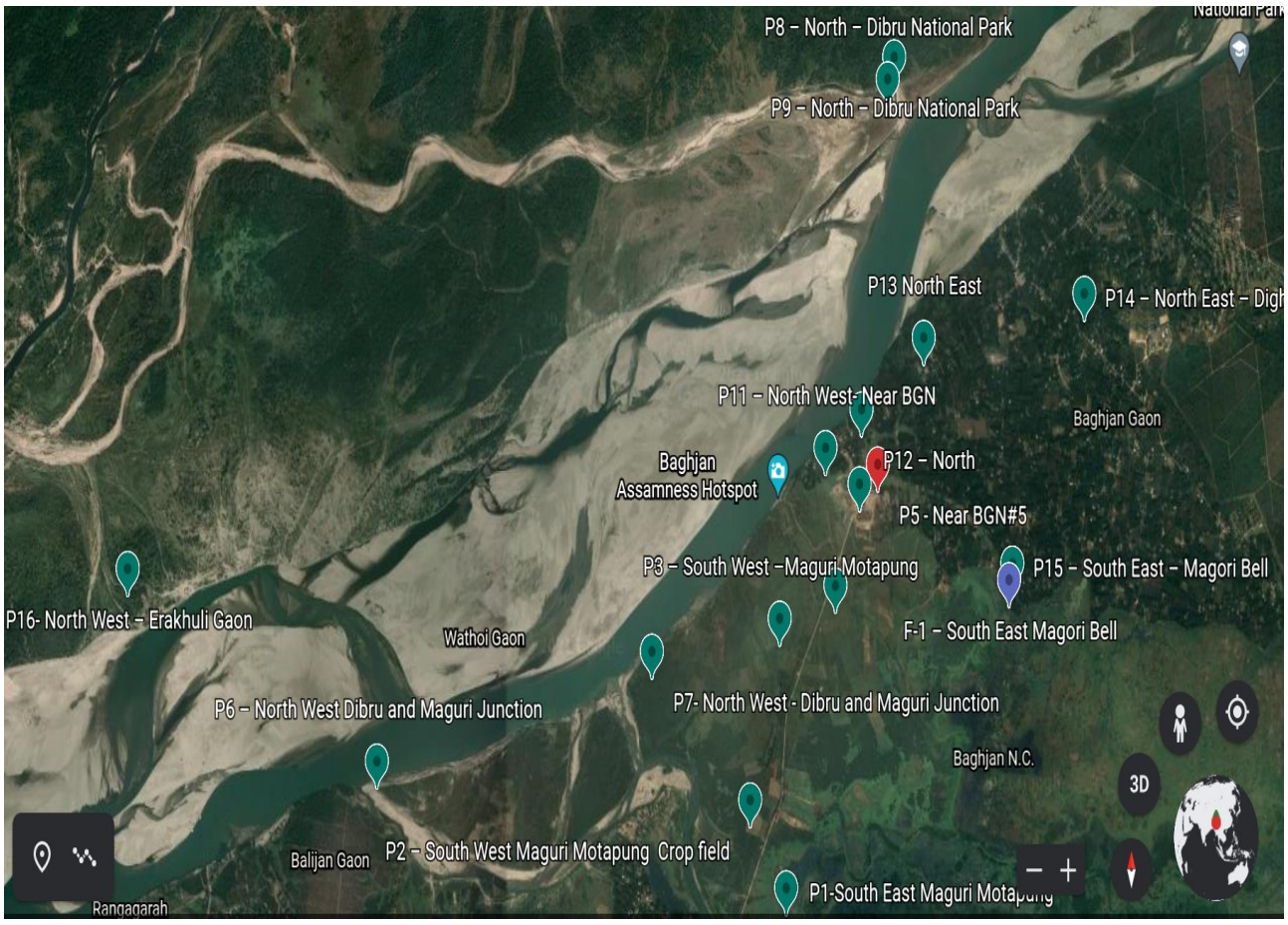


Figure 5. Plant/Vegetation and fish sampling location

Table 3. Plant/Vegetation and fish sample location details

S.No.	Sampling Location	GPS Coordinates of sampling Location (Lat, Long)	Distance from BGN#5	Sample ID	Date of sampling
1	P1 – South East Maguri Motapung	27°34'30.0"N 95°22'26.0"E	2.5 km	BSE-P01-34302226	01.12.2021
2	P2 – South West Maguri Motapung Crop field	27°34'46.0"N 95°22'15.0"E	2.1 km	BSW-P02-34462215	01.12.2021
3	P3 – South West –Maguri Motapung Grass land	27°35'19.0"N 95°22'24.0"E	2.2 km	BSW-P03-35192224	01.12.2021
4	P4 – South West –Maguri Motapung	27°35'25.0"N 95°22'41.0"E	776 m	BSE-P04-35252241	01.12.2021
5	P5 – Near BGN#5 (Within Fencing area)	27°35'47.0"N 95°22'54.0"E	40 m	BGN-P05-35472254	01.12.2021
6	P6 – North West Dibru and Maguri Junction	27°34'53.0"N 95°20'21.0"E	4.5 km	BNW-P06-34532021	02.12.2021
7	P7 – North West - Dibru and Maguri Junction	27°35'13.0"N 95°21'45.0"E	2.1 km	BNW-P07-35132145	02.12.2021
8	P8 – North – Dibru National Park	27°36'57.0"N 95°22'57.0"E	2.1km	BN-P08-36572257	02.12.2021
9	P9 – North – Dibru National Park	27°37'01.0"N 95°22'59.0"E	2.3 km	BN-P09-37012259	02.12.2021
10	P10 – East –250 m from BGN#5	27°35'42.0"N 95°22'52.0"E	190 m	BE-P010-35422252	03.12.2021
11	P11 – North West- 250 m from BGN #5	27°35'50.0"N 95°22'38.0"E	460 m	BNW-P011-35502238	03.12.2021
12	P12 – North 540 m from BGN#5, Baghjan	27°35'57.0"N 95°22'49.0"E	377 m	BN-P012-35572249	03.12.2021
13	P13 – North East, 1 km from BGN#5	27°36'10.0"N 95°23'08.0"E	819 m	BNE-P013-36092308	03.12.2021
14	P14 – North East – Dighastarang	27°36'18.0"N 95°23'57.0"E	1.9 km	BNE-P014-36192355	03.12.2021
15	P15 – South East – Magori Bell	27°35'29.0"N 95°23'35.0"E	1.2 km	BSE-P015-35262335	03.12.2021
16	P16- North West – Erakhuli Gaon	27°35'28.0"N 95°19'05.0"E	6.17 km	BNW-P016-35281904	04.12.2021
17	F-1 – South East Magori Bell	27°35'26.0"N 95°23'34.0"E	1.3 km	BSE-F01-35262334	03.12.2021

Table 4. Vegetation/Plant and fish quality testing in NABL accredited Laboratory

S.No.	Test Parameters	Test Methods
1	Copper, Cadmium, Lead, Mercury, Nickel, Hexavalent Chromium, Zinc	USEPA/IS/AOAC/Relevant SOP
2	Polynuclear Aromatic Hydrocarbons: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Phenanthrene, Fluoranthene, Pyrene, Benz[A]Anthracene, Chrysene, Benzo[K]Fluoranthene, Benzo[A]Pyrene, Benzo[ghi]Perylene, Dibenz[ah]Anthracene, Indeno[1,2,3-cd]Pyrene, Benzo[B]Fluoranthene,	
3	Total Petroleum Hydrocarbon	
4	BTEX	

5.3.3 Water sample

The water samples were collected in and around Bhajan gas well blowout site. The representative water samples has been collected from South East, South West, North West and North East direction from BGN well#5 covering 2 km radius. Two (2) surface water samples, ten (10) ground water samples and one (1) control sample has been collected. The field level testing parameters such as pH and dissolved oxygen was recorded in on-site. In order to compare the quality of groundwater from contaminated area with non-contaminated control site, one ground water sample have been collected from Plastic park, Tinsukia which is 5 km away from gas blowout BGN well#5. The sample ID, location latitude, longitude, distance from BGN well #5 has been presented in table 5 and analysis parameters and method has been highlighted in table 6. tHE

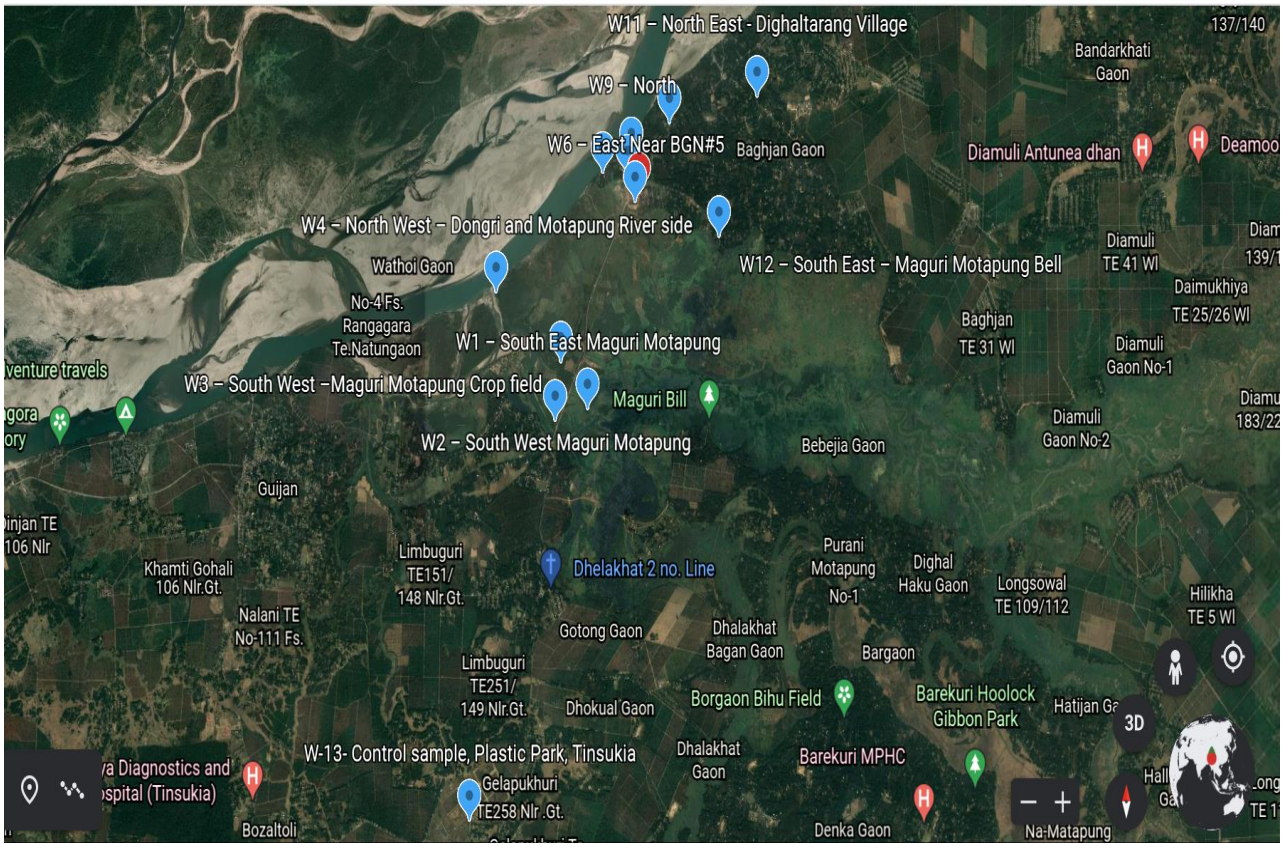


Figure 6. Water sampling locations

Table 5. Water sample location details

S.No	Sampling Location	GPS Coordinates of sampling Location (Lat, Long)	Distance from BGN#5	Sample ID	Date of sampling
1	W1 – South East, Maguri Motapung Beel	27°34'31.0"N 95°22'26.0"E	2.6 km	BSE-W01-34312226	01.12.2021
2	W2 – South West, Maguri Motapung Crop field	27°34'27.0"N 95°22'09.0"E	2.6 km	BNW-W02-34272209	01.12.2021
3	W3 – South West, Maguri Motapung Crop field	27°34'47.0"N 95°22'12.0"E	2.1 km	BSW-W03-34472215	02.12.2021
4	W4 – North West, Dongri and Motapung River side	27°35'11.0"N 95°21'38.0"E	2.3 km	BNW-W04-35112138	02.12.2021
5	W5 – East, Near BGN#5 (100 m from BGN#5)	27°35'45.0"N 95°22'53.0"E	270 m	BE-W05-35452253	03.12.2021
6	W6 – East, Ritu Moran House Near BGN#5 (100 m)	27°35'42.0"N 95°22'51.0"E	120 m	BE-W06-35422251	03.12.2021
7	W7 – Near West, BGN#5 (450 m)	27°35'52.0"N 95°22'34.0"E	575 m	BNW-W07-35522234	03.12.2021
8	W8 – North West 130 m from BGN#5	27°35'51.0"N 95°22'47.0"E	264 m	BNW-W08-35512247	03.12.2021
9	W9 – North, Baghjan (600 m from BGN#5	27°35'57.0"N 95°22'49.0"E	392 m	BN-W09-35572249	03.12.2021
10	W10 – North East (1 km from BGN#5)	27°36'09.0"N 95°23'09.0"E	873 m	BNE-W010-36092309	03.12.2021
11	W11 – North East - Dighaltarang Village	27°36'18.0"N 95°23'55.0"E	1.9 km	BNE-W011-36182355	03.12.2021
12	W12 – South East – Maguri Motapung Beel	27°35'30.0"N 95°23'35.0"E	1.2 km	BSE-W012-35302335	03.12.2021
13	W-13- Control sample, Plastic Park, Tinsukia	27°32'10.0"N 95°21'24.0"	5 km	BC-W013-32102124	05.12.2021

Table 6. Water sample analysis parameters analysis in NABL accredited laboratory

S.No.	Analysis parameters (IS 10500:2012) IS 3025 guidelines
1	Colour and Odour
2	pH
3	Turbidity
4	Electrical conductivity
5	Total dissolved solids
6	Total suspended solids
7	Dissolved oxygen
8	BOD
9	COD
10	Total hardness
11	Total alkalinity
12	Oil and Grease
13	Ammoniacal Nitrogen
14	Chloride
15	Calcium
16	Magnesium
17	Fluoride
18	Phenolic compounds
19	Copper
20	Zinc
21	Nickel
22	Iron
23	Total Chromium
24	Chromium (as Cr^{6+})
25	Lead
26	Sulphide
27	Sulphate
28	Cadmium
29	Polynuclear aromatic hydrocarbons (as PHA)

5.3.4 Quality Assurance and Quality Control

The Quality Assurance and Control Sampling (QA/QC) was followed. Every sample has been collected and analyzed in NABL labs as described. The soil samples was collected in individual cotton bags and placed in an ice cooler in the field immediately. The each soil grab samples from the 8 location (sub-sample) and then later pooled, homogenised and placed in a cloth bag. At the end of the sampling day the soils was placed in a freezer and used for the analysis. For the Polynuclear Aromatic Hydrocarbons and Total Petroleum Hydrocarbon (TPH) analysis, soil and plant samples was collected in 250 ml wide mouth glass container with PTFE-lined lid separately. For the BTEX analysis, soil and plant sample was collected in VOC vials separately. All the plant samples was collected, dried and powdered into a homogenized mixture for the analysis. For the PAH, TPH and BETEX analysis all the soil and plant samples was stored under < 6^0C. All the sampling and photographs of the sampling location was taken and documented. Appropriate test pit logs with photos, videos had been recorded as a part of quality standard requirement.

6. RESULTS AND DISCUSSION

6.1 Field survey

Field inventory was carried out in and around BGN#5 and surrounding 2 km radius covering terrestrial and aquatic environment. The field observation was made and field data sheet has been documented by collecting information from local people and farmers. The farmer's knowledge is instrumental in selection of sampling sites and other additional information to assess the long term changes in soil, vegetation and water quality. The field survey log sheets are enclosed as Annexure 2.

6.2 Terrestrial Environment

The environmental quality of terrestrial environment including soil and vegetation status has been assessed through soil and vegetation/plant sampling analysis. The soil and vegetation sampling has been done within 2 km radius from BGN well#5 and all physic chemical quality of the sample has been analyzed. The sample also collected from important biodiversity reserve such as Maguri Beel and Dibru-Saikhowa National Park. The vegetation samples such as accumulating aquatic plant samples, grass, tea garden, agricultural crops, creepers, climbers and edible part of the vegetables has been collected from each representative zones around BGN well #5.

Table 7. Summary of field observation from surrounding terrestrial environment (Soil)

S.No.	Sampling Location	Sample ID	Soil Type/Cultivation	Observation
1	SE, Maguri Motapung Beel	BSE-S01-34282221	Gray, Sand mixed with sand	No visible contamination
2	SW, Maguri Crop Field	BSW-S02-34472215	Clay mixed sand soil, Loose soil, Paddy, vegetable cultivation near Beel area	No visible contamination
3	SW, Maguri Motapung	BSW-S03-35212221	Batches of Paddy cultivation	No visible contamination
4	SE, Maguri Motapung area	BSE-S04-35242244	Mixed clay and sand type, Rich grass land, paddy and vegetable cultivation	No visible contamination
5	In and around BGN#5 well	BGN-S05-35462250	Brown gray soil,	Few batches of oily lumps seen
6	NW,Dibru river-Maguri Motapung Junction	BNW-S06-34532021	Sand sediments within junction point, Junction point of Dibru and Mogori River	No visible contamination
7	NW, Dongri River and Motapung Junction	BNW-S07-35152143	Gray sand silt type soil	No visible contamination
8	NW, Dangori River, Opp. to Dibru National Park	BNW-S08-35452221	Gray and sandy type of soil, Near wild grass growth	No visible contamination
9	North-Dibru National Park	BN-S09-36582257	Rich wild grass and tress	No visible contamination
10	North-Dibru National Park	BN-S010-37012300	Gray sand type soil, Grass land, wild grass	
11	East-Near BGN#5	BE-S011-35422252	Sandy clay type, Vegetable cultivation	No visible contamination
12	NW,250 M from BGN#5	BNW-S012-35422251	Clay sandy soil, Cattle grazing, Bampoo and Tea cultivation	No visible contamination
13	North, Baghjan, 540 m from BGN#5	BN-S013-35582251	Clay and sand mixture soil, Rich biodiversity and cultivations	No visible contamination
14	NW-1KM from BGN#5	BNE-S014-36112307	Alluvial soil type, Bamboo, vegetable cultivation	No visible contamination
15	NE,Dighastarang, Baghjan Gaon	BNE-S015-36152355	Clay mixed soil, batches of cultivation	No visible contamination
16	SW, Baghjan, End of Maguri Beel	BNE-S016-35292333	Clay mixed sandy soil, Agricultural area, Tea garden	No visible contamination

17	NW,Erakhuli Gaon	BNW-S017-35271906	Sandy soil type, Agricultural area	No visible contamination

The field data sheets and sampling activities photos have been listed in **annexure – I.**

6.2.1 Soil quality of surround environment

Physico-chemical characteristics of soil

The major soil sample showed alkaline to neutral pH from 7.16 to 9.1, whereas location like North, Baghjan, 540 m from BGN#5 (pH 4.96), NW-1 KM from BGN#5 (pH 5.02) and SW, Baghjan the end of Maguri Beel (pH 5.26) and NE, Dighastarang, Baghjan Gaon (pH 4.65) have acidic soil which is collected from agricultural cultivation site and tea garden. All the tested samples exhibited electrical conductivity (<1000 µs/cm). The soil samples recorded with EC range of 101.5 to 416 µs/cm. The soil shows slit concentration of 52 to 60.4 % and clay 9.2 to 18.2 % sand 21.8 to 37.2 % was recorded with characteristics of slit loam soil type.

Soil Nutrients: The available phosphorus in the sample was found in the range of 38.8 mg/kg to 58.7 mg/kg which is in the desirable range for the support of plant growth. The total organic carbon (TOC) was recorded in the range of 0.23 % to 1.37 % shows fertile top land soil. The higher total nitrogen concentration of 635.2 to 1139.35 mg/kg and available nitrogen in the range of 88.5 mg/kg to 1139.65 mg/kg was recorded. The Cation exchange capacity (CEC) is an important indicator of soil fertility because it shows the soil's ability to supply important plant nutrients. The CEC was recorded in the range of 17.6 to 23.5 me/100 ml due to its moderate organic content in the soil. The maximum sodium concentration was 98.86 mg/kg and minimum was 25.54 mg/kg and sodium absorption ratio in the range of 0.39 to 1.27 shows the non-alkaline nature of the soil. Higher concentration of potassium is reported in the range of 184.73 mg/kg to 1203 mg/kg. The sulphate content was in the range of 196.2 to 285.63 mg/kg and chloride in the range of 19.71 to 156.78 mg/kg was reported. These level of chloride and sulphate is optimum concentration reported in the soil.

Metals: The heavy metals like copper (0.03 to 11.3 mg/kg), Lead (0.04 to 1.42 mg/kg), Zinc (0.23 mg/kg), Nickel (0.05 to 1.5 mg/kg) and Cadmium (0.018 mg/kg) was reported in the collected soil. Mercury and Hexavalent Chromium were not detectable in the collected soil sample. The detected metal concentration is less than the soil remediation intervention values specified in Dutch Soil Remediation standards.

Total Petroleum hydrocarbon content (TPH): The maximum TPH concentration of 2425.6 mg/kg was reported in the sample collected near BGN#5 within 550 m distance. The 721.1 mg/kg of TPH was reported in northwest side of Erakhuil Goan located 6 km away from the BGN well#5. All the samples the TPH concentration was within the remediation standard guideline range of <5000 mg/kg given by CPCB.

PAH and BTEX: Among 17 soil samples collected from different locations, South west zone of Maguri Beel sample showed trace level of Fluoranthene (0.15 mg/kg) and Pyrene (0.11 mg/kg) was recorded. Remaining all other samples PAH level was below detectable limit. In all the sample the BTEX concentration was below detectable limit (Table 8-11). The laboratory analysis report of soil samples is enclosed as Annexure 1A.

Table 8. Chemical properties of soil collected from surrounding soil environment

Sample No.	Sample ID	pH	EC, µS/cm	Avilable Phosphorous mg/kg	Potassium mg/kg	Sodium mg/kg	Total Organic Carbon %	Cation Exchange Capacity (ECE) meq/100ml	Alkalinity mg/kg	Total Nitrogen mg/kg	Avilable Nitrogen mg/kg	Acidity mg/kg	Choride mg/kg	Sulphate mg/kg	Sodium Absorption Ratio
1	BSE-S01-34282221	**7.96**	**416**	56.1	706.85	**96.86**	1.05	19.6	212.6	964.23	136.2	8.5	118.26	**285.63**	1.21
2	BSW-S02-34472215	8.2	233	45.8	963.17	56.93	0.67	**23.5**	198.4	716.24	102.4	6.6	**19.71**	229.73	0.67
3	BSW-S03-35212221	8.32	251	48.6	736.3	74.36	0.83	24.8	**245.4**	723.83	105.07	**6.2**	78.84	209.8	0.78
4	BSE-S04-35242244	8.14	196.4	46.85	805.63	63.05	0.7	23.8	184.2	762.42	108.2	6.4	39.42	246.97	0.68
5	BGN-S05-35462250	9.1	167.6	42.68	**1203**	507.01	0.47	20.5	202.8	750.24	96.2	8.5	98.55	198.65	6.71
6	BNW-S06-34532021	8.14	208	51.2	710.16	80.05	0.45	21.6	180.4	762.8	84.62	6.7	98.32	241.04	0.93
7	BNW-S07-35152143	7.16	240	55.2	585.44	48.62	0.55	22.4	192.4	841.6	117.5	12.4	78.48	202.2	0.58
8	BNW-S08-35452221	8.04	249	**58.7**	517.54	70.5	0.52	20.2	176.5	798.64	103.42	14.7	78.49	224.86	0.84
9	BN-S09-36582257	8.25	216	56.4	809.88	34.64	0.31	20.4	190.4	724.15	96.7	12.8	97.71	212.8	0.42
10	BN-S010-37012300	8.26	294	46.8	565.19	37.66	**0.23**	23.4	192.5	942.3	132.8	12.4	116.09	216.8	**0.398**
11	BE-S011-35422252	7.6	222	57.2	629.8	69.13	0.96	22.5	73.6	**635.2**	**88.5**	22.1	39.23	238.7	**1.27**
12	BNW-S012-35422251	8.06	327	50.64	700.93	53.74	0.86	22.8	202.4	826.4	113.64	8.8	98.14	224.6	0.65
13	BN-S013-35582251	4.96	180	45.4	262.38	23.68	0.99	18.6	12.4	1096.45	150.6	126.4	156.18	198.8	0.57
14	BNE-S014-36112307	5.02	**101.5**	39.8	224.78	23.47	0.85	18.8	10.8	**1139.65**	**172.9**	**128.8**	96.76	201.5	0.62
15	BNE-S015-36152355	4.65	154.4	**38.8**	295.36	23.63	**1.37**	19.2	13.2	1012.4	138.8	124.2	98.39	204.9	0.58
16	BNE-S016-35292333	5.26	125.3	39.7	**184.73**	**25.54**	0.86	**17.6**	**10.4**	986.67	141.62	120.2	**156.78**	**196.2**	0.59
17	BNW-S017-35271906	8.17	297	48.95	723.35	83.91	0.55	21.6	210.6	795.24	106.41	18.7	96.16	240.5	0.83

Table 9. Physical properties of soil collected from surrounding soil environment

Sample No.	Sample ID	Moisture%	Spec.Gravity	Porosity %	Permeability cm/sec	Sand %	Clay %	Slit %
1	BSE-S01-34282221	18.71	2.28	44.3	0.00115	22.8	16.8	**60.4**
2	BSW-S02-34472215	18.44	2.28	44.74	**0.00086**	22.8	15.6	61.6
3	BSW-S03-35212221	19.6	2.2	44.1	0.00095	23.5	**18.2**	58.3
4	BSE-S04-35242244	20.82	2.14	42.8	0.0012	22.6	16.7	60.7
5	BGN-S05-35462250	4.86	2.2	34.5	0.00153	33.6	11.6	54.8
6	BNW-S06-34532021	6.15	**2.41**	42.3	0.00134	28.6	**9.2**	62.2
7	BNW-S07-35152143	6.23	2.38	42.86	0.00122	26.9	10.3	62.8
8	BNW-S08-35452221	4.79	2.24	**33.48**	0.00124	27.5	10.8	61.7
9	BN-S09-36582257	1.67	2.22	35.6	**0.00165**	36.5	10.2	53.3
10	BN-S010-37012300	8.57	2.28	37.72	0.00182	**37.2**	10.8	**52**
11	BE-S011-35422252	9.22	2.24	36.16	0.00141	32.6	12.6	54.8
12	BNW-S012-35422251	17.62	2.32	**45.69**	0.00097	**21.8**	17.8	60.4
13	BN-S013-35582251	21.93	2.13	40.38	0.00154	32.8	12.6	54.6
14	BNE-S014-36112307	10.09	2.21	38.01	0.00146	31.2	13.8	55
15	BNE-S015-36152355	8.5	**2.03**	35.46	0.00155	32.1	12.4	55.5
16	BNE-S016-35292333	9.04	2.14	38.32	0.00162	33.5	12.2	54.3
17	BNW-S017-35271906	18.87	2.28	45.62	0.00121	24.3	15.2	60.5

Table 10. Heavy metal content soil collected from surrounding soil environment

Sample No.	Sample ID	Cadmium mg/kg	Mercury	Zinc mg/kg	Lead mg/kg	Copper mg/kg	Hexavalent Chromium mg/kg	Nickel mg/kg
1	BSE-S01-34282221	0.04	BLQ	2.36	1.18	7.38	BDL	1.2
2	BSW-S02-34472215	0.04	BLQ	1.5	3.5	**11.3**	BDL	2.5
3	BSW-S03-35212221	0.03	BLQ	5.07	1.08	0.33	BDL	3.2
4	BSE-S04-35242244	0.04	BLQ	2.5	0.04	0.37	BDL	1.6
5	BGN-S05-35462250	0.03	BLQ	0.9	2.69	0.11	BDL	1.4
6	BNW-S06-34532021	0.03	BLQ	0.44	0.47	1.5	BDL	**4.5**
7	BNW-S07-35152143	0.02	BLQ	1.25	BLQ	3.2	BDL	2.2
8	BNW-S08-35452221	0.02	BLQ	1.95	1.34	0.17	BDL	4.2
9	BN-S09-36582257	**0.018**	BLQ	2	5.8	1.5	BDL	1.4
10	BN-S010-37012300	BLQ	BLQ	**0.23**	0.04	0.06	BDL	**0.05**
11	BE-S011-35422252	0.02	BLQ	0.24	**0.04**	0.6	BDL	2.7
12	BNW-S012-35422251	BLQ	BLQ	1	0.53	**0.03**	BDL	1.96
13	BN-S013-35582251	BLQ	BLQ	1.3	0.4	1.92	BDL	1.41
14	BNE-S014-36112307	BLQ	BLQ	1.17	0.33	1.65	BDL	1.16
15	BNE-S015-36152355	BLQ	BLQ	**BLQ**	0.27	1.4	BDL	0.98
16	BNE-S016-35292333	**BLQ**	BLQ	BLQ	BLQ	1.32	BDL	0.93
17	BNW-S017-35271906	0.043	BLQ	BLQ	**1.42**	0.4	BDL	1.5

Table 11. TPH, PAH and BTEX content in soil collected from surrounding soil environment

Sample No.	Sample ID	Naphthalene mg/kg	Acenapthalene mg/kg	Acenathane mg/kg	Fluorene mg/kg	Phenanthrene, mg/kg	Anthracene mg/kg	Fluoranthene mg/kg	Pyrene mg/kg	Benz[A] Anthracene mg/kg	Chrysene mg/kg	Benzo beta fluranthone, mg/kg	Benzo[K]Fluranthone, mg/kg
1	BSE-S01-34282221	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
2	BSW-S02-34472215	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
3	BSW-S03-35212221	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
4	BSE-S04-35242244	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
5	BGN-S05-35462250	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
6	BNW-S06-34532021	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
7	BNW-S07-35152143	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
8	BNW-S08-35452221	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
9	BN-S09-36582257	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
10	BN-S010-37012300	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
11	BE-S011-35422252	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
12	BNW-S012-35422251	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
13	BN-S013-35582251	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
14	BNE-S014-36112307	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
15	BNE-S015-36152355	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
16	BNE-S016-35292333	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	0.15	0.11	BLQ	BLQ	BLQ	BLQ
17	BNW-S017-35271906	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ

Sample No.	Sample ID	Benzo alpha Pyrene, mg/kg	Indino 1,2,3 - cd pyrene	Dibenzo (a,h) anthracene	Dibenzo (a,h,i) Perylene	Texture	TPH mg/kg	Benzene	Toluene	Ethylbenzene	Xylene
1	BSE-S01-34282221	BLQ	BLQ	BLQ	BLQ	Silt Loam	165.8	BLQ	BLQ	BLQ	BLQ
2	BSW-S02-34472215	BLQ	BLQ	BLQ	BLQ	Silt Loam	470.5	BLQ	BLQ	BLQ	BLQ
3	BSW-S03-35212221	BLQ	BLQ	BLQ	BLQ	Silt Loam	865	BLQ	BLQ	BLQ	BLQ
4	BSE-S04-35242244	BLQ	BLQ	BLQ	BLQ	Silt Loam	427.1	BLQ	BLQ	BLQ	BLQ
5	BGN-S05-35462250	BLQ	BLQ	BLQ	BLQ	Silt Loam	1534.1	BLQ	BLQ	BLQ	BLQ
6	BNW-S06-34532021	BLQ	BLQ	BLQ	BLQ	Silt Loam	686.1	BLQ	BLQ	BLQ	BLQ
7	BNW-S07-35152143	BLQ	BLQ	BLQ	BLQ	Silt Loam	734.3	BLQ	BLQ	BLQ	BLQ
8	BNW-S08-35452221	BLQ	BLQ	BLQ	BLQ	Silt Loam	460.1	BLQ	BLQ	BLQ	BLQ
9	BN-S09-36582257	BLQ	BLQ	BLQ	BLQ	Silt Loam	372.5	BLQ	BLQ	BLQ	BLQ
10	BN-S010-37012300	BLQ	BLQ	BLQ	BLQ	Silt Loam	207.7	BLQ	BLQ	BLQ	BLQ
11	BE-S011-35422252	BLQ	BLQ	BLQ	BLQ	Silt Loam	2097.5	BLQ	BLQ	BLQ	BLQ
12	BNW-S012-35422251	BLQ	BLQ	BLQ	BLQ	Silt Loam	1540	BLQ	BLQ	BLQ	BLQ
13	BN-S013-35582251	BLQ	BLQ	BLQ	BLQ	Silt Loam	**2425.6**	BLQ	BLQ	BLQ	BLQ
14	BNE-S014-36112307	BLQ	BLQ	BLQ	BLQ	Silt Loam	282	BLQ	BLQ	BLQ	BLQ
15	BNE-S015-36152355	BLQ	BLQ	BLQ	BLQ	Silt Loam	173.2	BLQ	BLQ	BLQ	BLQ
16	BNE-S016-35292333	BLQ	BLQ	BLQ	BLQ	Silt Loam	856.8	BLQ	BLQ	BLQ	BLQ
17	BNW-S017-35271906	BLQ	BLQ	BLQ	BLQ	Silt Loam	721.1	BLQ	BLQ	BLQ	BLQ

6.3 Vegetation/Plant Health status

Impact of BGN well blowout on surrounding vegetation was monitored and it was observed that there is a re-growth of grasslands and small trees. The fire event occurred during June, 2020 and after monsoon the pollutants may be washed out from the contaminated zones. It was also further evidenced from the field observation as well as from the sample analysis outcome. There is no visible condensate was observed in any of the sampling site. Within in 2 km radius the plan/vegetation samples including food crops was collected. The plant materials includes Biomass of grass, bamboo, jackfruit, tea, banana, Betel nut, paddy, different vegetables, Fig, Pepper, Kamul, Termaric was collected and analyzed for the various metals, TPH and PAH content (Table 12). The laboratory analysis report of plant/vegetation is enclosed as Annexure 1B.

Table 12. Summary of field observation from surrounding Vegetation

S.No.	Sampling Location	Distance from BGN#5	Crop/Plant Type	Other observation
1	P1 – South East Maguri Motapung	2.5 km	Healthy plants	No visible contamination
2	P2 – South West Maguri Motapung Crop field	2.1 km	Food crops: Paddy, sweet potato, Arbi Root collected	No visible contamination
3	P3 – South West –Maguri Motapung Grass	2.2 km	Grass land area, Creepers, climbers growth	No visible contamination
4	P4 – South West –Maguri Motapung	776 m	Grass land area, Creepers, climbers growth	No visible contamination
5	P5 – Near BGN#5 (Within Fencing area)	40 m	Small batch of grass	Visible contamination batches seen
6	P6 – North West Dibru and Maguri Junction	4.5 km	Shrubs trees creepers and climbers	No visible contamination
7	P7 – North West - Dibru and Maguri Junction	2.1 km	Batches of vegetable cultivation, batches of grass land	No visible contamination
8	P8 – North – Dibru National Park	2.1km	Wild grass land, creepers growth (Location near Dibru national park junction)	No visible contamination
9	P9 – North – Dibru National Park	2.3 km	Junction point of Subh nala and Dibru River, grass land	No Visible contamination
10	P10 – East –250 m from BGN#5	190 m	Cattle grazing seen, vegetable cultivation, grass land, Near bloremediation area	No visible contamination Oily odour has been noticed
11	P11 – North West- 250 m from BGN #5	460 m	Tea Garden, Banana planation, vegetable cultivation	No visible contamination
12	P12 – North 540 m from BGN#5, Baghjan	377 m	Tea garden, Fig, Pepper, Kamul, Termaric, Banana, Bagu Zooran cultivation	No visible contamination
13	P13 – North East, 1 km from BGN#5	819 m	Opp. Side of Subh Nala, Rich agricultural land, Vegetable cultivation	Farmers reported some batches of damage in tea after BGN# accident. Re-growth of tea plantation seen, Damaged Few batches has been removed.
14	P14 – North East – Dighastarang	1.9 km	Tea garden, Tambul cultivation	No Visible contamination
15	P15 – South East – Magori Bell	1.2 km	Near tea plantation, Water hyacinth-Eichhornia, Creepers and climbers	No visible contamination
16	P16- North West – Erakhuli Gaon	6.17 km	Vegetable cultivation	Sample collected due some from residents of Erakhui gaon

17	F-1 – South East Magori Bell	1.3 km	6 variety of fish has been collected	Point were some domestic garbage and wastewater mixing with wet land area

There is no accumulation of TPH and total PAH including Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Phenanthrene, Fluoranthene, Pyrene, Benz[A]Anthracene, Chrysene, Benzo[K]Fluoranthene, Benzo[A]Pyrene, Benzo[ghi]Perylene, Dibenz[ah]Anthracene, Indeno[1,2,3-cd]Pyrene, Benzo[B]Fluoranthene in the analyzed plant biomass. It shows that the affected surrounding environment is free from contamination. The heavy metals such as copper (0.5 to 3.45 mg/kg), cadmium (maximum 0.06 mg/kg), lead (maximum 1.28 mg/kg) and Nickel (0.3 to 2.62 mg/kg) was found in the plant/vegetation samples. These low level of heavy metal accumulation in plant may be due to presence of metal compounds in soil system. These reported heavy metals commonly present in the soil system leads to accumulation in vegetation/plant biomass (Table 13).

Table 13. Heavy metal, TPH and BTEX content in vegetation samples collected from surrounding environment

S.No.	Sample ID	Sampling Location	Copper, mg/kg	Cadmium , mg/kg	Lead, mg/kg	Mercury, mg/kg	Nickel, mg/kg	Hexavalent Chromium, mg/kg	Zinc, mg/kg	TPH %	BTEX
1	BSE-P01-34302226	SE, Maguri Motapung Beel	1.98	0.05	0.32	BLQ	1.18	BDL	1.49	BLQ	BLQ
2	BSW-P02-34462215	SW, Maguri Crop field	1.4	BLQ	0.19	BLQ	0.67	BDL	2.17	BLQ	BLQ
3	BSW-P03-35192224	SW, Maguri Motapung Beel	1.74	BLQ	0.56	BLQ	0.7	BDL	2.54	BLQ	BLQ
4	BSE-P04-35252241	SW, Maguri Motapung area	1.2	0.02	0.41	BDL	1.12	BDL	2.8	BLQ	BLQ
5	BGN-P05-35472254	In and around BGN#5	0.99	**0.02**	0.52	BLQ	**2.62**	BLQ	**3.3**	BLQ	BLQ
6	BNW-P06-34532021	Junction point Dibru and Maguri	2.39	0.08	**1.28**	BLQ	1.28	BLQ	0.82	BLQ	BLQ
7	BNW-P07-35132145	NW, Dangori and Motapung River junction	1.64	0.04	1.14	BLQ	1.23	BLQ	2.31	BLQ	BLQ
8	BN-P08-36572257	North, Dibru National Park	1.1	0.05	0.8	BLQ	2.36	BLQ	5.35	BLQ	BLQ
9	BN-P09-37012259	North, Dibru National Park	**0.5**	0.05	0.6	BLQ	0.63	BLQ	2.2	BLQ	BLQ
10	BE-P010-35422252	East, 250 m from BGN+5	2.39	0.04	0.95	BLQ	1.87	BLQ	1.5	BLQ	BLQ
11	BNW-P011-35502238	NW, 250 m from BGN#5	1.22	BLQ	BQL	BLQ	BDL	BLQ	0.3	BLQ	BLQ
12	BN-P012-35572249	North, 540 m from BGN#5, Baghjan	0.09	0.05	0.82	BLQ	0.5	BLQ	1.76	BLQ	BLQ
13	BNE-P013-36092308	NE, 1 km from BGN#5	0.57	0.06	0.99	BLQ	**0.35**	BLQ	1.57	BLQ	BLQ
14	BNE-P014-36192355	NE, Dighastarang, Baghjan	**3.45**	**0.06**	0.17	BLQ	1.19	BLQ	2.33	BLQ	BLQ

15	BSE-P015-35262335	SE, Maguri Beel, Baghjan	0.66	0.04	0.4	BLQ	1.55	BLQ	2.65	BLQ	BLQ
16	BNW-P016-35281904	NW, Erakhuli Gaon	1.09	0.05	0.3	BLQ	0.75	BLQ	**0.3**	BLQ	BLQ

Table 14. PAH content in vegetation samples collected from surrounding environment

S.No.	Sample ID	Naphthalene, mg/kg	Acenaphthylene mg/kg	Acenaphthene, mg/kg	Fluorene, mg/kg	Anthracene, mg/kg	Phenanthrene, mg/kg	Fluoranthene, mg/kg	Pyrene, mg/kg	Benz[A]Anthracene, mg/kg	Chrysene	Benzo[K] Fluoranthene	Benzo[A]Pyrene	Benzo[ghi]Perylene	Dibenz[ah] Anthracene	Indeno[1,2,3-cd]Pyrene	Benzo[B]Fluoranthene
1	BSE-P01-34302226	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
2	BSW-P02-34462215	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
3	BSW-P03-35192224	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
4	BSE-P04-35252241	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
5	BGN-P05-35472254	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
6	BNW-P06-34532021	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
7	BNW-P07-35132145	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
8	BN-P08-36572257	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
9	BN-P09-37012259	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
10	BE-P010-35422252	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
11	BNW-P011-35502238	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
12	BN-P012-35572249	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
13	BNE-P013-36092308	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
14	BNE-P014-36192355	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
15	BSE-P015-35262335	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
16	BNW-P016-35281904	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ

6.4 Aquatic Environment

The surface and ground water quality of water samples from selected location within 2 km radios was assessed to know the impact of BGN#5 blowout. The parameters includes Colour and Odour, pH, Turbidity, Electrical conductivity, Total dissolved solids, Total suspended solids, Dissolved oxygen, BOD, COD, Total hardness, Total alkalinity, Oil and Grease, Ammoniacal Nitrogen, Chloride, Calcium, Magnesium, Fluoride, Phenolic compounds, Copper, Zinc, Nickel, Iron, Total Chromium, Chromium (as Cr^{6+}), Lead, Sulphide, Sulphate, Cadmium and Polynuclear aromatic hydrocarbons (as PHA).

The representative water samples has been collected from South East, South West, North West and North East direction from BGN well#5 covering 2 km radius. Two (2) surface water samples, ten (10) ground water samples and one (1) control sample has been collected (Table 15). The laboratory analysis report of water samples is enclosed as Annexure 1C.

Table 15. Summary of field observation from surrounding aquatic environment

S.No	Sampling Location	Distance from BGN#5	Type of water sample	Depth of Ground water	Other observations
1	W1 – South East, Maguri Motapung Beel	2.6 km	Wet land surface water	20 foot	Clear water
2	W2 – South West, Maguri Motapung Crop field	2.6 km	Ground water	30 foot	Clear water
3	W3 – South West, Maguri Motapung Crop field	2.1 km	Ground water	70 foot	Clear water, Iron taste
4	W4 – North West, Dongri and Motapung River side	2.3 km	Ground water	45 foot	Clear water, Iron taste
5	W5 – East, Near BGN#5 (100 m from BGN#5)	270 m	Ground water	40 foot	Hand pump
6	W6 – East, Ritu Moran House Near BGN#5 (100 m)	120 m	Ground water	40 foot	Iron and oily odor, Precipitate in first pumping
7	W7 – Near West, BGN#5 (450 m)	575 m	Ground water	40 foot	Near Dibru river, Drinking water source,
8	W8 – North West 130 m from BGN#5	264 m	Surface water	Stagnant rain water	Near wet land , grass land area
9	W9 – North, Baghjan (600 m from BGN#5	392 m	Ground water	40 foot	Clear water, Iron odor, Soar taste
10	W10 – North East (1 km from BGN#5)	873 m	Ground water	50 foot	Clear water, Iron taste water
11	W11 – North East - Dighaltarang Village	1.9 km	Ground water	46 foot	Within Tea garden
12	W12 – South East – Maguri Motapung Beel	1.2 km	Ground water	40 foot	Clear water, Iron odor

13	W-13- Control sample, Plastic Park, Tinsukia	5 km	Ground water	40 foot	Considered as control sample

Table 16. Physico-chemical quality of surface and ground water samples

S.No.	Sample ID	Odour	Colour	pH	Turbidity, NTU	Electrical onductivity, µS/cm	TDS, mg/L	TSS, mg/L	DO, mg/L	BOD, mg/L
1	BSE-W01-34312226	Agreeable	Colourless	8.19	<1	162	98	10	8.4	3.4
2	BNW-W02-34272209	Agreeable	Light yellow	7.12	**11.5**	178	107	3	8.3	BDL
3	BSW-W03-34472215	Agreeable	Light yellow	7.29	**13**	216	132	13	7.8	BDL
4	BNW-W04-35112138	Agreeable	Dark Yellow	6.88	**80.6**	756	469	11.6	6.4	11.6
5	BE-W05-35452253	Agreeable	Colourless	6.04	<1	210	129	8	7.5	4.4
6	BE-W06-35422251	Agreeable	colourless	6.7	<1	679	415	1	7.4	3.4
7	BNW-W07-35522234	Agreeable	colourless	7.19	<1	221	134	BDL	7.4	BDL
8	BNW-W08-35512247	Agreeable	Light yellow	7.12	<1	256	158	6	7.6	8
9	BN-W09-35572249	Agreeable	Colourless	6.97	<1	136	86	BDL	8.4	BDL
10	BNE-W010-36092309	Agreeable	Colourless	6.7	<1	112	69	BDL	8.4	BDL
11	BNE-W011-36182355	Agreeable	Colourless	5.76	<1	310	188	BDL	8	BDL
12	BSE-W012-35302335	Agreeable	Colourless	5.58	<1	136	84	2	6.4	BDL
13	BC-W013-32102124	Agreeable	Colourless	6.88	<1	230	142	2	8.3	16.47
	Requirment as per drinking water specification IS 10500:2012	Agreeable	-	6.5 - 8.5	1	-	500	-	-	-

S.No.	Sample ID	COD, mg/L	Total Hardness, mg/L	Total alkalinity, mg/L	Oil and grease, mg/L	Ammoniacal Nitrogen, mg/L	Chloride, mg/L	Phenolic compounds, mg/L	Sulphide, mg/L	Sulphate, mg/L
1	BSE-W01-34312226	12	66	68	BDL	BDL	3.94	**0.0125**	BDL	3.64
2	BNW-W02-34272209	BDL	66	84	BDL	0.84	1.97	**0.0131**	BDL	9.03
3	BSW-W03-34472215	8	84	104	BDL	BDL	BDL	**0.028**	BDL	2.86
4	BNW-W04-35112138	40	364	**426**	BDL	4.5	2.96	**0.0036**	BDL	1.9
5	BE-W05-35452253	16	74	50	BDL	0.95	8.87	**0.0399**	BDL	32.29
6	BE-W06-35422251	12	244	**286**	BDL	BDL	26.61	**0.0146**	BDL	31.63
7	BNW-W07-35522234	8	94	100	BDL	BDL	3.94	**0.0293**	BDL	4.29
8	BNW-W08-35512247	24	74	114	BDL	BDL	6.9	**0.0193**	BDL	3.24
9	BN-W09-35572249	BDL	38	38	BDL	BDL	9.86	**0.0186**	BDL	8.85
10	BNE-W010-36092309	8	36	32	BDL	BDL	9.86	**0.0235**	BDL	BDL
11	BNE-W011-36182355	8	80	12	BDL	BDL	44.35	**0.0199**	BDL	2.32
12	BSE-W012-35302335	8	38	16	BDL	BDL	14.78	**0.02**	BDL	5.68
13	BC-W013-32102124	52	70	62	BDL	BDL	21.68	**0.0119**	BDL	12.6

In order to find put the movement of pollution plume in and around BGN#5 blowout incident area, the detailed sampling and analysis was carried out carried. The finger print of major pollutant such

	Requirment as per drinking water specification IS 10500:2012	-	200	200	-	0.5	250	**0.001**	0.05	200

as oil & grease, PAH and metallic compounds including other physic-chemical parameters was analyzed. As results shown in the table 2 & 3, the oil & grease, PAH and heavy metals were below the detection limit. The pH, electrical conductivity, TDS, TSS, Total hardness, chloride, sulphide and sulphate were within the acceptable limit of IS: 10500, 2012 drinking water standard. The sampling area was rich biodiversity and agricultural field with high groundwater-table. The sampling has been carried out covering agricultural fields, Maguri Motapung Beel and residential area. The aquifers mainly discharge towards the Maguri Motapung Beel and River leads to absence of pollutants plumes from the BGN#5.

