

भारत कोकिंग कोल लिमिटेड

एक मिनी रत्न कंपनी

(महारत्न कंपनी कोल इंडिया का एक उपक्रम)

पंजीकृत कार्यालय : कोयला भवन, कोयला नगर,

धनबाद-826005

सीआइएन : U10101JH1972GOI000918

परियोजना पदाधिकारी का कार्यालय
महुदा ग्रुप

पोस्ट / थाना: महुदा, जिला: धनबाद (झारखण्ड)-828305

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Bharat Coking Coal Limited

A Mini Ratna Company

(A Subsidiary of Coal India Limited: A Maharatna Company)

Regd. Off. : Koyla Bhawan, Koyla Nagar

Dhanbad - 826005

CIN : U10101JH1972GOI000918

OFFICE OF THE PROJECT OFFICER
MAHUDA GROUP

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"For uploading online on the 'Parivesh Portal' of MoEF&CC and sending by email"

Ref:- BCCL/WJA/ENV/2025/ 100

Date:- 29/05/2026

To,
The Regional Director,
Ministry of Environment & Forest and Climate Change
Regional Office (ECZ), Bunglow No. A-2,
Shyamali Colony, Ranchi – 834002.

Sub: - Submission of six-monthly reports on compliance of Environment Clearance for the period from **October 2025 to March 2026** with respect to **Cluster-XIII** group of mines of M/s Bharat Coking Coal Limited.

Ref: EC Order No. – J-11015/11/2010-IA.II (M), Dated: - 06.06.2013.

Respected Sir,

Please find enclosed herewith the six-monthly reports on compliance of Environment Clearances for the period from **October 2025 to March 2026** in respect of **Cluster XIII** group of mines of M/s Bharat Coking Coal Limited. We hope you will find in order.

Thanking you,

Encl: - As Above

Yours faithfully,

Project officer
Mahuda Group of Mines
(Cluster-XIII, BCCL)

ENVIRONMENTAL CLEARANCE COMPLIANCE OF CLUSTER-XIII
(GRANTED VIDE LETTER NO.J-11015/11/2010-IA.II (M) DATED
06.06.2013)

(October 2025 to March 2026)

Sl. No.	A. Specific Conditions by MOEF:	Compliance
i.	No mining shall be undertaken in/under the forestland until prior forestry clearance has been obtained under the provisions of FC Act 1980.	Currently, there is no mining activity in any of the mines within Cluster-XIII.
ii	The EC is granted to Murulidih 20/21 Pits U/G of 0.18 MTPA and a peak production of 2.34 MTPA in an ML area of 571. 32 ha.	Coal production from cluster XIII group of mines is Nil . Production from only working mine of Cluster-XIII i.e. Murulidih 20/21 Pits U/G is suspended from 27 th December 2015.
iii.	The maximum production in the cluster shall not exceed beyond that for which environmental clearance has been granted for the cluster XIII as per given below:	Being Complied. (Presently there is not any producing mine under Cluster XIII) <u>Annexure-I</u>
iv.	The measure identified in the environmental plan for cluster – XIII group of mine and the condition given in this environmental clearance letter shall be dovetailed to the implementation of Jharia Action Plan.	Being Complied
v.	As there is no fire in cluster XIII but the measure should be adopted proponent to control spread of neighboring fire to this cluster XIII. The proponent shall prepare time series maps of Jharia Coal field through NRSA to monitor & prevent fire problems in this Jharia Coalfield by Isothermal mapping / imaging and monitoring temperatures of the coal seam (whether they are closed spontaneous ignition temperatures) and based on which, areas with potential fire problems shall be identified. Measures to prevent ingress of air (ventilation) in such areas, to prevent restart fresh/spread fire in other areas including in mines of cluster – XIV shall be undertaken.	It has been complied. NRSC was engaged for preparation of time series maps to monitor and prevent fire problems of Jharia Coalfield by Isothermal mapping/imaging and monitoring temperature of the coal seams and NRSC has submitted their final report in April 2025 NRSC report is enclosed as <u>Annexure II</u> .
Vi.	Underground mining should be taken up after completion of reclamation of O/C mine area after two years.	Agreed. Presently there is no running O/C mine in cluster XIII.
vii.	No mining shall be undertaken where underground fires continue. Measure shall be taken to prevent/check such fire including in old OB dump.	Complied

Viii	There shall be no external OB dumps. OB from one patch OCP mine shall be backfilled. At the end of the mining there shall be no void and the entire mined out area shall be re-vegetated. Areas where opencast mining was carried out and completed shall be reclaimed immediately thereafter.	Being Complied.
ix.	A detailed calendar plan of production with plan for OB dumping and back filling (for open cast mines) and reclamation and final mine closure plan for each mine of cluster XIII shall be drawn up & implemented.	Being implemented. Mine closure plan is approved. There is no producing mine in Cluster XIII.
x.	The void in 5 ha. Area shall be converted in to a water reservoir of maximum depth of 15-20 mtr in post mining stage and shall be gently sloped and upper benches of the reservoir shall be stabilized with plantation and periphery of the reservoir fenced . The abandoned pits and voids should be backfilled with OB & biologically reclaimed with plantation and or may used for pisciculture.	Will be complied as per status. No running OC mine in Cluster-XIII.
xi.	Mining shall be carried out as per statute from the streams/nalas flowing within the lease and maintaining a safe distance from the Nalas flowing along the lease boundary. A safety barrier of a minimum 60m width shall be maintained along the nalas/water bodies. The small water bodies in OC shall be protected to the extend feasible and the embankment proposed along water body shall be strengthened with stone pitching.	Being Complied. There is no producing mine in Cluster XIII.
xii.	Active OB dumps near water body and rivers should be rehandled for back filling abandoned mine voids. However, those which have been biologically reclaimed need not be disturbed.	There is no opencast project in Cluster XIII at present.
xiii.	Thick green belt shall be developed along undisturbed areas, mine boundary and in mine reclamation. During post mining stage, a total of 91.75 ha would be reclaimed and afforested by planting native species in consultation with local DFO/Agriculture deptt. /Institutions with the relevant discipline. The density of the trees should be around 2500 plants per ha.	It is being complied. Four Eco-restoration Sites of total area 8.4 Ha. (Site-A = 4.2 Ha. Site-B =1.5 Ha, Site-C =1.8 Ha and Site-D = 0.9 Ha) reclaimed area are developed and maintained at Murulidih (More than 2500 plants per Ha).
Ha	The roads should be provided with avenue plantation on both sides as trees act as sink of carbon and other pollutant.	Agreed. Being complied.
xv.	Specific mitigative measures identified for the Jharia Coalfields in the Environmental Action	Being Implemented.

	Plan prepared for Dhanbad as a critically polluted area and relevant for Cluster XIII shall be implemented.	
xvi.	The locations of monitoring stations in the Jharia Coalfields should be finalized in consultation with the Jharkhand State Pollution Control Board. The Committee stated that smoke/dust emission vary from source to source (fuel wood, coal, fly ash from TPPs, silica from natural dust, etc.) and a Source Apportionment Study should be got carried out for the entire Jharia Coalfields. Mineralogical composition study should be undertaken on the composition of the suspended particulate matter (PM10 and PM2.5) in Jharia Coalfields and also quantified. These studies would help ascertain source and extent of the air pollution, based on which appropriate mitigative measures could be taken.	Location of monitoring stations was already finalized with the consultation of Jharkhand State Pollution Control Board. Source Apportionment Study: - Report of Source Apportionment Study has been submitted by NEERI, Nagpur. Report sent by NEERI is attached as <u>Annexure III</u>.
xvii.	No ground water shall be used for mining activities. Additional water required, if any, shall be met from mine water or by recycling/reused of the water from the existing activities and from rain water harvesting measures. The project authority shall meet water requirement of nearby village (s) in case the village wells go dry to dewatering of mine.	Agreed. Being implemented.
xviii.	Regular monitoring of groundwater level and quality of the study area shall be carried out by establishing a network of existing wells and construction of new piezometers. The monitoring for quantity shall be done four times a year in pre-monsoon (May), monsoon (August), post-monsoon (November) and winter (January) seasons and for quality including Arsenic and Fluoride during the month of May. Data thus collected shall be submitted to the Ministry of Environment & Forest and to the Central Pollution Control Board/SPCB quarterly within one month of monitoring. Rainwater harvesting measures shall be undertaken in case monitoring of water table indicates a declining trend.	Complied. CMPDI RI-II has prepared a report for Location and design of Piezometers. Groundwater monitoring data has been enclosed as <u>Annexure IV</u>.
xix.	Mine discharge water shall be treated to meet standards prescribed standards before discharge into natural water courses/agriculture. The quality of the water discharged shall be monitored at the outlet points and proper records maintained thereof and uploaded regularly on the company website.	Agreed. Being implemented. CMPDIL, Dhanbad is monitoring the same. Annexure-V.

xx.	ETP shall also be provided for workshop, and CHP, if any. Effluents shall be treated to confirm to prescribe standards in case discharge into the natural water course.	Presently there is no producing mine in Cluster-XIII. There is no effluent discharge into natural water course. There is neither Open Cast mine running nor CHP nor such workshop from where effluent discharge is found.
xxi.	Regular monitoring of subsidence movement on the surface over and around the working area and impact natural drainage pattern, water bodies, vegetation, structure, roads and surroundings shall be continued till movement ceases completely. In case observation of any high rate of subsidence movement, appropriate effective corrective measure shall be taken to avoid loss of life and material. Cracks shall be effectively plugged with ballast and clayey soil /suitable material.	Being implemented. Subsidence study is being conducted by ISM Dhanbad before the start of panel. Extraction done in Non Effective Width Method so that there is no subsidence on the surface. Subsidence monitoring is being done.
xxii.	Sufficient coal pillars shall be left un extracted around the air shaft (within subsidence influence area) to protect from any damage from subsidence, if any.	Complied.
xxiii.	High root density tree species shall be selected and planted over areas likely to be affected by subsidence.	Plantation in BCCL is being done on 3-tier basis, in which both, Monocotyledonae (Monocots) such as grasses, bamboo etc and Dicotyledonae (Dicots) such as sheesham, mango etc are being planted for developing an extensive root system. The Monocots having fibrous root system helps in developing the root density at the topsoil level while, Dicots having the tap root system have a distributed root density in topsoil, subsoil and regolith layer of soil. These two root system together forms the high root density system.
Xxiv.	Depression due to subsidence resulting in water accumulating within low lying areas shall be filled up or drained out by cutting drains.	Complied.
Xxv.	Solid barriers shall be left below the roads falling within the blocks to avoid any damage to the road.	Already complied as per statute.
xxvi.	No depillaring operation shall be carried out below the township/colony.	Presently there is no coal production from mines under Cluster-XIII.
xxvii.	The transportation plan for conveyor – cum – rail for cluster XIII should be dovetailed with Jharia Action Plan. Road transportation of coal during phase I should be by mechanically covered trucks, which should be introduced at the earliest. The plan for conveyor – cum – rail for cluster XIV	Will be Complied. Presently there is no coal production from mines under cluster-XIII.

	should be dovetailed with Jharia Action Plan. The road transportation of coal during phase I should be by mechanically covered trucks.	
xxviii.	A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.	Presently there is no producing mine under Cluster-XIII.
.xxix.	R & R of 2187 nos. of PAF's involved. They should be rehabilitated at cost of Rs. 11199.89 lakhs as per the approved Jharia Action Plan.	PAF's /PAP's involved is being rehabilitated as per cost specified as per Jharia Action Plan.

Xxx.	Details of transportation, CSR, R&R and implementation of environmental action plan for each of the 17 clusters should be brought out in a booklet for and submitted to Ministry.	Being Complied.
.Xxxi.	A detailed CSR action plan shall be prepared for cluster XIII group of mines. Specific activities shall be identified for CSR of Rs. 20.25 / annum @of Rs.5/ton of coal production as recurring expenditure. The area within the cluster XIII ML that would be existing waste land and not being acquired shall be put to productive use under CSR and developed with fruit bearing and other useful species for the local communities . Third party evaluation shall be got carried out regularly for the proper implementation of activities under taken in the project area under CSR. Issue raised in the public hearing should also be integrated with activities being taken up under CSR. The details of CSR undertaken along with budgetary provisions for the village wise various activities and the expenditure thereon shall be uploaded on the company website every year. The company must give priority to capacity building both within the company and to the local youth, who are motivated to carry out the work in future.	Agreed. Being implemented.

xxxii.	For monitoring land use pattern and for post mining land use, a time series of land use maps, based on satellite imagery (on a scale of 1: 5000) of the core zone and buffer zone, from the start of the project until end of mine life shall be prepared once in 3 years (for any one particular season which is consistent in the time series), and the report submitted to MoEF and its Regional office at Bhubaneswar.	Time series map of vegetation cover in the Jharia Coal field has been carried out through CMPDI.
xxxiii.	A Final Mine Closure Plan along with details of Corpus Fund shall be submitted to the Ministry of Environment & Forests five year before mine closure for approval. Habitat Restoration Plan of the mine area shall be carried out using a mix of native species found in the original ecosystem, which were conserved in-situ and ex-situ in an identified area within the lease for reintroduction in the mine during mine reclamation and at the post mining stage for habitat restoration.	Agreed .Eco-restoration sites (4 no. of total area 8.4 Ha) using native species are maintained. Mine closer plan is approved and implemented for Murulidih 20/21 Pits Colliery. Temporary Mine Closure Plan has been approved and it is under implementation for other six mines of cluster.
xxxiv.	A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the head of Company for implementing environment policy and socio – economic issues and the capacity building required in this regard.	A full-fledged Environment Department, headed by a HOD (Environment) along with a suitable qualified multidisciplinary team of executives (12 nos.) which includes Environment, Mining, Excavation, Civil, Survey ,Electrical & mechanical, Forestry disciplines executives and technicians (4 nos.) has been established in Headquarters. They are also trained in ecological restoration, sustainable development, rainwater Harvesting methods etc. At the project level, one Executive in each area has also been nominated as Project Nodal Officer (Environment) and is also entrusted with the responsibility of compliance and observance of the environmental Acts/ Laws including environment protection measures .The activities are monitored on regular basis at Area and at Headquarters levels. GM (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company. The team is multidisciplinary and very much motivated under the guidance of company's Director (Technical) and CMD. Further capacity building at both corporate and operating level is being done.
xxxv.	Implementation of final mine closure plan for cluster XIII, subject to obtaining prior approval of the DGMS in regard to Mines Safety issues.	Will be implemented.
Xxxvi.	Corporate Environment Responsibility:	
a)	The Company shall have a well laid down Environment Policy approved by the Board of Directors.	
b)	The Environment Policy shall prescribe for standard operating process/procedures to	Agreed.

c)	bring into focus any infringements/deviation/violation of the environmental or forest norms/conditions. The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions shall be furnished.	Already complied. Already complied.
d)	To have proper checks and balances, the company shall have a well laid down system of Reporting of non-compliances/violations of environmental norms to the Board of Directors of the company and/or shareholders or stakeholders at large.	Being followed.
Sl. No	B. General Conditions Conditions by MOEF:	Compliance
i.	No change in mining technology and scope of working shall be made without prior approval of the Ministry of Environment and Forests.	Being complied.
ii.	No change in the calendar plan of production for quantum of mineral coal shall be made.	Being Followed.
iii.	Four ambient air quality monitoring stations shall be established in the core zone as well as in the buffer zone for PM10, PM 2.5, SO 2 and NOx monitoring. Location of the stations shall be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr, etc carried out at least once in six months.	The locations of monitoring stations in the Jharia Coalfields has finalized in consultation with the Jharkhand State Pollution Control Board. The work of monitoring of ambient environment is being done through Central Mine Planning and Design Institute (CMPDI) having laboratory recognized under the EP Rules. Records for the same are maintained. Annexure - VI
iv.	Data on ambient air quality (PM 10, PM 2.5, SO 2 and NO x) and heavy metals such as Hg, As, Ni, Cd, Cr and other monitoring data shall be regularly submitted to the Ministry including its Regional Office at Bhubaneswar and to the State Pollution Control Board and the Central Pollution Control Board once in six months. Random verification of samples through analysis from independent laboratories recognized under the EPA rules, 1986 shall be furnished as part of compliance report.	Being complied. Monitoring done by CMPDIL. Enclosed as Annexure-VII.

v.	Adequate measures shall be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in blasting and drilling operations, operation of HEMM, etc shall be provided with Ear plugs/muffs.	Being Complied.
vi.	Industrial wastewater (workshop and wastewater from the mine) shall be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May 1993 and 31st December 1993 or as amended from time to time before discharge. Oil and grease trap shall be installed before discharge of workshop effluents.	The work of monitoring of ambient environment done through Central Mine Planning and Design Institute RI-II (CMPDI), Dhanbad which is having laboratory recognized under the EP Rules. There is no effluent discharge from workshop presently no coal production from any mines of Cluster – XIII.
vii.	Vehicular emissions shall be kept under control and regularly monitored. Vehicles used for transporting the mineral shall be covered with tarpaulins and optimally loaded.	Being Complied.
viii.	Monitoring of environmental quality parameters shall be carried out through establishment of adequate number and type of pollution monitoring and analysis equipment in consultation with the State Pollution Control Board and data got analyzed through a laboratory recognized under EPA Rules, Monitoring of environmental quality parameters shall be carried out through establishment of adequate number and type of pollution monitoring and analysis equipment in consultation with the State Pollution Control Board and data got analyzed through a laboratory recognized under EPA Rules, 1986.	It is being complied. Monitoring is done by CMPDIL. Having laboratory recognized under EPA Rules 1986.
ix.	Personnel working in dusty areas shall wear protective respiratory devices and they shall also be provided with adequate training and information on safety and health aspects.	Being Complied. Vocational training Centers under Separate Human Resource Development Deptt. is Conducting regular training programme on these issues.
x.	Occupational health surveillance program me of the workers shall be undertaken periodically to observe any contractions due to exposure to dust and to take corrective measures, if needed and records maintained thereof. The quality of environment due to outsourcing and the health and safety issues of the outsourced manpower should be addressed by the company while outsourcing.	Initial Medical Examination (IME) and Periodical Medical Examination (PME) of all the personnel are carried out as per the Statutes and Director General of Mines Safety (DGMS) `s guideline.
xi.	A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the Head of the	A full-fledged Environment Department, headed by a HOD (Environment) along with a suitable qualified multidisciplinary team of executives (12 nos.) which includes Environment, Mining, Excavation, Civil,

	company.	Survey,Electrical & mechanical, Forestry disciplines executives And technicians (4 nos.) have been established in Headquarters. They are also trained in ecological restoration, sustainable development, rainwater Harvesting methods etc. At the project level, one Executive in each area has also been nominated as Project Nodal Officer (Environment) and is also entrusted with the responsibility of compliance and observance of the environmental Acts/ Laws including environment protection measures .The activities are monitored on regular basis at Area and at Headquarters levels. GM (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company. The team is multidisciplinary and very much motivated under the guidance of company's Director (Technical) and CMD. Further capacity building at both corporate and operating level is being done.
xii.	The funds earmarked for environmental protection measures shall be kept in separate account and shall not be diverted for other purpose. Year-wise expenditure shall be reported to this Ministry and its Regional Office at Bhubaneswar.	It is being initiated to comply the same. Agreed to report the same.

xiii.	The Project authorities shall advertise at least in two local newspapers widely circulated around the project, one of which shall be in the vernacular language of the locality concerned within seven days of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution control Board and may also be seen at the website of the ministry of Environment & Forests at http://envfor.nic.in.	It has been complied.
xiv.	A copy of the environmental clearance letter shall be marked to concern Panchayat/Zila Parishad, Municipal Corporation or Urban local body and local NGO, if any, from whom any suggestion/representation has been received while processing the proposal. A copy of the clearance letter shall also be displayed on company's website.	Complied.

xv.	A copy of the environmental clearance letter shall be shall also be displayed on the website of the concerned State Pollution Control Board. The EC letter shall also be displayed at the Regional Office, District Industry Sector and Collector's Office/Tehsildar's Office for 30 days.	Complied.
xvi.	The clearance letter shall be uploaded on the company's website. The compliance status of the stipulated environmental clearance conditions shall also be uploaded by the project authorities on their website and updated at least once every six months so as to bring the same in public domain. The monitoring data of environmental quality parameter (air, water, noise and soil) and critical pollutant such as PM10, PM2.5, SO 2 and NOx (ambient) and critical sectoral parameters shall also be displayed at the entrance of the project premises and mine office and in corporate office and on company's website.	Complied.
xvii.	The project proponent shall submit six monthly compliance reports on status of compliance of the stipulated environmental clearance conditions (both in hard copy and in e-mail) to the respective Regional Office of the Ministry, respective Zonal Office s of CPCB and the SPCB.	Being complied.
xviii.	The Regional Office of this Ministry located at Bhubaneswar shall monitor compliance of the stipulated conditions. The Project authorities shall extend full cooperation to the office(s) of the Regional Office by furnishing the requisite data/information/monitoring reports.	Agreed. Being and shall be complied.

xix.	The Environmental statement for each financial year ending 31 March in For –V is mandated to be submitted by the project proponent for the concerned State Pollution Control Board as prescribed Under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be uploaded on the company's website along with the status of compliance of EC conditions and shall be sent to the respective Regional Offices of the MoEF by E-mail.	Being complied. Agreed.
7	The Ministry or any other competent authority may stipulate any further condition(s) for environmental protection.	Agreed
8	Failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract the provisions of the Environment (Protection) Act, 1986.	Agreed
9	The above conditions will be enforced inter-alia, under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and Rules. The proponent shall ensure to undertake and provide for the costs incurred for taking up remedial measures in case of soil contamination, contamination of groundwater and surface water, and occupational and other diseases due to the mining operations.	Agreed

10	The Environmental Clearance is subject to the outcome of the Writ Petition filed by M/S Bharat Coking Coal Limited (BCCL) in response to the closure orders issued by the Jharkhand State Pollution Control Board which is pending in the Jharkhand High Court.	Agreed
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 29/5/24
 Project officer
 Mahuda Group of Mines
 (Cluster-XIII, BCCL)

ANNEXURE- I

A. Production from October'25 to March '26 of Cluster XIII mines

Total Month		Oct '25	Nov '25	Dec'25	Jan'26	Feb'26	March 26	(Million ton)
Cluster XIII	Murulidih 20/21 pits	0	0	0	0	0	0	0
	Bhurungiya colliery	Nil						Nil
	Muchraidih colliery							
	Hantoodih Colliery							
	Padugora colliery							
	Murulidih colliery							
	Bhatdee colliery							
	Total (in Million ton)							
	Remarks: - Murulidih 20/21 pits colliery temporarily closed for production from December-2015.							

Project Report

On

Delineation of Surface Coal Fire and associated Land Subsidence in Jharia Coalfields (2022-2024), Jharkhand using satellite based remote-sensing techniques

A collaborative project between



**National Remote Sensing Centre (NRSC)
Indian Space Research Organisation (ISRO)
Hyderabad - 500 037**



Bharat Coking Coal Limited

**Bharat Coking Coal Limited
Koyla Bhawan, Koyla Nagar
Dhandbad, Jharkhand**

April, 2025

NATIONAL REMOTE SENSING CENTRE

REPORT / DOCUMENT CONTROL SHEET

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5	Document Control Number				
6	Title	DELINEATION OF SURFACE COAL FIRE AND ASSOCIATED LAND SUBSIDENCE IN JHARIA COALFIELDS (2022-2024), JHARKHAND USING SATELLITE BASED REMOTE-SENSING TECHNIQUES			
7	Particulars of collation	Pages 43	Figures 19	Tables 6	References 9
8	Author(s)	Shri Punit R Jalan, S/E 'SC', Shri Priyom Roy, S/E 'SE', Smt Nirmala Jain, S/E 'SE', Dr. Tapas Ranjan Martha, Head GMED			
9	Affiliation of authors	Geosciences Group, RSA-A, NRSC/ISRO			
10	Scrutiny mechanism	Compiled by Shri Punit R Jalan S/E 'SC'	Reviewed by Dr. Tapas Ranjan Martha Head, GMED Dr. I.C. Das Group Director, Geosciences	Approved /Controlled by Dr. K. Sreenivas DD (RSA-A)	
11	Originating unit	NRSC			
12	Sponsor(s)/ Name and Address	BCCL			
13	Date of Initiation	18/05/2022			
14	Date of Publication	XX/04/2025			
15	Abstract (with Keywords): Surface coal fires cause not only economic damage to the countries but also create harsh working conditions for the mine workers due to prolonged exposure to toxic fumes. Along with this, the sub-surface fire and underground mining create a void beneath the ground, causing subsidence and affecting local communities by damaging infrastructures. The present study addresses the delineation of surface coal fires for 2022-2024 and mining-related subsidence. Thermal and SWIR bands with high and medium spatial resolutions of winter season Landsat-8/9 images were used to identify the anomalous pixels (high temperature) compared to the surrounding area and demarcated as coal mine fire area. Further, ALOS-PALSAR 2, L band microwave data, was used to identify the zone of probable land subsidence (using differential interferometry) due to mining. The identified areas were field verified in 2023 and 2024, where the fire areas were classified in terms of mine fires and overburden dump fires, and the subsidence was verified through ground evidence. The study presents a comparative analysis of the dynamics of coal fire area between the previous studies and the maps generated for 2022 to 2024 and a block-wise distribution of coal fire zones for both classes (mine fire and overburden fire). The fire area increased from ~1.85 sq.km in 2020 to ~4.54 sq.km in 2022 and then again increased in 2023 to ~5.00 sq.km, which subsequently decreased to ~3.91 sq.km in 2024. The cardinal direction-wise comparative analysis for individual years is investigated to understand the major contributors to the total fire areas and changes from the previous year. Apart from this, subsidence in the old overburden dumping area of Nudkhurkee OCP was identified and verified during the fieldwork, where the cause of subsidence can be due to the settling of the dumped materials. The final coal mine fire and subsidence maps of the Jharia coal field is prepared.				

Acknowledgements

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Executive Summary

Surface coal fires cause not only economic damage to the countries but also create harsh working conditions for the mine workers due to prolonged exposure to toxic fumes. Along with this, the sub-surface fire and underground mining create a void beneath the ground, causing subsidence and affecting local communities by damaging infrastructures. The present study addresses the delineation of surface coal fires for 2022-2024 and mining-related subsidence. Thermal and SWIR bands with high and medium spatial resolutions of winter season Landsat-8/9 images were used to identify the anomalous pixels (high temperature) compared to the surrounding area and demarcated as coal mine fire area. Further, ALOS-PALSAR 2, L band microwave data, was used to identify the zone of probable land subsidence (using differential interferometry) due to mining. The identified areas were field verified in 2023 and 2024, where the fire areas were classified in terms of mine fires and overburden dump fires, and the subsidence was verified through ground evidence. The study presents a comparative analysis of the dynamics of coal fire area between the previous studies and the maps generated for 2022 to 2024 and a block-wise distribution of coal fire zones for both classes (mine fire and overburden fire). The fire area increased from ~1.85 sq.km in 2020 to ~4.54 sq.km in 2022 and then again increased in 2023 to ~5.00 sq.km, which subsequently decreased to ~3.91 sq.km in 2024. The cardinal direction-wise comparative analysis for individual years is investigated to understand the major contributors to the total fire areas and changes from the previous year. Apart from this, subsidence in the old overburden dumping area of Nudkhurkee OCP was identified and verified during the fieldwork, where the cause of subsidence can be due to the settling of the dumped materials. The final coal mine fire and subsidence maps of the Jharia coal field is prepared.

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CHAPTER I

INTRODUCTION

Coal fire is a perennial problem in Jharia coal field (JCF) covering 447 sq. km. area in the Dhanbad district of Jharkhand state. The severity and extent of mine fires in some of the Indian coalfields, particularly Jharia and Raniganj coalfields, are quite alarming. Combustion can occur either within coal or in coal dumps on the surface. Considerable economic loss and environmental problem arises due to the coal fire. Coal fire burns valuable coal and also creates difficulties in mining by increasing the cost of production or making existing operations difficult. Noxious gases like sulphur dioxide, nitrogen oxide, carbon monoxide, carbon dioxide, which are the result of coal burning process, often affect the immediate surroundings of an active coal fire area (Gangopadhyay, 2003). These greenhouse gases not only affect local atmosphere but also play a crucial role in the damages, found associated with coal fire such as land surface subsidence and surface cracking.

Coal fires are caused by oxidation of coal but the reaction involved in oxidation of coal is not understood till date. Broadly, the potential for spontaneous combustion lies in its ability to react with oxygen at ambient temperature. This occurs through the reaction of oxygen at the surface of the coal resulting in an exothermic reaction. As a consequence, the temperature of coal rises and if temperature reaches the threshold temperature, ranging between 80⁰ to 120⁰C, a steady reaction starts, which produces carbon dioxide. Temperature keeps on increasing once CO₂ started to form and at 2300⁰C, the exothermic reaction becomes rapid. It is known that high grade coals (high carbon content) are more fire prone, though the reason behind this is not well understood. Another important parameter, which controls fire, is the size of the particles. Larger the effective area of coal (fire particles), more rapidly the reaction proceeds. Cracks, fissures play a role like positive catalysts to coal oxidation by slowly supplying oxygen / air through their conduits.

Coal mining in Jharia Coal Field (JCF) started way back in 1895. History of fire in Jharia Coal Field dates back to 1916 when the first incidence of fire was reported from XIV seam of Bhowrah colliery. JCF was nationalised in 1972 and over the decades, the fire has spread or been contained but never extinguished. The combination of underground fire and subsidence have affected vast areas of JCF.

1.1 Background

Bharat Coking Coal Ltd. (BCCL), a Public Sector Undertaking is engaged in coal mining activities in the area. As a part of its operational activity, BCCL is monitoring the existing fire locations in the area and also their relative movement with time. Additionally, BCCL funds several activities to monitor and map the dynamic nature of the coal fires. In this regard, several satellite-based research works were taken up for mapping the coal fire in last two decades in the area (Chatterjee, 2006; Chatterjee et al., 1996; Martha et al., 2010; Reddy et al., 1993). These projects were funded and supported by BCCL. NRSC has carried out coal fire mapping projects in the past; conducting an airborne campaign in 1989 and using Landsat-5 TM data in 1995 (Bhattacharya et. al., 1995) over Jharia coalfield, Jharkhand and using data for 2001 over Raniganj coalfield, West Bengal. Further another project was executed in 2006, in which coal fire of the Jharia Coalfield was mapped for 2003 and 2006, using ETM+ and ASTER data, respectively. In the last decade, three similar projects were executed by NRSC in 2012, 2017 and 2020 to map the coal fire and land subsidence.

The current project is based on the letter (Ref. no. BCCL/GM(JMP)/File-2022/283) from General Manager (JMP), BCCL addressed to Director, NRSC on the 30 of September 2022 with a request to take up Coal fire and Land Subsidence study of the Jharia Coal Field using space-borne remote sensing techniques and to report the status of the same for the year 2022, 2023 and 2024 (three years). The project was initiated on 18-05-2023.

1.2 Objectives

The following objectives are formulated on the basis of the above-mentioned background.

- To map the coal fire in the study area based on pixel integrated relative radiant temperature derived Landsat-8/9 Thermal data as on 2022, 2023 and 2024.
- To compare the change in the coal fire distribution in the Jharia coalfield within the period of 2020, 2022, 2023 and 2024.
- To identify the land subsidence zones in Jharia coalfield, Jharkhand using microwave data.

1.3 Study Area

Jharia Coalfield is located in the Dhanbad district of Jharkhand state (Figure 1) and it is named after the main coal mining town of Jharia. It is situated in the Damodar River valley and is about 250 km NW of Kolkata. The coalfield is contained approximately within latitudes $23^{\circ} 42' N$ and $23^{\circ} 50' N$ and longitudes $86^{\circ} 09' E$ and $86^{\circ} 30' E$.

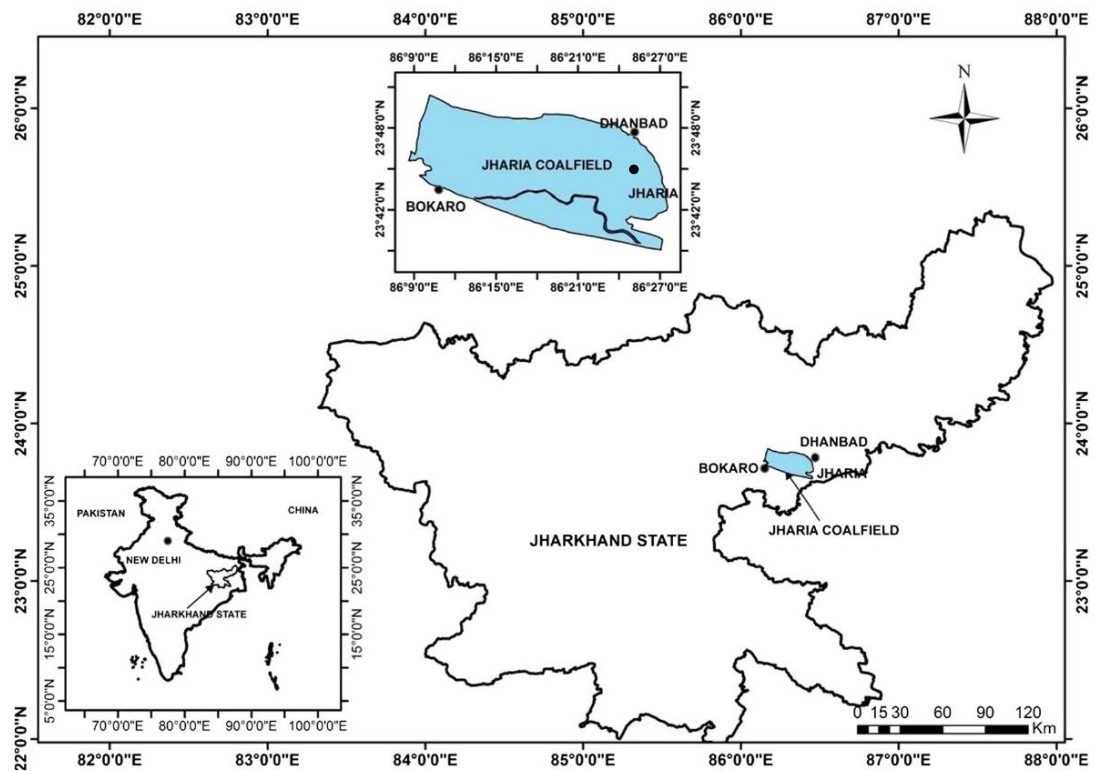


Figure 1: Study area map of Jharia Coalfield, Jharkhand.

CHAPTER II

GENERAL DESCRIPTION OF THE STUDY AREA

2.1 Location and Accessibility

Jharia is an old mining town in the Dhanbad district of Jharkhand. This town is famous for its surrounding mines producing high grade coal and supplying mainly to the neighbouring industrial areas. Jharia is approximately 6 km in south western direction from Dhanbad town and connected by metal road. Dhanbad is well connected to Kolkata by road and rail.

2.2 Physiography, Drainage and Climate

Jharia coalfield is characterised by undulatory topography with very low rolling slope towards the eastern part of the area. The average height of the area is around 200 meters above the mean sea level. Damodar is the major river in the study area. The other tributaries to the Damodar River in this area are Jamuniya Nadi, Khudia Nadi, Khatri Nadi, Jarian Nala, Kari Jora and Domohani Nadi. Damodar River flows from west to east in this area. The minimum temperature is $\sim 10^{\circ}$ C in the month of December – January and maximum temperature is $\sim 50^{\circ}$ C in the month of May – June.

2.3 General Geology

Gondwana Super Group of rocks of Up. Carboniferous to Lr. Cretaceous age (i.e. from 320 MY to 98 MY) are exposed here. Gondwana Super Group rocks unconformably overlie Archaean rocks. In Gondwana rocks, Raniganj and Barakar Formations of Permian age have more potential as far as the coal production is concerned. Barakar Formation is exposed in north and north eastern part of the basin (Figure 2). Most of the coal mines are confined to the Barakar Formation in JCF. Barakars consists of coarse, medium grey and white sandstones, shales and coal seams. Raniganj consists of grey and greenish soft feldspathic sandstones, shales and coal seams. Faults are prevalent in this portion of basins (Figure 2). NW trending faults are conspicuous in and around the northern part of Jharia coalfield. Many lamprophyre and dolerite dykes are also exposed in this area in a criss-cross manner. The Raniganj Formation though coal bearing, has suffered much deformation due to

faulting, thus causing difficulty for mining in the area. The generalised stratigraphy of JCF is mentioned below (after Saraf, et al., 1995).

FORMATION	LITHOLOGY	MAXIMUM THICKNESS
Supra Panchet	Red and Grey sandstones and shales	300m
Panchet	Micaceous Yellow and Grey sandstones, Red and Greenish shales	600m
Raniganj	Grey and Greenish soft feldspathic sandstones, shales and coal seams	1050m
Ironstone Shales	Dark carbonaceous shales with ironstone bands	360m
Barakar	Coarse and medium Grey and white sandstones, shales and coal seams	630m
Talchir Boulder Bed	Coarse sandstones above and Greenish shales below	300m

Table 1: Generalised stratigraphy of JCF.

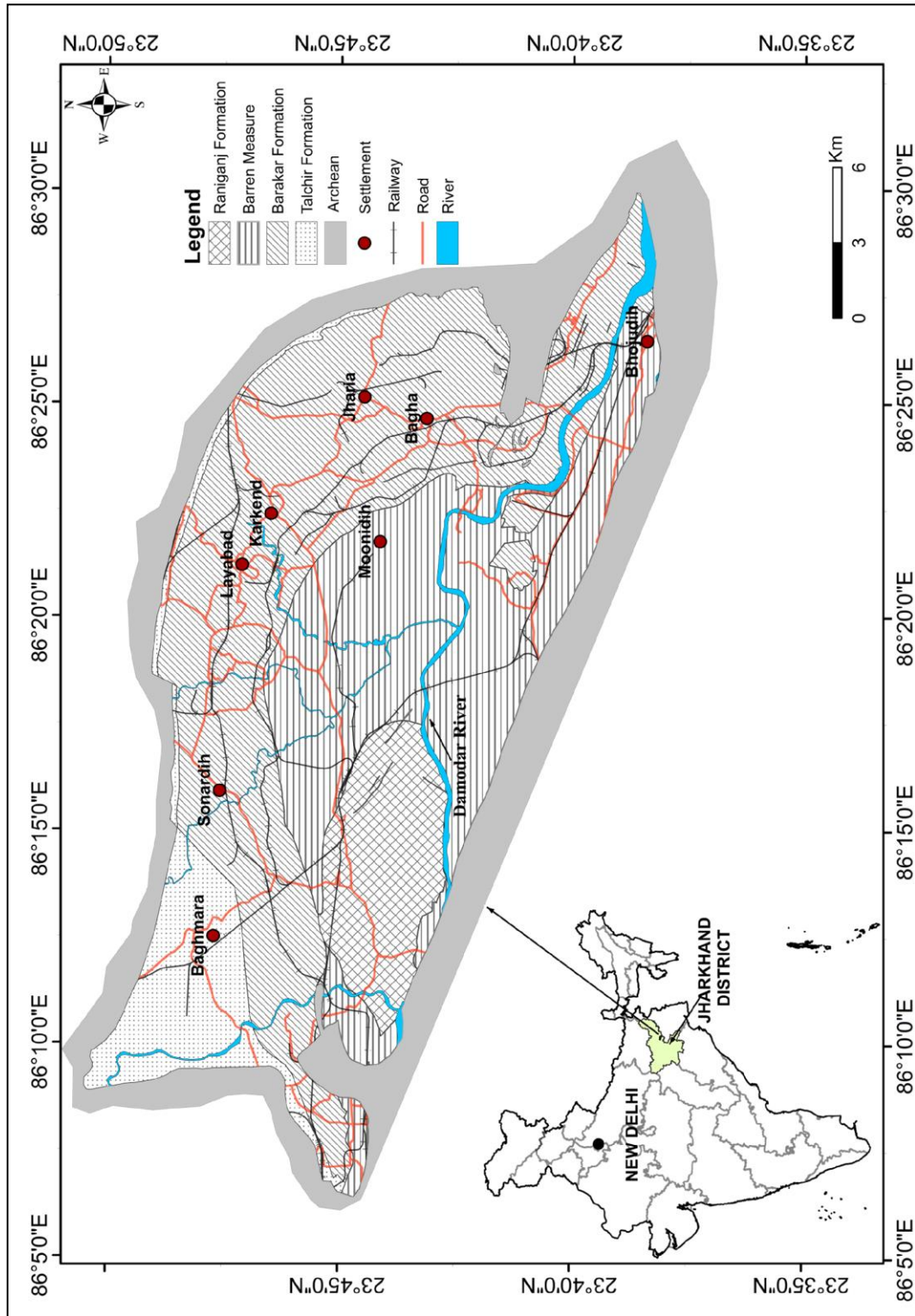


Figure 2 : Geological map of Jharia coal field, Dhanbad, Jharkhand (published by CMPDIL).

CHAPTER III

DATA REQUIREMENTS

3.1 Remote Sensing Data

Coal fire map was created from three years period from 2022 to 2024 using Landsat bands details of which are provided in the table 2. A comparative analysis was carried out for each year based on the previous year and 2020 coal fire map prepared by NRSC from the Landsat 8 TIRS bands.

For the land subsidence study, L-band microwave data from ALOS-PALSAR satellite (JAXA) were used. Seven scenes of "Fine Beam mode" SLC data were taken from PALSAR-2 archives over a period from February, 2021 to February, 2024. This was done to identify long term terrain changes and differentiate the same from short term changes due to mining excavations and overburden dumping.

Table 2: List of satellite data used in the present study.

Satellite	Sensor	Resolution	Time	Date	Data source
Landsat-8	TIRS 1/2	100m	Daytime	28 November 2022	USGS, USA
Landsat-9	TIRS 1/2	100m		12 December 2023	
	NIR	30m		and 03 December 2024	
	SWIR 1/2	30m			
ALOS	PALSAR-2 (Fine Beam mode)	10 m	NA	27 February 2021	JAXA, Japan
				11 November 2021	
				26 February 2022	
				10 November 2022	
				25 February 2023	
				07 December 2023	
				24 February 2024	
Landsat Satellite Bands			Wavelength (um)		
NIR			0.85 – 0.88		
SWIR 1			1.57 - 1.65		

SWIR 2	2.11 – 2.29
TIRS 1	10.6 – 11.19
TIRS 2	11.5 – 12.51
PALSAR-2 Frequency/ Wavelength: 1.27 Ghz / 23.62cm	

3.2 Ancillary data

1. Geological map of Jharia coal field
2. Mine surface plans as provided by BCCL

REMOTE SENSING DATA ANALYSIS

4.1 Methodology for fire zones identification and field verification

4.1.1 Processing of Landsat TIRS band Data

Since the launch of Landsat 4/5 satellite and subsequent launch of other Landsat 7/8/9 has made space borne thermal data available through its thermal infrared sensor (TIRS) bands. This has enabled monitoring of the earth with a spatial resolution of 100 m in the thermal domain with a repeat cycle of 16 days. The Landsat-8/9 has two channels (Band 10 and Band 11) in the thermal infrared region (Table 1) which ranges from 10.4 micrometer to 12.5 micrometer (Gangopadhyay et al. 2012). In present study, band 10 of TIRS sensor with the details of acquisition provided in table 2 has been used for coal fire mapping. The spectral domain of the band is known for its maximum transmittance (Chatterjee et al. 2007; Martha et al. 2010). The data are freely accessible through USGS portal (Landsat 8 download source: <http://landsatlook.usgs.gov>).

Landsat-8/9 data are available in GeoTiff format and the data are converted to top of the atmosphere spectral radiance using the radiance rescaling factors provided in the metadata file, using equation 1.

$$L_{\lambda} = M_L Q_{cal} + A_L \dots\dots\dots (1)$$

Where:

L_{λ} = Spectral radiance (Watts/ (m² * srad * μm)).

M_L = Band-specific multiplicative rescaling factor from the metadata.

A_L = Band-specific additive rescaling factor from the metadata.

Q_{cal} = Quantized and calibrated standard product pixel values (DN).

Once the spectral radiance (L_{λ}) for Landsat-8/9 band 10 data is generated, it is possible to calculate radiant (brightness) temperature directly using equation 2. Planck's radiation function (Planck, 1914) forms the basis of radiant temperature derivation from spectral radiances and the theory is discussed in detail in existing literature (Gupta, 2003).

$$T_R = K_2 / \ln ((K_1 / L_{\lambda}) + 1) \dots\dots\dots (2)$$

T_R = Radiant (brightness) temperature,

K_1 = Calibration constant (1260.56 K),

K_2 = Calibration constant (666.09 watts/ (m² *srad*μm)),

L_λ = Spectral radiance

4.1.2 Thresholding of radiant temperature image

Once the Landsat-8/9 data are converted to radiant temperature image, the next step was to segregate fire pixels from the background, which requires the estimation of the cut-off temperature. This has been attempted by the statistical analysis of sensor derived radiant temperature to delineate clusters (in the scatter-plot) indicative for fire and non-fire pixels. Mean and maximum radiant temperatures are derived from randomly sampled uniform sized pixel blocks distributed in entire spatial extent of Barakar Formation (Figure 3) known for fire bearing coal seams. The pixel block sizes are chosen to adequately represent the overall areal extent of the coalfield and homogeneously encompass all the mining blocks (27x27 pixels for Landsat-8/9, Figure 3). The maximum temperature value recorded in each representative area, derived from each of the datasets, is plotted against the mean temperature. The maximum temperature represents that of fire (wherever present), whereas the mean temperature represents the average background temperature, for normalization. The fire and background populations show considerable variance, separating coal fire and background radiant temperatures. The cut-off temperature derived is the maximum temperature of the background cluster, above which all temperatures represent coal fires. In the case of the Landsat-8/9 data used in this study, the cut-off temperature was determined for individual years from its respective Landsat images which came around 30.5°C for 2023 and 28°C for 2024 as shown in figure 4.

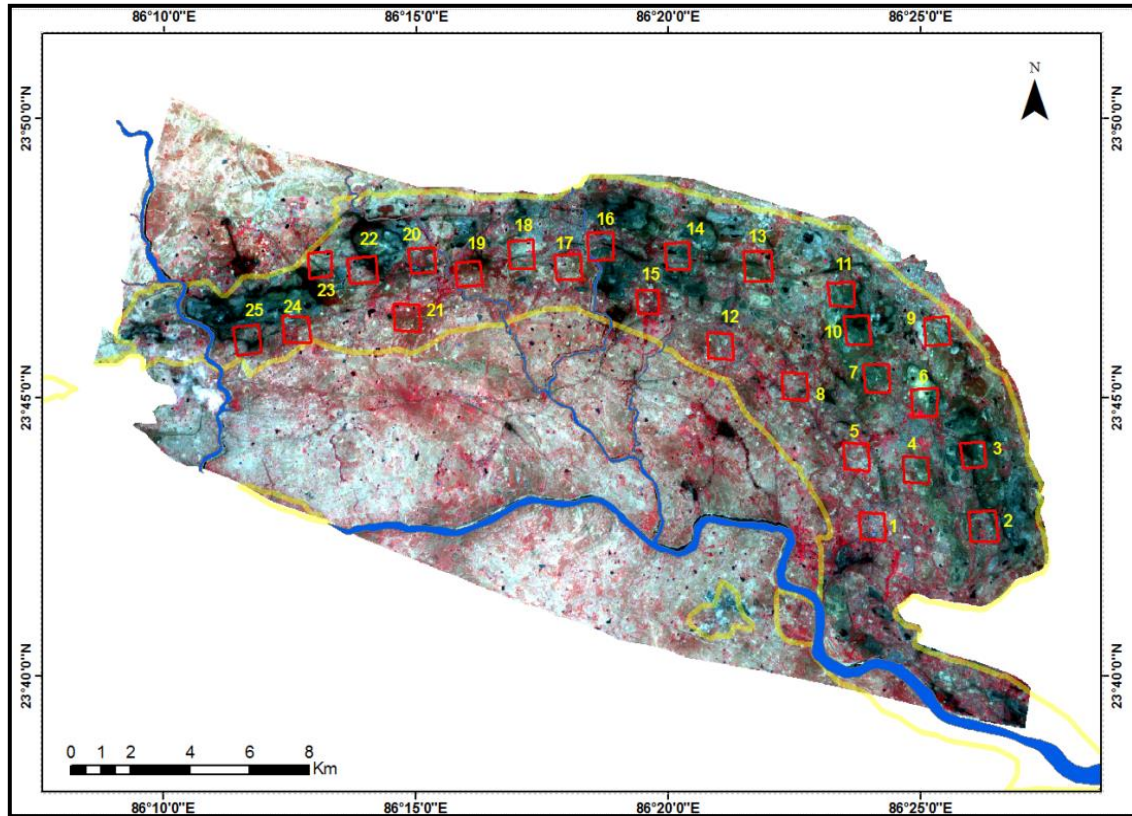


Figure 3. False colour composite image of Jharia Coalfield, with subset blocks (in red boxes) to obtain temperature values (from radiant temperature image) within the Barakar formation across the Jharia coalfield.

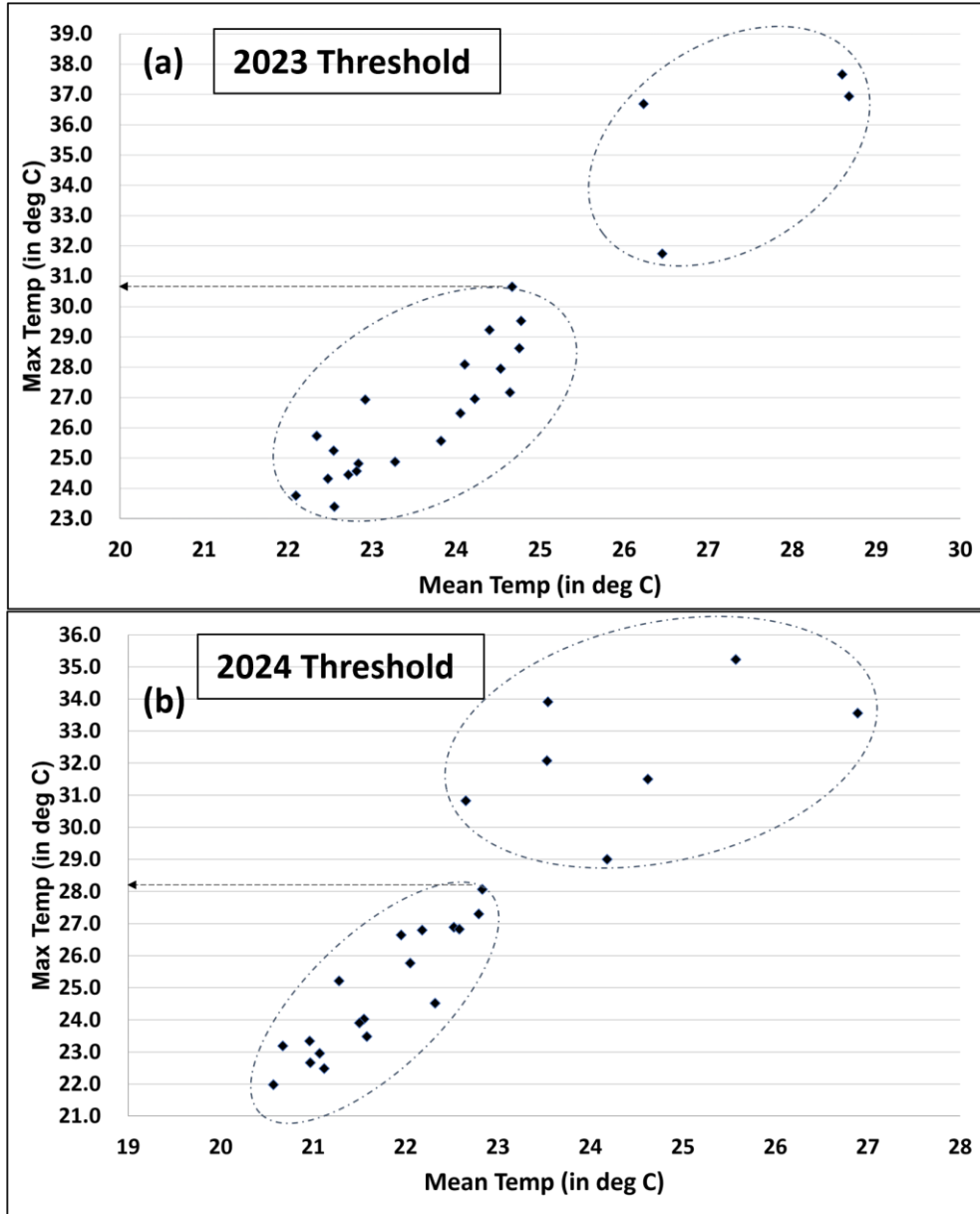


Figure 4. Maximum temperature plotted against mean temperature for various locations for 2023 and 2024; cluster separation observed around (a) 30.5°C for 2023 and (b) 28°C for 2024 (marked with arrow).

4.1.3 Medium-Resolution SWIR/NIR-based fire area identification.

The SWIR 1, 2 and NIR bands of Landsat-9 data for the year 2023 and 2024 were considered to detect small size coal fires that weren't identified through the Radiant Temperature as the TIRS band resolution is 100m. Based on Wein's displacement law distribution of energy, particle with higher energy emits radiation with peak at higher wavelengths hence the DN values for SWIR and NIR bands for fire pixels will look darker compared to the surrounding areas and when set to fire colour composite with

SWIR-2, SWIR-1 and NIR combination can be identified as red or orange pixels from the image. The cluster of pixels was then digitized manually.