Table 17. Physico-chemical quality of surface and ground water samples

S.No.	Sample Location	Zinc, mg/L	Nickel, mg/L	Iron, mg/L	Chromium, mg/L	Chromium (as Cr6+), mg/L	Lead, mg/L	Cadmium, mg/L	Polynuclear aromatic hydrocarbons (as PHA), mg/L	Copper, mg/L	Fluoride, mg/L	Calcium, mg/L	Magnesium, mg/L
1	BSE-W01-34312226	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	12.45	7.59
2	BNW-W02-34272209	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	0.072	22.89	12.04
3	BSW-W03-34472215	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	0.08	29.11	13.96
4	BNW-W04-35112138	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	**97.8**	45.65
5	BE-W05-35452253	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	56.25	26.87
6	BE-W06-35422251	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	52.05	25.15
7	BNW-W07-35522234	BLQ	BLQ	0.3	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	33.75	13.78
8	BNW-W08-35512247	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	0.09	23.94	7.49
9	BN-W09-35572249	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	13.55	4.63
10	BNE-W010-36092309	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	19.15	6.15
11	BNE-W011-36182355	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	25.36	11.52
12	BSE-W012-35302335	BLQ	BLQ	BLQ	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	12.6	4.12
13	BC-W013-32102124	BLQ	BLQ	BDL	BLQ	BDL	BLQ	BLQ	BLQ	BLQ	BDL	18.31	14.38
Requirement as per drinking water specification IS 10500:2012		5	0.02	0.3	0.05	-	0.01	0.003	0.0001	0.05	1	75	30

The metallic salts and heavy metals such as Zn, Ni, Cr, Cr ($^{6+}$), Pb and Cr were found to be below detection limits in all the tested water sample showed that the absence of pollutants plume in the ground water ecosystem. The parameters like total phenolic compounds found to be more than the

permissible limit prescribed in IS 10500:2012 which may be due to peculation from natural sources of phenols to aquatic systems include decomposition of aquatic vegetation.

6.4.1 Fish sample analysis

Maguri Motapung beel is also home to 84 species of fish and one of important wetland system situated in the periphery of BGNweel #5. One representative fish sample has been collected from Maguri Motapung Beel and analyzed for the Heavy metals, PAH and BTEX. The analysis results shows there no accumulation of PAH, BTEX and tested heavy metals like cadmium, lead, mercury, nickel and hexavalent chromium. The trace level of zinc 0.3 mg/kg has been recorded in the homogenized mixture. The laboratory analysis report of fish samples is enclosed as Annexure 1D.



Fig. 6 Different species of fish samples collected as representative sample for the analysis of pollutants

During the field visit there is no fish mortality or any other oil floating material or condensate was observed.

6.4.2 Sediment/Sludge sample

The very low to moderate concentration of TOC was recorded in the sediment/sludge samples collected from Maguri Motapung beel (0.4 % & 7.04 %), Dangri Motapung River Junction (0.03%) and Dibru River (0.04%) due to sandy soil nature in river side. The CEC content in the sludge is in the range of 18.2 % to 20.6% shows the high heavy clay content in the sediments. The laboratory analysis report of sediment samples is enclosed as Annexure 1E.

Table 18. Field survey and observations in wetland environment

S.No.	Sampling Location	Sample ID	Soil Type/Cultivation	Observation
1	SE, Maguri Motapung Beel	BSE-SL01-34312226	Gray sludge, Sludge from Maguri Beel	No visible contamination

2	NW, Dangri Motapung River Junction	BNW-SL02-35172141	Redish green batches, Surrounding area of Dibru river	Redish green algal growth looks like oily layer. No odour, This sample collected separately and tested
3	NW, Dibru River	BNW-SL03-36172229	Sediment inside Dibru river	No visible contamination
4	SW, Maguri Motapung Beel	BSE-SL04-35252333	Sludge gray black type, Sediment inside wet land	No visible contamination

7 MAJOR FINDINGS AND CONCLUSION

The quality of accidental zone is mainly assess through health of the surrounding terrestrial and aquatic system consisting of soil, vegetation, water and wetland sediments. The soil and water and its capacity to functions are generally evaluated through inherent and dynamic soil properties.

The major outcomes of the present study are

1. All the collected soil samples showed the TPH concentration within the remediation standard guideline range of <5000 mg/kg given by CPCB. All the collected soil samples showed the TPH concentration within the remediation standard guideline range of <5000 mg/kg given by CPCB. Among 17 soil samples collected from different locations, South west zone of Maguri Beel sample showed trace level of PAH Fluoranthene (0.15 mg/kg) and Pyrene (0.11 mg/kg). Remaining all other samples, the PAH level was below detectable limit. The BTEX concentration was also below detection limit in all tested soil samples. This results revealed that the surrounding soil environment is in free from contamination due to natural process like heavy rainfall during the monsoon.
2. The **surface and ground water** quality of water samples from selected location within 2 km radios was assessed to know the impact of BGN#5 blowout. The oil & grease, PAH and heavy metals concentration were below the detection limit. There is no significant pollutant plume was recorded in the water ecosystem in surface and ground water system.
3. The vegetation/plant and fish sample analysis results shows that there is no accumulation of PAH, BTEX and tested heavy metals like cadmium, lead, mercury, nickel and hexavalent chromium. There is no accumulation of TPH and total PAH in the analyzed **plant biomass**.

Based on the sampling and analysis of soil, water and vegetation sample in surround environment including bioreserve, the present study analysis reveal the absence of significant pollutants except traces of TPH content in the soil (within the acceptable limit) may the only concern in further assessment and mitigation.

IN THE SUPREME COURT OF INDIA
(CIVIL APPELLATE JURISDICTION)
CIVIL APPEAL NO. 2201 OF 2021

IN THE MATTER OF:

Bonani Kakkar ...Appellant

Versus

Oil India Limited & Ors. ...Respondents

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28.	**Annexure R27** A copy of the interim progress report of two seasons submitted by IUCN to Assam Biodiversity Board and the Answering Respondent.	496 – 589	
29.	**Annexure R28 (Colly.)** Print out of various newspapers articles reporting the sighting of the Mandarin Duck after a period of 118 years.	590 – 594	
30.	**Annexure R29 (Colly.)** Photographs of the Migratory Birds along with other birds and wild animals during the period of December 2021-February 2022 sighted at MaguriMotapung Wetland and at the DibruSaikhowa National Park.	595 – 615	
31.	**Annexure R30**	616	

	A copy of a map indicating the relevant areas.		
32.	**Annexure R31** A copy of the restoration report showing the visual representation of the areas prepared by the HSE team.	617 – 674	
33.	**Proof of Service**		

Filed by

TRUST LEGAL
Advocate for Respondent No 1
Trust Legal House C-224,
Defence Colony, New Delhi 11024
(Computer Code: 2725, Mob No.:9899545281)
Email: gaichangadvocate@gmail.com

New Delhi

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Biodiversity Impact Assessment Study for the proposed 7 Extended Reach Drilling Wells beneath DibruSiakhowa National Park, Assam

An Interim Progress report by International Union for Conservation of Nature (IUCN-India) submitted to Assam Biodiversity Board and Oil India Limited



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Biodiversity Assessment for OIL India Limited, Baghjan

1. Introduction

Biodiversity is the variety of life on Earth and is essential to sustaining the living systems we depend on for our health, economy, food and other vital services. To effectively protect and conserve biodiversity, it is necessary to understand biodiversity, the pressures that are acting upon it, and the opportunities for improvement. Various functions of human beings affect the environment in many ways.

The Convention on Biological Diversity (CBD) defines biodiversity as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystem and the ecological complexes of which they are part; this includes diversity within species, between species and ecosystems.

Oil and gas exploration, development and production activities can affect the natural and social environments in which they take place, including potential and actual impacts on biodiversity and the natural resources on which local communities depend. Industry operations and activities may also rely on ecosystem services provided by the natural environment, such as freshwater supply. Such potential and actual impacts and dependencies, and the consequent need to manage risk, are important factors. To suggest measures to avoid, reducing and mitigating some of the impacts, Biodiversity assessment of the exploration areas is necessary.



Project Background

In exercise of powers conferred under sub-section (1) of Section 22 of the Biological Diversity Act, 2002 (Act 18 of 2003), the Government of Assam constituted the 'Assam State Biodiversity Board' on 29th September 2010 to promote biodiversity conservation in the State of Assam, sustainable use of its components, equitable sharing of benefits arising out of the use of biological resources of the state and traditional knowledge associated with these resources, and matters incidental thereto or connected therewith.

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. Following the discovery of oil and gas in Baghjan area (2003) by OIL, extensive geoscientific works have been carried out through 3D seismic survey. Around 75 sq. km. of Petroleum Exploration License (PEL) area was converted into Baghjan Mining Lease (ML) and OIL has so far drilled 19 wells. Currently, 5000 bbl of oil has been produced from this field per day.

Be that as it may, the Assam State Biodiversity received a copy of the order of the Hon'ble Supreme Court in I.A. No.3934 in W.P. (Civil) No. 202 of 1995, dated 07.09.2017, which directed as follows:

"OIL will carry out Biodiversity Impact Assessment Study through Assam State Biodiversity Board, for which budgetary offer have already been obtained on 12th May 2017."

Earlier, the Assam State Biodiversity Board received a communication on 28.01.2017 from Oil India Limited, calling for a budgetary offer/estimate for undertaking of a 'Biodiversity Impact Assessment Study' for the 7 nos. Extended Reach Drilling (ERD) wells proposed beneath the Dibru-Saikhowa National Park (DSNP). In response thereto, the Assam State Biodiversity Board sent a budgetary offer for consultancy services, to the Oil India Limited, Duliajan on 12.05.2017 for undertaking the aforesaid study. However, the Assam State Biodiversity Board did not immediately receive any acceptance of this offer from the Oil India Limited.

On the aftermath of the oil-well blowout at Baghjan, that the Assam State Biodiversity Board received an email communication from the General Manager (HSE), S&E Department, Oil India Limited, Duliajan on 21.08.2020, requesting it to submit a fresh budgetary proposal for 'Biodiversity Impact Assessment Study' for drilling of the proposed 7. Nos. Extended Reach drilling wells, beneath the Dibru Saikhowa National Park, Assam. In response to this email, the Assam State Biodiversity Board sent its reply on 29.08.2020 which explained the Board's position as below:

"In the backdrop of the critical and extraordinary situation prevailing around the Baghjan / Dibru-Saikhowa / Maguri-Motapung Beel area on the aftermath of the oil-well blowout, it would not be possible for the Assam State Biodiversity Board to undertake any 'Biodiversity Impact Assessment Study', till the environmental crisis in and around Baghjan / Dibru-Saikhowa / Maguri-Motapung Beel area is fully mitigated by M/s. Oil India Limited."

In response to the Assam State Biodiversity Board's communication dated 29.08.2020, a letter from Oil India Limited was received on 14.12.2020 by email, seeking confirmation from the Assam State Biodiversity Board on undertaking the Biodiversity Impact Assessment Study at the proposed site, now that the Baghjan well No.5 crisis was over.

Accordingly, the Board sent a reply to the Oil India Limited on 30.12.2020, proposing the road-map

and modalities for carrying out the 'Biodiversity Impact Assessment Study', and followed it up with another clarification on 28.01.2021. The Board received confirmation from the Oil India Limited for the proposed road-map for undertaking the Biodiversity Impact Assessment vide communications dated 12.01.2021 & 02.02.2021.

After acceptance of the proposal for the 'Biodiversity Impact Assessment Study', by the Oil India Limited, the Assam State Biodiversity Board sought to partner with the International Union for Conservation of Nature (IUCN) for the study, in view of the fact that the said organization is an internationally reputed organization having expertise in the area of conservation of rare, threatened & endangered species of flora and fauna, across the world. Accordingly, a communication was addressed to the IUCN on 03.02.2021, and acceptance by the IUCN was conveyed on 08.02.2021. Thereafter, a draft tripartite MoU along with the budgetary estimate was communicated to the Oil India Limited on 17.02.2021. The Oil India Limited suggested a few modifications to the draft tripartite MoU on 23.02.2021, and again on 03.03.2021, which basically related to the payment terms, taxes, other expenditure to be incurred etc. The said modifications were communicated to the IUCN on 03.03.2021, and the draft tripartite MoU was accordingly revised.

The 'tripartite MoU' was finally signed on 04/05/2021 between the Assam State Biodiversity Board, International Union for conservation of Nature and Natural Resources (IUCN) and the Oil India Limited, after Model Code of Conduct (MCC) pertaining to the Legislative Assembly Elections, 2021 was lifted. The study at this point of time is ongoing.

Under the guidance of Assam State Biodiversity Board, IUCN will go beyond the compliance by conducting biodiversity impact assessment study as well as developing a Comprehensive Biodiversity Management plan with its implementation strategy and framework. IUCN will be using its Global biodiversity mapping tools like IBAT and other guiding and knowledge products to ensure the robust data collection and management.

OIL intends to drill seven (7) extension/appraisal locations in the riverbed areas of Dibru River alongside Dibru-Saikhowa National Park (DSNP). All seven locations will be drilled from three surface well pads viz. PAD 1, PAD 2 and PAD 3 of Baghjan ML located at a minimum distance of 1.3 km outside the boundary of the DSNP. The seven wells will be drilled from the proposed drill pads through Extended Reach Drilling (ERD) Technology. The target depth of each seven wells is planned to be 3950 m (TVD). Once hydrocarbon is established in this area, it is expected to enhance the cumulative oil production of OIL adding to the national economy.

Scope of the study

The major scope of the study is to conduct a Biodiversity Impact Assessment and prepare a Biodiversity Management Plan. This is an exhaustive study that includes on-site as well as desk work. It includes three main components – ecological assessment, biodiversity impact assessment and ecosystem services review. Based on the learning of these components, various strategies and action plans will be suggested to mitigate impact, enhance and conserve biodiversity.

This document is an Interim report that highlights the findings for the first two seasons i.e. monsoon and post-monsoon season.

Objectives of the Interim Report

- Documentation of baseline data of biodiversity in PADs and the buffer area of 10 km for two seasons

- Preparation of Comprehensive Biodiversity Inventory identified in and around the site along with the details such as Common and Scientific name, Family, Protection and Conservation status (WPA and IUCN) and its distribution and migration status.
- Listing aquatic diversity (zoo and phyto-plankton diversity)
- Preparation of Biodiversity Richness Map from Species Richness acquired from two season assessment

Project Area

The study area is situated in Baghjan Village, Doomdooma Tehsil, Tinsukia District of Assam. The seven subsurface locations are located within Dibru-Saikhowa National Park (DSNP). The seven wells will be drilled from three surface well pads within Baghjan Petroleum Mining Lease (PML). The three surface locations are present in Dighaltarang and Baghjan villages in Doomdooma Tehsil of Tinsukia District. The ERD surface locations can be accessed from the NH-37 through Doomdooma-Baghjan Road and is about 22 km from Doomdooma.

Following Table 1 and Figure 1 presents the locations of the subsurface and surface locations:

Table 1 Locations of Study Area

Name	Latitude	Longitude
Surface ERD Locations		
PAD 1	27.593769	95.384482
PAD 2	27.599916	95.404428
PAD 3	27.612782	95.414843
Sub-surface ERD Locations		
LOCATION A	27.603265	95.366276
LOCATION B	27.605741	95.374595
LOCATION C	27.612961	95.373864
LOCATION D	27.613475	95.383092
LOCATION E	27.618875	95.385301
LOCATION F	27.618095	95.391687
LOCATION G	27.621662	95.401668

Tropical Evergreen Forest, Tropical Semi Evergreen Forest and Seasonal swamp forests are the typical features of the study area, as the study area is in North East Region biogeographic zone[1]. The ERD surface and subsurface locations falls within the depositional plains of the River Brahmaputra and its tributaries. The elevation range varies between 110-130 m thus this area is relatively flat. This area falls in humid sub-tropical climate zone with warm seasons and moderately cold winters. The average annual temperature in Tinsukia is 23.7 °C; highest maximum temperature of 27.9 °C in monsoon and the minimum temperature can reach up to 10 °C in winters. It receives an average rainfall of about 2699 mm annually. Alluvial plains are the major physiography of the district followed by piedmont plain, flood plain and hilly terrain.[2]

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

[2] *https://slusi.dacnet.nic.in/srm/srmabstracts/SRM_39_Tinsukia.pdf*

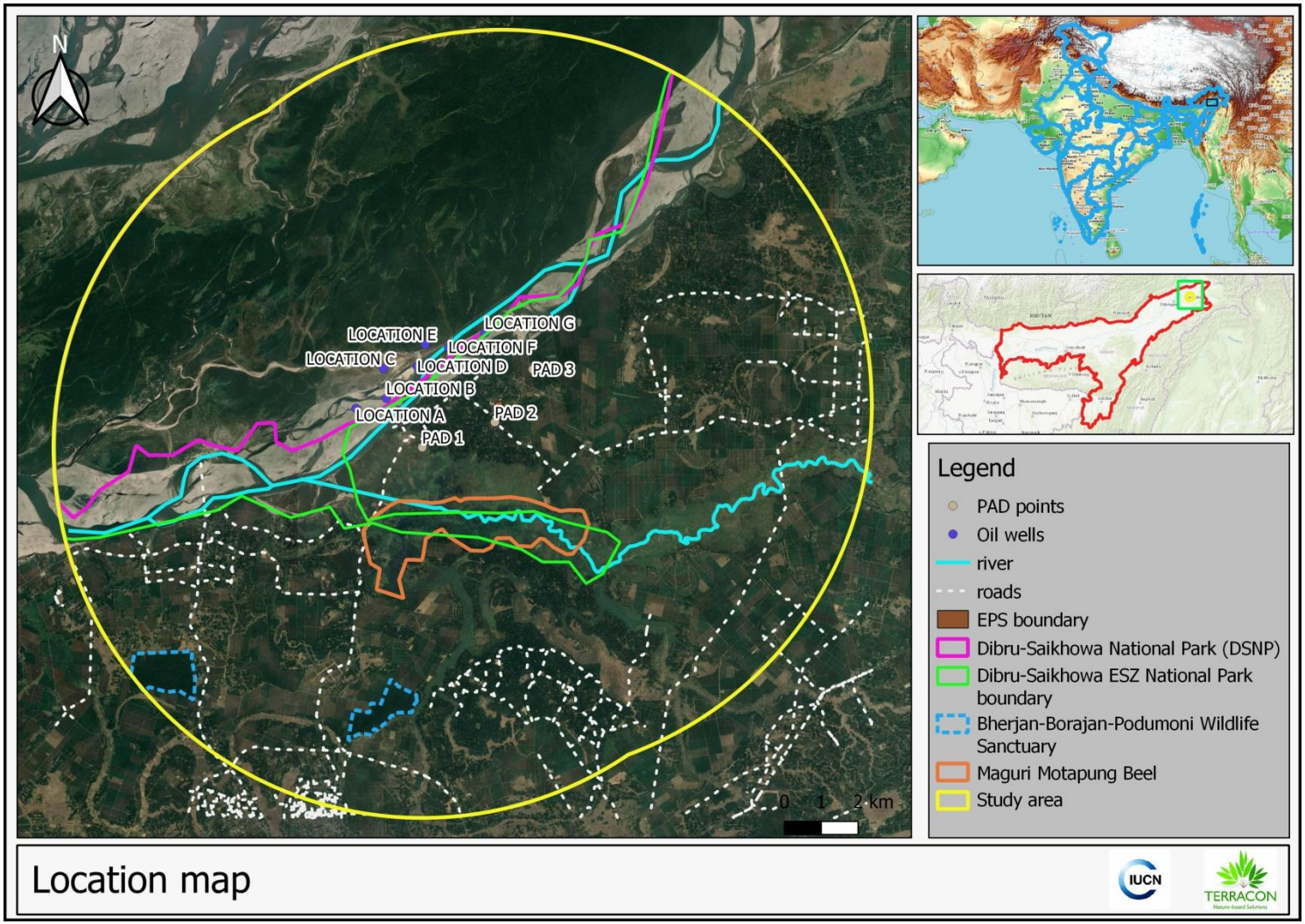


Figure 1 Location Map of Study Area

Locations

For Biodiversity assessment, a combination of an area within a 10 km radius from the boundaries of the PAD 1, PAD 2 and PAD 3 was considered as study area. For the convenience of the survey, the entire study area is divided into grids of 4 x 4 Km. Study plots are laid in each grid to record the present biodiversity and observe ecological conditions. (Refer Figure 2) A total of 29 study plots and 4 transects were laid in the study area. Line Transects was considered to document the diversity in the Ecological Sensitive Areas. Environmental settings of the ERD surface locations, i.e. well pads are as follows:

PAD 1: The well pad is located in Baghjan village, Doomdooma Tehsil of Tinsukia district. The topography of the area is flat. Approach road to the site is already developed for the transport of the drilling rig, equipment and materials to the site. The habitat of this well pad is categorised as a cropland/pastureland. Presence of Baghjan settlements is observed in the vicinity of the well pad location.



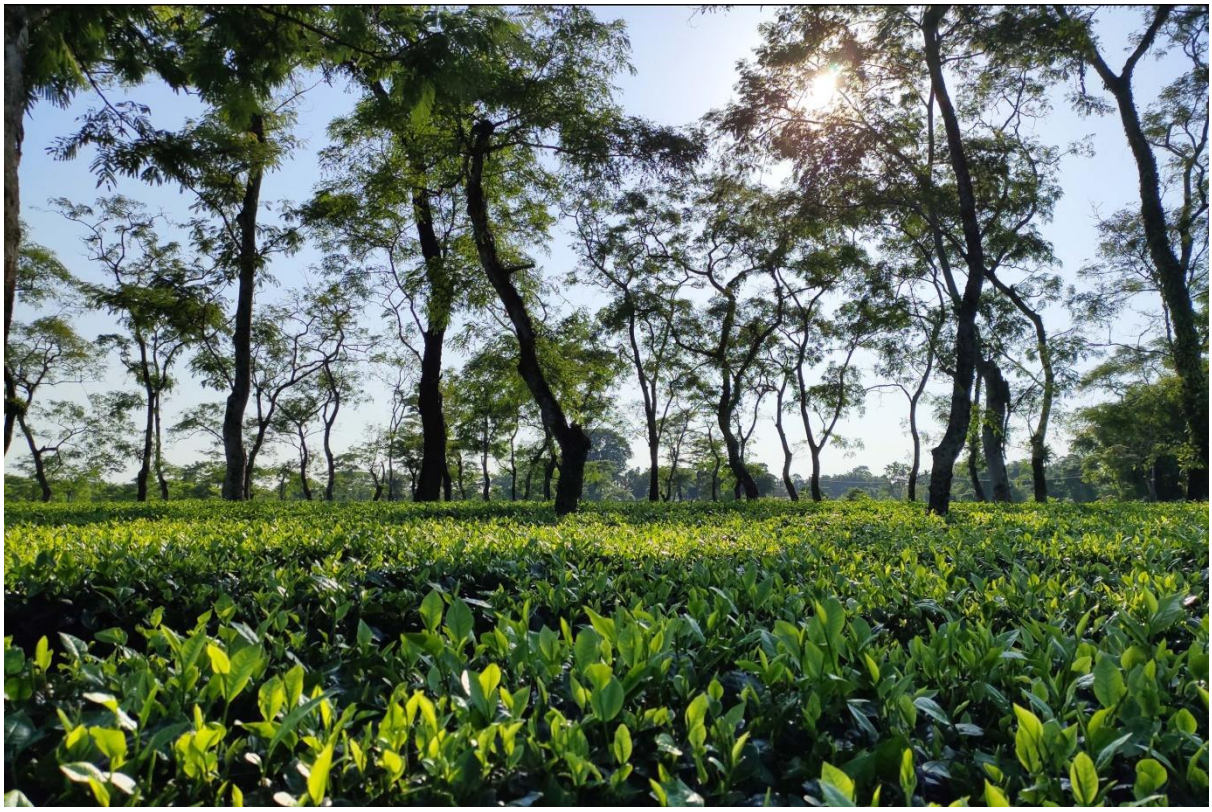
Location for PAD 1 – Cropland/Pasture land

PAD 2: The well pad is located in Baghjan village, Doomdooma Tehsil of Tinsukia district. The topography of the area is flat. Approach road to the site is already developed for the transport of the drilling rig, equipment and materials to the site. An earthen road passing through the village is connecting the approach road to the well pad. The habitat of this well pad is categorised as grassland. Presence of Dighaltarang and Baghjan settlements is observed in the vicinity of the well pad location.

PAD 3: The well pad is located in Dighaltarang Tea Estate, Doomdooma Tehsil of Tinsukia district. The topography of the area is flat. Approach road to the site is already developed for the transport of the drilling rig, equipment and materials to the site. It will pass through nearby tea estates. The habitat of this well pad is categorised as Tea Plantation. Presence of Dighaltarang settlements is observed in the vicinity of the well pad location.



Location for PAD 2 – Home Backyard



Location for PAD 3 – Tea Plantation

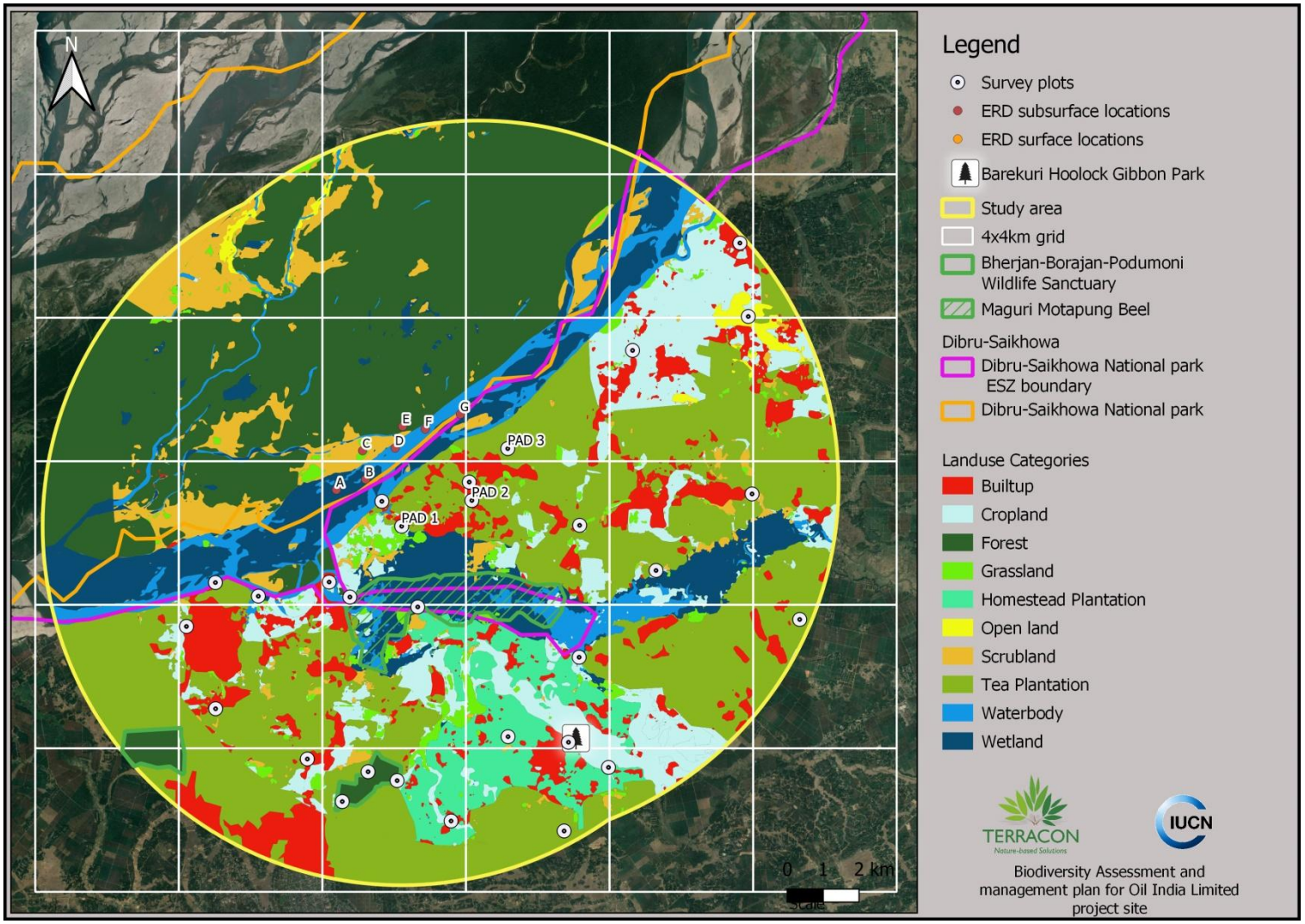


Figure 2: Landuse Map of Study Area with 4x4km grids

A landuse map was prepared to understand the distribution of various habitats. The study area comprises of different types of habitats such as Forest, Grassland, Tea Plantation, Wetland, Riverbank, Cropland, Dense Homestead Plantation, Pasture Land, Built up and Open land. These habitats show diversity in floral and faunal species. Baseline data was collected during the monsoon and winter season. For the convenience of the study, following habitats were clubbed together:

Habitat	Sub-habitat
Wetland/Waterbody	Wetland/Waterbody, Riverbank, River
Forest	Forest
Tea plantation	Tea plantation
Homestead plantation	Homestead plantation
Crop land	Cropland, Pastureland
Built up/open land	Settlements, Markets, EPS, Open land

The distribution of study plots across various habitats observed in the study area is as follows:

Habitat	Area (Sq.km.)	Proportion of Study Area (%)	Proportion of Survey Plots laid (%)
Wetland/Waterbody	58.73	16.11	27.27
Forest	98.32	26.98	12.12
Tea plantation	99.47	27.29	27.27
Homestead plantation	16.23	4.45	9.09
Crop land	38.58	10.58	15.15
Built up/open land	53.14	14.58	9.09

More number of survey plots were laid in wetland habitat, as it had various sub-habitats. Homestead plantation found to have many key species restricted to the habitat, scattered throughout the study area.

Ecological important areas – Important Bird Areas (IBA)

Dibru - Saikhowa Complex and Bherjan-Borajan-Podumoni Wildlife Sanctuary are the two, BirdLife International accredited Important Birding Sites (IBA).

Dibru - Saikhowa Complex comprises of Dibru-Saikhowa National Park, Poba Reserve Forest, Kobo chapori (river islands) proposed reserve forest, Amarpur chapori, Maguri and Motapung Beel, and the adjacent riverine tract of the Brahmaputra and Lohit rivers; out of which, only Dibru-Saikhowa National Park and Maguri Motapung Beel fall in the present study area.

Bherjan-Borajan-Podumoni Wildlife Sanctuary comprises of Bherjan (105 ha), Borajan (493 ha) and Podumoni (176 ha) as separate three pockets of lowland tropical forest, present in Tinsukia district, Assam. Bherjan and Podumoni regions fall in the present study area.

Table 2 IBAs in the study area

Site Name	PA Status	IBA Criteria	IBA site Code
Dibru - Saikhowa Complex[3]		A1, A2	IN378
Bherjan-Borajan-Podumoni Wildlife Sanctuary[4]	WLS	A1	IN371

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

Maguri Motapung Beel

This wetland is situated near Motapung village of Tinsukia district. It is a valuable natural capital for the region, providing critical habitat to numerous species, especially resident and migratory birds. It serves as a fisheries resource to local communities as well as a flood buffer and a water and sediment regime regulator. A small channel connects Maguri Beel with the Dibru River to the North; hence this wetland regime is a critical part of the Dibru-Saikhowa National Park (DSNP), an ecological corridor to Namdhapa National Park, and sustains the ecological integrity of the Indo-Burma Biodiversity Hotspot.



Maguri Motapung Beel

[3] *http://datazone.birdlife.org/site/factsheet/dibru--saikhowa-complex-iba-india*

[4] *http://datazone.birdlife.org/site/factsheet/bherjan-borajan-podumoni-wildlife-sanctuary-iba-india*

Dibru-Saikhowa National Park (DSNP)

The Dibru-Saikhowa NP proper covers 34,000 ha in the districts of Tinsukia and Dibrugarh in eastern Assam. It is 13 km north of Tinsukia town. It is also a Biosphere Reserve. Dibru-Saikhowa has the largest Salix swamp forest in north-eastern India. Tropical Moist Deciduous, Tropical Semi-evergreen, Evergreen Forests and grassland forms the main habitat type. The original vegetation of the Park was tropical rainforest, but a large part sank by a few meters during the earthquake in 1950, causing significant geomorphological changes. Due to regular flooding, the rainforest gradually gave way to deciduous forest and swamps[5]. The park is surrounded by the Brahmaputra River, Lohit river and Arunachal Hills in the north and Dibru river, Debang river, Dibru and Patkai hills in the south, making for verdant environments.

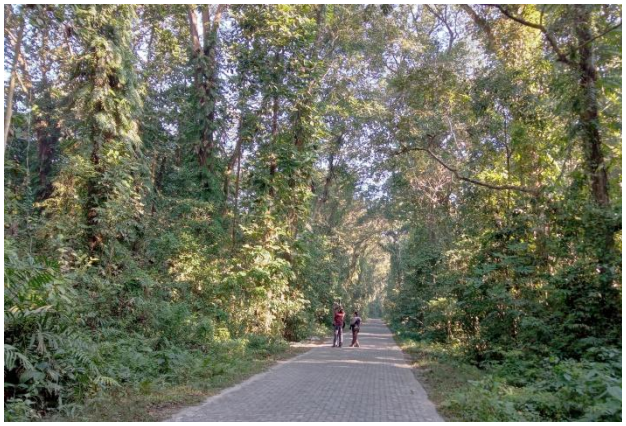


Dibru-Saikhowa National Park (DSNP)

Bherjan-Borajan-Podumoni Wildlife Sanctuary

Bherjan, Borajan, and Podumoni are three different forest regions disjunct and separated by tea gardens and human habitations. These are entirely on the flat plains of the Brahmputra Valley, so they lie in the Endemic Bird Area called Assam Plains by BirdLife International. The site lies in Biome-9 (Indo-Chinese Tropical Moist Forest) as classified by BirdLife International. It is a perfect habitat for primates and it nestles many rare birds. Bherjan is almost entirely covered with trees with closed canopy. Delakhat road passes through forest area. The Podumoni region is observed to have a broken canopy and it is surrounded by tea estates, village settlements and croplands.

[5] *Choudhury, A. U. (1998) Mammals, birds and reptiles of Dibru-Saikhowa wildlife sanctuary, Assam, India. Oryx 32(3) 192-200.*



Bherjan Forest



Podumoni Forest

2. Methodology

Ecological assessments - Flora and Fauna

Ecological assessment includes the compilation of baseline data, collected through literature review and field survey, about the biodiversity and ecosystems, of the study area. It involves off-site as well as on-site studies where data collection will be carried out. It comprises of three main sections – Background studies, primary data collection and preparation of a Biodiversity richness map of the study area.

Background Studies

In the preparatory phase of the assessment, desk studies were carried out to move forward to the baseline study. Secondary records were collected regarding the bio-geographical conditions of the study area, from various sources. This involves information such as the geographical location of the site, layout maps of the core, the land-use pattern of the study area (10 km radius), etc. Previous documentation of the biodiversity of the region, documents such as environmental impact assessment and monitoring reports were obtained from the ASBB and OIL. After a comprehensive study of the project site, the primary data collection was initiated.

Primary Data Collection

The primary data collection entails all the information on biodiversity at the sites and in the entire project area. It includes the baseline data collection as well as information obtained from the various stakeholders identified in the social interactions. Data on the flora and fauna in the area under 10 km radial distance of the PAD 1, PAD 2, and PAD 3 was collected on the field. Baseline data collection was carried out for two seasons. A stratified random sampling method was used for the selection of the study locations. Standard ecological sampling techniques were used for documenting the biodiversity; such as the quadrat method for flora and point count and line transect method for fauna.



Boat Survey in Maguri Motapung Beel

Table 3 Methods for Primary Data Collection

Methodology for biodiversity documentation		
Flora Survey	Trees	10m circular plot (List Count Method)
	Shrubs and Climbers	5m concentric circle (List Count Method)
	Herbs	1m x 1m quadrat
Fauna Survey	Avifauna	50m circular plot (Point Center Count) Aquatic: Total Count
	Herpetofauna	Intensive time constrained
	Mammals	Direct Sighting (Visual Encounter) Indirect sightings (droppings, scat, other tracts and signs)
	Fish	Fish Capture technique/Local fish market surveys
	Phyto and Zooplankton	Sampling and Fixation
	Other insects and Arachnids	Opportunistic sightings

Opportunistic sightings of all taxas were also documented for creating species richness of the study area. The different habitats were noted during the primary data collection.

For navigation and taking GPS readings, 'Samsung A51' device was used. For creating .kmz file of GPS points taken, android software titled 'GPS essentials' was used in 'Samsung A51' android device.

For making observations of biodiversity, for photo-documentation of flora and fauna, Canon 600D with 55-250mm Canon lens, Canon 80D with 150-600mm Tamron lens and Canon 700D with 100-400mm Tamron lens.

For identification of fauna various field guides were used (Inskipp, 2011) and citizen science portals (Butterflies of India, BirdLife International) were also referred for taking expert help. For latest scientific names of flora, website *https://www.theplantlist.org* was referred.

Besides the baseline data on terrestrial flora and fauna, the aquatic biodiversity was documented. The number of samples was decided based on the background studies of the study area. The samples were collected from various water-bodies within a 10 km distance. The samples were collected using standard ecological techniques using plankton net. These samples were preserved using standard methods and were analyzed in the laboratory to identify the presence of phytoplankton, zooplankton and their diversity. Analysis such as Simpson Diversity index was calculated. Terrestrial flora and fauna were analyzed using statistical tools of relative density and relative frequency.



Terrestrial Survey at PAD 1

Secondary information on the data such as the conservation and protection status (IUCN and Wildlife Protection Act Schedules), distribution status (whether indigenous or exotic, in case of flora and whether resident or migratory, in case of birds), ecological significance, etc. was also collected off-site. This will further help in assessing the impacts of the operations and formulating management actions.

Socio-ecological surveys are best known to reveal information (including traditional) about biodiversity hold by the local communities. Information on the presence of biodiversity management committees, use of biodiversity in day-to-day life, the dependence of local people on biodiversity, etc. can be obtained from these surveys. Although tentative baseline data was collected by field surveys, it is sometimes difficult to directly obtain data on taxa such as mammals and reptiles.

To obtain this data, socio-ecological surveys were conducted. These surveys include the knowledge of local communities for information on the biodiversity of the region, the use of biodiversity and their awareness about biodiversity. Community conservation initiatives, reports by Government bodies and other such information were documented.

Also, to devise alien invasive species population control methods, it is important to understand the extent of the population of alien invasive species found in the study area and the magnitude of nuisance caused by them to the local population.



Team photographing ground birds at Podumoni Forest

Species Richness Map

A species richness map depicts the survey habitats of a study along with the number of species of all taxa observed in those habitats. It allows a comparative overview of the biodiversity present in the study area. Key areas such as national parks, wildlife sanctuaries and such protected areas are also depicted in this map. Areas not legally protected but of ecological concern such as roosting sites, breeding sites, migratory pathways, important bird areas, Ramsar sites, etc. are also marked on the map. This integrated biodiversity richness map uses the data collected and analyzed during the primary data collection.

Species Richness is the number of species of trees, shrubs, herbs, butterflies, birds, amphibians, reptiles and mammals recorded at a sampling site. In the given study area, 6 habitats were surveyed for flora and fauna diversity. Number of species recorded in both the monsoon and winter season helped us determine the richness of the habitat.

3. Observations

The study area falls in North East Region biogeographic zone[6], which is characterized by Tropical Evergreen Forest, Tropical Semi Evergreen Forest and Seasonal swamp forests. The ERD surface and subsurface locations falls within the depositional plains of the River Brahmaputra and its tributaries. The study area comprises of different types of habitats such as Forest, Tea Plantation, Waterbody, Cropland, Homestead Plantation, Built up and Open land. These habitats show diversity in floral and faunal species. Tea Plantation is the dominant habitat of the study area followed by Forest, Waterbody, Built-up and Open land, Cropland, and Homestead Plantation.

Baseline data was collected during the monsoon and winter season. In the two seasons a total of 85 species of trees, 57 shrubs, 152 herbs and 47 Pteridophytes were recorded under flora; whereas 147 species of Birds, 112 species of Butterflies, 10 species of Mammals, 6 species of Herpetofauna and 19 species of Fishes were recorded under fauna.



Asian Openbills at Maguri Motapung Beel

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

Forest Habitat

It includes protected area of Dibru-Saikhowa National Park and Bherjan-Borajan-Podumoni Wildlife Sanctuary. Area of DNSP falling into the study area is 143.10 Sq.Km. along with Eco-sensitive Zone of 123 Sq. Km.; it has been conserved for its unique and pristine forest and its biodiversity. DSNP has river Dibru at its north and river and river Brahmaputra to its south, and is at the extreme east of State Assam, India. National park is situated in the flood plains of Brahmaputra has among the most vibrant wildness on earth and is also distinct for its pristine scenic beauty and harbors many extremely rare and endangered species of Wildlife.

Bherjan-Borajan-Podumoni Wildlife Sanctuary comprises of Bherjan, Borajan and Podumoni as separate three pockets of lowland tropical forest, present in Tinsukia district, Assam. Bherjan and Podumoni regions fall in the present study area. Area of Bherjan and Podumoni region was 1.21 Sq.Km. and 1.68 Sq.Km. respectively.



Bherjan Forest

Flora

Unique bio-geographic factors and huge water resource Brahmaputra has contributed a lot to the State unique biodiversity. State is very rich in its endemic plant diversity. Secondary data suggests more than 3000 species of flowering plants have been recorded in Assam which constitutes 25.12% of total floristic wealth of India. Apart from the angiosperms, state is rich in ferns, fern allies and orchid flora. State holds many species primitive angiosperms and Gymnosperms. Variety in huge fern species, especially the tree fern species are the special features in the understory here, making the forest most attractive and distinct from the rest of Indian forest.[7]

[7] *http://www.asbb.gov.in/*

Complexity in bio-geography has made forest so spectacular that it is often difficult to clearly identify and separate the forest types due to overlapping of forest species. According to the Champion & Seth's "Revised forest types of India", state Assam has 51 forest types/sub types. Further, for convenience, these forest types are broadly classified into 8 forest types. Out of these, District Dibrugarh and Tinsukia have the Tropical Wet Evergreen Forest.[8]

Bherjan region has tall trees with closed canopy. It has good number of *Dipterocarpus macrocarpus, Lagerstroemia parviflora* and *Terminalia myriocarpa*. Locals use *Mesua ferra, Dillenia indica* for eco-friendly dinner plate making. Along the periphery, *Alstonea scholaris*, *Tectona grandis, Dillenia indica* was planted. Fairly good diversity of Pteridophytes is observed in the forest. Dhekia lata (*Stenochlaena palustris),* Dragon scale fern *Pyrrosia piloselloides and* Bird Nest fern (*Aslplenuim nidus)* are the common pteridophytes of Bherjan.



Stenochlaena palustris



Dillenia indica

Amongst the tree species, Apple (*Dillenia indica), Dipterocarpus macrocarpus, Lagerstromoea* parviflora, Bishop Wood (*Bischofia javanica)*, Borpat *(Ailanthes altissima), East Indian Almond (Terminalia myriocarpa)* forms the major tree component.

Understorey of the forest was dominated with *Brassaiopsis sp.,* Hamiltonian Sterculia *(Sterculia hamiltoniana),* Nilgiri Actephila *(Actephila excels). Apart from the angiosperms,* King fern (*Angiopteris evecta)*, and Giant Cyathea (*Cyathea gigantean)* are the most prominent tree ferns species of the forest.

The vertical mid zone of forest showed presence of Climbing fern (*Lygodium flexuosus)* Bird Nest's fern (*Asplenium nidus*), Climbing Aroid (*Pothos scandens)* and Climbing Swamp fern *(Stenochlaena palustris)* as pioneers.

Settlements are observed in the vicinity of Podumoni region. Forest was disturbed and is in degrading state, canopy is broken and some of the trees were fallen. Bamboo, *Dillenia indica, Lagerstromoea sp*. are common here. Hollong tree (*Dipterocarpus marcrocarpus*) is dominant tree species. During the winter season, Hollong trees were in fluting stage, whereas new growths of bamboo shoots were commonly observed.

[8] *Govt. of Assam, India website*



Angiopteris evecta



Asplenium nidus



Hollong Tree with seeds

The forest type of Dibru-Saikhowa comprises of semi-evergreen forests, deciduous forests, littoral and swamp forests and patches of wet evergreen forests and prominent grasslands. The Park is renowned for natural regeneration of Salix trees.

The Indian Subcontinent possesses tropical tall grasslands which are strongly latitude dependent and climate driven. Grass community or formations *Phragmites, Saccharum, Imperata* are present across the alluvial soils of the entire north-western Gangetic plain to the eastern Brahmaputra plain descending along the Ganges-Brahmaputra-Meghna watersheds.

Grasslands cover the major area of area of national park. Three grass species (given below in table) are dominant here in sanctuary. These grass species been tall and densely packet, are been used by the large mammals such as Elephants.

Table 4 Grasses observed at Dibru-Saikhowa National Park

Sr. No.	Grass species	Common name	Origin
1	*Phragmites karka*	Tall Reed	Exotic
2	*Saccharum ravennae*	Ravenna grass	Native
3	*Imperata cylindrical*	Cogon grass	Native



Ravenna grass - *Saccharum ravennae & Imperata cylindrica* (DSNP)

In spite of being noxious weeds and unpalatable or low palatable to cattle's, both Ravenna Grass and Elephant grass are important species of landscape. Grasses being not favored by cattle's or other herbivores remain untouched and intact. Such unpalatable grasses, in turn, have been assumed to be ideal for proper avian breeding, feeding and roosting ground. Wild buffalos, Elephants, Feral horses and other herbivores depend on grasslands and birds mostly use it to refuge and ambush.

Fauna

A wide range of birds and butterflies were found in forest habitats. In total 61 birds, 67 butterflies, 5 mammals, and 1 Herpetofauna species was found in the forested habitat of the study areas.