4.1.4 Surface Fire Temperature estimation using Thermal Sensor

The validation of the surface fire temperature estimated from the satellite platforms was carried out using handheld thermal infrared imager which captured heat map of an area and provided approximate surface temperature and temperature difference using inverse square law. Important details of the instrument are given in the table 3.

Table 3: Details of the handheld thermal infrared imager.

Description	Value
Make	Fluke
Model	Ti 300
Detection type	Infrared / emitted radiation
Operating wavelength	8-14 μm
Field of View (H * V)	24 * 17 deg
Temperature measuring range	-20 to +650 deg C
Accuracy	± 1 deg C

The images are captured by aiming the instrument (Figure 5) at the specific spot and taking a snap of the area. The captured thermal images during the field work were taken by reaching the closest proximity of the pre-field identified areas. The captured image gives details of the fire temperature at that spot. The optical image is also captured by the instrument along with the thermal image of a focused area.



Figure 5: Left image shows the front portion and right image shows the rear portion of the Fluke Ti300 hand held thermal imager.

4.2 Methodology for Subsidence Detection

4.2.1 Processing of ALOS-PALSAR 2 Data

Differential Interferometric SAR (DInSAR) techniques consist of combination of two SAR images of the same area acquired from slightly different positions (Figure 6).

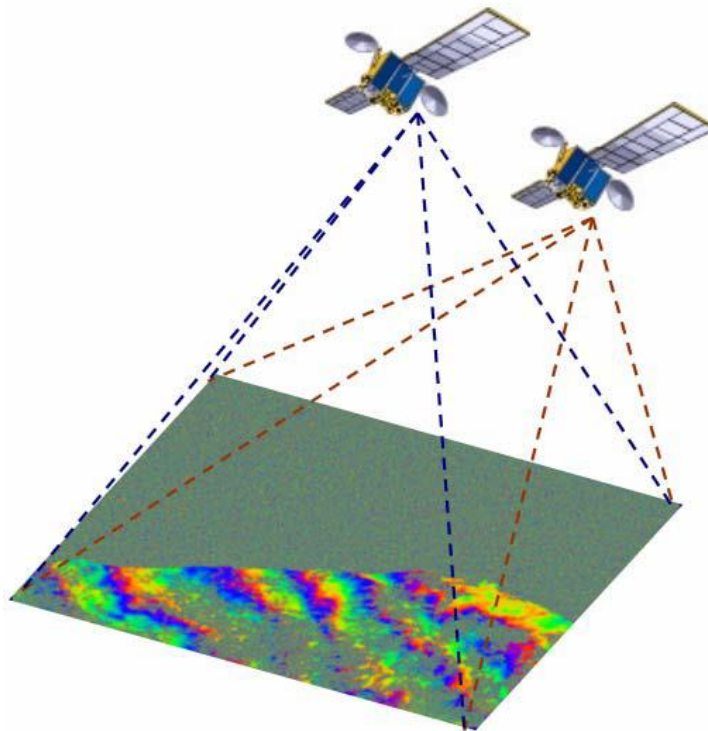


Figure 6. DInSAR acquisition scheme.

The result of this combination provides a new image, known as 'interferogram', whose phase component is formed by the following term:

$$\Delta\Phi_{\text{Int}} = \Phi_{\text{Topo}} + \Phi_{\text{Mov}} + \Phi_{\text{Atm}} + \Phi_{\text{Noise}} \quad (3)$$

where, Φ_{Topo} denotes the topographic component, Φ_{Mov} denotes the terrain deformation/ displacement component, Φ_{Atm} is the noise component and Φ_{Noise} is the thermal noise.

Topography, atmospheric effects and thermal noise needs to be removed or optimized to obtain precise measurements of terrain movement. When working with classical DInSAR interferograms (combination of two SAR images) the main problem is the presence of atmospheric artefacts, since there is no way to cancel them without a priori information. On the other hand, the term related with topography can be cancelled out using an external Digital Elevation Model (DEM) and the orbital ephemeris from the SAR acquisitions, considering no height errors on the DEM.

$$\Delta\Phi_{\text{dif}} = \Phi_{\text{ErrorTopo}} + \Phi_{\text{Mov}} + \Phi_{\text{Atm}} + \Phi_{\text{Noise}} \quad (4)$$

Since the coal mine area is very dynamic in terms of its surfacial changes (open cast mine, abandoned mine, fire affected waste/reclaimed land, over burden dumps) over time, it is proposed to utilize an advanced DInSAR technique. It is a recent remarkable improvement in SAR differential interferometry that has led to an innovative approach based on the use of a large dataset of SAR images over the same area to overcome the intrinsic limitations of conventional DInSAR in terms of temporal and geometrical decorrelation as well as atmospheric disturbances (Carnec et al., 1996; Bürgmann et al., 2000).

Broad work flow diagram for generating land subsidence map using satellite based DInSAR technique is shown in Figure 7.

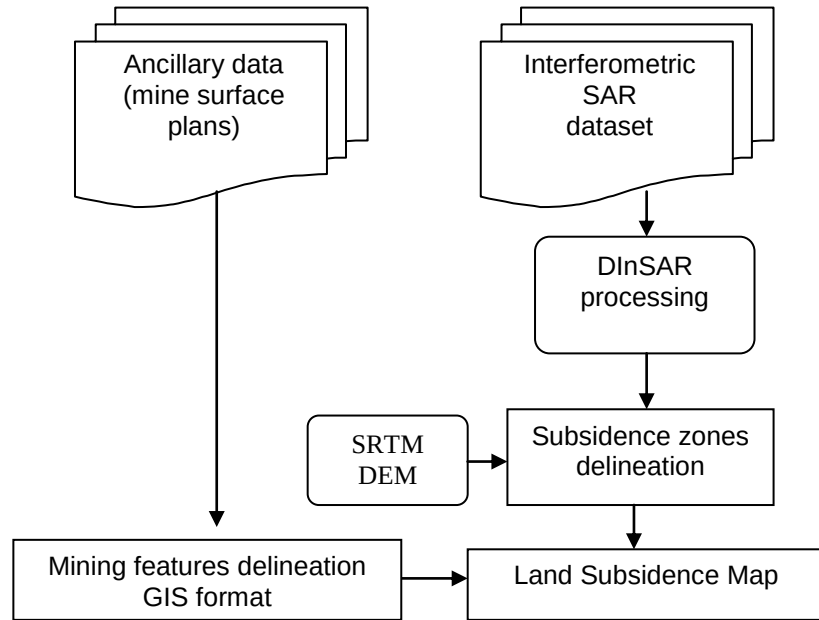


Figure 7. Work flow diagram for generating land subsidence map using DInSAR technique.

4.2.2 Identification of subsidence zones through processed Interferograms

In the present study, 7 sets of ALOS-PALSAR L-band microwave data (as mentioned in table 1) were procured. The datasets were paired into master-slave pairs. The interferograms for the long temporal baselines include data pairs of time difference of ~ one year were produced. The short temporal baselines could not be carried out due to satellite offset. The figure 8 shows the interferograms pairs produced.

		SLAVE IMAGE				
		27 February 2021	11 November 2021	26 February 2022	10 November 2022	25 February 2023
MASTER IMAGE	27 February 2021					
	11 November 2021					
	26 February 2022					
	10 November 2022					
	25 February 2023					
	07 December 2023					
	24 February 2024					
		Satellite Offset				
		Interferogram produced				

Figure 8. ALOS-PALSAR - 2 Master-Slave pairs long temporal base line processing

The master-slave pairs of long temporal baseline (approximately one year as shown in figure 8) will incorporate terrain changes due to mining activities as well, as long-term ground subsidence from underground mining, settling of old Overburden dump and subsidence due to mining. The figure 9 shows an example of the identifiable subsidence area through the interferogram.

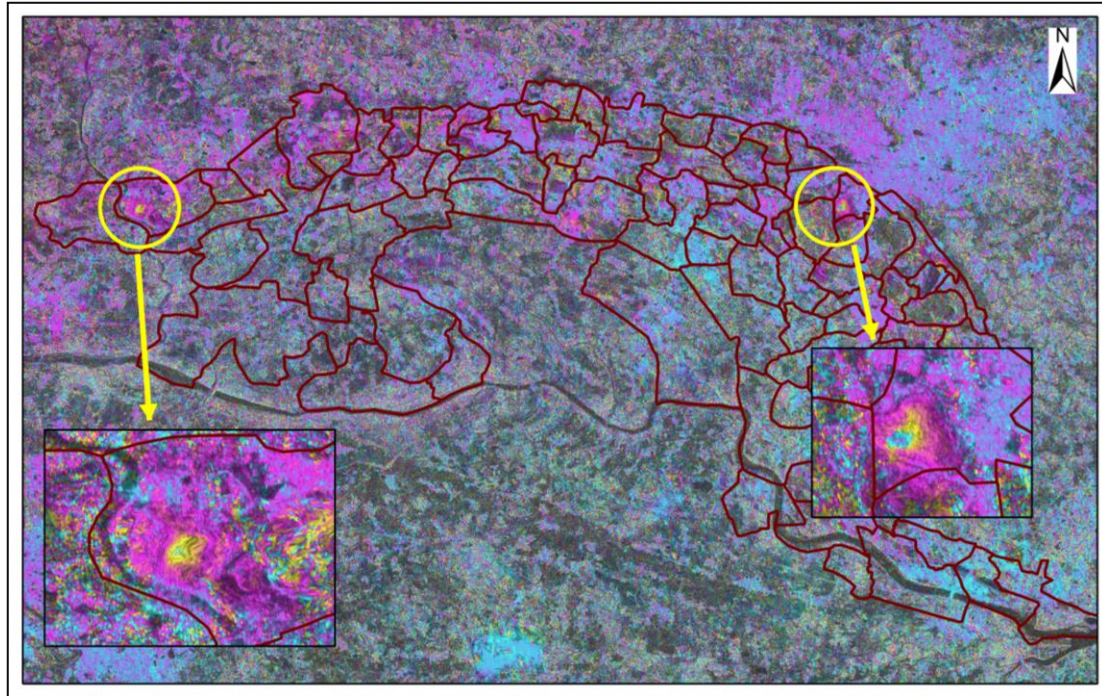


Figure 9. Fringe patterns generated from long baseline processing (e.g. Master: 26 February 2022 Slave: 27 February 2021).

The results from the long baseline processing can be compared and zone where fringes have been developed due to terrain changes due to mining excavation and dumping, can be systematically identified and demarcated. The remaining fringes from the long temporal baseline processing will then indicated towards zones where subsidence has taken place. Using this, a subsidence map of the Jharia Coalfield was generated.

FIELD WORK

Field work for verification of the coal fire locations for 2023 and 2024 and the subsidence points generated from 2022 to 2024 as identified by the satellite data was carried out from 15 to 18 December 2023 and 22 to 25 February 2025, respectively. NRSC further independently and physically verified both the coal fire and the subsidence locations. A total of 53 coal fire points for 2023, 54 coal fire points and 30 subsidence locations for 2024 were identified from the satellite data analysis (figure 10-11). The surface temperature for the coal fire areas was captured using the handheld sensor. Specific evidence of subsidence around the active mine areas and old Overburden dumps was identified to verify the subsidence map, which is shown in the result section.

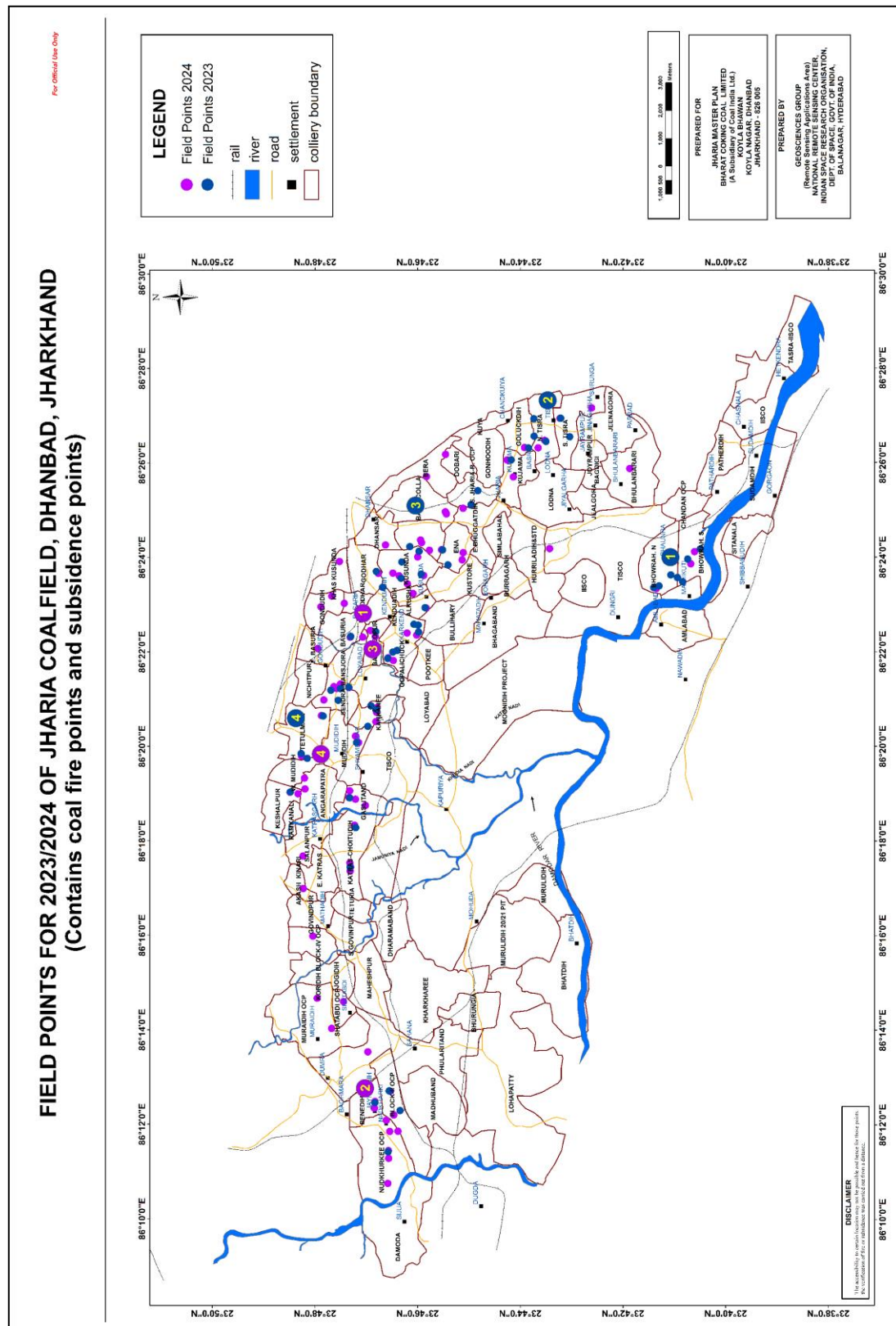


Figure 10. Field data points for coal fire and subsidence (only for 2024) verification for 2023 and 2024.

Fire location observations:

1. The 100+ fire locations were visited during the field for 2023 and 2024; all the points were verified and classified as Overburden dump Fire and Active Mine Fire. Accordingly, the polygon associated with the field point was assigned its particular class.
2. Upon physically reaching the fire location, the fire area could easily be identified due to large fissures, cracks, carbonated rocks or through CMB, CO, CO₂ gases smell, and by visible blazing fire (burning fire) in the active mining areas. For locations at a distance, the fire could be identified from the change in the refraction due to the emitting gasses or through the handheld thermal sensor.
3. Largely the extent of fire in and around large Overburden dump areas such as Kusunda, Bhowrah, Block-II, Gopalichuck, etc., identified in 2023 and 2024, have remained approximately the same as seen during the field. The blazing fire inside the active mining areas of ENA, Basjuria, Bhowrah, etc, was found only in 2024. The blazing fire locations, such as Benedih/Block-II OCP, Mudidih, etc, identified during the 2023 field visit were still persisting.
4. As shown in the results section, the fire area decreased as compared to 2023 in 2024, while based on the field observation.

Subsidence location observations:

1. Subsidence locations identified from the satellite data are difficult to verify in the field unless there are tell-tale signatures like large cracks or fissures on the ground, bending of the trees, or damage to anthropogenic constructions like vertical cracks on building cracks, etc.
2. Out of the 30 identified subsidence locations from the interferograms produced through the ALOS-PALSAR-2 SLC pairs of microwave data. The identified location can be categories into three categories as; old Overburden dump regions, new Overburden dump regions and active mining area or edge of the active mining area.
3. The two main areas of subsidence, as seen from Figure 9, where subsidence is occurring on a pervasive scale, were identified in the old Overburden dump area of Nudkhurkee OCP and the old Overburden dump area of Dhansar,

where the bending / slanting trees due to the slow settling of the dumped material could be observed. Similar features to Nudkhurkee OCP old Overburden dump could be identified in the other regions of old or new Overburden dump areas; a few field photographs are shown in section 6.2.

4. The slanting trees and cracks on the ground could be identified at the edge of the active mine regions, where at one of the identified points in the Kankanee block.
5. Three other locations where subsidence is seen from microwave data fall within the mining lease of TISCO and IISCO and, hence, are not under the purview of BCCL mining authorities.

RESULTS**6.1 Coal Fire Maps and Mine-Wise fire area statistics**

The Landsat images of 2022 to 2024 used to prepare the coal mine fire area maps to indicate thermal anomalies as identified through a 100m spatial resolution TIRS band and 30m spatial resolution SWIR 1/2 and NIR band. The anomalies are identified based on the surrounding areas; hence, any small fires through fissures with minor differences in temperature as compared to the surroundings go undetected, or any fire with a size lower than the detectable limit also goes undetected. A few other limitations of the methodology are mentioned in Chapter 8. The Coal fire maps, as shown in Figure 11-13 for 2022 to 2024 in comparison to previous similar studies, show the trend in shift of coal fire zones.

To understand the dynamic spatial extent of the fire pockets, a total fire area comparison between the 2020 block-wise fire area distribution and distribution for the subsequent years is shown in Table 4. The table highlights the year-on-year increment and decrement by assigning a red or green color to the cell. The red indicates an increase in the total fire area for a block as compared to the previous year, and the green indicates a decrease in the total fire area for a block as compared to the previous year. The total fire area was 1.85 sq.km, 4.54 sq.km, 5.00 sq.km, and 3.91 sq.km for 2020, 2022, 2023, and 2024 respectively.

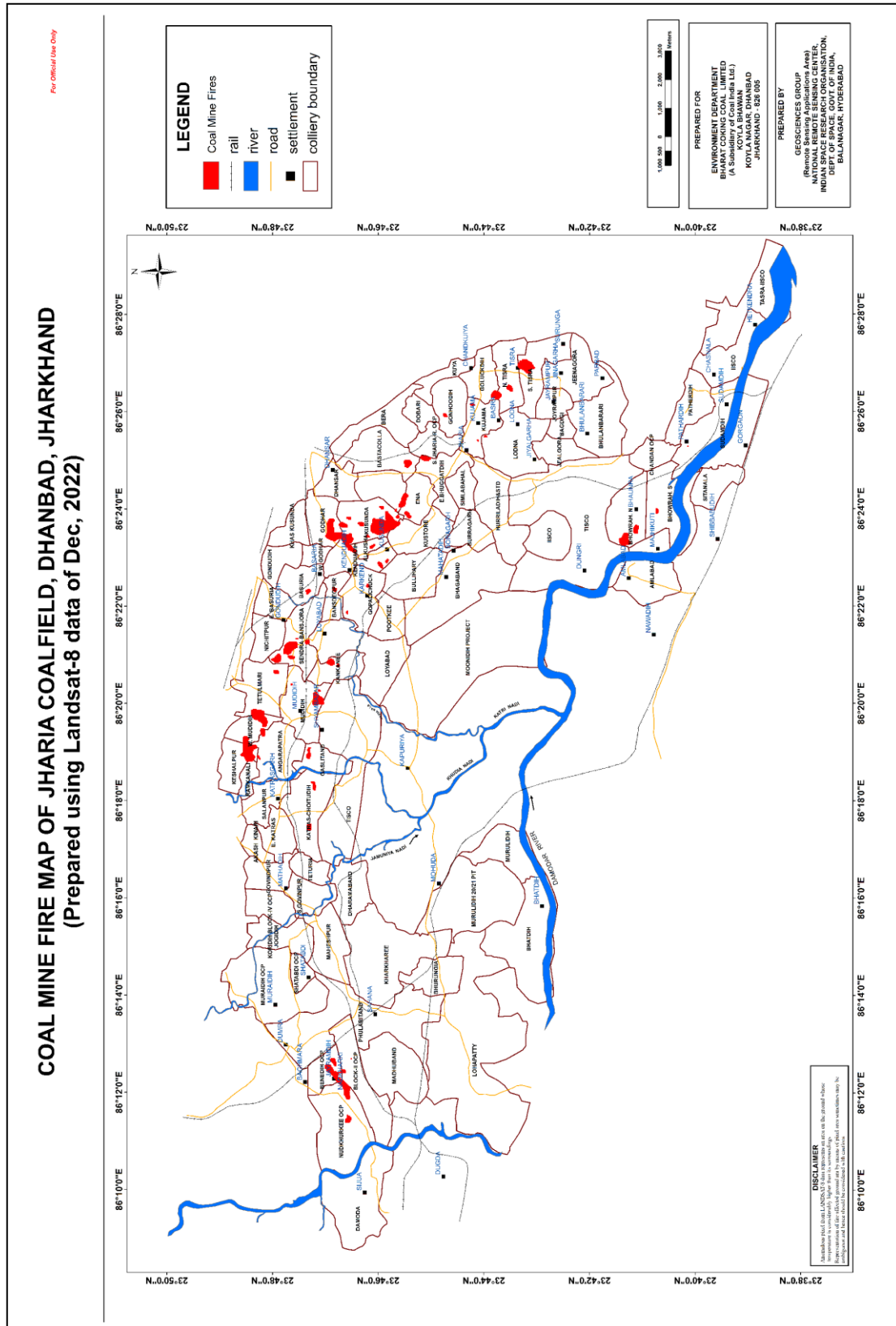


Figure 11. Coal fire map of the Jharia Coalfield (from Landsat-8 Data of Dec 2022)

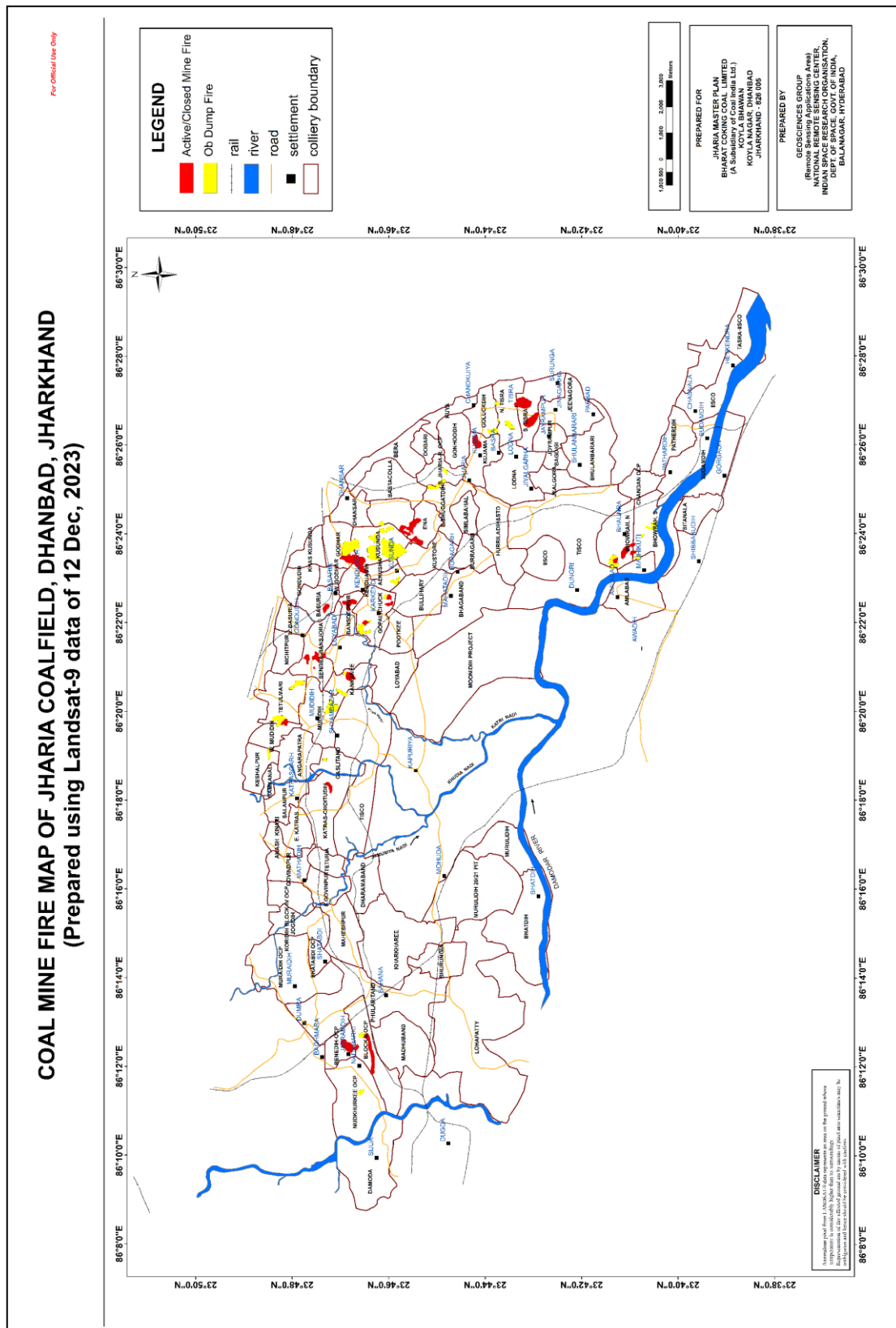


Figure 12. Coal fire map of the Jharia Coalfield (from Landsat-9 Data of Dec 2023)

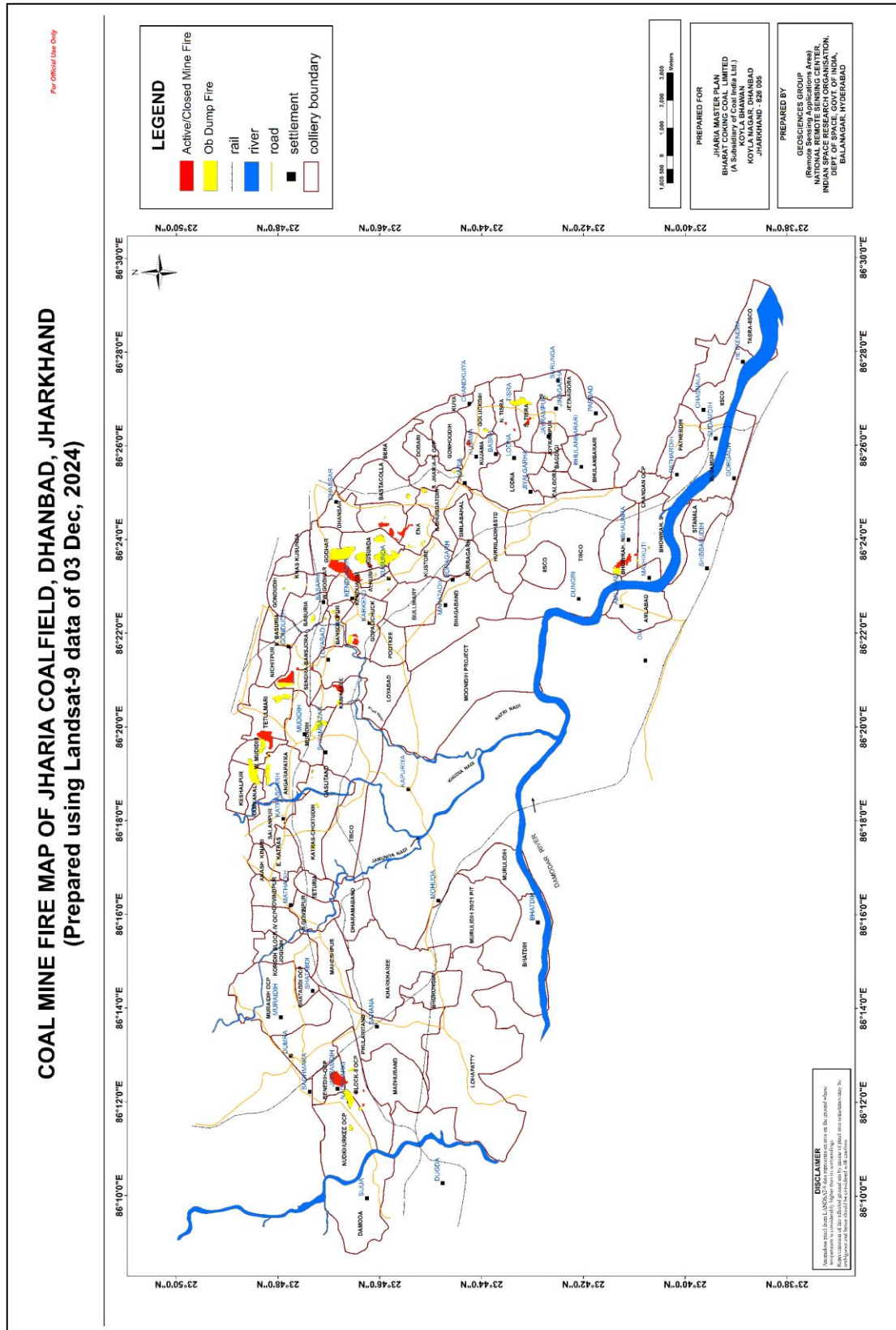


Figure 13. Coal fire map of the Jharia Coalfield (from Landsat-9 Data of Dec 2024)

Based on the figure 11 and 12, cardinal direction-wise fire zones distribution is as follows:

- For the coal fire map of 2023, the eastern side of the covering regions such as Jharia OCP, Kujama, Tisra (North and South), and Bhowrah (North and South) contains large patches of coal fire areas and regions with high increase in fire area in comparison to 2020 and 2022.
- The western side of Nudkharkee OCP, Block-II OCP, and Benedih OCP, with fire patches covering both the active mine and Overburden dump areas, shows a shift from the northern region to the south region, which may be indicative of a shift in the mining zone. The fire patch area for the western side has remained approximately similar in comparison to 2022 but has primarily increased as compared to 2020.
- The North-Eastern side from Kusunda, Ena, covering Godhar, Alkusa till Basuria and Bansdeopur, etc., is the most significant contributor to the total coal fire area for the Jharia coal mines, with most portions seeing a significant increase in fire patches in comparison with 2022 and a very high increase in regions of Gopalichuck and Kusunda. The portion has remained the largest contributor for the years 2020 and 2022 as well.
- The Northern side from Loyabad to Katras, consisting of areas such as Sendra-Bansjora, Mudidh, Keshalipur, and Katras, sees scattered small to large fire patches of the coal fire area. The total coal fire area has slightly decreased, specifically for West Mudidh and Keshalipur, but the small patches have scattered even further in comparison to 2022.

Table 4: The tables show Year on Year mine wise comparison for total fire area for 2022-2024, where red indicates increase in fire area and green indicates decrease in fire area compared to previous year. Zero indicates no fire or fire is below the detection resolution of Landsat images.

COLLIERY AREA NAME	FIRE AREA 2020 (SQ. KM.)	FIRE AREA 2022 (SQ. KM.)	FIRE AREA 2023 (SQ. KM.)	FIRE AREA 2024(SQ. KM.)
AKASH KINARI	0.000	0.000	0.000	0.000
ALKUSHA	0.046	0.073	0.022	0.066
AMLABAD	0.000	0.000	0.003	0.000
ANGARAPATRA	0.036	0.083	0.000	0.116

BAGDIGI	0.000	0.000	0.000	0.000
BANSDEOPUR	0.000	0.052	0.123	0.044
BARAREE	0.040	0.000	0.000	0.000
BASTACOLLA	0.000	0.080	0.000	0.023
BASURIA	0.012	0.000	0.058	0.032
BENEDIH OCP	0.020	0.256	0.168	0.208
BERA	0.000	0.000	0.000	0.000
BHAGABAND	0.000	0.000	0.000	0.000
BHATDIH	0.000	0.000	0.000	0.000
BHOWRAH. N	0.006	0.203	0.275	0.196
BHOWRAH. S	0.023	0.027	0.156	0.013
BHURUNGIA	0.000	0.000	0.000	0.000
BLOCK-II OCP	0.034	0.065	0.285	0.086
BULLIHARY	0.000	0.003	0.000	0.000
BURRAGARH	0.000	0.000	0.000	0.000
CHANDAN OCP	0.000	0.000	0.000	0.000
DAMODA	0.000	0.000	0.000	0.000
DHANSAR	0.000	0.000	0.000	0.000
DHARAMABAND	0.000	0.000	0.000	0.000
DOBARI	0.000	0.000	0.000	0.000
E. BASURIA	0.000	0.000	0.000	0.000
E. KATRAS	0.000	0.000	0.000	0.000
E.BHUGGATDIH	0.020	0.054	0.053	0.024
ENA	0.004	0.115	0.335	0.203
GASLITAND	0.156	0.079	0.018	0.009
GODHAR	0.132	0.299	0.353	0.374
GOLUCKDIH	0.000	0.051	0.062	0.022
GONDUDIH	0.000	0.000	0.000	0.013
GONHOODIH	0.001	0.029	0.000	0.000
GOPALICHUCK	0.000	0.082	0.255	0.107
GOVINDPUR	0.000	0.000	0.000	0.000
HURRILADIH&STD	0.000	0.000	0.000	0.000
IISCO	0.000	0.000	0.000	0.000
INDUSTRY	0.000	0.000	0.000	0.000
JEALGORA	0.000	0.000	0.000	0.000
JEENAGORA	0.000	0.000	0.000	0.000
JOGIDIH	0.000	0.000	0.000	0.000
JOYRAMPUR	0.011	0.000	0.000	0.000
KANKANEE	0.057	0.084	0.140	0.090
KATRAS- CHOITUDIH	0.214	0.090	0.067	0.038
KENDUADIH	0.001	0.133	0.158	0.110
KESHALPUR	0.134	0.232	0.040	0.177
KHARKHAREE	0.000	0.000	0.000	0.000
KHAS KUSUNDA	0.000	0.000	0.000	0.000
KORIDIH BLOCK- IV OCP	0.000	0.000	0.000	0.000

KUJAMA	0.000	0.026	0.123	0.029
KUSTORE	0.014	0.033	0.039	0.021
KUSUNDA	0.399	0.858	1.030	0.711
KUYA	0.000	0.000	0.000	0.000
LODNA	0.000	0.000	0.000	0.000
LOHAPATTY	0.000	0.000	0.000	0.000
LOYABAD	0.000	0.006	0.003	0.000
MADHUBAND	0.000	0.000	0.000	0.000
MAHESHPUR	0.000	0.000	0.000	0.000
MOONIDIH PROJECT	0.000	0.000	0.000	0.000
MUDIDIH	0.220	0.197	0.194	0.109
MURAIIDIH OCP	0.006	0.000	0.000	0.009
MURULIDIH	0.000	0.000	0.000	0.000
MURULIDIH 20/21 PIT	0.000	0.000	0.000	0.000
N. TISRA	0.031	0.097	0.123	0.041
NICHITPUR	0.000	0.000	0.000	0.000
NUDKHURKEE OCP	0.000	0.400	0.039	0.154
PATHERDIH	0.000	0.000	0.000	0.000
PHULARITAND	0.000	0.000	0.000	0.000
POOTKEE	0.000	0.000	0.000	0.000
RAMKANALI	0.000	0.011	0.000	0.016
S. JHARIA-R. OCP	0.010	0.005	0.085	0.020
S. TISRA	0.021	0.210	0.367	0.157
S.GOVINDPUR	0.000	0.000	0.000	0.000
SALANPUR	0.000	0.000	0.000	0.000
SENDRA- BANSJORA	0.110	0.350	0.152	0.248
SHATABDI OCP	0.005	0.000	0.000	0.000
SIMLABAHAL	0.000	0.000	0.000	0.000
SITANALA	0.000	0.000	0.000	0.000
SUDAMDIH	0.000	0.000	0.000	0.000
TASRA-IISCO	0.000	0.000	0.000	0.000
TETULMARI	0.011	0.000	0.232	0.253
TETURIA	0.000	0.000	0.000	0.000
TISCO	0.000	0.000	0.000	0.004
W. GODHAR	0.000	0.000	0.000	0.002
W. MUDIDIH	0.085	0.265	0.050	0.192
Total	1.85	4.54	5.00	3.91

The classification of the coal fire area was based on field observation of whether the fire existed in the open cast mining areas/ old mining areas or the overburden dump of the active mine area. The larger patches of anomalies identified by the Landsat images were meticulously separated from mine fires or Overburden

dump fires after the field. The classified maps of 2023 and 2024 are shown in Figures 12 and 13. The spatial extent statistics and block-wise fire distribution for the separate classes of mine fire and Overburden dump fire for 2023 and 2024 are also shown in Tables 5 and 6, respectively. The bar graph-based statistical figure for block-wise increment and decrement of the fire area of the two classes is shown in Figures 14 and 15.

Table 5: Mine-wise area under coal fire classified in two classes of mine fire and Overburden dump fire for 2023 (grey cells in the table indicate the area has no fire or the fire is below detection resolution of satellite).

Mine Area Name	Mine Fire (sq. km)	Overburden Fire (sq. km)
ALKUSHA	0.020	0.002
AMLABAD		0.003
BANSDEOPUR	0.123	
BASURIA	0.058	
BENEDIH	0.168	
BHOWRAH. N	0.161	0.115
BHOWRAH. S	0.023	0.133
BLOCK-II	0.242	0.043
E.BHUGGATDIH		0.053
ENA	0.307	0.028
GASLITAND		0.018
GODHAR	0.139	0.214
GOLUCKDIH		0.062
GOPALICHUCK	0.105	0.150
KANKANEE	0.089	0.051
KATRAS	0.056	0.012
KENDUADIH	0.096	0.062
KESHALPUR		0.040
KUJAMA	0.123	
KUSTORE		0.039
KUSUNDA	0.109	0.922
LOYABAD	0.002	0.000
MUDIDIH		0.194
N. TISRA	0.015	0.107
NUDKHURKEE	0.002	0.037
S. JHARIA		0.085
S. TISRA	0.367	
BANSJORA	0.152	
TETULMARI	0.013	0.219
W. MUDIDIH	0.036	0.014
Total	2.41	2.60

Table 6: Mine-wise area under coal fire classified into two classes of mine fire and Overburden dump fire for 2024 (grey cells in the table indicate the area has no fire or the fire is below detection resolution of satellite).

Mine Area Name	Mine Fire (sq. Km)	Overburden Fire (sq. Km)
ALKUSHA	0.060	0.006
ANGARAPATRA		0.116
BANSDEOPUR	0.021	0.023
BASTACOLLA		0.023
BASURIA		0.032
BENEDIH-OCP	0.203	0.005
BHOWRAH. N	0.127	0.069
BHOWRAH. S		0.013
BLOCK-II OCP	0.040	0.046
E.BHUGGATDIH		0.024
ENA	0.169	0.034
GASLITAND		0.009
GODHAR	0.185	0.189
GOLUCKDIH		0.022
GONDUDIH		0.013
GOPALICHUCK	0.058	0.049
JEENAGORA		0.001
KANKANEE	0.074	0.016
KATRAS-CHOITUDIH		0.038
KENDUADIH	0.105	0.005
KESHALPUR		0.177
KUJAMA	0.029	
KUSTORE		0.021
KUSUNDA	0.056	0.655
MUDIDIH		0.109
MURAI DIH OCP		0.009
N. TISRA	0.012	0.028
NUDKHURKEE OCP		0.154
RAMKANALI		0.016
S. JHARIA-R. OCP	0.006	0.014
S. TISRA	0.033	0.124
SENDRA-BANSJORA	0.157	0.091
TETULMARI	0.130	0.123
TISCO		0.004
W. GODHAR		0.002
W. MUDIDIH	0.066	0.127
Total	1.53	2.38

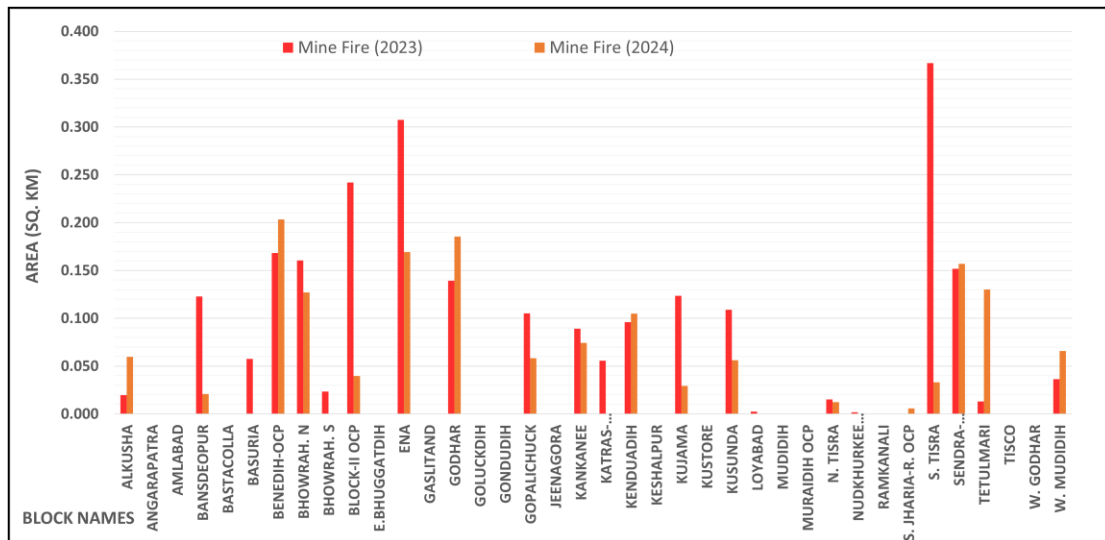


Figure 14. Block-wise comparison between 2023 and 2024 of Mine fire area.

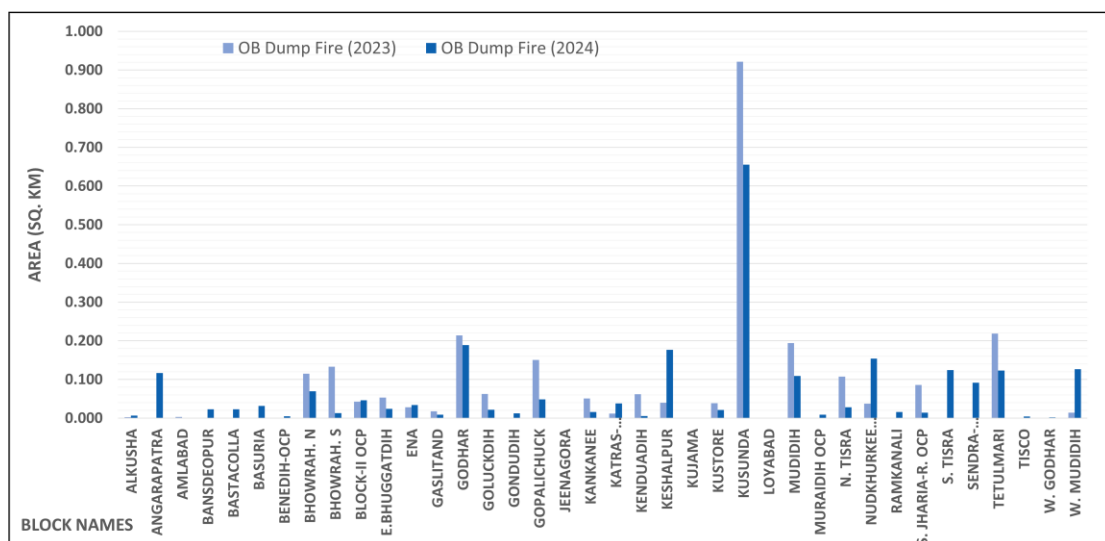


Figure 15. Block-wise comparison between 2023 and 2024 of Overburden dump fire area.

A similar cardinal direction-wise analysis of 2024 in comparison to 2023 provides a larger picture while at the same time allowing for focused analysis of the portions, with further distribution of fire area to two classes enabling us to provide further details on the regions of increasing and decreasing fire which helps the user in area-wise objective specific mitigation strategy.

- The eastern side of the mining extent has seen a significant decrease in overall fire area, number of fire patches, and specifically active mine fire from 2023 to 2024, with a significant decrease in active mine fire area for South Tisra Block, the Bhowrah active mining fire area regions and extent is approximately unchanged from 2023 to 2024.

- The western side has also seen a decrease in total fire area and active mine fire portions but an increase in the Overburden dump fire for the Nudkhurkee OCP block, which is part of a single mining area covering the Benedih OCP and Block-II OCP as well.
- The north-eastern side, while still being the highest contributor to the total fire area, has seen a slight decrease in the extent, specifically in the active mine fire areas due to Basuria and Bansdeopur blocks. At the same time, the Kusunda, Ena, and Gopalichuck portions have remained mainly similar for both classes.
- The northern portion has seen a significant increase in approximately all the parameters about coal mine fires, including the number of blazing fires in active mines, total mining area, and the extent to the two separate classes of mine fire. Although the northern portion was always the second largest contributor to the total mine fire area for the Jharia coalfield, the increase has made its contribution comparable to that of the north-eastern side, which was not observed in previous years—a large portion of Overburden dumps fire in the regions of Keshalpur, West. Mudidh and Angartapatra and the newly identified active mine fire regions of Sendra-Bansjora are the few key changes from 2023. The Overburden dump fire area of Mudidh and the active mine fire area of Kankanee have primarily remained as they were in 2023.

The ground temperature measurements for the fire area were taken for both years using the handheld thermal sensor, and the sensed temperature for a few of the Overburden dump fire and mine fire areas are shown in figures 16 and 17 for 2023 and 2024, respectively with the respective field location shown in figure 10. The surface temperature reading was taken for most of the fire locations using the handheld thermal sensor, where the Overburden dump fire temperature ranged from 100° to 500° C degrees. In comparison, the mine fire either contained only fissures/cracks where the temperature ranged from 300° to 500°C or fissures/cracks along with blazing fire where the temperature was very high, surpassing the detectable limit of 650° C of the temperature for few locations.

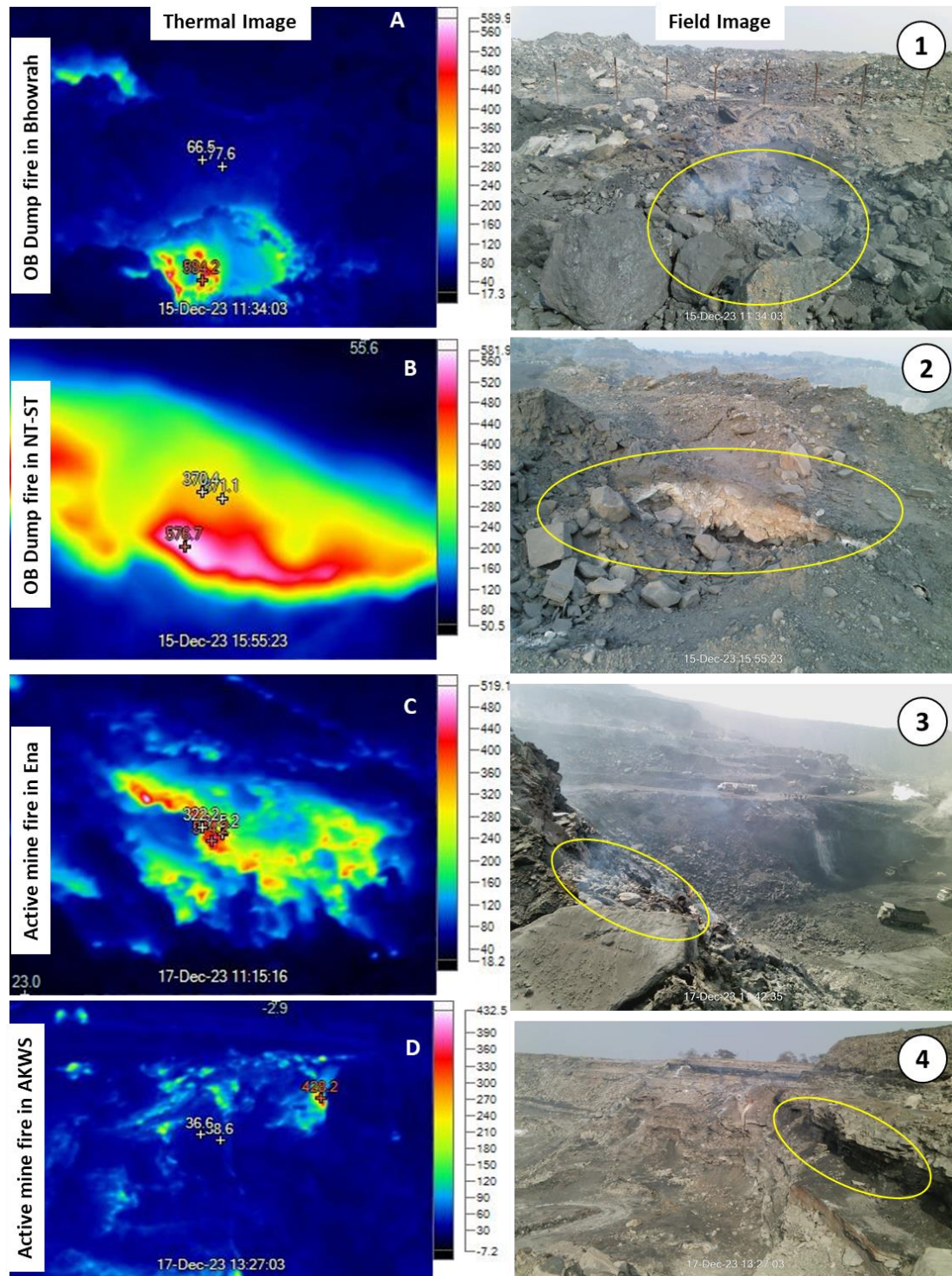


Figure 16. Thermal images and ground photographs from field survey for 2023 (yellow polygon shows the location from where thermal measurements are taken).

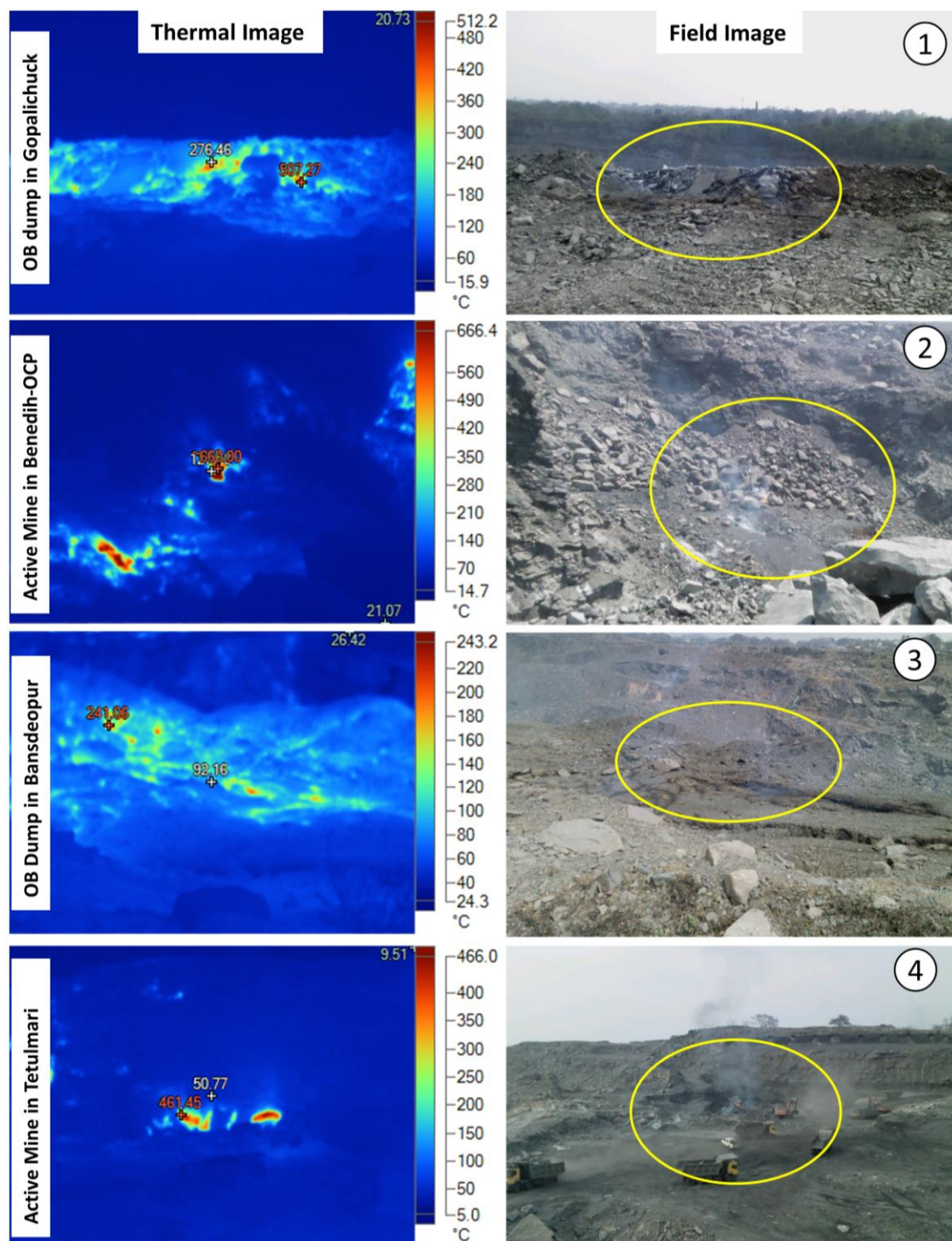


Figure 17. Thermal images and ground photographs from field survey for 2024 (yellow polygon shows the location from where thermal measurements are taken).

6.2 Subsidence Maps and Field images

The interferogram pair-by-pair processing for the seven acquired ALOS-PALSAR-2 L Band SLCs was carried out, and through the visual interpretation of the interferograms, the possible subsidence area was identified. The ground-based signature could be identified for the areas of Basuria, ENA, Dobari, and Nudkhurkee OCP as the bending of the treeing at the edge of the mine or settling of old Overburden dump or fall of loose material from Overburden dump areas. A few field photographs are shown in Figure 18, and the Jharia subsidence map is in Figure 19.



Figure 18. Field photographs for identified ground evidence for the subsidence areas for four different locations with (a) showing slanting trees, (b) showing falling of loose material, (c) edge of the mine slanting trees and (d) showing large crack due to mining activities.

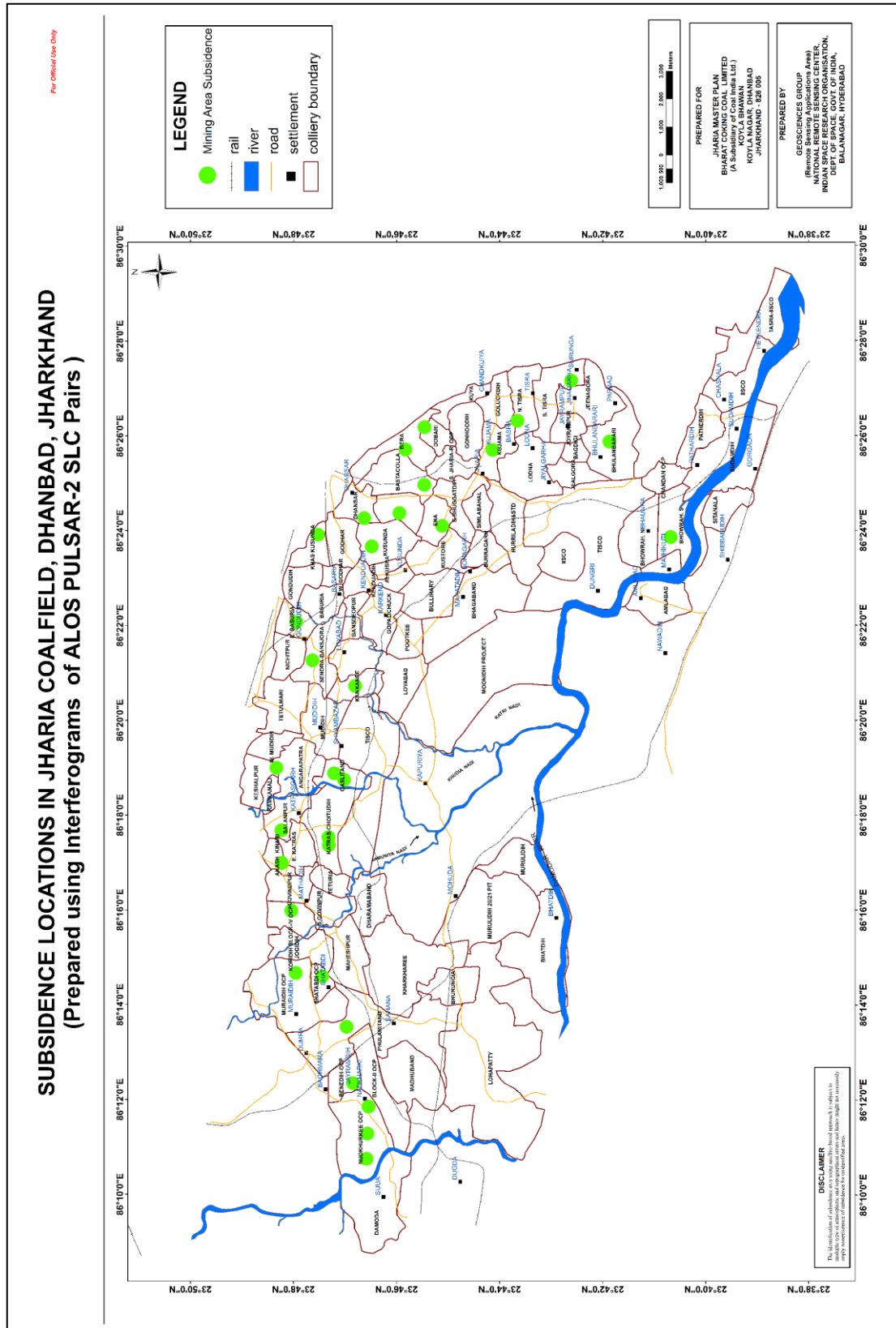


Figure 19. Subsidence map of the Jharia Coalfield (from ALOS PALSAR-2 data)

DISCUSSIONS AND CONCLUSIONS**7.1 Discussion****7.1.1 Coal fire analysis**

The present status of the fire in the Jharia Coal Fields for the period of 2022 to 2024 shows an increase in fire area for 2022 in comparison to 2020 (although field verification was not carried out in 2022) and an increase for 2023 in comparison to 2022 in approximately 0.5 sq. km where the cardinal direction-wise fire zones distributions were analysed in section 6.1. The identification of two classes in mine fire areas and overburden dump fire areas allowed for a deeper look into the areas of increment and decrement, which were analysed for the years 2023 and 2024, as shown in Figures 14 and 16. There is a decrease in total fire area of approximately 1.0 sq. km for 2023 and 2024 and a decrease in fire area in the two subclasses as well.

The identification of anomalous pixels from the Landsat images has changed from the previous analysis, where the coarse resolution of 100m x 100m of TIRS bands was solely used by converting it into radiant temperature through Planck's radiation function to using the fire color composite of medium resolutions of 30m x 30m bands of SWIR and NIR bands to identify the bright pixels indicative of fire along with the previous methodology. The change in the strategy has allowed for the identification of areas with fire patches covering smaller spatial extent while validating the identified areas through both methodologies for each other. As the identifiable overall resolution decreased, the total identified areas of coal fires increased, contributing to the increase in overall fire from previous years.

All the fire areas identified were field verified, and the accuracy of identification through satellite imagery is still consistently very high, strengthening the outcomes of the methodology for the identification of fire areas. The Fluke Ti300 thermal sensor provides a temperature estimate of the identified fire zones and a causative relationship between the satellite-measured temperature and the actual surface temperature.

7.1.2 Subsidence analysis

An attempt to identify subsidence zones in the Jharia Coalfield was also carried out using ALOS-PALSAR-2 L-band microwave data using a differential interferometric technique. Seven scenes of PALSAR-2 data spanning 2021 to 2024 were used to identify the subsidence in the region and separately identify them from the terrain changes due to mining. Verifying the subsidence zones as seen from data is difficult as it requires visible signatures of subsidence in the form of cracks on the ground and damage to anthropogenic structures. In this study, data analysis and consequent field verification resulted in identifying a few subsidence areas within the BCCL mine boundary. The two main areas of subsidence lie in the old Overburden dump area of Nudkharkee OCP and the old Overburden dump area of Dhansar, while the other subsidence point lies in the active mine areas or Overburden dump areas; no subsidence was identified in the human habitation zones. No quantitative estimates of the subsidence have been carried out in the study.

7.2 Conclusions

The change in the areal extent of fire as identified by the Landsat images and block-wise distribution calculated for 2023 and 2024 and compared with old data of 2020 and non-verified maps of 2022, where an increase in the fire area for 2023 was majorly contributed by the north-eastern and eastern sides and decrease for 2024 was due to eastern side while the central area of focus being the northern side due to substantial increase in the fire area from 2023 to 2024. The persistent coal fire zones from 2022 to 2024 in the North-eastern sides were also identified and verified during the field.

The accuracy of the generated maps, as verified from the field, was very high, and the causative relationship between the temperature measurement from the handheld thermal sensor and the identified higher fire pixel anomalies was satisfactory, with a higher degree of anomalies relating to the higher measured temperatures on the surface. The results section also discussed the temperature range for Overburden dump areas and active mine fire areas.

No subsidence was observed in the human habitation zones, and the main areas of subsidence do not seem to have consequences of the near settlements, while

the active mining area subsidence and new Overburden dump subsidence can be of concern for the mining area personnel due to constant failure of the loose material

***Note:** The minimum mapable unit from satellite image is 30m by 30m or 0.0009 km². Estimations of fire extent (in terms of sq.km.) for the present study carried out for 2023-2024. They may differ from the actual ground area under fire. These estimations are made for comparative purpose only, to indicate the increase or decrease of areal extent of fire. Hence, they should not be quoted as fire area on the ground.*

CHAPTER VIII

LIMITATIONS

Delineation and mapping of coal fire from thermal data of remote sensing platforms carries with it some inherent limitations which needs to be understood in order to decipher the results obtained from it. This will assist in deducing the correct information and remove any ambiguity associated with the results. The key limitations of the data and the results obtained are as follows:

- 1) An anomalous pixel from LANDSAT data represents an area of 30m x 30m for the fire area composite and 100m x 100m for TIRS bands based radiant temperature (resampled to 30m x 30m spatial resolution) on the ground whose temperature is considerably higher than its surroundings. This can be attributed to two circumstances, namely the area has a very high intensity fire located within a smaller pocket or there are a number of low intensity fires spread across it. In both the mentioned cases the actual areal extent of the fire on the surface differs, but appears as a single anomalous pixel in the data. Hence, representation of fire affected ground area by means of pixel area is ambiguous and hence should be considered with caution.
- 2) There are locations as observed during the fieldwork, where coal seams are affected by active fires along vertical/semi-vertical sections of open cast mines. In such cases, the actual areal expression of the fire affected area as seen by the sensor changes considerably and the representation from the same is not accurate.
- 3) As discussed in section 4.1.2, thresholding the data to separate the fires from the non fire areas, is a statistical technique. However, this method is dependent on how the temperature of non-fire background area is distinctive from the fire temperature.
- 4) The background temperatures vary with the time of the day when the data are collected, topography, and season of the year when the data is acquired. Night-time data has lower background temperature as compared to day-time. Similarly a data collected in October-November will have a considerably lower background temperature than that collected in May-June due to seasonal temperature variations. Hence, identification of the background temperature range becomes essential in

estimation of threshold temperature and the same varies depending upon the discussed controlling factors.

6) Due to the mitigation measures taking place in various mines, it is seen that in a number of places the fire affected seam is excavated and dumped as overburden. However, these overburden dumps retain the excavated burning coals and thus are seen to have active fires occasionally. There lies a possibility that the same will be identified as anomalous pixels and hence, although the fire is not a part of any active coal seam, it will be included as a fire affected area in the final map.

7) Considering the precision of DInSAR data for different wavelengths, topographic and atmospheric errors, slow subsidence rates may not be detected. Further, the displacement measured is along the line of sight of the sensor and not vertical displacement.

8) Temporal decorrelation and noise due to adverse land use and land cover may affect DInSAR based detection and monitoring of land subsidence. Changes in vegetation pattern over time can cause significant decorrelation between the master and slave image, thus producing a very low coherent output. Under such conditions, subsidence information may not be retrieved.

9) Verification of the subsidence zones as detected from the interferometric technique is sometimes difficult due to lack in observable signatures of subsidence such as cracks on the ground and damage to anthropogenic structures.

Therefore, in quantitative estimation of fire affected areas and areas denoted as subsidence, the above-mentioned limitations need to be taken into account diligently, as it is inevitable that the area estimate will not define the actual fire/subsidence affected area on the ground. However, the areal extent estimated from the data can be "like to like" compared to earlier estimates of similar studies to understand the change and dynamism of the fire in terms of area affected and spatial disposition.

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“Source apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand”

Sponsor

Bharat Coking Coal Limited (BCCL)



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Chapter 1 Introduction

Jharia Coalfield (JCF) is one of the oldest coalfields of India and has been subjected to coal exploitation for more than 100 years. JCF is one of the significant coal-producing areas in the country and occupies an important place in India's industrial and energy scenario by virtue of prime coking coal and is an essential source of coal. Jharia coalfield is crucial and a large coalfield situated in Dhanbad and Bokaro district, Jharkhand. Geographically the JCF is bounded by latitude 23°38' N to 23°49' N and longitude 86°09'E to 86°30'E and encompassing a total area of about 450sq km (Figure 1.1). Jharia is the largest coal producer in India and has an estimated reserved of 19.4 billion tonnes of coking coal. The coalfield contributes to the local economy and directly or indirectly employs the local population.

Bharat Coking Coal Limited, a subsidiary of Coal India Limited, has been operating the majority of the coal mines in the Jharia coalfield regions since its inception in 1972. Jharia, one of the eight blocks in Dhanbad and the main source of metallurgical coal in India can be termed as the country powerhouse since its mines are the only source for the best quality coking coal required by the steel industries and others in the country.

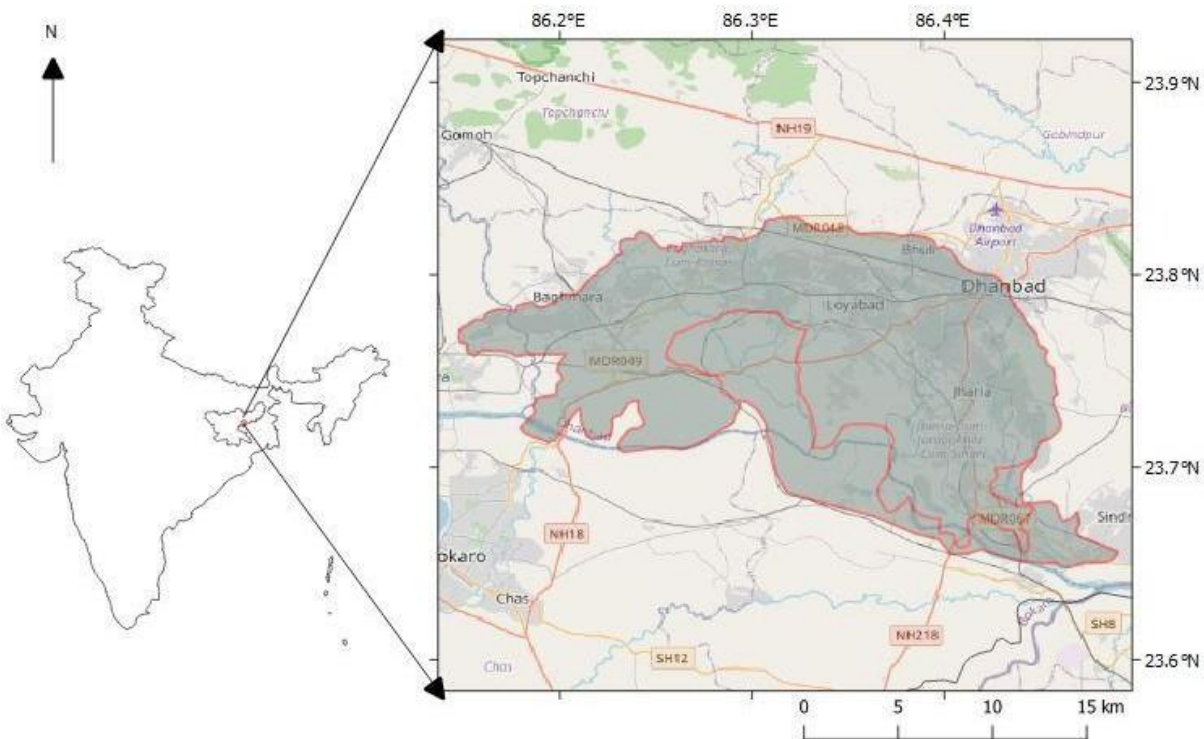


Figure 1.1: Geographical location of Jharia Coalfield in India

1.1. Climate

Dhanbad lies 236 m above the mean sea level and experiences the tropical climate. When compared with the winter, the summers have much more rainfall. The Köppen-Geiger climate classification is Aw (Tropical wet-dry climate) and experiences an average temperature of 25.9 °C and 1203 mm of precipitation falls annually. The driest month is December. There is 3 mm of precipitation in December. In July, the precipitation reaches its peak, with an average of 321 mm. With an average of 32.5 °C, May is the warmest month. At 18.4 °C on average, January is the coldest month of the year. The windrose for the March-June months is presented in Figure 1.2.

1.2. Land use & Land cover

In the present investigation, the Jharia coalfield area (2827.43 sq km) has been undertaken to study the Land use land cover (LULC), For this study, Sentinel-2A satellite image is used in the month of 17 February 2019 having a minimum cloud. These images were downloaded from the United States Geological Survey (USGS) Earth Explorer. Each Sentinel 2A satellite imagery band was geo-referenced to the WGS_84 datum and Universal Transverse Mercator Zone 45 North coordinate system. The Sentinel 2A satellite image stacking of the band-2, band-3, band-4 and band-8 of 10 m resolution was performed on the ArcGIS 10.5 software for studying the LULC of the Jharia coalfield.

For LULC classification, supervised classification was carried out in the study area. Thus allocations of each classified area in sq. km and its percentages are tabulated in Table 1.1. The percentage of areas as classified as; agriculture (74.5%), barren land (7.45%) built-up areas (5.14%), mining (2.64%), vegetation (9.40%) and water body (0.86%) (Figure 1.2).

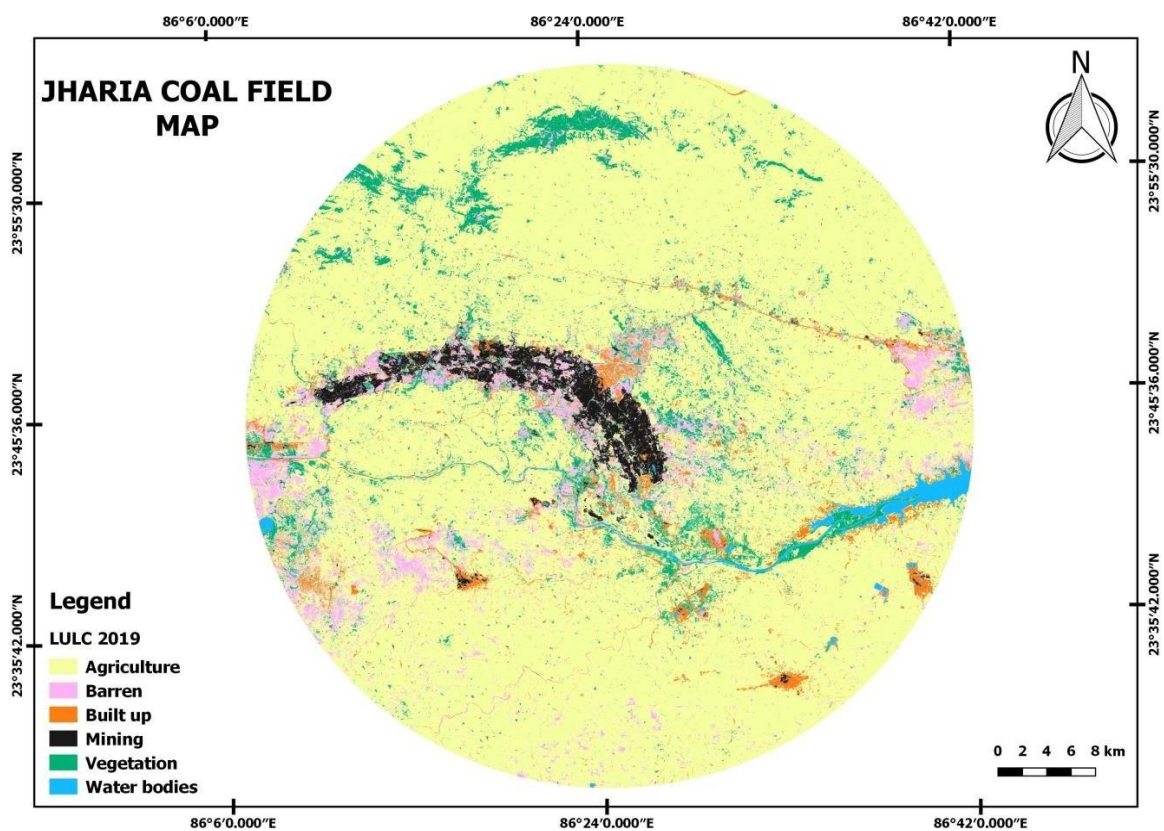


Figure 1.2: Land Use land cover map of Jharia coal field area

Table 1.1: LULC classification of Dhanbad study area

Sr. No	Name	Area in sq. km	Area in %
1.	Agriculture	2106.7	74.51
2.	Barren	210.64	7.45
3.	Built up	145.31	5.14
4.	Mining	74.67	2.64
5.	Vegetation	265.74	9.40
6.	Water bodies	24.37	0.86
Total		2827.43	100

1.3. Population

The study area covers four district boundaries; namely Dhanbad (1710.2sq km), Bokaro (620.43sq km), Giridih (29.8sq km) in Jharkhand and Puruliya (465.85sq km) district in West Bengal state. The Dhanbad district covers the maximum study area and the population is around 23, 94,434 in the year 2001 and is around 26,84,487 in 2011. The Bokaro district total population is in 2001 is 17, 75,961 and in 2011 it is 20, 62,330. The Giridih district total population is 19, 01,564 in 2001 and is 24,45,474 in 2011. The Puruliya district in West Bengal state total population is in 2001 is 25, 35,233 and in 2011 are 29, 30,115.

Based on the covered study area the total population in the study area is tabulated in Table 1.2. The total population in the study area based on Census book 2001 is 25,32,195 and 2011 is 28,62,600.

Table 1.2: Population in the study area as per 2011 census

District Name	District Area Covered by Study Area	% of Area Covered of District by Study Area	Population of 2001	Population 2001 in Study Area	Population of 2011	Population 2011 in Study Area
Bokaro	620.43	21.50	17,75,961	3,81,791	2,062,330	4,43,353
Dhanbad	1710.2	81.51	23,94,434	19,51,645	2,684,487	21,88,060
Giridih	29.8	0.59	19,01,564	11,275	2,445,474	14,500
Puruliya	465.85	7.40	25,35,233	1,87,484	2,930,115	2,16,686
Total	2826.28		Total Population 2001	25,32,195	Total Population 2011	28,62,600

1.4. Purpose of Study

Urban air pollution is a notable concern across the world. Inferring to the rapid rates of industrialization and urbanization in Indian cities, polluted air quality is considered a key factor in crumbling the quality of life with an adverse effect on the human being. Hence air quality gained a significant role in recent decades since it is worsened by emission from major pollutants including particulate matter (PM₁₀ and PM_{2.5}), NO₂, SO₂ and O₃ were found to exceed the national ambient air quality standard (NAAQS) limits.

Particulate pollution is a major concern in the field of air pollution. The particulate matter in the air result from dispersion of dust from industrial (mining and non-mining) and allied activities, transportation, local vehicular movement and domestic fuel (Coal, wood-burning etc.) burning. Assessment of the air quality can provide useful insight for the development of the air quality management plan. The database developed on air quality also helps the regulatory agency identify the locations where natural resources and human health could be at risk.

Jharia coal mines having low ash content and high calorific value coals are subjected to intensive mining activities because of the easy availability of coal at shallow depths in thick seams. Therefore, they are often used directly in iron and steel plants for metal oxide reduction after washing. Although these coal mines are highly-priced for their high-quality coal, they are notorious for their mine fires, which cause a lot of fugitive gaseous and PM emissions. Hence, the Jharia region has been under scrutiny by various public authorities and the common public with a vision to improve the ambient air quality.

Various sources contribute to high particular matter concentration in the Jharia region: vehicles, mining activities, re-suspended dust, fugitive emissions, fuel oils, household LPG. The percentage contribution of these factors in the ambient depends exclusively on a particular region's economic activities. To improve the existing ambient air quality, the major sources of PM emissions first need to be identified.

Hence, the environmental clearance committee of MoEFCC has directed BCCL to conduct a source apportionment study for particulate matter. In this context, BCCL has approached CSIR-NEERI to conduct a source apportionment study of ambient air particulate matter in the Jharia coalfields region to quantify the various sources of PM emissions and suggest an effective environmental management plan.

The study's major objective is to assess the current ambient air quality, sources of air pollution, and propose the priorities for the actions for improvement of air quality. The study includes the entire Jharia Coalfield and an area up to 10 Km from the periphery/boundary of BCCL mines.

The detailed objectives are as follows:

i. Ambient Air Monitoring

- Monitoring of ambient air quality at selected receptor locations for pollutants including PM₁₀, PM_{2.5}(limited), SO_x, NO_x, PAHs to establish the status of the air quality in Jharia Coalfields and an area up to 10 K.M from the periphery/boundary of BCCL mines. Also, review of the available air quality monitoring data from Central Pollution Control Board (CPCB) /Jharkhand State Pollution Control Board (JSPCB).
- To validate dispersion modelling predictions using measured air quality parameters
- To draw supportive data through the specific site-related monitoring regarding impact causing sources such as kerbside monitoring
- To establish the impact of meteorological conditions on a few select indicator pollutants in different micrometeorological conditions of the Jharia Coalfields

- Emission Inventory related to Jharia Coalfields along with area up to 10 Km from the periphery/boundary of BCCL mines
- ii. To identify the pollution load grid wise for point, line and area source
- To establish possibilities of receptor level concentrations of air pollutants by matching dispersion modelling and air quality monitoring data
 - Source apportionment
 - To identify and apportion the pollution load at receptor level to various sources in the Jharia Coalfields along with an area up to 10 Km from the periphery/boundary of BCCL mines
 - To carry out the source apportionment using molecular markers for a limited number of samples through a time-resolved sample collection at various periods of the day and day-of-the-week.
 - Any other item in consensus between both BCCL/CIL & NEERI evolved during the study.

1.5. Approach of study

The study approach has many components, each one of them having its importance and interdependence as shown in Figure 1.3. The ultimate objective is source apportionment of ambient air of JCF that primarily requires knowledge of ambient air quality status, sources and emission load. These three objectives were achieved by monitoring air pollutants at 13 locations in Jharia Coalfield using various instruments and multiple analyses. These locations were selected based on land use and activity profile. All monitoring was carried out using varied instruments and all attributes were analysed using standards methodologies. The study's methodology of the study was divided into three parts namely ambient air quality monitoring, sources emission inventory and source apportionment analysis.

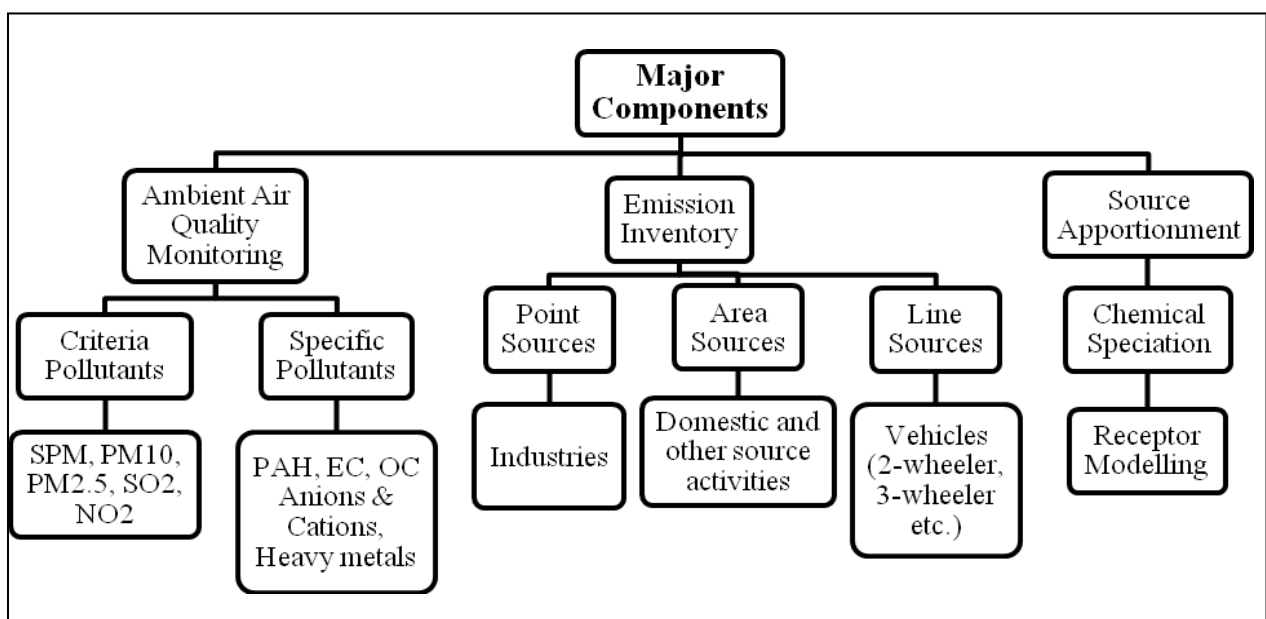


Figure 1.3: Air quality Monitoring & emission source apportionment studies

Chapter 2 Emission Inventory

This section consists of all methodologies that have been applied for the emission inventory and dispersion modelling in the Jharia Coalfield. The emission inventory is the process to identify the possible source and its contribution. Emission inventory and dispersion modelling are based on the primary data collection to calculate emission load from a particular source. It provides fundamental information for air quality modelling and air pollution control strategy development. In the coal mining area, mining, non-mining, industrial, vehicular and other sources are contributing. Air quality monitoring includes the suitable location selected based on the metrological conditions, chemical characterization for identification of the source, CMB model to estimate the source apportionment to PM_{2.5}.

Air pollutant emission inventory is a process to identify the possible sources and their contribution. It provides fundamental information for air quality modelling and air pollution control strategy development. Mining, non-mining, industrial, vehicular and other sources are contributing to critical coal mining zone like JCF, India. According to possible emission sources, sources are divided into three categories like point sources, area sources and line sources. The inventory of these sources is important to make a proper source profile.

2.1. Inventory of Point Sources

A point source of pollution is a single identifiable source that is responsible for significant pollution load in the study area, like thermal power stations. A comprehensive list of different point-like industries in the study area was obtained from the regional office of the Jharkhand State Pollution Control Board (JSPCB), at Dhanbad. The industries specific information of includes production capacities, raw material used, manufacturing process, fuel consumption, etc. also collected from the regional office by the CSIR-NEERI team.

2.2. Inventory of Area Sources

Area sources are sources of pollution that emit a substance or radiation from a specified area. Mining activities, domestic/hotel fuel (coal) burning, garbage burning, etc. are the major contributor to area sources. In order to assess the fuel consumption in the study area, the necessary information was collected through surveys at petrol pumps, hotels and restaurants, bakeries, open eat out and crematoria. Also, surveys collected data on the seasonal implication of fuel used particularly wood and coal. The data on trash burning and solid waste generated in the study were collected from Municipal Corporation Dhanbad.

2.3. Inventory of Line Sources

Vehicles contribute a whole range of HCs besides contributing SO_x, NO_x (as NO₂), HC and lead. Diesel vehicles are the primary source of smoke and NO_x in addition to CO and HCs. However, CO and HCs per litre of fuel consumed by diesel vehicles is relatively low compared to gasoline-powered vehicles. In gasoline-powered vehicles, the exhaust is the major source of pollution that contributes 100 % CO and NO_x and 80% of HCs emitted to the atmosphere. The remaining 20% of HCs are emitted from crankcase blow-by and evaporative emissions. In the

two-stroke engine, the crankcase blow-by is absent. The exhaust emissions are the principal sources of pollutants emitting about 40% of fuel supplied without burning due to short circulating, contributing high concentration of HCs. In diesel vehicles, practically all pollutants are emitted through exhaust gases and the contribution to crankcase blow-by and evaporative fuel emission are negligible.

Though the quantity of pollutants emitted by the vehicles is directly proportional to the number of vehicles playing on the road, the intensity of pollution potential depends on several contributory factors such as a geographical location, unplanned development of central business areas, inadequate and ill-maintained road as well as the type of vehicle, unplanned traffic management, meteorological conditions, and non-availability of adequate emission control technology.

Vehicle activity data were collected during the field campaign at 12 road networks in the study area, and the daily average vehicular activity is presented in Table 2.1.

Table 2.1a: Daily average vehicle activity on different road network considered during the field survey

Label	Road Network	HDV	LMV	3W	2W	Total
L1	Jharia to Lodna -5 km	1254	1385	3640	9560	15839
L2	Pathardih to Sindri -7 km	1539	5356	4362	15633	26890
L3	Bastacola to Pathardih -13km	2153	8325	3678	10233	24389
L4	Bhuli to Bankmore - 6km	1475	13832	12965	18241	46513
L5	Katras to Harina–12.5 km	1802	7290	3156	15329	27577
L6	Bankmore to Kusunda -5 km	658	2685	1896	10235	15474
L7	Kusunda to Katras - 10 km	1306	4521	5327	15689	26843
L8	Monidih to Kusunda -7 Km	1208	7659	3985	14698	27550
L9	Lohpiti to Mahuda Area Colony - 8 km	1535	4523	2235	6356	14649
L10	Mahuda to Parasia Chowk -7 km	1223	4023	1759	5623	12628
L11	Parasia Chowk To Moonidih - 3 km	269	2159	236	2347	5011
L12	Bhowra to Parbatpur - 13 Km	2135	7856	4258	14578	28827

Table 2.1b: Average vehicle speed of different categories of vehicle in the road network

		Average vehicle speed*			
Label	Road Network	HDV	LMV	3W	2W
L1	Jharia to Lodna -5 km	20	35	30	40
L2	Pathardih to Sindri -7 km	20	40	35	40
L3	Bastacola to Pathardih -13km	20	40	35	40
L4	Bhuli to Bankmore - 6km	15	30	30	30
L5	Katras to Harina–12.5 km	20	35	30	40
L6	Bankmore to Kusunda -5 km	15	30	20	30
L7	Kusunda to Katras - 10 km	20	40	30	40
L8	Monidih to Kusunda -7 Km	20	35	30	40
L9	Lohpiti to Mahuda Area Colony - 8 km	20	40	30	40
L10	Mahuda to Parasia Chowk -7 km	15	30	20	30

L11	Parasia Chowk To Moonidih - 3 km	20	35	35	40
L12	Bhowra to Parbatpur - 13 Km	20	40	30	40

* Average travel speed on the road network is considered during traffic surveys and input form Traffic police and vehicle drivers

The vehicle utilization factors (km travelled per day per vehicle type) were adapted from the Auto Fuel Policy Report (Table 2.2). Two-to-four-wheelers Emission factors were taken from various project reports conducted by CPCB and Indian Clean Air Programmed (ICAP) (CPCB 2010; ARAI 2007). The percentage distribution of various types of vehicles moving on the road network considered during the field survey is presented in Fig 2.1. It shows that major numbers of vehicles moving in the considered Road network are two-wheelers (51%), followed by light motor vehicles (26%), three-wheeler (17%) and heavy-duty diesel vehicles (6%).

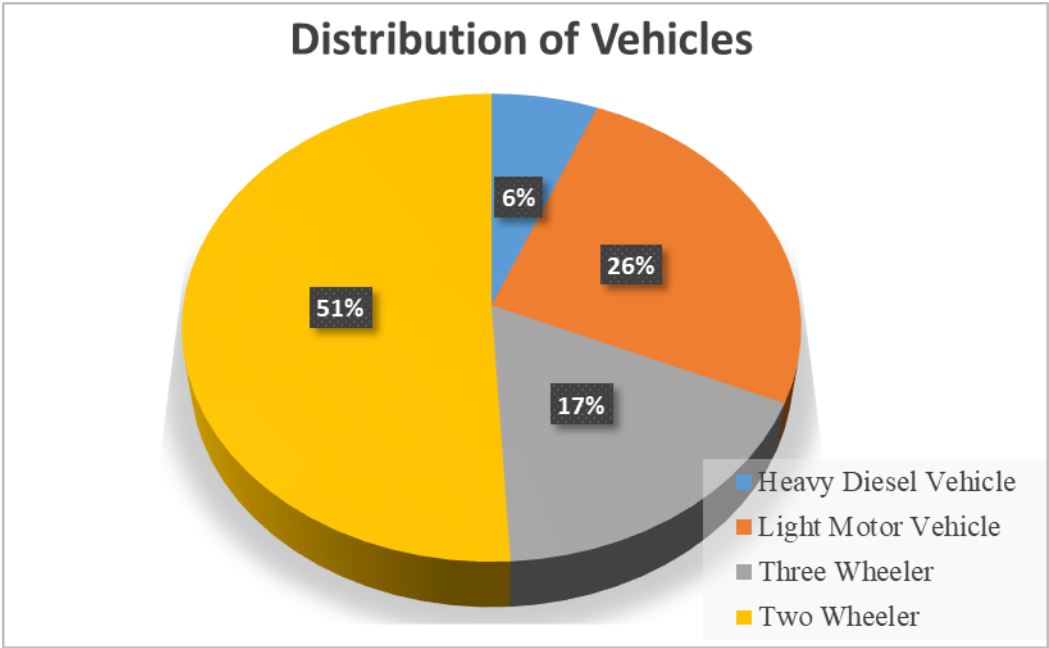


Figure 2.1 Percentage of different types of vehicle surveyed on the road network during the field survey

Table 2.2: Utilization Factors for different types of vehicle

Vehicle Type	km per day
LMV (Car Jeep)	52.6
LMV (Taxi)	77.89
2 Wheeler	25.1
3 Wheeler (Auto)	97.72
HDV	45.5

2.4. Methodology

The following method is adopted to estimate the emission load due to vehicles

$$E_i = N_v \times VKT \times E_f \tag{2.1}$$

Where, E_i is the emission from a particular type of vehicle

N_v is the number of vehicles of a particular type

VKT is the vehicle km travelled

E_i , km is the emission factor for a specific vehicle

Table 2.3a: Emission estimate for road transport

Label	Road Network	Emission (kg/day)	
		PM ₁₀	PM _{2.5}
L1	Jharia to Lodna -5 km	230.12	113.08
L2	Pathardih to Sindri -7 km	379.07	180.37
L3	Bastacola to Pathardih -13km	632.21	451.98
L4	Bhuli to Bankmore - 6km	331.41	187.69
L5	Katras to Harina–12.5 km	719.42	415.63
L6	Bankmore to Kusunda -5 km	308.69	194.34
L7	Kusunda to Katras - 10 km	576.31	277.95
L8	Monidih to Kusunda -7 Km	317.83	114.25
L9	Lohpiti to Mahuda Area Colony - 8 km	360.24	151.99
L10	Mahuda to Parasia Chowk -7 km	241.56	148.24
L11	Parasia Chowk To Moonidih - 3 km	94.26	57.23
L12	Bhowra to Parbatpur - 13 Km	592.82	379.80

Re-suspension of the unpaved and paved roads depends on the „silt loading“ factor and „vehicles weight“ roaming on the road (Table 2.4). The silt loading (SL) is the mass of the silt-sized material per unit area of the road surface. The amount of dust produces by vehicles movement on paved (eq. 2.2a) and unpaved (eq. 2.2b) roads can be appraised by the following equations (adapted from US-EPA, AP-42):

$E = k. (SL/2)^{0.65} . (W/3)^{1.5}$ (2.2a)

$E = [k. (SL/12).(S/30)^{0.5} (W/3)^{1.5}]/(M/0.5)^{0.2}$ (2.2b)

Where, „E“ = emission rate of PMs (Table 2.3);

SL is silt load (g/m2);

W is the average weight of the vehicle (Tons);

M is the surface moisture content (%)

k is constant (the function of particle size) in g VKT⁻¹ (Vehicle Kilometer Travel)

Table 2.3b: Surface silt load in paved and unpaved road

Label	Road Network (Paved: 97.4%; Unpaved: 2.6%)	Surface Silt load (g/m2)	
		unpaved	paved
L1	Jharia to Lodna -5 km	102.3	18.2
L2	Pathardih to Sindri -7 km	--	16.8
L3	Bastacola to Pathardih -13km	63.2	12.1
L4	Bhuli to Bankmore - 6km	--	17.5
L5	Katras to Harina–12.5 km	92.8	12.6
L6	Bankmore to Kusunda -5 km	--	18
L7	Kusunda to Katras - 10 km	--	17.3
L8	Monidih to Kusunda -7 Km	56.5	12.8
L9	Lohpiti to Mahuda Area Colony - 8 km	--	15.5
L10	Mahuda to Parasia Chowk -7 km	--	19

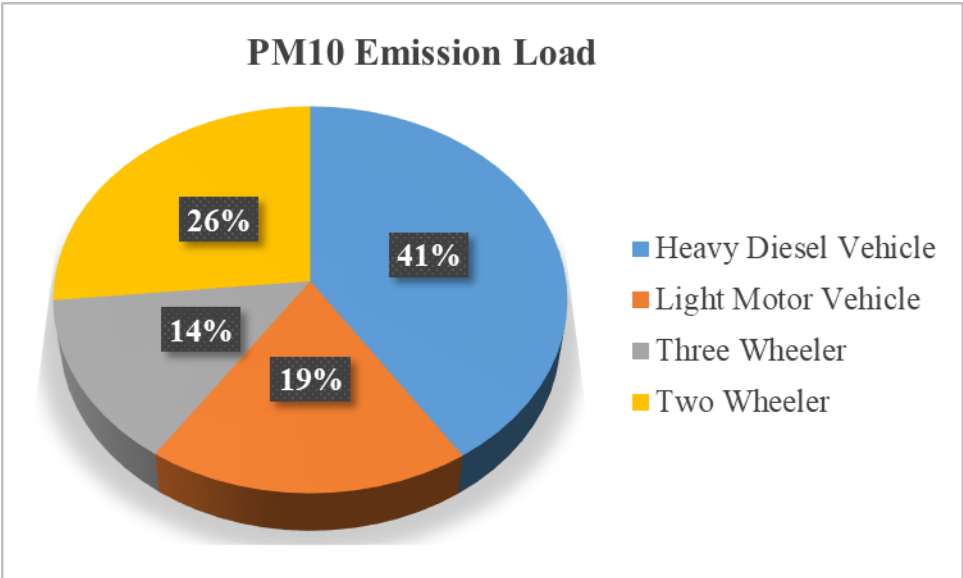


Figure 2.2 PM₁₀ emission load for different categories of vehicle

It is observed that 41% of PM₁₀ emission is contributed by the Heavy-duty diesel vehicles followed by two-wheelers (26%), Light motor vehicles (19%) and three-wheelers (14%) in the considered road network during the study period. The particle size multiplier (k) in the equations 2.2a and 2.2b varies with aerodynamic size range as shown in EPA technical document ([13.2.1_paved_roads.pdf \(epa.gov\)](#)).

Table 2.4: Emission rate for the paved and unpaved road

Emission Sector	Emission Rate	
	PM ₁₀ (kg/day)	PM _{2.5} (kg/day)
Re-suspension dust from Paved & Unpaved Road	1756	843

2.5. Results

2.5.1. Industrial Emission

Emission inventory estimates are determined based on considering available industrial activity information, emission factors (Table 2.5) and observations. For the current study, industrial and mining information was collected for emission inventory development. Emission inventory information for industries was collected from the regional office of JSPCB. In Dhanbad, the major industries are the power plant and the coking industry. Other

than those are coal mines, thus coal as a fuel is majorly used in industries and households. Emission loads by point source are depicted in Table 2.6 as per emission inventory.

Table 2.5: Emission factor for coal mining activities

EF	TSP	PM ₁₀	PM _{2.5}	SO ₂	NO ₂
g/Mg Coal	1914	1864	1176	420	820

Table 2.6: Emission load from Industrial sector in JCF

Sr. No	Name of Industry	Type of Fuel	Fuel consumption	Unit	TSP (Ton/yr)	PM ₁₀ (Ton/yr)	PM _{2.5} (Ton/yr)	SO ₂ (Ton/yr)	NO ₂ (Ton/yr)
1	M/s Mahalaxmi Industries	Coal	4	MT/Oven/ cycle (24hrs)	2.79	2.72	1.72	0.61	1.20
2	GEETEE Hard Coke Traders	Coal	100	TPD	69.86	68.04	42.92	15.33	29.93
3	M/s Shree Gopal Coke Industries	Coal	77.4	TPD	54.07	52.66	33.22	11.87	23.17
4	M/s Laxmi Hard coke Manufacturing Company	Coal	102	TPD	71.26	69.40	43.78	15.64	30.53
5	M/s - Sanjay Hard Coke Industries	Coal	70	TPD	48.90	47.63	30.05	10.73	20.95
6	M/s Inder Hard Coke Industries	Coal	36	TPD	25.15	24.49	15.45	5.52	10.77
7	M/s Shiv Shakti Coke Industries	Coal	80	TPD	55.89	54.43	34.34	12.26	23.94
8	Khetawat Coke Manufacturing Company	Coal	4.5	MT/ Oven/ Batch (24hrs)	3.14	3.06	1.93	0.69	1.35
9	M/s Pawan Hard Coke Industries	Coal	100	TPD	69.86	68.04	42.92	15.33	29.93
10	M/s Ganapati Udyog	Coal	135	TPD	94.31	91.85	57.95	20.70	40.41
11	M/s Aman Soft Coke Industries	Coal	29.76	TPD	20.79	20.25	12.77	4.56	8.91

2.5.2. Area/Distributed source

An area source emission inventory estimates the pollutant loads emanating from several small but numerous individual sources in a specific geographic area and which cannot be included underline no point sources.

Area sources considered for emission inventory for JCF region are:

- Cooking operations in households: Slum and non-slum
- Cooking operations in hotels, restaurants, open eat-outs and bakeries
- Crematoria

The following sections will detail the methodology adopted for estimating emissions from each of the above-mentioned sources and the results thusobtained.

➤ **Emission load from mining activities**

The emission loads from coal mine activities are depicted in Table 2.7. The emission load is calculated based on the secondary data collected from the BCCL mines covered in the study. The data includes coal and overburden quantity handled per day during loading and unloading, transfer from pit to stockyard through haul road and conveyor, vehicular movement frequency and diesel consumption for HEMM and DG sets. Emission factors from EEA air pollutant emission inventory guidebook 2019 were considered for the estimations of TSP and PM load.

Table 2.7: Emission load from coal mine activities in Jharia coalfield region

Mine	Area (m ²)	PM ₁₀ (Tone/y)	PM _{2.5} (Tone/y)
ABOCP	2355283	156.1	78.0
ADI Colliery	1444818	47.9	23.9
ASP Colliery	19540	27.7	13.8
Bhowra south	78079	26.9	13.4
Block IV Govindpur	432827	22.5	11.2
DBOCP	605747	64.7	32.4
East Bassuriya Colliery	576494	24.3	12.2
Gopalichuck Colliery	37573	3.7	1.9
Jeenagora OCP	2079123	208.0	104.0
Kuya OCP	1134723	90.1	45.1
NAKC	245205	78.3	39.1
NGK	261847	126.0	63.0
Nichitpur colliery	791140	61.4	30.7
Phularitand colliery	335887	84.1	42.1
Rajapur OCP	1170784	90.4	45.2
Sendra Bansjora	472760	63.0	31.5
Shatabdi colliery (Muraidhih)	34270	77.0	38.5
Tetulmari	876320	23.3	11.7
Total		1275.4	637.7

➤ **Cooking operations in non-slum household**

A survey of 20 non-slum household areas was conducted in randomly selected areas of Dhanbad to understand which fuels are being used in these households and their quantities. The survey results indicated that Liquefied Petroleum Gas (LPG) was the fuel of choice in all the households and that each household used about 1 cylinder per month on average. It was assumed that LPG use remains the same for all 365 days of the year. The results obtained are presented in Table 2.8.

Table 2.8: Emissions from the use of LPG in non-slum households in Dhanbad

LPG Pollutant	PM ₁₀	SO ₂	NO ₂	CO	HC
Emission Factor (g/kg)	2.1	0.4	1.8	0.25	0.07
Emission (T/Year)	0.00575	0.0011	0.0049	0.0007	0.0002

➤ **Cooking operations in slum households**

A survey of 15 areas having slum households was conducted, spread in Jharia Coalfield which was known to have significant slum populations, to understand which fuels are being used in these households and their quantities. It was seen that a majority of the slum households use coal as a cooking fuel (Table 2.9).

Table 2.9: Emission from coal as fuel

Pollutant	SPM	SO ₂	NO ₂	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	28.354	18.856	5.657	35.330	0.709

➤ **Emissions from crematorium**

In order to calculate emission from crematoria data were obtained from crematoriums in Dhanbad. Emission from the burning of bodies using woods mainly produces PM₁₀, CO and HC majorly as depicted in Table 2.10.

Table 2.10: Emission from Crematoria using Wood as fuel

Pollutant	PM ₁₀	SO ₂	NO ₂	CO	HC
Emission Factor (g/kg)	17.3	0.2	1.3	126.3	114.5
Emission (T/Year)	28.88	0.033	0.216	20.99	19.03

➤ **Emissions from bakeries**

Data were collected from 34 bakeries operating in Dhanbad in which 12 bakeries were using electrical ovens. The emissions from such bakeries were not considered. All the other bakeries were using coal as fuel. Emissions from such bakeries are given in Table 2.11.

Table 2.11: Emission from Bakeries using Coal as fuel

Pollutant	SPM	SO ₂	NO ₂	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	6.26	4.16	1.25	7.80	0.16

➤ **Emissions from hotels and restaurants**

Data were collected from 35 hotels in Dhanbad city. It has been found that most hotels/restaurants were using a combination of coal and LPG as cooking fuel. Emission

from coal and LPG were calculated and depicted in Table 2.12 and 2.13.

Table 2.12: Emission from Hotel & Restaurants using Coal

Pollutant	SPM	SO ₂	NO ₂	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	81.10	5.393	1.618	10.105	0.203

Table 2.13: Emission from Hotel & Restaurants using LPG

Pollutant	PM ₁₀	SO ₂	NO ₂	CO	HC
Emission Factor (g/kg)	2.1	0.4	0.8	0.25	0.07
Emission (T/Year)	0.136	0.026	0.117	0.016	0.005

➤ **Emission from open eat-outs**

From the survey it has been observed that most of the open eat-outs were using coal as cooking fuel, only a few were using LPG (Table 2.14).

Table 2.14: Emission loads from open eat-outs

Pollutant	SPM	SO ₂	NO ₂	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	140.7	9.36	2.81	17.54	0.35

2.5.3. Grid wise emission inventory

The grid-wise particulate emission inventory maps were prepared from the primary and secondary data collected during the field surveys and the information received from the open cast mines, respectively. The PM emissions from restaurants, eat-outs, domestic chullahs, vehicles, crematoria, etc. were estimated based on the primary data obtained from the filed campaigns, whereas, the emissions from the mine operations were estimated based on the data received from the mines and the emission factors reported in the literature. Once the emissions rates were estimated, the cumulative emissions (including all types of sources like line, point, and area) were calculated falling under the grid defined (shown in Figure 2.3 and Figure 2.4). From the figures, it can be interpreted that the PM emissions are high on the northeast side of the study area. Whereas, the actual transport and dispersion of these emissions can be interpreted through the dispersion modelling carried out using the AERMOD model.