Birds such as Chestnut tail Starling (*Sturnia malabarica*), Hair Crested Drongo (*Dicrurus hottentottus*), Red vented Bulbul (*Pycnonotus cafer*), White throated Bulbul (*Alophoixus flaveolus*), Great Myna (*Acridotheres grandis*), Oriental Pied Hornbill (*Anthracoceros albirostris*) and Lineated Barbet (*Psilopogon lineatus*) were observed in the forested areas frequently. Rare bird sightings include Rusty-bellied Shortwing (*Brachypteryx hyperythra*) & Lesser racket-tailed Drongo (*Dicrurus remifer*) in Bherjan region, Kalij Pheasant (*Lophura leucomelanos*) in Podumoni region and Lesser Fish-eagle (*Icthyophaga humilis*) in DSNP regions.

Migratory birds like Scarlet Minivet (*Pericrocotus flammeus*), Long-tailed Shrike (*Lanius schach*), Verditer Flycatcher (*Eumyias thalassinus*), Brown Shrike (*Lanius cristatus*), Large Hawk-cuckoo (*Hierococcyx sparverioides*) were observed using emergent layer; whereas Grey-bellied Tesia (*Tesia cyaniventer*), Lesser Shortwing (*Brachypteryx leucophris*), Large Niltava (*Niltava grandis*), Small Niltava (*Niltava macgrigoriae*) where observed in the dense under cover of the Bherjan forest. Single individuals of resident birds like Black-napped Monarch (*Hypothymis azurea*) and Little Spiderhunter (*Arachnothera longirostra*) were observed feeding on insects in the Podumoni region.



Great Myna



Lineated Barbet



Scarlet Minivet



Large Niltava

Dibru-Saikhowa complex is very rich in bird life. It is one of the sites in the northeast where highly endangered and elusive species have been observed. The tall wet grasslands of Dibru-Saikhowa are important for many threatened and non-threatened species. White-rumped Vulture (*Gyps bengalensis*), Himalayan Griffon (*Gyps himalayensis*), Griffon Vulture (*Gyps fulvus*) were spotted soaring in the skies of DSNP along with migratory flocks of Black Storks (*Ciconia nigra*). Common Greenshanks (*Tringa nebularia*) along with many other migratory birds were seen on the dried riverbed. Mating pairs of Oriental Pied Hornbill (*Anthracoceros albirostris*) and its nesting site was sighted in DSNP.

Assamese macaque (*Macaca assamensis*) and Northern Pig-tailed Macaque (*Macaca leonina*) were observed in the Bherjan wildlife Sanctuary. Rhesus Macaque (*Macaca mulatta*) was sighted in the Dibru Saikhowa National Park. Presence of Asian Elephant (*Elephas maximus*) was confirmed by the footmarks and dung. Pugmarks of Golden Jackal (*Canis aureus*) were also observed on the dried river bed in the DSNP.

In the study area, Western Hoolock Gibbons (*Hoolock hoolock*) has become extirpated in recent years from Podumoni and Bherjan region of Bherjan-Borajan-Podumoni Wildlife Sanctuary as per the locals,

forest guards and forest official, interviewed informally. But interestingly, there is occurrence of Hoolock Gibbons in village homestead plantations/woodlands.



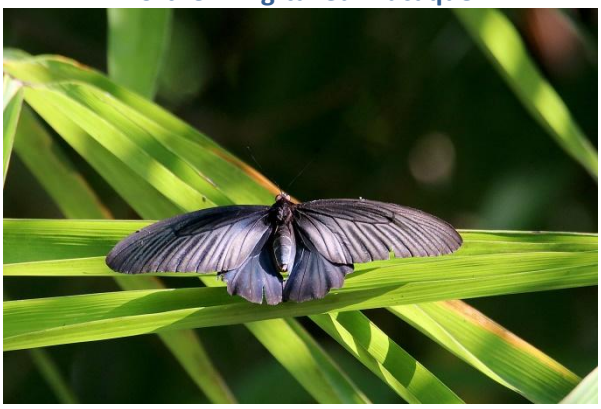
Assamese Macaque



Northern Pig-tailed Macaque



Wizard Butterfly



Lesser Batwing

A total of 67 species of butterflies were observed in the forest habitat. Wizards (*Rhinopalpa polynice*), Lesser Batwing (*Atrophaneura aidoneus*), Red Lacewing (*Cethosia biblis*), and Angled Red Forester (*Lethe chandica*) were some of the rare sightings from these protected areas to name a few. Large numbers of the butterflies were seen feeding on the flowers of *Sida acuta, Eupatorium odoratum, Leucas sp., Mikania micrantha, Sena tora, tectona grandis, and Leea sp.* And mud puddling in the wet patches of forests and riverbeds of Dibru River along the DNSP boundaries.



Himalayan Vulture



Griffon Vulture

Road kills of Reptile species, Checkered Keelback (*Fowlea piscator*) was observed on the Dhelakhat road passing through the Bherjan region.

Waterbody Habitat

Waterbodies and its riparian habitats are ecologically diverse and may occur in a range of general habitat types, including damp grasslands, wetlands, marshes, forests, jungles, canyons, and mountains. The primary characteristics of these areas are an active water source and the subsequent vegetation that relies on that water.

They are often home to a wide range of flora and fauna, easily meeting basic survival needs, including food in the form of fish and aquatic invertebrates, a shelter made from aquatic vegetation, and nesting sites within the aquatic vegetation that are sheltered from view.

Waterbody/wetland areas in the study area comprise of Maguri Motapung Beel, Dibru River with its riverbeds and riparian areas. From IBA of Dibru - Saikhowa Complex, Maguri Motapung Beel falls in the wetland habitat of the study area. Maguri Motapung Beel is one of the largest floodplain lakes in upper Brahmaputra basin. Maguri Motapung Beel is connected to Dibru River and is affected by frequent channel changes and sedimentation. A small channel connects the Beel with the Dibru River to the North; hence this wetland regime is a critical part of the Dibru-Saikhowa National Park (DSNP), an ecological corridor to Namdhapa National Park, and sustains the ecological integrity of the Indo-Burma Biodiversity Hotspot. The Beel is also very rich in aquatic life and this has led to development of many fishing camps near it. The nearby areas of the Beel displays grassland environment, creating a suitable shelter for grassland birds.



Maguri Motapung Beel

Flora

A variety of birds were seen nesting, feeding, and perching on the tall reeds of *Phragmites karka* and other low vegetation, such as *Nymphea sp.*, *Alternanthera sp., Persicaria sp.*, *Diplanzium esculantum*, *Colocasia esculentus, Doob grass (Cyanodon dactylon*) and other floating/ submerged plants.

It is observed that the alien invasive plant species Water Hyacinth (*Eicchornia crassipes)* has taken over the landscape. 28 Aquatic plant species are recorded in Beel, out of which 4 species are free floating, 7 species submerged in water, 6 species were anchored to the bottom of lake with their leaves and flowers floating on water surface and 11 species on the land with their stem growing inward to the water.



Nymphae spp.



Ravenna grass

Dibru-Saikhowa is said to have the largest Salix swamp forest in north-eastern India. Tropical Moist Deciduous, Tropical Semi-evergreen, Evergreen Forests and grassland forms the main habitat type observed at the national park. On the banks of Dibru River, dense vegetation of Tall Reeds *(Phragmites karka)*, Ravenna grass *(Saccharum ravennae)* and Tall reed *(Imperata cylindrica)* were observed. Apart from grasses, river bank has good number of *Dubanga grandiflora*, Red-Silk cotton *(Bombax ceiba),* Utenga *(Dillenia indica), Terminalia myriocarpa* species.

Fauna

A total of 41 species of birds were recorded in monsoon season and 79 species of birds were recorded during winter season; out of which 34 species of birds are migratory in the study area. Enormous flocks of migratory birds such as Ruddy Shelduck (*Tadorna ferruginea*), Bar-headed Goose (*Anser indicus*), Eurasian Wigeon (*Mareca penelope*), and Wagtails were observed in the Maguri Motapung Beel. Mallard ducks (*Anas platyrhynchos*) dominated the banks of Dibru River. Little Pratincole (*Glareola lactea*), Purple Swaphen (*Porphyrio porphyrio*), Glossy Ibis (*Plegadis falcinellus*), Asian Openbill (*Anastomus oscitans*), Lesser Whistling-duck (*Dendrocygna javanica*), Jacanas, Egrets etc. were most commonly sighted, amongst the resident birds. A mating pair of Oriental Pied hornbill (*Anthracoceros albirostris*) was also observed during the monsoon season along the boundaries of the Beel. Reeds, free floating plants, submerged plants, fish and insect diversity of the Beel provides a good breeding and feeding ground for resident as well as migratory birds.

Common Castor (*Ariadne merione*), Chocolate Albatross (*Appias lyncida*), Common Grass Yellow (*Eurema hecabe*), Common Mormon (*Papilio polytes*), Lemon Emigrant (*Catopsilia pomona*), Striped Tiger (*Danaus genutia*) and Pale Wanderer (Pareronia avatar) were some of the butterflies frequently sighted at the Beel.

During the boat survey at Dibru River, three adult Gangetic Dolphins (*Platanista gangetica*) were recorded along transect marked in Figure 2. Gangetic dolphin (*Platanista gangetica*) is one of the two species of river dolphins found in the India. The Ganges River system in Northern India and the Assam's Brahmaputra River system in of North Eastern India are the major habitats of this endangered river dolphin species. River dolphins also act as indicator of river health. Presence of elephant was confirmed by the dung and foot marks on the banks of Dibru River; dominated by the Elephant Grass.

Rhesus macaque (*Macaca mulatta*) and Golden Jackal (*Canis aureus*) were the other two mammals observed on the river banks.



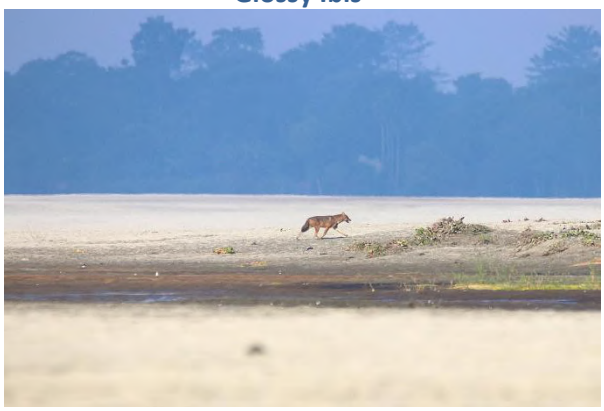
Bar-headed Geese



Glossy Ibis



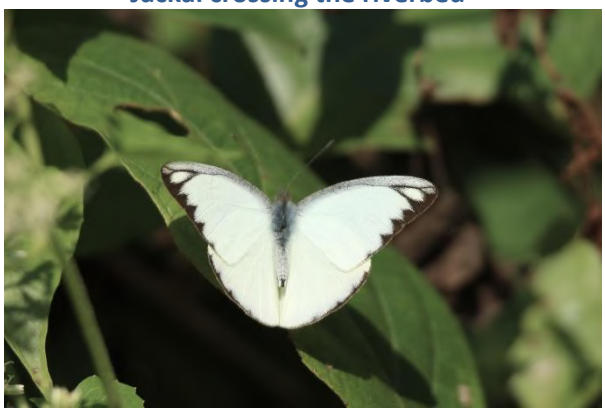
Rhesus Macaque



Jackal crossing the riverbed



Common Castor



Chocolate Albatross

A total of 35 species of butterflies in were sighted in two seasons in the wetland habitat of study area. Wizard (*Rhinopalpa polynice*), Commander (*Moduza procris*), Map Butterfly (*Cyrestis thyodamas*), Chocolate Tiger (*Parantica melaneus*), Yellow-crested Spangle (*Papilio elephenor*), Eastern Striped Albatross (*Appias olferna*) were sighted at DNSP.

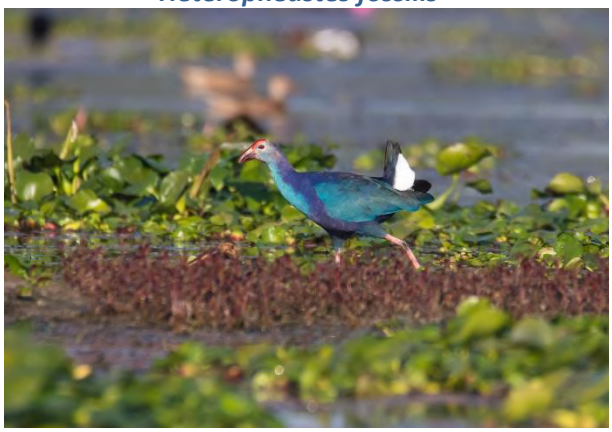
19 species of fish were reported from Maguri Motapung Beel and Dibru River. *Wallago attu* which is categorized as “Vulnerable” in IUCN Red List was also reported. Grass Carp (*Ctenopharyngodon Idella)* was the only exotic species found in fish-catch of the Beel.



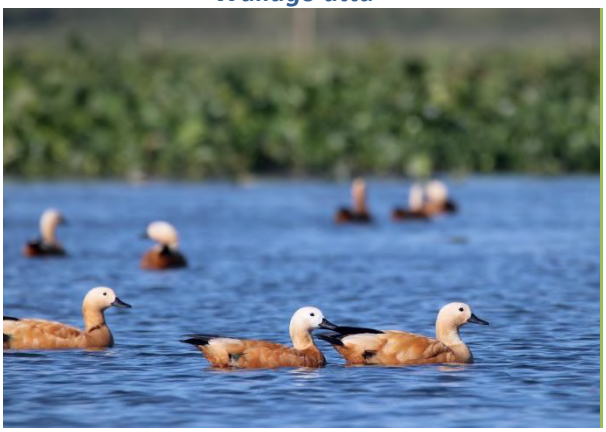
Heteropneustes fossilis



Wallago attu



Purple Swamphen



Ruddy Shelduck

Phytoplanktons and Zooplanktons

To assess phytoplankton and zooplankton diversity, water samples were collected from two different locations, preserved and analysed using standard methods.

Table 5 Station Details

Station Name	Area	Location
Station 1	Maguri Motapung Beel	N27.663280 E95.481476
Station 2	Dibru river	N27.625099 E95.399617

Phytoplanktons

A total of 16 species of Phytoplanktons with density of 188 no /ml at station 1 and 15 species with density of 174 no/ml at station 2 were recorded in the monsoon season. While in the winter season, a total of 18 species of Phytoplanktons with density of 159 no /ml at station 1 and 19 species of Phytoplanktons with density 181 no/ml at station 2 were recorded.

Group *Bacillariophyceae* were dominant in the Monsoon followed by group *Chloro-Phyceae* and *Cyanophyceae* while in winter season group *Chlorophyceae* were dominant followed by *Bacillariophyceae* and *Cyanophyceae.*

Zooplanktons

Station 1 represents 13 species of zooplankton with 118 no/ml density and Station 2 represents 12 species of zooplankton with 107 no/ml density at station 2 in the monsoon season, while in winter, station 1 represents 12 species of zooplankton with 179 no/ml density at station 1 and station 2 represents 14 species of zooplankton with 140 no/ml density.

Group *Rotifera* and *Cladocera* found dominant followed by *Copepoda* at both station in both seasons. The organisms like *Microcystis sp., Oscillatoria sp., Navicula sp., Euglena sp., Closterium sp., Ankistrodesmus sp., Anabaena sp., Nitzschia sp., Scenedesmus sp., among phytoplanktons* and zooplanktons forms like *Brachionus sp., Keratella sp., Mesocyclopes sp*. are the water pollution tolerant species.

Table 6 List of Phytoplankton genera observed in study area during Monsoon and Winter season survey

Sr. No.	Class	Species	Station 1	Station 2
1	Cyanophyceae	**Anabaena sp.*	√	√
2		*Merismopedia spp.*	√	√
3		**Oscillatoria sp.*	√	√
4		**Microcystis sp.*	√	√
5	Chlorophyceae	**Ankistrodesmus sp*	√	√
6		*Actinastrum sp*	√	√
7		**Closterium sp*	√	√
8		*Pedistrum sp*	√	√
9		**Scenedesmus*	√	√
10		*Cosmarium sp.*	√	-
11		*Eudorina sp*	√	√
12	Bacillariophyceae	*Asterionella sp.*	√	√
13		*Amphora sp.*	√	√
14		**Navicula sp.*	√	√
15		**Nitzschia sp.*	√	√
16		*Synedra sp.*	√	√
17		*Urosolenia sp.*	√	√
18	Euglenophyceae	**Euglna sp*	√	√
19	Chrysophyta	*Dinobryon sp*	√	√

*Note: * indicates pollution tolerant species*

Table 7 Zooplankton genera observed in study area during Monsoon and Winter season survey

Sr. No.	Genera	Species	Station 1	Station 2
1	Rotifera	*Brachionus sp	√	√
2		Plationus sp	√	√
3		*Keratella sp.	√	√
4		Trichocerca sp	√	√
5		Filinia sp.	√	-
6	Copepoda	*Mesocyclops sp	√	√
7		Thermocyclops sp.	√	√
8	Cladocerans	Diaphanosoma sp.	√	√
9		Scapholeberis sp.	√	√
10		Bosminopsis sp.	√	√
11		Moinodaphnia sp.	√	√
12		Insect larva	√	√
13		Mosquito larva	√	√

*Note: * indicates pollution tolerant species*

Tea Plantation Habitat

Large areas of district Tinsukia and Dibrugarh are under Tea plantation. Both commercial tea estates and home backyard tea plantation are seen thought the study area. Locally very few homestead tea gardens were present. Tea leaves harvested are exported internationally.



Tea Plantation Habitat

Flora

Fast growing trees were planted in the rows in tea gardens to provide shade. Tree species planted include, the Chinese Albizia *(Albizia chinensis), Albizia lenticularis,* Indian Poison Berry *(Melia azedarach)*. In home backyard Tea plantations, along with the above tree species, Areca nut (*Areca catechu*) was also recorded.



Camellia sinensis – Flower of Tea Plant

Fauna

Tea plantations are intensive monoculture of *Camellia sinensis* species with spares tree cover of Chinese Albizia (*Albizia chinensis*), Albizia lenticularis, Indian Poison Berry (*Melia azedarach*). Most of the tea estates in the study area are adjacent to Bherjan forest region, Maguri Motapung Beel and Dibru River, which forms an ecotone zone. This area does not show a gradient in floral community but displays an abrupt switch from one habitat type to another.

A total of 45 species of birds were observed in the two seasons in Tea plantation habitat. Insectivorous birds such as Common Myna (*Acridotheres tristis*), Jungle Myna (*Acridotheres fuscus*), Great Tit (*Parus major*), Red-vented Bulbul (*Pycnonotus cafer*), and Green bee-eaters (*Merops orientalis*) were a common sight in the tea gardens.



Asian Barred Owlet



Jungle Myna

Tea is perennial mono-culture crop. It provides a relatively steady microclimate and food supply for insect and mite pests; which in turn attracts insectivorous birds. Resident birds such as Asian barred

Owlet (*Glaucidium cuculoides*), Green Billed Malkova (*Phaenicophaeus tristis*) and migratory birds such as Small (*Niltava macgrigoriae*) and Large Niltava (*Niltava grandis*), Rusty-bellied shortwing (*Brachypteryx hyperythra*) etc. were also seen using the ecotone region. Tea estates adjacent to the wetlands, birds such as Cattle egret (*Bubulcus ibis*), Greater (*Phalacrocorax carbo*) & Little Cormorant (*Microcarbo niger*), Pond heron (*Ardeola grayii*), Osprey (*Pandion haliaetus*) were seen roosting on tall trees of Albizia.



Dark Evening Brown



Pond Heron



Roadkill of Checkered Keelback



Indian Roller

Mammals such as Hoary-bellied Squirrels (*Callosciurus pygerythrus)* were encountered during the surveys. Presence of Leopards, Golden Jackals (*Canis aureus*), and Hare were confirmed from the locals and workers.

A total of 47 species of butterflies were observed in the two seasons in Tea plantation habitat. Common Grass Yellow (*Eurema hecabe*), Grey Pansy (*Junonia atlites*), Common Gull (*Cepora nerissa*), Lemon Emigrant (*Catopsilia pomona*), Peacock Pansy (*Junonia almana*), Striped Tiger (*Danaus genutia*), Indian Wanderer (*Pareronia hippia*), Dark Evening Brown (*Melanitis phedima*), Pale Wanderer (*Pareronia avatar*), Common Five-ring (*Ypthima baldus*), Yeoman (*Cirrochroa tyche*), Plain Tiger (*Danaus chrysippus*), Three-spot Grass Yellow (*Eurema blanda*) were seen in the Tea Plantation Habitat.

Two roadkill of Checkered Keelbacks (*Fowlea piscator*) were observed on the Delakhat road, on the edges of tea garden and Bherjan Forest boundary.

The well PAD 3 is located in Dighaltarang Tea Estate of Doomdooma Tehsil. Birds such as Common Myna (*Acridotheres tristis*), Indian Roller (*Coracias benghalensis*), Red-vented Bulbul (*Pycnonotus cafer*) and butterflies such as Common Grass Yellow (*Eurema hecabe*), Lemon Emigrant (*Catopsilia*

pomona), and Striped Tiger (*Danaus genutia*) were the observed in this area along with *camellia sinensis* tea plantation.



Common Yeoman

Cropland Habitat

Cropland majorly comprised of paddy fields of rice. Crop land when not in cultivation is used as a pasture land.



Cropland Habitat

Flora

Few areas were under the agriculture. Paddy fields were observed in the study area. After harvesting the land remains fallow and is used as a pasture/grazing land for cattle, sheep and goat grazing.





Pastureland/ Cropland Habitat

Fauna

A variety of management practices such as land preparation, crop establishments, irrigation, nutrient and pest management, harvesting within the paddy field facilitate to create different habitats with different ecotones and suitable food for bird species.



Asian Pied Starling



Cattle Egret



Grass Yellow Butterfly



Striped Tiger

A total of 43 species of birds were observed in the two seasons in Cropland Habitat. The insects and worms in paddy field attract insectivorous birds such as Jungle Myna (*Acridotheres fuscus*), Cattle Egret (*Bubulcus ibis*), Common Myna (*Acridotheres tristis*), Asian Pied Starling (*Gracupica contra*), and Red-vented Bulbul (Pycnonotus cafer). These birds also act as a pest control for the paddy field. Migratory birds sighted during the survey are Barn swallows (*Hirundo rustica*), Common Stonechat (*Saxicola torquatus*), Rosy Pipit (*Anthus roseatus*). A single individual of Lesser Adjutant (*Leptoptilos javanicus*), which falls in the Near Threatened category of IUCN Red List of Threatened Species, was observed.

Hoary-bellied Squirrel (*Callosciurus pygerythrus*) was the mammal species sighted in the Cropland. A troop of Northern Pig-tailed Macaques (*Macaca leonina*) was sighted in the Bherjan forest area was observed feeding on rice crop uprooted from the adjacent field.

A total of 19 species of butterflies were observed in the two seasons in Cropland Habitat. Common Grass Yellow (*Eurema hecabe*) was the most dominant butterfly species in this habitat.

The well PAD 1 is located in Dighaltarang Tea Estate of Doomdooma Tehsil, falls into Cropland Habitat category. Birds such as Common Myna (*Acridotheres tristis*), Indian Roller (*Coracias benghalensis*), Red-vented Bulbul (*Pycnonotus cafer*) and butterflies such as Common Grass Yellow (*Eurema hecabe*), Lemon Emigrant (*Catopsilia pomona*), and Striped Tiger (*Danaus genutia*) were the observed in this area along with *camellia sinensis* tea plantation.

Homestead Plantation Habitat

Homestead plantation is naturally or planted trees on community or private land. Bamboo and timber woods are planted in this area.



Homestead Plantation

Flora

Naturally or planted trees on community or private land are cultivated in these areas. Tea plantations were prominently seen in the backyards of the houses as well as in the between patches of the dense homestead plantation.

Lofty emergent trees top of Jackfruit *(Artocarpus heterophyllus),* Burr-flower *(Neolamarkia cadamba)* and Hollong tree *(Dipterocarpus macrocarpus),* Devils tree *(Alstonea scholaris)* were being used as by Western Hoolock Gibbons (*Hoolock Hoolock*) for swinging through the forest and foraging for food. Some of these shy individuals also use Bamboo patches for crossing through the forests.



Areca nut Plantation in Homesteads



Gibbon feeding on Kadamba Tree

Some important tree species observed were *Mangifera indica, Melia azedarach, Aegle marmelos, Delonix regia, Ficus religiosa, Syzigium cumini, Gmelina arborea,* etc.

Fauna

Survey plots were laid in the Homestead plantations of Barekuri Village. A total of 14 species of birds were observed in the two seasons in homestead plantations. Birds like Blue-throated Barbet, Common Myna (*Acridotheres tristis*), Oriental Magpie Robin (*Copsychus saularis*) etc. were the common birds sighted during the survey in this area. Owl species such as Brown Boobook (*Ninox scutulata*) & Asian Barred Owlet (*Glaucidium cuculoides*) were observed roosting in the dense bamboo plantations.



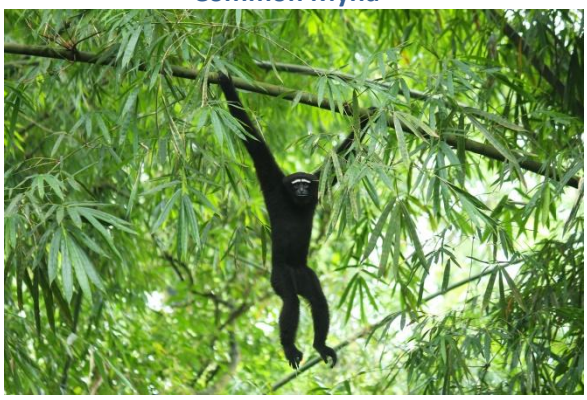
Blue-throated Barbet



Common Myna



Brown Boobook



Western Hoolock Gibbons

Western Hoolock Gibbons (*Hoolock Hoolock*) have inhabited in the homestead plantations of Na-Matapung Gaon, Borgaon, Denka Gaon, Dighal Sako Gaon, Baghjan Gaon, and Dhelakhat Gaon Villages. Western Hoolock Gibbon (*Hoolock Hoolock*) is the only ape species found in India; it is an extremely shy and strictly arboreal animal, is classified as Endangered by IUCN Red List. These families of Gibbons in this region have adapted themselves to coexist with humans. They were observed foraging and singing songs on Jackfruit, Burr-flower trees, Hollong tree, Devils trees. Hoary-bellied Squirrel (*Callosciurus pygerythrus*) was also a mammal species found in these homestead plantations.

A total of 37 species of butterflies were observed in the two seasons in homestead plantations. Great Orange-tip (*Hebomoia glaucippe*), Punchinello (*Zemeros flegyas*), Grey Pansy (*Junonia atlites*) and Red Helen (*Papilio helenus*) were some of the commonly sighted species in this area.

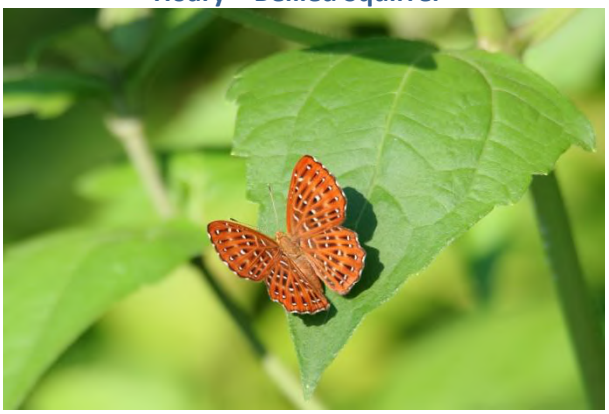
The well PAD 2 is located in Baghjan village of Doomdooma Tehsil; it has the habitat of homestead plantation/backyard. Birds such as Common Myna (*Acridotheres tristis*), Red-vented Bulbul (*Pycnonotus cafer*), and Rufous Treepie (*Dendrocitta vagabunda*) were the observed in this area.



Hoary – Bellied Squirrel



Grey Pansy



Punchinello



Red Helen

Built up and Openland Habitat

Roadside plantations, settlements and market areas encompassed built ups habitat. The survey plots were laid at Guijan Market, Plastic park industrial area, and Baghjan EPS. Compared to other plots low diversity was observed in these areas.



Built-Up Habitat

Flora

These Built up landscapes were modified by the addition of the horticulture varieties. Roadsides walkways were planted with avenue trees species. In villages, the front yards of the houses had small homestead tea gardens.

In total 9 species of trees, 4 species of Shrubs and 14 species Herbs were observed in the two seasons. Flora such as Burr-flower (*Mytragyna parviflora*), Pongam (*Pongamia pinnata*) and Devil's tree (*Alstonea scholaris*) were predominant in this habitat.

Fauna

Human dominated built-up areas showed less diversity compared to the other landuse. A total of 18 species of birds and 18 species of butterflies were observed in the two seasons in Built up and open land Habitats.

Birds such as Jungle Myna (*Acridotheres fuscus*), Eurasian Tree Sparrow (*Passer montanus*) and butterflies like Common Lascar (*Pantoporia hordonia*) and Lemon Emigrant (*Catopsilia pomona*) were predominant.



Built-Up Habitat – Market Area



Jungle Myna



Eurasian Tree Sparrow



Common Lascar

Socio Ecological Survey



Socio Ecological Survey at Barekuri Village

Informal discussions with the locals revealed that Dighal Haku Gaon is famously known as Barekuri Hoolock Gibbon Park, it has 22 families of Gibbons in homestead plantation/woodland of the village, as per the last counting done the villagers. Apart from Gibbons, Slow Loris and Indian Leopards were also rarely sighted around the village. Tea workers and officials also revealed that leopards have been sighted using the tea gardens as the corridors to move around in the study area along with Jackals and Hares.

Forest guards and officials confirmed that Western Hoolock Gibbons are no longer sighted in Podumoni and Bherjan regions of Bherjan-Borajan-Podumoni Wildlife Sanctuary but can be sighted in Dibru Saikhowa National Park. Other mammals mentioned by them in Podumoni and Bherjan regions were Common Palm Civet (*Paradoxurus hermaphroditus*), Small Indian Civet (*Viverricula indica*), Slow Loris (Nycticebus bengalensis), Capped Langur (Trachypithecus pileatus), and small wild cats; whereas Stump-tailed Macaque (*Macaca arctoides*), Wild Water Buffalo (Bubalus arnee), Jungle cat (Felis chaus), Clouded leopard (Neofelis nebulosa), Wild Boar (Sus scrofa), Sambar (Rusa unicolor), Indian crested porcupine (Hystrix indica), otters (Family: Mustelidae) are mammals seen in DSNP.

Locations of important Mammal species sighted in the study area

Western Hoolock Gibbons (*Hoolock hoolock*) were sighted in Homesteaded plantations whereas other macaques such as Northern Pig-tailed (*Macaca leonina*), Assamese (*Macaca assamensis*) and Rhesus (*Macaca mulatta*) were observed in the Forested habitats. Ganges River Dolphin (*Platanista gangetica*) was sighted swimming in Dibru River. Following table shows the locations of mammals sighted in the study area:

Table 8 Locations of important Mammal species sighted in the study area

Mammal Species	Latitude	Longitude
Assamese Macaque	27.5249	95.3662
Northern Pig-tailed Macaque	27.5298	95.3818
Golden Jackal	27.5771	95.3437
Indian Grey Mongoose	27.5801	95.3637
Indian Flying Fox	27.5783	95.3299
	27.5291	95.3791
	27.5618	95.4307
Asian Elephant	27.6453	95.4295
Ganges River Dolphin	27.6379	95.4232
	27.6267	95.4049
	27.6541	95.4385
Rhesus Macaque	27.6326	95.4112
Hoary-bellied Squirrel	27.5253	95.3672
	27.5322	95.3737
	27.5294	95.3814
	27.5387	95.4303
	27.5194	95.3966
Western Hoolock Gibbon	27.5678	95.4046
	27.5319	95.3882
	27.5361	95.4163
	27.5398	95.4303
	27.5388	95.4112
	27.5671	95.3921

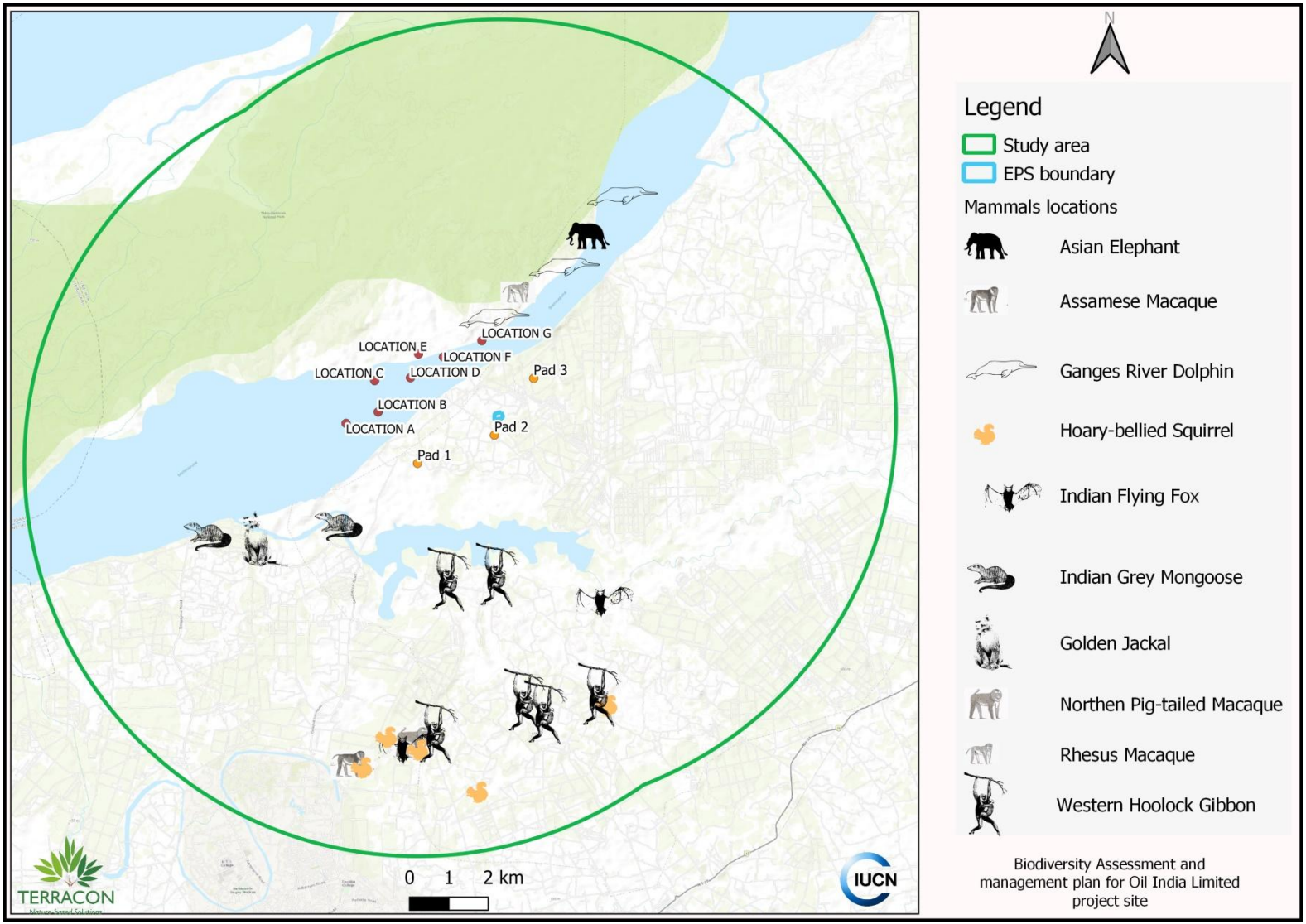


Figure 3 Locations of important Mammal species sighted in the study area

4. Species of Special Concern

Biodiversity data collected in the study area is analyzed qualitatively as well as quantitatively. Qualitative analysis involves referencing the IUCN (International Union for Conservation of Nature and Natural Resources) Red List for worldwide population and conservation status of the species and Indian Wildlife (Protection) Act (WPA), 1972 which provides legal protection level to different species in India. This information helps predict the sensitive species present in the study area to formulate an action plan for their protection and conservation within the study area.

The quantitative analysis involves the calculation of relative density and relative frequency for the recorded population of floral and faunal biodiversity. These values indicate species with the densest population, most frequently encountered species and areas with good biodiversity richness.

IUCN (International Union for Conservation of Nature and Natural Resources) Red List of Threatened Species

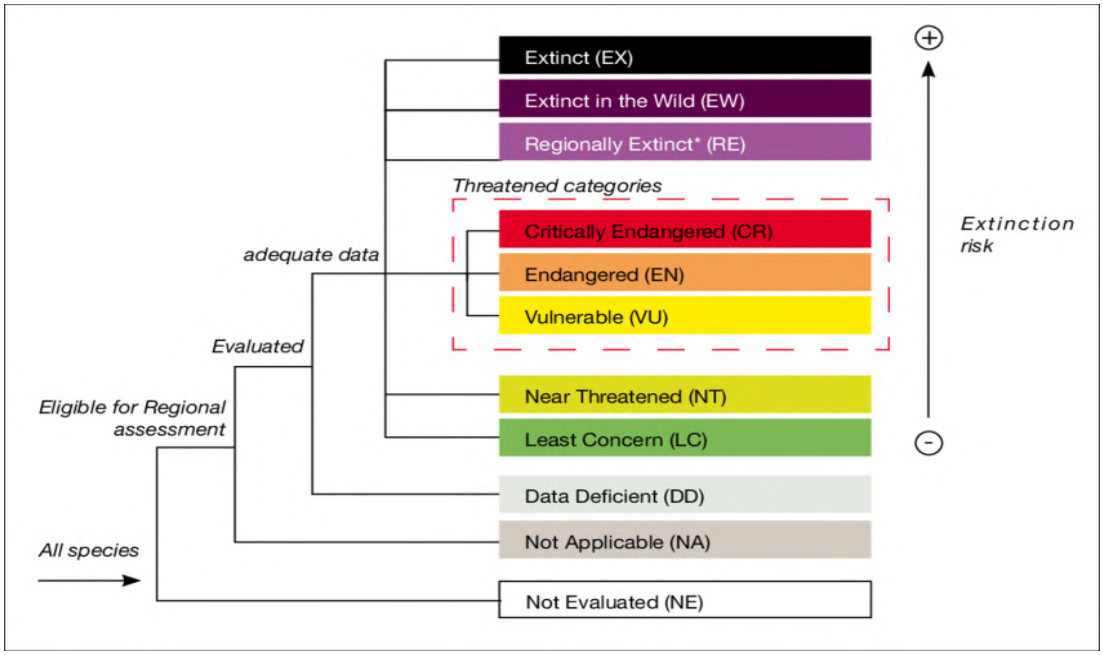


Figure 4 IUCN Red List Categories

The IUCN Red List is a critical indicator of the health of the world's biodiversity. Far more than a list of species and their status, it is a powerful tool to inform and catalyze action for biodiversity conservation and policy change, critical to protecting the natural resources we need to survive. It provides information about a range, population size, habitat and ecology, use and/or trade, threats, and conservation actions that will help inform necessary conservation decisions.

The IUCN Red List of Threatened Species is widely recognized as the most comprehensive global approach for evaluating the conservation status of plant and animal species. The Red List has been created by applying a rigorous set of scientific quantitative criteria. It is widely recognized as the most comprehensive and reliable data on the conservation status of a species. The red list categorizes all the species in 8 broad categories with varying degrees of conservation importance. These categories are prepared based on certain criteria. The most critical categories are the 'threatened categories' consisting of Vulnerable, Endangered and Critically Endangered Species; While, 'Near Threatened' category denotes likeliness of a species to fall in the threatened categories due to the decline in the population.

Fauna

White-rumped Vulture (*Gyps bengalensis*) was sighted soaring in the DNSP, which falls under Critically Endangered category of IUCN Red List. Lesser Adjutant (*Leptoptilos javanicus*), a large solitary scavenging bird was observed in the croplands and in Maguri Motapung Beel along with Common Pochard (*Aythya ferina*), Swamp Francolin (*Francolinus gularis*), three of which fall in the Vulnerable category of IUCN Red List.

Western Hoolock Gibbons (*Hoolock hoolock*), the only ape species found in India, were sighted swinging along high canopies of Barekuri Village, Na-Matapung Gaon, Borgaon, Denka Gaon, Dighal Sako Gaon, Baghjan Gaon, and Dhelakhat Gaon Villages Assam. Secondary data suggests presence of Western Hoolock Gibbons (*Hoolock hoolock*) in the DNSP regions; however, no sightings were occurred in the study period. Asian Elephant (*Elephas maximus*) footprints were observed on the riverbeds' regions of DNSP whereas Ganges River Dolphin (*Platanista gangetica*) was seen moving across Dibru River, on the edges of DNSP. All of these mammals fall in the Endangered category of IUCN Red List.

Wallago attu, is a widely consumed fish in the study area, falls under Vulnerable category of IUCN Red List. During Fish market surveys, this fish found in the fish catch, captured from Maguri Motapung Beel as well as from Dibru River by the fishermen.

As the Table 9 suggests, 7 birds and one mammal species, falling in the Near Threatened category of IUCN Red List were also observed in the study area.

Table 9 Fauna species under IUCN Red List

Sr. No.	Species Name	Scientific name	IUCN status
Birds			
1	Lesser Adjutant	*Leptoptilos javanicus*	VU
2	Red-breasted Parakeet	*Psittacula alexandri*	NT
3	Rusty-bellied Shortwing	*Brachypteryx hyperythra*	NT
4	Common Pochard	*Aythya ferina*	VU
5	Swamp Francolin	*Francolinus gularis*	VU
6	Oriental Darter	*Anhinga melanogaster*	NT
7	Ferruginous Duck	*Aythya nyroca*	NT
8	Lesser Fish-eagle	*Icthyophaga humilis*	NT
9	Himalayan Griffon	*Gyps himalayensis*	NT
10	White-rumped Vulture	*Gyps bengalensis*	CR
11	Black-tailed Godwit	*Limosa limosa*	NT
Mammals			
1	Western Hoolock Gibbon	*Hoolock hoolock*	EN
2	Assamese Macaque	*Macaca assamensis*	NT
3	Northern Pig-tailed Macaque	*Macaca leonina*	VU
4	Asian Elephant	*Elephas maximus*	EN
5	Ganges River Dolphin	*Platanista gangetica gangetica*	EN
Fishes			
1	-	*Wallago attu*	VU

Flora

No IUCN Red Listed floral Species were observed during the survey conducted.

Wildlife (Protection) Act, 1972 Schedules

Indian Wildlife (Protection) Act, 1972 (here onwards mentioned as WPA) categorizes the wildlife of India in six different schedules, the first five of which are for animals and the sixth for plants. Organisms listed in these schedules are accorded varying degrees of protection, with animals falling under Schedule I and Schedule II being accorded maximum protection. Table 10 explains the degree of protection for each schedule.

Table 10 Wildlife (Protection) Act, 1972 Schedules

Schedules	Description
Schedule I and Schedule II	Provide absolute protection – offences under these are charged with the highest penalties
Schedule III and IV	Provide protection, penalties milder than that of Schedule I and Schedule II
Schedule V	'Vermin' animals as per the act
Schedule VI	Plants that are prohibited from cultivation and planting

Thus, schedule I and II are most essential from a conservation point of view. It is important to know whether any species under these schedules are present in an area, their population status and threats to implement conservation measures.

Fauna

Lesser Fish-eagle (*Icthyophaga humilis*) and White-rumped Vulture (*Gyps bengalensis*) were observed near the forested regions of DSNP. Kalij Pheasant (*Lophura leucomelanos*) was observed in the thickets of Podumoni region of Bherjan-Bhorajan-Podumoni wildlife sanctuary. Osprey (*Pandion haliaetus*) was observed perched on a tree near the riparian areas of Maguri Motapung Beel. These birds along with mammals such as Western Hoolock Gibbon (*Hoolock hoolock*), Asian Elephant (*Elephas maximus*), and Ganges River Dolphin (*Platanista gangetica*) are protected under schedule I of the wildlife (protection) Act, 1972.

Four mammal species which are Rhesus Macaque (*Macaca mulatta*), Assamese Macaque (*Macaca assamensis*), Northern Pig-tailed Macaque (*Macaca leonina*), Golden Jackal *(Canis aureus*) and Indian Grey Mongoose (*Urva edwardsii)* are found to be protected under schedule II of the WPA.

In terms of butterfly species documented during survey, 4 species were found to be protected under schedule I of the WPA and 19 under schedule II of the WPA. One reptile species 'Checkered Keelback' (*Fowlea piscator*) was found to be placed in schedule II of the WPA.

Table 11 Fauna species under WPA Schedule

Sr. No.	Species Name	WPA schedule
Birds		
1	Osprey	I
2	Kalij Pheasant	I
3	Lesser Fish-eagle	I
4	White-rumped Vulture	I
Mammals		
1	Western Hoolock Gibbon	I
2	Rhesus Macaque	II
3	Assamese Macaque	II
4	Northern Pig-tailed Macaque	II
5	Golden Jackal	II

6	Indian Grey Mongoose	II
7	Asian Elephant	I
8	Ganges River Dolphin	I
Butterflies		
1	Eastern Striped Albatross	II
2	Chocolate Albatross	II
3	Common Pierrot	I
4	Danaid Eggfly	I
5	Grey Count	II
6	Common Gull	II
7	Common Duffer	I
8	Great evening brown	II
9	Metallic Cerulean	II
10	Orchid Tit	I
11	Blackvein Sergeant	II
12	Common Gem	II
13	Sylhet Oakblue	II
14	Tawny Rajah	II
15	Pale Wanderer	II
16	Clear Sailer	II
17	Double-branded Bushbrown	II
18	Wizard	II
19	Yellow-crested Spangle	II
20	Tamil Oakblue	II
21	Chinese Bushbrown	II
22	Pale Four-Lineblue	II
23	Lesser Gull	II
Reptiles		
1	Checkered Keelback	II

Flora

No floral species falling in schedule of WPA 1972 was observed during the survey conducted.

Invasive Species

The species documented during the study was screened through the IUCN Global Invasive Species Database for documenting the invasive species. *Trapa natans* and *Eicchornia crassipes*, Ceratophyllum demersum and *Hydrilla verticillata, Ipomoea aquatic* are the species exclusively dominating the waterscapes. Out of which *Ceratophyllum demersum* and *Hydrilla verticillata* are water submerged species, and *Trapa natans* and *Eicchornia crassipes* are water surface floating species. Ipomoea aquatic is marginal species, growing along the periphery of lake. *Imperata cylindrica* is found around the wetland habitat.

Ageratum conyzoides, Alternanthera sessilis, Eupatorium odoratum, Mikania micrantha, Senna tora are the terrestrial plant species and were recorded in all habitats in the study area.