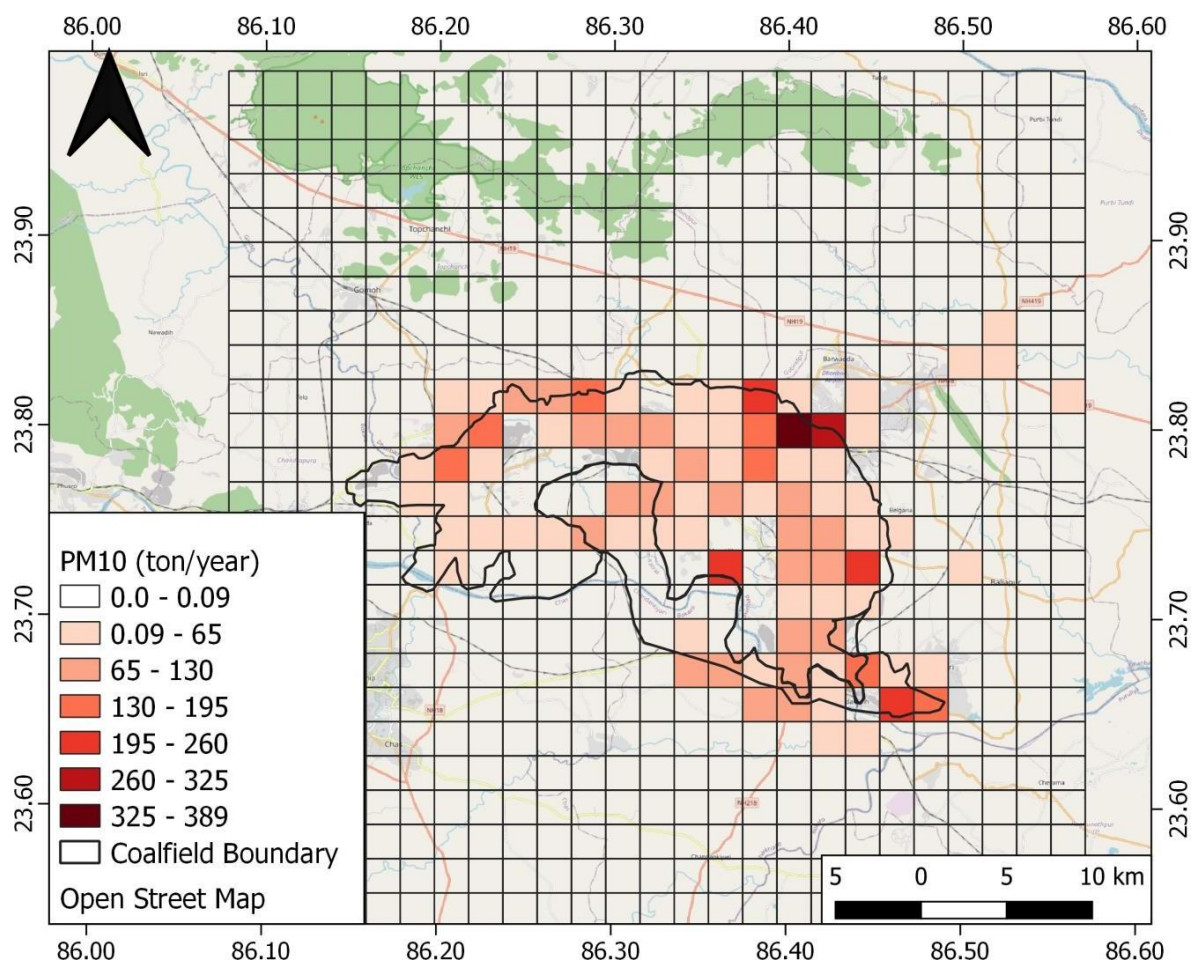


Figure 2.3 Grid-wise emission inventory of PM₁₀ in tons/year over the study area

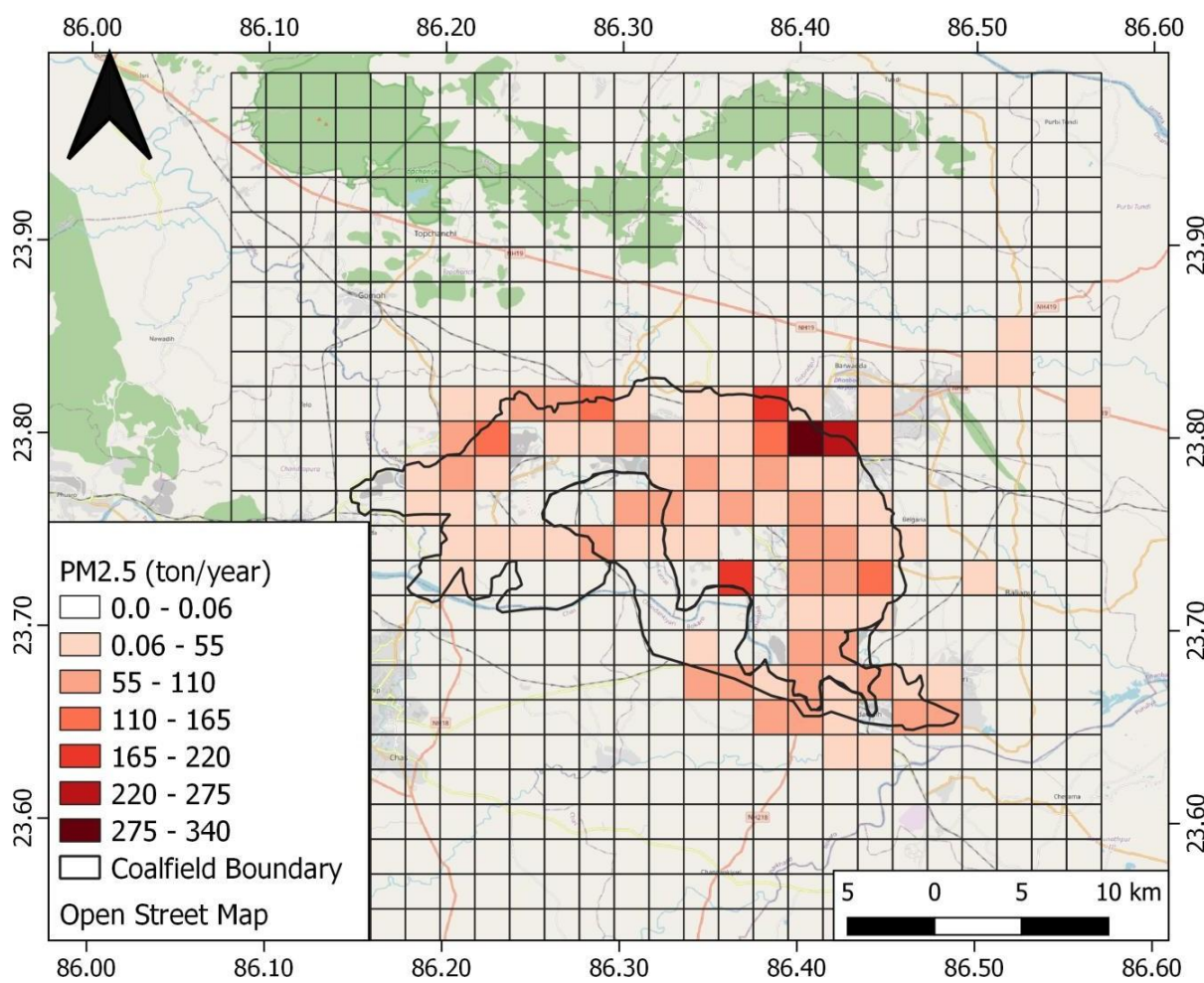
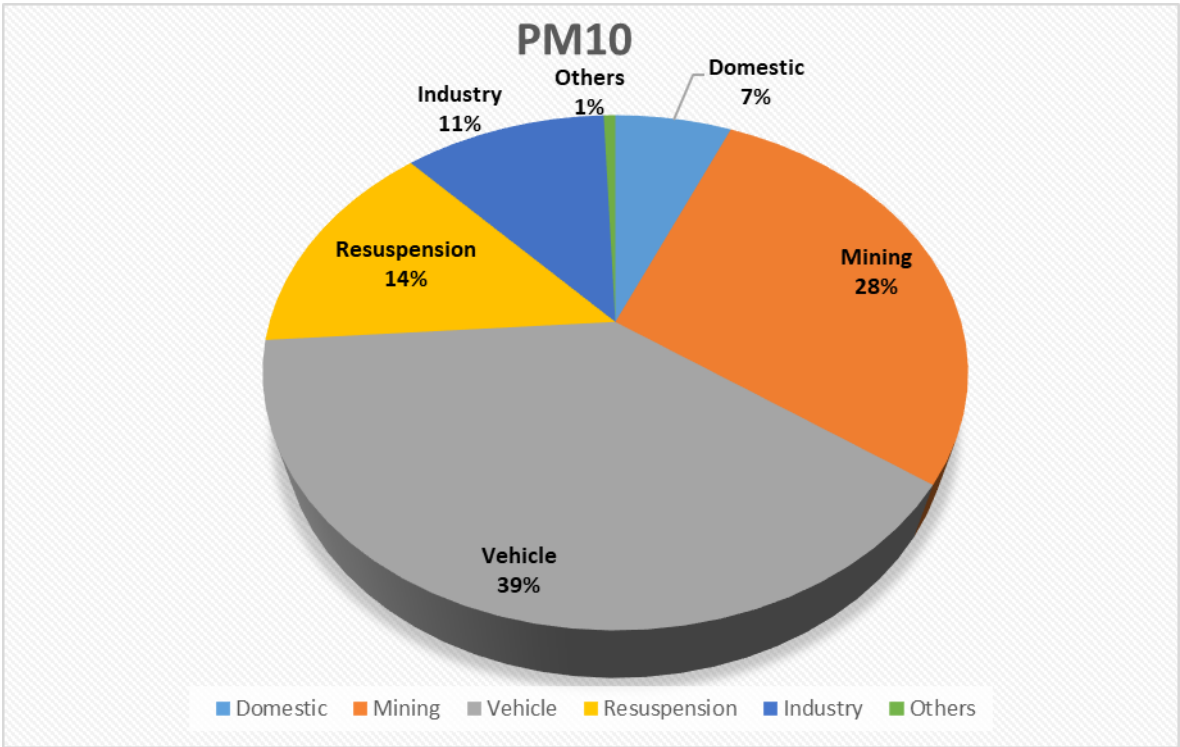


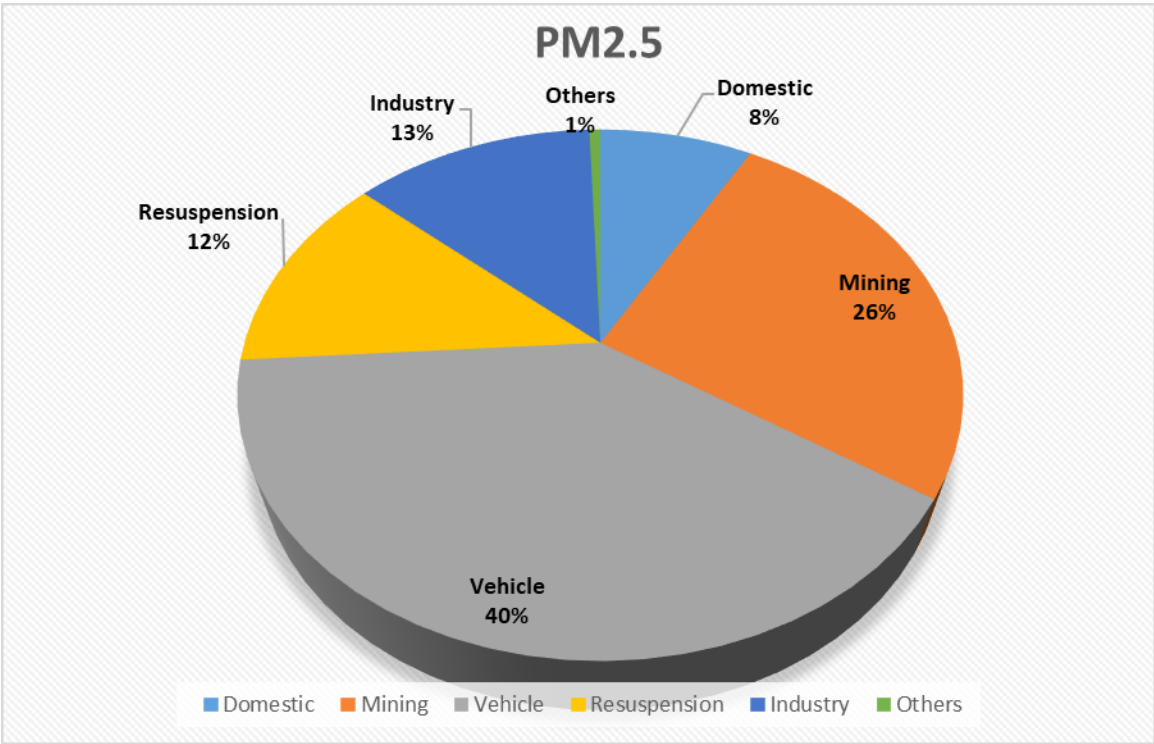
Figure 2.4 Grid-wise emission inventory of PM_{2.5} in tons/year over the study area

The respective share of various emission sources is represented through pie diagrams shown in Figure 2.5. Data shows that PM₁₀ emissions are contributed mostly from vehicular emissions

followed by emissions from the mines whereas, PM_{2.5} emissions are contributed mostly from vehicular emissions, domestic burning and mine activities. The grid-wise emission inventory maps and the information on the pollution sources provide the basis for the policymakers to target the hotspots of pollution generation in order to take effective mitigation actions.



(a)



(b)

Figure 2.5 (a) and (b) represents emission load from various sectors over JCF region for PM₁₀ and PM_{2.5} respectively

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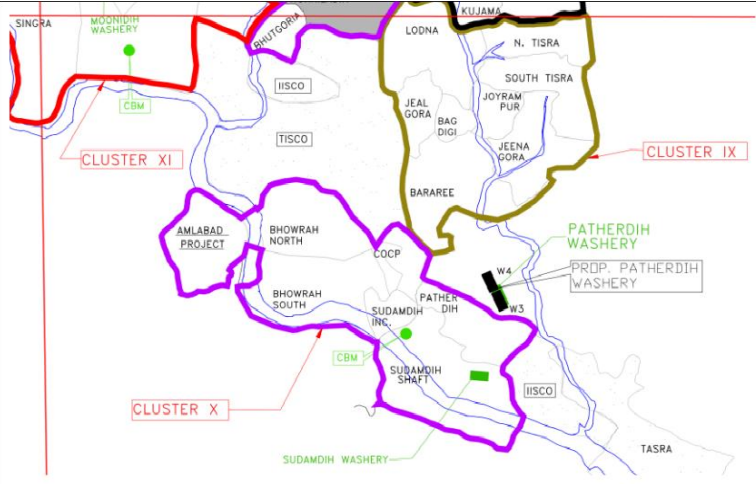
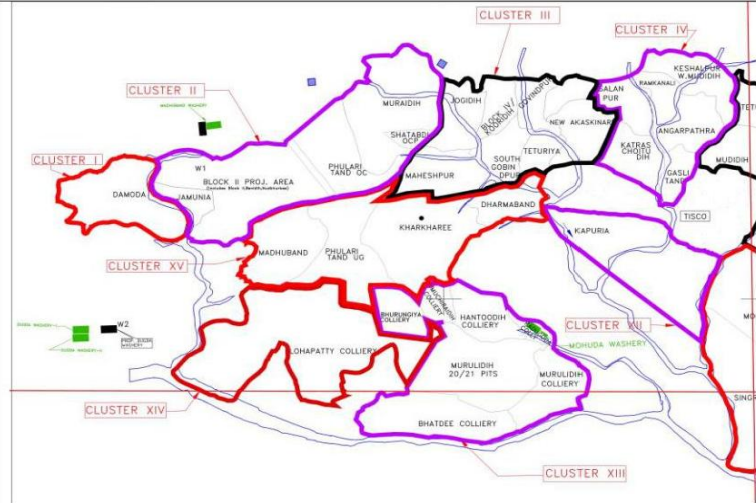
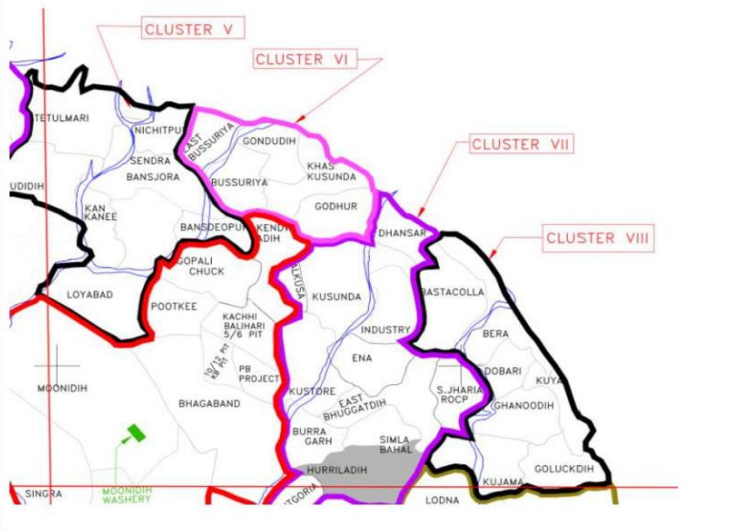
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Chapter 3 Air Quality Monitoring and Receptor modelling

BCCL environmental department provided the map of the Jharia region. The site visit was carried out with assistance from BCCL’s team. The 15 Jharia mines coal fields were segregated into three parts. The details of the visit and mine cluster names are given in Table 3.3.1. The Entire Jharia Coal Field (JCF) is divided into 16 clusters. Both open cast and underground mines are operational in JCF. Standard mining operations like drilling, blasting, hauling, accumulation, and transfer are the major sources of emissions and air pollution. Apart from that, a typical emission source, mine fire, is prevailing at JCF. Besides, JCF encompasses large non-mining regions with their emission sources like vehicular emission in congested traffics, road dust, Power Plant emission, other industrial emissions (coke oven plants, brick kilns, stone crushers, etc.), crematoria, domestic burning, open burning, etc.

Table 3.3.1: The details of mine cluster in Jharia Coalfield

	Day 1: Cluster I, II, III, IV, XII, XIII, XV and XIV
	Day 2: Cluster V, VI, VII, and VIII
	Day 3: Cluster IX, X and XI

Based on preliminary field visit by NEERI Scientists along with BCCL staffs, the following locations (Figure 3.1) were selected for the establishment of Air Quality Monitoring Stations for source apportionment study;

- **Core Zone**

1. Cluster XIV Lohapatty– nearby sources: Chandrapura Thermal Power Plant
2. Cluster VII Mine rescue station- nearby sources: Coal Mine, Industry
3. Cluster V- Katras
4. Cluster IX Lodhna
5. Cluster XI Moonidih nearby sources: Coal Mine
6. Cluster X Patherdih: nearby sources: Coal Mine, Steel Industry
7. Cluster VIII Bastacola nearby sources: Coal Mine

- **Buffer Zone**

8. Bank More
9. Harina
10. Bhuli
11. Sindri
12. Parbatpur Electro steel/ Bhaga
13. Background

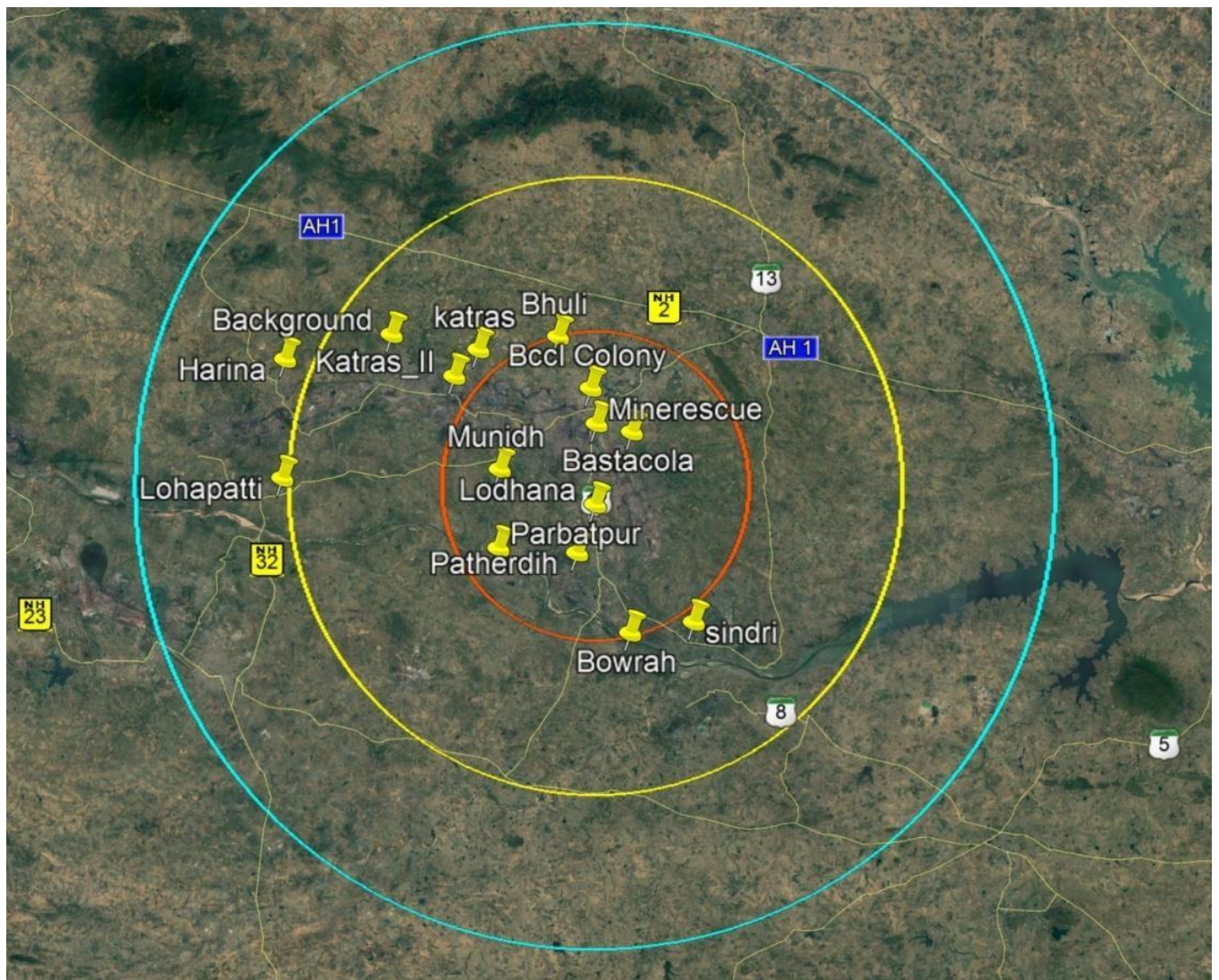


Figure 3.1: Air monitoring sites under 30 km buffer area

3.1. Sampling Method and Schedule

The PM₁₀ and PM_{2.5} sampling for Jharia Coalfields was done at all the 13 sampling sites for the period of 24 h using low volume respirable suspended particulate matter samplers (Instrumax, ARA and Envirotech) on Quartz and polytetrafluoroethylene (PTFE) filter paper of 47 mm diameter. Samplers at a flow rate of 16.67 LPM were used. The filter papers were desiccated before and after sampling for 24h at a temperature of 27 ± 3°C and at a relative humidity (RH) of 55 ± 2% to remove the moisture present in them. The PM₁₀ and PM_{2.5} field samples were collected periodically throughout the sampling period. The sampling frequency and types of equipment used for monitoring are described in Table 3.3.2 and 3.3.3. The national Ambient quality and Standards for Coal Mines (Stipulated by Ministry of Environment and Forests are depicted in Table 3.3.4. and Table 3.3.5.

Table 3.3.2: Frequency of Air pollutants sampling in Jharia Coalfields

Parameter	Number of Days	Change of Filter/ absorbing media	Reporting
PM ₁₀	10	24 hourly, Teflon: 5 Days Quartz: 5 Days	24 hourly
PM _{2.5}	10	24 hourly Teflon: 5 Days Quartz: 5 Days	24 hourly
NO ₂	10	8 hourly	8 hourly
SO ₂	10	8 hourly	8 hourly

Table 3.3.3: Ambient Air Quality Sampling/Analysis Methodology for Target Pollutants

Particulars	Parameters			
	PM ₁₀	PM _{2.5}	NO ₂	SO ₂
Sampling Instrument	INSTUMEX and ARA-N-FRM Sampler	INSTUMEX and ARA-N-FRM Sampler	APM sampler	APM sampler
Sampling Principle	Cyclonic Flow Technique	Cyclonic Flow Technique	Chemical absorption in suitable media	Chemical absorption in suitable media
Flow rate	16.7 LPM	16.7 LPM	0.5 LPM	0.5 LPM
Sampling Period	24 hourly	24 hourly	8 hourly	8 hourly
Sampling Frequency	7 days continuous, Teflon and quartz on alternate days	7 days continuous, Teflon and quartz on alternate days	7 days continuous	7 days continuous
Analytical Instrument	Electronic Micro Balance	Electronic Micro Balance	Spectrophotometer	Spectrophotometer
Analytical Method	Gravimetric	Gravimetric	Modified Jacob and Hochheiser method	Colorimetric Improved West & Gaeke Method
Minimum reportable value	5µg/m ³	5µg/m ³	9µg/m ³	4µg/m ³

Table 3.3.4: National Ambient Air Quality Standards (2009)

Sr. No.	Pollutant	Time Weighted Average	Concentration in ambient Air (in µg/m ³) Industrial, Residential Rural & Other Areas	Concentration in ambient Air (in µg/m ³) Ecologically Sensitive Area	Concentration In ambient Air (in µg/m ³) Methods of Measurement
1	Sulphur Dioxide (SO ₂)	Annual*	50	20	Improved West & Geake, Ultraviolet fluorescence
		24Hours**	80	80	
2	Nitrogen Dioxide (NO ₂)	Annual*	40	30	Modified Jacob & Hochheiser (Na-Arsenite) Chemiluminescence
		24Hours**	80	80	
3	Particulate matter (Size less than 10µm) or PM ₁₀	Annual*	60	60	Gravimetric, TOEM, Beta attenuation
		24Hours**	100	100	
4	Particulate matter (Size less than 2.5µm) or PM _{2.5}	Annual*	40	40	Gravimetric, TOEM, Beta attenuation
		24Hours**	60	60	
5	Ozone (O ₃)	8 Hours*	100	100	UV photometric, Chemiluminescence chemical method
		1 Hour	180	180	
6	Lead (Pb)	Annual*	0.5	0.5	ASS / ISP method after sampling on EPM 2000 or equivalent filter paper ED-XRF using Teflon filter
		24Hours**	1	1	
7	Carbon Monoxide (CO)	Annual*	0.2	0.2	Non-dispersive Infra-Red (NDIR) Spectroscopy
		24Hours**	0.4	0.4	
8	Ammonia (NH ₃)	Annual*	100	100	Chemiluminescence, Indo-phenol's blue method
		24Hours**	400	400	
9	Benzene (C ₆ H ₆)	Annual*	0.5	0.5	Gas Chromatography based continuous analyzer. Adsorption and desorption followed by GC analysis
10	Benzo (a) Pyrene (BaP)- particulate phase only	Annual*	0.1	0.1	Solvent extraction followed by HPLC / GC analysis
11	Arsenic (As)	Annual*	0.6	0.6	AAS/ ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni)	Annual*	20	20	

Table 3.3.5 Standards for Coal Mines (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)

Pollutant	Time weighted Average	Concentration in Ambient Air	
		New Coal Mines (commenced after 25.09.2000)	Existing Coal Mines (commenced prior to 25.09.2000)
Suspended Particulates Matter (SPM)	Annual Average 24 hours	360µg/m ³ 500µg/m ³	430µg/m ³ 600µg/m ³
Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average 24 hours	180µg/m ³ 250µg/m ³	215µg/m ³ 300µg/m ³
Sulphur Dioxide (SO ₂)	Annual Average 24 hours	80µg/m ³ 120µg/m ³	80µg/m ³ 120µg/m ³
Oxides of Nitrogen as NO ₂	Annual Average 24 hours	80µg/m ³ 120µg/m ³	80µg/m ³ 120µg/m ³

3.2. Chemical Analysis

3.2.1. Gravimetric analysis

The exposed filters were analysed by gravimetric technique using a weighing balance for PM₁₀ particles and using a microbalance for PM_{2.5} particles with a precision of 5µg with automatic (internal) calibration.

3.2.2. Elemental analysis

PM₁₀ samples collected on glass fibre filters were digested in a microwave digester. The samples were made up to 50ml using deionized distilled water. Similarly, the exposed filters containing PM_{2.5} particles were cut equally into 2 halves. A part of the exposed filter was used for ions analysis. Whereas, the other half was cut into tiny fragments and digested and made up to 15mL using distilled deionized water. The obtained samples (both PM₁₀ and PM_{2.5}) after digestion were stored in vials and refrigerated at 4°C until further analysis. These samples were later subjected to estimate the elemental composition using ICP-OES (Thermo Scientific, USA).

3.2.3. Analysis of SO₂ and NO₂

SO₂ analysis: Modified West and Gaeke method was followed for sampling and analysis of Sulfur dioxide in ambient air. SO₂ from the air is absorbed in a solution of potassium tetracholo-mercute (TCM). A dichlorosulphitomercurate complex, which resists oxidation by the oxygen in the air was formed. Once formed, that complex was stable to strong oxidants such as ozone and oxides of nitrogen and therefore, the absorber solution may be stored for some time prior to analysis. The complex was made to react with pararosaniline and formaldehyde to form the intensely colored pararosaniline methylsulphonic acid. The absorbance of the solution was measured by means of a suitable spectrophotometer.

NO₂ analysis: Modified Jacobs and Hochheiser method was followed for sampling and analysis of NO₂ in ambient air. Ambient NO₂ was collected by bubbling air through a solution of sodium hydroxide and sodium arsenite. The concentration of nitrite ion produced during sampling was determined calorimetrically by the nitrite ion reaction with phosphoric acid, sulphanilamide, and N-(1-naphthyl)-ethylenediamine di-hydrochloride (NEDA) and the absorbance of the highly colored azo dye was measured at 540nm.

3.2.4. Ion analysis

The filter papers containing both PM₁₀ and PM_{2.5} samples were extracted and subjected to ion analysis as per standards. The filter papers were divided into tiny fragments and moistened with isopropanol slightly before extraction since the filters are hydrophobic. Further 25 mL of deionized distilled water was added and sonicated using an ultrasonic bath for 60 min at 60°C. The samples were then kept overnight after sonication. Furthermore, the samples were then filtered using nylon filter discs (25mm, 0.45mm) and were refrigerated at 4°C until further analysis. The extracted samples were subjected to IC to analyse the ions (anions and cations) present in them.

3.2.5. Polycyclic Aromatic Hydrocarbons (PAH) analysis

Filter papers were cut into pieces using scissors and transferred to a 100 ml beaker and 50 ml of Dichloromethane (DCM) (GC/HPLC grade) was added. The samples were extracted with DCM using an ultrasonic bath for about 30 minutes. The extracted samples were filtered with Whatman filter paper containing 2gm Anhydrous Sodium Sulphate. After filtration, the filtrate is concentrated using a rotary vacuum evaporator to 2ml final volume. Solid-phase extraction may be used to clean up the impurities of the sample and re-concentrated in a rotary evaporator. The samples were analyzed through GC with conditions as injector 300°C and FID temperature 320°C.

3.2.6. EC & OC analysis

This is a thermal/optical-transmittance (TOT) method that speciates carbon in particulate matter collected on a quartz-fiber filter into OC, EC, and CC. In the first (or non-oxidizing) heating stage, organic and carbonate carbon is thermally desorbed from the filter under a flow of helium with controlled temperature ramps. The oven is then partially cooled, and the original flow of helium is switched to an oxidizing carrier gas (He/O₂). In the second (or oxidizing) heating stage, the original elemental carbon component plus pyrolyzed organic carbon formed during the first heating stage are oxidized/desorbed from the filter with another series of controlled temperature ramps. All carbon evolved from the sample is converted to CO₂ in an oxidizing oven immediately downstream from the desorption oven, and the CO₂ is converted to methane (CH₄) by a methanator oven before being measured with a flame ionization detector (FID). (<https://www3.epa.gov/ttnamti1/files/ambient/pm25/spec/RTIOCECSOP.pdf>)

3.3. Results

3.3.1. Mass concentration of PM₁₀ and PM_{2.5}

In summer monitoring, the mean mass concentrations of PM₁₀ particles in all 13 sampling sites were found to be in the range of 74-184µg/m³ with the highest concentration of 184µg/m³ at mine rescue site and lowest concentration of 74µg/m³ at Bastacola site. Also, the mean mass concentration of PM_{2.5} particles was found in the range of 49-117µg/m³ with the highest concentration of 117µg/m³ and the lowest concentration of 49µg/m³ recorded at Harina and Lohapatti site respectively.

The average concentrations of PM₁₀ and PM_{2.5} in two seasons are described in Table 3.6 and 3.7. Results revealed that the average concentrations of PM₁₀ are within the prescribed limits of MoEF notification guidelines for coal mine areas. In the case of PM_{2.5}, there is no Govt. notified standard for mining areas but in the case of buffer zones, National Ambient Air Quality Standard, NAAQS, 2009 may be applicable. The highest PM₁₀ and PM_{2.5} concentrations were found in Mine rescue and Harina (Figure 3.2 and 3.3).

Table 3.6: Average concentration of PM₁₀ and PM_{2.5} in Summer of Jharia Coalfield

Monitoring Sites		Average Concentration (µg/m ³)-Summer	
	Site Description	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
Lohapatti	Core Zone	133.7	49.42
		(83-203)	(44-83)
Mines Rescue	Core Zone	184.8	83.43
		(124-255)	(55-205)
Katras	Core Zone	141.4	80.01
		(100-216)	(42-150)
Lodhna	Core Zone	156.8	63.98
		(100-303)	(32-99)
Moonidih	Core Zone	118.4	62.84
		(80-153)	(34-94)
Patherdih	Core Zone	94.7	67.22
		(50-119)	(37-91)
Bastacola	Core Zone	104.32	93.27
		(154 -316)	(64-158)
BCCL colony	Buffer Zone	157.35	74.37
		(113-222)	(47-103)
Harina	Buffer Zone	177.7	117.3
		(73-265)	(42-175)
Bhuli	Buffer Zone	141.7	105.89
		(85-243)	(44-161)
Sindri	Buffer Zone	122.2	76.05
		(82-139)	(18-127)
Parabatpur	Buffer Zone	122.4	110.98
		(86-171)	(70-150)
Background	Buffer Zone	144.4	57.13
		(24-255)	(23-97)

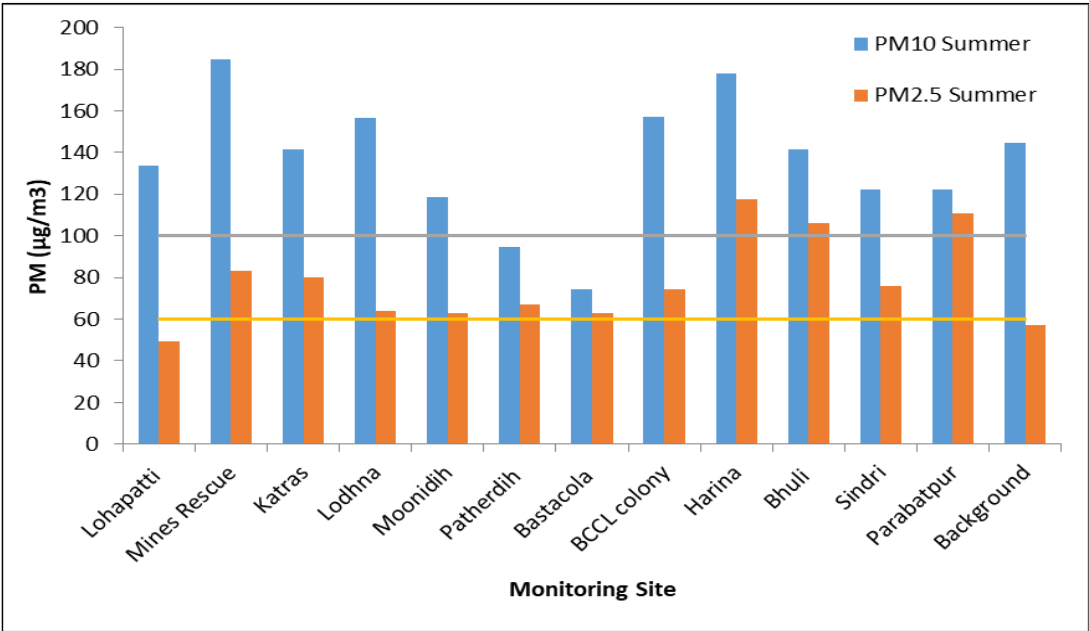


Figure 3.2: Average concentration of PM₁₀ and PM_{2.5} in JCF region in summer compared to NAAQS (2009)

Table 3.7: Average concentration of PM₁₀ and PM_{2.5} in winter of Jharia Coalfield.

Monitoring Sites	Site Description	Average Concentration (µg/m ³)-Winter	
		PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
Lohapatti	Core Zone	174.28	139.59
		(122-241)	(114-236)
Mines Rescue	Core Zone	303.49	176.97
		(175-350)	(114-233)
Katras	Core Zone	230.06	50.87
		(134-332)	(24-78)
Lodhna	Core Zone	322.8	112.17
		(243-412)	(98-209)
Moonidih	Core Zone	300.16	188.27
		(128-728)	(64-600)
Patherdih	Core Zone	222.71	113.23
		(182-246)	(111-167)
Bastacola	Core Zone	332.05	176.48
		(251-663)	(54-425)
BCCL colony	Buffer Zone	219.98	128.79
		(155-300)	(94-175)
Harina	Buffer Zone	130.73	42.93
		(65-215)	(44-98)
Bhuli	Buffer Zone	174.75	151.66
		(150-200)	(89-180)
Sindri	Buffer Zone	171.82	167.07
		(81-210)	(142-184)
Parabatpur	Buffer Zone	228.76	148.16
		(75-660)	(101-192)
Background	Buffer Zone	233	121.18
		(195-254)	(63-170)
Katras II		107.13	98.42
	Core Zone	(128-181)	(94-104)

Whereas in winter monitoring, the highest PM₁₀ mass concentration was found to be 332µg/m³ at Bastacola site (exceeding the prescribed limit of **GSR 742(E)**) along with other core mining zones like Mines Rescue, Moonidih. The lowest average concentration of PM₁₀ was found in Katras II (Table 3.7).

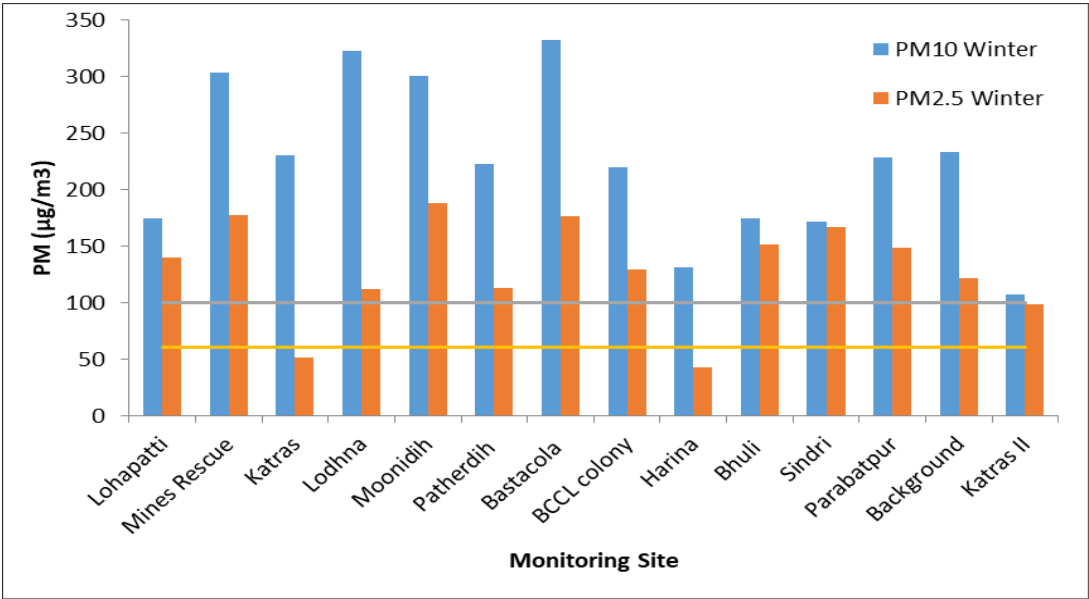


Figure 3.3: Average concentration of PM₁₀ and PM_{2.5} in JCF region during Winter compared to NAAQS (2009)

3.3.2. Elemental concentration of PM₁₀ and PM_{2.5} in summer

The digested samples of PM₁₀ and PM_{2.5} particles from all the 13 sampling sites were subjected to estimate the elemental composition using ICP-OES. The analysis of PM₁₀ particles yields 11 different elements such as Al, As, Cd, Co, Cu, M, Ni, Pb, Zn, Fe and Cr. Similarly, the samples containing PM_{2.5} particles revealed the same elements as PM₁₀. It was observed that Al and Fe were found to be higher for both PM₁₀ and PM_{2.5} particles. Al is the most abundant element. The concentration of Al was detected in the range of 6.32-14.62µg/m³. Maximum Al concentrations were found at BCCL colony, Parbatpur, Harina and Background. The concentrations of Fe and Cr were estimated as 0.78-7.74µg/m³ and 0.075-1.32µg/m³ respectively. The highest concentrations of both Fe (7.74µg/m³) & Cr (1.32µg/m³) were found at the Bastacola site Figure 3.4. Similarly, in the case of PM_{2.5} particles the concentrations of Al (4.87-14.47µg/m³), Fe (0.44-11.77µg/m³) and Cr (0.066-2.17µg/m³) were found higher than other elements. For PM_{2.5} particles, maximum concentrations of Fe (11.77µg/m³) and Cr (2.17µg/m³) were obtained at the Mine Rescue site and Al (14.47µg/m³) at Katras. Since, the elements such as Al, Fe and Cr possess higher concentrations in the PM₁₀ elemental composition, Al would have been emitted from road dust, whereas Fe would have been emitted from the re-suspension of dust containing deposits from the emissions of vehicular and other anthropogenic activities Figure 3.5.

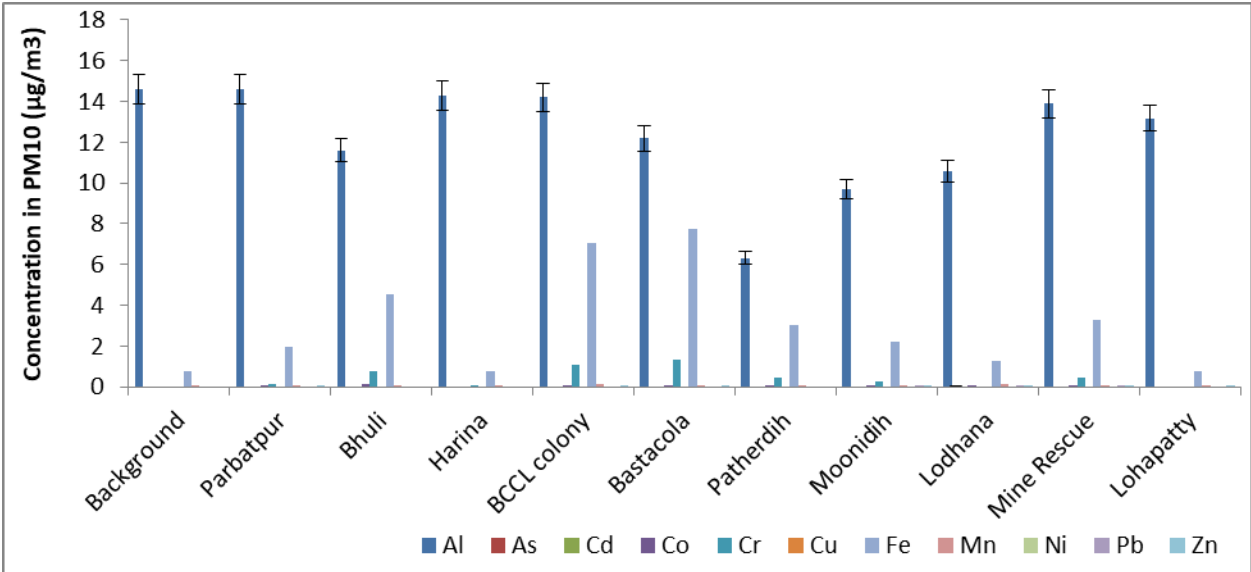


Figure 3.4: Metal concentration of PM₁₀ in the summer season

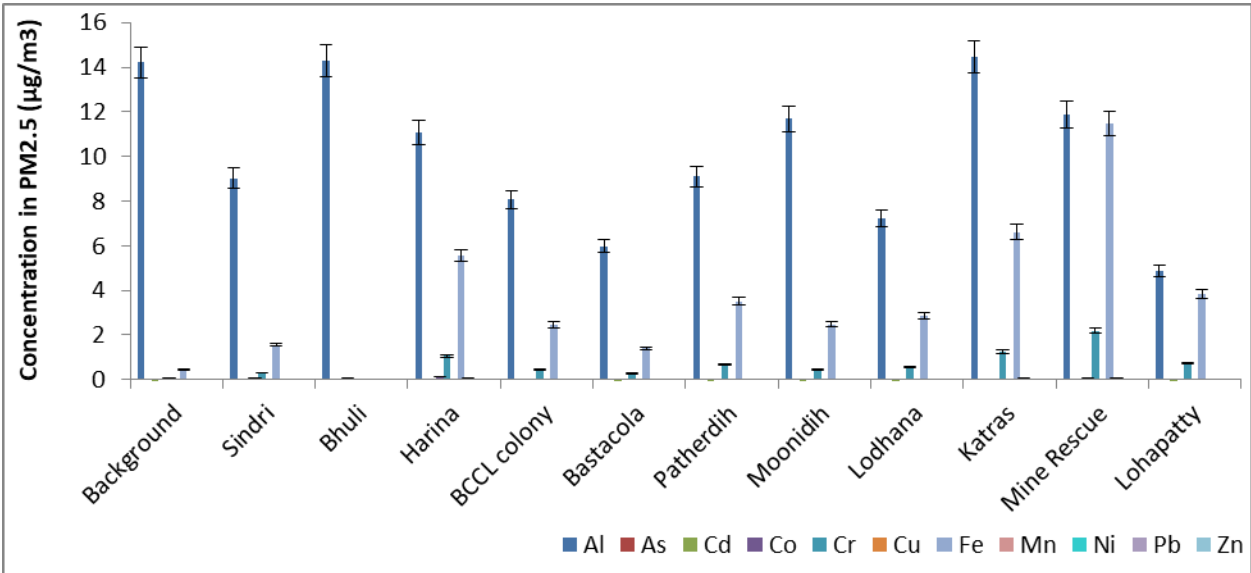


Figure 3.5: Metal concentration of PM_{2.5} in the summer season

3.3.3. Elemental Concentration of PM₁₀ and PM_{2.5} in Winter

The elemental analysis was performed using inductively coupled plasma optical emission spectroscopy (ICP-OES). For the air quality assessment, the concentrations of 11 elements i.e. Al, As, Cd, Cr, Cu, Fe, K, Mn, Ni, Pb, and Zn in PM₁₀ and PM_{2.5} samples, were measured. Among all the elements, Al, Fe, and K concentrations were found considerably higher for PM₁₀ samples in the winter season. Al was observed in the range of 2.02-10.77µg/m³ followed by Fe (0.79-9.26µg/m³) and K (0.90-4.19µg/m³). Maximum Al concentration (10.77µg/m³) was observed at the BCCL colony, followed by Lodhna (10.29µg/m³). The Highest Fe concentration (9.26µg/m³) was observed at Bastacola while K (4.19µg/m³) at the Lodhna site. This may be due to vehicular emissions, paved roads, construction dust, coal combustion, soil dust, etc. The concentration of As, Ni, Pb was found within the limits of CPCB standards. The remaining elements i.e. Cd, Cr, Cu, Mn, and Zn were found very low (Figure 3.6).

Similarly, in the case of PM_{2.5} samples concentrations of Al, Fe and K were detected higher than other elements. The concentration of Al, Fe, and K was obtained as 0.11-2.91µg/m³, 0.05-1.93µg/m³ and 0.08-2.12µg/m³. For PM_{2.5} particles, maximum Al and K were found at the Munidih site, which were 2.91µg/m³ and 2.12µg/m³ respectively. The highest concentration of

Fe i.e. $1.93\mu\text{g}/\text{m}^3$ was detected at Lodhna site. The concentrations of all other analysed elements were low (Figure 3.7).

From the elemental analysis of the summer and winter seasons, it was observed that the average Al concentration obtained was more in the summer season than in the winter season. In contrast, the average concentration of Cr was more in the winter season.

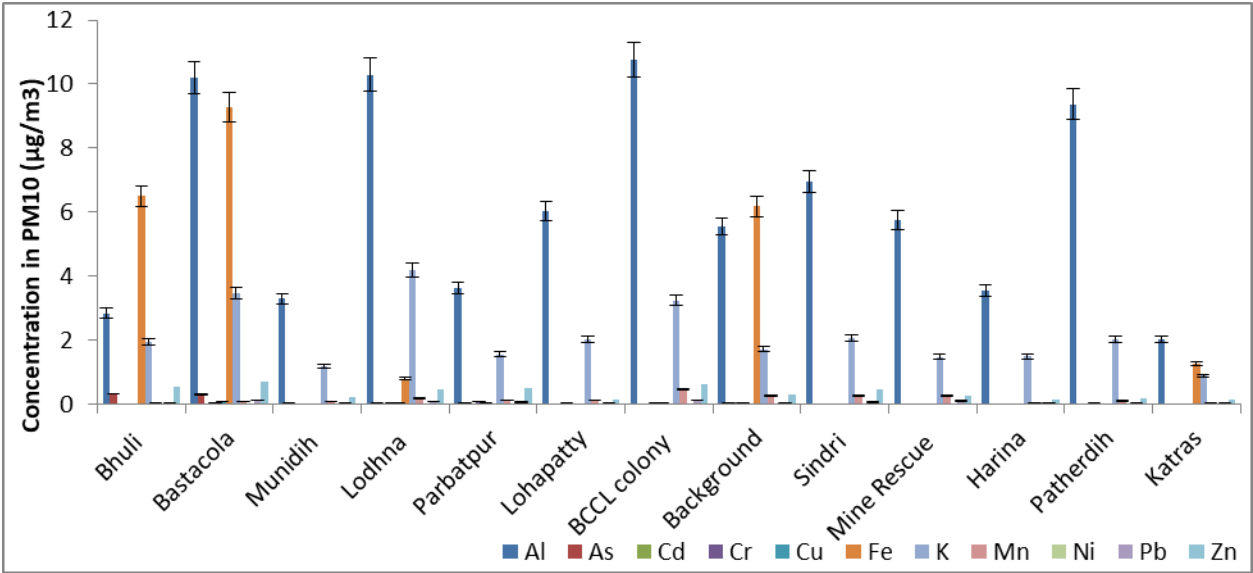


Figure 3.6: Metal concentration of PM₁₀ in winter season

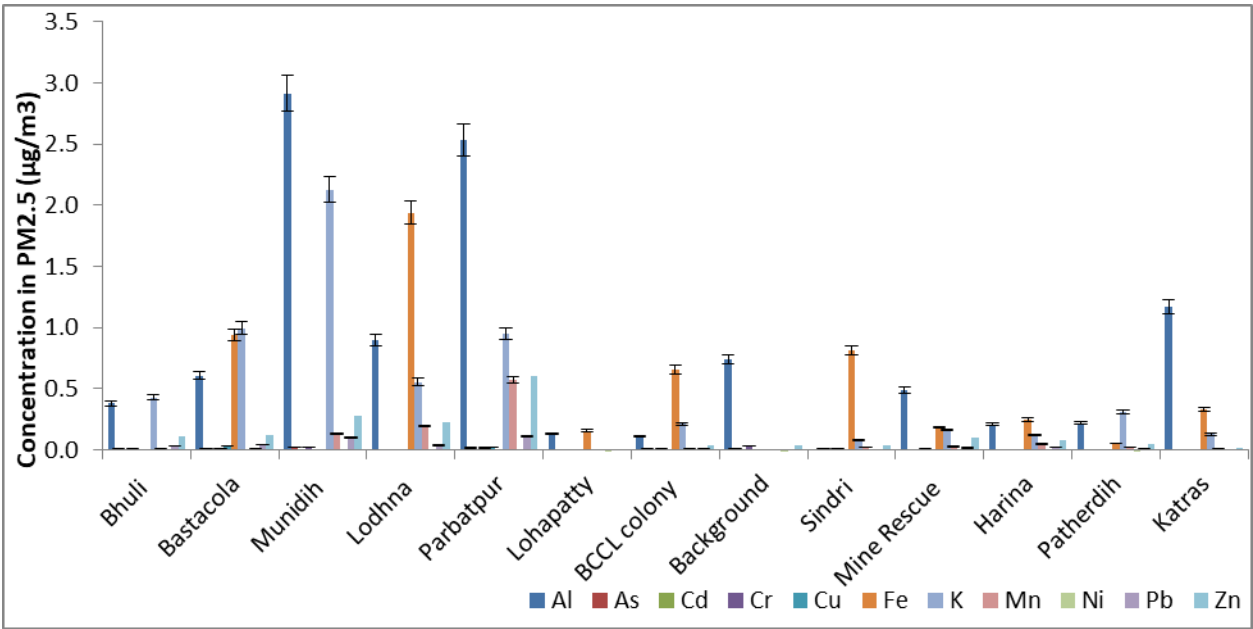


Figure 3.7: Metal concentration of PM 2.5 in winter season

3.3.4. SO₂ and NO₂ concentration in ambient air in the Summer season

The mean average SO₂ concentration in the summer season among all the monitoring stations ranged between 11µg/m³ (Harina & Bastacola) and 24.5µg/m³ (Moonidih), being well below the threshold limits of 80µg/m³ (residential or industrial). The 8-hour average NO₂ concentrations were between 10.3µg/m³ (Background) and 40.9µg/m³ (Lodhana), well within the standard limits of 80µg/m³ (residential or industrial) Figure 3.8. The SO₂ in the residential areas may be received from the open burning of raw coal and other domestic and commercial activities.

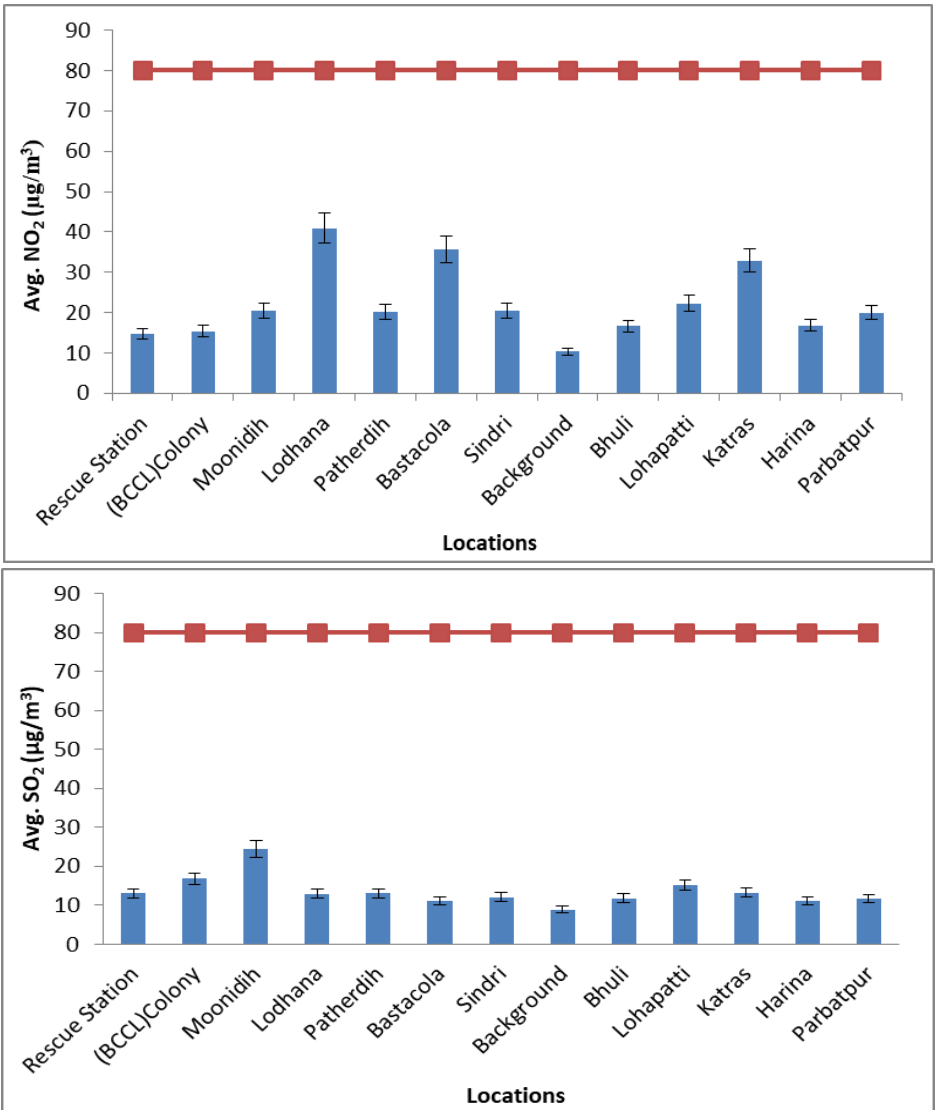


Figure 3.8: NO₂ and SO₂ Concentration of all monitoring sites in summer season

3.3.5. SO₂ and NO₂ concentration in ambient air in Winter season

The mean concentration of NO₂ and SO₂ in the winter season was found below the threshold limit i.e. 80µg/m³. The concentration of SO₂ was below 10µg/m³ in Katra, BCCL colony, Mine Rescue, Bastacola, Lodhana and Munidih. Bastacola and Bhuli site has a NO₂ concentration above 10µg/m³ (Figure 3.9). It has been observed that the concentration of NO₂ and SO₂ in the winter and summer seasons were below the standard limit. But the average concentration of NO₂ and SO₂ in the summer season was higher than in the winter season.

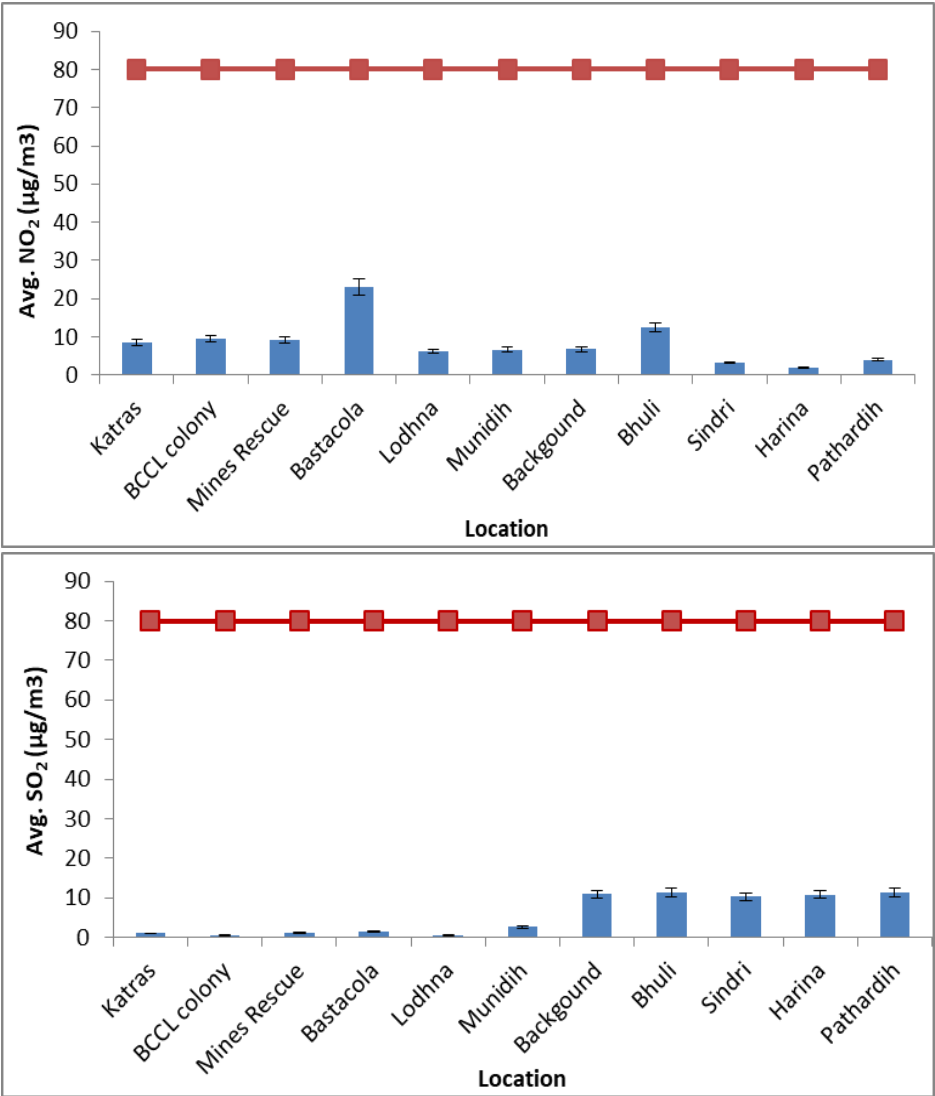


Figure 3.9: NO₂ and SO₂ Concentration of all monitoring sites in Winter season

3.3.6. Carbonaceous Aerosol/EC & OC in Summer

Data were obtained for four OC fractions (OC1, OC2, OC3 and OC4 in He atmosphere at 140, 280, 480 and 580°C, respectively) and three EC fractions (EC1, EC2, and EC3 in a 2% O₂/98% He atmosphere at 580, 740 and 840°C, respectively). The IMPROV protocol defines OC as OC1 + OC2 + OC3 + OC4 and EC as EC1 + EC2 + EC3. The mass concentration of organic matter (OM) in the atmosphere was estimated by multiplying OC by 1.6 (conversion factor for urban aerosol). The total carbonaceous aerosol (TCA) was calculated as the sum of OM and EC. The highest concentration of OC and EC in PM_{2.5} was found in the BCCL colony site i.e. 37.85 and 42.33µg/m³, respectively, and the lowest OC concentration was 15.36µg/m³ and EC was 13.08µg/m³ in Sindri site. In comparison, the concentration of OC (67.35µg/m³) and EC (81.67µg/m³) in PM₁₀ were higher in the BCCL colony among all the sites. The lowest OC concentration as 17.95µg/m³ was in Bastacola and EC in Parbatpur i.e. 15.44µg/m³ (Figure 3.10).

3.3.7. Carbonaceous Aerosol/EC & OC in winter

The mass concentration of EC and OC in PM₁₀ and PM_{2.5} are more significant than 100µg/m³ and 70µg/m³, respectively in Bastacola, Katras, Mine Rescue, Background, and Sindri. The highest concentration of EC in PM₁₀ and PM_{2.5} was observed in the Sindri site, whereas OC was found higher in Sindri and Bastacola. OC contributing to PM₁₀ mass concentration was lowest in

Harina followed by Lohapatti and Patherdih. In the case of PM_{2.5}, Parbatpur was found to have the lowest concentration among other sites.

The higher mean concentration of EC and OC in winter were likely related to the influence of emissions from residential heating (in addition to traffic source) and, on the other hand, to the unfavourable meteorological conditions leading to more excellent dispersion of pollutants in the atmosphere during this season. Elemental carbon is emitted directly into the atmosphere during incomplete combustion emissions, such as motor vehicle exhaust, fuel burning, and biomass burning (Figure 3.11).

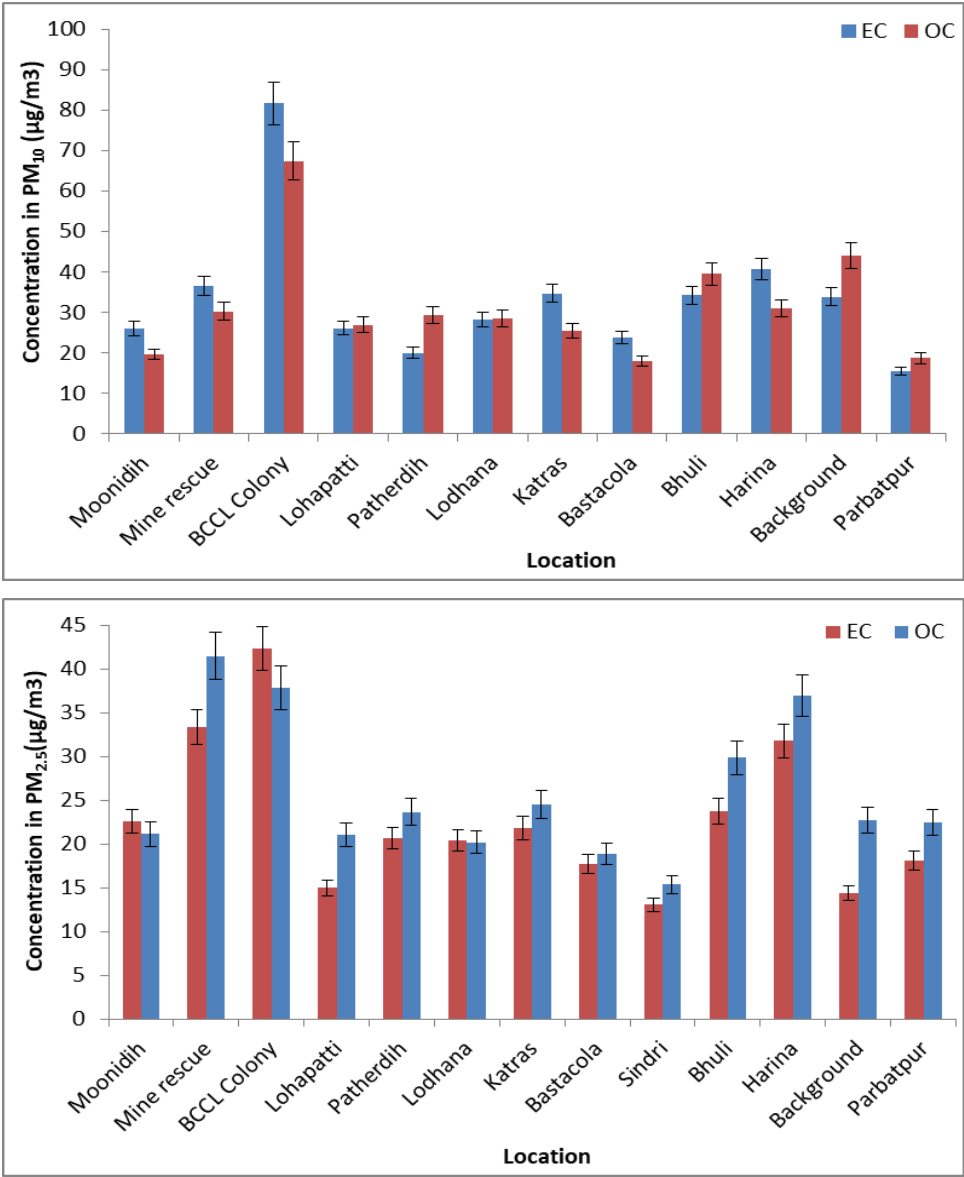


Figure 3.10: EC & OC concentration in PM₁₀ and PM_{2.5} in Summer season

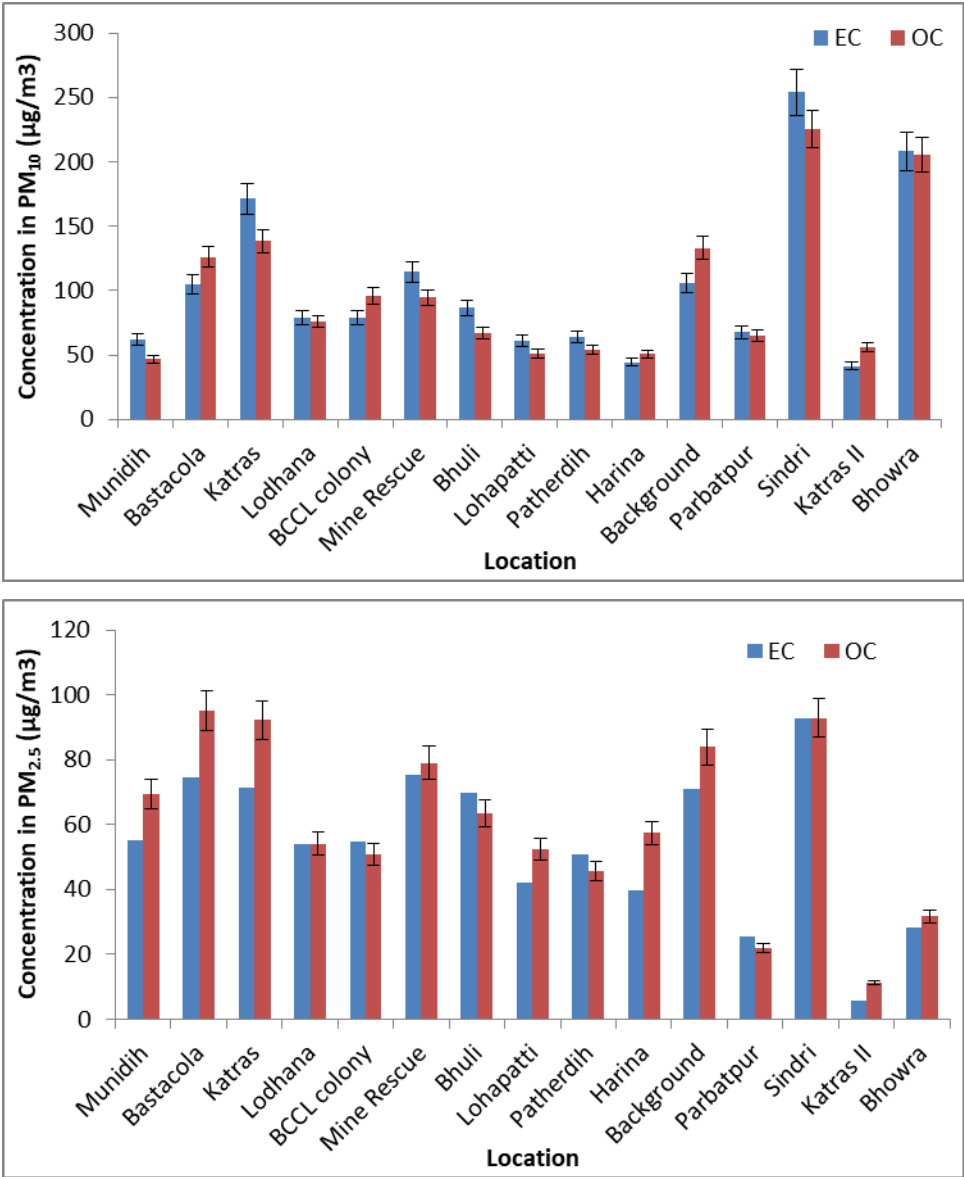


Figure 3.11: EC & OC concentration in PM₁₀ and PM_{2.5} in Winter Season

3.3.8. Ionic composition of PM₁₀ and PM_{2.5} in Summer season

The anions (SO_4^{2-} , NO_3^- and Cl^-) and cations (NH_4^+ , Na^+ , Ca^{2+} , K^+) are the water-soluble inorganic ions found in abundance. In summer, the mass concentration of SO_4^{2-} in PM_{10} was in the range of $1.06\text{-}20.17\mu\text{g}/\text{m}^3$ where a higher concentration was observed in Harina, BCCL colony, and Lodhana sites. Likewise, NO_3^- was in the range of $0.32\text{-}19.2\mu\text{g}/\text{m}^3$ with the highest in the Harina site. PO_4^{3-} and Cl^- concentration was highest in Harina and $< 2\mu\text{g}/\text{m}^3$ in other locations. NH_4^+ was in the range of $0.75\text{-}16.24\mu\text{g}/\text{m}^3$, Harina with the highest concentration, and Bastacola with the lowest concentration. Na^+ concentration ($0.18\text{-}8.6\mu\text{g}/\text{m}^3$) was highest in Harina followed by BCCL colony and less than $2\mu\text{g}/\text{m}^3$ in remaining sites. Ca^{2+} concentration ($1.5\text{-}11.77\mu\text{g}/\text{m}^3$) was highest in Lohapatti and BCCL colony while lowest in Katras. K^+ ion was also observed in the Harina site with a concentration of $5.85\mu\text{g}/\text{m}^3$ (Figure 3.12).

The mass concentration of SO_4^{2-} in $\text{PM}_{2.5}$ was highest in Patherdih with a concentration of $15.13\mu\text{g}/\text{m}^3$ and lowest in Bhuli. In Bastacola site, the concentration of NO_3^- ($2.85\mu\text{g}/\text{m}^3$), Cl^- ($2.04\mu\text{g}/\text{m}^3$), K^+ ($1.84\mu\text{g}/\text{m}^3$) were the highest among the other sites. Ca^{2+} ($6.17\mu\text{g}/\text{m}^3$) and Mg^{2+} ($0.57\mu\text{g}/\text{m}^3$) concentration was highest in Lohapatti site (Figure 3.13).

3.3.9. Ionic composition of PM₁₀ and PM_{2.5} in Winter season

PM_{10} ions concentration in Bastacola and Background were highest among all the monitoring

sites which followed the increasing order of $\text{Na}^+ < \text{Mg}^{2+} < \text{F}^- < \text{K}^+ < \text{Ca}^{2+} < \text{Cl}^- < \text{NH}_4^+ < \text{SO}_4^{2-} < \text{NO}_3^-$. It has been observed that SO_4^{2-} , NO_3^- and NH_4^+ ions were present in abundant in PM_{10} mass concentration, and concentration of NO_3^- in these sites contributes majorly to PM_{10} . Ions concentration in Katras, Lohapatti, and Bhuli sites were observed having lower ionic concentration Figure 3.14.

The ionic composition of $\text{PM}_{2.5}$ comprises mainly of SO_4^{2-} , NO_3^- , Cl^- , NH_4^+ , Ca^{2+} and K^+ ions. Locations such as Bastacola and Parbatpur have higher concentration of ions compared to remaining sites in following order: $\text{Mg}^{2+} < \text{Na}^+ < \text{Ca}^{2+} < \text{K}^+ < \text{Cl}^- < \text{NH}_4^+ < \text{SO}_4^{2-} < \text{NO}_3^-$. The same trend has been observed i.e. SO_4^{2-} , NO_3^- and NH_4^+ ions contribute mainly in $\text{PM}_{2.5}$ mass concentration. The average concentration of SO_4^{2-} and NO_3^- in winter was higher than in summer.

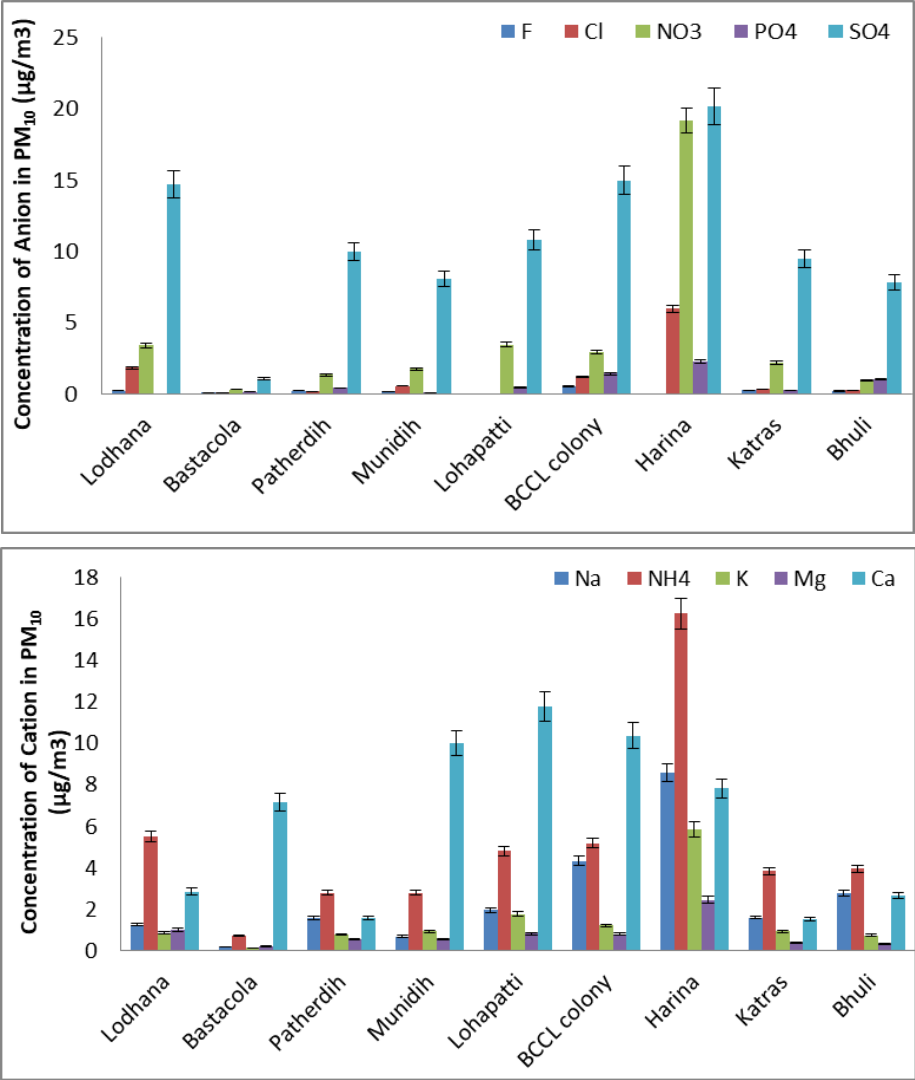


Figure 3.12: Anion and Cation concentration in PM_{10} in summer

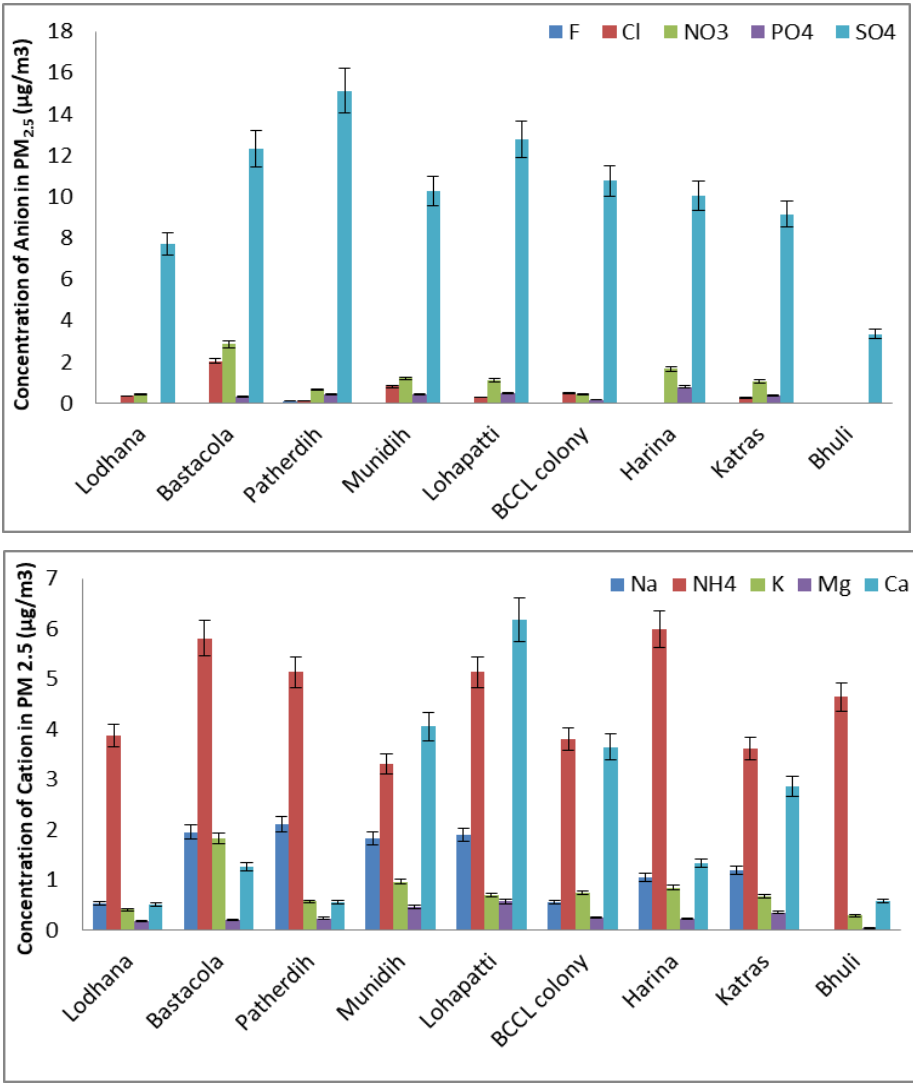


Figure 3.13: Anion and Cation concentration in $PM_{2.5}$ in summer

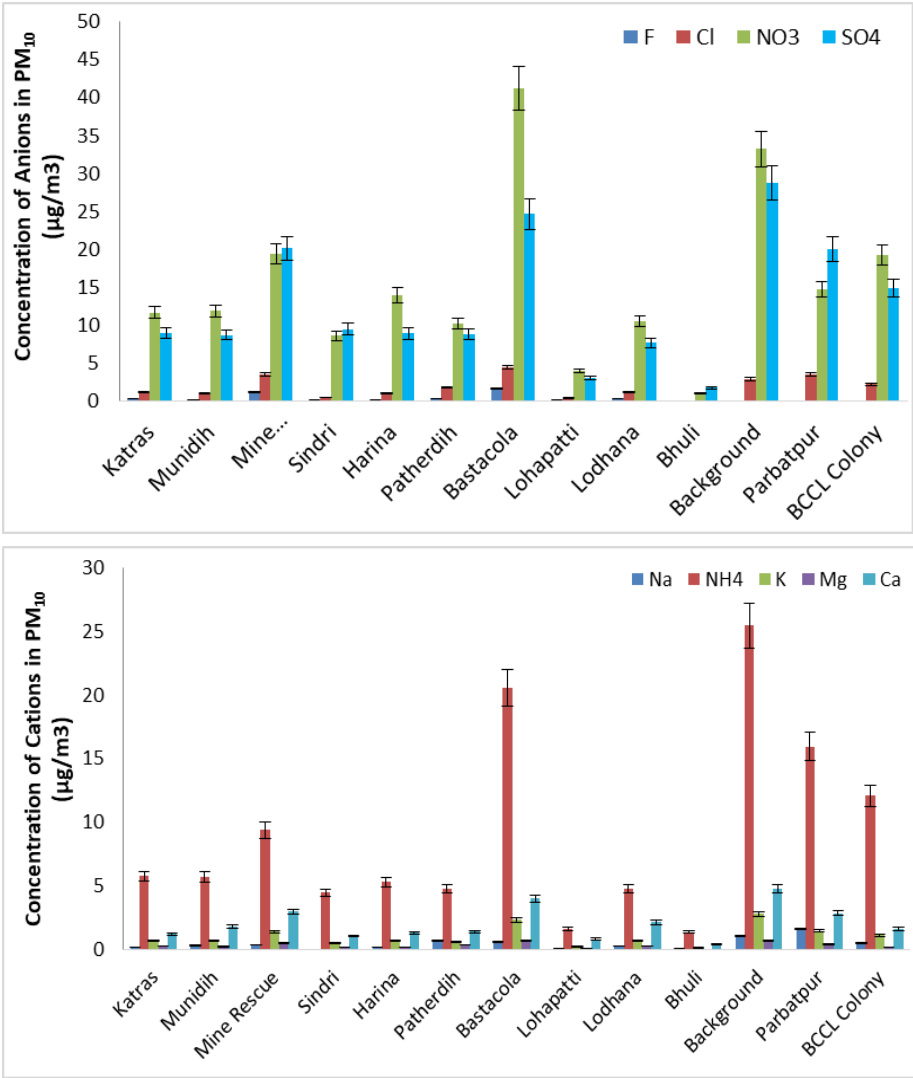


Figure 3.14: Anion and Cation concentration in PM_{10} in winter

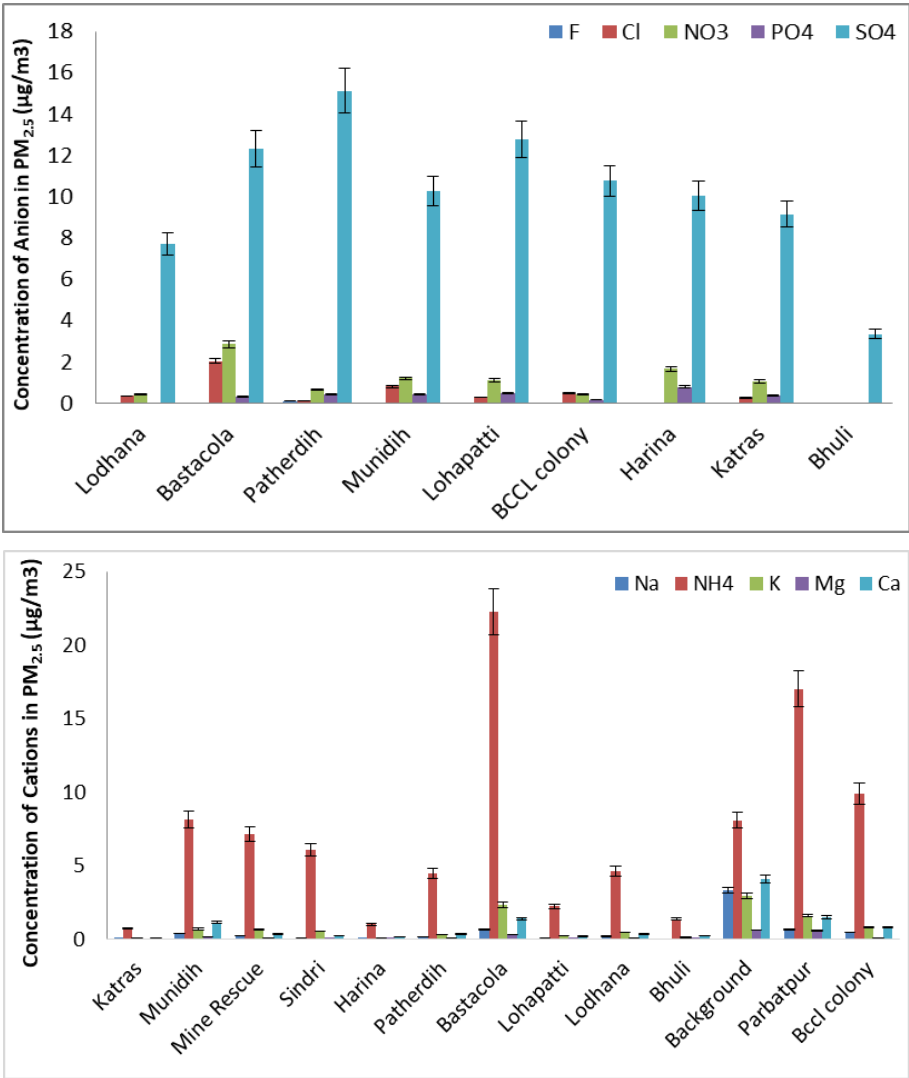


Figure 3.15: Anion and Cation concentration in $\text{PM}_{2.5}$ in winter

Chapter 4 Receptor modelling

4.1. Source Apportionment

The source apportionment study was carried out to identify the potential sources contributing to the particulate matter of aerodynamic size less than 10 μm in the Jharia coalfield (JCF) using a receptor modelling approach. In receptor modelling, the particulate matter (PM_{10}) characterization in terms of metal, ions, elementary and organic carbon profiles is statistically matched with that of various source profiles in the study area. For the source apportionment study of JCF, the area is divided into various zones (buffer, core and background zone). And the ambient PM_{10} characterization obtained from the multiple monitoring locations in the study area is conflated and compared with source profiles viz. industrial (mining and non-mining) and allied industrial activities, transportation, local vehicular movement and domestic fuel (coal wood burning, etc.). The chemical mass balance (CMB) model EPA-CMB v8.2 is one of the several receptor models and is most trusted for coarse and fine particulate matter source apportionment. The CMB model estimates source contributions by determining the best linear combination of emission source profiles and the chemical composition of ambient particulate, aerosol, and volatile organic compound samples. The study is studying the apportionment of particulate matter is considered owing to the nature of high particulate matter pollution in the study area. The source apportionment study is useful for devising an effective action plan for abatement of emission load in the region; thereby the region's overall air quality can be improved.

Jharia is one of the eight blocks in Dhanbad and is the main source of metallurgical coal in India, and is termed as the powerhouse of the country owing to its best quality coking coal, which is required by the steel and other industries in India. Dhanbad lies between $23^{\circ}37'3''$ N and $24^{\circ}4''$ N latitude and between $86^{\circ}6'30''$ E and $86^{\circ}50''$ E longitude with an average elevation of 222 m. Its geographical length, extending from North to South, is 43 miles and width 47 miles, stretching across East to West. It shares its boundaries with West-Bengal in the Eastern and Southern parts, Dumka and Giridih in the North, Bokaro in the west. It is the administrative headquarter of the district and Dhanbad Municipal Corporation (DMC).

The air quality status is determined by dividing the study area into background, core, and buffer zones. Thirteen sites were selected to represent various regions, including two references or background sites. The sampling locations are shown in Figure 3.1.

4.1.1. Chemical Mass Balance (CMB)

A mass balance equation can be written to account for all the chemical species in the samples as contributions from independent sources:

$$C_i = \sum_j m_j X_{ij} a_{ij} \quad 4.1$$

C_i is the concentration of species i measured at a receptor site (derived from the chemical analysis), X_{ij} is the i^{th} elemental concentration measured in the j^{th} sample, and m_j is the airborne mass concentration of material from the j^{th} source contributing to the j^{th} sample. The term a_{ij} is

included as an adjustment for any gain or loss of species i between the source and receptor. The term is assumed to be unity for most of the chemical species.

The CMB 8.2 software (USEPA 1997) is used in this study. It is windows-based software that requires input data on ambient (at receptor locations) and source profiles of PM characterization. The model runs multiple iterations to provide optimum goodness of fit among the sources and receptors and verifies the model with various checks viz. Chi-square statistic, t-tests, mass percentage, and correlation coefficient. The following assumptions should be understood before proceeding with the CMB analysis.

The CMB model assumptions are:

- The concentration of emissions sources is constant throughout ambient and source sampling;
- Chemical species do not react with each other (i.e., they add linearly);
- All sources with potential for contributing to the receptor have been identified and have had their emissions characterized;
- The number of sources or source categories is less than or equal to the number of species;
- The source profiles are linearly independent of each other; and
- Measurement uncertainties are random, uncorrelated, and normally distributed.

The following steps are followed for running the CMB model:

- Identification of the contributing emission source types based on primary survey and emission inventory data collected around the monitoring sites.
- The selection of chemical species to be included in the CMB modelling calculation is based on the Central pollution control board (CPCB) guidelines.
- The source profiles with the fraction of each chemical species and uncertainty are withdrawn from the SPECIATE 5.1 database. SPECIATE 5.1 is US-EPA's repository of organic gas and particulate matter (PM) speciation profile of air pollution sources.
- Estimate ambient concentration (ambient data) is based on chemical analysis of the PM samples collected at the respective site during monitoring. The uncertainty of the chemical species is mainly based on the instrument uncertainty.
- The CMB 8.2 model run provides the solution of the chemical mass balance equation.

For source apportionment of PM_{10} , CMB 8.2 software (USEPA 1997) provides many goodness's of fit tests to verify the accuracy of the model. The normal checks, as specified in the manual by USEPA (1997) to accept the model are; t-statistics i.e., source contribution divided by the error of source contribution should be greater than 2, χ^2 (chi-square) is the weighted sum of squares of the differences between calculated and measured fitting species concentrations divided by the effective variance and the degrees of freedom, it should be less than 4. The weighting is inversely proportional to the squares of the precision in the source profiles and ambient data for each species. Ideally, χ^2 would be zero, there would be no difference between calculated and measured species concentrations. The χ^2 less than one indicate a very good fit for the data. Values greater than 4 indicate that one or more of the fitting species concentrations are

not well-explained by the source contribution estimates (SCE). The source contribution estimate approximates the total mass concentration which is a convenient check on the %mass explained value. When the SCE is less than its standard error, the source contribution is undetectable. Two or three times the standard error may be taken as the upper limit of the SCE in this case. Assuming that the errors are normally distributed, there is about a 66% probability that the true source contribution is within one standard error and about a 95% probability that the true concentration is within two standard errors of the SCE.

R^2 is determined by the linear regression of the measured versus model-calculated values for the fitting species. R^2 ranges from 0 to 1. The closer the value is to 1.0, the better the SCEs explain the measured concentrations. When R^2 is less than 0.8, the SCEs does not explain the observations very well with the given source profiles. The percentage mass explained should be between 80% and 120%, the ratio of the computed and the measured concentration of each element (C/M ratio) should be close to 1 and R/U ratio, i.e., the ratio of residuals to uncertainty should be less than 2. As the model requires the source contribution estimates and receptor concentrations in ambient air, the significant sources in the area need to be identified first. The investigation of sources of PM_{10} to be accounted for in the CMB model is carried out using emission inventory studies.

4.1.2. Source profiling

The Chemical profile needs to be developed for the air-polluting source as input to the receptor-oriented source apportionment models like CMB8.2 (chemical mass balance). The U.S Environmental Protection Agency's (EPA) SPECIATE database and several studies carried out in other parts of the world provide an extensive collection of source profiles. The source profiles required in this study are extracted from SPECIATE5.1 the database.

The source of the particulate matter in JCF accompanies various coal handling activities such as opencast coal mining and its associated activities, thermal power stations, automobiles, generator sets fuel burning, construction activities, domestic coal, cooking gas burning, etc. and even the background contribution of natural dust (crustal origin) cannot be ruled out, particularly, in the zones having loose topsoil (Roy and Singh 2014). So, the sources profiles considered here are coal dust, coal combustion, road dust, heavy vehicle diesel, light vehicle gasoline, etc.

4.1.3. Ambient profiling

As discussed in Chapter 3, the samples collected from the sampling location undergo chemical characterization. The species obtained from the chemical analysis used in ambient profile structuring and the uncertainty is based on the instrument.

The overall methodology used in the source apportionment study is depicted by the flow diagram as follows:

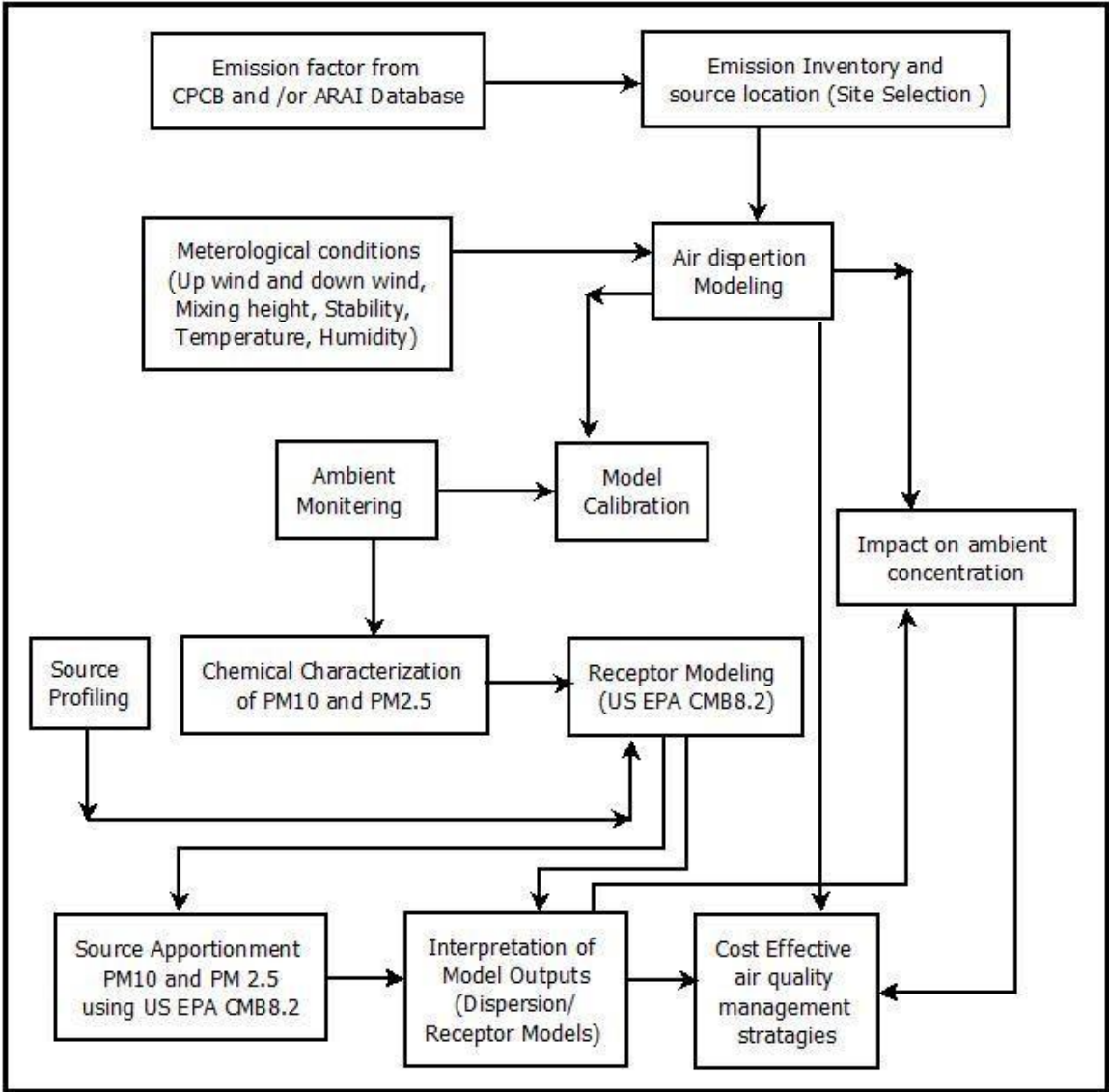


Figure 4.1: General methodology followed in the source apportionment studies

4.2. Results of the Chemical Mass Balance

CMB8.2 is performed for all the air quality monitoring locations. The significant sources in the area are identified first based on the field surveys. The general category of sources included in the model for all the sites are composites of all the vehicular sources, domestic combustion, road dust, agricultural waste burning, Industries, etc (Summary of relevant air quality studies from major Indian cities is given in Table 4.1). However, the choice of sources varies concerning the activities prevailing in the area and CMB model performance. A similar approach also applies to the selection of species. Efforts were made to include as many species in the model as possible. The choice was, however, restricted based on model performance. The source contributions are shown in the following Figures 4.3. The CMB model performance with respect to various sources is shown in Annexure 1.

4.2.1. Domestic combustion

In the summer season, the foremost emission source was domestic combustion for PM₁₀ and PM_{2.5}. The domestic combustion percentage was observed at 22% and 25% for PM₁₀ and PM_{2.5} in the summer season. In the winter season, domestic combustion contribution was the second most percentage contributor for PM₁₀ and PM_{2.5}. The PM₁₀ percentage was 23% while the PM_{2.5}

percentage contribution was 28% in this season. The higher concentration of Cl^- , F^- , Cr, and Br. Cl^- and F^- are the markers of coal-burning and wood-burning (Jain et al., 2020). High Br along with Cl^- suggests the contributions from coal combustion.

4.2.2. Industrial Emission

The industrial combustion percentage contribution observed 16% in PM_{10} and 13% in $\text{PM}_{2.5}$ in the summer season. In the winter season, contribution to industries is determined to be 15% in PM_{10} and 24% in $\text{PM}_{2.5}$. The abundances of elements like As, Zn, Fe, Cu, Cr, Pb, and S indicate the industrial source's emissions. Kumar et al. (2001) used Cu, Mn, and Ni as tracers for industrial emissions in Mumbai; Sharma et al. (2014b) used Cu, Cr, Mn, Ni, Co, and Zn as industrial emission tracers for metal manufacturing plants in Delhi; Kulshrestha et al. (2009) used a combination of Ni, Cu, Fe, and Cr as a marker for construction activities in Agra; and Karet al. (2010) used Zn, Cu, and Ni as tracers of galvanizing, metallurgy, and electroplating industries while Cr from tannery industry in Kolkata.

4.2.3. Coal Mining

Opencast coal mining activity comprises heavy-duty diesel vehicle usage, blasting, Coal handling and overburden management. During the summer season, the coal mining activity in PM_{10} and $\text{PM}_{2.5}$ is observed to be 8% and 7% respectively while in the winter season it contributes somewhat 6% and 5% in PM_{10} and $\text{PM}_{2.5}$ respectively.

4.2.4. Transportation

The overall transportation contribution is 25% for PM_{10} and 32% for $\text{PM}_{2.5}$ in the summer season. In the winter season, the transportation emission contribution is examined at 16% for PM_{10} and 18% for $\text{PM}_{2.5}$. The OC/EC ratio is a convenient diagnostic tool for investigating the sampling site and its emission sources. In the present study, the OC/EC ratio shows significant seasonal variations for a coarser fraction of PM than for a finer fraction. It is well established that OC/EC ratio values between 1.4 and 4 indicate emissions from gasoline catalyst vehicles and 0.3 to 1 suggest diesel vehicle emissions (Amato et al., 2016; Cesari et al., 2018). Assessing the ratio of $\text{nss-K}^+/\text{EC}$ is another diagnostic check for estimating the relative loading of vehicular emissions, where nss-K^+ is a non-sea-salt water-soluble potassium ion (calculated as $\text{K}^+ - 0.129\text{Na}^+$) (Andreae and Merlet, 2001).

4.2.5. Secondary Inorganic Aerosol

During summer, the secondary inorganic aerosol contribution to PM_{10} and $\text{PM}_{2.5}$ is about 8% and 16%, respectively. Secondary inorganic aerosols contribution found in winter is about 14% and 17%, respectively for PM_{10} and $\text{PM}_{2.5}$. The secondary inorganic aerosol source is a high concentration of nitrate (NO_3^-), sulphate (SO_4^{2-}), and ammonium ((NH_4^+)). These secondary products are formed in the atmosphere, being emitted either by natural or anthropogenic sources. The oxidation of NO_x forms the secondary nitrate. It is favoured by low temperature (Li et al. 2004), while high temperature and strong solar radiations favour the formation of secondary sulfates through photochemical reactions (Seinfeld and Pandis, 2016). Secondary inorganic aerosol formation from precursors (SO_2 and NO_2) enhances the pollution burden over the

vicinity. Biomass burning, the presence of metal traces (Fe, Al, Mn, Zn, Cr etc.) from vehicular or industrial emission play a key role to neutralise the oxides of nitrogen and sulphur and thus raises the amount of secondary inorganic aerosols in the atmosphere.

4.2.6. Agriculture

The agriculture contribution observed that 5% for PM₁₀ and 2% for PM_{2.5} in the study period during the summer season. In the winter season, the contribution is 3% and 2% for PM₁₀ and PM_{2.5} respectively. Agricultural activities contribute ammonium to the atmosphere (Pant and Harrison, 2012; Jain et al., 2019). The OC and EC are also significant agricultural activity sources (Ram and Sarin 2011; Sharma et al. 2016a).

4.2.7. Open burning

The contribution of open burning in the summer season is 5% for both PM₁₀ and PM_{2.5}. In winter, the garbage burning contribution is 6% and 2% for PM₁₀ and PM_{2.5} respectively during study time. The abundance of tracers like K⁺, Pb, Br and considerable Cl⁻ marks this garbage/biomass burning source. K⁺ and levoglucosan are globally employed as biomass burning markers. Biomass consists of residential and agricultural wastes, post-harvest residue, cow dung, dry leaves, fuelwood, and wildfires (Almeida et al., 2006; Khare and Baruah, 2010; Shridhar et al., 2010). The OC and EC are also traced insignificant amounts along with K⁺, indicating the biomass burning emanations (Cesari et al., 2018; Sharma et al., 2014; Jain et al., 2018).

4.2.8. Road Resuspension dust

The re-suspension dust is a significant contributor to PM₁₀. The contribution of resuspension dust is during the summer season 12% while in the winter season the emission contribution is 10% for PM₁₀. In the summer season, resuspension dust's contribution is higher because of the high wind velocity and dry condition. The lower percentage contribution of road dust to fine particulate matter is attributed to substantial road dust particulates in coarse mode, found in other studies (Gupta et al., 2007; Masri et al., 2015). Crustal elements are significant constituents of airborne soil and re-suspension road dust. Generally, they contribute to coarse aerosols, including Al, Si, Ca, Ti, Mg, Fe, and Na used as tracers for soil dust or crustal re-suspension (Lough et al. 2005; Begum et al. 2011). The marker elements that have been used in India for the identification of soil dust include Al, Si, Ca, Ti, Fe, Pb, Cu, Cr, Ni, Co, and Mn (Sharma et al., 2017). Cu, Zn, and Ba are associated with road dust/re-suspension dust due to the release of these marker elements from cars and non-exhaust sources.

4.2.9. Other emission Contribution

Other area sources contributed in the summer season is 12% for PM₁₀ and 7% for PM_{2.5} during the study period. In the winter season, emission contribution is 14% for PM₁₀ and 9% for PM_{2.5}.

4.3 Inferences

The receptor modelling (CMB) results (Figure 4.3) revealed that the transport sector and domestic combustion are the predominant emission sources contributing to the receptor levels. During the summer season, the contribution of the transport sector was found maximum in both PM₁₀ (23%) and PM_{2.5} (30%) followed by the contribution of domestic combustion (17% and 23% for PM₁₀ & PM_{2.5} respectively). While in the winter season, the contribution of domestic combustion outruns the contribution of the transport sector. During the winter season, domestic combustion has contributed 22% (PM₁₀) and 28% (PM_{2.5}) whereas the transport sector has contributed 16% (PM₁₀) and 21% (PM_{2.5}) of the total emission.

After transport sector and domestic combustion, Industrial emission (12% of PM₁₀ emission) and Road Resuspension (12% of PM₁₀ emission) followed by Coal mining activity and secondary inorganic aerosol formation (both 8%) are contributing majorly to PM₁₀ emission at receptor during the summer season.

In PM_{2.5} source contribution, secondary inorganic aerosol formation contributed majorly (16% & 15% in summer and winter seasons respectively) after domestic combustion and transport sector. Secondary inorganic aerosol formation from precursors (SO₂ and NO₂) enhances the pollution burden over the vicinity. Biomass burning, the presence of metal traces (Fe, Al, Mn, Zn, Cr etc.) from vehicular or industrial emission play a key role to neutralise the oxides of nitrogen and sulphur and thus raises the amount of secondary inorganic aerosols in the atmosphere.

Industrial activity contributed 12% and 11% of total PM₁₀ load in summer and winter respectively but in the case of finer dust (PM_{2.5}), it contributed 17% in the winter season at the receptor level. This may be due to the calm winter conditions that allow finer dust (PM_{2.5}) to settle near to ground than that of summer conditions that allow more turbulence mixing in the atmosphere.

Road re-suspension of dust contributes significantly in PM₁₀ load at receptor both in summer (12%) and in winter (8%). As these are larger and heavier particles, they contribute to PM₁₀ fraction and are not found in PM_{2.5} fraction at the receptor.

After the contribution of the industrial sector, coal-mining activity contributed around 8% and 6% of the total PM₁₀ receptor dust load during summer and winter respectively. In the case of PM_{2.5} dust load at the receptor, coal-mining activity contributed 7% and 5% during summer and winter respectively.

From the results and analysis of receptor modelling, it can be summarised that mitigation and abatement of the emissions from domestic combustion and transport sector alone may reduce receptor dust load by 40% (approx.).