Table 12 IUCN Global Invasive Species (GISD) species in study area

Sr. No.	*Scientific Name*	Habit	English Common Name
1	*Ageratum conyzoids*	Herbs	Billy Goat Weed
2	*Alternanthera sessilis*	Herbs	Dwarf Copperleaf
3	*Ceratophyllum demersum*	Herbs	Coon Tail
4	*Eichhornia crassipes*	Herbs	Common Water Hyacinth
5	*Eupatorium odoratum*	Shrubs	Siam Weed
6	*Hydrilla verticillata*	Herbs	Hydrilla
7	*Imperata cylindrica*	Herbs	Cogon Grass
8	*Ipomoea aquatic*	Herbs	Water Spinach
9	*Lantana camera*	Shrubs	West Indian Lantana
10	*Mikania micrantha*	Herbs	-
11	*Mimosa pudica*	Herbs	Touch Me Not
12	*Potamogeton crispus*	Herbs	Curled Pondweed
13	*Solanum torvum*	Shrubs	Turkey Berry
14	*Solanum viarum*	Shrubs	Tropical Soda Apple
15	*Trapa natans*	Herbs	Water Chestnut
16	*Ipomea carnea*	Shrubs	Bush Morning Glory
17	*Senna tora*	Herbs	Sickle Pod

5. Species Richness Map

The species richness was mapped according to their presence of in the habitats

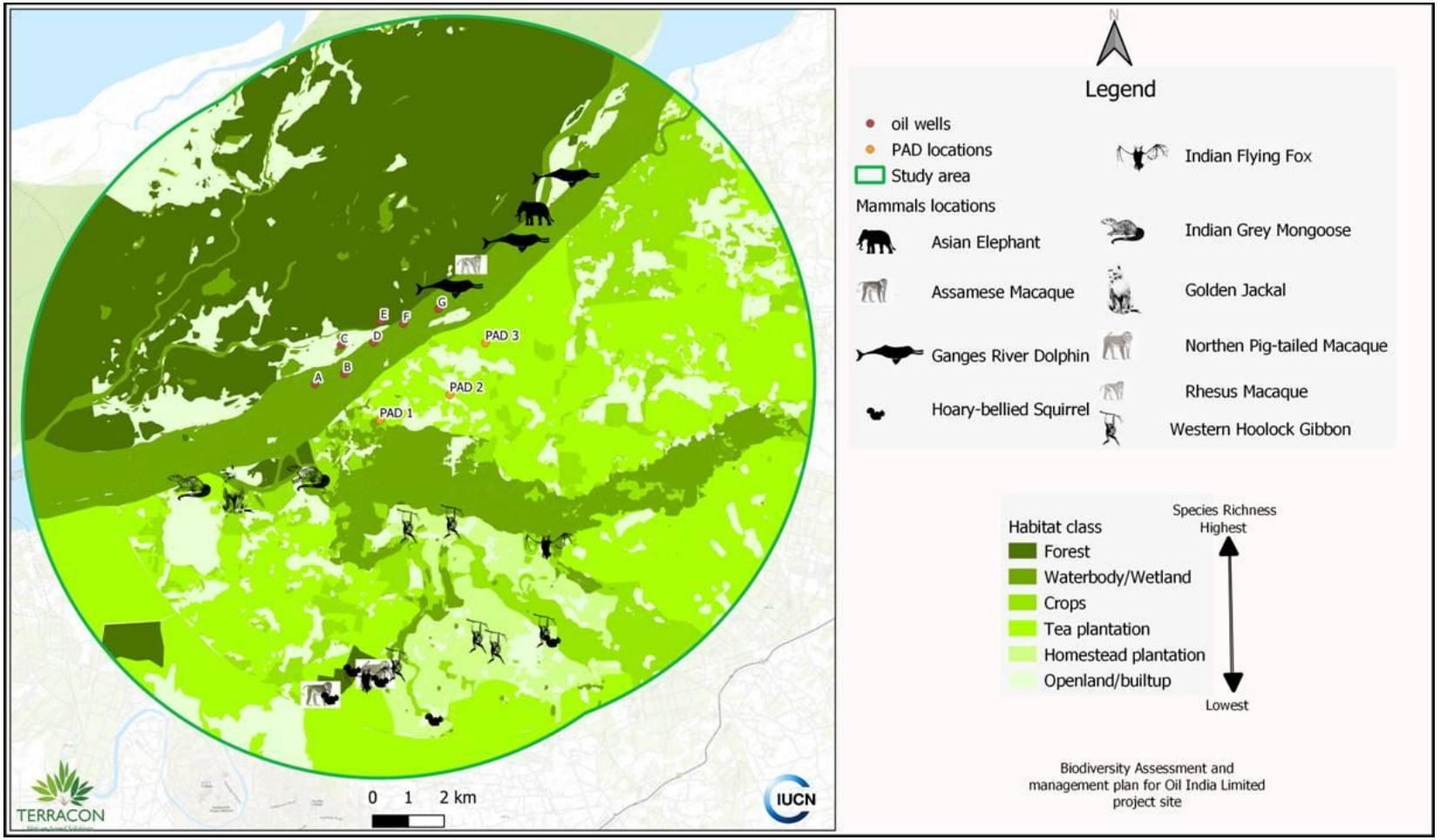


Figure 5: Species richness map

6. Analysis

To gain a perspective on the population trend of various species present in the study area, relative frequency and relative density i.e. frequency and density of each species for frequencies and densities of all the species of taxa found in the study area, are considered. These values give us the species of fauna and flora that is encountered most commonly (relative frequency value) and in most numbers (relative density value).

The floral diversity of the study area shows a wide spectrum, from species of scrubland forests, dry deciduous forests to species of riparian habitats. The floral diversity is bound to change as per seasonal changes.

The present study was carried out in August and December, representing monsoon and winter vegetation and related fauna respectively. Analysis of recorded population and diversity in the study area is discussed in this section.

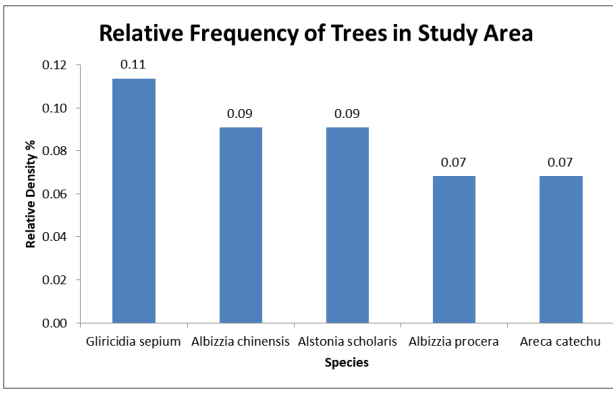
The forest habitat shows the highest species richness having an overall good diversity compared to others. It is followed by waterbodies which is a congregation point of many migratory and resident birds like Ruddy Shelduck (*Tadorna ferruginea*), Glossy Ibis (*Plegadis falcinellus*), Purple Swamphen (*Porphyrio porphyrio*), Mallard (*Anas platyrhynchos*), Eurasian Wigeon (*Mareca penelope*), Wagtails, Egrets, Jacanas etc. Human dominated Built-up areas show the least species richness. Pad 1, 2 and 3 lies in the Cropland, homestead plantation and tea plantation respectively and shows medium to low species richness.

Flora – Season 1 (Monsoon)

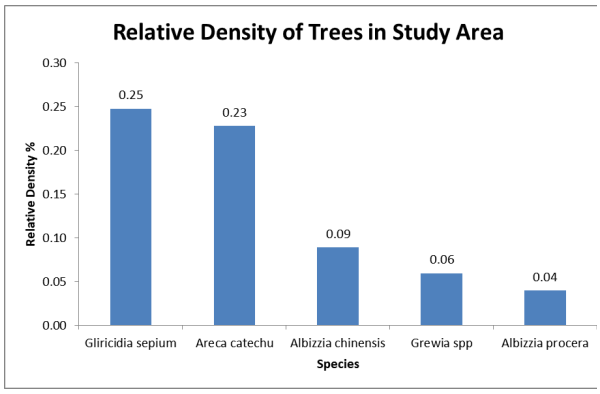
Trees

The quantitative analysis involves calculation of relative density, relative for the recorded population of floral and faunal biodiversity. These values indicate species with densest population, most frequently encountered species and areas with good biodiversity.

For primary data collection, circular plot of 10m radius was laid for trees. Considering the same center, another circle of 5m radius was taken for the shrubs. On the periphery to the shrub circle, total four-square plots of 1X1 sq. were placed radially, for herbs.



Relative Frequency of trees in study area



Relative Density of trees in the study area

Relative frequency of trees in study area

Alstonia Scholari was observed in all plots. Albizzia chinensis is common tree *species in tea gardens. Areca catechu with good density is restricted to the homestead tea gardens.* Good density of Gliricidia

sepium is only observed near Pad II and Barekuri Gibbon Park area. In study area, forest plots being few, wild trees are not showing dominance in graph.

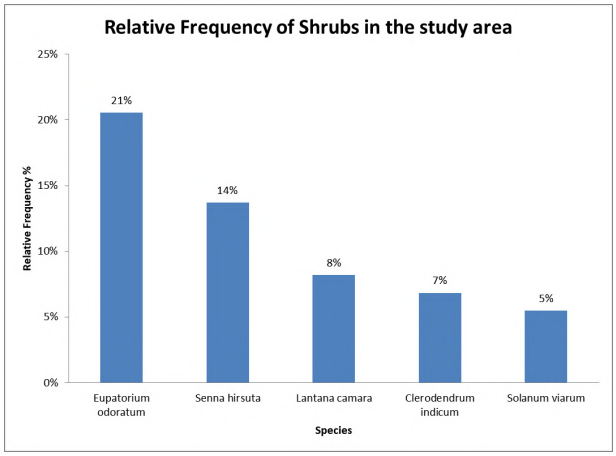
Relative density of trees in the study area

With respect to the data analysed, spreads to trees species seems to be even. *Albizzia chinensis* is common trees in the study area planted in the tea estates. *Alstonia scholaris, Albizzia procera* and *Gliricidia sepium* are dominant in landscape. Areca catechu is reported from Homestead tea gardens.

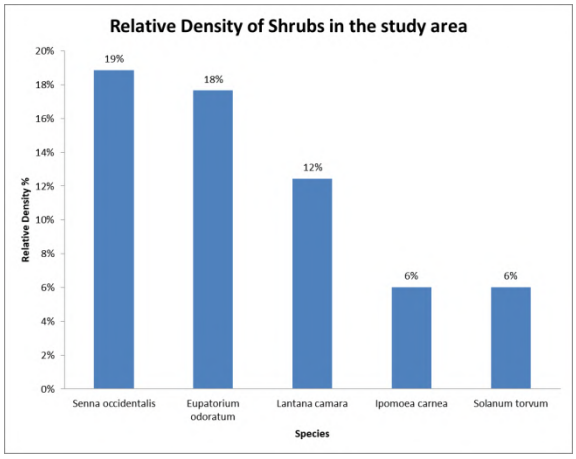
Shrubs

Relative frequency of Shrubs in study area

Eupatorium and *Senna hirstua* is widely spread in the landscape. *Lantana camara, Senna occidentalis* and *Solanum viarum* are common species in forest landscape. Shrub community is evenly distributed.



Relative Frequency of Shrubs in study area



Relative Density of Shrubs in the study area

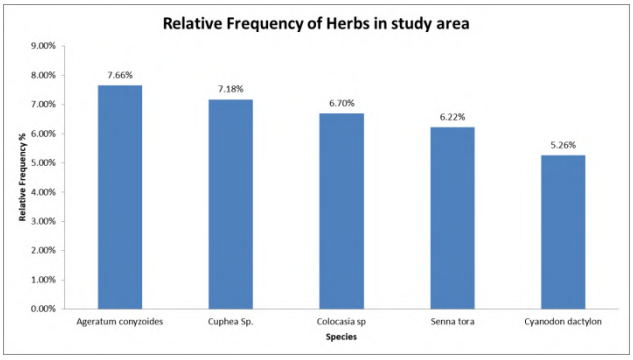
Relative density of Shrubs in the study area

Eupatorium odoratum, Lantana camara and *Senna occidentalis* all three alien invasive species has invaded the study area. *Ipomoea carnea* is dominant in wetland habitat.

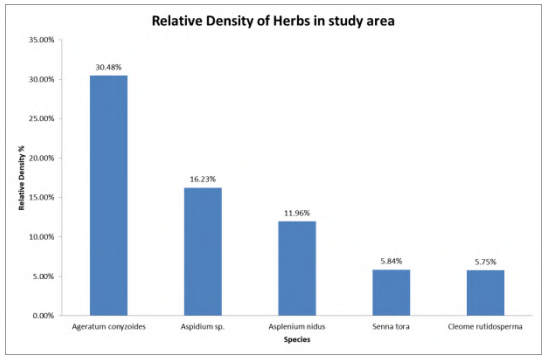
Herbs

Relative frequency of Herbs in study area

Ageratum conyzoides shows its dominance in all the landscapes. *Aspidium sp.* and *Asplenium nidus* are dominant in forest landscapes whereas, *Senna tora* and *Cleome rutidosperma* forms the dominant around waterbodies. Moreover, the species dominance seems to be even in the respective landscape.



Relative Frequency of Herbs in study area



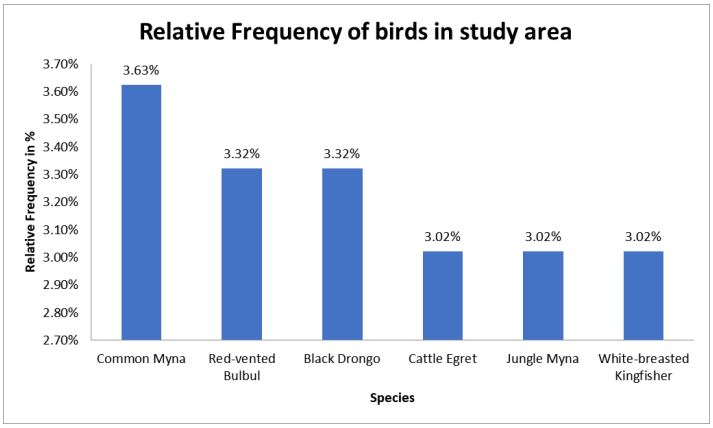
Relative Density of Herbs in the study area

Relative density of Herbs in the study area

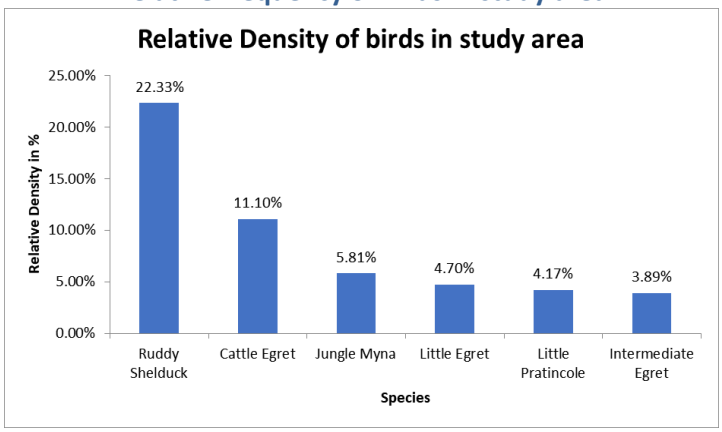
With respect to the data analysed, the herbs community seems to be distributed evenly, through the landscape in their respective habitat.

Fauna – Season 1(Monsoon)

Birds



Relative frequency of Birds in study area



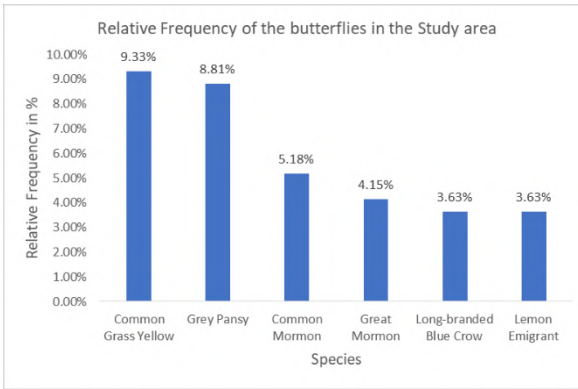
Relative density of Birds in the study area

In Monsoon Season, omnivores and insectivores' birds like Common myna (*Acridotheres tristis*), Cattle Egret (*Bubulcus ibis*), Red Vented Bulbul (*Pycnonotus cafer*), Rufous Treepie (*Dendrocitta vagabunda*), Jungle myna (*Acridotheres fuscus*) were common seen throughout the study area. This is be due to ground-foraging habits of most of the above-mentioned bird and greater availability of insects and files during the monsoon season in the tea plantation, croplands and wetlands. Huge flocks of Barn swallow (*Hirundo rustica*) and Jungle myna (*Acridotheres fuscus*) were found in the wetlands and agricultural areas hence showing the high density.

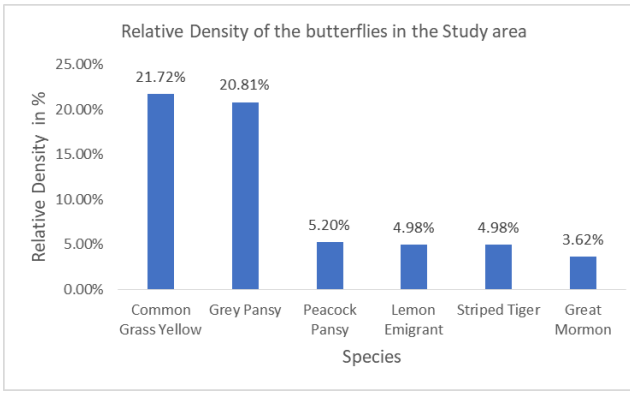
Butterflies

Common Grass yellow (*Eurema hecabe*) and Grey Pansy (*Junonia atlites*) were found to have the highest frequency and highest density due to availability of large source of both nectar and food plants, in tea plantation and forested areas. Swallowtails such as Great Mormon (*Papilio memnon*)

and Common Mormon (*Papilio polytes*) are also attracted to the flowering trees throughout the study area. The adults usually fly rapidly at tree-top height, except when they come down to feed at flowering bushes or to look for oviposition sites. *Citrus maxima* are a host plant for these two *Papilio* species, was found throughout the study area. Availability of wet patches for mud puddling along with abundant herbs added to the high species number.



Relative frequency of Butterflies in study area



Relative density of Butterflies in the study area

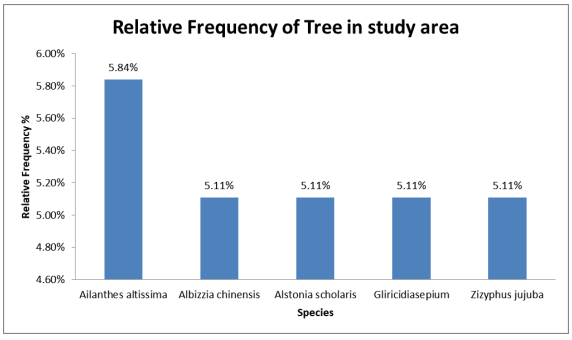
Flora – Season 2 (Winter)

Trees

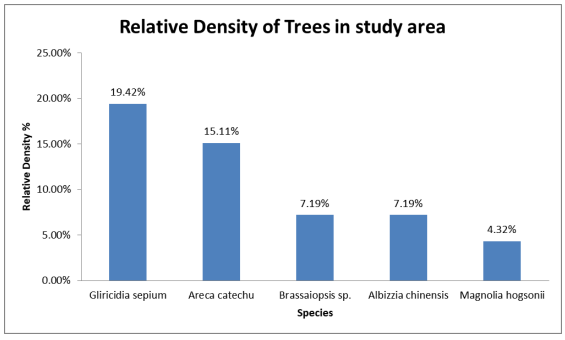
Relative frequency of trees in study area

Distribution of tree species is even throught the landscape. *Albizzia chinensis* is common trees planted in the tea estates.

Alstonia scholaris, Albizzia procera, Ailanthes altissima and *Gliricidia sepium* are not dominant in landscape but individuals are reported at many places showing their presence in most of the area. *Areca catechu*s are reported from Homestead tea gardens.



Relative Frequency of trees in study area



Relative Density of trees in the study area

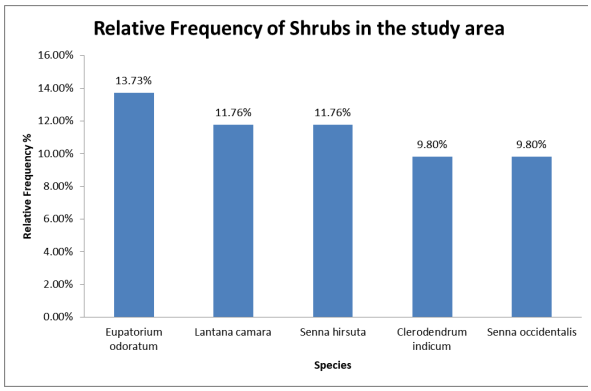
Relative density of trees in the study area

Tea gardens occupies the majority of the region in the study area. *Albizzia chinensis* is common tree species in tea gardens. Eventhough the tea landscape is vast, density of Albizzia chinenis is low in the data collected. The reason for this can be given as the large spacing between two individuals planted of the tree in the tea plantation. *Areca catechu* with good density is restricted to the homestead tea gardens. Good density of *Gliricidia sepium* is only observed near Pad II and Barekuri Gibbon Park area. In study area, forest area being few, wild trees are not showing dominance in graph even though they are forming good dense community.

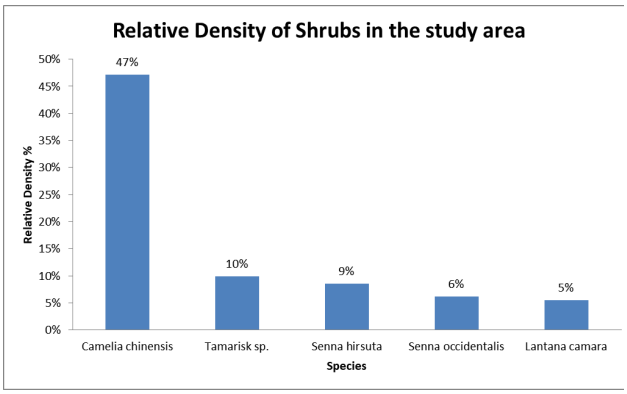
Shrubs

Relative frequency of Shrubs in study area

Shrub community is showing even distribution across the study area. *Eupatorium odoratum, Lantana camara, Senna hirsuta ans Senna occidentalis* are frequently distributed over the landscape. *Clerodendrum indicum* was mostly observed along the agriculture and forest.



Relative Frequency of Shrubs in study area



Relative Density of Shrubs in the study area

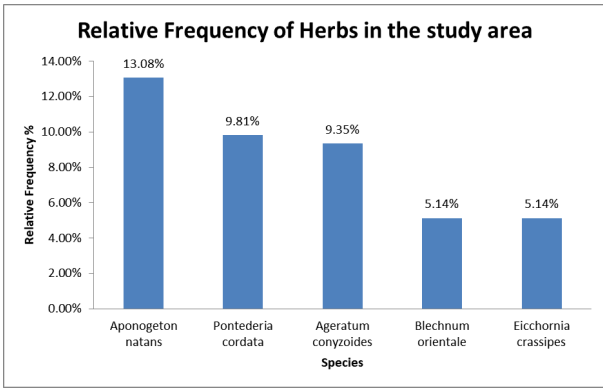
Relative density of Shrubs in the study area

Tea plant *(Camelia sinensis)* is observed in large quantities due to Tea plantation. Other species *Senna hirsuta, Senna occidentalis* and *Lantana camara* are showing even dominance in all landscapes whereas, *Tamrisk* occupies the periphery of all water bodies.

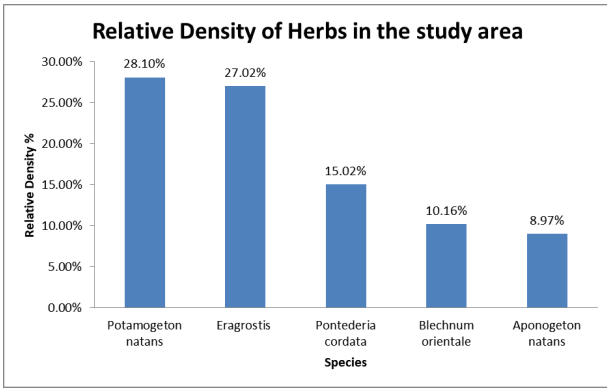
Herbs

Relative frequency of Herbs in study area

Ageratum conyzoides were recorded all habitats. Waterloving species like, *Pontederia cordata*, *Aponogeton natans* were observed where ever the water was accumulated in small pools. Other herbs community is evenly distributed in the study area.



Relative Frequency of Herbs in study area



Relative Density of Herbs in study area

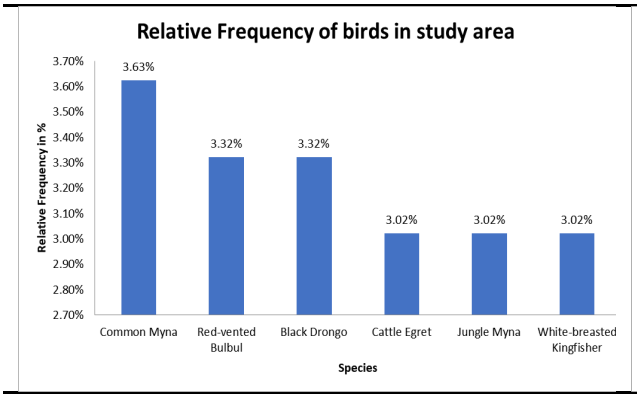
Relative density of Herbs in study area

Water loving species *Potamogeton natans* and *Pontederia cordata* are found in the agriculture plots where water was accumulated, and around the Maguri-Motapung beels (Wetland). Other herb community showed the even dominance in all habitats.

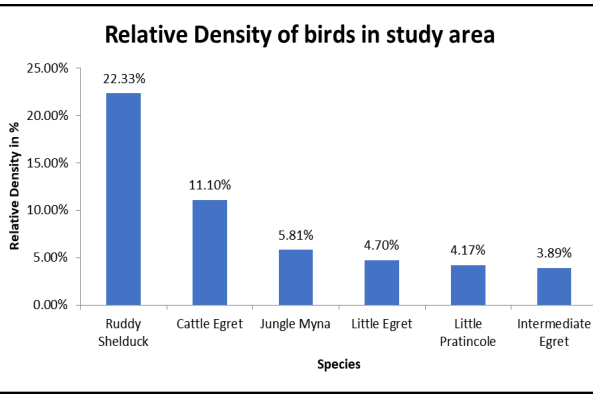
Herb diversity is high across the all habitats, but in terms of density herbs are low. The probable reason for the low density could be the removal of herbs species from the tea plantations and home stead gardens which covers the large area of study area.

Fauna- Season 2 (Winter)

Birds



Relative frequency of Birds in study area

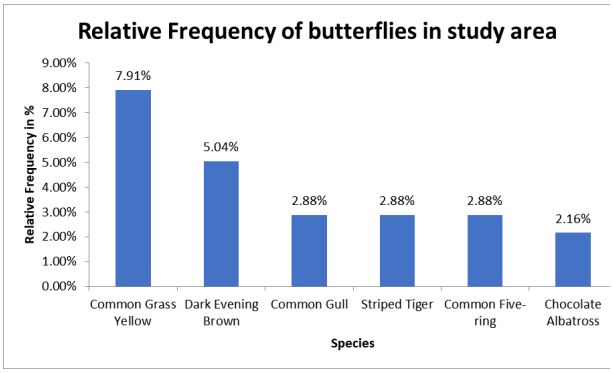


Relative density of Birds in the study area

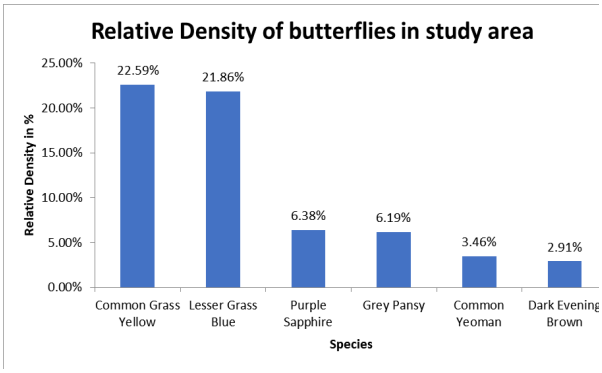
In Season two omnivores and insectivores' birds like Common myna (*Acridotheres tristis*), Black drongo (*Dicrurus macrocercus*), Cattle Egret (*Bubulcus ibis*), Red Vented Bulbul (*Pycnonotus cafer*), Jungle myna (*Acridotheres fuscus*) were common seen throughout the study area. Agriculture area, tea plantation and wetland provided steady microclimate and food supply for insect.

Huge flocks of Ruddy shelduck (*Tadorna ferruginea*), more than 500 individuals, were observed in Maguri Motapung Beel and also isolated pairs were observed at the other wetlands of the study area, hence showing the highest density in the season two. Ruddy shelduck (*Tadorna ferruginea*) is an extreme high-altitude migrant. Asian populations of this bird are mostly migratory in nature which migrates to winter at lower latitudinal and altitudinal freshwater or saline water sources, grasslands, marshlands, open steppe, upland plateaus and mountainous regions reaching up to 5000m in Himalayas in India.

Butterflies



Relative frequency of Butterflies in study area



Relative density of Butterflies in the study area

Common Grass yellow (*Eurema hecabe)* was found to be the one with highest frequency and highest density due to availability of flowering plants species such as *Sida acuta, Eupatorium odoratum, Leucas sp., Mikania micrantha, Sena tora, tectona grandis, and Leea spp.*

Many morphs of Dark Evening Brown (*Melanitis phedima*) were seen throughout the study area; as the host plants from family Poecea were in greater numbers in the study area. Purple Sapphire (*Heliophorus epicles*) was seen in abundantly in the Podumoni region of Bherjan-Borajan-Podumoni Wildlife Sanctuary.

7. Summary

For Biodiversity Assessment for OIL India Limited, Baghjan, baseline data was collected during the monsoon and winter season. Tea Plantation is the dominant habitat of the study area followed by Forest, Waterbody, Built-up and Open land, Cropland, and Homestead Plantation.

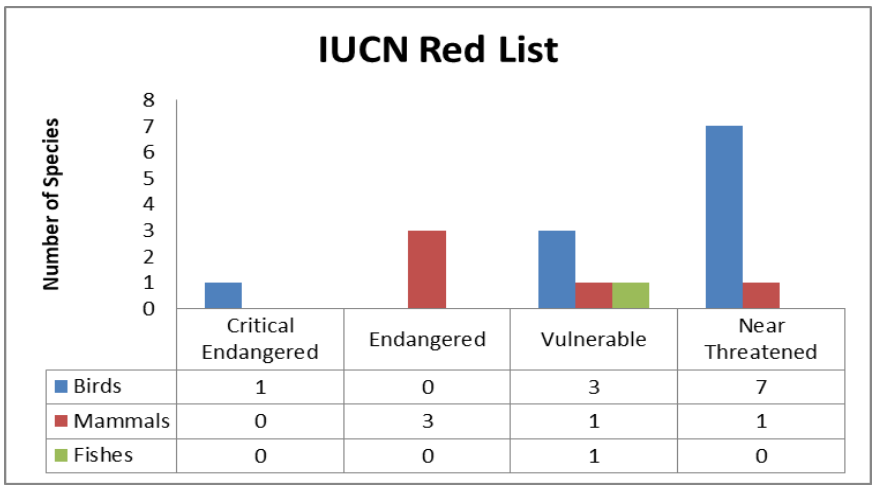
In monsoon season, 39 species of trees, 33 shrubs, 62 herbs and 13 Pteridophytes were recorded under flora; whereas 65 species of Birds, 70 species of Butterflies, 4 species of Mammals, 4 species of Herpetofauna and 17 species of Fishes were recorded under fauna.

In winter season, 44 species of trees, 33 shrubs, 86 herbs and 20 Pteridophytes were recorded under flora; whereas 133 species of Birds, 80 species of Butterflies, 10 species of Mammals, 2 species of Herpetofauna and 19 species of Fishes were recorded under fauna.

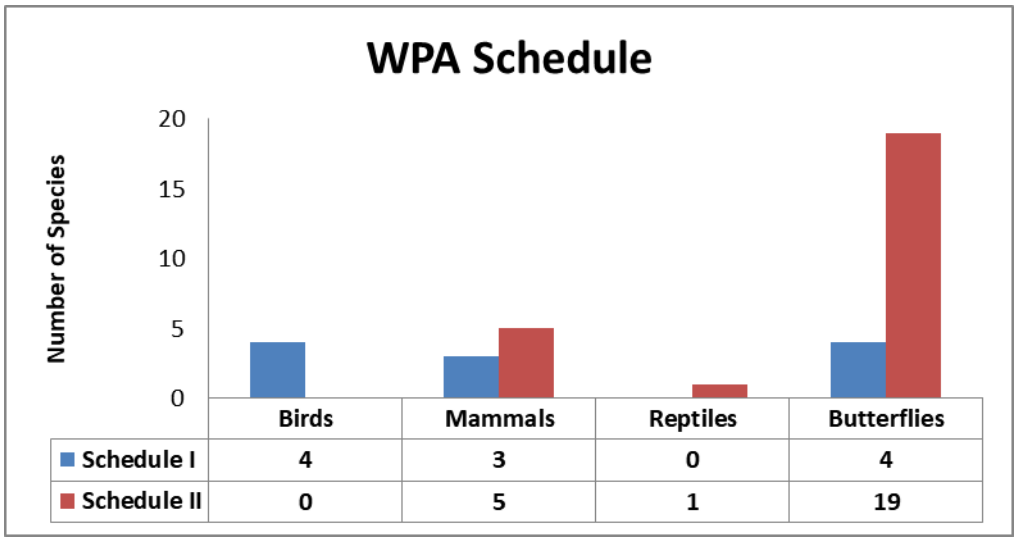
Taxa	Season 1	Season 2	COMBINED
Birds	**65**	**133**	**147**
Butterflies	**70**	**80**	**112**
Mammals	**4**	**10**	**10**
Herpetofauna	**4**	**2**	**6**
Fishes	**17**	**19**	**19**
Trees	**39**	**44**	**85**
Shrubs	**33**	**33**	**57**
Herbs	**62**	**86**	**152**
Pteridophytes	**13**	**20**	**47**

In the two seasons a total of 85 species of trees, 57 shrubs, 152 herbs and 47 Pteridophytes were recorded under flora; whereas 147 species of Birds, 112 species of Butterflies, 10 species of Mammals, 6 species of Herpetofauna and 19 species of Fishes were recorded under fauna.

Various species falling under IUCN Red List and WPA Schedules were obsevered during the primary data collection. Number of species falling under IUCN Red List across the taxa are as follows:



Number of species falling under WPA Shedules across the taxa are as follows:



	Birds	Mammals	Reptiles	Butterflies
Schedule I	4	3	0	4
Schedule II	0	5	1	19



Indian Roller

8. Appendix

Table 13 List of flora observed in study area in Season 1 (Monsoon)

SR. NO.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
	TREES					
1	*Albizia chinensis*	Chinese albizia	Sau koroi	Fabaceae	-	-
2	*Albizia procera*	White siris	Siris	Fabaceae	LC	-
3	*Alstonia scholaris*	Devil tree	Satiana	Apocynaceae	LC	-
4	*Anthocephalus cadamba*	Burflower tree	Kadam	Rubiaceae	-	-
5	*Areca catechu*	Areca palm	Tamul	Arecaceae	-	-
6	*Artocarpus heterophyllus*	Jackfruit	Kothal	Moraceae	-	-
7	*Bischofia javanica*	Bishop Wood	Urium	Phyllanthaceae	LC	-
8	*Bixa orellana*	Lipstick tree	Sendur gos	Bixaceae	LC	-
9	*Bombax ceiba*	Cotton tree	Simalu	Bombacaceae	LC	-
10	*Callicarpa arborea*	Beautyberry tree	–	Lamiaceae	-	-
11	*Caryota urens*	Fish tail palm	Sowat gos	Arecaceae	LC	-
12	*Cassia fistula*	Golden shower tree	Sonaru	Fabaceae	LC	-
13	*Chukrasia tabularis*	Chitta gong wood	Boga-poma	Meliaceae	LC	-
14	*Citrus limon*	Lemon	Nemu	Rutaceae	-	-
15	*Citrus maxima*	Pomelo	Robab tenga	Rutaceae	LC	-
16	*Delonix regia*	Royal poinciana	Krishnasura	Fabaceae	LC	-
17	*Dillenia indica*	Elephant apple	Ou tenga	Dilleniaceae	LC	-
18	*Dipterocarpus macrocarpus*	Hollong tree	Hollong	Dipterocarpaceae	-	-
19	*Erythrina sp.*	Indian Coral Tree	Madaar	Fabaceae	LC	-
20	*Ficus asperrima*	Forest Sandpaper Fig	–	Moraceae	LC	-
21	*Ficus racemosa*	Cluster fig	–	Moraceae	LC	-
22	*Ficus religiosa*	Sacred fig	Ahot gos	Moracaea	-	-

SR. NO.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
23	*Garcinia sp.*	Malabar tamarind	Thekera	Clusiaceae	–	-
24	*Garuga pinnata*	Grey Downy Balsam	Pama	Burseraceae	–	-
25	*Glochidion sp.*	Cheese trees	–	Phyllanthaceae	–	-
26	*Gmelina arborea*	White Teak	Gomari	Verbenaceae	LC	-
27	*Lagerstroemia speciosa*	Queen's crepe-myrtle	Azar	Lythraceae	-	-
28	*Macaranga denticulata*	Blistery Macaranga	–	Euphorbiaceae	–	-
29	*Magnolia champaca*	Champak	Titasopa	Magnoliacea	LC	-
30	*Magnolia hodgsonii*	Hodgson magnolia	Borhomthuri	Magnoliacea	LC	-
31	*Melia azedarach*	Chinaberry	Ghora-nim	Meliaceae	LC	-
32	*Mesua ferrea*	Ceylond ironwood	Nahor	Clusiacea	-	-
33	*Murraya koenigii*	Curry leaf tree	Narasingha	Meliaceae	-	-
34	*Oroxylum indicum*	Indian trumpet flower	Bhatghila	Bignoniaceae	-	-
35	*Pongamia pinnata*	Indian Beech Tree	Koroch	Fabaceae	LC	-
36	*Shorea robusta*	Sal tree	Sal	Dipterocarpaceae	LC	-
37	*Tectona grandis*	Teak	Sagun	Verbenaceae	-	-
38	*Terminalia bellirica*	Baheda	Bhomora	Combretaceae	-	-
39	*Ziziphus mauritiana*	Indian jujube	Bogori	Rhamnaceae	-	-
	SHRUBS					
1	*Actephila excels*	Nilgiri Actephila	–	Phyllanthaceae	-	-
2	*Bambusa sp.*	–	–	Poaceae	-	-
3	*Boehmaria sp.*	–	–	Urticaceae	-	-
4	*Brassaiopsis sp.*	–	–	Araliaceae	-	-
5	*Calamus tenuis*	Palm	Bet	Arecaceae	LC	
6	*Cleodendrum infortunatum*	Hill glory flower	Dhapatita	Verbenanceae	-	-
7	*Cleome gynandra*	Spiderwisp	–	Cleomaceae	-	-
8	*Diploclisia sp.*	–	–	Menespermaceae	-	-
9	*Eupatorium odoratum*	Siam weed	Jarmoni ban	Asteraceae	-	Yes
10	*Globba sp.*	–	–	Zingiberaceae	-	-

SR. NO.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
11	*Glochidion sp.*	–	–	Phyllanthaceae	-	-
12	*Imperata cylindrica*	Cogon grass	–	Poaceae	-	-
13	*Ipomea carnea*	Bush morning glory	Bih Kolmou	Convolvulaceae	-	-
14	*Lantana camera*	West Indian lantana		Verbenaceae	-	Yes
15	*Leea indica*	Bandicoot berry	Kukura-thengia	Vitaceae	LC	-
16	*Lippia alba*	Bushy matgrass	Pahu-kuta	Verbenanceae	-	-
17	*Manihot esculenta*	Bitter cassava	Simalu alu	Euphorbiaceae	DD	-
18	*Melastoma malabarthricum*	Malabar melastoma	Phutkola	Melastomaceae	-	-
19	*Mussanda roxburgii*	East Himalayan mussanda	Sonarupa	Rubiaceae	-	-
20	*Myriophyllum tuberculatum*	Red Watermillifoil	–	Haloragaceae	-	-
21	*Pandanus sp.*	–	–	Pandanaceae	-	-
22	*Pothos scandens*	Climbing Aroid	–	Araceae	-	-
23	*Rhaphidophora decursiva*	Creeping Philodendron	–	Araceae	-	-
24	*Schefflera arboricola*	Dwarf Umbrella tree	–	Araliaceae	-	-
25	*Senna alata*	Candle stick senna	Kharpat	Fabaceae	LC	-
26	*Senna hispida*	Hairy senna		Fabaceae	-	-
27	*Senna occidentalis*	Stinking weed	Bor medelua	Fabaceae	-	-
28	*Smilax sp.*	–	–	Smilacaceae	-	-
29	*Solanum diaphyllum*	twoleaf nightshade		Solanaceae	-	-
30	*Solanum torvum*	Turkey berry	Hati bhekuri	Solanaceae	-	Yes
31	*Solanum viarum*	Tropical soda apple	Tit bhekuri	Solanaceae	LC	Yes
32	*Sterculia hamiltonina*	Hamiltonian starculia	–	Malvaceae	-	-
33	*Tamarix sp.*	–	–	Tamariaceae	-	-
34	*Urena lobata*	–	–	Malvaceae	-	-
35	*Vallisneria spiralis*	Vallisneria	–	Hydrocharitaceae	-	-
	HERBS					
1	*Cynadon dactylon*	Scutuch grass	Dubori bon	Poaceae	-	-
2	*Polygonum hydropiper*	Water pepper	Patharua bihalagani	Polygonaceae	LC	-

SR. NO.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
3	*Acampe rigida (Orchid)*	Stiff Acampe	–	Orchidaceae	-	-
4	*Achyranthes aspera*	Devil's horsewhip	Hati-huria	Piperaceae	-	-
5	*Acorus calamus*	Sweet flag	–	Acoraceae	-	-
6	*Ageratum conyzoids*	Billy goat weed	–	Asteraceae	LC	Yes
7	*Alternanthera sp.(Button like)*	Joy weed, Copperleaf	–	Amaranthaceae	-	–
8	*Alternanthera sessilis*	Dwarf copperleaf	Matikaduri	Amaranthaceae	-	Yes
9	*Amaranthus spinosus*	Spiny amaranth	Hati khutura	Amaranthaceae	-	-
10	*Amaranthus viridis*	Green Amaranth	–	Amaranthaceae	-	-
11	*Amorphophallus campanulatus*	Elephant Foot Yam	–	Araceae	-	-
12	*Asplenium nidus*	Bird's-nest Fern	–	Aspleniaceae	-	-
13	*Bidens pilosa*	Beggarticks	–	Asteraceae	-	-
14	*Bidens sp.*	Bidens sp.	–	Asteraceae	-	-
15	*Cardiospermum halicacabum*	Balloon Vine	–	Sapindaceae	LC	-
16	*Centella asiatica*	Indian Pennywort	–	Apiaceae	-	-
17	*Centratherum punctatum*	Brazilian Bachelor's Button	–	Asteraceae	-	-
18	*Ceratophyllum desmersum*	Coon tail	–	Ceratophyllaceae	-	-
19	*Cleome rutidospermum*	Fringed spiderflower	–	Capparaceae	-	-
20	*Cleome viscosa*	Yellow Spider flower	–	Cleomaceae	-	-
21	*Clerodendrum chinense*	Chinese Glory Bower	–	Verbenaceae	LC	-
22	*Clerodendrum colebrookeanum*	East Indian Glory Bower	Nephaphu	Verbenaceae	-	-
23	*Colocassia esculenta*	Taro	–	Araceae	-	-
24	*Cuphea sp.*	False heather	–	Lythraceae	-	-
25	*Cynodon dactylon*	Bermuda grass	Doob	Poaceae	-	-
26	*Dichanthium annulatum*	Sheda grass, Blue stem	–	Poaceae	-	-
27	*Eichhornia crassipes*	Water Hyacinth	Jal Kumbhi	Pontederiaceae	LC	-
28	*Eleusine indica*	Indian goosegrass	Bobosa- bon	Poaceae	-	-
29	*Eragrostis sp.*	Bunch grass	–	Poaceae	-	-
30	*Gynura sp.*	–	–	Asteraceae	-	-

SR. NO.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
31	*Hydrilla verticillata*	Hydrilla, Water Thyme	–	Hydrocharitaceae	LC	-
32	*Hydrocotyl sibthorpioides*	Water pennyworts	–	Araliaceae	-	-
33	*Impatiens balsamina*	Balsams	Keruphul	Balsaminaceae	-	-
34	*Kyllinga sp.*	Green Water Sedge	–	Cyperaceae	LC	-
35	*Leea indica*	Bandicoot Berry	Kukur jihwa	Vitaceae	LC	-
36	*Leonurus sibiricus*	Honey weed	–	Lamiaceae	-	-
37	*Leucas aspera*	Common leucas	Doron	Lamiaceae	-	-
38	*Lindernia crustacea*	Malaysian Lindernia	–	Lindernaceae	LC	-
39	*Lippia alba*	Bushy Lippia	Pitiona, Hierba negra	Verbenaceae	-	-
40	*Ludwigia perennis*	Paddy clove	Bon Jalakia	Onagraceae	-	-
41	*Luisia trichorrhiza*	Hairy-Root Luisia	–	Orchidaceae	-	-
42	*Mazus sp.*	–	–	Mazaceae	-	-
43	*Mimosa pudica*	Touch me not	Lajuki lota	Fabaceae	-	-
44	*Musa x paradisica*	Banana	–	Musaceae	-	-
45	*Nelumbo nucifera*	Sacred Lotus	Kamal	Padam	DD	-
46	*Oldenlandia corymbosa*	Diamond flower	Daman pappar	–	-	-
47	*Peperomia pellucida*	Slate Pencil Plant, Silverbush	–	Pononoa	-	-
48	*Persicaria sp.*	Asiatic waterpepper	–	Polygonaceae	-	-
49	*Phyla nudiflora*	Frog fruit	Jal pipali	Verbenaceae	-	-
50	*Phyllanthus urinaria*	Chamber Bitter, Shatterstone	Hajarmani	Bhui Amlakhi	-	-
51	*Piper betle*	Betel leaf	Pan	Piperaceae	-	-
52	*Pistia stratiotes*	Water lettuce, Nile Cabbage	Barpuni	Araceae	LC	-
53	*Pontederia cordata*	Pickerel Weed	–	Pontederiaceae	-	-
54	*Scophuria dulcis*	Sweet broom	Madhumehari, bon chini	Plantaginaceae	-	-
55	*Senna tora*	Sickle pod	Medelua	Fabaceae	-	-
56	*Sida acuta*	Common wireweed	Boriala	Malvaceae	-	-
57	*Sida rhombifolia*	Arrowleaf sida	Boriala	Malvaceae	-	-
58	*Solanum nigrum*	Black nightshade	Pichkati	Solanaceae	-	-

SR. NO.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
59	*Spilanthes acmella*	Paracress	Bon narji	Asteraceae	-	-
	FERNS AND ALLIES					
1	*Angiopteris evecta*	King fern	-	Marattiaceae	-	-
2	*Asplenuim nidus*	Bird's nest fern	-	Aspleniaceae	-	-
3	*Azolla sp.*	-	-	Azollaceae	-	-
4	*Blechnum sp.*	Hard fern	-	Blechnaceae	-	-
5	*Cyathea gigantea*	-	-	Cyatheaceae	-	-
6	*Diplazium esculentum*	Vegetable Fern	Linguda	Athyriaceae	-	-
7	*Drymoglossum heterophylum*	Dragon scale	-	Polypodiaceae	-	-
8	*Gleichenia sp.*	Forked climbing fern	-	Gleicheniaceae	-	-
9	*Lygodium flexuosum*	Climbing fern	-	Lygodiaceae	-	-
10	*Marselia sp.*	Clover fern	-	Marseliaceae	-	-
11	*Pteris vitata*	Chinese brake fern	-	Pteridiaceae	-	-
12	*Salvinia sp.*	-	-	Salviniaceae	-	-
13	*Selaginella sp.*	Peacock fern	-	Selaginellaceae	-	-