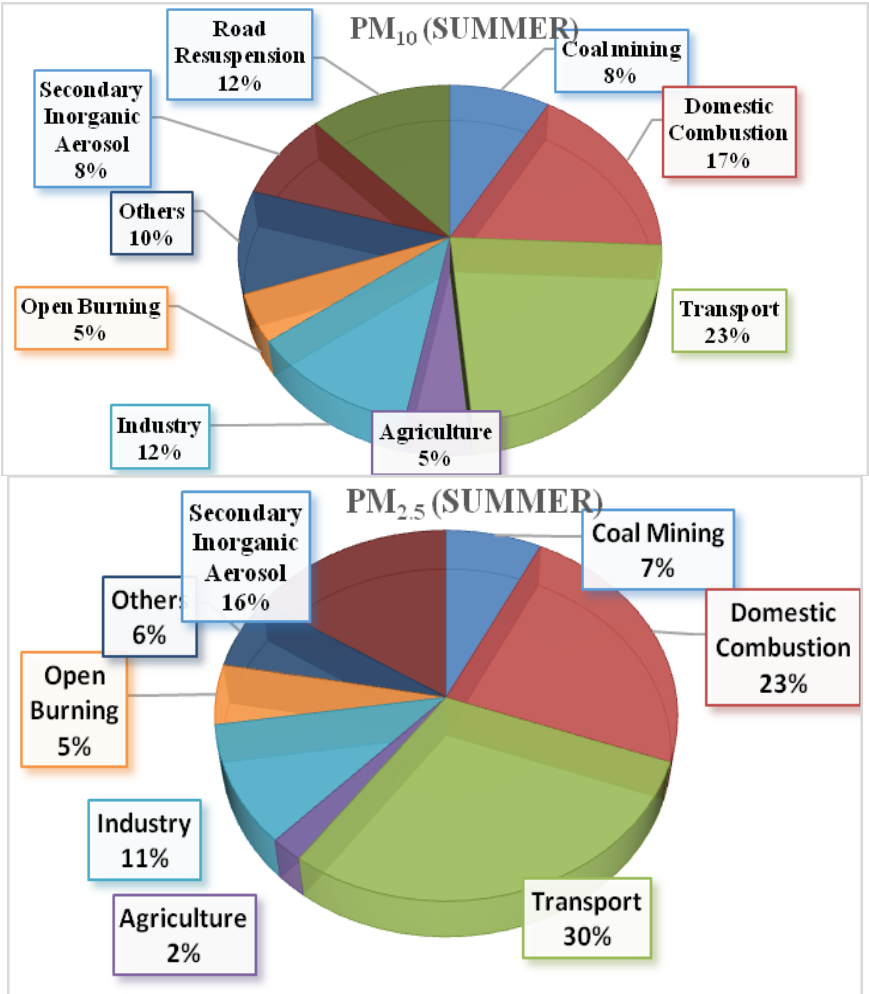


Figure 4.2: Source contribution at receptor locations of PM₁₀ and PM_{2.5} in summer

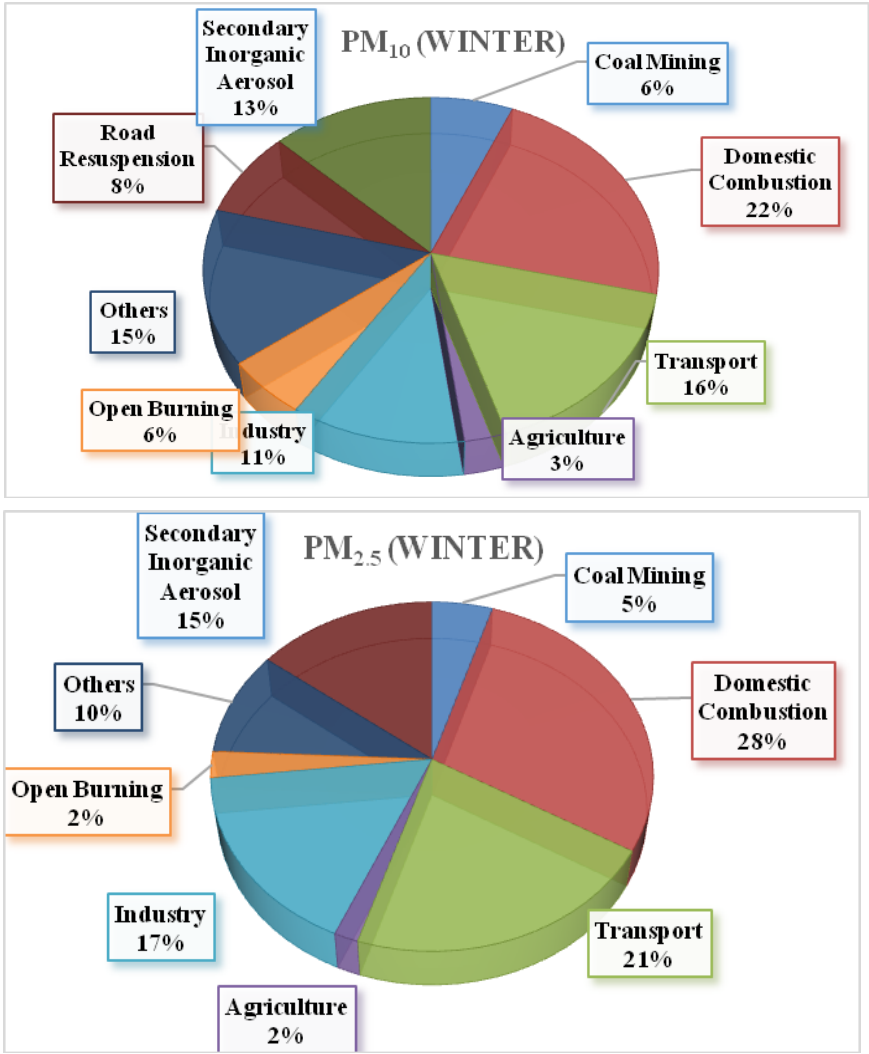


Figure 4.3: Source contribution at receptor locations of PM₁₀ and PM_{2.5} in winter

Table 4.1: Summary of relevant air quality studies from major Indian cities.

Area/Location	Particle size	Sources	Elements and Ions	References
Delhi	PM ₁₀ and PM _{2.5}	Secondary Nitrate, Secondary Sulfate, Vehicular emission, Biomass burning, Soil dust, Fossil fuel combustion, Sodium and magnesium salt, Industrial emission	Al, Mg, Ca, Ti, Fe, Cr, Mn, Zn, As, Pb, Br, M, F ⁻ , Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , K ⁺ , NH ₄ ⁺ , and Na ⁺	Jain et. Al., 2020
Mangalore	PM ₁₀ and PM _{2.5}	Construction dust, Diesel generator, Tyre wear emission, Brake lining emission, Sand dust emission, gasoline vehicle emission, Diesel vehicle emission, Unpaved and paved road emission, Biomass burning, LPG stove emission, Solid fuel emission, Ferrous and steel industries emission, Fabrication and welding emission, Kerosene stove emission	As, Ba, Cd, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sr, Zn, F ⁻ , Cl ⁻ , NO ₃ ⁻ , PO ₄ ³⁻ , SO ₄ ²⁻ , Na ⁺ , K ⁺ , Mg ²⁺ and Ca ²⁺	G. Kalaiarasan et al. 2018
Delhi NCR	PM ₁₀ and PM _{2.5}	Dust construction, Vehicle emission, Biomass Burning, Industrial emission, Secondary Pollutants, DG sets emission,	Al, Si, P, S, Cl, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ca, F ⁻ , Cl ⁻ , NO ₃ ⁻ , Br ⁻ , NO ₂ ⁻ , SO ₄ ²⁻ , Na ⁺ , K ⁺ , Mg ²⁺ and Ca ²⁺	Report No. ARAI/16- 17/DHI-SA- NCR/Final Report August 2018
Delhi	PM _{2.5}	Secondary Aerosol, Vehicular emission, Biomass burning, Soil dust, Fossil fuel combustion, Sea salt, Industrial emission	Al, Mg, S, Si, Cl, K, Ca, Ti, Cu, Mn, Fe, Zn, Br, Cr, As, Pb, F ⁻ , Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , K ⁺ , NH ₄ ⁺ , and Na ⁺	Jain et. Al., 2017
Nagpur	PM _{2.5}	DG sets, biomass burning, resuspended dust, secondary aerosol and mobile sources.	Al, Ba, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Si, Zn. F ⁻ , Cl ⁻ , NO ₃ ⁻ , PO ₄ ³⁻ , SO ₄ ²⁻ , Na ⁺ , K ⁺ , Mg ²⁺ and Ca ²⁺	Pipalatkar et al., 2014
Raipur	PM _{2.5}	Brick kiln process, steel re- rolling mills, steel processing industries, biomass burning, metallurgical industrial emissions and coal burning	Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, S, Sb, Se, V, Zn, Na ⁺ , K ⁺ , Mg ²⁺ NH ₄ ⁺ , F ⁻ , Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , and Ca ²⁺	Matawle et al., 2014
Hyderabad	PM ₁₀ and PM _{2.5}	Vehicles exhaust, resuspension of dust, secondary sulfates, secondary nitrates, biomass	Na, Mg, K, Al, Si, Ca, Fe, Cl, SO ₄ ²⁻ , NO ₃ , NH ₄ ⁺	Guttikunda et al., 2013

		burning, coal burning.		
Pune	PM ₁₀ and PM _{2.5}	Vehicles, DG sets, construction dust, solid fuels emissions, resuspended dust	Al, Pb, Cu, Zn, As, Se, Br, Ni, Fe, Mn, Mg, Cr, Ti, Ca, Cd, S, Si, Na, Ba, Sb, Cd, Sr, Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , K ⁺ , NH ₄ ⁺	ARAI, 2010
Kanpur	PM ₁₀ and PM _{2.5}	Vehicles, open burn, road dust, domestic wood, coal and LPG, metal smelting, DG sets.	Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , K ⁺ , NH ₄ ⁺ , Na ⁺ , Ca ²⁺ , Mg ²⁺ , Si, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Cd, Sn, Sb, Pb	CPCB, 2010b
Mumbai	PM ₁₀ and PM _{2.5}	Wood combustion, Fuel oil combustion, kerosene combustion, biomass burning, LPG, ammonium sulfate, ammonium nitrate, heavy duty diesel vehicles emissions, soil dust.	Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La, Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb. F ⁻ , Cl ⁻ , Br ⁻ , NO ₂ ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , K ⁺ , NH ₄ ⁺ , Na ⁺ , Ca ²⁺ , Mg ²⁺	CPCB, 2010a
Chennai	PM ₁₀ and PM _{2.5}	Vehicles, DG sets, bakeries, soil dust, construction dust, paved road dust, kerosene and LPG emissions.	As, Ag, Ca, Na, Fe, Mg, Cu, Zn and other metals. Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , K ⁺ , NH ₄ ⁺ , Na ⁺ , Mg ²⁺	IIT Madras, 2010
Bangalore	PM ₁₀ and PM _{2.5}	Petrol vehicles, diesel vehicles, secondary particulates, fuel oil burning, wood domestic wood burning, DG set, kerosene generator set, paved road dust re suspension, soil dust.	Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La, Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb. F ⁻ , Cl ⁻ , Br ⁻ , NO ₂ ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , Na ⁺ , K ⁺ , Mg ²⁺ and Ca ²⁺	TERI, 2010

DG - Diesel generators; LPG - Liquefied petroleum gas; OC - Organic carbon; EC - Elemental carbon.

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Chapter 5 Dispersion Modelling

Air quality modeling includes four major processes (a) emission of pollutants, (b) transportation of the pollutants due to mean wind profile (c) chemical transformations and (d) deposition/removal. In the present study the particulate matter emissions, transportation and dispersion are carried out using the AERMOD model, which is developed by USEPA. AERMOD model estimates the spatial profile of pollutants based on the Gaussian plume equation, which is an analytical solution to the steady-state approximation of the advection-diffusion phenomenon. The boundary conditions about the atmospheric mixing height and other thermodynamic vertical profiles for the simulations are derived from the mesoscale model. The model relies on the atmospheric stability classes for deriving the dispersion coefficients across the multiple dimensions with respect to the distance away from the sources. In this study, only the ground level concentrations of the particulate matter are simulated during the study period. The study domain envelops the Jharia Coal Fields situated in the Jharkhand state of India. The methodology followed in the present study is shown in Figure 5.1. The southwest part of the Dhanbad City shares borders with the study area, but the majority of emission load used in the study is included from the JCF.

5.1. Wind data analysis

The nearest IMD (India Meteorological Department) observations are at Patna and Kolkata, which are approximate >150km from the study area. Hence, hourly meteorological observations required for the study for the AERMOD dispersion model were simulated through the Weather Research and Forecast, version-3.9 (WRF), which is a meteorological model that dynamically downscales the global NCAR/UCAR meteorological data to the regional level data (www.mmm.ucar.edu). Nested domains of grid resolution 12km and 4km, respectively were laid over the study area for simulation of hourly meteorological variables using the WRF model (Figure 5.2). Hourly meteorological data, including both the surface variables and upper atmosphere variables, were simulated for the study period viz. 23 May to 12 June 2019 and 23 January to 12 February 2020, representing the summer and winter seasons, respectively.

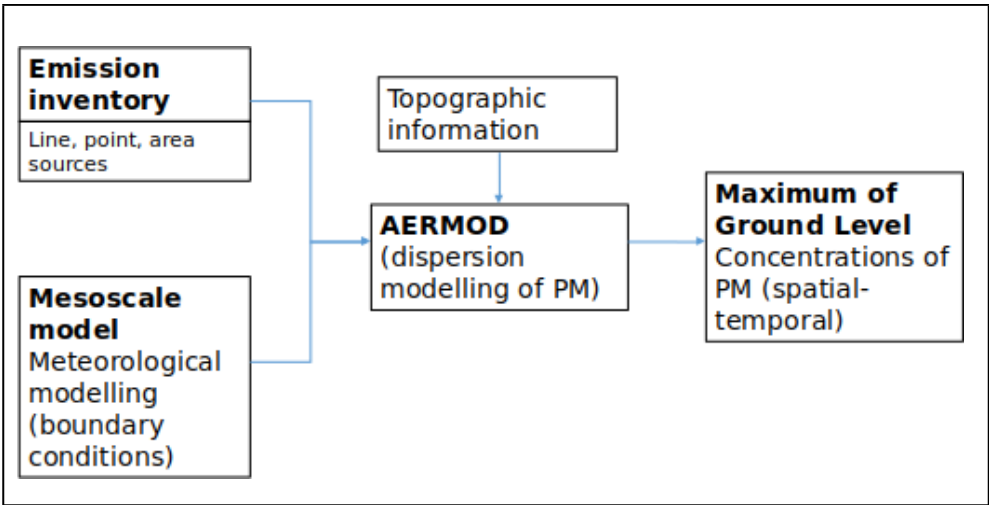


Figure 5.1: Methodology followed in the study.

The mesoscale model interface program MMIF (<https://www.epa.gov/>) converter tool was used

to convert the inner domain’s gridded WRF model simulated meteorological data into a format suitable for the AERMOD model. The AERMOD receptor grid covering the study area is shown in Figure 5.3. A Cartesian receptor grid having 21 rows and 21 columns with a resolution of 2000 m was laid for the simulation of particulate matter dispersion /concentration at the receptor locations. Overall there are 20 grids in each direction covering an area of 40 km by 40 km enveloping the JCF.

The spatial pattern of the predominant wind profile over the study area is plotted using the windrose diagrams for the summer (March to May 2019) and winter season (November 2019 to February 2020), shown in Figures 5.2 and 5.3, respectively. Results show that the study area is experiencing the predominant wind (having high frequency) flow from east to west direction followed by north-west to south-east direction during summer, while in winter the predominant wind direction is from north to south. The wind speeds vary in the range of 0.5 to 11.1m/s during the summer predominantly in the range of 2.1 to 3.6m/s whereas wind speeds vary in the range of 0.5 to 8.8m/s during the winter, predominantly in the range of 2.1 to 3.6m/s.

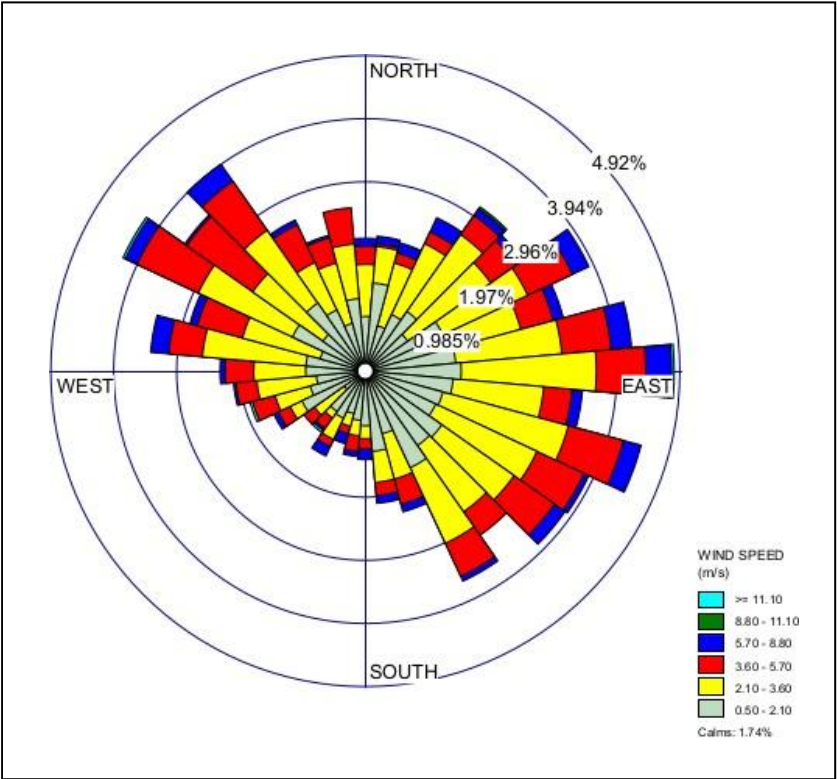


Figure 5.2: Windrose of the study area during March-June, 2019 (wind direction blowing towards the center)

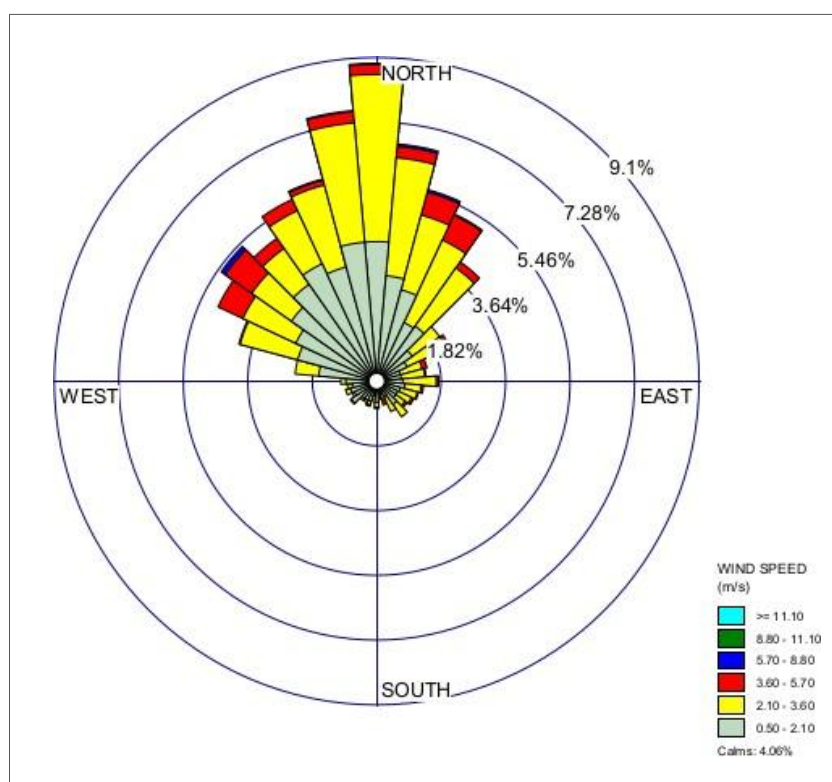


Figure 5.3: Windrose of the study area during November-December 2019 (wind direction blowing towards the centre)

5.2. Dispersion of Particulate matter

Spatial profiles of maximum ground-level concentrations of 24-hour average values of PM_{10} and $PM_{2.5}$ were simulated using the AERMOD Gaussian plume model. The emission rates of particulate matter from multiple source types including the point, line, and area were derived from the field monitoring of the emission inventory. Point sources mainly include the emissions from the industries situated in the study area that mainly use coke/coal as the fuel. The line sources include the emissions from the vehicular exhaust. Emission inventory of traffic pollution was carried out in the study area by noting down the vehicular activity. The vehicular activity of different vehicular types such as trucks, light motor vehicles, three-wheeled vehicles, motorbikes, etc. was multiplied by the corresponding emission factors for the estimation of gaseous pollution. The summation of emissions from all vehicle types adds to the overall line sources contributing to the pollution load in the study area. The area sources include emissions from the open cast mining emissions (including all the activities in the mine premises) and domestic burning (including emissions from crematoria, bakeries, open eat-outs, restaurants, chulha burning from the slum, etc.).

The emissions in grams per second were calculated from the emission inventory survey, for the line and point sources. Whereas, the emission rates in $g/s/m^2$ were calculated for the area sources including mining. These emission rates from each source type have been computed in the study area and fed into the AERMOD model domain for the simulation of spatial average concentrations of PM_{10} and $PM_{2.5}$. In the present study, the maximum GLC (ground level concentrations, in $\mu g/m^3$) was simulated at several receptor grid locations in AERMOD domains. The AERMOD model was run during the sampling period in May 2019 and November 2019, representing the pre-monsoon and post-monsoon seasons, respectively.

Analysis of WRF model simulated wind speed and direction data shows that the wind is

predominantly flowing from south-east direction to north-west direction, followed by the reversal in the direction, during the monitoring in summer, representing pre-monsoon conditions (Figure 5.5). The wind speeds during the monitoring period in summer month varied between 0.5 and 8.8m/s. During the monitoring period in winter (post-monsoon), the wind predominantly flowed from the north-east to south-west direction having wind speeds in the range of 0.5 to 3.6m/s (Figure 5.5).

The wind blowing from different directions in the study area determines the direction of pollution dispersion. The Gaussian plume equation used in the AERMOD model estimates the diffusion and advection of the pollutants concerning the emission rates and meteorology (wind speed, direction and atmospheric stability categories). The model simulated maximum ground level concentration of the particulate matter (PM_{10} and $PM_{2.5}$) in the study area covering the JCF is shown through the isopleths. The isopleths (contours connecting the regions with the same ground level concentration in the context of the present study) of maximum GLC of PM_{10} and $PM_{2.5}$ were observed to form a pattern according to the predominant wind directions flowing in different monitoring seasons. It is observed that the line sources in the study area have contributed the maximum to the surface GLC of PM_{10} , following the open cast mines. The AERMOD model simulated the value of GLC of PM_{10} due to line sources, open cast mines, and all sources are 927, 286, and 978 $\mu\text{g}/\text{m}^3$, respectively, for the summer season. The $PM_{2.5}$ maximum GLC contributed by the line sources, open cast mines, and all sources included are 809, 143, and 835 $\mu\text{g}/\text{m}^3$, respectively. It is evident from the result that the line sources are significantly contributing to the overall particulate pollution in the study area during summer. The analysis of the PM_{10} and its maximum GLC simulated by the AERMOD model for the winter season also follows a similar pattern as of summer. The contribution of line sources, open cast mines, and all sources included are 1565, 597, and 1679 $\mu\text{g}/\text{m}^3$, respectively. The $PM_{2.5}$ maximum GLCs during the winter are 1004, 299, 1167 $\mu\text{g}/\text{m}^3$ as contributed by line, open cast mines, and all sources including, respectively. Based on the emission inventory and the prevailing meteorological conditions during the winter season have in general contributed to the higher particulate matter than that of the summer season.

Pockets of maximum concentrations of PM_{10} (200-1000 $\mu\text{g}/\text{m}^3$ and above) are observed in the vicinity to roads nearer to the open cast mines south of Dhanbad City during the winter (Figure 5.5). The localities of the high concentrations of PM_{10} are Sabji Patti road and Sudamdih mine area, which is reflected in the figure. The area covering the Dhanbad city and the mines situated in the southwest have PM_{10} concentrations in the range of 200-900 $\mu\text{g}/\text{m}^3$. The fringes of the JCF have recorded the PM_{10} concentrations in the range of 100-250 $\mu\text{g}/\text{m}^3$. In contrast, the PM_{10} concentrations for the summer season have significantly lower and the majority of the study area have $PM_{10} < 100\mu\text{g}/\text{m}^3$, however, the area extending from south of Dhanbad City and Sudamdih mine have relatively high PM_{10} concentration in the range of 100-500 $\mu\text{g}/\text{m}^3$. Baghmara and Sonardih mine area in the west of Dhanbad City have also been observed to have high GLC of PM_{10} in the range of 100-500 $\mu\text{g}/\text{m}^3$.

A similar pattern of the spatial distribution of $PM_{2.5}$ is reflected as of PM_{10} . As the underlying meteorological conditions are the same for both the PM_{10} and $PM_{2.5}$ simulations the

spatial pattern is nearly similar. High concentrations of $PM_{2.5}$ ($100-500\mu g/m^3$) are observed in the southwest direction of Dhanbad City (Figure 5.6). The maximum GLC of PM_{10} is found to be higher than $PM_{2.5}$ during both the monitoring seasons, and higher concentrations are observed during the winter season. The prevailing winter meteorology in the region has lower wind speeds and mixing heights, which poses an unfavorable situation for the dispersion of particulate matter, hence containing a high chance of accumulation of airborne pollutants. The significant contribution of particulate matter from the line sources is observed in the study area, followed by the area sources (from open cast mining, domestic burning, bakeries, open eat-outs, and restaurants). The locations of the highly polluted can be interpreted from the images shown in Figures 5.6 (a) and 5.6 (b) for devising realistic and grass-root level mitigation strategies.

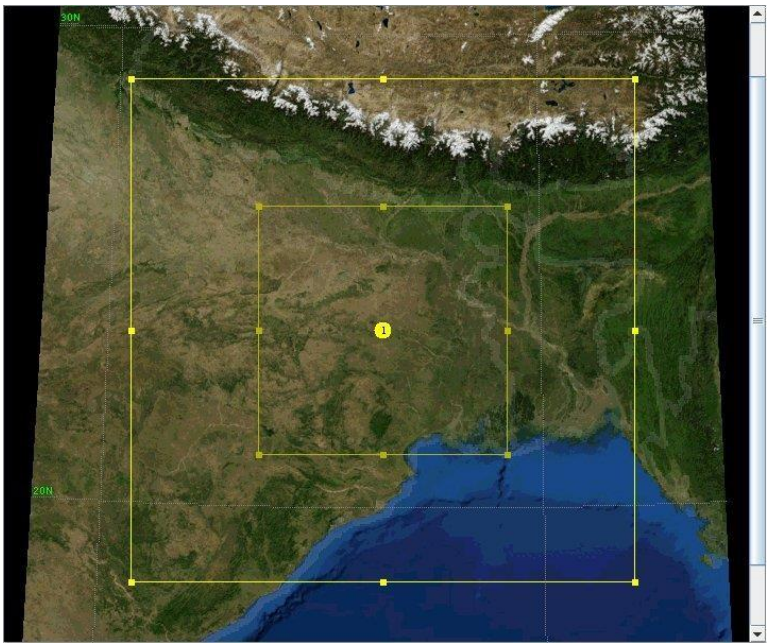


Figure 5.4: AERMOD grid covering the Jharia Coal Fields (JCF). The line, area, and point sources covered in the study are indicated in red color. The UTM coordinates of the left bottom point are $x=406111$ and $y=2603492$, and the coordinates of the right top point are $x=456248$ and $y=2653417$.

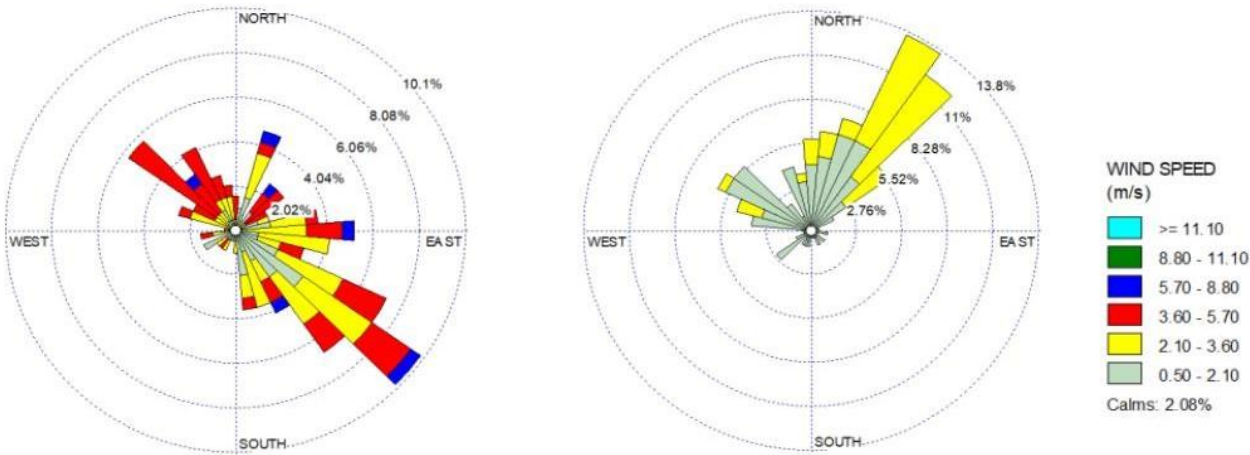


Figure 5.5: Windrose diagram for the summer (left) and winter seasons (right) at Jharia Coal Fields during the sampling period. Wind direction is flowing towards the centre.

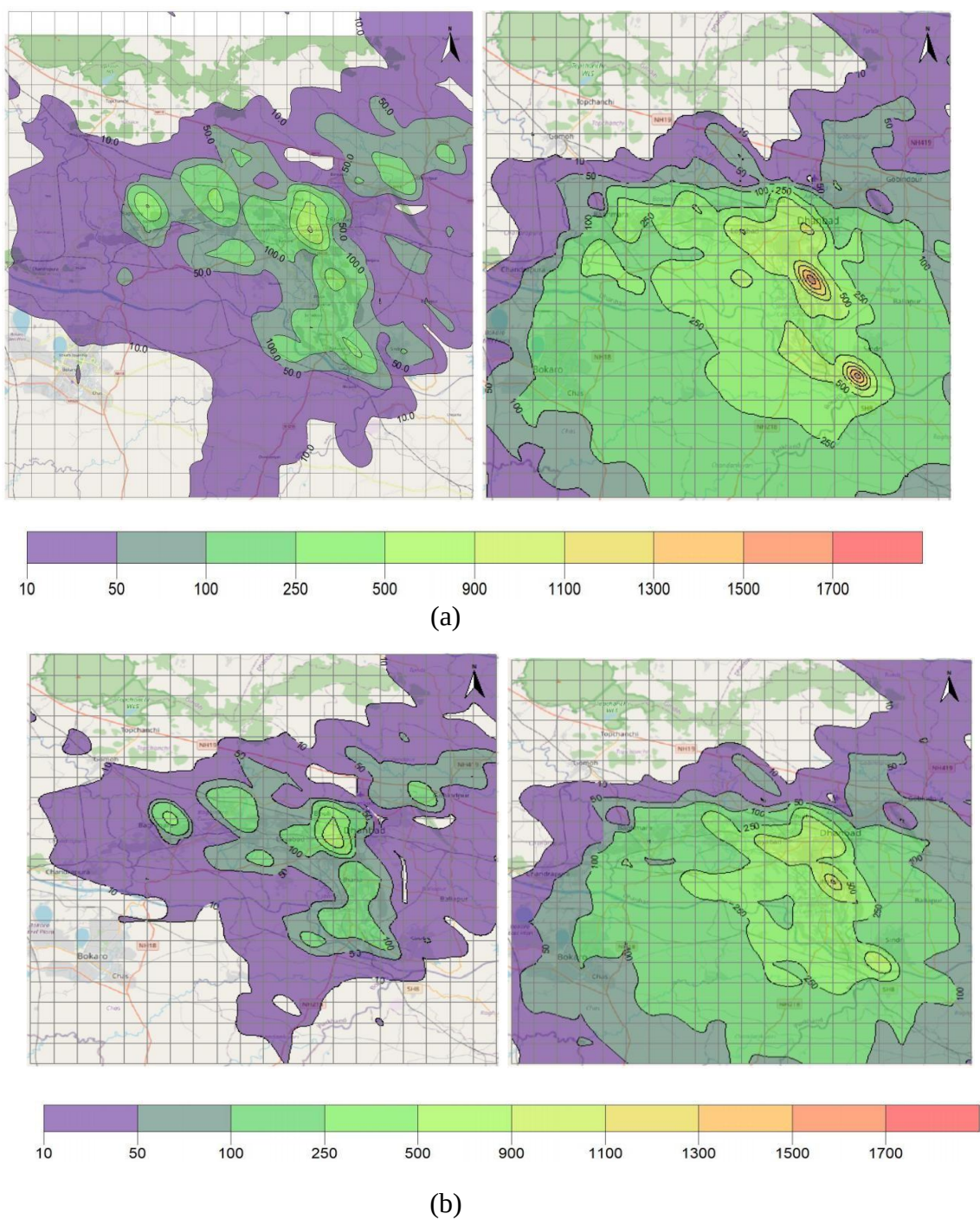


Figure 5.6: 24-hour average maximum ground level concentration of PM contours in the study area simulated during the study periods in summer (left) and winter (right) seasons (a) PM₁₀ ($\mu\text{g}/\text{m}^3$) and (b) PM_{2.5} ($\mu\text{g}/\text{m}^3$)

5.3 Validation of the model

Comparison between the model simulated period average PM and the measured PM concentrations was made to determine the overall efficiency of the dispersion model. In the present study, the model validation metrics viz. mean bias (MB), normalized mean bias (NMB), mean gross error (MGE), normalized mean gross error (NMGE), and Pearson’s correlation (r) were calculated for PM₁₀ and PM_{2.5} separately including data of both seasons. At some of the monitoring locations like Mines Rescue, Katras, Patherdih, Harina, Lodhna, and Lohapatti the discrepancies between the modeled and observed data were found to be high, for both summer and winter seasons. At remaining locations for both seasons, the results indicate an acceptable/fair degree of model performance in simulating the particulate dispersion. Results show that the correlation coefficient between the measured and modeled PM₁₀ is 0.6, which is

fair enough in environmental open systems, similarly, for $PM_{2.5}$ the correlation value is around 0.7 (Table 5.1).

Table 5.1 Performance Stimulation Metric

Model metric	PM_{10}	$PM_{2.5}$
MB	-19.46	20.67
NMB	-0.11	0.24
NMGE	0.32	0.37
Correlation Coefficient	0.6	0.7

The NMB values are observed to be lower for PM_{10} (-0.11) than $PM_{2.5}$ (0.24), which indicates the slight negative bias in PM_{10} simulations (under-prediction of the concentrations) and positive bias in $PM_{2.5}$ (over-prediction of the concentrations). Whereas, the NMGE for both PM_{10} and $PM_{2.5}$ are 0.32 and 0.37, respectively, which indicates the variation in the model simulations deviate around 30% from the mean values on average (which is a result due to some extreme values in the simulations). However, this discrepancy could be minimized if long-term simulations are carried out, which is highly computationally intensive. Nevertheless, the model performance metrics in terms of correlation and normalized mean gross error infer that the model could capture the spatial profile of the particulate matter distribution to a good extent.

Chapter 6 Recommendation

6.1. Mine industries

1. The project proponent might consider installing conveyor systems for transporting the coal from the coal handling plant to the railway siding or to the nearest thermal power plant (if feasible).
2. A sufficient number of plants should be planted around the mine pit to arrest the movement of particulate matter or dust into the surrounding areas.
3. Scientific studies might be necessary to design a green belt with an optimized dimension of plot size and direction as per the prevailing meteorology. Similar studies are required to design a wind barrier for optimized benefits.
4. Adequate dust control measures should be in place, like mechanized sweeping, water sprinkling or mist spraying systems on the haul roads and at loading sites. Long-range misting or fogging canons are also should be in place.
5. Dust suppression measures at all operations of mining should be ensured.
6. Ensuring the complete coverage of the trucks and railway wagons that carry coal with a tarpaulin sheet is necessary.
7. In the long-run mobilization of closed trucks to carry the coal is preferable.
8. The coal transport roads should not be left with open curb sides. End to end covering up of curb side is essential to avoid the re-suspension of coal due to the truck movement.

6.2. Area Sources

Area sources are mainly domestic sources of fuel (coal, wood, kerosene, LPG) burning, trash/MSW combustion, bakeries, hotels/restaurants etc. and re-suspension of dust. Based on the survey and assessment, the following recommendations emerge:

1. Construction and demolition of buildings in the urban area give high local dust contribution resulting health problems. These practices need to follow compliance guidelines to reduce emissions.
2. Road and pavement should be well constructed to suppress road dust. The standard specifications and code of practice for road construction should be followed and implemented as per the Indian Road Congress (IRC) guidelines or international standard guidelines.
3. Strategically placed green cover in urban and semi-urban areas can help to improve local air quality.
4. Manage agricultural residues, including strict enforcement of bans on open burning
5. Strictly enforce bans on the open burning of household waste.
6. Use clean fuels – electricity, natural gas, liquefied petroleum gas (LPG) in cities, and LPG and advanced biomass cooking and heating stoves in rural areas; substitution of coal by briquettes
7. Use incentives to improve the energy efficiency of household appliances, buildings, lighting, heating and cooling; encourage roof-top solar installations
8. Promote the use of electric vehicles

9. Encourage centralized waste collection with source separation and treatment, including gas utilization.
10. There is a substantial population that also uses available coal. These houses could be given a combination of improved chulla or free/subsidised power for cooking purposes.
11. Hotels and dhabas need to be educated and compulsorily asked to use LPG for its cooking purposes.
12. The trash and MSW burning is very common. Some of the places contain a mix of plastics and thermocol. The combustion of these materials is very harmful to human health.
13. Coal depot pollution is due to open storage and unregulated buying, selling and transportation. These coal depots are responsible for nearby air pollution peaks. However, the contribution of the same need to be assessed.

6.3. Line Source

The vehicular sector in cities has been seen to be a major source of gaseous and fine particulate matter. The action plan for this sector would need a combination of efforts:

1. Vehicle inspection and maintenance: Enforce mandatory checks and repairs for vehicles.
2. Improved public transport: Encourage a shift from private passenger vehicles to public transport.
3. Set up a mechanism of Inspection and Maintenance programme for all vehicles in the district through RTO with automated system assessment.
4. The Inspection & Maintenance (I & M) centre shall also test all vehicles for their inbuilt emission tests.
5. All commercial vehicles should be phased out after 8 years of age or subjected to two years extension after rigorous I&M tests
6. All private vehicles should be subjected to proper assessment and fitness tests through I&M centres.
7. All autos and buses shall also be subjected to I&M tests
8. Dhanbad city does not have a designated place for truck parking and maintenance related activities. A separate designated place should be allocated to prevent illegal parking and repair shops on the roads and kerbside.
9. Dhanbad city does not have a designated place for Auto-rikshaw. A separate designated place should provide to prevent traffic congestion and control vehicle emission.
10. Major haul trucks with heavy loads should not pass through the main city. The plan being made should be implemented in the next 1-1.5 years.
11. Overloading is a common phenomenon in the region resulting in poor road quality. This can be avoided through online checking when vehicles leave industries with a guarantee that the vehicle is not carrying more material than its designated loads.

6.4. Others

- There is a need to explore various options for controlling air pollutants to tackle increased emissions in future.
- The local authority should stress sustainable and affordable public transport keeping clean air goals in mind.
- Frequent (time to time) arrangement of campaign/awareness programmes for lawmakers, stakeholders, health professionals, academicians to brainstorm about the future scenario and importance of clean air.
- Strategic installation of continuous air quality monitoring systems at various locations of urban, semi-urban and rural areas to check the existing air quality and information dissemination to the general public.

Annexure -1

[A] Cumulative receptor sample of PM₁₀ for source profiling with fitting parameters

Source contribution estimate	Source profiles	Std Error	R-square	Chi-square
82.7% mass	Unpaved road	0.056	0.96	2.41
	Coal combustion	0.643		
	Light Duty vehicle	1.60		
	Heavy Diesel vehicle	2.19		
	Residential combustion	5.59		
	Iron and steel industry	7.16		
	Agriculture soil dust	0.212		
	Solid waste	1.37		

[B] Cumulative receptor sample of PM_{2.5} for source profiling with fitting parameters

Source contribution estimate	Source profiles	Std Error	R-square	Chi-square
88.1% mass	Residential combustion	3.34	0.98	2.44
	Coal combustion	0.094		
	Light Duty vehicle	0.30		
	Heavy Diesel vehicle	1.91		
	Agriculture soil dust	0.10		
	Flyash	0.51		

Annexure -2

Emission Inventory Data

Name of Mine:

S.no	Operation	Quantity Kg/day	Type of fuel & quantity (litre/day)	Moisture content %	Silt content %	Details
Point source						
1	Drilling					Hole dia ---mm & Frequency ---/day
2	Blasting					----/day
3.	Overburden loading					Drop height ----m; Frequency -----/day
4	Coal loading					Drop height ----m; Frequency -----/day
5	Overburden unloading					Drop height -----m; Frequency ----/day
6	Coal unloading					Drop height ----m; Frequency -----/day
7	Top soil removal					
8	Crushing					
9	DG sets					
Line source						
10	Transfer of coal through haul road					Average speed ----- km/hr & frequency -----/day Distance ---- km Width -----m
11	Transfer of OB through haul road					Average speed -----km/hr & frequency -----/day Distance -----km
12	Transport road					Average speed -----km/hr Distance ----- km
13	Haul Road length (km)					-----Km
Area Source						
14	Stockyard					Unloading freq. -----/day & Coal Loading -----T/day Area ----- m ²
15	Workshop (m ²)					Area
16	Exposed pit (km ²)					
17	Colony					Fuel for cooking :-----



**WATER QUALITY REPORT
OF
BHARAT COKING COAL LIMITED, CLUSTER
– XIII**

**(FOR THE Q.E. DECEMBER 2025)
E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.**



CMPDI

ISO 9001 Company
**Regional Institute-II
Dhanbad, Jharkhand**

CLUSTER - XIII

(FOR THE Q.E. DECEMBER 2025)

CONTENTS

SL. NO.	CHAPTER	PARTICULARS
1.		EXECUTIVE SUMMARY
2.	CHAPTER - I	INTRODUCTION
3.	CHAPTER-II	WATER SAMPLING & ANALYSIS
4.	Plates: Plate No. - I	SURFACE PLAN SHOWING WATER MONITORING LOCATIONS

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affect the environment around us. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. One of these major attributes is water.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Water sampling stations

The Water sampling stations were selected for mine sump water, Ground water supply, well/ Hand pump water & also surface water samples.

3.0 Methodology of sampling and analysis

3.1 Water quality

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

4.0 Results and interpretations

4.1 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, IS.10500/2012 (Ground water) and IS: 2296 (Surface water), are within permissible limits

CHAPTER - I

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by the Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal Limited (BCCL), a subsidiary company of Coal India Limited (CIL) is operating UG Mines and Opencast Mines in Jharia Coalfield (JCF). The Jharia Coalfield (JCF) has an area of 450 Sq.KM.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and a well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdee. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by the Katri River & Damodar River.
- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from the Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

In compliance with these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC & SPCB and other statutory authorities.

CHAPTER – II

WATER QUALITY MONITORING

2.1 Location of sampling sites (Refer **Plate No. - I**)

- i) Ground Water quality at **Murlidih 20/21 (GW13)**
- iii) Surface Water quality at **U/S of Damodar River (SW29)**
- ii) Surface Water quality at **D/S of Damodar River (SW30)**
- iii) Mine Water Quality at Murlidih(20/21) (**MW13**)

2.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

2.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results show that most of the parameters are within the permissible limits.






CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

GROUND WATER ANALYSIS TEST REPORT

CMPDIL, RI-II

KOYLA BHAWAN COMPLEX

DHANBAD. -826005

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Month & Year	QUARTER ENDING DECEMBER 2025	Name of Cluster	CLUSTER XIII			ULR No.	TC143212600000242 4P
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	17.03.2026
Project	Murlidih	Sample Ref. No.	REM/BCCL/25-26/GW/	Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)		
Sampling Stations	GW13	Date of Sampling	17.11.2025	Sample Collected in 5 Ltr Jerricane , Color as observed is transparent			
			Period of Analysis	17.11.2025	to	04.02.2026	
Sl. No.	Parameter	Method of Analysis	Observed Values			IS 10500: 2012	
			GW13 G0215	Range Of Testing	LDL	Acceptable Limit (Max)*	Permissible Limit in the Absence of Alternate Source (Max)
1	Colour, Hazen unit	APHA, 24th edition ,2120-c-Spectrophotometric Single Wavelength Method, 2023	<1	1-500.0	1	5	15
2	Calcium, mg/l	IS 3025, (Part 40): 1991 R:2019,AAS-Flame Method & EDTA Method	98	2.0-800.0	2	75	200
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 , Argentometric Method	117	2.0-1500.0	5	250	1000
4	Fluoride, mg/l	APHA, 24th Edition, SPADNS Method	0.53	0.2-2.00	0.2	1	1.5
5	Iron, mg/l	IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame Method	<0.2	0.2-10	0.2	1	No relaxation
6	Magnesium	APHA 24th edition, 3500-Mg B: Calculation Method	109	6.0-700	6	30	100
7	Nitrate , mg/l	APHA, 24th edition, UV-Spectrophotometric Method	12.75	0.5-45.0	0.5	45	No relaxation
8	Odour	APHA, 24th Edition, , 2150-C	Agreeable	Qualitative	Qualitative	Agreeable	Agreeable
9	pH value	IS 3025, Part 11 : 1983 R 2023 Electrometric(pH Meter) Method	7.88	1-14	0.1	6.5-8.5	No relaxation
10	Sulphate, mg/l	APHA -24th edition, 4500 S , Turbidity Method	81	10.0-400.0	10	200	400
11	Taste	APHA,24th edition, 2160-C	Acceptable	Qualitative	Qualitative	Acceptable	Agreeable
12	Total Alkalinity (CaCO ₃), mg/l, Max	IS 3025, Part 23: 1986 R 2019 Titration Method	145	4.0-2000.0	4	200	600
13	Total Dissolved Solids, mg/l	IS 3025, Part 16: 1984 R 2023 Gravimetric method	827	25.0-5000.0	25	500	2000
14	Total Hardness, mg/l	IS 3025, (Part 21): 2019 EDTA Method	695	4.0-2000.0	4	200	600
15	Turbidity, NTU	IS 3025, (Part 10):1984, R-2023 Nephelometric/Turbiditometric Method	1.8	1-800	0.1	1	5
16	Zinc, mg/l	IS 3025(Part 49) : 1994,R:2019, AAS-Flame Method	<0.1	0.10 – 10.0	0.1	5	15



(Gaurav Kant)

REVIEWED BY



(Kumar Vaibhav)

Authorised Signatory

ANALYSED BY

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

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---- End of Report ----



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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
GROUND WATER ANALYSIS TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
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Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		CLUSTER XIII					
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)								Date of Issue	17.03.2026
Project		Murlidih			Sample Ref. No.		REM/BCCL/25-26/GW/		Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)	
Sampling Stations		GW13		Date of Sampling		17.11.2025		Sample Collected in 5 Ltr Jerricane , Color as observed is transparent			
					Period of Analysis			17.11.2025		to	04.02.2026
Sl. No.	Parameter	Method of Analysis			Observed Values					IS 10500: 2012	
					GW13		Range Of Testing	LDL	Acceptable Limit (Max)*	Permissible Limit in the Absence of Alternate Source (Max)	
1	Boron (as B), mg/l, Max	APHA, 24th edition ,Carmine			<0.2		0.2-10	0.2	0.5	1	
2	Copper (as Cu), mg/l, Max	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA			<0.01		0.01-10.0	0.01	0.05	1.5	
3	Free Residual Chlorine, mg/l, Min	APHA, 24th Edition, , 4500-Cl- B. (Iodometric Method-I)			<0.04		0.04-5	0.04	0.2	1	
4	Lead (as Pb), mg/l, Max	IS:3025(Part 47):1994 (Reaffirmed 2019) APHA, 24th edition, AAS-GTA			<0.005		0.005-10	0.005	0.01	No relaxation	
5	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 24th Edition,4-Amino Autipyrine			<0.001		0.001-10	0.001	0.002	0.002	
6	Selenium, mg/l, Max	APHA 24th edition IS-3025,part 56:2003, R-2019/, AAS-VGA			<0.007		0.007-10	0.007	0.01	No relaxation	
7	Total Arsenic (as As), mg/l, Max	IS-3025,part 37:1988, R-2019/ APHA 24th edition AAS-VGA			<0.006		0.006-10	0.006	0.01	0.05	
8	Total Chromium (as Cr), mg/l, Max	IS-3025 Part 52:2003, R:2019,AAS-Flame APHA, 24th edition, AAS-GTA			<0.01		0.01-10.0	0.01	0.05	No relaxation	
9	Nickel as Ni, mg/l Max	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA			<0.005		0.005-10	0.005	0.02	No relaxation	
10	Manganese as Mn, mg/l, Max	APHA, 24 TH Edition:2023 AAS-GTA Method			<0.02		0.02-10.0	0.02	0.1	0.3	

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

(Signature)

(Signature)

(Signature)

(Gaurav Kant)

REVIEWED BY

(Kumar Vaibhav)

ANALYSED BY

Authorised Signatory

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
SURFACE WATER ANALYSIS TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone: 0326-223-850
email: rdri2.cmpdi@coalindia.in

Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		XIII & XIV		ULR No.	TC1432126000002457P TC1432126000002458P		
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	17.03.2026		
Project		Sample Ref. No.			REM/BCCL/25-26/SW /		Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13			
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV) (SW29)			Date of Sampling		29.12.2025		Period of Analysis	
		(ii)	Downstream in Damodar River(SW30)			Date of Sampling		29.12.2025		29.12.2025 TO 02.02.2026	
Sl. No.	Parameter	Method of Analysis			Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL		
					SW 29	SW 30 S00055					
1	BOD (3 days 27°C), mg/l	IS 3025 (Part 44) : 1993, R-2019 , 3 day incubation at 27°C			<2.0	<2.0	3	2.00-100.00	2		
2	Colour,Hazen Units	APHA 24th edition , 2120-B-:2023			1	1	10	1-500.0	1		
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 Argentometric Method			69	60	600	2.0-1500.0	5		
4	Copper, mg/l	IS 3025 (Part 42) : 1992 R : 2019, AAS-Flame Method			<0.2	<0.2	1.5	0.2-10.0	0.2		
5	Dissolved Oxygen, mg/L	IS 3025 (Part 38) : 1989, R:2003 Winkler Azide Method			6.5	6.4	4	1.0-10.0	0.1		
6	Fluoride, mg/l	APHA, 24th edition, SPADNS Method			0.41	0.61	1.5	0.2-2.00	0.2		
7	Hexavalent Chromium, mg/l	APHA 24th edition, 1,5-Diphenylcarbohydrazide Method IS 3025 (Part 52) : 2003,R-2019			<0.01	<0.01	0.05	0.01-1.4	0.01		
8	Iron, mg/l	IS 3025 (Part 53):2003,R:2019, AAS-Flame Method			<0.2	<0.2	50	0.2-10	0.2		
9	Nitrate , mg/l	APHA, 24th edition, UV-Spectrophotometric Method			7.83	7.17	50	0.5-45.0	0.5		
10	pH value	IS 3025, (Part 11) : 1983 R-2023 Electrometric (Ph Meter) method			7.58	7.51	6.5-8.5	1.0-14.0	2		
11	Sulphate, mg/l	APHA -24th edition,4500- S, Turbidity Method			49	50	400	10.0-400.0	10		
12	Total Dissolved Solids, mg/l	IS 3025, (Part 16): 1984 R-2023 Gravimetric method			293	268	1500	25.0-10000.0	25		
13	Zinc, mg/l	IS 3025(Part 49) : 1994, R : 2019, AAS-Flame Method			<0.1	<0.1	15	0.10 – 10.0	0.1		

****Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit**

*****All units in mg/L unless specified otherwise Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**

[Signature]
Gaurav Kant

(Gaurav Kant)

[Signature]
Kumar Vaibhav

(Kumar Vaibhav)

Analysed by

REVIEWED BY

Authorised Signatory

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email: rdri2.cmpdi@coalindia.in

Month & Year		QUARTER ENDING DECEMBER 2025	Name of Cluster	XIII &XIV			
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	17.03.2026
Project		Sample Ref. No.		REM/BCCL/25-26/SW /	Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV)Downstream of Jarian Nala(SW 01) (SW29)	Date of Sampling	29.12.2025	Period of Analysis	
		(ii)	Downstream in Damodar River(SW30)	Date of Sampling	29.12.2025	29.12.2025 TO 02.02.2026	
Sl. No.	Parameter	Method of Analysis	Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL
			SW 29	SW 30			
1	Arsenic (as As), mg/l, Max	IS-3025,Part 37:1988, R-2019/ APHA 24th edition AAS-VGA	<0.006	<0.006	0.2	0.006-10	0.006
2	Lead (as Pb), mg/l, Max	APHA, 24th edition, AAS-GTA	<0.005	<0.005	0.1	0.005-10	0.005
3	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 24th Edition 4-Amino Antipyrine	<0.002	<0.002	0.005	0.002-10	0.002
4	Selenium, mg/l, Max	IS-3025 ,Part 56:2003, R-2019/ APHA 24th edition, AAS-VGA	<0.007	<0.007	0.05	0.007-10	0.007

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit

***All units in mg/L unless specified otherwise **Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**

(Gaurav Kant)

(Kumar Vaibhav)

Analysed by

REVIEWED BY

Authorised Signatory

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Environment Laboratory, Regional Institute-II
MINE EFFLUENT ANALYSIS TEST REPORT