Table 14 Inventory of bird species observed in study area - Season 1 (Monsoon)

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
1	Ashy drongo	*Dicrurus leucophaeus*	Dicruridae	LC	R	IV
2	Asian Barred Owlet	*Glaucidium cuculoides*	Strigidae	LC	R	IV
3	Asian Openbill	*Anastomus oscitans*	Ciconiidae	LC	R	IV
4	Asian palm swift	*Cypsiurus balasiensis*	Apodidae	LC	R	IV
5	Asian Pied Starlings	*Gracupica contra*	Sturnidae	LC	R	IV
6	Baya weaver	*Ploceus philippinus*	Ploceidae	LC	R	IV
7	Barn Swallow	*Hirundo rustica*	Hirundinidae	LC	WV	-
8	Black Bittern	*Ixobrychus flavicollis*	Ardeidae	LC	R	IV

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
9	Black-hooded Oriole	*Oriolus xanthornus*	Oriolidae	LC	R	IV
10	Blue-tailed Bee-eater	*Merops philippinus*	Meropidae	LC	SW	-
11	Blue-throated Barbet	*Psilopogon asiaticus*	Megalaimidae	LC	R	IV
12	Chestnut tailed Starling	*Sturnia malabarica*	Sturnidae	LC	R	IV
13	Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	LC	R	IV
14	Cattle Egret	*Bubulcus ibis*	Ardeidae	LC	R	IV
15	Cinnamon Bittern	*Ixobrychus cinnamomeus*	Ardeidae	LC	R	IV
16	Common Moorhen	*Gallinula chloropus*	Rallidae	LC	R	-
17	Common Myna	*Acridotheres tristis*	Sturnidae	LC	R	IV
18	Common tailorbird	*Orthotomus sutorius*	Cisticolidae	LC	R	-
19	Cotton pygmy goose	*Nettapus coromandelianus*	Anatidae	LC	R	IV
20	Eastern Jungle crow	*Corvus macrorhynchos*	Corvidae	LC	R	-
21	Grey-capped Emerald Dove	*Chalcophaps indica*	Columbidae	LC	R	IV
22	Eurasian Collared-dove	*Streptopelia decaocto*	Columbidae	LC	R	IV
23	Eurasian Tree Sparrow	*Passer montanus*	Passeridae	LC	R	-
24	Great Tit	*Parus major*	Paridae	LC	R	IV
25	Green bee-eater	*Merops orientalis*	Meropidae	LC	R	-
26	Green-billed Malkova	*Phaenicophaeus tristis*	Cuculidae	LC	R	-
27	Common Hill Myna	*Gracula religiosa*	Sturnidae	LC	R	IV
28	Oriental Honey-buzzard	*Pernis ptilorhynchus*	Accipitridae	LC	R	-
29	House Crow	*Corvus splendens*	Corvidae	LC	R	V
30	Asian House Martin	*Delichon dasypus*	Hirundinidae	LC	R	-
31	Indian Roller	*Coracias benghalensis*	Coraciidae	LC	R	IV
32	Indian Cuckoo	*Cuculus micropterus*	Cuculidae	LC	R	IV
33	Intermediate Egret	*Ardea intermedia*	Ardeidae	LC	R	IV
34	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC	R	IV
35	Lesser Adjutant	*Leptoptilos javanicus*	Ciconiidae	VU	R	-
36	Lesser Coucal	*Centropus bengalensis*	Cuculidae	LC	R	-

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
37	Lesser Whistling-duck	*Dendrocygna javanica*	Anatidae	LC	R	IV
38	Lineated Barbet	*Psilopogon lineatus*	Megalaimidae	LC	R	IV
39	Little Cormorant	*Microcarbo niger*	Phalacrocoracidae	LC	R	IV
40	Little Egret	*Egretta garzetta*	Ardeidae	LC	R	IV
41	Little Heron	*Butorides striata*	Ardeidae	LC	R	-
42	Oriental Pied Hornbill	*Anthracoceros albirostris*	Bucerotidae	LC	R	-
43	Oriental Magpie Robin	*Copsychus saularis*	Muscicapidae	LC	R	-
44	Osprey	*Pandion haliaetus*	Pandionidae	LC	WV	I
45	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	LC	R	IV
46	Pied Kingfisher	*Ceryle rudis*	Alcedinidae	LC	R	IV
47	Plain Martin	*Riparia chinensis*	Hirundinidae	LC	R	-
48	Indian Pond-heron	*Ardeola grayii*	Ardeidae	LC	R	-
49	Purple heron	*Ardea purpurea*	Ardeidae	LC	R	-
50	Common Redshank	*Tringa totanus*	Scolopacidae	LC	WV	-
51	Red-vented Bulbul	*Pycnonotus cafer*	Pycnonotidae	LC	R	IV
52	Red-breasted Parakeet	*Psittacula alexandri*	Psittacidae	NT	R	IV
53	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	LC	R	-
54	Rock Dove	*Columba livia*	Columbidae	LC	R	IV
55	Rose-ringed parakeet	*Alexandrinus krameri*	Psittacidae	LC	R	IV
56	Rufous Treepie	*Dendrocitta vagabunda*	Corvidae	LC	R	-
57	Scaly-breasted Munia	*Lonchura punctulata*	Estrildidae	LC	R	IV
58	Shikra	*Accipiter badius*	Accipitridae	LC	R	-
59	Hair-crested Drongo	*Dicrurus hottentottus*	Dicruridae	LC	R	IV
60	Eastern Spotted Dove	*Spilopelia chinensis*	Columbidae	LC	R	IV
61	White-breasted Kingfisher	*Halcyon smyrnensis*	Alcedinidae	LC	R	IV
62	White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	LC	R	IV
63	White-throated Bulbul	*Alophoixus flaveolus*	Pycnonotidae	LC	R	IV
64	Yellow Bittern	*Ixobrychus sinensis*	Ardeidae	LC	R	IV

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
65	Yellow-footed Green Pigeon	*Treron phoenicopterus*	Columbidae	LC	R	IV

Table 15 Inventory of butterflies observed in study area- Season 1 (Monsoon)

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
1	Eastern Striped Albatross	*Appias olferna*	Pieridae	-	II
2	Indian Ace	*Halpe homolea aucma*	Hesperiidae	-	-
3	Blue Tiger	*Tirumala limniace*	Nymphalidae	-	-
4	Common Bluebottle	*Graphium sarpedon*	Papilionidae	-	-
5	Common Four-ring	*Ypthima huebneri*	Nymphalidae	-	-
6	Common Castor	*Ariadne merione*	Nymphalidae	-	-
7	Chocolate Albatross	*Appias lyncida*	Pieridae	-	II
8	Chocolate Pansy	*Junonia iphita*	Nymphalidae	-	-
9	Colour Sergeant	*Athyma inara*	Nymphalidae	-	-
10	Common Birdwing	*Troides helena*	Papilionidae	LC	-
11	Common Crow	*Euploea core*	Nymphalidae	-	-
12	Common Grass Yellow	*Eurema hecabe*	Pieridae	-	-
13	Common Jay	*Graphium doson*	Papilionidae	-	-
14	Common Mormon	*Papilio polytes*	Papilionidae	-	-
15	Common Pierrot	*Castalius rosimon*	Lycaenidae	-	I
16	Common Peacock	*Papilio bianor*	Papilionidae	-	-
17	Common Yeoman	*Cirrochroa tyche*	Nymphalidae	-	-
18	Long-branded Blue Crow	*Euploea algea*	Nymphalidae	-	-
19	Danaid Eggfly	*Hypolimnas misippus*	Nymphalidae	LC	I
20	Elbowed Pierrot	*Caleta elna*	Lycaenidae	-	-
21	Fluffy Tit	*Zeltus amasa*	Lycaenidae	-	-
22	Glassy Tiger	*Parantica aglea*	Nymphalidae	-	-
23	Great Eggfly	*Hypolimnas bolina*	Nymphalidae	-	-

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
24	Great Mormon	*Papilio memnon*	Papilionidae	-	-
25	Great Orange-tip	*Hebomoia glaucippe*	Pieridae	-	-
26	Grey Count	*Tanaecia lepidea*	Nymphalidae	-	II
27	Grey Pansy	*Junonia atlites*	Nymphalidae	-	-
28	Common Gull	*Cepora nerissa*	Pieridae	-	II
29	Indian Cabbage White	*Pieris canidia*	Pieridae	-	-
30	Common Duffer	*Discophora sondaica*	Nymphalidae	-	I
31	Bispot Banded Ace	*Halpe porus*	Hesperiidae	-	-
32	Leopard Lacewing	*Cethosia cyane*	Nymphalidae	-	-
33	Common Lascar	*Pantoporia hordonia*	Nymphalidae	-	-
34	Lemon Emigrant	*Catopsilia pomona*	Pieridae	-	-
35	Lime Swallowtail	*Papilio demoleus*	Papilionidae	NA	-
36	Indian Nawab	*Charaxes bharata*	Nymphalidae	-	-
37	Common Palmfly	*Elymnias hypermnestra*	Nymphalidae	-	-
38	Peacock Pansy	*Junonia almana*	Nymphalidae	LC	-
39	Plain Tiger	*Danaus chrysippus*	Nymphalidae	LC	-
40	Psyche	*Leptosia nina*	Pieridae	-	-
41	Punchinello	*Zemeros flegyas*	Riodinidae	-	-
42	Purple Sapphire	*Heliophorus epicles*	Lycaenidae	-	-
43	Red Helen	*Papilio helenus*	Papilionidae	-	-
44	Common Rose	*Pachliopta aristolochiae*	Papilionidae	LC	-
45	Rustic	*Cupha erymanthis*	Nymphalidae	-	-
46	Striped Tiger	*Danaus genutia*	Nymphalidae	-	-
47	Three-spot Grass Yellow	*Eurema blanda*	Pieridae	-	-
48	Pioneer	*Belenois aurota*	Papilionidae	-	-
49	Indian Wanderer	*Pareronia hippia*	Pieridae	-	-
50	Yamfly	*Loxura atymnus*	Lycaenidae	-	-
51	Dark-branded Bushbrown	*Mycalesis mineus*	Nymphalidae	-	-
52	Common Sergeant	*Athyma perius*	Nymphalidae	-	-

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
53	Common Four-ring	*Ypthima huebneri*	Nymphalidae	-	-
54	Knight	*Lebadea martha*	Nymphalidae	-	-
55	Great evening brown	*Melanitis zitenius*	Nymphalidae	-	II
56	Metallic Cerulean	*Jamides alecto*	Lycaenidae	-	II
57	Smaller Dartlet	*Oriens goloides*	Hesperiidae	-	-
58	Long-branded Bushbrown	*Mycalesis visala*	Nymphalidae	-	-
59	Bamboo Treebrown	*Lethe europa*	Nymphalidae	-	-
60	Orchid Tit	*Hypolycaena othona*	Lycaenidae	-	I
61	Straight Swift	*Parnara guttatus*	Hesperiidae	-	-
62	Tailless Lineblue	*Prosotas dubiosa*	Lycaenidae	-	-
63	Blackvein Sergeant	*Athyma ranga*	Nymphalidae	-	II
64	Light Straw Ace	*Pithauria stramineipennis*	Hesperiidae	-	-
65	Suffused Snow flat	*Tagiades gana*	Hesperiidae	-	-
66	Common Snow flat	*Tagiades japetus*	Hesperiidae	-	-
67	Constable	*Dichorragia nesimachus*	Nymphalidae	-	-
68	Small Green Awlet	*Burara amara*	Hesperiidae	-	-
69	Veined Pierrot	Tarucus venosus	Lycaenidae	-	-
70	Lesser Grass Blue	*Zizina otis*	Lycaenidae	-	-

Table 16 Inventory of Mammals observed in study area- Season 1 (Monsoon)

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
1	Western Hoolock Gibbon	*Hoolock hoolock*	Hylobatidae	EN	I
2	Rhesus Macaque	*Macaca mulatta*	Cercopithecidae	LC	II
3	Hoary-bellied Squirrel	*Callosciurus pygerythrus*	Sciuridae	LC	-
4	Indian Flying Fox	*Pteropus giganteus*	Pteropodidae	LC	V

Table 17 Inventory of Herpetofauna observed in study area- Season 1 (Monsoon)

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
1	Oriental garden lizard	*Calotes versicolor*	Agamidae	-	-
2	Skittering frog	*Euphlyctis cyanophlyctis*	Dicroglossidae	LC	-
3	Gecko Spp	-	-	-	-
4	Skink Spp	-	-	-	-

Table 18 Inventory of Fishes observed in study area- Season 1 (Monsoon)

Sr.No.	Common Name	Scientific name	Family	IUCN Status	WPA
1	Elongate glassy perchlet	*Chanda nama*	Ambassidae	LC	-
2	Spotted Snakehead	*Channa punctata*	Channidae	LC	-
3	Snakehead Murrel	*Channa striata*	Channidae	LC	-
4	Wagur	*Clarias magur*	Clariidae	LC	-
5	Grass carp	*Ctenopharyngodon idella*	Cyprinidae	-	-
6	Gangetic leaffish	*Nandus nandus*	Nandidae	LC	-
7	Catla	*Gibelion catla*	Cyprinidae	LC	-
8	Indian River Shad	*Gudusia chapra*	Clupeidae	LC	-
9	Singee	*Heteropneustes fossilis*	Heteropneustidae	LC	-
10	Spiny Eel	*Mastacembelus armatus*	Mastacembelidae	LC	-
11	Gangetic mudeel	*Monopterus cuchia*	Synbranchidae	LC	-
12	-	*Mystus cavasius*	Bagridae	LC	-
13	Spotfin Swamp Barb	*Puntius sophore*	Cyprinidae	LC	-
14	Reba Carp	*Cirrhinus reba*	Cyprinidae	LC	-
15	Dwarf gourami	*Trichogaster lalius*	Osphronemidae	LC	-
16	-	*Wallago attu*	Siluridae	VU	-
17	-	*Xenentodon cancila*	Belonidae	LC	-

Table 19 List of flora observed in study area in Season 2 – (Winter)

Sr. No.	*SCIENTIFIC NAME*	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
Trees						
1	*Albizia chinensis*	Chinese albizia	Sau koroi	Fabaceae	-	-
2	*Albizia procera*	White siris	Siris	Fabaceae	LC	-
3	*Alstonia scholaris*	Devil tree	Satiana	Apocynaceae	LC	-
4	*Anthocephalus cadamba*	Burflower tree	Kadam	Rubiaceae	-	-
5	*Areca catechu*	Areca palm	Tamul	Arecaceae	-	-
6	*Artocarpus heterophyllus*	Jackfruit	Kothal	Moraceae	-	-
7	*Bauhinia variegata*	-	-	Fabaceae	-	-
8	*Bischofia javanica*	Bishop Wood	Urium	Phyllanthaceae	LC	-
9	*Bixa orellana*	Lipstick tree	Sendur gos	Bixaceae	LC	-
10	*Bombax ceiba*	Cotton tree	Simalu	Bombacaceae	LC	-
11	*Callicarpa arborea*	Beautyberry tree	-	Lamiaceae	-	-
12	*Caryota urens*	Fish tail palm	Sowat gos	Arecaceae	LC	-
13	*Cassia fistula*	Golden shower tree	Sonaru	Fabaceae	LC	-
14	*Chukrasia tabularis*	Chitta gong wood	Boga-poma	Meliaceae	LC	-
15	*Citrus limon*	Lemon	Nemu	Rutaceae	-	-
16	*Citrus maxima*	Pomelo	Robab tenga	Rutaceae	LC	-
17	*Delonix regia*	Royal poinciana	Krishnasura	Fabaceae	LC	-
18	*Dillenia indica*	Elephant apple	Ou tenga	Dilleniaceae	LC	-
19	*Dipterocarpus macrocarpus*	Hollong tree	Hollong	Dipterocarpaceae	-	-
20	*Duabana grandiflora*	-	-	Combretaceae	-	-
21	*Erythrina sp.*	Indian Coral Tree	Madaar	Fabaceae	LC	-
22	*Ficus asperrima*	Forest Sandpaper Fig	-	Moraceae	LC	-
23	*Ficus racemosa*	Cluster fig	-	Moraceae	LC	-
24	*Ficus religiosa*	Sacred fig	Ahot gos	Moracaea	-	-
25	*Garcinia sp.*	Malabar tamarind	Thekera	Clusiaceae	-	-

Sr. No.	*SCIENTIFIC NAME*	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
26	*Garuga pinnata*	Grey Downy Balsam	Pama	Burseraceae	-	-
27	*Glochidion sp.*	Cheese trees	-	Phyllanthaceae	-	-
28	*Gmelina arborea*	White Teak	Gomari	Verbenaceae	LC	-
29	*Lagerstroemia speciosa*	Queen's crepe-myrtle	Azar	Lythraceae	-	-
30	*Macaranga denticulata*	Blistery Macaranga	-	Euphorbiaceae	-	-
31	*Magnolia champaca*	Champak	Titasopa	Magnoliacea	LC	-
32	*Magnolia hodgsonii*	Hodgson magnolia	Borhomthuri	Magnoliacea	LC	-
33	*Melia azedarach*	Chinaberry	Ghora-nim	Meliaceae	LC	-
34	*Mesua ferrea*	Ceylond ironwood	Nahor	Clusiacea	-	-
35	*Murraya koenigii*	Curry leaf tree	Narasingha	Meliaceae	-	-
36	*Oroxylum indicum*	Indian trumpet flower	Bhatghila	Bignoniaceae	-	-
37	*Phyllanthus assamicus*	-	-	Phyllanthaceae	-	-
38	*Pongamia pinnata*	Indian Beech Tree	Koroch	Fabaceae	LC	-
39	*Pritchardia pacifica*	Fan palm	-	Arecaceae	-	-
40	*Shorea robusta*	Sal tree	Sal	Dipterocarpaceae	LC	-
41	*Tectona grandis*	Teak	Sagun	Verbenaceae	-	-
42	*Terminalia bellirica*	Baheda	Bhomora	Combretaceae	-	-
43	*Terminalia myriocarpa*	-	-	Combretaceae	-	-
44	*Ziziphus mauritiana*	Indian jujube	Bogori	Rhamnaceae	-	-
Shrubs						
1	*Actephila excels*	Nilgiri Actephila	-	Phyllanthaceae	-	-
2	*Bambusa sp.*	-	-	Poaceae	-	-
3	*Brassaiopsis sp.*	-	-	Araliaceae	-	-
4	*Calamus tenuis*	Palm	Bet	Arecaceae	LC	-
-5	*Cleodendrum infortunatum*	Hill glory flower	Dhapatita	Verbenanceae	-	-
6	*Cleome gynandra*	Spiderwisp	-	Cleomaceae	-	-
7	*Diploclisia sp.*	-	-	Menespermaceae	-	-
8	*Eupatorium odoratum*	Siam weed	Jarmoni ban	Asteraceae	-	Yes

Sr. No.	*SCIENTIFIC NAME*	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
9	*Globba sp.*	-	-	Zingiberaceae	-	-
10	*Ipomea carnea*	Bush morning glory	Bih Kolmou	Convolvulaceae	-	-
11	*Lantana camera*	West Indian lantana	-	Verbenaceae	-	Yes
12	*Leea indica*	Bandicoot Berry	Kukur jihwa	Vitaceae	LC	-
13	*Manihot esculenta*	Bitter cassava	Simalu alu	Euphorbiaceae	DD	-
14	*Melastoma malabarthricum*	Malabar melastoma	Phutkola	Melastomaceae	-	-
15	Mezoneuron cucullatum	Hooded-flowered brasiletto	-	Fabaceae	-	-
16	*Mussanda roxburgii*	East Himalayan mussanda	Sonarupa	Rubiaceae	-	-
17	*Mycetia nutans*	-	-	Rubiaceae	-	-
18	*Myriophyllum tuberculatum*	Red Watermillifoil	-	Haloragaceae	-	-
19	*Pandanus unguifer Hook.*	-	-	Pandanaceae	-	-
20	*Pothos scandens*	Climbing Aroid	-	Araceae	-	-
21	*Schefflera venulosa*	Dwarf Umbrella tree	-	Araliaceae	-	-
22	*Senna alata*	Candle stick senna	Kharpat	Fabaceae	LC	-
23	*Senna hispida*	Hairy senna	-	Fabaceae	-	-
24	*Senna occidentalis*	Stinking weed	Bor medelua	Fabaceae	-	-
-25	*Smilax sp.*	-	-	Smilacaceae	-	-
26	*Solanum diaphyllum*	twoleaf nightshade	-	Solanaceae	-	-
27	*Solanum torvum*	Turkey berry	Hati bhekuri	Solanaceae	-	Yes
28	*Solanum viarum*	Tropical soda apple	Tit bhekuri	Solanaceae	LC	Yes
29	*Sterculia hamiltonina*	Hamiltonian starculia	-	Malvaceae	-	-
30	*Tamarix sp.*	-	-	Tamariaceae	-	-
31	*Thunbergia coccinea*	Scarlet Clock Vine	Chonga lota	Acanthaceae	-	-
32	*Thunbergia laurifolia*	Laurel Clock Vine	-	Acanthaceae	-	-
33	*Urena lobata*	-	-	Malvaceae	-	-
Herbs						
1	*Cynadon dactylon*	Scutuch grass	Dubori bon	Poaceae	-	-
2	*Polygonum hydropiper*	Water pepper	Patharua bihalagani	Polygonaceae	LC	-

Sr. No.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
3	*Acampe rigida (Orchid)*	Stiff Acampe	-	Orchidaceae	-	-
4	*Achyranthes aspera*	Devil's horsewhip	Hati-huria	Piperaceae	-	-
5	*Acorus calamus*	Sweet flag	-	Acoraceae	-	-
6	*Ageratum conyzoids*	Billy goat weed	-	Asteraceae	LC	Yes
7	*Alternanthera sp.(Button like)*	Joy weed, Copperleaf	-	Amaranthaceae	-	-
8	*Alternanthera sessilis*	Dwarf copperleaf	Matikaduri	Amaranthaceae	-	Yes
9	*Amaranthus spinosus*	Spiny amaranth	Hati khutura	Amaranthaceae	-	-
10	*Amaranthus viridis*	*Green Amaranth*	-	Amaranthaceae	-	-
11	*Amorphophallus campanulatus*	Elephant Foot Yam	-	Araceae	-	-
12	*Aponogeton natans*	Floating lace plant	-	Aponogetonaceae	LC	No
13	*Bidens pilosa*	Beggarticks	-	Asteraceae	Yes	-
14	*Boehmaria sp.*	-	-	Urticaceae	-	-
15	*Cardiospermum halicacabum*	Balloon Vine	-	Sapindaceae	LC	-
16	*Centella asiatica*	Indian Pennywort	-	Apiaceae	LC	No
17	*Centratherum punctatum*	Brazilian Bachelor's Button	-	Asteraceae	-	-
18	*Ceratophyllum demersum*	Coon tail	-	Ceratophyllaceae	LC	Yes
19	*Cleome rutidospermum*	Fringed spiderflower	-	Capparaceae	-	-
20	*Cleome viscosa*	Yellow Spider flower	-	Cleomaceae	-	-
21	*Clerodendrum chinense*	Chinese Glory Bower	-	Verbenaceae	LC	-
22	*Clerodendrum colebrookeanum*	East Indian Glory Bower	Nephaphu	Verbenaceae	-	-
23	*Clerodendrum indicum*	-	-	Verbenaceae	-	-
24	*Colocasia esculenta*	Wild taro	-	Araceae	LC	No
25	*Cuphea sp.*	False heather	-	Lythraceae	-	-
26	*Dichanthium annulatum*	Sheda grass, Blue stem	-	Poaceae	-	-
27	*Eclipta prostrata*	False daisy	-	Compositae	LC	No

Sr. No.	*SCIENTIFIC NAME*	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
28	*Eicchornia crassipes*	Common water hyacinth	Jal Kumbhi	Pontederiaceae	-	Yes
29	*Eleusine indica*	Indian goosegrass	Bobosa- bon	Poaceae	-	-
30	*Eragrostis sp.*	Bunch grass	-	Poaceae	-	-
31	*Gynura sp.*	-	-	Asteraceae	-	-
32	*Hydrilla verticillata*	Hydrilla	-	Hydrocharitaceae	LC	Yes
33	*Hydrocotyl sibthorpioides*	Water pennyworts	-	Araliaceae	-	-
34	*Hydrocotyle sibthorpioides*	Lawn marsh pennywort	-	Araliaceae	-	No
35	*Impatiens balsamina*	Balsams	Keruphul	Balsaminaceae	-	-
36	*Imperata cylindrica*	Cogon grass	-	Poaceae	-	-
37	*Ipomoea aquatica*	Water spinach	-	Convolvulaceae	LC	Yes
38	*Ipomoea carnea*	Pink morning glory	-	Convolvulaceae	-	No
39	*Kyllinga sp.*	Green Water Sedge	-	Cyperaceae	LC	-
40	*Lemna perpusilla*	Tiny duckweed	-	Araceae	LC	No
41	*Leonurus sibiricus*	Honey weed	-	Lamiaceae	-	-
42	*Leucas aspera*	Common leucas	Doron	Lamiaceae	-	-
43	*Lindernia crustacea*	Malaysian Lindernia	-	Lindernaceae	LC	-
44	*Lippia alba*	Bushy Lippia	Pitiona, Hierba negra	Verbenaceae	-	-
45	*Ludwigia perennis*	Perennial water primrose	Bon Jalakia	Onagraceae	LC	No
46	*Luisia trichorrhiza*	Hairy-Root Luisia	-	Orchidaceae	-	-
47	*Mazus sp.*	-	-	Mazaceae	-	-
48	*Mimosa pudica*	Touch me not	Lajuki lota	Fabaceae	Yes	-
49	*Musa x paradisica*	Banana	-	Musaceae	-	-
50	*Najas graminea*	Ricefield water-nymph	-	Hydrocharitaceae	LC	No
51	*Najas indica*	Guppy grass	-	Hydrocharitaceae	LC	No
52	*Najas marina*	Holly leaved Naiad	-	Hydrocharitaceae	LC	No
53	*Nelumbo nucifera*	Sacred Lotus	Kamal	Padam	DD	-
54	*Nymphaea nouchali*	Blue lotus		Nymphaeaceae	LC	No
55	*Oldenlandia corymbosa*	Diamond flower	Daman pappar	-	-	-

Sr. No.	*SCIENTIFIC NAME*	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
56	*Peperomia pellucida*	Slate Pencil Plant, Silverbush	-	Pononoa	-	-
57	*Persicaria sp.*	Asiatic waterpepper	-	Polygonaceae	-	-
58	*Phragmites karka*	Tall Reed	Nala dala	Poaceae	-	-
59	*Phyla nudiflora*	Frog fruit	Jal pipali	Verbenaceae	-	-
60	*Phyllanthus rotundifolius*	-	-	Phyllanthaceae	-	No
61	*Phyllanthus urinaria*	Chamber Bitter, Shatterstone	Hajarmani	Bhui Amlakhi	-	-
62	*Piper betle*	Betel leaf	Pan	Piperaceae	-	-
63	*Piper betleoides*	-	-	-	-	-
64	*Pistia stratiotes*	Water lettuce, Nile Cabbage	Barpuni	Araceae	LC	-
65	*Pollia sp.*		-	Commelinaceae	-	-
66	*Pontederia cordata*	Pickerel Weed	–	Pontederiaceae	-	-
67	*Potamogeton crispus*	Curled Pondweed	-	Potamogetonaceae	LC	Yes
68	*Potamogeton natans*	Broad leaved Pondweed	-	Potamogetonaceae	LC	No
69	*Potamogeton nodosus*	Loddon Pondweed	-	Potamogetonaceae	LC	No
70	*Rhaphidophora decursiva*	Creeping Philodendron	-	Araceae	-	-
71	*Rhaphidophora hookeri*	-	-	-	-	-
72	*Rotala indica*	Indian toothcup	-	Lythraceae	LC	No
73	*Ruppia maritima*	Beaked tassleweed	-	Ruppiaceae	LC	No
74	*Sabia lanceolata*	-	-	Sabiaceae	-	-
75	*Saccharum ravennae*	Ravenna grass	-	Poaceae	-	-
76	*Scophuria dulcis*	Sweet broom	Madhumehari, bon chini	Plantaginaceae	-	-
77	*Senna tora*	Sickle pod	Medelua	Fabaceae	-	-
78	*Sida acuta*	Common wireweed	Boriala	Malvaceae	-	-
79	*Sida rhombifolia*	Arrowleaf sida	Boriala	Malvaceae	-	-
80	*Solanum nigrum*	Black nightshade	Pichkati	Solanaceae	-	-
81	*Spilanthes acmella*	Paracress	Bon narji	Asteraceae	-	-
82	*Spilanthes paniculata*	Paracress	-	Compositae	-	No

Sr. No.	SCIENTIFIC NAME	ENGLISH COMMON NAME	ASSAMESE NAME	FAMILY	IUCN STATUS	INVASIVE
83	*Spirodela sp.*	Duck weed	-	Araceae	-	-
84	*Trapa natans*	Water Chestnut	-	Lythraceae	LC	Yes
85	*Trianthema portulaceastrum*	Water primrose	-	Onagraceae	-	No
86	*Utricularia aurea*	Golden Bladder wort	-	Lentibulariaceae	LC	No
87	*Vallisneria spiralis*	Vallisneria	-	Hydrocharitaceae	-	-

Table 20 List of Ferns and Allies from Season 2 – (Winter)

SR.NO.	SCIENTIFIC NAME	COMMON NAME	FAMILY	ORIGIN	IUCN CATEGORY	INVASIVE
Ferns and Allies (Pteridophytes)						
1	*Acrostichum heterophyllum*	-	Pteridaceae	-	-	No
2	*Adiantum capillus-veneris*	Southern Maidenhair Fern	Pteridaceae	-	LC	No
3	*Amblovenatum opulentum*	-	Thelypteridaceae	-	-	No
4	*Angiopteris evecta*	Giant fern	Marattiaceae	Native	-	No
5	*Araiostegia divaricata*	-	Davalliaceae	-	-	No
6	*Asplenium nidus*	See bird's-nest fern	Aspleniaceae	Native	-	No
7	*Blechnum orientale*	Centipede Fern	Blechnaceae	Native	-	No
8	*Bolbitis heteroclita*	El Nino Fern	Dryopteridaceae	Native	-	No
9	*Christella parasitica*	Parasitic maiden fern	Thelypteridaceae	Native	-	No
10	*Cyathea gigantea*	Tree fern	Cyatheaceae	Native	-	No
11	*Cyathea spinulosa*	Tree fern	Cyatheaceae	Native	-	No
12	*Cyclosorus interruptus*	Hottentot fern	Thelypteridaceae	Native	-	No
13	*Dicranopteris linearis*	Old World forked fern	Gleicheniaceae	Exotic	LC	No
14	*Diplazium dilatatum*	-	Athyriaceae	-	-	No
15	*Diplazium esculentum*	Vegetable fern	Athyriaceae	Native	LC	No
16	*Lygodium flexuosum*	Maidenhair creeper	Lygodiaceae	-	-	No
17	*Lygodium japonicum*	Japanese climbing fern	Lygodiaceae	Native	-	No

SR.NO.	*SCIENTIFIC NAME*	COMMON NAME	FAMILY	ORIGIN	IUCN CATEGORY	INVASIVE
18	*Microlepia speluncae*	-	Dennstaedtiaceae	Native	-	No
19	*Microsorum pteropus*	Java fern	Polypodiaceae	Native	LC	No
20	*Microsorum punctatum*	Fishtail fern	Polypodiaceae	-	-	No
21	*Pityrogramma calomelanos*	Silverback fern	Pteridaceae	Exotic	-	No
22	*Pteris biaurita*	Thinleaf brake	Pteridaceae	-	-	No
23	*Pteris ensiformis*	Slender brake	Pteridaceae	-	-	No
24	*Pteris longipinnula*	-	Pteridaceae	-	-	No
25	*Pteris semipinnata*	-	Pteridaceae	Exotic	-	No
26	*Pteris vittata*	Chinese brake	Pteridaceae	Native	LC	No
27	*Pyrrosia lanceolata*	-	Polypodiaceae	Native	-	No
28	*Pyrrosia piloselloides*	Dragonscale fern	Polypodiaceae	-	-	No
29	*Selaginella monospora*	-	Selaginellaceae	-	-	No
30	*Selaginella semicordata*	-	Selaginellaceae	-	-	No
31	*Sphenomeris chinensis*	Lace Fern	Lindsaeaceae	Exotic	-	No
32	*Stenochlaena palustris*	Climbing Swamp Fern	Blechnaceae	Native	-	No
33	*Vittaria elongata*	Tape fern	Pteridaceae	-	-	No
34	*Salvinia sp.*	Salvinia	Salviniaceae	Exotic	-	-

Table 21 List of Wetland plants from Season 2 – (Winter)

Sr. No.	*Scientific name*	Common name	Family	Origin	INVASIVE	IUCN
Wetland Plants						
1	*Utricularia aurea*	Golden Bladder wort	Lentibulariaceae	Native	No	LC
2	*Aponogeton natans*	Floating lace plant	Aponogetonaceae	Native	No	LC
3	*Azolla pinnata*	Azolla	Azollaceae			
4	*Centella asiatica*	Indian pennywort	Apiaceae	Native	No	LC
5	*Ceratophyllum demersum*	Rigid hornwort	Ceratophyllaceae	Native	Yes	LC

Sr. No.	*Scientific name*	Common name	Family	Origin	INVASIVE	IUCN
6	*Colocasia esculenta*	Wild taro	Araceae	Native	No	LC
7	*Eclipta prostrata*	False daisy	Compositae	Native	No	LC
8	*Eicchornia crassipes*	Common water hyacinth	Pontederiaceae	Exotic	Yes	NA
9	*Hydrilla verticillata*	Hydrilla	Hydrocharitaceae	Native	Yes	LC
10	*Hydrocotyle sibthorpioides*	Lawn marsh pennywort	Araliaceae	Native	No	NA
11	*Ipomoea aquatica*	Water spinach	Convolvulaceae	Native	Yes	LC
12	*Ipomoea carnea*	Pink morning glory	Convolvulaceae	Exotic	No	NA
13	*Lemna perpusilla*	Tiny duckweed	Araceae	Exotic	No	LC
14	*Ludwigia perennis*	Perennial water primrose	Onagraceae	Native	No	LC
15	*Najas graminea*	Ricefield water-nymph	Hydrocharitaceae	Exotic	No	LC
16	*Najas indica*	Guppy grass	Hydrocharitaceae	Native	No	LC
17	*Najas marina*	Holly leaved Naiad	Hydrocharitaceae	Exotic	No	LC
18	*Nymphaea nouchali*	Blue lotus	Nymphaeaceae	Native	No	LC
19	*Phyllanthus rotundifolius*	NA	Phyllanthaceae	Native	No	NA
20	*Potamogeton crispus*	Curled Pondweed	Potamogetonaceae	Native	Yes	LC
21	*Potamogeton natans*	Broad leaved Pondweed	Potamogetonaceae	Exotic	No	LC
22	*Potamogeton nodosus*	Loddon Pondweed	Potamogetonaceae	Exotic	No	LC
23	*Rotala indica*	Indian toothcup	Lythraceae	Native	No	LC
24	*Ruppia maritima*	Beaked tassleweed	Ruppiaceae	Native	No	LC
25	*Spilanthes paniculata*	Paracress	Compositae	Native	No	NA
26	*Spirodela sp.*	Duck weed	Araceae	–	–	NA
27	*Trapa natans*	Water Chestnut	Lythraceae	Native	Yes	LC
28	*Trianthema portulaceastrum*	Water primrose	Onagraceae	Native	No	NA
29	*Vallisneria sp.*	Vallisneria	Hydrocharitaceae	NA	–	NA

Table 22 Inventory of birds observed in Season 2 – (Winter)

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
1	Ashy drongo	*Dicrurus leucophaeus*	Dicruridae	LC	R	IV
2	Asian Barred Owlet	*Glaucidium cuculoides*	Strigidae	LC	R	IV
3	Asian Openbill	*Anastomus oscitans*	Ciconiidae	LC	R	IV
4	Asian palm swift	*Cypsiurus balasiensis*	Apodidae	LC	R	IV
5	Asian Pied Starlings	*Gracupica contra*	Sturnidae	LC	R	IV
6	Barn Swallow	*Hirundo rustica*	Hirundinidae	LC	WV	-
7	Black-hooded Oriole	*Oriolus xanthornus*	Oriolidae	LC	R	IV
8	Blue-throated Barbet	*Psilopogon asiaticus*	Megalaimidae	LC	R	IV
9	Chestnut tailed Starling	*Sturnia malabarica*	Sturnidae	LC	R	IV
10	Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	LC	R	IV
11	Cattle Egret	*Bubulcus ibis*	Ardeidae	LC	R	IV
12	Common Moorhen	*Gallinula chloropus*	Rallidae	LC	R	-
13	Common Myna	*Acridotheres tristis*	Sturnidae	LC	R	IV
14	Common tailorbird	*Orthotomus sutorius*	Cisticolidae	LC	R	-
15	Cotton pygmy goose	*Nettapus coromandelianus*	Anatidae	LC	R	IV
16	Eastern Jungle crow	*Corvus macrorhynchos*	Corvidae	LC	R	-
17	Eurasian Collared-dove	*Streptopelia decaocto*	Columbidae	LC	R	IV
18	Eurasian Tree Sparrow	*Passer montanus*	Passeridae	LC	R	-
19	Great Tit	*Parus major*	Paridae	LC	R	IV
20	Green-billed Malkova	*Phaenicophaeus tristis*	Cuculidae	LC	R	-
21	Oriental Honey-buzzard	*Pernis ptilorhynchus*	Accipitridae	LC	R	-
22	Indian Roller	*Coracias benghalensis*	Coraciidae	LC	R	IV
23	Intermediate Egret	*Ardea intermedia*	Ardeidae	LC	R	IV
24	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC	R	IV
25	Lesser Adjutant	*Leptoptilos javanicus*	Ciconiidae	VU	R	-
26	Lesser Coucal	*Centropus bengalensis*	Cuculidae	LC	R	-
27	Lesser Whistling-duck	*Dendrocygna javanica*	Anatidae	LC	R	IV

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
28	Lineated Barbet	*Psilopogon lineatus*	Megalaimidae	LC	R	IV
29	Little Cormorant	*Microcarbo niger*	Phalacrocoracidae	LC	R	IV
30	Little Egret	*Egretta garzetta*	Ardeidae	LC	R	IV
31	Oriental Pied Hornbill	*Anthracoceros albirostris*	Bucerotidae	LC	R	-
32	Oriental Magpie Robin	*Copsychus saularis*	Muscicapidae	LC	R	-
33	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	LC	R	IV
34	Pied Kingfisher	*Ceryle rudis*	Alcedinidae	LC	R	IV
35	Plain Martin	*Riparia chinensis*	Hirundinidae	LC	R	-
36	Indian Pond-heron	*Ardeola grayii*	Ardeidae	LC	R	IV
37	Red-vented Bulbul	*Pycnonotus cafer*	Pycnonotidae	LC	R	IV
38	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	LC	R	-
39	Rock Dove	*Columba livia*	Columbidae	LC	R	IV
40	Rose-ringed parakeet	*Alexandrinus krameri*	Psittacidae	LC	R	IV
41	Rufous Treepie	*Dendrocitta vagabunda*	Corvidae	LC	R	-
42	Shikra	*Accipiter badius*	Accipitridae	LC	R	-
43	Hair-crested Drongo	*Dicrurus hottentottus*	Dicruridae	LC	R	IV
44	Eastern Spotted Dove	*Spilopelia chinensis*	Columbidae	LC	R	IV
45	White-breasted Kingfisher	*Halcyon smyrnensis*	Alcedinidae	LC	R	IV
46	White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	LC	R	IV
47	White-throated Bulbul	*Alophoixus flaveolus*	Pycnonotidae	LC	R	IV
48	Grey-headed Canary-flycatcher	*Culicicapa ceylonensis*	Stenostiridae	LC	WV	IV
49	Blyth's Leaf-warbler	*Phylloscopus reguloides*	Phylloscopidae	LC	WV	-
50	Lesser Racquet-tailed Drongo	*Dicrurus remifer*	Dicruridae	LC	R	IV
51	Scarlet Minivet	*Pericrocotus flammeus*	Campephagidae	LC	WV	IV
52	Verditer Flycatcher	*Eumyias thalassinus*	Muscicapidae	LC	WV	IV
53	Grey-bellied Tesia	*Tesia cyaniventer*	Scotocercidae	LC	WV	-
54	Large Hawk-cuckoo	*Hierococcyx sparverioides*	Cuculidae	LC	WV	IV
55	Whistler's Warbler	*Phylloscopus whistleri*	Phylloscopidae	LC	WV	-

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
56	Rusty-bellied Shortwing	*Brachypteryx hyperythra*	Muscicapidae	NT	WV	-
57	Lesser Shortwing	*Brachypteryx leucophris*	Muscicapidae	LC	WV	-
58	Large Niltava	*Niltava grandis*	Muscicapidae	LC	WV	-
59	Small Niltava	*Niltava macgrigoriae*	Muscicapidae	LC	WV	-
60	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC	R	IV
61	Ruddy Shelduck	*Tadorna ferruginea*	Anatidae	LC	WV	IV
62	Glossy Ibis	*Plegadis falcinellus*	Threskiornithidae	LC	R	IV
63	Purple Swamphen	*Porphyrio porphyrio*	Rallidae	LC	R	-
64	Indian Spot-billed Duck	*Anas poecilorhyncha*	Anatidae	LC	R	IV
65	Common Kingfisher	*Alcedo atthis*	Alcedinidae	LC	R	IV
66	Black Drongo	*Dicrurus macrocercus*	Dicruridae	LC	R	IV
67	Common Pochard	*Aythya ferina*	Anatidae	VU	WV	IV
68	Common Stonechat	*Saxicola torquatus*	Muscicapidae	LC	WV	-
69	Brahminy Starling	*Sturnia pagodarum*	Sturnidae	LC	R	IV
70	Northern Shoveler	*Spatula clypeata*	Anatidae	LC	R	-
71	Common Sandpiper	*Actitis hypoleucos*	Scolopacidae	LC	WV	IV
72	Rosy Pipit	*Anthus roseatus*	Motacillidae	LC	WV	IV
73	Long-tailed Shrike	*Lanius schach*	Laniidae	LC	WV	-
74	Bengal Bushlark	*Mirafra assamica*	Alaudidae	LC	R	IV
75	Brown Boobook	*Ninox scutulata*	Strigidae	LC	R	IV
76	Eurasian Wigeon	*Mareca penelope*	Anatidae	LC	WV	IV
77	White-rumped Shama	*Kittacincla malabarica*	Muscicapidae	LC	R	-
80	Common Snipe	*Gallinago gallinago*	Scolopacidae	LC	WV	IV
81	Citrine Wagtail	*Motacilla citreola*	Motacillidae	LC	WV	-
82	Wood Sandpiper	*Tringa glareola*	Scolopacidae	LC	WV	IV
83	Brownish-flanked Bush-warbler	*Horornis fortipes*	Scotocercidae	LC	WV	-
84	Brown Shrike	*Lanius cristatus*	Laniidae	LC	WV	-
85	Grey Wagtail	*Motacilla cinerea*	Motacillidae	LC	WV	-

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
86	Long-legged Buzzard	*Buteo rufinus*	Accipitridae	LC	WV	-
87	Black-winged Kite	*Elanus caeruleus*	Accipitridae	LC	R	-
88	Collared Sand Martin	*Riparia riparia*	Hirundinidae	LC	WV	-
89	White Wagtail	*Motacilla alba*	Motacillidae	LC	WV	-
91	Little Ringed Plover	*Charadrius dubius*	Charadriidae	LC	R	IV
93	Common Greenshank	*Tringa nebularia*	Scolopacidae	LC	WV	-
94	Swamp Francolin	*Francolinus gularis*	Phasianidae	VU	R	-
95	Richard's Pipit	*Anthus richardi*	Motacillidae	LC	WV	IV
96	Oriental Darter	*Anhinga melanogaster*	Anhingidae	NT	R	IV
97	Laughing Dove	*Spilopelia senegalensis*	Columbidae	LC	R	IV
98	Smoky Warbler	*Phylloscopus fuligiventer*	Phylloscopidae	LC	WV	IV
99	Yellow-bellied Prinia	*Prinia flaviventris*	Cisticolidae	LC	R	-
100	Bar-headed Goose	*Anser indicus*	Anatidae	LC	WV	IV
101	Ferruginous Duck	*Aythya nyroca*	Anatidae	NT	WV	IV
102	Red Junglefowl	*Gallus gallus*	Phasianidae	LC	R	IV
103	Little Spiderhunter	*Arachnothera longirostra*	Nectariniidae	LC	R	-
104	Crimson Sunbird	*Aethopyga siparaja*	Nectariniidae	LC	R	IV
105	Kalij Pheasant	*Lophura leucomelanos*	Phasianidae	LC	R	I
106	Greater Racquet-tailed Drongo	*Dicrurus paradiseus*	Dicruridae	LC	R	IV
107	Common Iora	*Aegithina tiphia*	Aegithinidae	LC	R	IV
108	Black-naped Monarch	*Hypothymis azurea*	Monarchidae	LC	R	-
109	Mallard	*Anas platyrhynchos*	Anatidae	LC	R	IV
110	Indian Cormorant	*Phalacrocorax fuscicollis*	Phalacrocoracidae	LC	R	IV
111	Little Pratincole	*Glareola lactea*	Glareolidae	LC	R	IV
112	Green-backed Heron	*Butorides striata*	Ardeidae	LC	R	IV
113	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	LC	WV	IV
114	Yellow Wagtail	*Motacilla flava*	Motacillidae	LC	WV	-
115	Great Crested Grebe	*Podiceps cristatus*	Podicipedidae	LC	WV	IV

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	MIGRATION STATUS	WPA SCHEDULE
116	Grey-headed Woodpecker	*Picus canus*	Picidae	LC	R	IV
117	Tickell's Leaf-warbler	*Phylloscopus affinis*	Phylloscopidae	LC	WV	-
118	Lesser Fish-eagle	*Icthyophaga humilis*	Accipitridae	NT	R	I
119	Himalayan Griffon	*Gyps himalayensis*	Accipitridae	NT	WV	IV
120	White-rumped Vulture	*Gyps bengalensis*	Accipitridae	CR	R	I
121	Black Stork	*Ciconia nigra*	Ciconiidae	LC	WV	IV
122	Griffon Vulture	*Gyps fulvus*	Accipitridae	LC	WV	IV
123	Great Myna	*Acridotheres grandis*	Sturnidae	LC	R	IV
124	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	Jacanidae	LC	R	IV
125	Common Teal	*Anas crecca*	Anatidae	LC	WV	IV
126	Black-tailed Godwit	*Limosa limosa*	Scolopacidae	NT	WV	-
127	Great White Egret	*Ardea alba*	Ardeidae	LC	R	IV
128	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	LC	R	IV
129	Temminck's Stint	*Calidris temminckii*	Scolopacidae	LC	WV	-
130	Bluethroat	*Cyanecula svecica*	Muscicapidae	LC	WV	-
131	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	LC	WV	-
132	Acrocephalus	-	Acrocephalidae	-	-	-
133	Greylag Goose	*Anser anser*	Anatidae	LC	WV	IV