CMPDIL, RI-II
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 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		CLUSTER XIII				ULR No.		TC1432126000002483P	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)								Date of Issue		17.03.2026	
Project		Murlidih 20/21			Sample Ref. No.		REM/BCCL/25-26/MW/		Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)			
Sampling Stations		MW13		Date of Sampling	22.12.2025		Sample Collected in 5 Ltr Jerricane , Color as observed is transparent						
						Period of Analysis			22.12.2025		TO	13.02.2026	
Sl. No.	Parameter			Method of Analysis			MW13 M1909	Range Of Testing	LDL		MOEF -SCH-VI STANDARDS Class ‘A’		
1	B.O.D (3 days 27°C), mg/l, Max			IS 3025 /44:1993,R:20033 day incubation at 27°C			<2.0	2-10000.0	2		30		
2	Colour			APHA,24th edition ,2120-B-:2023			1	1.0-500.0	1		-		
3	COD, mg/l, Max			APHA 24th edition 5220 C Titrimetric Method			36	4.0-800.0	4		250		
4	Copper (as Cu), mg/l, Max			IS 3025(Part42): 1992 R : 2019, AAS-Flame			<0.2	0.2-10.0	0.2		3		
5	Dissolved Phosphate (as P), mg/l, Max			IS 3025/ 31, 1988 R 2019			<0.1	0.1-5.0	0.1		5		
6	Fluoride (as F) mg/l, Max			APHA, 24th Edition, Page 4-90 to , 4500 – F- D (SPADNS Method)			0.65	0.2-2.0	0.2		2		
7	Hexavalent Chromium, mg/l, Max			IS 3025 (Part 52) : 2003,Reaffirmed 2019			<0.01	0.01-1.40	0.01		0.1		
8	Iron (as Fe), mg/l, Max			IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame			<0.2	0.2-10	0.2		3		
9	Manganese(as Mn), mg/l, Max			APHA, 24th edition, AAS-Flame			<0.1	0.1-10	0.1		0.1		
10	Nickel (as Ni), mg/l, Max			IS-3025(Part 54):2003, R:2019 AAS-Flame			<0.1	0.1-10.0	0.1		3		
11	Nitrate Nitrogen, mg/l, Max			APHA, 24th Edition,UV-Spectrphotometric			2.55	0.5-45	0.5		10		
12	Oil & Grease, mg/l, Max			IS 3025/39:1991, R : 2019, Partition Gravimetric			<4.0	2.0-1000	2		10		
13	pH value			IS-3025/11:1983, R-2023, Electrometric			8.01	1 -14	0.1		5.5 to 9.0		
14	Temperature (°C)			IS-3025/09:1984, Thermometric			22.5	1-100	.		Shall not exceed 5° C above the receiving temp.		
15	Total Chromium (as Cr), mg/l, Max			IS-3025(Part 52):2003, R:2019 AAS-Flame			<0.1	0.1-10.0	0.1		2		
16	Total Suspended Solids, mg/l, Max			IS 3025/17:1984, R :2023, Gravimetric			40	10-5000	10		100		
17	Zinc (as Zn), mg/l, Max			IS 3025 /49 : 1994, R : 2019, AAS-Flame			<0.1	0.1-10.0	0.1		5		
18	Odour			APHA, 24th Edition, , 2150-C			Agreeable	Qualitative	Qualitative		Qualitative		

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

 (Gaurav Kant) REVIEWED BY	 (Kumar Vaibhav) Authorised Signatory
 ANALYSED BY	

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Environment Laboratory, Regional Institute-II
MINE EFFLUENT ANALYSIS TEST REPORT

CMPDIL, RI-II
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email: rdri2cmpdi@coalindia.in

Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		CLUSTER XIII							
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue		17.03.2026		
Project		Murlidih 20/21			Sample Ref. No.		REM/BCCL/25-26/MW/		Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)			
Sampling Stations		MW13		Date of Sampling	22.12.2025		Sample Collected in 5 Ltr Jerricane , Color as observed is transparent						
						Period of Analysis			22.12.2025		TO	13.02.2026	
Sl. No.	Parameter		Method of Analysis										
						MW13	Range Of Testing	LDL		MOEF -SCH-VI STANDARDS Class 'A'			
1	Ammonical Nitrogen, mg/l, Max		IS 3025/34:1988,R : 2009, Nessler's			<0.02	0.02-100	0.02		50			
2	Arsenic (as As), mg/l, Max		IS-3025,part 37:1988, R-2019/ APHA 24th edition AAS-VGA			<0.006	0.006-5	0.006		0.2			
3	Free Ammonia, mg/l, Max		IS:3025/34:1988, Nessler's			<0.01	0.01-10	0.01		5			
4	Lead (as Pb), mg/l, Max		IS-3025(Part 59):2006, R 2023 AAS-GTA/APHA, 24 th Edition, 3111B, AAS-GTA			<0.005	0.005-10	0.005		2			
5	Phenolic compounds		APHA, 24th edition4-Amino Antipyrine			<0.002	0.002-5	0.002		1			
6	Selenium, mg/l, Max		IS-3025,part 56:2003, R-2019/ APHA 24th edition, AAS-VGA			<0.007	0.007-5	0.007		0.05			
7	Sulphide (as S ²⁻) mg/l Max.		APHA 24th edition Methylene Blue Method			<0.005	0.005-5	0.005		2			
8	Total Kjeldahl Nitrogen, mg/l, Max		IS:3025/34:1988, Nessler's			<1	1-200	1		100			
9	Total Residual Chlorine, mg/l, Max		APHA, 24th Edition, , 4500-Cl B. (Iodometric Method-I)			<0.04	0.04-5.00	0.04		1			

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

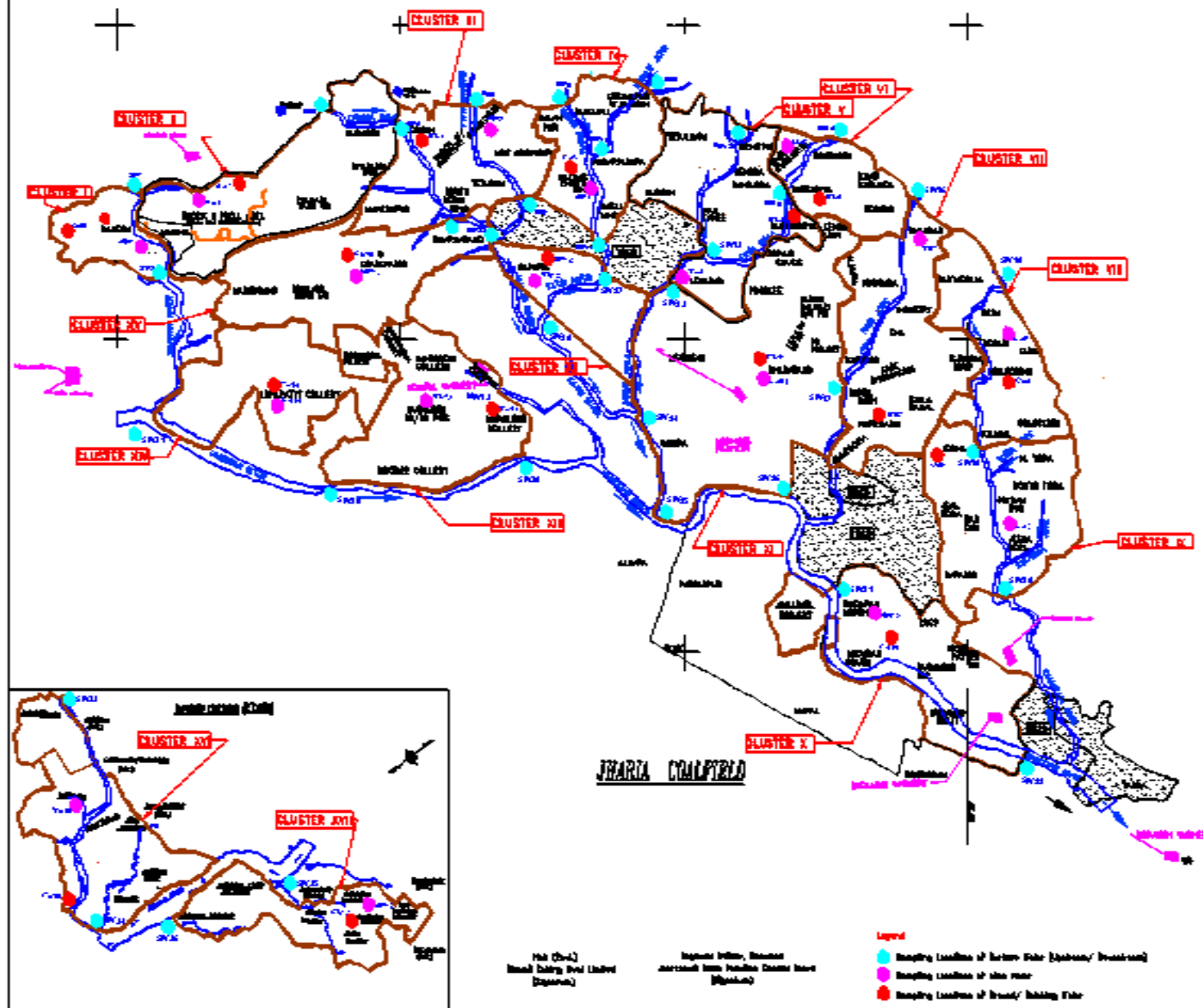
	 (Gaurav Kant) REVIEWED BY	 (Kumar Vaibhav) Authorised Signatory
ANALYSED BY		

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Water Sampling Locations in BCCL



INDEX

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THE BROWN ENGINE COMPANY

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WATER QUALITY REPORT OF BHARAT COKING COAL LIMITED CLUSTER – XIII

(FOR THE Q.E. MARCH 2026)
E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.



CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CLUSTER - XIII

(FOR THE Q.E. MARCH 2026)

CONTENTS

SL. NO.	CHAPTER	PARTICULARS
1.		EXECUTIVE SUMMARY
2.	CHAPTER - I	INTRODUCTION
3.	CHAPTER-II	WATER SAMPLING & ANALYSIS
4.	Plates: Plate No. - I	SURFACE PLAN SHOWING WATER MONITORING LOCATIONS

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affect the environment around us. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. One of these major attributes is water.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Water sampling stations

The Water sampling stations were selected for mine sump water, Ground water supply, well/ Hand pump water & also surface water samples.

3.0 Methodology of sampling and analysis

3.1 Water quality

Water samples were collected as per standard practice. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

4.0 Results and interpretations

4.1 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, IS.10500/2012 (Ground water) and IS: 2296 (Surface water), are within permissible limits.

CHAPTER - I

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by the Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal Limited (BCCL), a subsidiary company of Coal India Limited (CIL) is operating UG Mines and Opencast Mines in Jharia Coalfield (JCF). The Jharia Coalfield (JCF) has an area of 450 Sq.KM.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and a well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdee. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by the Katri River & Damodar River.
- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from the Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

In compliance with these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC & SPCB and other statutory authorities.

.....

CHAPTER – II

WATER QUALITY MONITORING

2.1 Location of sampling sites (Refer **Plate No. - I**)

- i) Ground Water quality at **Murlidih 20/21 (GW13)**
- ii) Surface Water quality at **U/S of Damodar River (SW29)**
- iii) Surface Water quality at **D/S of Damodar River (SW30)**

2.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

2.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results show that most of the parameters are within the permissible limits.



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Environment Laboratory, Regional Institute-II
GROUND WATER ANALYSIS TEST REPORT

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Month & Year	QUARTER ENDING MARCH 2026		Name of Cluster		CLUSTER XIII			ULR No.		TC1432126000002522P		
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue		16.05.2026		
Project	Murlidih			Sample Ref. No.		REM/BCCL/25-26/GW/		Sampling Method		CMPDI/RI-II/LPM 13,(IS 3025:Part -1)		
Sampling Stations	GW13		Date of Sampling		09.02.2026		Sample Collected in 5 Ltr Jerricane , Color as observed is transparent					
					Period of Analysis		09.02.2026		to		14.05.2026	
Sl. No.	Parameter	Method of Analysis	Observed Values					IS 10500: 2012				
			GW13 G0231		Range Of Testing		LDL		Acceptable Limit (Max)*		Permissible Limit in the Absence of Alternate Source (Max)	
1	Colour, Hazen unit	APHA, 24th edition ,2120-c-Spectrophotometric Single Wavelength Method ,2023	1		1-500.0		1		5		15	
2	Calcium, mg/l	IS 3025, (Part 40): 1991 R:2019,AAS-Flame Method & EDTA Method	130		2.0-800.0		2		75		200	
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 , Argentometric Method	45		2.0-1500.0		5		250		1000	
4	Fluoride, mg/l	APHA, 24th Edition, SPADNS Method	0.51		0.2-2.00		0.2		1		1.5	
5	Iron, mg/l	IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame Method	<0.2		0.2-10		0.2		1		No relaxation	
6	Magnesium	APHA 24th edition, 3500-Mg B: Calculation Method	37		6.0-700		6		30		100	
7	Nitrate, mg/l	APHA, 24th edition, UV-Spectrophotometric Method	26.74		0.5-45.0		0.5		45		No relaxation	
8	Odour	APHA, 24th Edition, , 2150-C	Agreeable		Qualitative		Qualitative		Agreeable		Agreeable	
9	pH value	IS 3025, Part 11 : 1983 R 2023 Electrometric(pH Meter) Method	7.99		1-14		0.1		6.5-8.5		No relaxation	
10	Sulphate, mg/l	APHA -24th edition, 4500 S , Turbidity Method	69		10.0-400.0		10		200		400	
11	Taste	APHA,24th edition, 2160-C	Acceptable		Qualitative		Qualitative		Acceptable		Agreeable	
12	Total Alkalinity (caCO3), mg/l, Max	IS 3025, Part 23: 1986 R 2019 Titration Method	160		4.0-2000.0		4		200		600	
13	Total Dissolved Solids, mg/l	IS 3025, Part 16: 1984 R 2023 Gravimetric method	858		25.0-5000.0		25		500		2000	
14	Total Hardness, mg/l	IS 3025, (Part 21): 2019 EDTA Method	476		4.0-2000.0		4		200		600	
15	Turbidity, NTU	IS 3025, (Part 10):1984, R-2023 Nephelometric/Turbiditometric Method	1.8		1-800		0.1		1		5	
16	Zinc, mg/l	IS 3025(Part 49) : 1994,R:2019, AAS-Flame Method	<0.1		0.10 - 10.0		0.1		5		15	

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

(Gaurav Kant)
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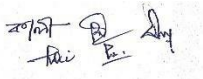
CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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Month & Year	QUARTER ENDING MARCH 2026		Name of Cluster		CLUSTER XIII				
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue	16.05.2026
Project	Murlidih			Sample Ref. No.	REM/BCCL/25-26/GW/	Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)		
Sampling Stations	GW13		Date of Sampling	09.02.2026	Sample Collected in 5 Ltr Jerricane , Color as observed is transparent				
					Period of Analysis		09.02.2026	to	14.05.2026
Sl. No.	Parameter	Method of Analysis	Observed Values					IS 10500: 2012	
			GW13 G0231	Range Of Testing	LDL	Acceptable Limit (Max)*		Permissible Limit in the Absence of Alternate Source (Max)	
1	Boron (as B), mg/l, Max	APHA, 24th edition ,Carminc	<0.2	0.2-10	0.2	0.5		1	
2	Copper (as Cu), mg/l, Max	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA	<0.01	0.01-10.0	0.01	0.05		1.5	
3	Free Residual Chlorine, mg/l, Min	APHA, 24th Edition, , 4500-Cl- B. (Iodometric Method-I)	<0.04	0.04-5	0.04	0.2		1	
4	Lead (as Pb), mg/l, Max	IS:3025(Part 47):1994 (Reaffirmed 2019) APHA, 24th edition, AAS-GTA	<0.005	0.005-10	0.005	0.01		No relaxation	
5	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 24th Edition,4-Amino Autipyrine	<0.001	0.001-10	0.001	0.002		0.002	
6	Selenium, mg/l, Max	APHA 24th edition IS-3025,part 56:2003, R-2019/, AAS-VGA	<0.007	0.007-10	0.007	0.01		No relaxation	
7	Total Arsenic (as As), mg/l, Max	IS-3025,part 37:1988, R-2019/ APHA 24th edition AAS-VGA	<0.006	0.006-10	0.006	0.01		0.05	
8	Total Chromium (as Cr), mg/l, Max	IS-3025 Part 52:2003, R:2019,AAS-Flame APHA, 24th edition, AAS-GTA	<0.01	0.01-10.0	0.01	0.05		No relaxation	
9	Nickel as Ni, mg/l Max	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA	<0.005	0.005-10	0.005	0.02		No relaxation	
10	Manganese as Mn, mg/l, Max	APHA, 24 TH Edition:2023 AAS-GTA Method	0.05	0.02-10.0	0.02	0.1		0.3	

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,


Gaurav Kant

(Gaurav Kant)
REVIEWED BY


(Kumar Vaibhav)

ANALYSED BY

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
SURFACE WATER ANALYSIS TEST REPORT

CMPDIL, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone: 0326-223-850
 email: rdri2.cmpdi@coalindia.in

Month & Year		QUARTER ENDING MARCH 2026	Name of Cluster	XIII & XIV		ULR No.	TC1432126000002555P TC1432126000002556P	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	16.05.2026
Project		Sample Ref. No.		REM/BCCL/25-26/SW /	Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13		
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV) (SW29)	Date of Sampling	31.03.2026	Period of Analysis		
		(ii)	Downstream in Damodar River(SW30)	Date of Sampling	31.03.2026	31.03.2026 TO 14.05.2026		
Sl. No.	Parameter	Method of Analysis	Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL	
			(i)	S0059				
1	BOD (3 days 27°C), mg/l	IS 3025 (Part 44) : 1993, R-2019 , 3 day incubation at 27°C	<2.0	<2.0	3	2.00-100.00	2	
2	Colour,Hazen Units	APHA 24th edition , 2120-B-:2023	2	1	10	1-500.0	1	
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 Argentometric Method	36	38	600	2.0-1500.0	5	
4	Copper, mg/l	IS 3025 (Part 42) : 1992 R: 2019, AAS-Flame Method	<0.2	<0.2	1.5	0.2-10.0	0.2	
5	Dissolved Oxygen, mg/L	IS 3025 (Part 38) : 1989, R:2003 Winkler Azide Method	6.7	6.6	4	1.0-10.0	0.1	
6	Fluoride, mg/l	APHA, 24th edition, SPADNS Method	0.44	0.51	1.5	0.2-2.00	0.2	
7	Hexavalent Chromium, mg/l	APHA 24th edition, 1,5-Diphenylcarbohydrazide Method IS 3025 (Part 52) : 2003,R-2019	<0.01	<0.01	0.05	0.01-1.4	0.01	
8	Iron, mg/l	IS 3025 (Part 53):2003,R:2019, AAS-Flame Method	<0.2	<0.2	50	0.2-10	0.2	
9	Nitrate , mg/l	APHA, 24th edition, UV-Spectrophotometric Method	4.47	4.54	50	0.5-45.0	0.5	
10	pH value	IS 3025, (Part 11) : 1983 R-2023 Electrometric (Ph Meter) method	7.95	7.62	6.5-8.5	1.0-14.0	2	
11	Sulphate, mg/l	APHA -24th edition,4500- S, Turbidity Method	50	45	400	10.0-400.0	10	
12	Total Dissolved Solids, mg/l	IS 3025, (Part 16): 1984 R-2023 Gravimetric method	231	213	1500	25.0-10000.0	25	
13	Zinc, mg/l	IS 3025(Part 49) : 1994, R: 2019, AAS-Flame Method	<0.1	<0.1	15	0.10 – 10.0	0.1	

****Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit**

*****All units in mg/L unless specified otherwise Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**

(Signature)
 (Gaurav Kant)

(Signature)
 (Gaurav Kant)

(Signature)
 (Kumar Vaibhav)

Analysed by

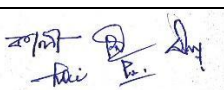
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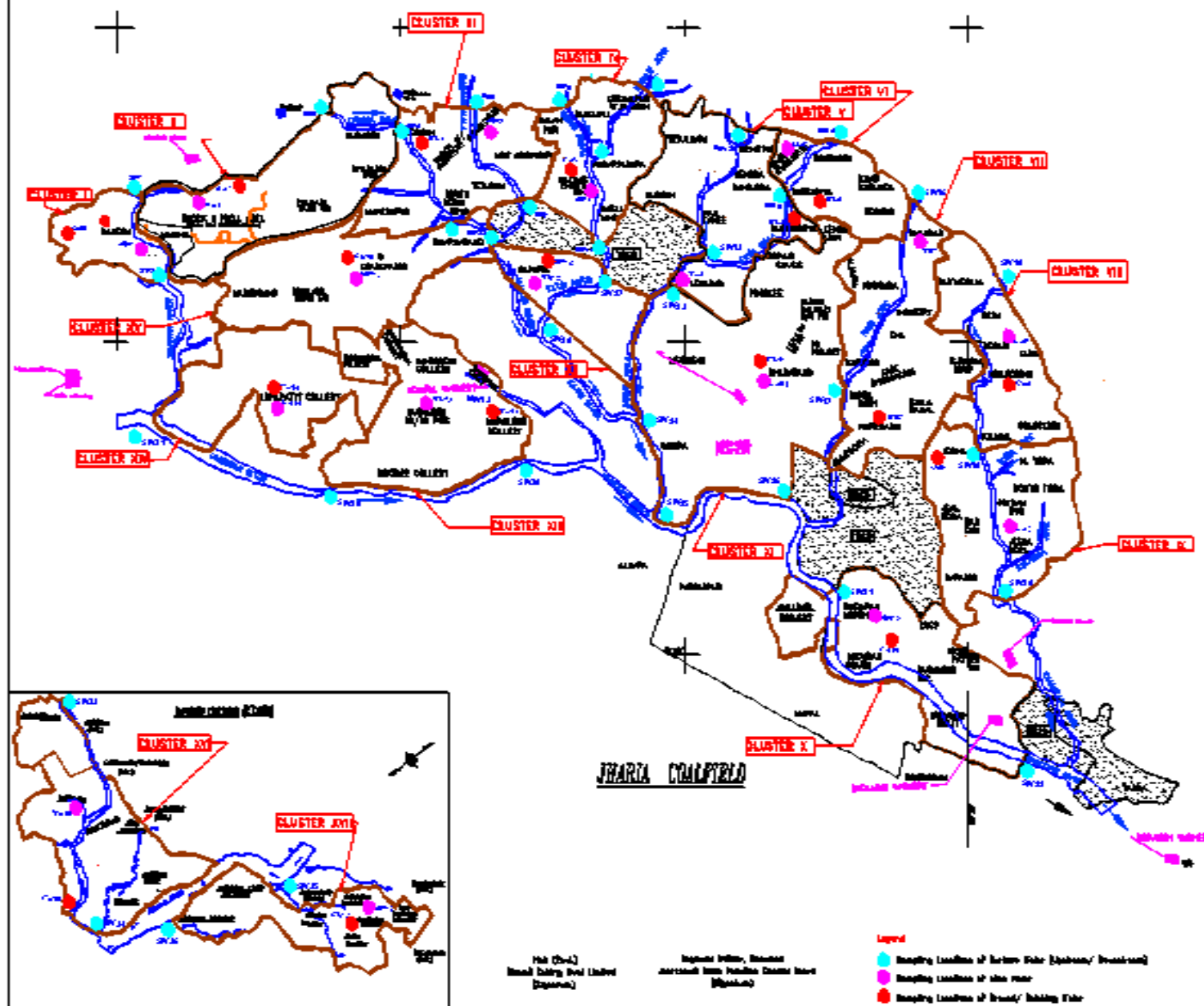
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Month & Year		QUARTER ENDING MARCH 2026	Name of Cluster	XIII & XIV		Report No.		
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	16.05.2026	
Project		Sample Ref. No.		REM/BCCL/25-26/SW /	Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13		
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV)(SW29)	Date of Sampling		31.03.2026	Period of Analysis	
		(ii)	Downstream in Damodar River(SW30)	Date of Sampling		31.03.2026	31.03.2026 TO 14.05.2026	
Sl. No.	Parameter	Method of Analysis	Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL	
			(i)	(ii)				
1	Arsenic (as As), mg/l, Max	IS-3025,Part 37:1988, R-2019/ APHA 24th edition AAS-VGA	<0.006	<0.006	0.2	0.006-10	0.006	
2	Lead (as Pb), mg/l, Max	APHA, 24th edition, AAS-GTA	<0.005	<0.005	0.1	0.005-10	0.005	
3	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 24th Edition 4-Amino Antipyrine	<0.002	<0.002	0.005	0.002-10	0.002	
4	Selenium, mg/l, Max	IS-3025 ,Part 56:2003, R-2019/ APHA 24th edition, AAS-VGA	<0.007	<0.007	0.05	0.007-10	0.007	
Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit *All units in mg/L unless specified otherwise Sample Collected in 5 Ltr Jerricane , Color as observed is transparent								
 (Gaurav Kant)			 (Kumar Vaibhav)					
Analysed by			REVIEWED BY			Authorised Signatory		
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---- End of Report ----								
Page -2 of 2								

Water Sampling Locations in BCCL



INDEX

Cluster	Sampling Point	Sampling Location	Sampling Point	Sampling Location
I	SP1, SP2	SP1, SP2	SP1, SP2	SP1, SP2
II	SP3, SP4	SP3, SP4	SP3, SP4	SP3, SP4
III	SP5, SP6	SP5, SP6	SP5, SP6	SP5, SP6
IV	SP7, SP8	SP7, SP8	SP7, SP8	SP7, SP8
V	SP9, SP10	SP9, SP10	SP9, SP10	SP9, SP10
VI	SP11, SP12	SP11, SP12	SP11, SP12	SP11, SP12
VII	SP13, SP14	SP13, SP14	SP13, SP14	SP13, SP14
VIII	SP15, SP16	SP15, SP16	SP15, SP16	SP15, SP16
IX	SP17, SP18	SP17, SP18	SP17, SP18	SP17, SP18
X	SP19, SP20	SP19, SP20	SP19, SP20	SP19, SP20
XI	SP21, SP22	SP21, SP22	SP21, SP22	SP21, SP22
XII	SP23, SP24	SP23, SP24	SP23, SP24	SP23, SP24
XIII	SP25, SP26	SP25, SP26	SP25, SP26	SP25, SP26
XIV	SP27, SP28	SP27, SP28	SP27, SP28	SP27, SP28
XV	SP29, SP30	SP29, SP30	SP29, SP30	SP29, SP30
XVI	SP31, SP32	SP31, SP32	SP31, SP32	SP31, SP32
XVII	SP33, SP34	SP33, SP34	SP33, SP34	SP33, SP34
XVIII	SP35, SP36	SP35, SP36	SP35, SP36	SP35, SP36
XIX	SP37, SP38	SP37, SP38	SP37, SP38	SP37, SP38
XX	SP39, SP40	SP39, SP40	SP39, SP40	SP39, SP40

BCCL	BCCL
BCCL	BCCL
BCCL	BCCL
BCCL	BCCL
BCCL	BCCL



**WATER QUALITY REPORT
OF
BHARAT COKING COAL LIMITED, CLUSTER
– XIII**

**(FOR THE Q.E. DECEMBER 2025)
E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.**



CMPDI

ISO 9001 Company
**Regional Institute-II
Dhanbad, Jharkhand**

CLUSTER - XIII

(FOR THE Q.E. DECEMBER 2025)

CONTENTS

SL. NO.	CHAPTER	PARTICULARS
1.		EXECUTIVE SUMMARY
2.	CHAPTER - I	INTRODUCTION
3.	CHAPTER-II	WATER SAMPLING & ANALYSIS
4.	Plates: Plate No. - I	SURFACE PLAN SHOWING WATER MONITORING LOCATIONS

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affect the environment around us. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. One of these major attributes is water.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Water sampling stations

The Water sampling stations were selected for mine sump water, Ground water supply, well/ Hand pump water & also surface water samples.

3.0 Methodology of sampling and analysis

3.1 Water quality

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

4.0 Results and interpretations

4.1 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, IS.10500/2012 (Ground water) and IS: 2296 (Surface water), are within permissible limits

CHAPTER - I

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by the Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal Limited (BCCL), a subsidiary company of Coal India Limited (CIL) is operating UG Mines and Opencast Mines in Jharia Coalfield (JCF). The Jharia Coalfield (JCF) has an area of 450 Sq.KM.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and a well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdee. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by the Katri River & Damodar River.
- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from the Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

In compliance with these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC & SPCB and other statutory authorities.

CHAPTER – II

WATER QUALITY MONITORING

2.1 Location of sampling sites (Refer **Plate No. - I**)

- i) Ground Water quality at **Murlidih 20/21 (GW13)**
- iii) Surface Water quality at **U/S of Damodar River (SW29)**
- ii) Surface Water quality at **D/S of Damodar River (SW30)**
- iii) Mine Water Quality at Murlidih(20/21) (**MW13**)

2.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

2.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results show that most of the parameters are within the permissible limits.






CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

GROUND WATER ANALYSIS TEST REPORT

CMPDIL, RI-II

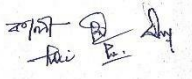
KOYLA BHAWAN COMPLEX

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Phone:0326-223-850

email: rdri2cmpdi@coalindia.in

Month & Year	QUARTER ENDING DECEMBER 2025	Name of Cluster	CLUSTER XIII			ULR No.	TC143212600000242 4P
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	17.03.2026
Project	Murlidih	Sample Ref. No.	REM/BCCL/25-26/GW/	Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)		
Sampling Stations	GW13	Date of Sampling	17.11.2025	Sample Collected in 5 Ltr Jerricane , Color as observed is transparent			
			Period of Analysis	17.11.2025	to	04.02.2026	
Sl. No.	Parameter	Method of Analysis	Observed Values			IS 10500: 2012	
			GW13 G0215	Range Of Testing	LDL	Acceptable Limit (Max)*	Permissible Limit in the Absence of Alternate Source (Max)
1	Colour, Hazen unit	APHA, 24th edition ,2120-c-Spectrophotometric Single Wavelength Method ,2023	<1	1-500.0	1	5	15
2	Calcium, mg/l	IS 3025, (Part 40): 1991 R:2019,AAS-Flame Method & EDTA Method	98	2.0-800.0	2	75	200
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 , Argentometric Method	117	2.0-1500.0	5	250	1000
4	Fluoride, mg/l	APHA, 24th Edition, SPADNS Method	0.53	0.2-2.00	0.2	1	1.5
5	Iron, mg/l	IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame Method	<0.2	0.2-10	0.2	1	No relaxation
6	Magnesium	APHA 24th edition, 3500-Mg B: Calculation Method	109	6.0-700	6	30	100
7	Nitrate , mg/l	APHA, 24th edition, UV-Spectrophotometric Method	12.75	0.5-45.0	0.5	45	No relaxation
8	Odour	APHA, 24th Edition, , 2150-C	Agreeable	Qualitative	Qualitative	Agreeable	Agreeable
9	pH value	IS 3025, Part 11 : 1983 R 2023 Electrometric(pH Meter) Method	7.88	1-14	0.1	6.5-8.5	No relaxation
10	Sulphate, mg/l	APHA -24th edition, 4500 S , Turbidity Method	81	10.0-400.0	10	200	400
11	Taste	APHA,24th edition, 2160-C	Acceptable	Qualitative	Qualitative	Acceptable	Agreeable
12	Total Alkalinity (CaCO ₃), mg/l, Max	IS 3025, Part 23: 1986 R 2019 Titration Method	145	4.0-2000.0	4	200	600
13	Total Dissolved Solids, mg/l	IS 3025, Part 16: 1984 R 2023 Gravimetric method	827	25.0-5000.0	25	500	2000
14	Total Hardness, mg/l	IS 3025, (Part 21): 2019 EDTA Method	695	4.0-2000.0	4	200	600
15	Turbidity, NTU	IS 3025, (Part 10):1984, R-2023 Nephelometric/Turbiditometric Method	1.8	1-800	0.1	1	5
16	Zinc, mg/l	IS 3025(Part 49) : 1994,R:2019, AAS-Flame Method	<0.1	0.10 – 10.0	0.1	5	15



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GROUND WATER ANALYSIS TEST REPORT

CMPDIL, RI-II
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Month & Year	QUARTER ENDING DECEMBER 2025		Name of Cluster	CLUSTER XIII				
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	17.03.2026
Project	Murlidih			Sample Ref. No.	REM/BCCL/25-26/GW/	Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)	
Sampling Stations	GW13		Date of Sampling	17.11.2025	Sample Collected in 5 Ltr Jerricane , Color as observed is transparent			
				Period of Analysis		17.11.2025	to	04.02.2026
Sl. No.	Parameter	Method of Analysis	Observed Values				IS 10500: 2012	
			GW13	Range Of Testing	LDL	Acceptable Limit (Max)*	Permissible Limit in the Absence of Alternate Source (Max)	
1	Boron (as B), mg/l, Max	APHA, 24th edition ,Carmin	<0.2	0.2-10	0.2	0.5	1	
2	Copper (as Cu), mg/l, Max	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA	<0.01	0.01-10.0	0.01	0.05	1.5	
3	Free Residual Chlorine, mg/l, Min	APHA, 24th Edition, , 4500-Cl- B. (Iodometric Method-I)	<0.04	0.04-5	0.04	0.2	1	
4	Lead (as Pb), mg/l, Max	IS:3025(Part 47):1994 (Reaffirmed 2019) APHA, 24th edition, AAS-GTA	<0.005	0.005-10	0.005	0.01	No relaxation	
5	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 24th Edition,4-Amino Autipyrine	<0.001	0.001-10	0.001	0.002	0.002	
6	Selenium, mg/l, Max	APHA 24th edition IS-3025,part 56:2003, R-2019/, AAS-VGA	<0.007	0.007-10	0.007	0.01	No relaxation	
7	Total Arsenic (as As), mg/l, Max	IS-3025,part 37:1988, R-2019/ APHA 24th edition AAS-VGA	<0.006	0.006-10	0.006	0.01	0.05	
8	Total Chromium (as Cr), mg/l, Max	IS-3025 Part 52:2003, R:2019,AAS-Flame APHA, 24th edition, AAS-GTA	<0.01	0.01-10.0	0.01	0.05	No relaxation	
9	Nickel as Ni, mg/l Max	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA	<0.005	0.005-10	0.005	0.02	No relaxation	
10	Manganese as Mn, mg/l, Max	APHA, 24 TH Edition:2023 AAS-GTA Method	<0.02	0.02-10.0	0.02	0.1	0.3	

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

(Signature)

(Signature)

(Signature)

(Gaurav Kant)

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(Kumar Vaibhav)

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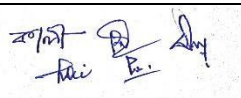
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SURFACE WATER ANALYSIS TEST REPORT

CMPDIL, RI-II
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Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		XIII & XIV		ULR No.	TC1432126000002457P TC1432126000002458P		
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	17.03.2026		
Project		Sample Ref. No.			REM/BCCL/25-26/SW /		Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13			
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV) (SW29)			Date of Sampling		29.12.2025		Period of Analysis	
		(ii)	Downstream in Damodar River(SW30)			Date of Sampling		29.12.2025		29.12.2025 TO 02.02.2026	
Sl. No.	Parameter	Method of Analysis			Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL		
					SW 29	SW 30 S00055					
1	BOD (3 days 27°C), mg/l	IS 3025 (Part 44) : 1993, R-2019 , 3 day incubation at 27°C			<2.0	<2.0	3	2.00-100.00	2		
2	Colour,Hazen Units	APHA 24th edition , 2120-B-:2023			1	1	10	1-500.0	1		
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 Argentometric Method			69	60	600	2.0-1500.0	5		
4	Copper, mg/l	IS 3025 (Part 42) : 1992 R : 2019, AAS-Flame Method			<0.2	<0.2	1.5	0.2-10.0	0.2		
5	Dissolved Oxygen, mg/L	IS 3025 (Part 38) : 1989, R:2003 Winkler Azide Method			6.5	6.4	4	1.0-10.0	0.1		
6	Fluoride, mg/l	APHA, 24th edition, SPADNS Method			0.41	0.61	1.5	0.2-2.00	0.2		
7	Hexavalent Chromium, mg/l	APHA 24th edition, 1,5-Diphenylcarbohydrazide Method IS 3025 (Part 52) : 2003,R-2019			<0.01	<0.01	0.05	0.01-1.4	0.01		
8	Iron, mg/l	IS 3025 (Part 53):2003,R:2019, AAS-Flame Method			<0.2	<0.2	50	0.2-10	0.2		
9	Nitrate , mg/l	APHA, 24th edition, UV-Spectrophotometric Method			7.83	7.17	50	0.5-45.0	0.5		
10	pH value	IS 3025, (Part 11) : 1983 R-2023 Electrometric (Ph Meter) method			7.58	7.51	6.5-8.5	1.0-14.0	2		
11	Sulphate, mg/l	APHA -24th edition,4500- S, Turbidity Method			49	50	400	10.0-400.0	10		
12	Total Dissolved Solids, mg/l	IS 3025, (Part 16): 1984 R-2023 Gravimetric method			293	268	1500	25.0-10000.0	25		
13	Zinc, mg/l	IS 3025(Part 49) : 1994, R : 2019, AAS-Flame Method			<0.1	<0.1	15	0.10 – 10.0	0.1		

****Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit**

*****All units in mg/L unless specified otherwise Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**


(Gaurav Kant)



(Kumar Vaibhav)

Analysed by

REVIEWED BY

Authorised Signatory

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
SURFACE WATER ANALYSIS TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone: 0326-223-850
email: rdri2.cmpdi@coalindia.in

Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		XIII &XIV			
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	17.03.2026
Project		Sample Ref. No.			REM/BCCL/25-26/SW /		Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV)Downstream of Jarian Nala(SW 01) (SW29)			Date of Sampling		29.12.2025	Period of Analysis
		(ii)	Downstream in Damodar River(SW30)			Date of Sampling		29.12.2025	29.12.2025 TO 02.02.2026
Sl. No.	Parameter		Method of Analysis	Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL	
				SW 29	SW 30				
1	Arsenic (as As), mg/l, Max		IS-3025,Part 37:1988, R-2019/ APHA 24th edition AAS-VGA	<0.006	<0.006	0.2	0.006-10	0.006	
2	Lead (as Pb), mg/l, Max		APHA, 24th edition, AAS-GTA	<0.005	<0.005	0.1	0.005-10	0.005	
3	Phenolic compounds (as C6H5OH), mg/l, Max		APHA, 24th Edition 4-Amino Antipyrine	<0.002	<0.002	0.005	0.002-10	0.002	
4	Selenium, mg/l, Max		IS-3025 ,Part 56:2003, R-2019/ APHA 24th edition, AAS-VGA	<0.007	<0.007	0.05	0.007-10	0.007	

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit

***All units in mg/L unless specified otherwise **Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**

(Gaurav Kant)

(Kumar Vaibhav)

Analysed by

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Environment Laboratory, Regional Institute-II
MINE EFFLUENT ANALYSIS TEST REPORT

CMPDIL, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		CLUSTER XIII			ULR No.		TC1432126000002483P			
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue		17.03.2026			
Project		Murlidih 20/21			Sample Ref. No.		REM/BCCL/25-26/MW/		Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)				
Sampling Stations		MW13		Date of Sampling	22.12.2025		Sample Collected in 5 Ltr Jerricane , Color as observed is transparent							
								Period of Analysis		22.12.2025		TO	13.02.2026	
Sl. No.	Parameter		Method of Analysis											
					MW13 M1909	Range Of Testing		LDL		MOEF -SCH-VI STANDARDS Class ‘A’				
1	B.O.D (3 days 27°C), mg/l, Max		IS 3025 /44:1993,R:20033 day incubation at 27°C		<2.0	2-10000.0		2		30				
2	Colour		APHA,24th edition ,2120-B:-2023		1	1.0-500.0		1		-				
3	COD, mg/l, Max		APHA 24th edition 5220 C Titrimetric Method		36	4.0-800.0		4		250				
4	Copper (as Cu), mg/l, Max		IS 3025(Part42): 1992 R : 2019, AAS-Flame		<0.2	0.2-10.0		0.2		3				
5	Dissolved Phosphate (as P), mg/l, Max		IS 3025/ 31, 1988 R 2019		<0.1	0.1-5.0		0.1		5				
6	Fluoride (as F) mg/l, Max		APHA, 24th Edition, Page 4-90 to , 4500 – F- D (SPADNS Method)		0.65	0.2-2.0		0.2		2				
7	Hexavalent Chromium, mg/l, Max		IS 3025 (Part 52) : 2003,Reaffirmed 2019		<0.01	0.01-1.40		0.01		0.1				
8	Iron (as Fe), mg/l, Max		IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame		<0.2	0.2-10		0.2		3				
9	Manganese(as Mn), mg/l, Max		APHA, 24th edition, AAS-Flame		<0.1	0.1-10		0.1		0.1				
10	Nickel (as Ni), mg/l, Max		IS-3025(Part 54):2003, R:2019 AAS-Flame		<0.1	0.1-10.0		0.1		3				
11	Nitrate Nitrogen, mg/l, Max		APHA, 24th Edition,UV-Spectrphotometric		2.55	0.5-45		0.5		10				
12	Oil & Grease, mg/l, Max		IS 3025/39:1991, R : 2019, Partition Gravimetric		<4.0	2.0-1000		2		10				
13	pH value		IS-3025/11:1983, R-2023, Electrometric		8.01	1 -14		0.1		5.5 to 9.0				
14	Temperature (°C)		IS-3025/09:1984, Thermometric		22.5	1-100		.		Shall not exceed 5° C above the receiving temp.				
15	Total Chromium (as Cr), mg/l, Max		IS-3025(Part 52):2003, R:2019 AAS-Flame		<0.1	0.1-10.0		0.1		2				
16	Total Suspended Solids, mg/l, Max		IS 3025/17:1984, R :2023, Gravimetric		40	10-5000		10		100				
17	Zinc (as Zn), mg/l, Max		IS 3025 /49 : 1994, R : 2019, AAS-Flame		<0.1	0.1-10.0		0.1		5				
18	Odour		APHA, 24th Edition, , 2150-C		Agreeable	Qualitative	Qualitative	Qualitative	Qualitative					

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

(Signature)

(Signature)

(Signature)

(Gaurav Kant)

REVIEWED BY

(Kumar Vaibhav)

Authorised Signatory

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT ANALYSIS TEST REPORT

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

Month & Year		QUARTER ENDING DECEMBER 2025		Name of Cluster		CLUSTER XIII							
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue		17.03.2026		
Project		Murlidih 20/21			Sample Ref. No.		REM/BCCL/25-26/MW/		Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)			
Sampling Stations		MW13		Date of Sampling	22.12.2025		Sample Collected in 5 Ltr Jerricane , Color as observed is transparent						
						Period of Analysis			22.12.2025		TO	13.02.2026	
Sl. No.	Parameter		Method of Analysis										
						MW13	Range Of Testing	LDL		MOEF -SCH-VI STANDARDS Class 'A'			
1	Ammonical Nitrogen, mg/l, Max		IS 3025/34:1988,R : 2009, Nessler's			<0.02	0.02-100	0.02		50			
2	Arsenic (as As), mg/l, Max		IS-3025,part 37:1988, R-2019/ APHA 24th edition AAS-VGA			<0.006	0.006-5	0.006		0.2			
3	Free Ammonia, mg/l, Max		IS:3025/34:1988, Nessler's			<0.01	0.01-10	0.01		5			
4	Lead (as Pb), mg/l, Max		IS-3025(Part 59):2006, R 2023 AAS-GTA/APHA, 24 th Edition, 3111B, AAS-GTA			<0.005	0.005-10	0.005		2			
5	Phenolic compounds		APHA, 24th edition4-Amino Antipyrine			<0.002	0.002-5	0.002		1			
6	Selenium, mg/l, Max		IS-3025,part 56:2003, R-2019/ APHA 24th edition, AAS-VGA			<0.007	0.007-5	0.007		0.05			
7	Sulphide (as S ²⁻) mg/l Max.		APHA 24th edition Methylene Blue Method			<0.005	0.005-5	0.005		2			
8	Total Kjeldahl Nitrogen, mg/l, Max		IS:3025/34:1988, Nessler's			<1	1-200	1		100			
9	Total Residual Chlorine, mg/l, Max		APHA, 24th Edition, , 4500-Cl B. (Iodometric Method-I)			<0.04	0.04-5.00	0.04		1			

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

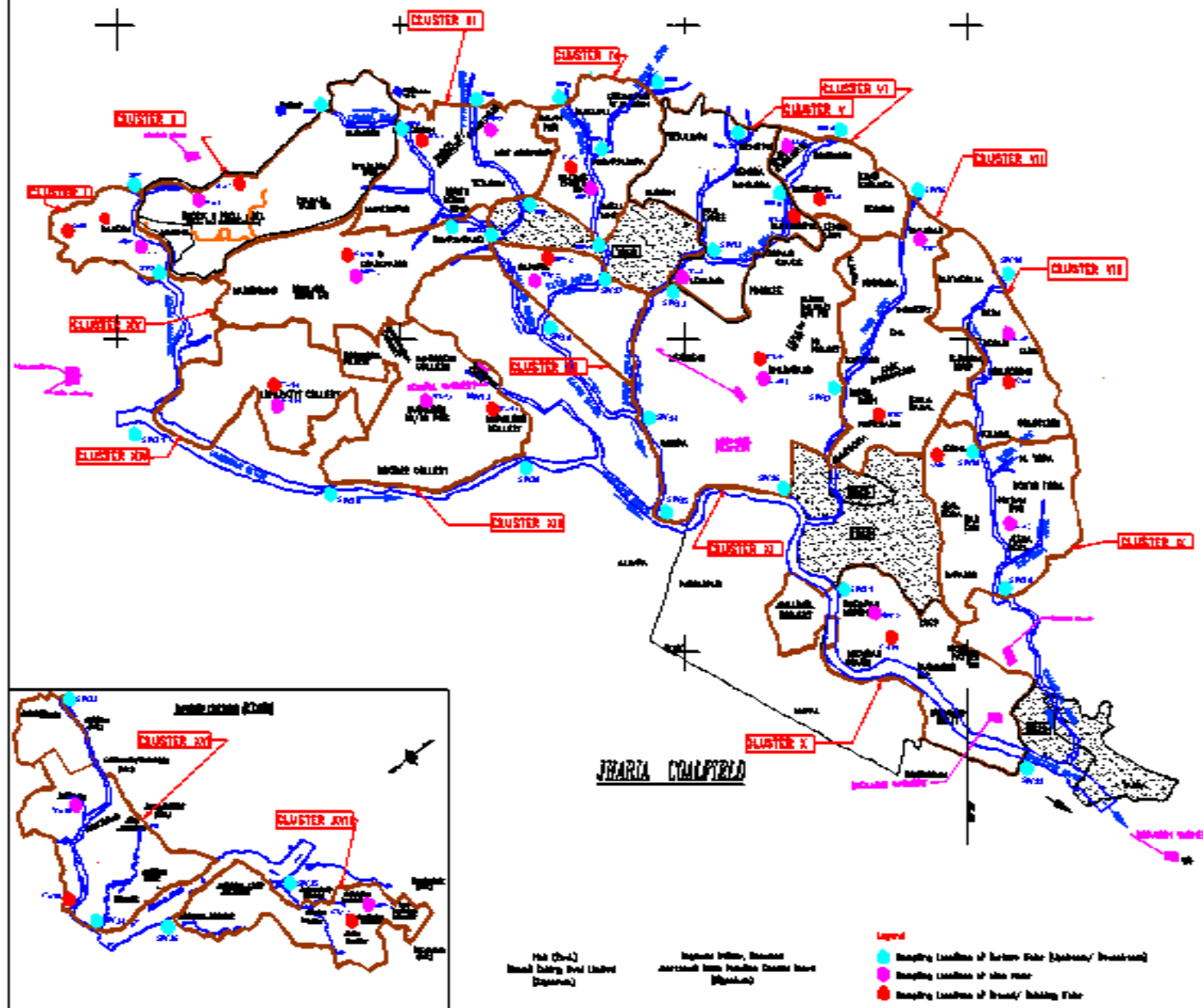
	 (Gaurav Kant) REVIEWED BY	 (Kumar Vaibhav) Authorised Signatory
ANALYSED BY		

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Water Sampling Locations in BCCL



INDEX

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WATER QUALITY REPORT OF BHARAT COKING COAL LIMITED CLUSTER – XIII

(FOR THE Q.E. MARCH 2026)
E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.



CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CLUSTER - XIII

(FOR THE Q.E. MARCH 2026)

CONTENTS

SL. NO.	CHAPTER	PARTICULARS
1.		EXECUTIVE SUMMARY
2.	CHAPTER - I	INTRODUCTION
3.	CHAPTER-II	WATER SAMPLING & ANALYSIS
4.	Plates: Plate No. - I	SURFACE PLAN SHOWING WATER MONITORING LOCATIONS

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affect the environment around us. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. One of these major attributes is water.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Water sampling stations

The Water sampling stations were selected for mine sump water, Ground water supply, well/ Hand pump water & also surface water samples.

3.0 Methodology of sampling and analysis

3.1 Water quality

Water samples were collected as per standard practice. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

4.0 Results and interpretations

4.1 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, IS.10500/2012 (Ground water) and IS: 2296 (Surface water), are within permissible limits.

CHAPTER - I

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by the Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal Limited (BCCL), a subsidiary company of Coal India Limited (CIL) is operating UG Mines and Opencast Mines in Jharia Coalfield (JCF). The Jharia Coalfield (JCF) has an area of 450 Sq.KM.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and a well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdee. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by the Katri River & Damodar River.
- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from the Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

In compliance with these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC & SPCB and other statutory authorities.

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CHAPTER – II

WATER QUALITY MONITORING

2.1 Location of sampling sites (Refer **Plate No. - I**)

- i) Ground Water quality at **Murlidih 20/21 (GW13)**
- ii) Surface Water quality at **U/S of Damodar River (SW29)**
- iii) Surface Water quality at **D/S of Damodar River (SW30)**

2.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on a quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad.

2.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results show that most of the parameters are within the permissible limits.