Table 23 Inventory of Butterflies observed in Season 2 – (Winter)

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
1	Eastern Striped Albatross	*Appias olferna*	Pieridae	-	II
2	Blue Tiger	*Tirumala limniace*	Nymphalidae	-	-
3	Common Four-ring	*Ypthima huebneri*	Nymphalidae	-	-
4	Common Castor	*Ariadne merione*	Nymphalidae	-	-
5	Chocolate Albatross	*Appias lyncida*	Pieridae	-	II
6	Chocolate Pansy	*Junonia iphita*	Nymphalidae	-	-

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
7	Common Grass Yellow	*Eurema hecabe*	Pieridae	-	-
8	Common Mormon	*Papilio polytes*	Papilionidae	-	-
9	Common Yeoman	*Cirrochroa tyche*	Nymphalidae	-	-
10	Danaid Eggfly	*Hypolimnas misippus*	Nymphalidae	LC	I
11	Elbowed Pierrot	*Caleta elna*	Lycaenidae	-	-
12	Fluffy Tit	*Zeltus amasa*	Lycaenidae	-	-
13	Glassy Tiger	*Parantica aglea*	Nymphalidae	-	-
14	Great Orange-tip	*Hebomoia glaucippe*	Pieridae	-	-
15	Grey Count	*Tanaecia lepidea*	Nymphalidae	-	II
16	Grey Pansy	*Junonia atlites*	Nymphalidae	-	-
17	Common Gull	*Cepora nerissa*	Pieridae	-	II
18	Common Lascar	*Pantoporia hordonia*	Nymphalidae	-	-
19	Lemon Emigrant	*Catopsilia pomona*	Pieridae	-	-
20	Common Palmfly	*Elymnias hypermnestra*	Nymphalidae	-	-
21	Peacock Pansy	*Junonia almana*	Nymphalidae	LC	-
22	Plain Tiger	*Danaus chrysippus*	Nymphalidae	LC	-
23	Psyche	*Leptosia nina*	Pieridae	-	-
24	Punchinello	*Zemeros flegyas*	Riodinidae	-	-
25	Purple Sapphire	*Heliophorus epicles*	Lycaenidae	-	-
26	Red Helen	*Papilio helenus*	Papilionidae	-	-
27	Common Rose	*Pachliopta aristolochiae*	Papilionidae	LC	-
28	Rustic	*Cupha erymanthis*	Nymphalidae	-	-
29	Striped Tiger	*Danaus genutia*	Nymphalidae	-	-
30	Indian Wanderer	*Pareronia hippia*	Pieridae	-	-
31	Yamfly	*Loxura atymnus*	Lycaenidae	-	-
32	Dark-branded Bushbrown	*Mycalesis mineus*	Nymphalidae	-	-
33	Common Sergeant	*Athyma perius*	Nymphalidae	-	-
34	Smaller Dartlet	*Oriens goloides*	Hesperiidae	-	-
35	Long-branded Bushbrown	*Mycalesis visala*	Nymphalidae	-	-

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
36	Bamboo Treebrown	*Lethe europa*	Nymphalidae	-	-
37	Blackvein Sergeant	*Athyma ranga*	Nymphalidae	-	II
38	Lesser Grass Blue	*Zizina otis*	Lycaenidae	-	-
39	Dark Evening Brown	*Melanitis phedima*	Nymphalidae	-	-
40	Common Evening Brown	*Melanitis leda*	Nymphalidae	-	-
41	Common Gem	*Poritia hewitsoni*	Lycaenidae	-	II
42	Pale Green Awlet	*Burara gomata*	Hesperiidae	-	-
43	Sylhet Oakblue	*Arhopala silhetensis*	Lycaenidae	-	II
44	Opaque Six-Lineblue	*Nacaduba beroe*	Lycaenidae	-	-
45	Angled Red Forester	*Lethe chandica*	Nymphalidae	-	-
46	Tawny Rajah	*Charaxes bernardus*	Nymphalidae	-	II
47	Pale Wanderer	*Pareronia avatar*	Pieridae	-	II
48	Clear Sailer	*Neptis nata*	Nymphalidae	-	II
49	Straight Swift	*Parnara guttatus*	Hesperiidae	-	-
50	Dark Velvet Bob	*Koruthaialos butleri*	Hesperiidae	-	-
51	Wax Dart	*Cupitha purreea*	Hesperiidae	-	-
52	Common Five-ring	*Ypthima baldus*	Nymphalidae	-	-
53	Large Yeoman	*Cirrochroa aoris*	Nymphalidae	-	-
54	Common Sailer	*Neptis hylas*	Nymphalidae	-	-
55	Common Forester	*Lethe isana*	Nymphalidae	-	-
56	Double-branded Bushbrown	*Mycalesis adamsonii*	Nymphalidae	-	II
57	Chocolate Demon	*Ancistroides nigrita*	Hesperiidae	-	-
58	Parnara Swift spp	*Parnara spp.*	Hesperiidae	-	-
59	Common Leopard	*Phalanta phalantha*	Nymphalidae	LC	-
60	Tawny Coster	*Acraea terpsicore*	Nymphalidae	-	-
61	Wizard	*Rhinopalpa polynice*	Nymphalidae	-	II
62	Commander	*Moduza procris*	Nymphalidae	-	-
63	Map Butterfly	*Cyrestis thyodamas*	Nymphalidae	-	-
64	Chocolate Tiger	*Parantica melaneus*	Nymphalidae	-	-

SR. NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
65	Yellow-crested Spangle	*Papilio elephenor*	Papilionidae	-	II
66	Red-base Jezebel	*Delias pasithoe*	Pieridae	-	-
67	Tamil Oakblue	*Arhopala bazaloides*	Lycaenidae	LC	II
68	Saronis Sunbeam	*Curetis saronis*	Lycaenidae	-	-
69	Large Four-Lineblue	*Nacaduba pactolus*	Lycaenidae	-	-
70	Common Batwing	*Atrophaneura varuna*	Papilionidae	LC	-
71	Dark Palm-Dart	*Telicota bambusae*	Hesperiidae	-	-
72	Red Lacewing	*Cethosia biblis*	Nymphalidae	-	-
73	Small Branded Swift	*Pelopidas mathias*	Hesperiidae	LC	-
74	Chinese Bushbrown	*Mycalesis gotama*	Nymphalidae	-	II
75	Pale Four-Lineblue	*Nacaduba hermus*	Lycaenidae	-	II
76	Common Tit	*Hypolycaena erylus*	Lycaenidae	-	-
77	Common Jester	*Symbrenthia lilaea*	Nymphalidae	-	-
78	Lesser Batwing	*Atrophaneura aidoneus*	Papilionidae	LC	-
79	Lesser Gull	*Cepora nadina*	Pieridae	-	II
80	Extra Lascar	*Pantoporia sandaka*	Nymphalidae	-	-

Table 24 Inventory of Mammals observed in Season 2 – (Winter)

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
1	Hoary-bellied Squirrel	*Callosciurus pygerythrus*	Sciuridae	LC	-
2	Assamese Macaque	*Macaca assamensis*	Cercopithecidae	NT	II
3	Northern Pig-tailed Macaque	*Macaca leonina*	Cercopithecidae	VU	II
4	Western Hoolock Gibbon	*Hoolock hoolock*	Hylobatidae	EN	I
5	Golden Jackal	*Canis aureus*	Canidae	LC	II
6	Indian Grey Mongoose	*Urva edwardsii*	Herpestidae	LC	II
7	Asian Elephant	*Elephas maximus*	Elephantidae	EN	I
8	Ganges River Dolphin	*Platanista gangetica gangetica*	Platanistidae	EN	I
9	Rhesus Macaque	*Macaca mulatta*	Cercopithecidae	LC	II

10	Indian Flying Fox	*Pteropus giganteus*	Pteropodidae	LC	V

Table 25 Inventory of Herpetofauna observed in Season 2 – (Winter)

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA SCHEDULE
1	Checkered Keelback	*Fowlea piscator*	Colubridae	LC	II
2	Keeled Indian Mabuya	*Eutropis carinata*	Scincidae	LC	-

Table 26 Inventory of Herpetofauna observed in Season 2 – (Winter)

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA
1	Elongate glassy perchlet	*Chanda nama*	Ambassidae	LC	-
2	Spotted Snakehead	*Channa punctata*	Channidae	LC	-
3	Snakehead Murrel	*Channa striata*	Channidae	LC	-
4	Wagur	*Clarias magur*	Clariidae	LC	-
5	Grass carp	*Ctenopharyngodon idella*	Cyprinidae	-	-
6	Gangetic leaffish	*Nandus nandus*	Nandidae	LC	-
7	Catla	*Gibelion catla*	Cyprinidae	LC	-
8	Indian River Shad	*Gudusia chapra*	Clupeidae	LC	-
9	Singee	*Heteropneustes fossilis*	Heteropneustidae	LC	-
10	Spiny Eel	*Mastacembelus armatus*	Mastacembelidae	LC	-
11	Gangetic mudeel	*Monopterus cuchia*	Synbranchidae	LC	-
12	-	*Mystus cavasius*	Bagridae	LC	-
13	Spotfin Swamp Barb	*Puntius sophore*	Cyprinidae	LC	-
14	Reba Carp	*Cirrhinus reba*	Cyprinidae	LC	-
15	Dwarf gourami	*Trichogaster lalius*	Osphronemidae	LC	-
16	-	*Wallago attu*	Siluridae	VU	-
17	-	*Xenentodon cancila*	Belonidae	LC	-
18	-	*Leiodon cutcutia*	Tetraodontidae	LC	-

SR.NO.	COMMON NAME	SCIENTIFIC NAME	FAMILY	IUCN STATUS	WPA
19	Giant Murrel	*Channa marulius*	Channidae	LC	-



INTERNATIONAL UNION

FOR CONSERVATION OF NATURE

INDIA COUNTRY OFFICE

H-4, GREEN PARK EXTENSION,

NEW DELHI-110 016, INDIA
TEL. +91 11 2616 7742, 2618 5554

MOB: +91 9810200484

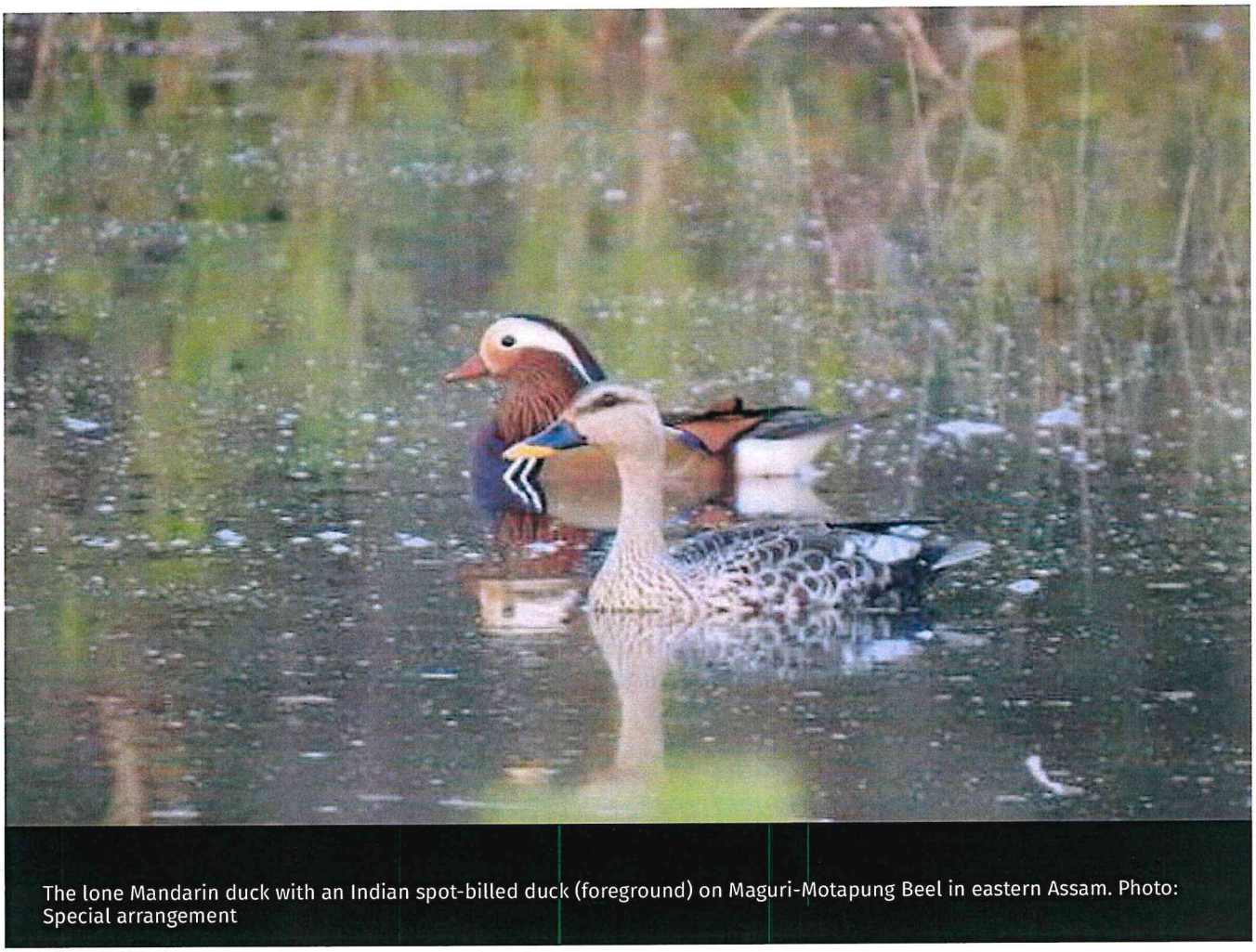
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NATIONAL

Mandarin duck sighted after 118 years in Assam's gas well blowout-affected wetland

Special Correspondent

GUWAHATI: FEBRUARY 11, 2021 15:51 IST
UPDATED: FEBRUARY 11, 2021 15:52 IST



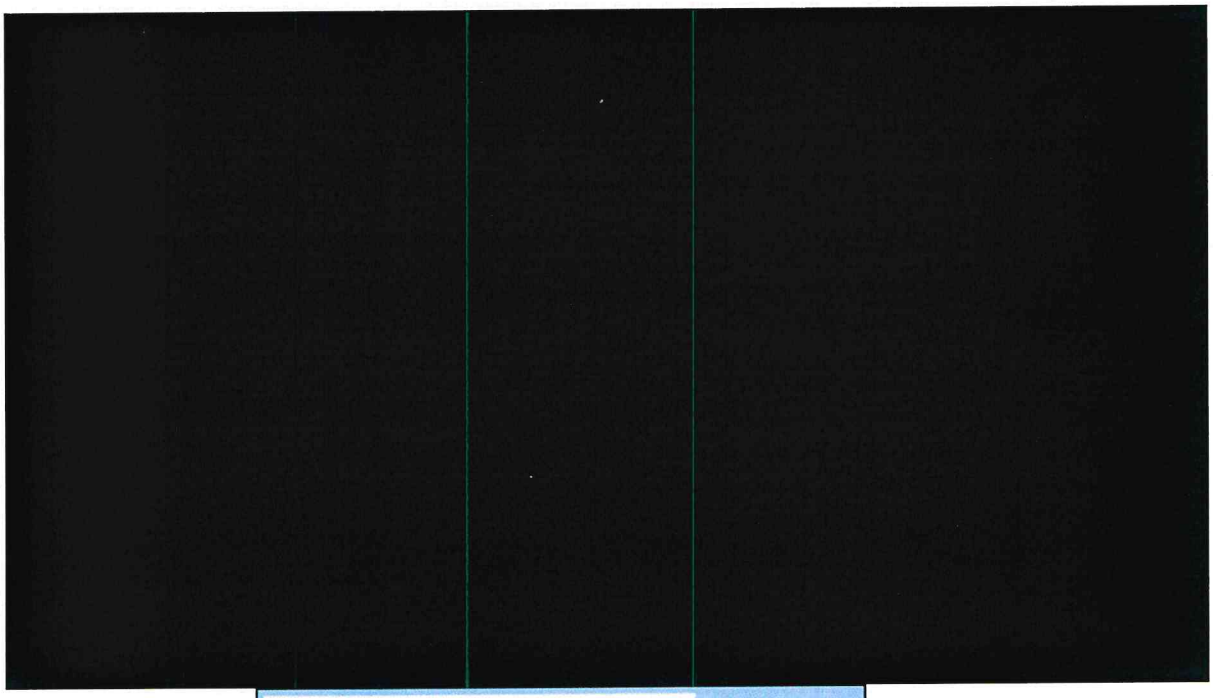
The lone Mandarin duck with an Indian spot-billed duck (foreground) on Maguri-Motapung Beel in eastern Assam. Photo: Special arrangement

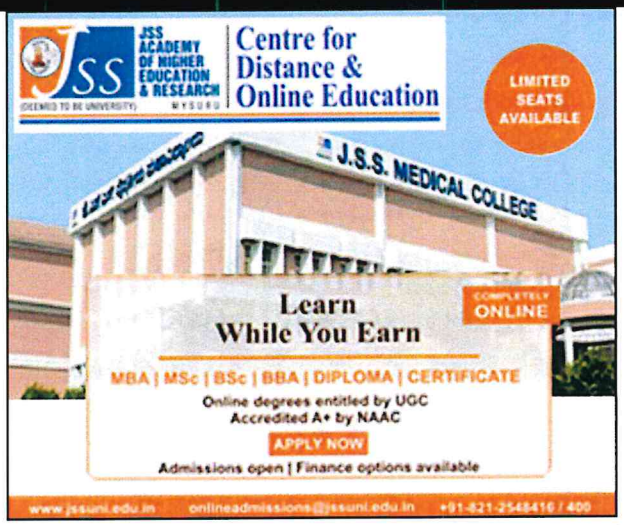
Birders believe the lone duck lost its way and accompanied a flock of

Indian spotbill duck to Maguri-Motapung Beel off its migratory route

A colourful duck from eastern Asia spotted in Assam after 118 years has raised hopes for a wetland that was affected by a blowout and inferno at a natural gas well in May-June, 2020.

Spotting the lone Mandarin duck on the Maguri-Motapung Beel in eastern Assam's Tinsukia district a few days ago was an "accident" for a team of avian specialists from the Wildlife Trust of India (WTI) and birding volunteers.





The duck, whose primary habitat is in eastern China and southern Japan, had landed in Assam by accident too.

"Mandarin ducks do not come regularly to India but one or two may join other migratory birds and go wherever they go. This duck accompanied a flock of Indian spot-billed duck that could have migrated to China or Japan," WTI's Aftab Ahmed told *The Hindu* on Thursday.

The last time a Mandarin duck was spotted in Assam was in 1902.

"Spotting the Mandarin duck was a pleasant surprise as we had decided to visit the Maguri-Motapung Beel on way to Arunachal Pradesh for a survey of the white-winged wood duck," he said.

One of the largest living species of ducks, the white-winged wood duck is mostly found in Assam's Nameri National Park and Dehing-Patkai Wildlife Sanctuary. At about 200 individuals, it is much rarer than the Mandarin duck.

"Mixed flocking is not unusual among different species of ducks. This Mandarin duck possibly lost its way or broke away from its kind to fly with the Indian spot-billed ducks," Mr. Ahmed said.

Whatever the reason, the Mandarin duck has been a "fantastic find" from the ecological point of view, WTI's chief executive officer Vivek Menon said.

Green activists said this augurs well for Maguri-Motapung Beel where birds and fishes had died after a gas well operated by the Oil India Limited at the adjoining Baghjan had a blowout – uncontrolled ejection of oil condensates at great speed – in May 2020. The well caught fire less than a fortnight later to pose a greater ecological threat to the wetland.

"What the sighting of the Mandarin duck tells us is that Maguri Beel is still an important place for migratory birds after it took a hit because of the blowout," Mr. Ahmed said.

NEye

Rare mandarin duck spotted in over Assam's wetland

MYITHILI HAZARIKA 10 February, 2021 02:23 pm IST



Mandarin duck was spotted in Assam's Maguri Motapung Beel | Twitter/@vivek4wild

New Delhi: A mandarin duck was spotted in Assam's Maguri Motapung Beel (a wetl earlier this week, possibly for the first time in over a 100 years, by a team of the Wildl India (WTI).

The Maguri Beel, situated close to the state's Baghjan village, had suffered damage las following a blowout in one of the oil wells belonging to the Oil India limited. The oil v caught fire on 9 June 2020 and burned for 170 days, before the blowout was doused ir November.

Advertisement

The mandarin duck has a distinctive, elaborate plumage and it nests in trees. The bir to East Asia, but has established feral populations throughout Western Europe.

WTI CEO Vivek Menon took to Twitter Monday to announce the happy news.

It has also been reported that the duck was last seen in the area in 1902, making the l sighting the first in 118 years.

Assam engineering students develop TikTok alterna 'Tip Teapi'

Three students from the Jorhat Engineering College in Assam have come up with a T alternative called Tip Teapi. The video sharing and social networking mobile app has developed by Saswati Kotoky from Dergaon, Amarjyoti Gautam from Jorhat, and Him Madhukalya of Dibrugarh district in the state.

"The idea was conceived during the lockdown to fill the vacuum by developing such a alternative to the Chinese app TikTok. The app – Tip Teapi will work similar to TikTol who is in charge of sales and marketing of the app, has been quoted as saying. She als app has privacy protection unlike Chinese apps.

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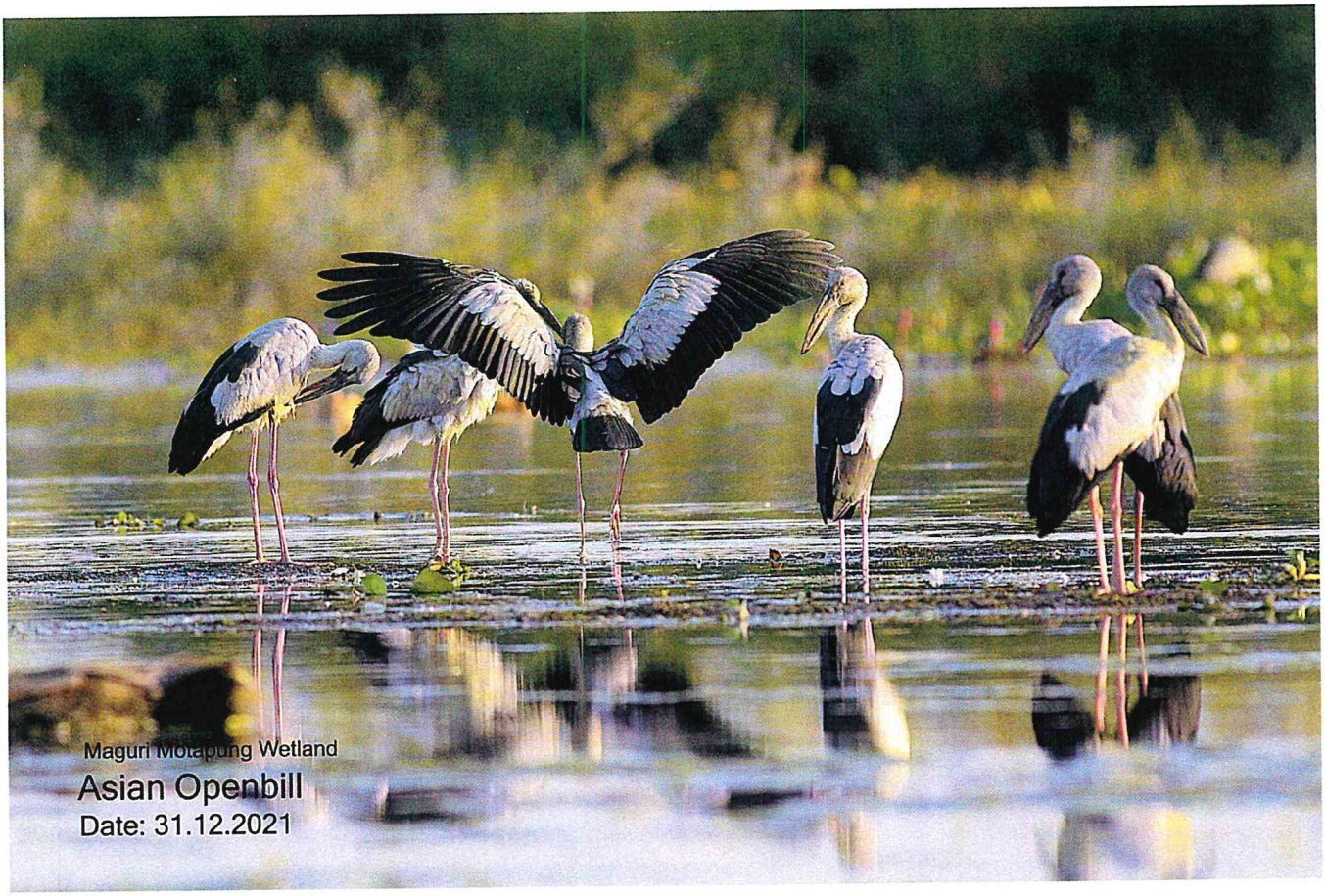
Tip Teapi is similar to TikTok and allows users to make friends, follow others, like anc on videos, as well as share them via other social media sites. The developers have alsc they have introduced the app with an aim to provide people with a platform to show talents or skills in 12 different categories such as music, art, drama, cooking, science a education.

Naga musician to hold concert at orphanage on Valentine's Day to raise funds

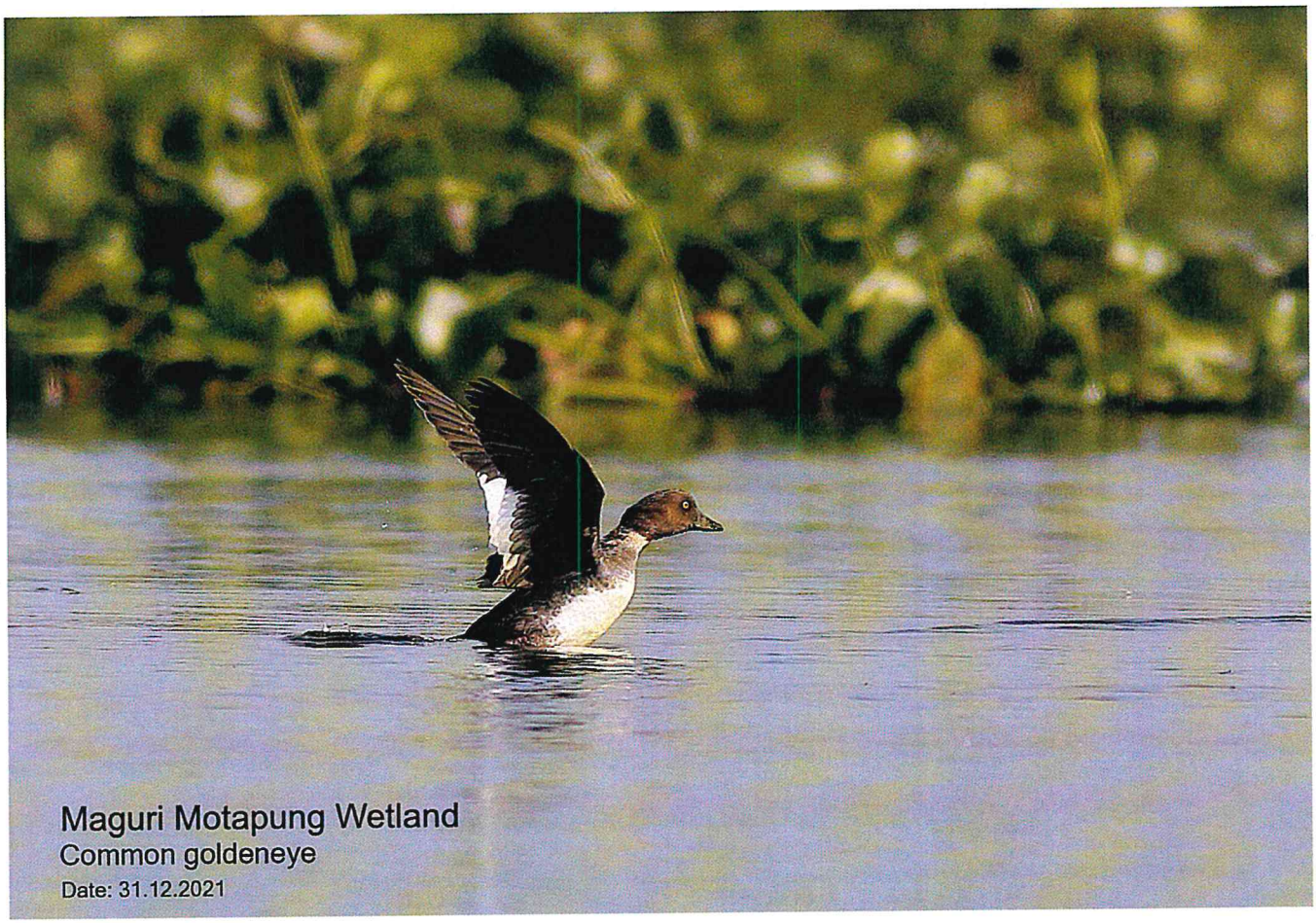
Naga musician Alobo Naga will hold a music concert at an orphanage in Dimapur on Valentine's Day.

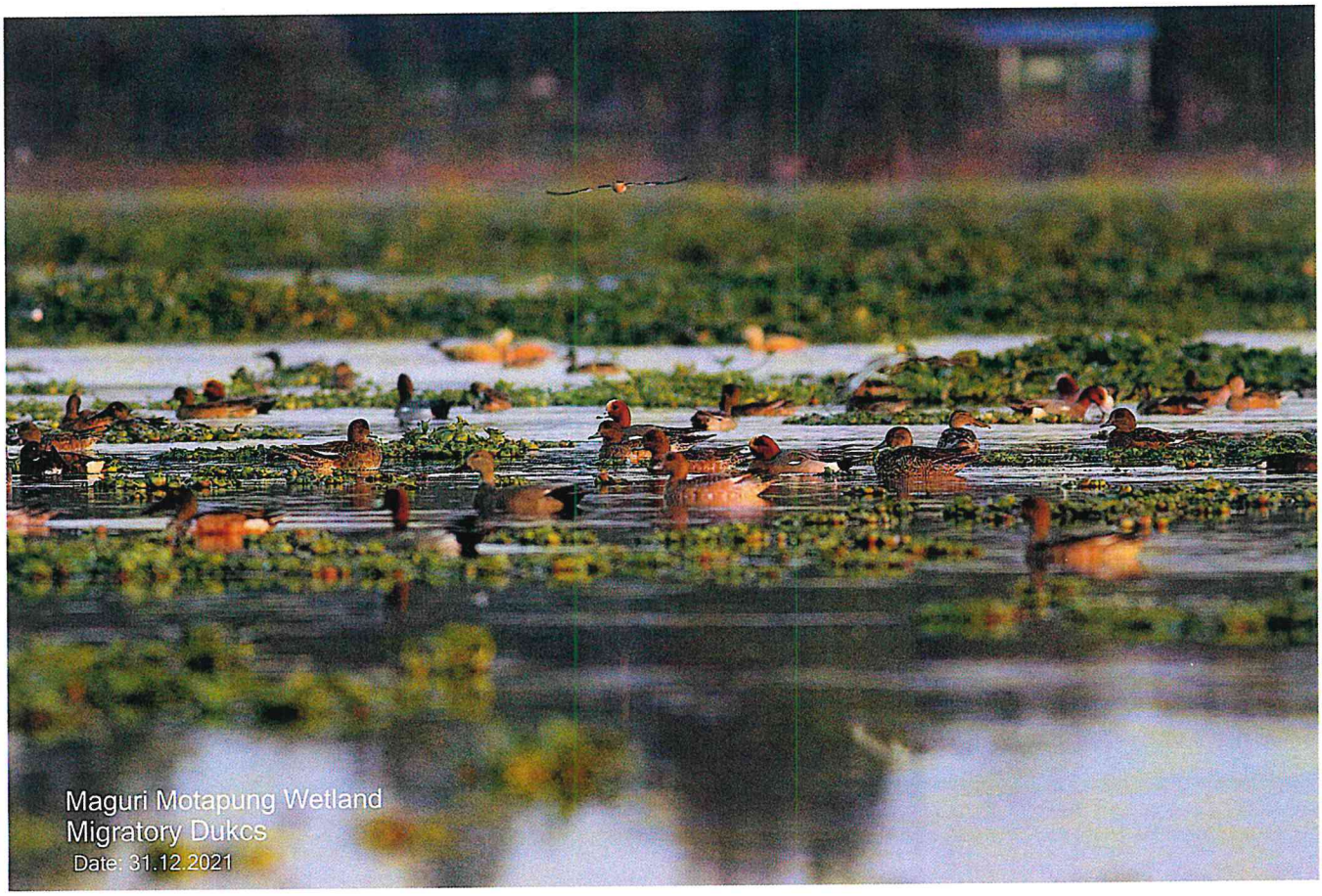
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"ANNEXURE - R 29" (colly)





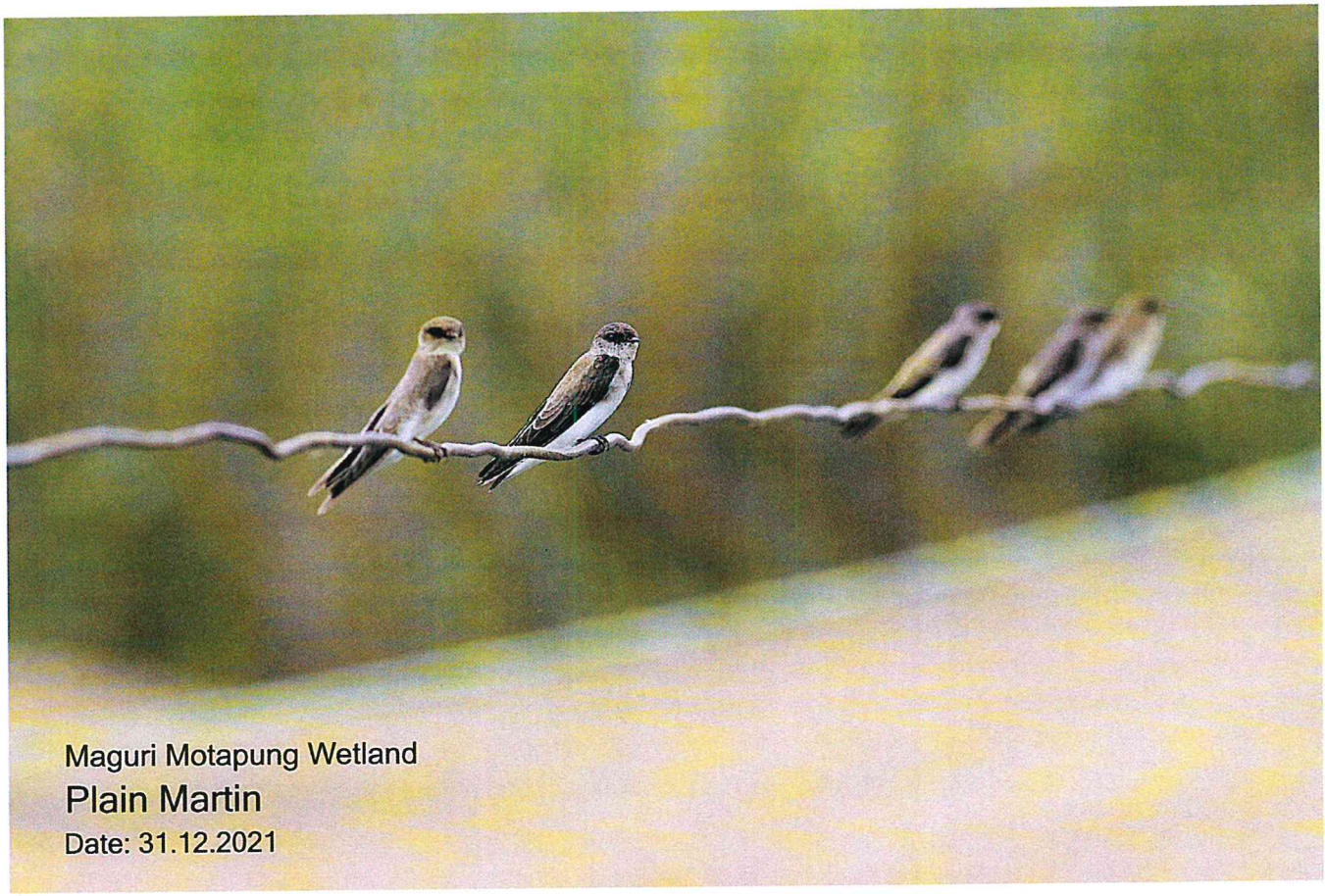

Maguri Motapung Wetland
Common goldeneye
Date: 31.12.2021

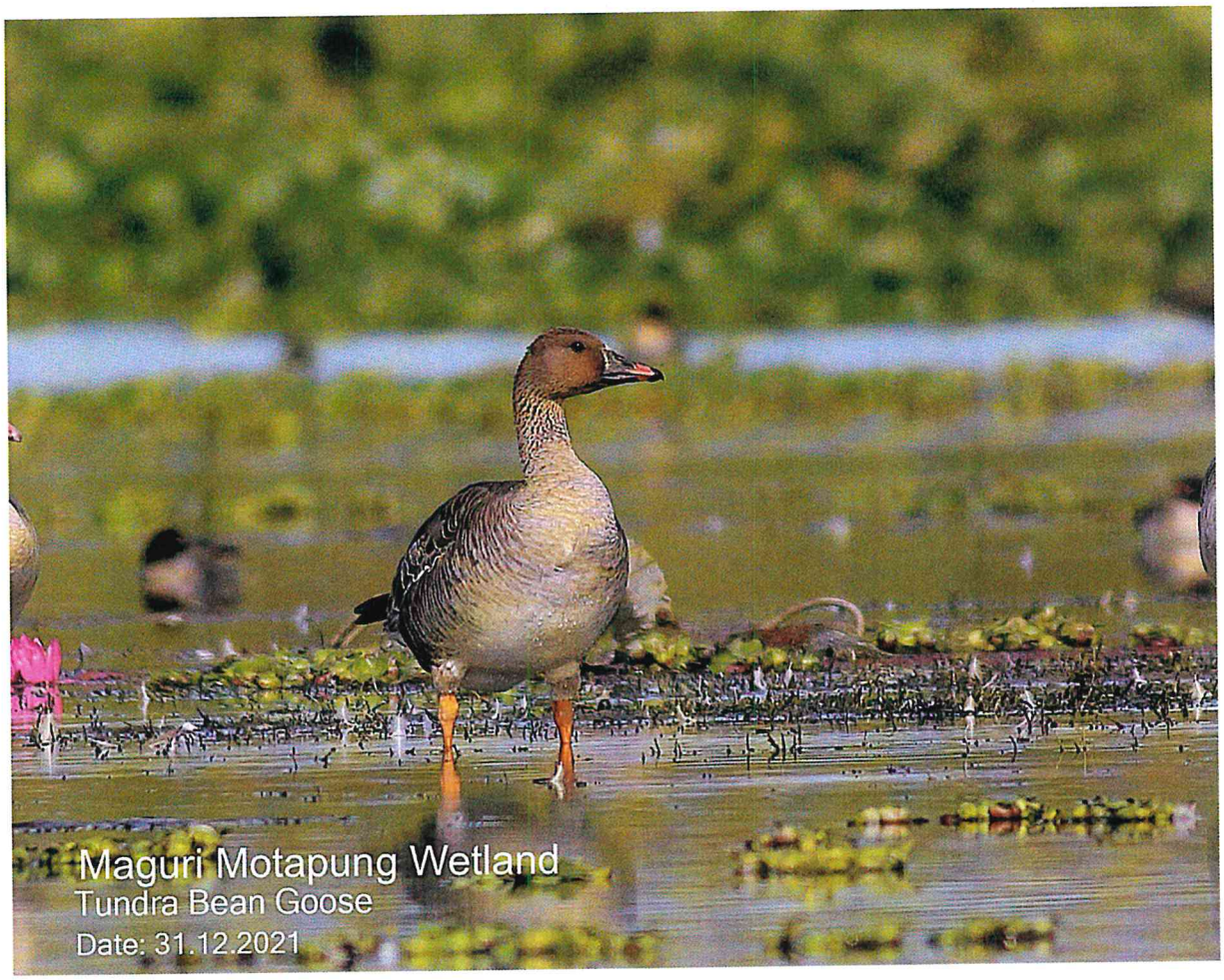

Maguri Motapung Wetland
Migratory Dukcs
Date: 31.12.2021

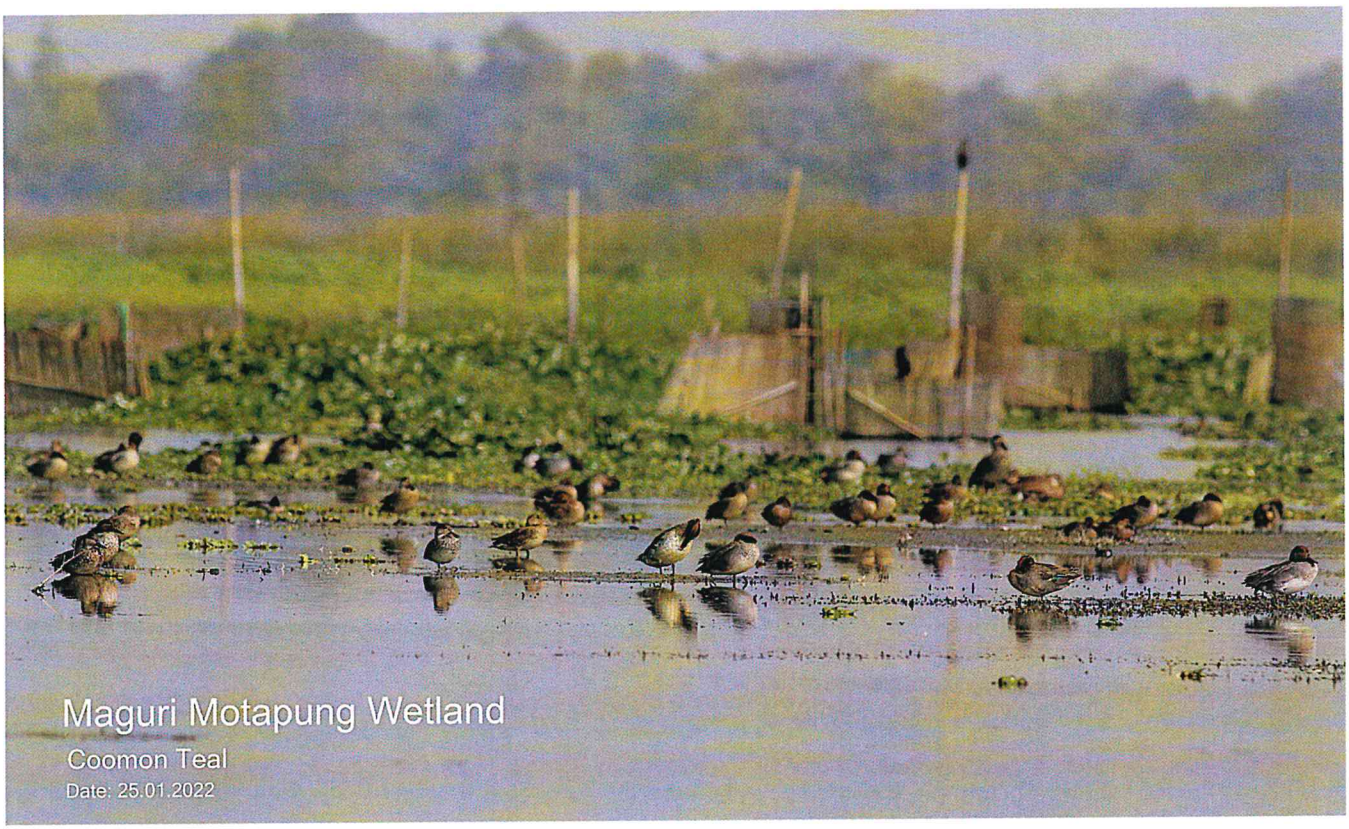

Maguri Motapung Wetland
Ferruginous Pochard
Date: 31.12.2021


Maguri Motapung Wetland
Greylag Goose
Date: 31.12.2021

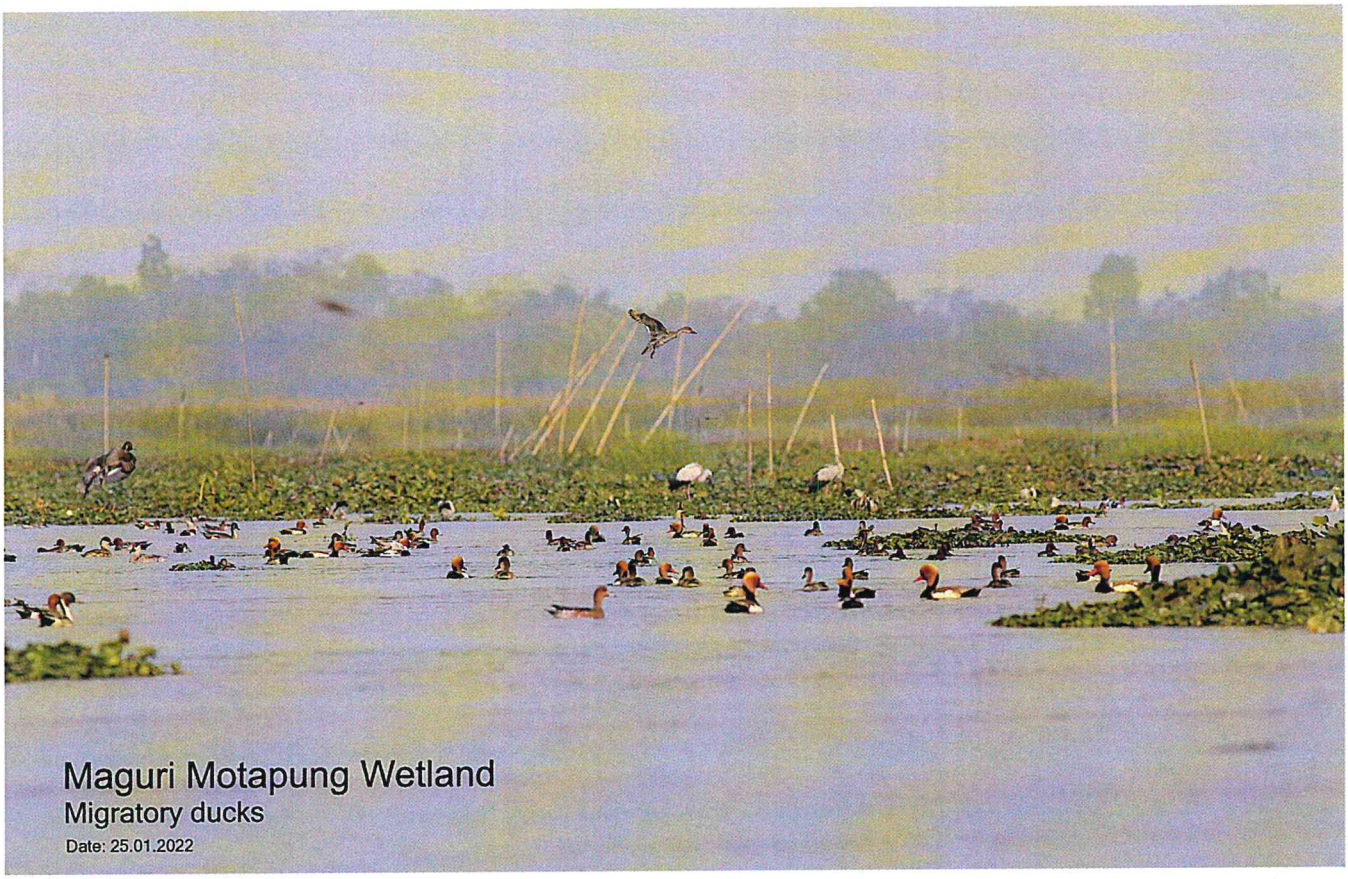

Maguri Motapung Wetland
Glossy Ibis
Date: 31.12.2021


Maguri Motapung Wetland
Plain Martin
Date: 31.12.2021


Maguri Motapung Wetland
Tundra Bean Goose
Date: 31.12.2021


Maguri Motapung Wetland
Coomon Teal
Date: 25.01.2022


Maguri Motapung Wetland
Lesser whistling duck
Date: 25.01.2022


Maguri Motapung Wetland
Migratory ducks
Date: 25.01.2022

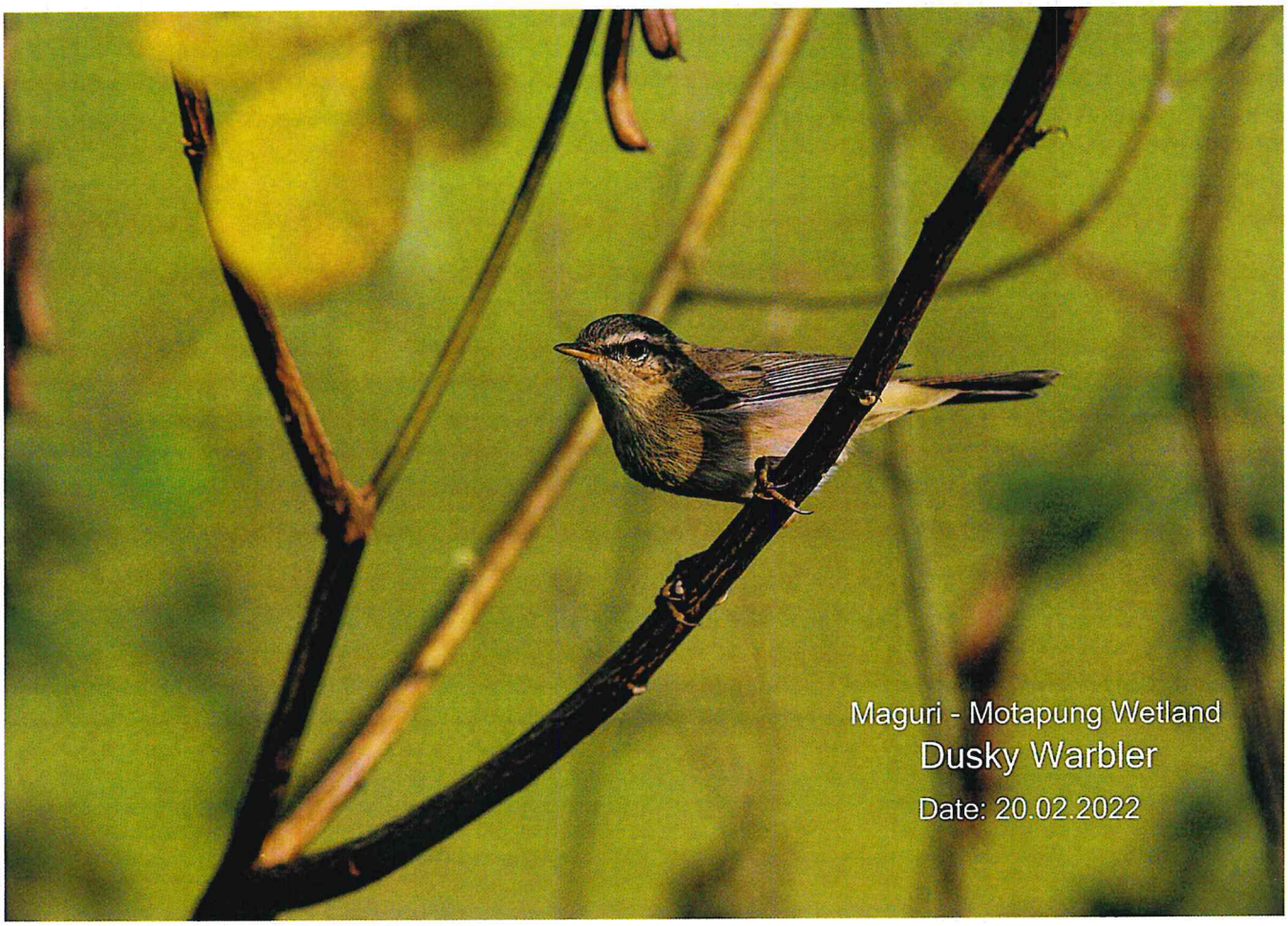

Maguri Motapung Wetland
Migratory ducks
Date: 25.01.2022

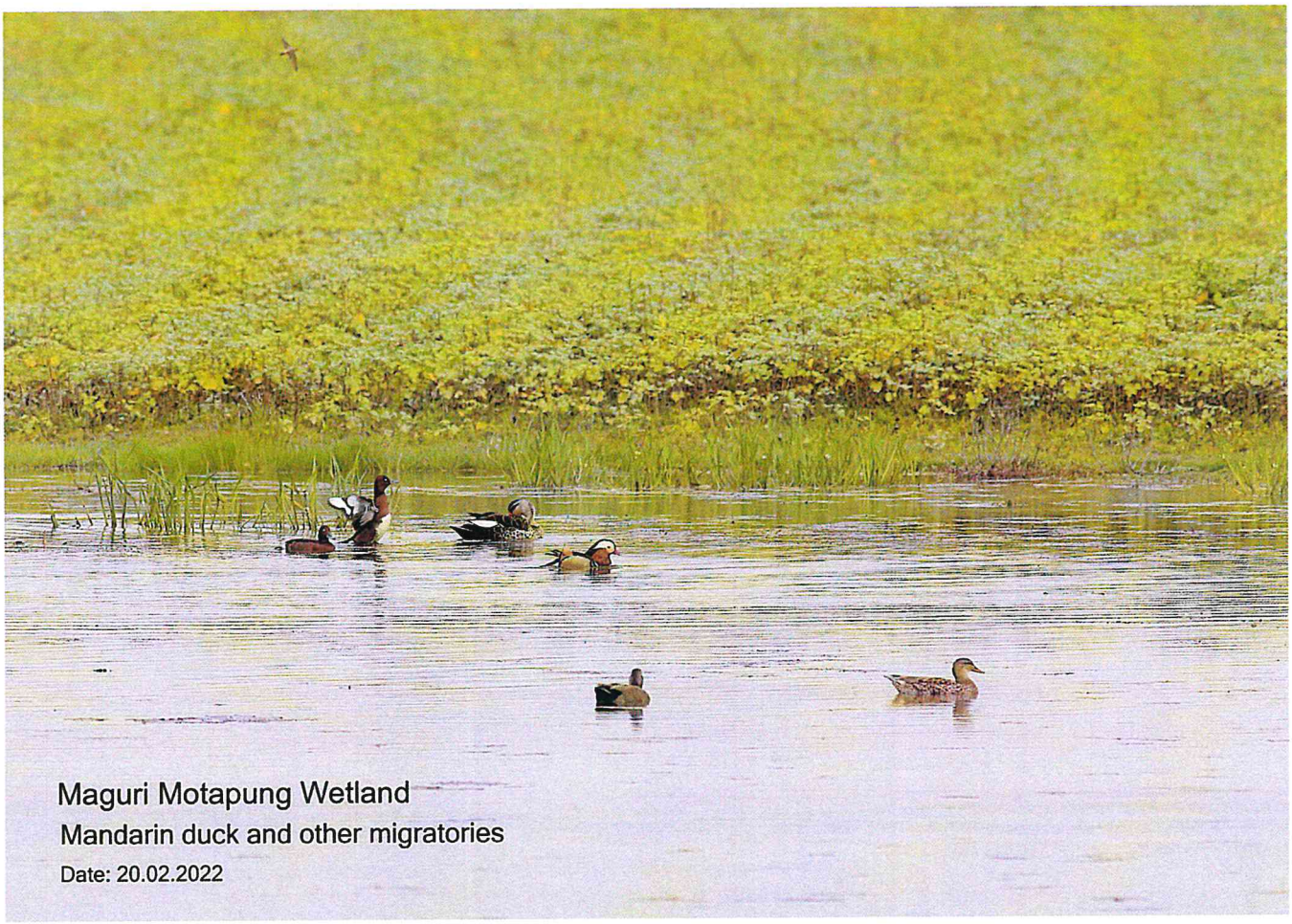

Maguri Motapung Wetland
Northern Lapwing
Date: 25.01.2022


Maguri Motapung Wetland
Temminck's stint
Date: 25.01.2022

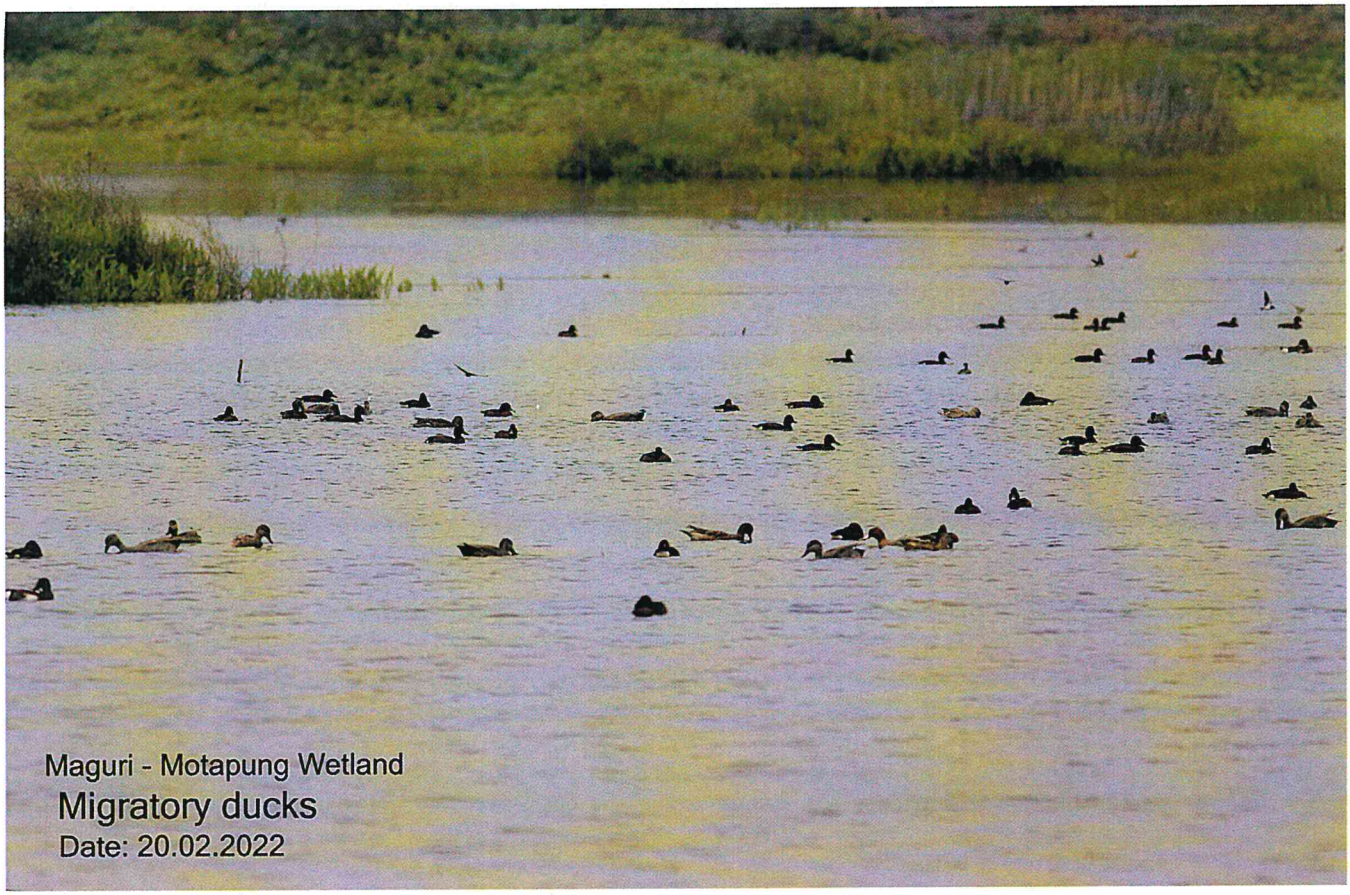

Maguri Motapung Wetland
Wild water buffalo
Date: 25.01.2022


Maguri - Motapung Wetland
Common Stonechat
Date: 20.02.2022


Maguri - Motapung Wetland
Dusky Warbler
Date: 20.02.2022

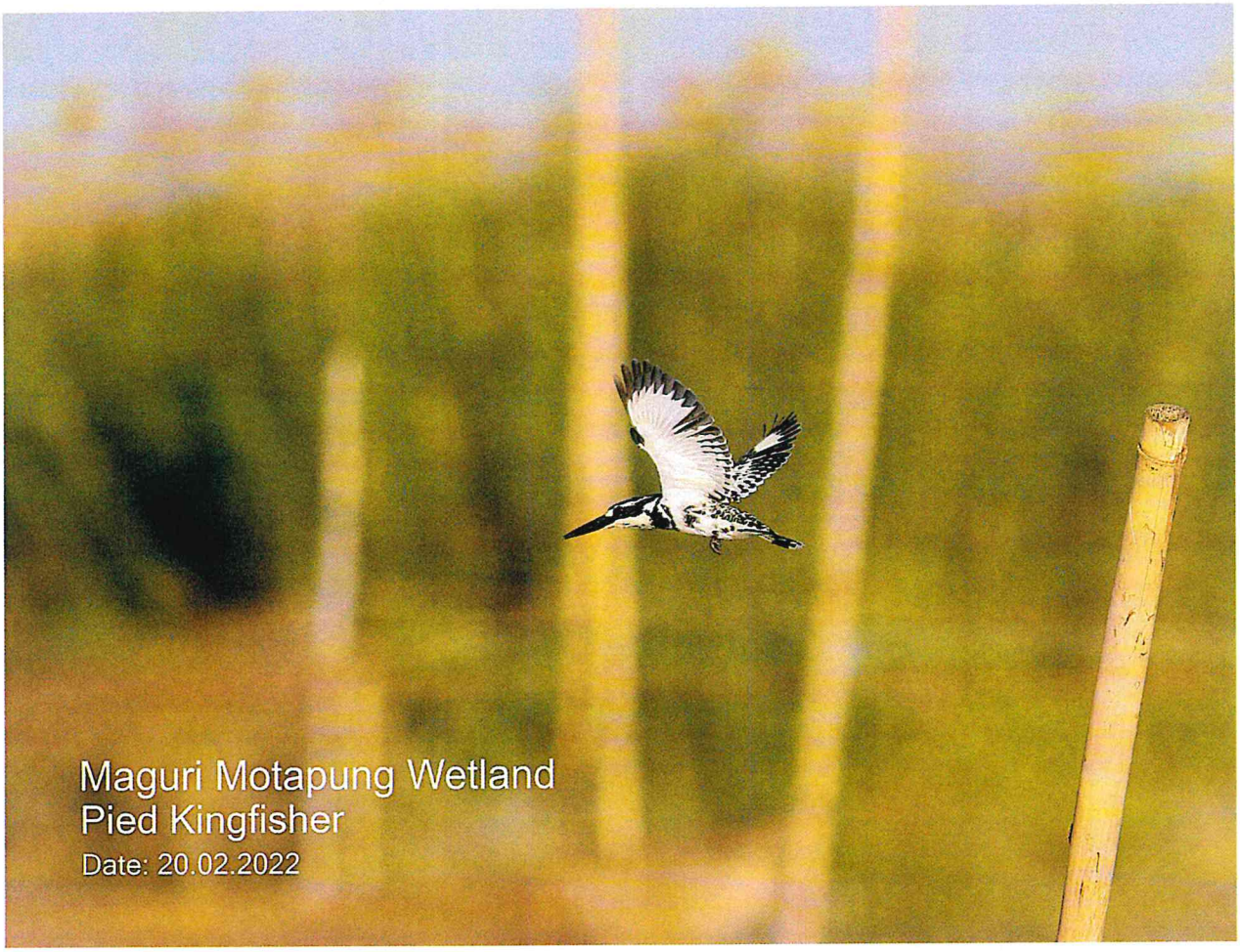


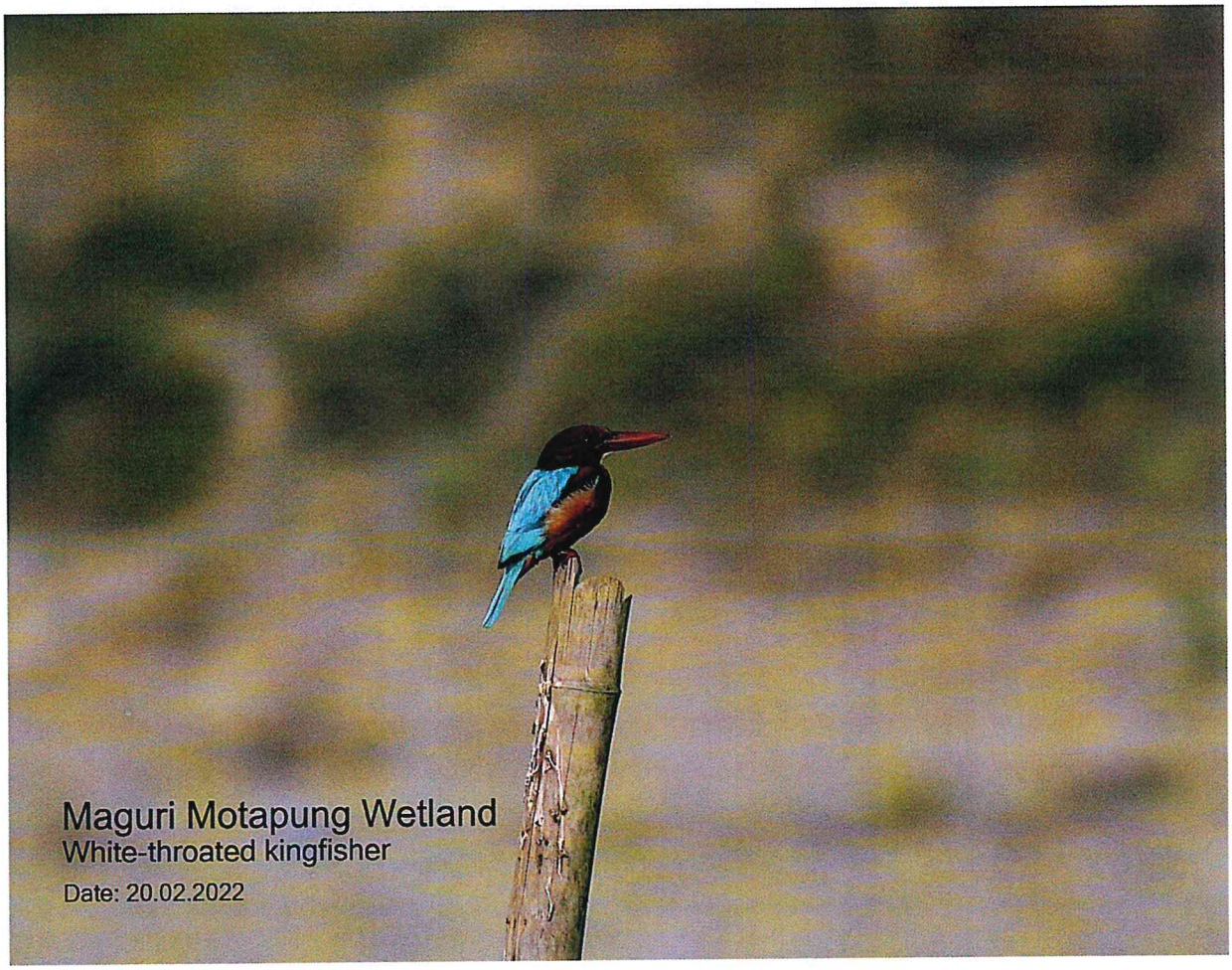
Maguri Motapung Wetland
Mandarin duck and other migratories
Date: 20.02.2022



Maguri - Motapung Wetland
Migratory ducks
Date: 20.02.2022

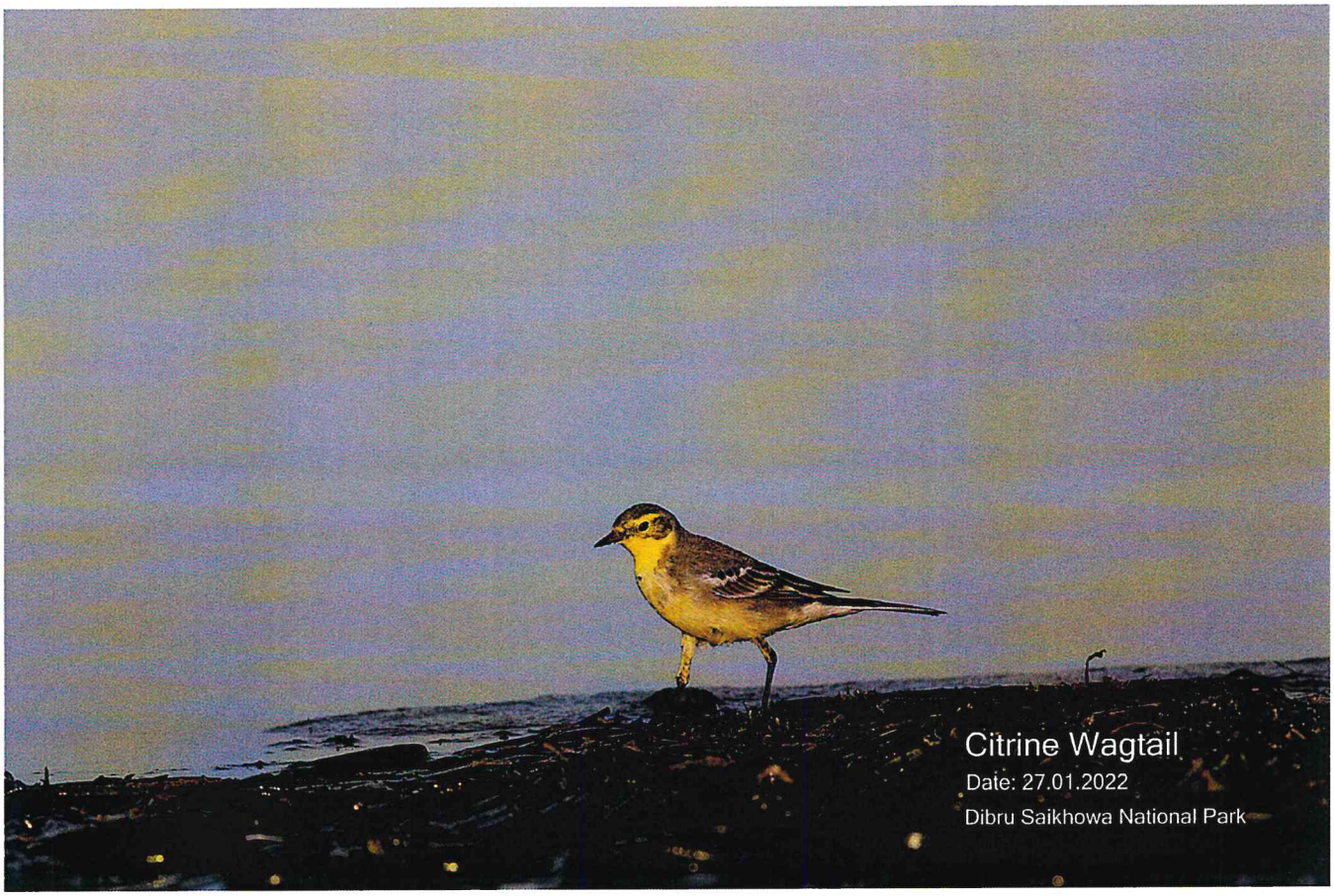

Maguri Motapung Wetland
Pheasant-tailed jacana
Date: 20.02.2022

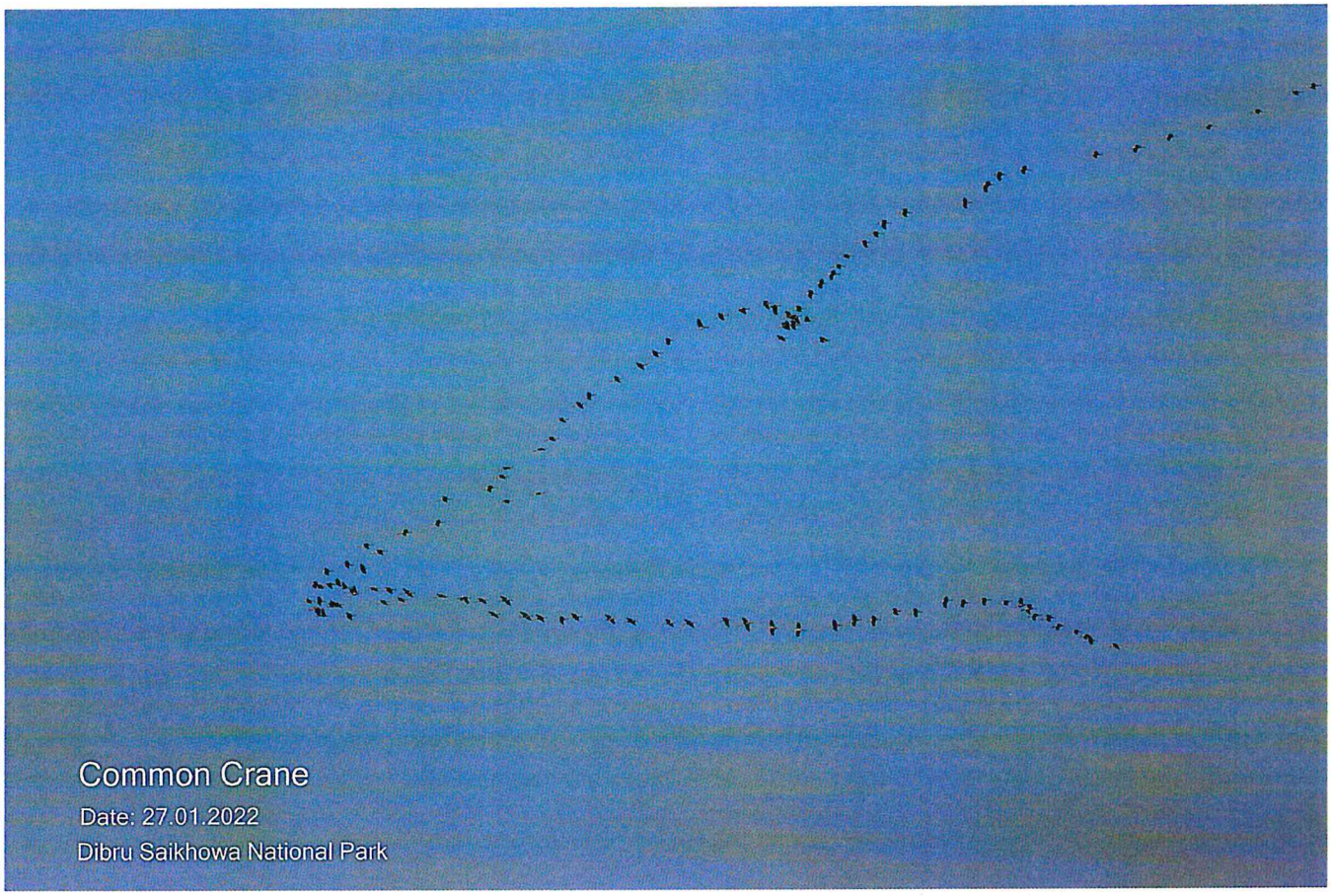

Maguri Motapung Wetland
Pied Kingfisher
Date: 20.02.2022


Maguri Motapung Wetland
White-throated kingfisher
Date: 20.02.2022


Black-breasted Parrotbill
Date: 27.01.2022
Dibru Saikhowa National Park


Chestnut-capped babbler
Date: 27.01.2022
Dibru Saikhowa National Park

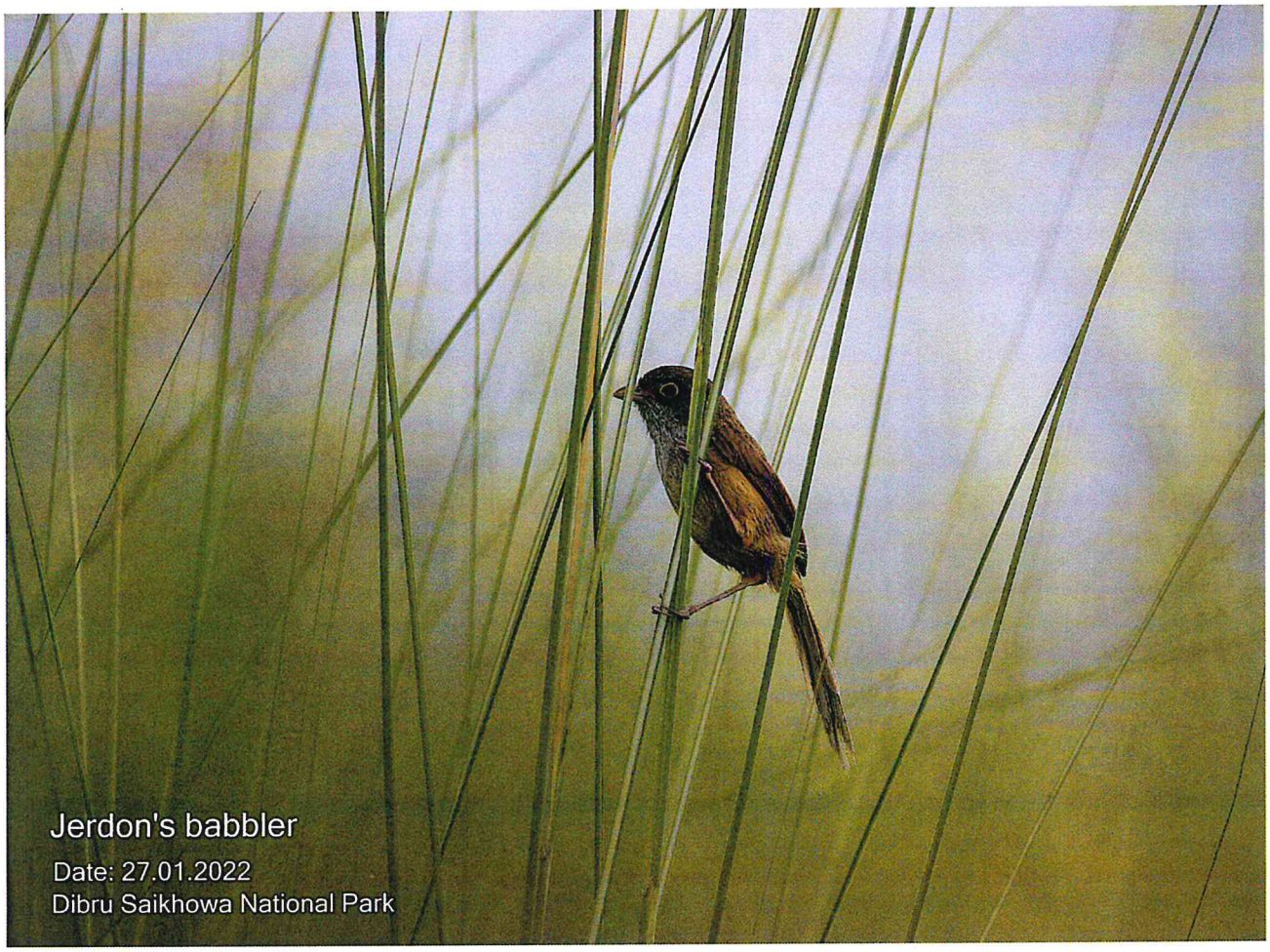

Citrine Wagtail
Date: 27.01.2022
Dibru Saikhowa National Park

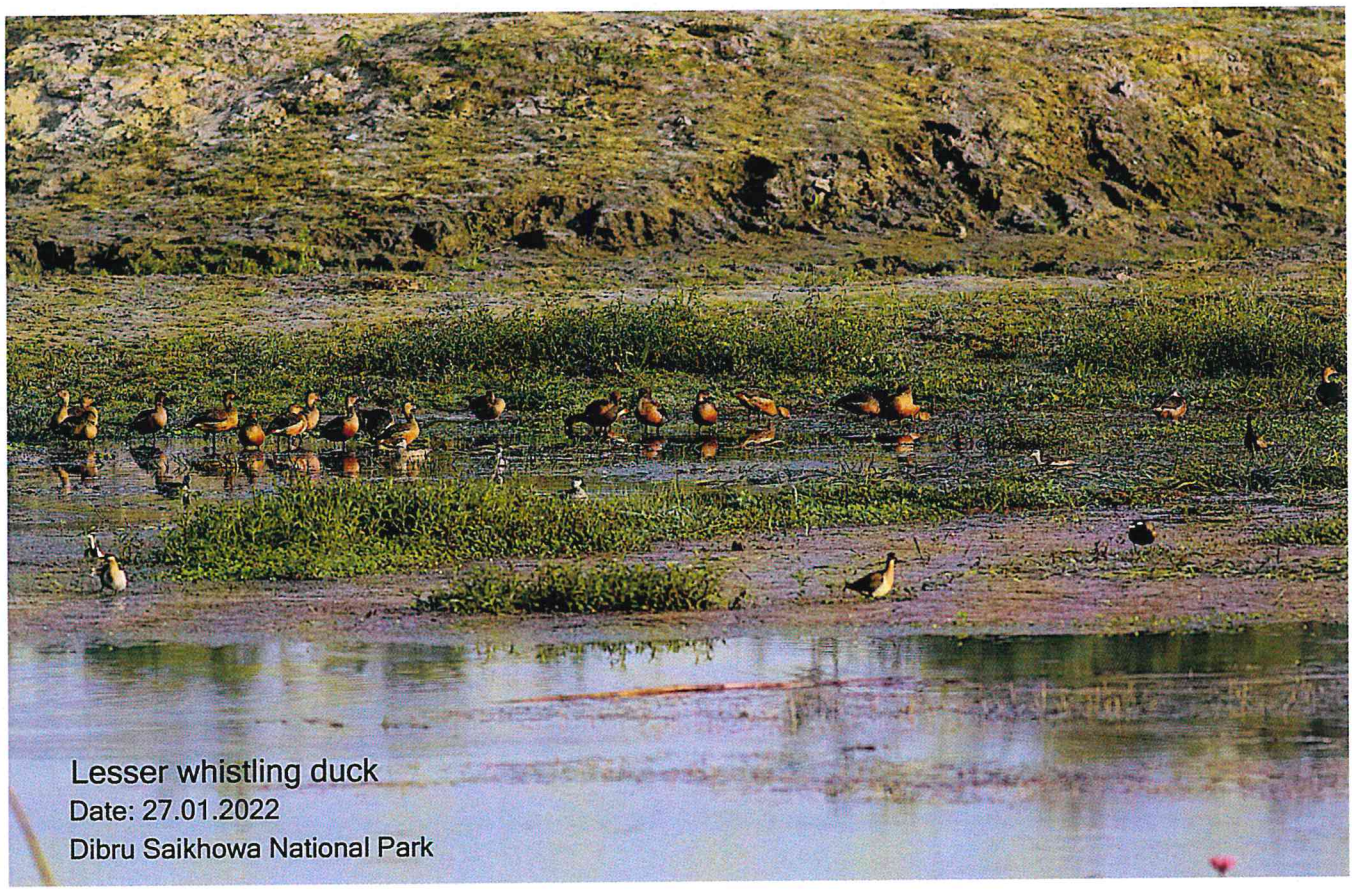

Common Crane
Date: 27.01.2022
Dibru Saikhowa National Park


Common stonechat
Date: 27.01.2022
Dibru Saikhowa National Park

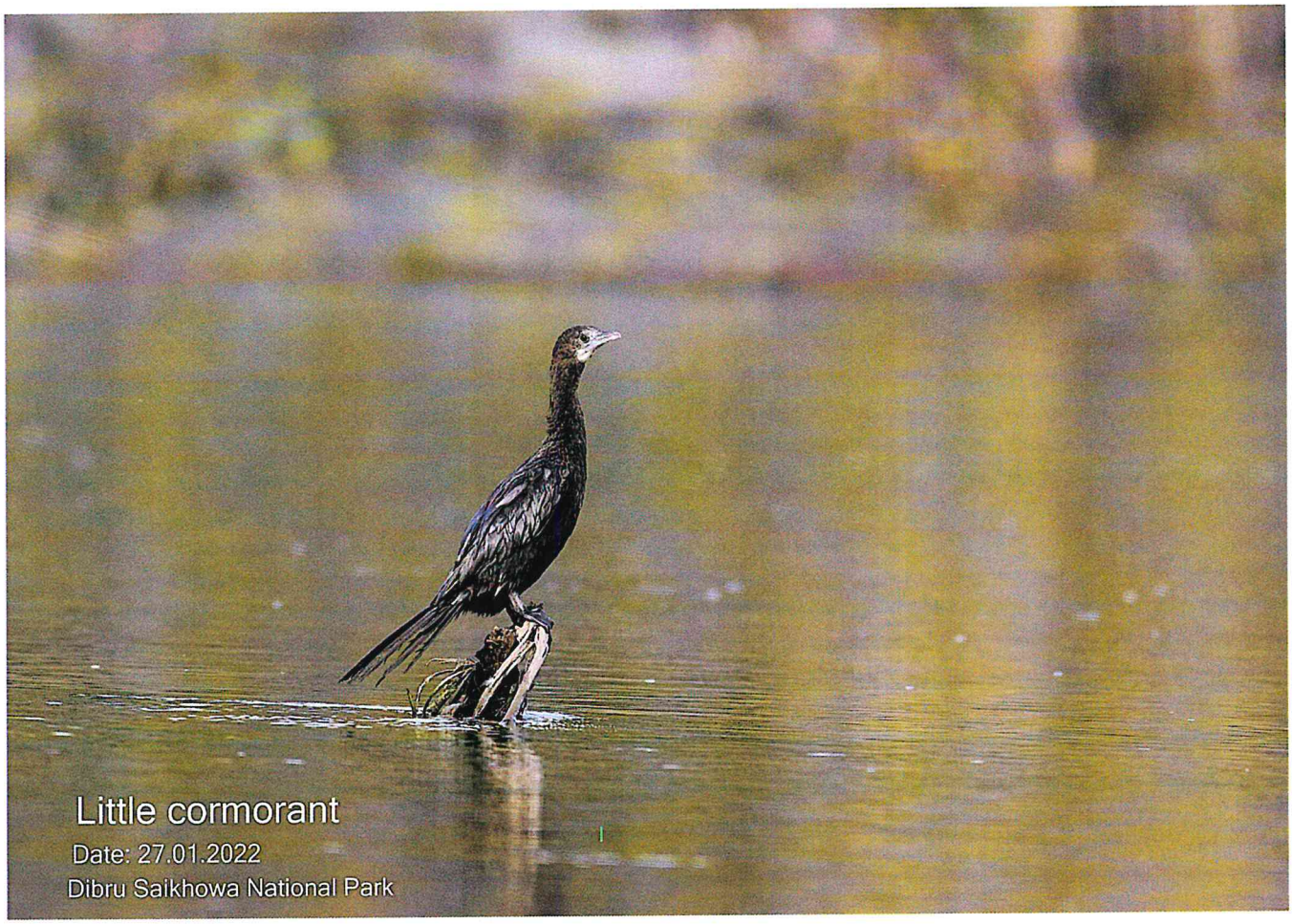

Great cormorant
Date: 27.01.2022
Dibru Saikhowa National Park


Indian spot-billed duck
Date: 27.01.2022
Dibru Saikhowa National Park


Jerdon's babbler
Date: 27.01.2022
Dibru Saikhowa National Park

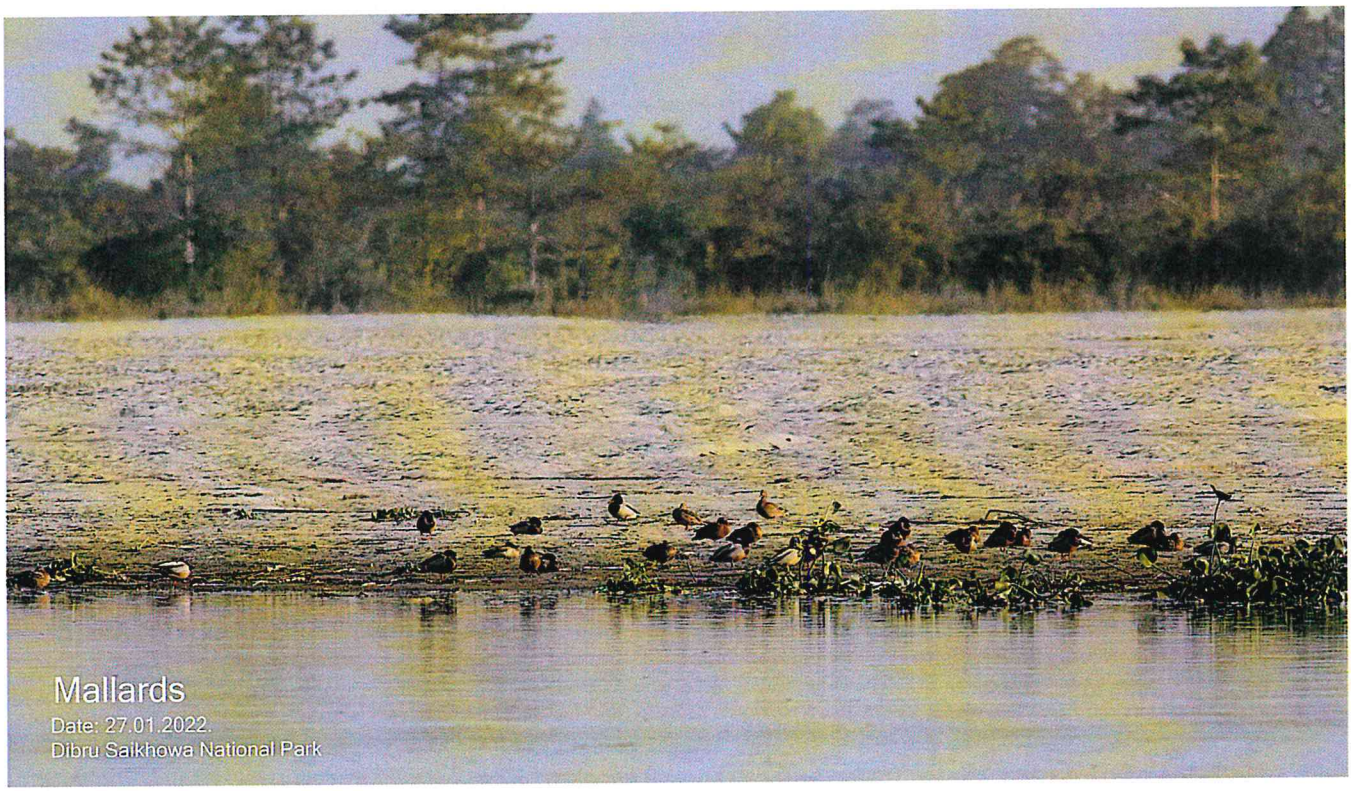


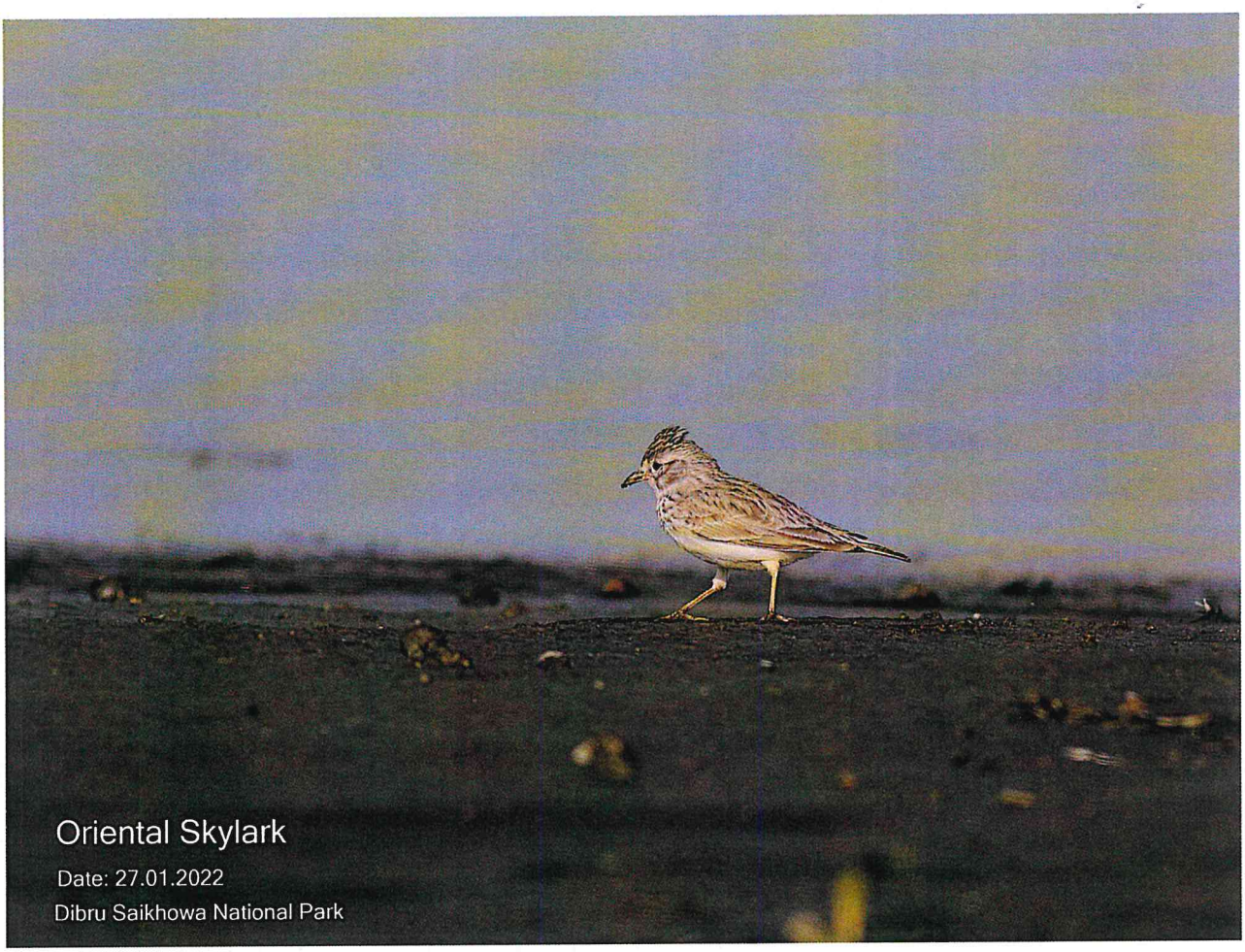
Lesser whistling duck
Date: 27.01.2022
Dibru Saikhowa National Park

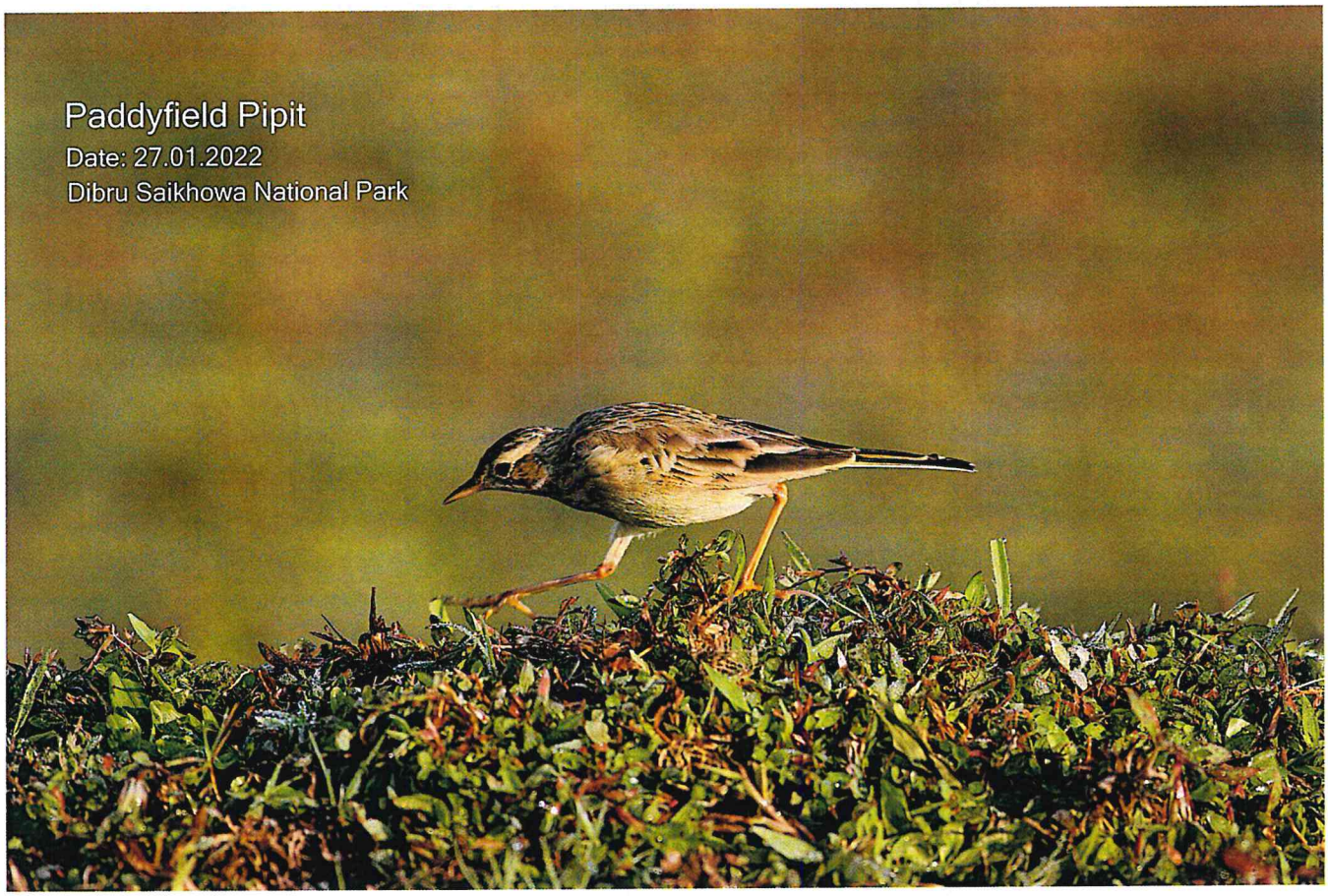


Little cormorant
Date: 27.01.2022
Dibru Saikhowa National Park


Mallard
Date: 27.01.2022.
Dibru Saikhowa National Park


Mallards
Date: 27.01.2022.
Dibru Saikhowa National Park


Oriental Skylark
Date: 27.01.2022
Dibru Saikhowa National Park


Paddyfield Pipit
Date: 27.01.2022
Dibru Saikhowa National Park


White Wagtail
Date: 27.01.2022
Dibru Saikhowa National Park


Zitting Cisticola
Date: 27.01.202
Dibru Saikhowa National Park

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BAGHJAN OIL FIELD

3082

616

ANNEXURE - R30

N

Dibru Saikhuwa Wild life Sanctury

1 No. Darjijan

2 No. Darjijan

Gotong Gaon

Baghjan TE
353 NLR Grant

Dighaltarang TE
126/120/215/213 No. NLR Grant

Dighaltarang TE
120/119 No. & 353 No. NLR Grant

BGN#-25,26,27

BGN#-14,15,16,17,18,19 & 22

BGN#-11,12,13,24

Baghjan TE
214/167/164 No. NLR Grant

Baghjan TE
351/352 No.
NLR Grant

Dighaltarang Gaon

BGN#-2,8,23 & WDW#-1&9

BAGHJAN_EPS

BGN#-4,6,7,9 & 10
SWR-2

PROP. LOC.-BJG

Diamuli TE
205/203

Baghjan Gaon

BGN#-3 & BGN#-20

Dighaltarang TE
121/118/12/119 No. NLR Grant

BAGHJAN POLICE STATION

Dangori River

BGN#-5 & 21
(Abandoned)

PROP. LOC.-BJD

SBJ#-1 & BGN#-1

Baghjan TE
140/137 No. (A) NLR Grant

Diamuli TE
140/138

Kaliapani

BAGHJAN_NC

Baghjan TE
140/137 No. (B) NLR Grant

LOC.-TBK

PROP.LOC.-TAM

Baghjan TE

Diamuli TE

Dibru River

Dibru River

Maguri Bill

5 No. Puroni Motapung Gaon
1st Block

4 No. Puroni Motapung Gaon
2nd Block

4 No. Puroni Motapung Gaon
1st Block

1 No. Diamuli

Guijan River

Motapung Bill

5 No. Puroni Motapung
Gaon
2nd Block

Guijan River

3 No. Puroni Motapung Gaon

Haupjan River

Dhelakhat TE

2 No. Puroni Motapung Gaon
2nd Block

2 No. Puroni
Motapung Gaon
1st Block

Bebejia Gaon

1 No. Hatibat

2 No. Hatibat

1 No. Puroni Motapung Gaon

TINSUKIA REVENUE CIRCLE

LEGEND

1)	Village Boundary	
2)	Road	
3)	Tea Garden	
4)	River	
5)	Bill	
6)	Well Site/Loc.	
a)	Drilled Loc.	
b)	Proposed Loc.	
c)	Abandoned Well	
7)	Wild Life Sanctury	

SCALE: 4" = 1 MILE

ANNEXURE- R31

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RESTORATION REPORT

A Picturesque Demonstration



Picture of Baghjan area as on 25.04.2022

Report by:

The Health, Safety and Environment Team
(Oil India Limited)
06.05.2022

ऑयल इंडिया लिमिटेड
Oil India Limited

INDEX

- Background
- Introduction and Methodology
- Visual Representations of the current situation of-
  - Blowout site - Baghjan Well No. 5
  - Maguri Motapung Wetland (MMW)
  - Dibru Saikhowa National Park (DSNP)
  - Nearby villages
- Conclusion
- Way Forward

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Background:

Oil India Limited (OIL) is engaged in the business of exploration, development and production of crude oil and natural gas, transportation of crude oil and production of LPG. Baghjan is one of the main hydrocarbons producing field of OIL. Baghjan Oil & Gas field of Oil India Limited is located in the Tinsukia district in the State of Assam. Pursuant to the discovery of Oil & Gas in Baghjan area in the year 2003, PML was granted in May 2003. The production from the field started in 2005 in Baghjan Well No. 2. Although the Baghjan Well No. 5 was drilled in the year 2006, however actual production of gas and condensate started in September 2015. Since then, Baghjan Well No. 5 was producing 88000 SCMD of natural gas with 29 KLPD condensate from 3870 m Langpar sand. To enhance the gas production, the work over operations were being carried out on the Baghjan Well No. 5 by the contractor M/s John Energy Ltd. On 27.05.2020, while the workover operations were being carried out, suddenly a blowout from the well was reported around 10:30 am. While efforts were being made to control the leakage of gas, the well caught fire on 09.06.2020. The fire was finally put off on 15.11.2020 and the well was permanently capped and abandoned on 03.12.2020.

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Introduction and Methodology:

A Health, Safety and Environment **("HSE")** Team of OIL which included a natural environment photographer and conservation biologist carried out a detailed inspection at the restoration site in the last week of April 2022 to understand the efforts on restoration and bio-remediation carried out by OIL in and around the Baghjan area. The said Team visited the area to collect and capture visuals thereby assessing the impact and understanding the current state and situation of the said area while also interacting with locals for their feedback.

This Report majorly consists of visuals and observations made by the HSE team of OIL on the four areas around the blowout site namely the Baghjan Well No. 5 and its surroundings, Maguri Motapung Wetland (MMW), Dibru Saikhowa National Park (DSNP) and the nearby villages.

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ECOLOGICAL RESTORATION IN AND AROUND BLOWOUT SITE – BAGHJAN WELL NO. 5 (UPTO 1 KM)

The observations made by the Team during its visit to the area in and around the Baghjan site, as also depicted by the photographs are listed herein below:



Baghjan Well No. 5 as on 25.04.2022 (flower in the picture is Solanum Sisymbriifolium)



Picture of the Baghjan Blowout
Source: News 18, article dated 13.06.2020



Current state of the Baghjan Blowout Site as on 25.04.2022

- As depicted in the photograph (right), the blowout area has now been bio-remediated and restored as complete regeneration and re-growth was visible.
- The capped well was properly buried and not visible.
- There was no visual contamination on the site and no hazardous waste substances were found.
- Further, no oily sludge, condensate or blackish water was visible or smelled on the entire site.

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Well-barricaded site with visible regeneration and re-growth.; Baghjan blowout site as on 25.04.2022

- The entire site was well guarded, properly barricaded with appropriate signboards and enclosures ensuring safety and security.
- Well-developed grass along with green leaves re-growing could also be seen.

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Baghjan Well No. 5 as on 25.04.2022 (the board "BGN-5" indicates the drilling spot of the well)

- The plants were also flowering depicting the health and beauty of the area.

- The full growth of the grass, plants and flowers also indicates the fertility of the soil.

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COMPARISON



Picture of Baghjan blowout; Source: Hindustan Times article dated 28.11.2020



Baghjan Blowout site as on 25.04.2022

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Baghjan Well No. 5 Blowout site as on 25.04.2022



Area within 1 km from the Blowout site as on 25.04.2022

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Banana plantation within 500 metres around the Baghjan blowout site as on 25.04.2022

- The villagers are engaged in the agricultural activities and carried out various other local activities for the development of their villages.

- The cultivation of maize, corn and banana plantation has been undertaken by the villagers which indicates fertility of soil and good quality water in the area.

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Corn plantation within 500 metres around the Baghjan blowout site as on 25.04.2022

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Presence of algae near Baghjan Well No. 5 as on 25.04.2022

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Presence of algae near Baghjan Well No. 5 as on 25.04.2022

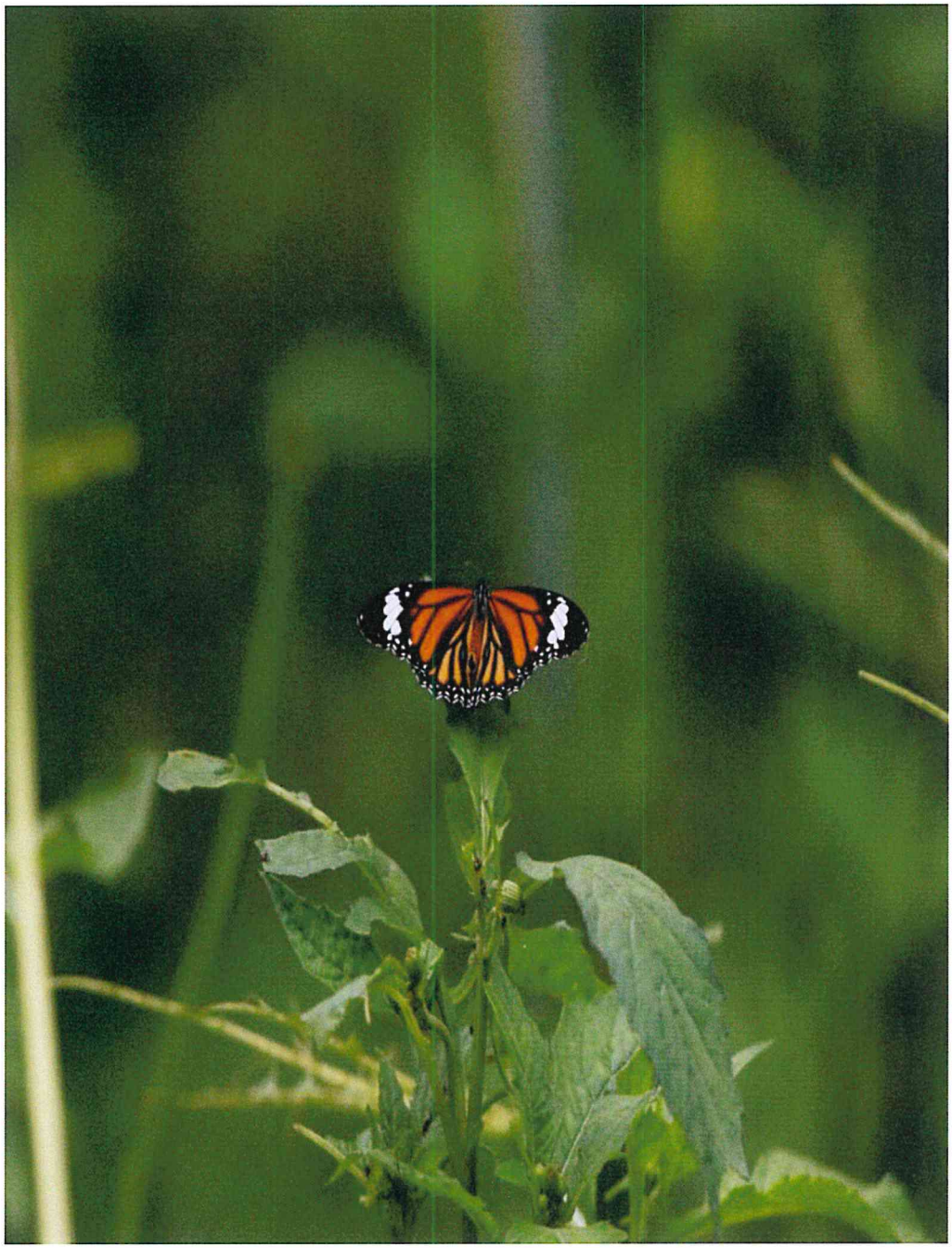
- Algae were found growing on the surface in and around the blow out site of Baghjan Well No. 5.
- The reappearance of algal growth in water or soil is a clear indicator of life, and toxin free water or soil
- Algal indicators have been used to assess the environmental status of an area.



Mating of butterflies within 500 m from the Baghjan Well No. 5 as observed on 25.04.2022

- The presence of butterflies in the vicinity of the Baghjan area depicts that the area is free from pollution.
- Butterflies are a significant indicator species when it comes to signalling a healthy ecosystem in view of their high degree sensitivity to any change in the environment and habitat.
- As per the conservation biologist, no butterflies can survive in the presence of even a slightest quantity of hydrocarbon present.
- Thus, the existence of butterflies in the vicinity of the Baghjan area is proof of the ambient air quality in the area and restored ecosystem.

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Butterflies observed in nearby areas of Baghjan site as on 25.04.2022

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Butterflies spotted in nearby areas of Baghjan Well No. 5 as on 25.04.2022

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Fresh saplings within 500 m around the Baghjan site as on 25.04.2022





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Cattle found grazing within 500m of the Baghjan site as on 25.04.2022

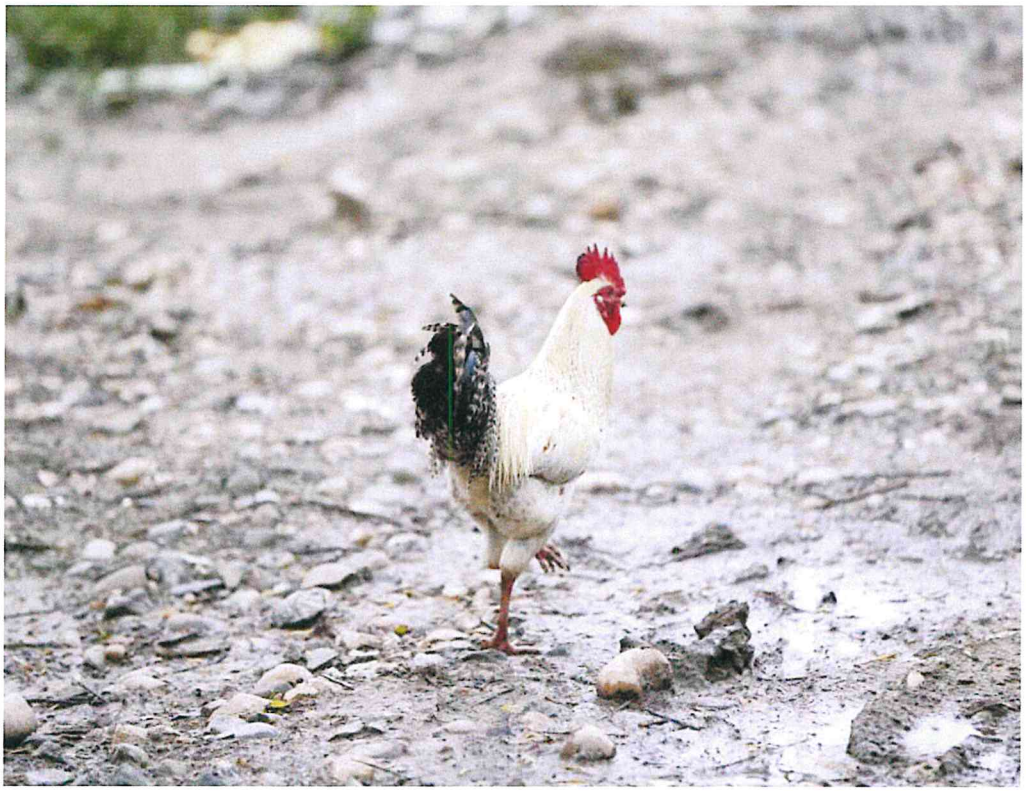




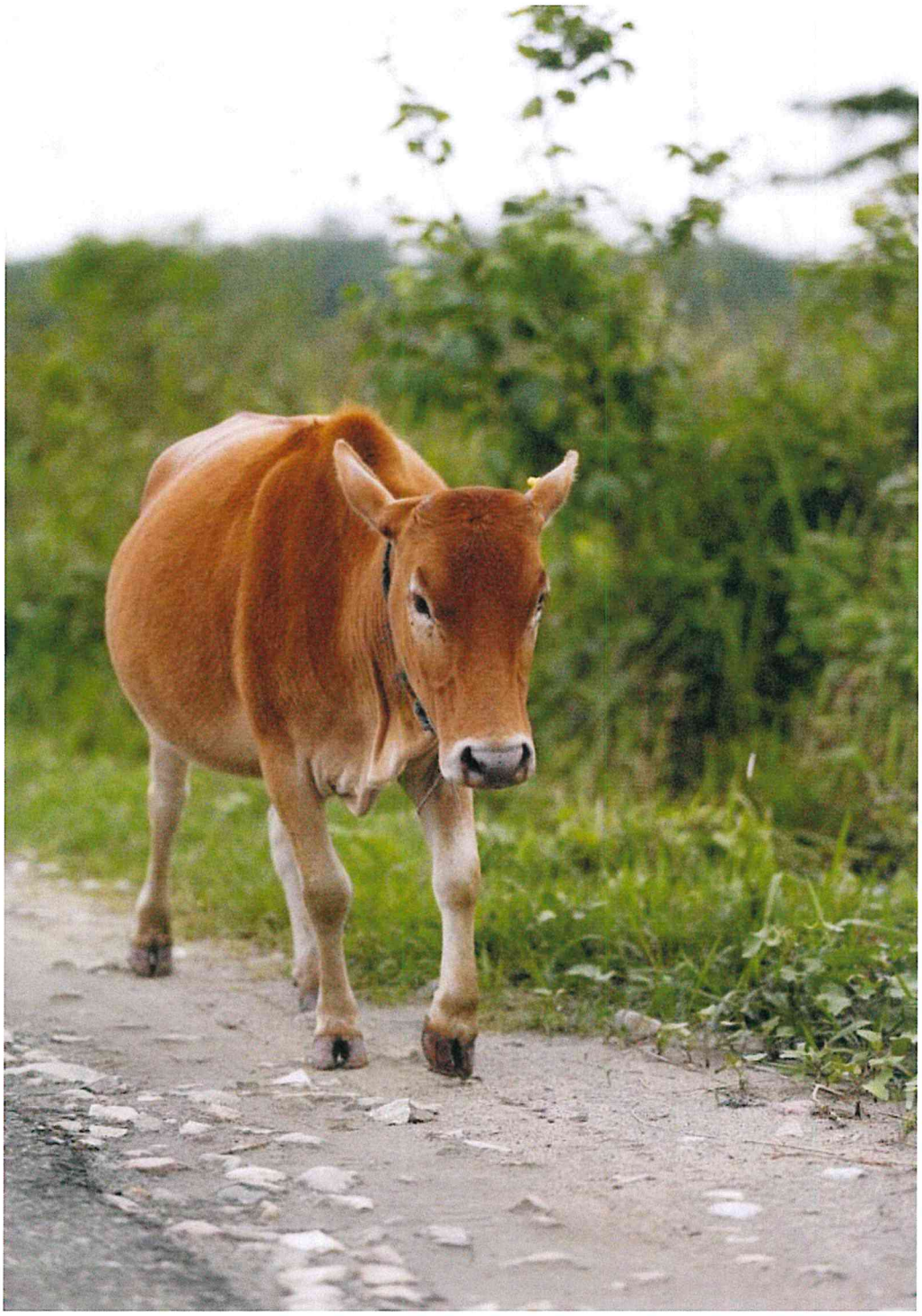
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Cattle & Livestock in the nearby area as on 25.04.2022





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Cattle found grazing in the nearby area of the Baghjan site as on 25.04.2022

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COMPARISON



Picture of area within 500 m from Baghjan blowout site in 2020 during the continuation of the blowout



Villagers residing in properly built houses and huts indicating a normal life as on 26.04.2022

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Villagers leading their normal lives in nearby areas of the Baghjan Well No. 5 as on 26.04.2022

During the interactions with the local villagers around the Baghjan Well No. 5 site, it was informed that:

- Children are going to nearby schools for studying as reported by the nearby villagers.

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Villagers leading their normal lives in nearby areas of the Baghjan Well No. 5 as on 26.04.2022

- The villagers are leading normal lives and earning income through fishing, agricultural activities and other local activities.
- They were seen to be living in properly built houses and huts.
- There are no unnatural diseases or abnormalities reported by the villagers as a long-term effect of the incident.

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MAGURI MOTAPUNG WETLAND (MMW): APPROXIMATELY 1 KM FROM BAGHJAN WELL NO. 5



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COMPARISON



Picture of Maguri Motapung Wetland; Source: The Third Pole article dated 30.05.2020



Maguri Motapung Wetland as on 26.04.2022

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Locals busy in fishing in Maguri Motapung Wetland as on 26.04.2022

- It has been observed that there was no oily sludge, patches of oil or condensate in the water of the Maguri Motapung Wetland. The said fact was also confirmed by the fisherman of the wetland.

- Water was found to be clean, transparent and free from any foul smell.

- The area surrounding the wetland was observed to be in a restored and healthy state.

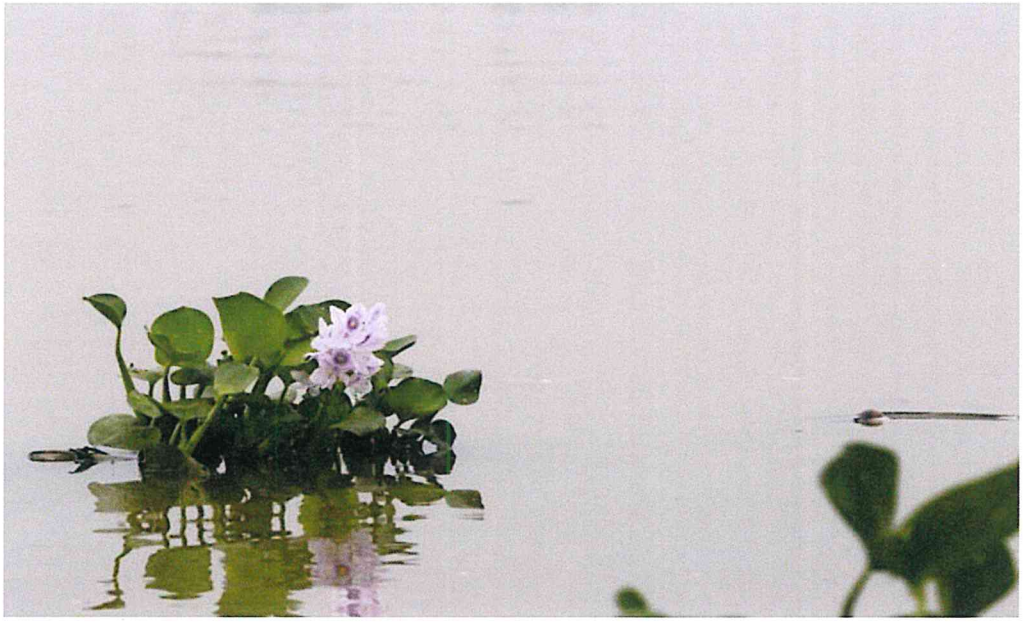
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Water hyacinth with purple flowers found blooming in MMW; as on 26.04.2022





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Water hyacinth with purple flowers found blooming in Maguri Motapung Wetland as on 26.04.2022

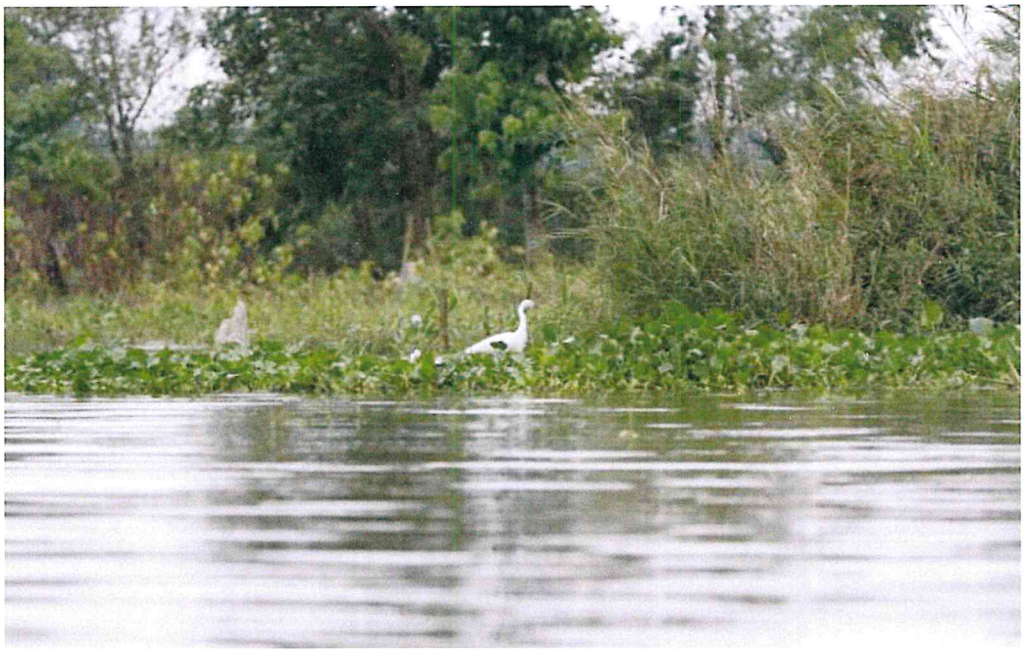
- Water Hyacinths with purple colour flowers were observed in abundance in the wetland which are good absorbent of pollutants. This luxuriant growth indicates the suitability of water for pisciculture with suitable nutrient levels.

- The aquatic flora and fauna were abundantly found indicating regeneration and regrowth alongwith proof of the ambient water and soil quality.

- The plants were also flowering indicating a healthy and restored ecosystem.

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Egret birds spotted at Maguri Motapung Wetland as on 26.04.2022





- There were sightings of several wetland species like Egret birds, ducks etc.

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Egret birds spotted at Maguri Motapung Wetland as on 26.04.2022

- Birds are recognized as one of the most important indicators of the state of the environment as they are sensitive to habitat change and because they are easy to census, birds are the ecologist's favourite tool.

- From the above, it could be concluded that the said area has fishes in abundance in the water of wetland and health of wetland has restored to its original level.

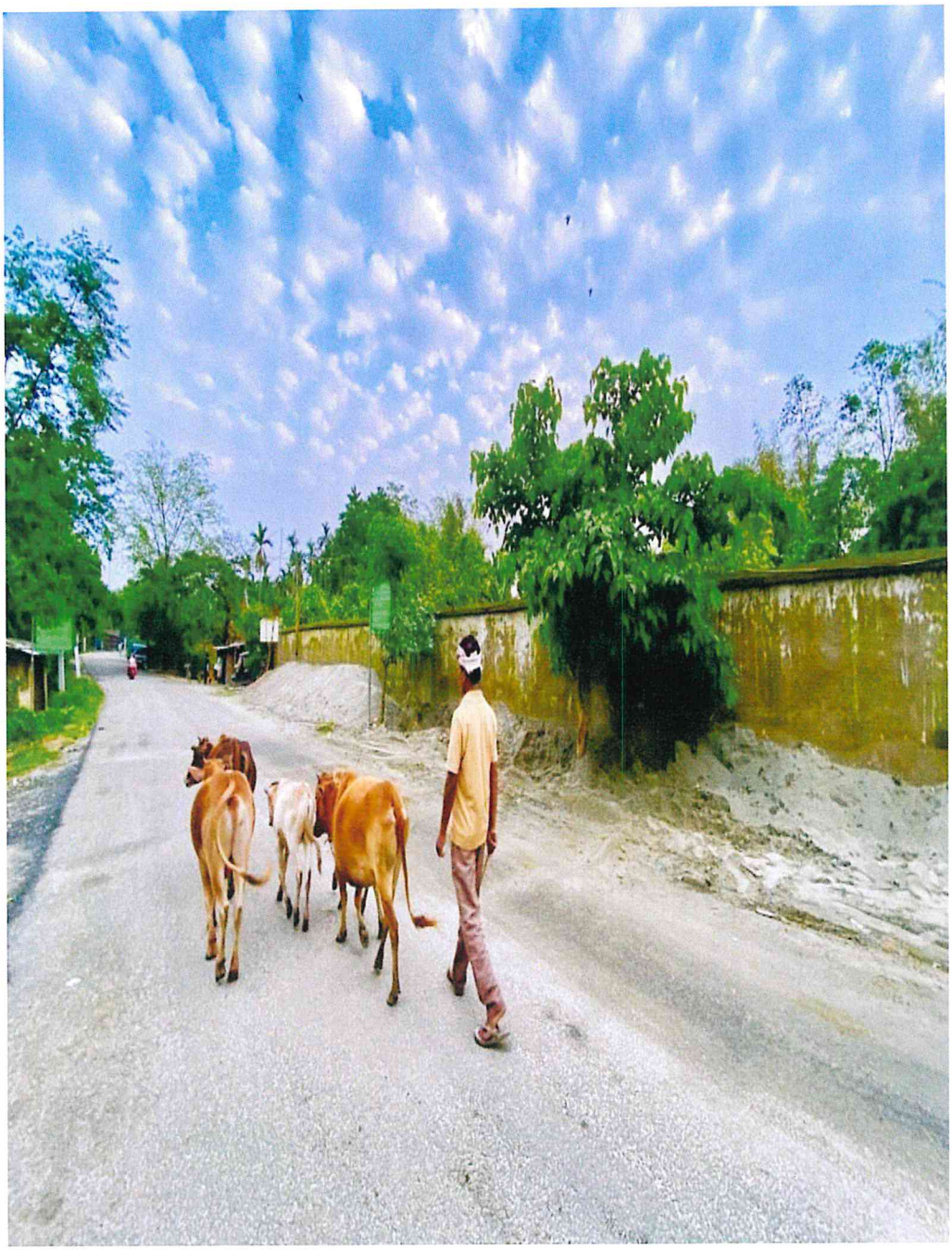
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Sighting of birds at Maguri Motapung Wetland on 26.04.2022





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Picture around the Baghjan area as on 26.04.2022

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Fishermen busy in fishing and setting up cages in Maguri Motapung Wetland as on 26.04.2022



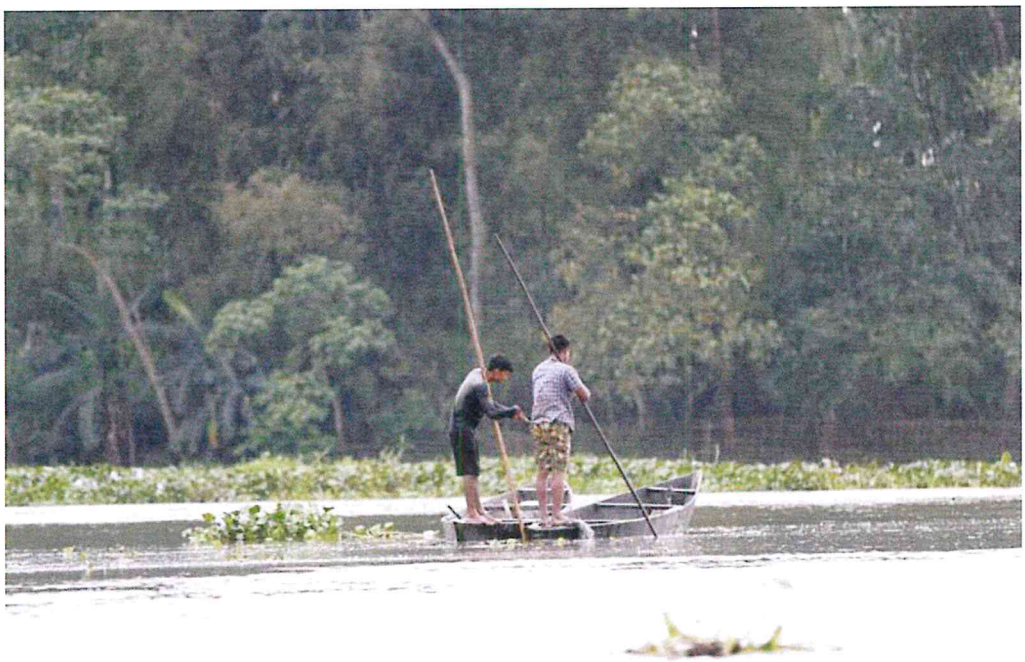


- Around 15-16 fishermen were found in the wetland, fishing and setting up cages and fishnets further confirming the presence of abundant fishes in the wetland water.
- As reported by them, there was no trace of oil in the wetland water.

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Fishermen busy in fishing and setting up cages in Maguri Motapung Wetland as on 26.04.2022





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Re-growth and regeneration observed in Maguri Motapung Wetland as on 26.04.2022



Locals near the wetland as on 25.04.2022

- A lady, residing near the wetland was interviewed by the team. As reported by her, she was happy and satisfied with the income she was receiving on a daily basis by running her tea shop. Her husband in engaged in fishing and boating and her son is studying in a nearby school. They own about 12-13 cows, which are in a healthy state.

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DIBRU SAIKHOWA NATIONAL PARK (DSNP): APPROXIMATELY 2-3 KMS FROM BAGHJAN WELL NO. 5



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- The water of the Dibru River was found to be clean, transparent and free from any foul smell. No visible condensate material or oily sludge was observed on the water of Dibru River.

- There were also no patches of oil floating observed on the river thus indicating a healthy ecosystem.

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Dibru Saikhowa National Park as on 26.04.2022

- Vegetation was observed to be good and healthy.
- Tall grass and lush green trees were found in abundance depicting healthy flora and also fertile quality of soil.

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Eastern yellow wagtail spotted in Dibru Saikhowa National Park on 26.04.2022



White-breasted waterhen spotted in Dibru Saikhowa National Park on 26.04.2022

- There was sighting of birds flying in and around the area which is a good indicator of the environment and ecosystem health.

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Insects found in Dibru Saikhowa National Park on 26.04.2022





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Footprint of wild buffalos alongwith grass growth in Dibru Saikhowa National Park on 26.04.2022

- Many insects and butterflies were also spotted in and around Dibru Saikhowa National Park alongwith footprints of wild buffalos indicating clean air and water available for their sustenance and survival.

- There were no diseases, effects or abnormalities reported or observed in the wildlife, insects, fishes of the area as a result of the incident.

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Dibru Saikhowa National Park as on 26.04.2022





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- As reported by the locals in the area, they were found leading their normal lives and earning income through fishing and farming.
- As reported and confirmed by a few locals, the effect of the blowout incident was hardly seen on the National Park.

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Locals carrying out fishing in Dibru Saikhowa National Park on 26.04.2022

- Locals were found fishing and consuming them as well, indicating that life was back to normal in the area.

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Picture of locals nearby Dibru Saikhowa National Park as on 26.04.2022

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NEARBY VILLAGES –AROUND 1-2 KMS FROM BAGHJAN WELL NO. 5



Baghjan area in 2020; Source: The Print, article dated 13.03.2021



Current state of Baghjan area as on 26.04.2022

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Farming in Natun village as on 26.04.2022



Tea plantation observed in Natun Village as on 26.04.2022

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Re-growth and regeneration observed in nearby villages as on 26.04.2022



- The Baghjan and Natun villages were visited by the Team. At present, the environment has regained originality and all types of flora and fauna are found.

- Tea plantations were found to be grown in abundance in the entire village indicating good quality, fertile soil and ambient air and water quality.

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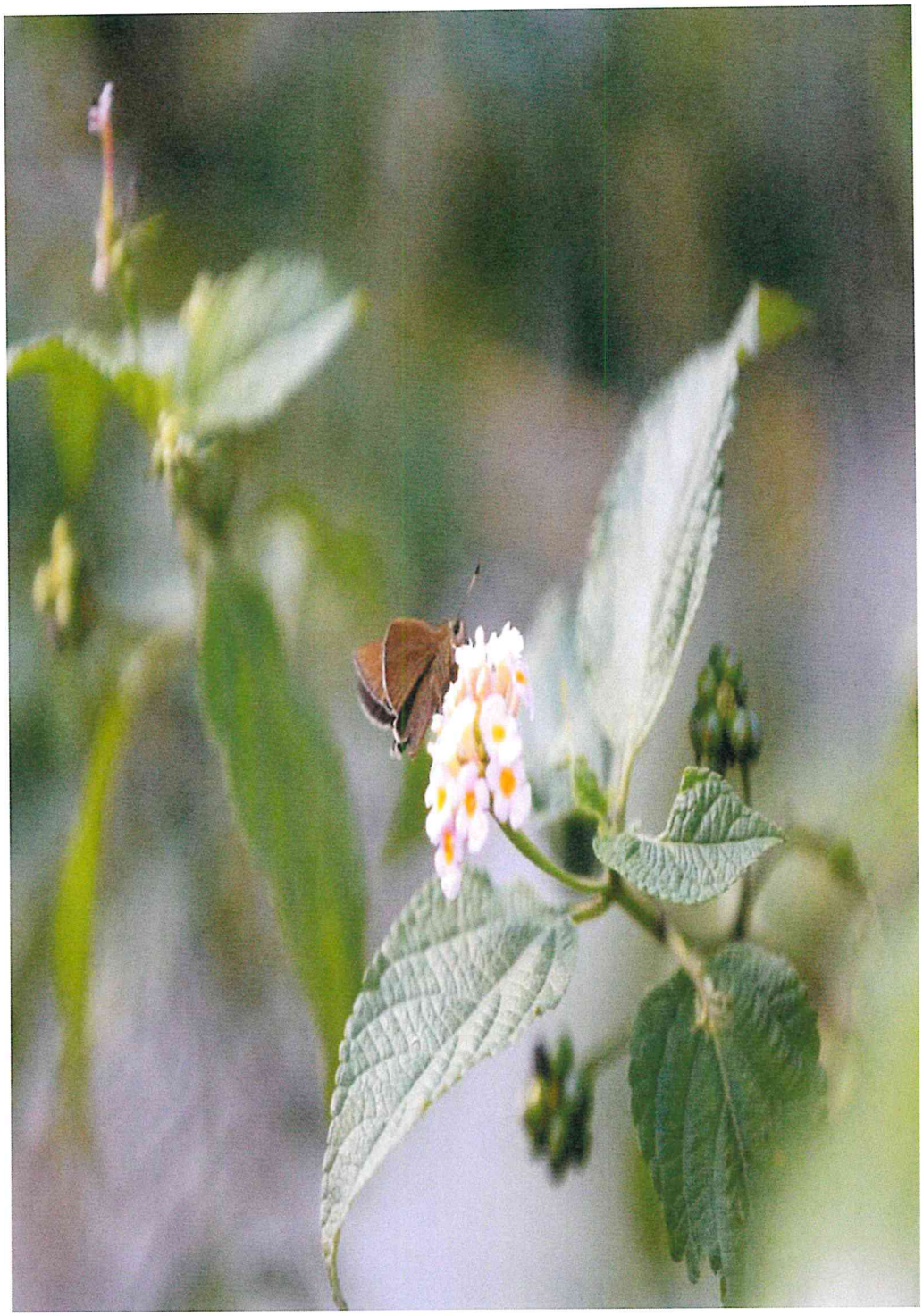
Cattle Egret sighted in the nearby villages as on 26.04.2022





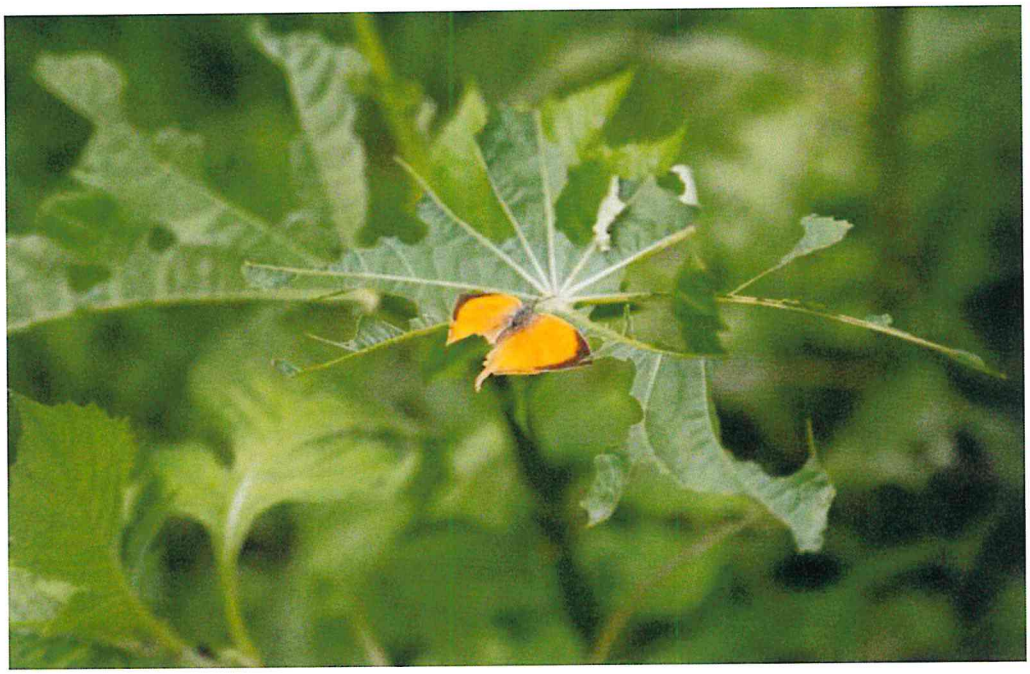
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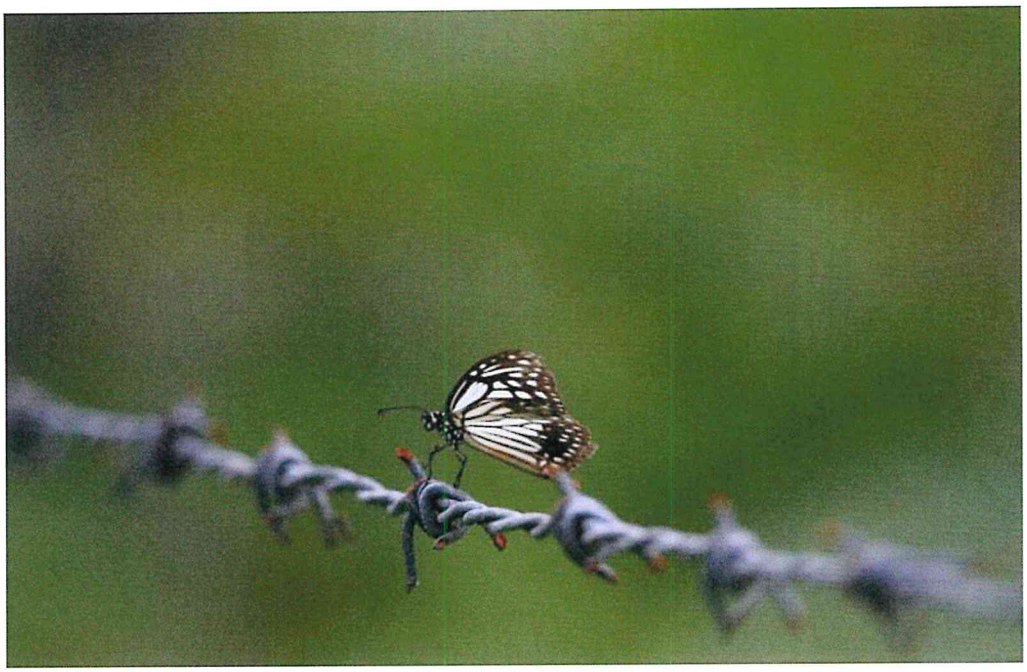
Butterflies spotted in nearby village areas of Baghjan site as on 26.04.2022



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Butterflies spotted in nearby villages of Baghjan site as on 26.04.2022







Ladies celebrating Bihu as on 26.04.2022



Wedding preparations being carried out in a nearby village as on 26.04.2022

- The Baghjan and Natun villages were visited by the team and the villagers were seen celebrating festivals and preparing for wedding functions.

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Locals seen carrying out livelihood activities as on 26.04.2022

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Locals seen carrying out livelihood activities as on 26.04.2022

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Children playing in nearby villages as on 26.04.2022



Locals engaged in farming and cultivation as on 26.04.2022

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CONCLUSION

From above, it may be concluded that the affected areas under question have been restored to a great extent. This exercise, by the HSE Team has been carried out to assess the impact as felt by the people on ground and based on finding design projects/programme for residents of the affected area and dispel the notions and rumours which are far from true.

Through this picturesque depiction OIL has tried to recreate the action depiction of Baghjan area and show the actual lives, farms, wetland, wildlife, flora, and fauna in its current state as they are today, for a self-assessment of its restoration work being carried out in the Baghjan area.

THE WAY FORWARD

OIL will continue to its journey of a responsible organisation and undertake activities for improving the quality of lives of the people and the environment including but not limited to taking afforestation drive at Blowout site.