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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
GROUND WATER ANALYSIS TEST REPORT

CMPDIL, RI-II
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DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

Month & Year	QUARTER ENDING MARCH 2026		Name of Cluster	CLUSTER XIII			ULR No.	TC1432126000002522P
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	16.05.2026
Project	Murlidih			Sample Ref. No.	REM/BCCL/25-26/GW/	Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)	
Sampling Stations	GW13		Date of Sampling	09.02.2026	Sample Collected in 5 Ltr Jerricane , Color as observed is transparent			
				Period of Analysis		09.02.2026	to	14.05.2026
Sl. No.	Parameter	Method of Analysis	Observed Values				IS 10500: 2012	
			GW13 G0231	Range Of Testing	LDL	Acceptable Limit (Max)*	Permissible Limit in the Absence of Alternate Source (Max)	
1	Colour, Hazen unit	APHA, 24th edition ,2120-c-Spectrophotometric Single Wavelength Method ,2023	1	1-500.0	1	5	15	
2	Calcium, mg/l	IS 3025, (Part 40): 1991 R:2019,AAS-Flame Method & EDTA Method	130	2.0-800.0	2	75	200	
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 , Argentometric Method	45	2.0-1500.0	5	250	1000	
4	Fluoride, mg/l	APHA, 24th Edition, SPADNS Method	0.51	0.2-2.00	0.2	1	1.5	
5	Iron, mg/l	IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame Method	<0.2	0.2-10	0.2	1	No relaxation	
6	Magnesium	APHA 24th edition, 3500-Mg B: Calculation Method	37	6.0-700	6	30	100	
7	Nitrate , mg/l	APHA, 24th edition, UV-Spectrophotometric Method	26.74	0.5-45.0	0.5	45	No relaxation	
8	Odour	APHA, 24th Edition, , 2150-C	Agreeable	Qualitative	Qualitative	Agreeable	Agreeable	
9	pH value	IS 3025, Part 11 : 1983 R 2023 Electrometric(pH Meter) Method	7.99	1-14	0.1	6.5-8.5	No relaxation	
10	Sulphate, mg/l	APHA -24th edition, 4500 S , Turbidity Method	69	10.0-400.0	10	200	400	
11	Taste	APHA,24th edition, 2160-C	Acceptable	Qualitative	Qualitative	Acceptable	Agreeable	
12	Total Alkalinity (caCO3), mg/l, Max	IS 3025, Part 23: 1986 R 2019 Titration Method	160	4.0-2000.0	4	200	600	
13	Total Dissolved Solids, mg/l	IS 3025, Part 16: 1984 R 2023 Gravimetric method	858	25.0-5000.0	25	500	2000	
14	Total Hardness, mg/l	IS 3025, (Part 21): 2019 EDTA Method	476	4.0-2000.0	4	200	600	
15	Turbidity, NTU	IS 3025, (Part 10):1984, R-2023 Nephelometric/Turbiditometric Method	1.8	1-800	0.1	1	5	
16	Zinc, mg/l	IS 3025(Part 49) : 1994,R:2019, AAS-Flame Method	<0.1	0.10 – 10.0	0.1	5	15	

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

[Signature]

[Signature]
(Gaurav Kant)
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(Kumar Vaibhav)

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Month & Year	QUARTER ENDING MARCH 2026		Name of Cluster		CLUSTER XIII				
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue	16.05.2026
Project	Murlidih			Sample Ref. No.	REM/BCCL/25-26/GW/	Sampling Method	CMPDI/RI-II/LPM 13,(IS 3025:Part -1)		
Sampling Stations	GW13		Date of Sampling	09.02.2026	Sample Collected in 5 Ltr Jerricane , Color as observed is transparent				
					Period of Analysis		09.02.2026	to	14.05.2026
Sl. No.	Parameter	Method of Analysis	Observed Values				IS 10500: 2012		
			GW13 G0231	Range Of Testing	LDL	Acceptable Limit (Max)*	Permissible Limit in the Absence of Alternate Source (Max)		
1	Boron (as B), mg/l, Max	APHA, 24th edition ,Carmine	<0.2	0.2-10	0.2	0.5	1		
2	Copper (as Cu), mg/l, Max	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA	<0.01	0.01-10.0	0.01	0.05	1.5		
3	Free Residual Chlorine, mg/l, Min	APHA, 24th Edition, , 4500-Cl- B. (Iodometric Method-I)	<0.04	0.04-5	0.04	0.2	1		
4	Lead (as Pb), mg/l, Max	IS:3025(Part 47):1994 (Reaffirmed 2019) APHA, 24th edition, AAS-GTA	<0.005	0.005-10	0.005	0.01	No relaxation		
5	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 24th Edition,4-Amino Autipyrine	<0.001	0.001-10	0.001	0.002	0.002		
6	Selenium, mg/l, Max	APHA 24th edition IS-3025,part 56:2003, R-2019/, AAS-VGA	<0.007	0.007-10	0.007	0.01	No relaxation		
7	Total Arsenic (as As), mg/l, Max	IS-3025,part 37:1988, R-2019/ APHA 24th edition AAS-VGA	<0.006	0.006-10	0.006	0.01	0.05		
8	Total Chromium (as Cr), mg/l, Max	IS-3025 Part 52:2003, R:2019,AAS-Flame APHA, 24th edition, AAS-GTA	<0.01	0.01-10.0	0.01	0.05	No relaxation		
9	Nickel as Ni, mg/l Max	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA, 24th edition, AAS-GTA	<0.005	0.005-10	0.005	0.02	No relaxation		
10	Manganese as Mn, mg/l, Max	APHA, 24 TH Edition:2023 AAS-GTA Method	0.05	0.02-10.0	0.02	0.1	0.3		

***All units in mg/L unless specified otherwise,

**Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

(Signature)

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(Gaurav Kant)

(Kumar Vaibhav)

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 Phone: 0326-223-850
 email: rdri2.cmpdi@coalindia.in

Month & Year		QUARTER ENDING MARCH 2026	Name of Cluster	XIII & XIV		ULR No.	TC1432126000002555P TC1432126000002556P	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	16.05.2026
Project		Sample Ref. No.		REM/BCCL/25-26/SW /	Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13		
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV) (SW29)	Date of Sampling	31.03.2026	Period of Analysis		
		(ii)	Downstream in Damodar River(SW30)	Date of Sampling	31.03.2026	31.03.2026 TO 14.05.2026		
Sl. No.	Parameter	Method of Analysis	Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL	
			(i)	S0059				
1	BOD (3 days 27°C), mg/l	IS 3025 (Part 44) : 1993, R-2019 , 3 day incubation at 27°C	<2.0	<2.0	3	2.00-100.00	2	
2	Colour,Hazen Units	APHA 24th edition , 2120-B-:2023	2	1	10	1-500.0	1	
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 Argentometric Method	36	38	600	2.0-1500.0	5	
4	Copper, mg/l	IS 3025 (Part 42) : 1992 R: 2019, AAS-Flame Method	<0.2	<0.2	1.5	0.2-10.0	0.2	
5	Dissolved Oxygen, mg/L	IS 3025 (Part 38) : 1989, R:2003 Winkler Azide Method	6.7	6.6	4	1.0-10.0	0.1	
6	Fluoride, mg/l	APHA, 24th edition, SPADNS Method	0.44	0.51	1.5	0.2-2.00	0.2	
7	Hexavalent Chromium, mg/l	APHA 24th edition, 1,5-Diphenylcarbohydrazide Method IS 3025 (Part 52) : 2003,R-2019	<0.01	<0.01	0.05	0.01-1.4	0.01	
8	Iron, mg/l	IS 3025 (Part 53):2003,R:2019, AAS-Flame Method	<0.2	<0.2	50	0.2-10	0.2	
9	Nitrate , mg/l	APHA, 24th edition, UV-Spectrophotometric Method	4.47	4.54	50	0.5-45.0	0.5	
10	pH value	IS 3025, (Part 11) : 1983 R-2023 Electrometric (Ph Meter) method	7.95	7.62	6.5-8.5	1.0-14.0	2	
11	Sulphate, mg/l	APHA -24th edition,4500- S, Turbidity Method	50	45	400	10.0-400.0	10	
12	Total Dissolved Solids, mg/l	IS 3025, (Part 16): 1984 R-2023 Gravimetric method	231	213	1500	25.0-10000.0	25	
13	Zinc, mg/l	IS 3025(Part 49) : 1994, R: 2019, AAS-Flame Method	<0.1	<0.1	15	0.10 – 10.0	0.1	

****Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit**

*****All units in mg/L unless specified otherwise Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**

(Signature)
 (Gaurav Kant)

(Signature)
 (Gaurav Kant)

(Signature)
 (Kumar Vaibhav)

Analysed by

REVIEWED BY

Authorised Signatory

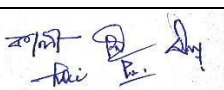
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

Page -1 of 2

Month & Year		QUARTER ENDING MARCH 2026	Name of Cluster		XIII & XIV		Report No.	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	16.05.2026	
Project		Sample Ref. No.		REM/BCCL/25-26/SW /		Sampling Method	(IS 3025 , Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations		(i)	Damodar River (upstream wrt clusterXIII, Downstream wrt clusterXIV)(SW29)		Date of Sampling		31.03.2026	
		(ii)	Downstream in Damodar River(SW30)		Date of Sampling		31.03.2026	
Sl. No.	Parameter	Method of Analysis	Observed Values		IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL	
			(i)	(ii)				
1	Arsenic (as As), mg/l, Max	IS-3025,Part 37:1988, R-2019/ APHA 24th edition AAS-VGA	<0.006	<0.006	0.2	0.006-10	0.006	
2	Lead (as Pb), mg/l, Max	APHA, 24th edition, AAS-GTA	<0.005	<0.005	0.1	0.005-10	0.005	
3	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 24th Edition 4-Amino Antipyrine	<0.002	<0.002	0.005	0.002-10	0.002	
4	Selenium, mg/l, Max	IS-3025 ,Part 56:2003, R-2019/ APHA 24th edition, AAS-VGA	<0.007	<0.007	0.05	0.007-10	0.007	

***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit*
****All units in mg/L unless specified otherwise Sample Collected in 5 Ltr Jerricane , Color as observed is transparent*


 (Gaurav Kant)


 (Kumar Vaibhav)

Analysed by

REVIEWED BY

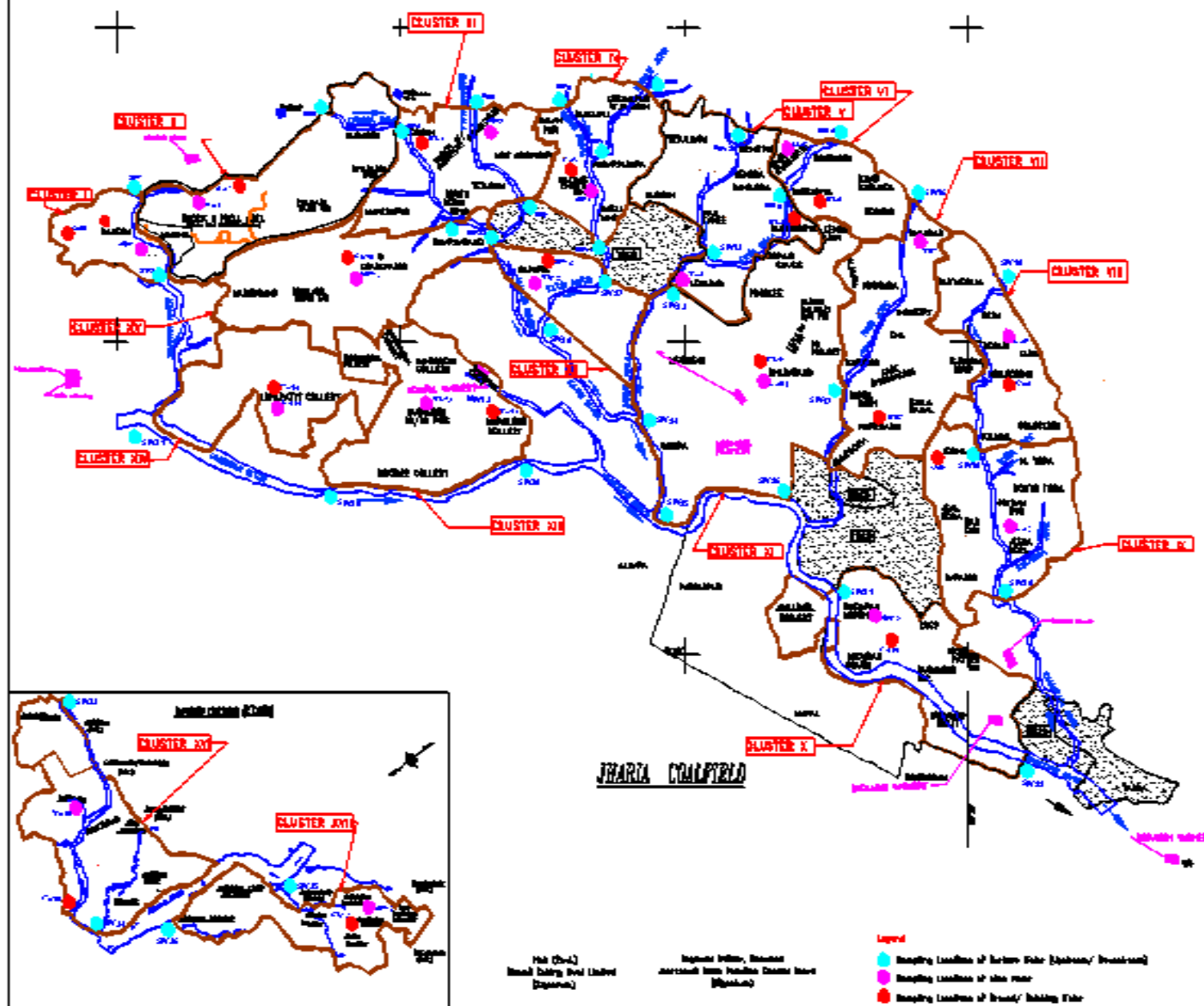
Authorised Signatory

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

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Water Sampling Locations in BCCL



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Cluster	Sampling Point	Water Type	Depth (m)	Flow (m³/s)	Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	Chlorophyll a (µg/L)	Chlorophyll b (µg/L)	Chlorophyll c (µg/L)	Chlorophyll total (µg/L)	Secchi Disk (cm)	Water Color	Notes
I	SP1	Surface	1.5	0.5	28.5	7.2	8.5	150	10	10	5	15	30	15	10	Sample taken at 10:00 AM
II	SP2	Surface	2.0	0.8	29.0	7.5	9.0	180	12	12	6	18	35	18	12	Sample taken at 11:00 AM
III	SP3	Surface	2.5	1.0	29.5	7.8	9.5	200	15	15	8	23	40	20	15	Sample taken at 12:00 PM
IV	SP4	Surface	3.0	1.2	30.0	8.0	10.0	220	18	18	10	28	45	22	18	Sample taken at 1:00 PM
V	SP5	Surface	3.5	1.5	30.5	8.2	10.5	240	20	20	12	32	50	24	20	Sample taken at 2:00 PM
VI	SP6	Surface	4.0	1.8	31.0	8.5	11.0	260	22	22	14	36	55	26	22	Sample taken at 3:00 PM
VII	SP7	Surface	4.5	2.0	31.5	8.8	11.5	280	25	25	16	40	60	28	25	Sample taken at 4:00 PM
VIII	SP8	Surface	5.0	2.2	32.0	9.0	12.0	300	28	28	18	44	65	30	28	Sample taken at 5:00 PM
IX	SP9	Surface	5.5	2.5	32.5	9.2	12.5	320	30	30	20	48	70	32	30	Sample taken at 6:00 PM
X	SP10	Surface	6.0	2.8	33.0	9.5	13.0	340	32	32	22	52	75	34	32	Sample taken at 7:00 PM
XI	SP11	Surface	6.5	3.0	33.5	9.8	13.5	360	35	35	24	56	80	36	35	Sample taken at 8:00 PM
XII	SP12	Surface	7.0	3.2	34.0	10.0	14.0	380	38	38	26	60	85	38	38	Sample taken at 9:00 PM
XIII	SP13	Surface	7.5	3.5	34.5	10.2	14.5	400	40	40	28	64	90	40	40	Sample taken at 10:00 PM
XIV	SP14	Surface	8.0	3.8	35.0	10.5	15.0	420	42	42	30	68	95	42	42	Sample taken at 11:00 PM
XV	SP15	Surface	8.5	4.0	35.5	10.8	15.5	440	45	45	32	72	100	45	45	Sample taken at 12:00 AM
XVI	SP16	Surface	9.0	4.2	36.0	11.0	16.0	460	48	48	34	76	105	48	48	Sample taken at 1:00 AM
XVII	SP17	Surface	9.5	4.5	36.5	11.2	16.5	480	50	50	36	80	110	50	50	Sample taken at 2:00 AM
XVIII	SP18	Surface	10.0	4.8	37.0	11.5	17.0	500	52	52	38	84	115	52	52	Sample taken at 3:00 AM
XIX	SP19	Surface	10.5	5.0	37.5	11.8	17.5	520	55	55	40	88	120	55	55	Sample taken at 4:00 AM
XX	SP20	Surface	11.0	5.2	38.0	12.0	18.0	540	58	58	42	92	125	58	58	Sample taken at 5:00 AM

BCCL (BENTONG) CO. LTD.	
BENTONG, MALAYSIA	
DATE: 10/10/2018	
BY: [Signature]	
FOR: [Signature]	

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**TRACE METAL CONCENTRATION OF
AMBIENT AIR QUALITY REPORT
OF
BHARAT COKING COAL LIMITED,
(FOR THE HALF YEAR ENDING, DECEMBER, 2025)**



CMPDI

ISO 9001 Company
**Regional Institute-II
Dhanbad, Jharkhand**

(FOR THE Q.E. DECEMBER, 2025)

CONTENTS

SL. NO.	CHAPTER	PARTICULARS
1.	CHAPTER - I	EXECUTIVE SUMMARY INTRODUCTION
2.	CHAPTER-II	AIR SAMPLING & ANALYSIS
3.	PLATES: PLATE NO. - I	SURFACE PLAN SHOWING AIR & NOISE MONITORING LOCATIONS

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the environment around us. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. One of these major attributes is water.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Heavy Metal in Ambient Air

Parameters chosen for assessment of Heavy metal in Ambient Air Quality were Cadmium (Cd), Mercury (Hg), Arsenic (As), Chromium (Cr), Nickel (Ni), and Lead (Pb). Respirable Dust Samplers (RDS) were used for sampling these heavy metals on EPM filter paper. These heavy metals are analyzed regularly on half yearly basis. The samples were analyzed in Environment Laboratory of CMPDI, RI-II, Dhanbad.

4.0 Results and interpretations

4.1 Heavy Metal in Ambient Air

The results of Heavy metal in Ambient Air Quality are presented in tabular form for each monitoring station. The concentration of heavy metals in ambient air is well within the permissible limit.

CHAPTER - I

INTRODUCTION

1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guidelines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

The very purpose of environmental monitoring is to assess the quality of various attributes which affects the environment. As per quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a subsidiary company of Coal India Limited (CIL) is operating UG Mines and Opencast Mines in Jharia Coalfield (JCF). The Jharia Coalfield (JCF) having an area of 450 Sq.KM.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC & JSPCB and other statutory authorities.

CHAPTER – II

AMBIENT AIR QUALITY MONITORING

2.1 Results and interpretations

The results of Heavy metal in Ambient Air Quality are presented in tabular form for each monitoring station. The concentration of heavy metals in ambient air is well within the permissible limit.

TRACE METAL CONCENTRATION IN AMBIENT AIR QUALITY

Name of the Company: **Bharat Coking Coal Limited**

Year : **2025-26.**

PERIOD: **HALF YEAR ENDING DECEMBER, 2025**

HEAVY METAL ANALYSIS REPORT OF AMBIENT AIR QUALITY

Results of 6 Heavy Metal for the month of NOV-2025								
SAMPLE CODE	DATE	Station Name	Cd CONC. IN $\mu\text{g}/\text{m}^3$	Hg CONC. IN $\mu\text{g}/\text{m}^3$	As CONC. IN ng/m^3	Cr CONC. IN $\mu\text{g}/\text{m}^3$	Ni CONC. IN ng/m^3	Pb CONC. IN $\mu\text{g}/\text{m}^3$
A1	24.11.25	Karmatand Village	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A2	18.11.25	Damoda	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A3	19.11.25	Madhuband Washery	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A4	25.11.25	Block-II	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A5	19.11.25	Muraidih	<0.001	<0.001	<1.0	<0.01	2.05	<0.005
A6	21.11.25	Block-IV	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A7	28.11.25	Govindpur/Ramkanali	<0.001	<0.001	<1.0	<0.01	<2.0	0.016
A8	24.11.25	Nichitpur	<0.001	<0.001	<1.0	<0.01	<2.0	0.005
A9	27.11.25	East Basseriya	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A10	24.11.25	Dhansar/Kusunda	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A11	21.11.25	Dobari	<0.001	<0.001	<1.0	<0.01	<2.0	0.005
A12	21.11.25	Kusmatand Village	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A13	26.11.25	Jeenagora	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A14	26.11.25	Bhowrah North	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A15	25.11.25	Sudamdih Washery	<0.001	0.001	<1.0	<0.01	<2.0	<0.005
A16	26.11.25	Pootki	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A17	27.11.25	Moonidih UGP	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A18	21.11.25	Rudih Basti	<0.001	<0.001	<1.0	<0.01	<2.0	0.007
A19	27.11.25	Murlidih 20/21	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A20	21.11.25	Lohapatti	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005

Results of 6 Heavy Metal for the month of NOV-2025

SAMPLE CODE	DATE	Station Name	Cd CONC. IN $\mu\text{g}/\text{m}^3$	Hg CONC. IN $\mu\text{g}/\text{m}^3$	As CONC. IN ng/m^3	Cr CONC. IN $\mu\text{g}/\text{m}^3$	Ni CONC. IN ng/m^3	Pb CONC. IN $\mu\text{g}/\text{m}^3$
A21	20.11.25	Kharkharee	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A22	20.11.25	Dahibari	<0.001	<0.001	<1.0	<0.01	<2.0	0.020
A23	20.11.25	Basantimata	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A24	20.11.25	Gopinathpur	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A25	21.11.25	Guliardih	<0.001	<0.001	<1.0	<0.01	<2.0	0.005
A26	18.11.25	Begunia	<0.001	<0.001	<1.0	<0.01	<2.0	0.011
A27	17.11.25	Damagoria	<0.001	<0.001	<1.0	<0.01	<2.0	0.020
A28	26.11.25	Huriladih	<0.001	<0.001	<1.0	<0.01	<2.0	0.014
A29	27.11.25	Moonidih Washery	<0.001	0.005	<1.0	<0.01	<2.0	<0.005
A30	24.11.25	Sitanala	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A31	25.11.25	Dumarda	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A32	20.11.25	Telmacho Bridge	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A33	24.11.25	Madhuband UGP	<0.001	0.001	<1.0	<0.01	<2.0	<0.005
A34	24.11.25	Bhojudih Washery	<0.001	0.015	<1.0	<0.01	<2.0	0.024
A35	17.11.25	Dugda Washery	<0.001	0.006	<1.0	<0.01	<2.0	0.016
A36	28.11.25	Mahuda	<0.001	0.005	<1.0	<0.01	<2.0	<0.005
A37	28.11.25	Katras Choitudih	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A38	26.11.25	Sinidih Workshop	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A39	25.11.25	Patherdih	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A40	20.11.25	Koyla Nagar	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A41	25.11.25	Sudamdih Shaft	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A42	20.11.25	RHB	<0.001	<0.001	<1.0	<0.01	2.04	<0.005
A43	17.11.25	Pandwabhitia	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A44	17.11.25	Sadariadih	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005
A45	24.11.25	Bhojudih Buffer	<0.001	<0.001	<1.0	<0.01	<2.0	<0.012
A46	17.11.25	C.H.D	<0.001	<0.001	<1.0	<0.01	<2.0	<0.005

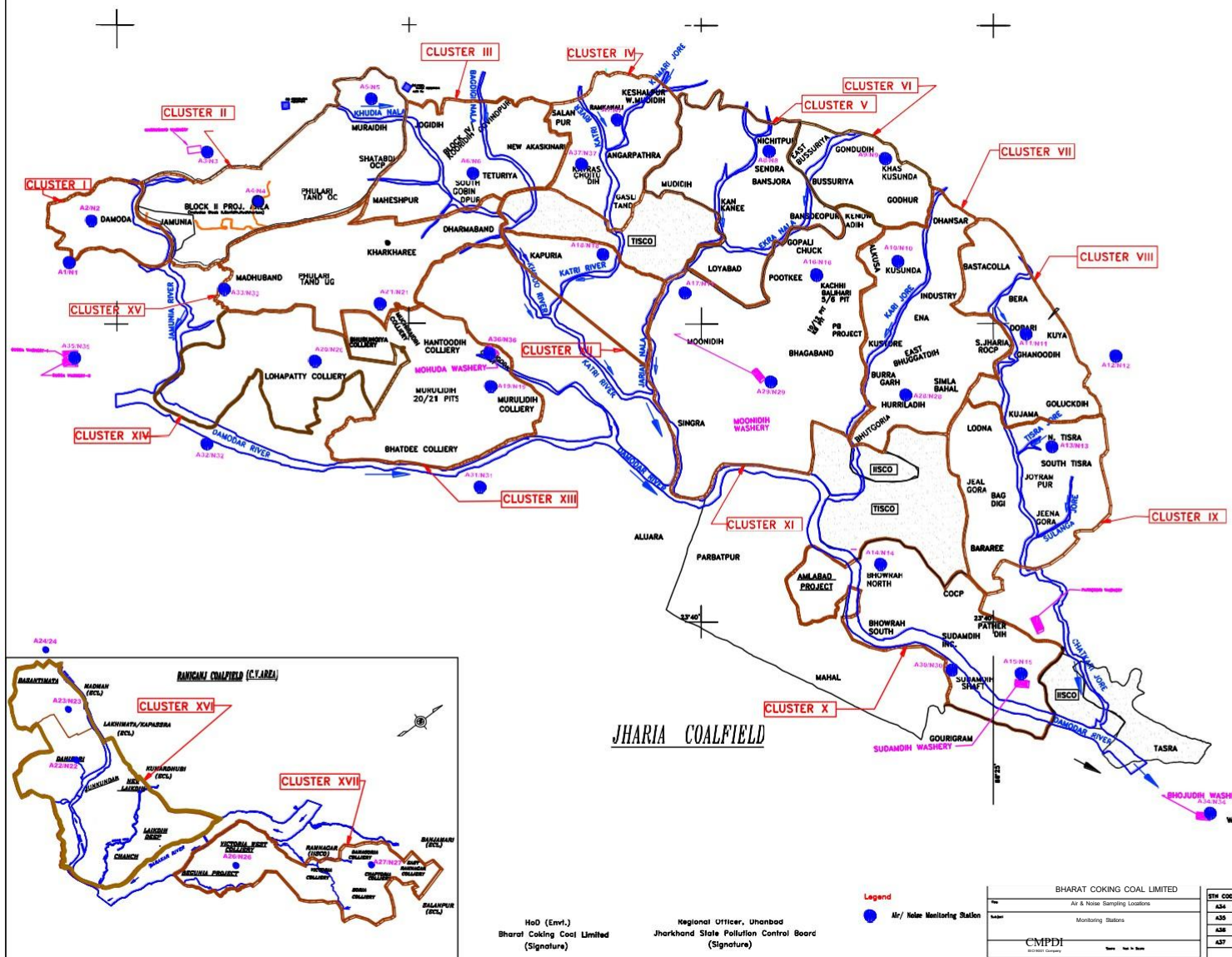
#BDL-Below detection limit

Metal	BDL	Standard as per NAAQS
Hg ($\mu\text{g}/\text{m}^3$)	0.001	*Standard Not defined
Cr($\mu\text{g}/\text{m}^3$)	0.01	*Standard Not defined
As (ng/m^3)	1	6
Pb ($\mu\text{g}/\text{m}^3$)	0.005	0.5
Ni (ng/m^3)	2	20
Cd ($\mu\text{g}/\text{m}^3$)	0.001	*Standard Not defined


 Analysed By
 JSA/SA/SSA


 Checked By
 Lab In Charge
 RI-2, CMPDI, Dhanbad

Location of Air & Noise Monitoring Stations in BCCL



Head (Env.)
Bharat Coking Coal Limited
(Signature)

Regional Officer, Unand
Jharkhand State Pollution Control Board
(Signature)

Prepared by: _____
Checked by: _____
Date: _____

Signature: _____
Name: _____

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**ENVIRONMENTAL MONITORING REPORT
OF
BHARAT COKING COAL LIMITED,
CLUSTER – XIII**

(FOR THE MONTH OCTOBER, 2025)

E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.



CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

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EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the fauna and flora. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

2.2 Water sampling stations

The Water sampling stations were selected for mine discharge water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM₁₀), Fine Particulate Matter (PM_{2.5}), Sulphur Di-oxide

(SO₂) and Nitrogen Oxides (NO_x). Respirable Dust Samplers (RDS) were used for sampling of PM₁₀, SO₂, & NO_x and Fine Dust Sampler (PM_{2.5} sampler) were used for sampling of PM_{2.5} at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

Water samples were collected as per standard practice. The Mine effluent samples were collected and analysed for four parameters on fortnightly basis. Thereafter the samples were preserved and analysed at the Environmental Laboratory of CMPDI, RI- II, Dhanbad.

3.3 Noise level monitoring

Noise level measurements in form of 'LEQ' were taken using Integrated Data Logging Sound Level Meter. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB(A).

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like PM₁₀, PM_{2.5}, SO₂ and NO_x are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM₁₀& PM_{2.5} exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

The following preventive and suppressive mitigative measures can be undertaken to contain the pollution level within prescribed level:-

- Wet drilling and controlled blasting should be practice.
- Explosive used should be optimised to restrict the dust generation.
- Transportation roads should be permanently asphalted free of ruts, potholes etc.
- Water should be sprayed on coal transportation road, service road more frequently and at regular interval.
- Dust from roads should be removed physically or mechanically.
- Greenbelts around industrial sites, service building area besides Avenue plantation along roads should be created.
- Coal dust should be suppressed by using fixed sprinklers.
- Regular maintenance of plant and machinery should be undertaken.

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, are within permissible limits.

4.3 Noise Level

During the noise level survey it has been observed that the noise level in the sampling locations is within the permissible limits prescribed as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines for Industrial Area and Noise pollution (Regulation and Control) Rules, 2000.

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdih. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Katri River & Damodar River..

- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

Ministry of Environment, Forests and Climate Change while granting environmental clearance has given one of the General conditions that “ Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM₁₀, PM_{2.5}, SO₂, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board.” And other conditions regarding water / effluent and noise level monitoring.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC& SPCB and other statutory authorities.

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Murlidih 20/21 (A19): Industrial Area

The location of the sampling station is 23°43' 51.82" N & 86° 16' 21.17" E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

II. BUFFER ZONE Monitoring Location

i) Lohapatti (A20)

The location of the sampling station is 23°44'29.42" N & 86°16'49.96" E. The sampler was placed at a height of approx. 1.5m above ground level at Safety Office.

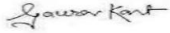
ii) Kharkharee CISF Office (A21)

The location of the sampling station is 23°46' 29.00" N 86° 14' 37.08"E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

ii) Dumarda (A31)

The location of the sampling station is 23° 42' 50.00" N 86° 15' 4.00"E. The location was selected for studying the impact of the mining activity on the DuAPRILda village as it lies in the buffer zone for the Cluster

AMBIENT AIR QUALITY DATA

 		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in	
Test Report for Ambient Air Samples							
Month & Year	10/2024	Cluster	Cluster XIII			ULR No.	TC1432125000002198F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	05.12.2025
Project	Murlidih 20/21	Sample Ref. No.	REM/BCCL/2025/10		Sampling Method	CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling	09.10.25	24.10.25	Period of Analysis	09.10.25	25.11.25	Zone of Station:	Core Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)
			A4662	A4742			NAAQS, 2009
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	77	74	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300
2	PM _{2.5}	IS -5182(Part 24):2019	34	33	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	20	26	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120
Environmental Condition : Sunny							
* LDL indicates Lower Detection Limit,							
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,							
 ANALYSED BY		 (Gaurav Kant) REVIEWED BY			 (Kumar vaibhav) Authorised Signatory		
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
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Test Report for Ambient Air Samples

Month & Year		10/2025	Cluster	Cluster XIII				ULR No.	TC1432125000002198F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	05.12.2025
Project		Lohapatti		Sample Ref. No.	REM/BCCL/2025/10	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		08.10.25		23.10.25	Period of Analysis	08.10.25	25.11.25	Zone of Station:	Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009	
			A4651	A4730					
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	78	76	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100	
2	PM _{2.5}	IS -5182(Part 24):2019	34	30	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60	
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	10	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80	
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	17	27	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80	

Environmental Condition : Sunny

** LDL indicates Lower Detection Limit,*

***All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,*

ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Kumar vaibhav)
Authorised Signatory

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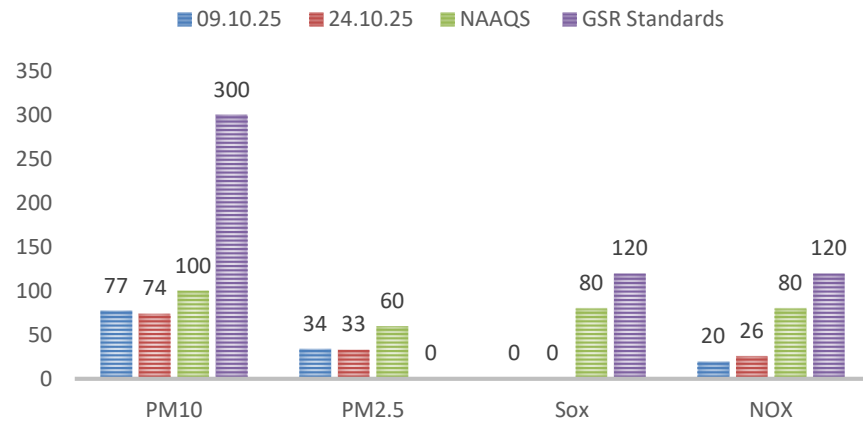
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Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

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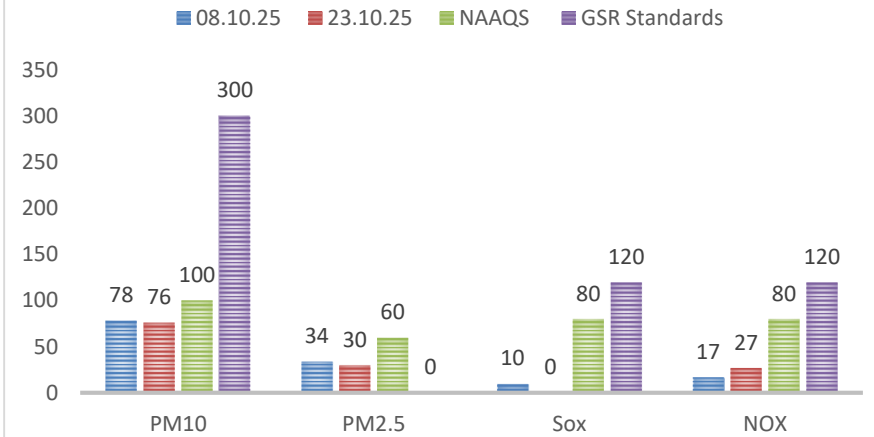
Test Report for Ambient Air Samples											
Month & Year		10/2025		Cluster		Cluster XIII		ULR No.		TC1432125000002198F	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue		05.12.2025	
Project		Kharkharee		Sample Ref. No.		REM/BCCL/2025/10		Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		10.10.25		28.10.25		Period of Analysis		10.10.2025		25.11.2025	
Zone of Station:		Buffer Zone									
Sl. No.		Parameter		Method of Analysis		Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing		LDL	
						A4674		A4751			
										MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	
										NAAQS, 2009	
1		PM ₁₀		IS -5182(Part 23):2006, R-2017		73		70		10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	
2		PM _{2.5}		IS -5182(Part 24):2019		35		35		10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	
3		SO ₂		IS-5182(Part-2): 2001 , R-2017		<10		10		10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	
4		NO ₂		IS-5182 (Part-6): 2006 , R-2017		34		29		06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	
Environmental Condition : Sunny											
* LDL indicates Lower Detection Limit,											
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,											
 ANALYSED BY				 REVIEWED BY (Gaurav Kant)				 Authorised Signatory (Kumar vaibhav)			
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 		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in	
Test Report for Ambient Air Samples							
Month & Year	10/2025	Cluster	XIII			ULR No.	TC1432125000002198F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	05.12.2025
Project	Dumarda	Sample Ref. No.	REM/BCCL/2025/10	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling	09.10.25	24.10.25	Period of Analysis	09.10.25	25.11.25	Zone of Station:	Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)
			A4667	A4746			NAAQS, 2009
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	82	75	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300
2	PM _{2.5}	IS -5182(Part 24):2019	37	32	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	21	33	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120
Environmental Condition : Sunny							
* LDL indicates Lower Detection Limit,							
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,							
 ANALYSED BY		 (Gaurav Kant) REVIEWED BY		 (Kumar vaibhav) Authorised Signatory			
Note: The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.							
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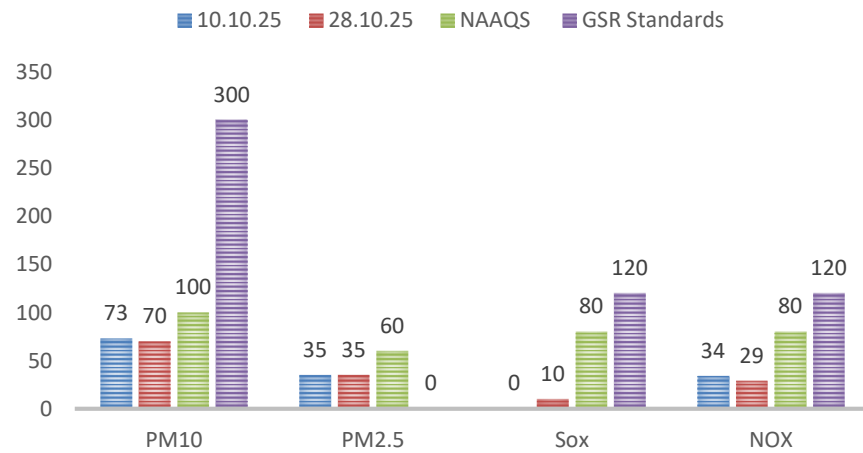
AMBIENT AIR QUALITY AT MURLIDIH 20/21



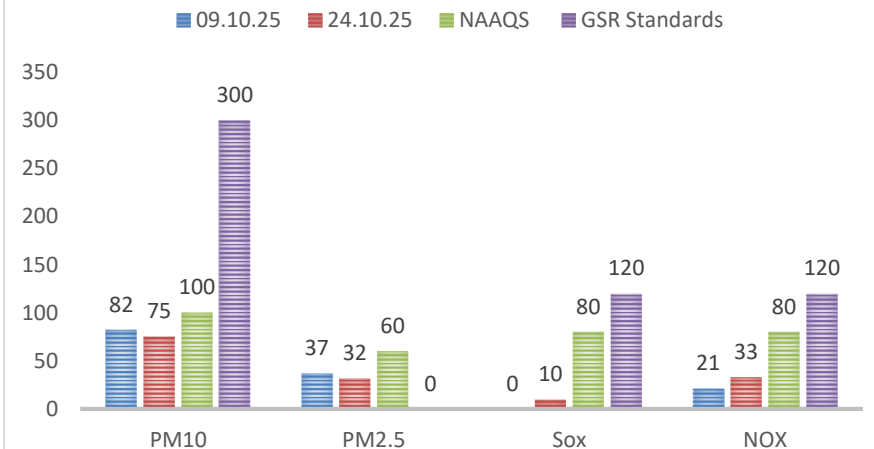
AMBIENT AIR QUALITY AT LOHAPATTI



AMBIENT AIR QUALITY AT KHARKHAREE



AMBIENT AIR QUALITY AT DUMARDA



WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Murlidih 20/21 (MW13)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jamunia.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDI, RI-II
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Test Report for Mine Effluent samples

Month & Year	10/2025	Cluster	Cluster XIII		ULR No.		TC1432125000002215F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	05.12.2025	
Project		Sampling Ref. No.	REM/BCCL/2025/10		Sampling Method		IS 3025 (Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations		Murlidih 20/21	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			Period of Analysis	11.10.25 TO 31.10.25	
			Date of Sampling		11.10.25	25.10.25		
Sl. No.	Parameter	Method of Analysis	Observed Values		STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)	LDL		
			M1782	M1807				
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	41	44	41	40		
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.59	7.58	8.06	8.02		
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<4.0	<4.0	<4.0	<4.0		
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	40	44	44	48		

***Grab sampling carried out for water samples **All units in mg/L unless specified otherwise *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

ANALYSED BY

(Gaurav Kant)

REVIEWED BY

(Kumar vaibhav)

Authorised Signatory

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---- End of Report ----

NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites

- i) **Murlidih (N19)**
- ii) **Lohapatti (N20)**
- iii) **Kharkharee CISF Office (N21)**
- iv) **Dumarda (N31)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of ' L_{EQ} ' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented. The observed values at all the monitoring locations are found to be within permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

CMPDI, RI-II
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 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Month & Year	10/2025	Cluster	Cluster XIII				ULR No.	TC1432125000002232F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	05.12.2025	
Project			Sample Ref. No.	REM/BCCL/2025/10		Sampling Method		CMPDI/RI-II/LPM 22	
Sampling Stations	i	Murlidih		Date of Sampling	09.10.25	24.10.25	Zone Category of Station:		Core Zone
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	49.4	49.3	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	49.5	49.7					
3		08:00 - 09:00	51.6	52.7					
4		09:00 – 10:00	50.9	51.8					
5		10:00 - 11:00	53.8	53.8					
6		11:00 - 12:00	54.3	53.9					
7		12:00 - 13:00	55.8	56.9					
8		13:00 - 14:00	56.2	56.3					
9		14:00 - 15:00	56.7	56.9					
10		15:00 - 16:00	57.8	58.9					
11		16:00 - 17:00	57.6	57.2					
12		17:00 - 18:00	55.2	55.2					
13		18:00 - 19:00	51.8	52.7					
14		19:00 - 20:00	51.5	51.8					
15		20:00 - 21:00	50.5	50.5					
16		21:00 - 22:00	50.3	50.2					
		Leq DAY	54.2	54.6					
1	Noise Level dB(A)Leq -Night	22:00-23:00	37.6	37.8	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	37.2	37.7					
3		00:00- 01:00	36.9	37.4					
4		01.00-02.00	36.8	37.3					
5		02.00-03.00	36.7	36.9					
6		03.00-04.00	37.2	36.7					
7		04.00-05.00	37.4	37.2					
8		05:00-06:00	37.6	37.3					
		Leq Night	37.2	37.3					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants

(Gaurav Kant)
REVIEWED BY

ANALYSED BY

(Kumar vaibhav)
Authorised Signatory

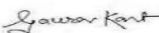
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	10/2025	Cluster	Cluster XIII				ULR No.	TC143212500002232F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	05.12.2025	
Project		Sample Ref. No.	REM/BCCL/2025/10			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Lohapatti	Date of Sampling	08.10.25	23.10.25	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	36.4	37.1	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	47	46.2					
3		08:00 - 09:00	41.8	46.7					
4		09:00 - 10:00	39	41.5					
5		10:00 - 11:00	41.8	43.2					
6		11:00 - 12:00	40.4	45.5					
7		12:00 - 13:00	41.5	44.1					
8		13:00 - 14:00	42.7	45.7					
9		14:00 - 15:00	42.1	43.5					
10		15:00 - 16:00	44.7	45					
11		16:00 - 17:00	44.8	44.9					
12		17:00 - 18:00	44.6	45.7					
13		18:00 - 19:00	44.6	45.5					
14		19:00 - 20:00	44.1	43.7					
15		20:00 - 21:00	44	43.8					
16		21:00 - 22:00	43.8	43.7					
		Leq Day	43.3	44.5					
1	Noise Level dB(A)Leq - Night	22:00-23:00	41	41	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	40.9	40.4					
3		00:00- 01:00	40.6	40.5					
4		01:00-02:00	40.3	41.1					
5		02:00-03:00	40.2	40.4					
6		03:00-04:00	40.1	40.2					
7		04:00-05:00	39.7	40.3					
8		05:00-06:00	40.4	40.7					
		Leq Night	40.4	40.6					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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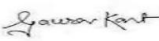
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Page -1 of 1

  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	10/2025	Cluster	Cluster XIII					ULR No.	TC143212500002232F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue	05.12.2025
Project		Sample Ref. No.	REM/BCCL/2025/10			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Kharkharee	Date of Sampling	10.10.25	28.10.25	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	43.7	44.5	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	59.1	59					
3		08:00 - 09:00	70.2	70.4					
4		09:00 - 10:00	70.1	69.8					
5		10:00 - 11:00	66.5	65.4					
6		11:00 - 12:00	63.6	63.2					
7		12:00 - 13:00	61.2	62.2					
8		13:00 - 14:00	59.6	58.9					
9		14:00 - 15:00	57.4	56.7					
10		15:00 - 16:00	55.8	56.1					
11		16:00 - 17:00	56.1	56.8					
12		17:00 - 18:00	55.9	56.5					
13		18:00 - 19:00	53.3	53.3					
14		19:00 - 20:00	51.5	51.6					
15		20:00 - 21:00	49.5	49.7					
16		21:00 - 22:00	48.9	49.3					
		Leq Day	63.1	63.0					
1	Noise Level dB(A)Leq -Night	22:00-23:00	43.6	41.6	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	41	41.5					
3		00:00- 01:00	41.1	41.5					
4		01:00-02:00	39.4	40.5					
5		02:00-03:00	39.1	36.2					
6		03:00-04:00	38.6	39.9					
7		04:00-05:00	38.4	37.4					
8		05:00-06:00	37.2	35.2					
		Leq Night	40.2	39.8					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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Page -1 of 1

  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD - 826005 Phone: 0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	10/2025	Cluster	XIII				ULR No.	TC1432125000002232F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	05.12.2025	
Project		Sample Ref. No.	REM/BCCL/2025/10			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Dumarda	Date of Sampling	09.10.25	24.10.25	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	45	45.6	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	49	50.2					
3		08:00 - 09:00	50.1	50.9					
4		09:00 - 10:00	50.5	51.3					
5		10:00 - 11:00	55.8	53					
6		11:00 - 12:00	61.5	60.9					
7		12:00 - 13:00	64.4	63.5					
8		13:00 - 14:00	65.9	64.3					
9		14:00 - 15:00	60.1	59.1					
10		15:00 - 16:00	51.2	51.1					
11		16:00 - 17:00	52.7	51.1					
12		17:00 - 18:00	50	50.2					
13		18:00 - 19:00	57.3	58.4					
14		19:00 - 20:00	51.7	56.1					
15		20:00 - 21:00	50.2	55.5					
16		21:00 - 22:00	45	45.7					
		Leq Day	58.4	57.7					
1	Noise Level dB(A)Leq -Night	22:00-23:00	42.5	43	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	42.3	42.9					
3		00:00- 01:00	42.2	42.6					
4		01:00-02:00	42.1	42.3					
5		02:00-03:00	41.7	42.2					
6		03:00-04:00	41.2	41.6					
7		04:00-05:00	40.9	41.2					
8		05:00-06:00	42.5	42.6					
		Leq Night	42.0	42.3					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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Ambient Air Quality Standards for Jharia Coal Field
As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R. 742(E), dated 25.9.2000.

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m ³ 700 µg/m ³	- High Volume Sampling (Average flow rate not less than 1.1 m ³ /min)
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m ³ 300 µg/m ³	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO ₂)	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO ₂	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause 2.

** 24 hourly/8 hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th NOVEMBER 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

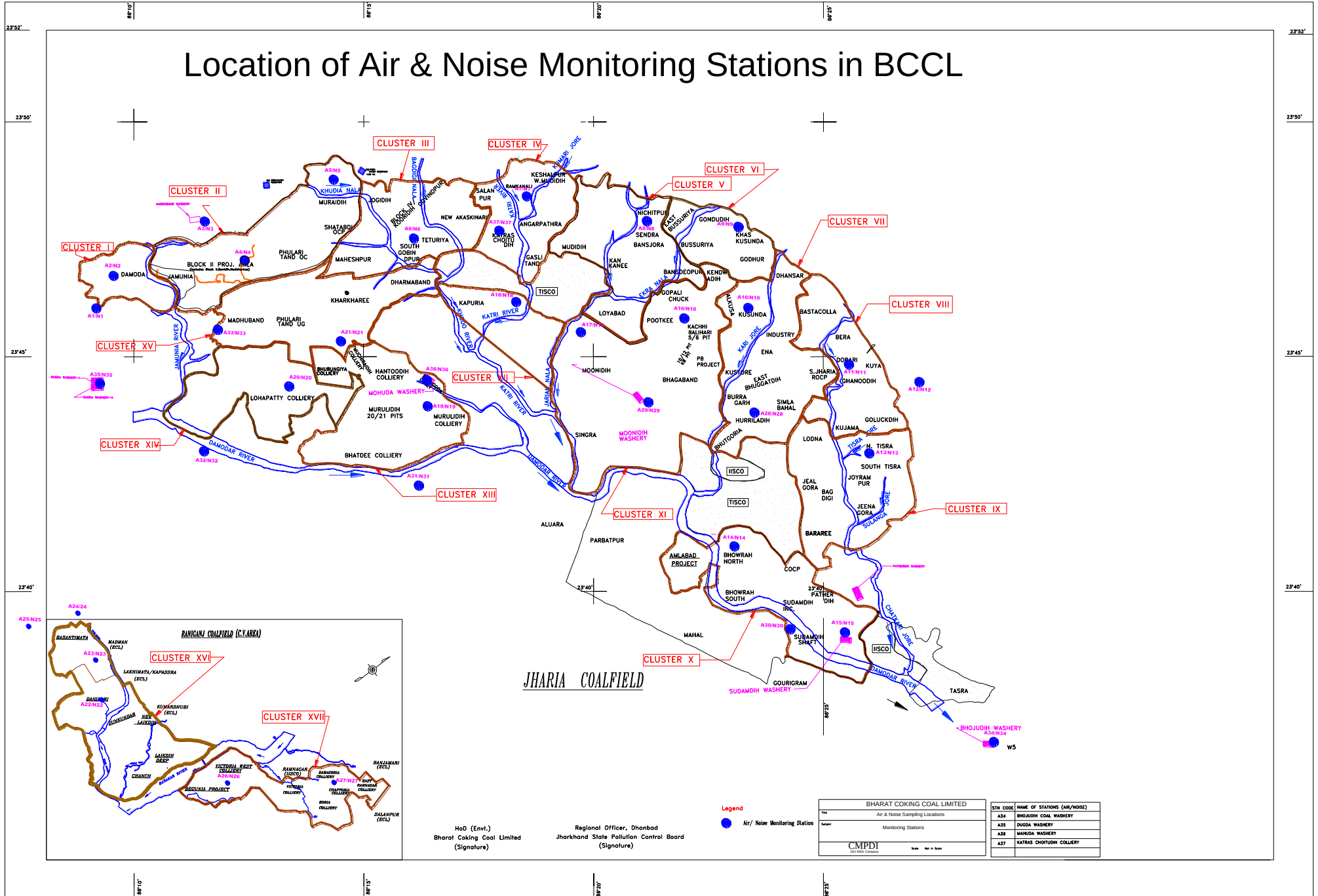
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO₂), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogendioxide (NO₂), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob &Hochheiser modified (NaOH-NaAsO ₂) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM₁₀, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or PM_{2.5}, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O₃) , µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb) , µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH₃), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C₆H₆), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed byHPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

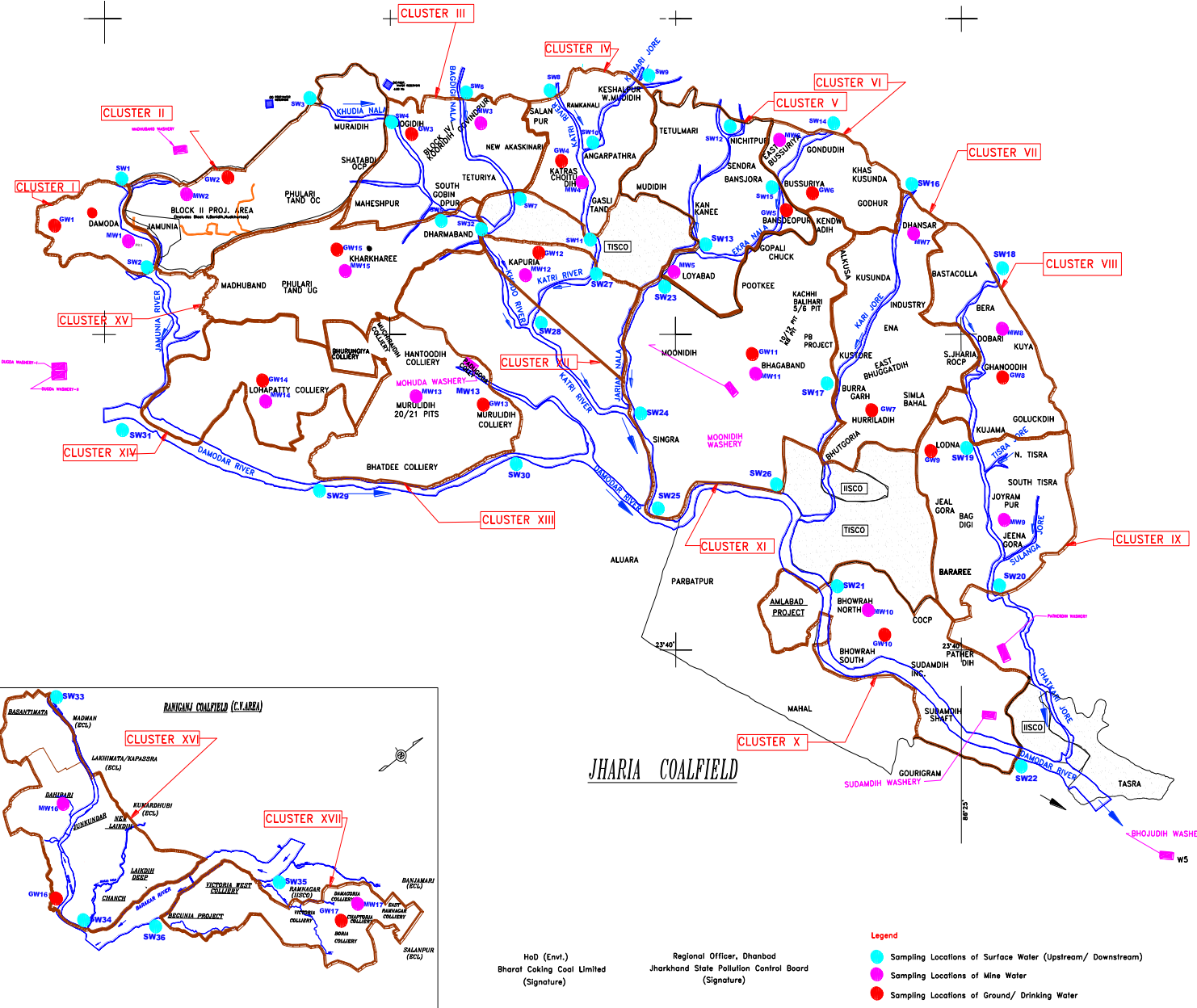
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they JUNE exceed the limits but not on two consecutive days of monitoring.

NOTE:Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category

Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL



INDEX

Cluster	Surface Water (JUS, DIS)	Name of River/Nala	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Damodar River	MW1	Damoda Area	GW1	Chutkai Village
II	SW3, SW4	Khudra Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudra Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogdih Village
IV	SW8, SW11, SW9, SW10	Kain River, Kuman Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansora Borewell
VII	SW16, SW17	Kain Jore	MW7	Bhansar UGP	GW7	Huriladih
VIII	SW18, SW19	Kain Jore	MW8	Doban UGP	GW8	Ghanudih
IX	SW19, SW20	Kain Jore	MW9	Jewagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband UGP	GW11	Bhagaband
XII	SW27, SW28	Kain River	MW12	Kapura	GW12	Kapura
XIII	SW29, SW30	Damodar River	MW13	Murudih (20/21)	GW13	Murudih
XIV	SW31, SW32	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW33, SW34	Khudra Nala	MW15	Kharkhar UGP	GW15	Kharkhar
XVI	SW35, SW36	Khudra River	MW16	Dahiban OCP	GW16	Palaban Village
XVII	SW37, SW38	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria

HoD (Env.)
Bharat Coking Coal Limited
(Signature)

Regional Officer, Dhanbad
Jharkhand State Pollution Control Board
(Signature)

Legend

- Sampling Locations of Surface Water (Upstream/ Downstream)
- Sampling Locations of Mine Water
- Sampling Locations of Ground/ Drinking Water

Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS
Scale	Not to Scale

CMPDI
COAL MINING PROJECTS DEVELOPMENT INSTITUTE

STRICTLY RESTRICTED**FOR COMPANY USE ONLY RESTRICTED**

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ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER – XIII

(FOR THE MONTH NOVEMBER, 2025)

E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.



CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

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2.	CHAPTER-II	INTRODUCTION	6
3.	CHAPTER-III	RESULTS	7-19
4.	CHAPTER-IV	STANDARDS AND PLANS	20-21

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the fauna and flora. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

2.2 Water sampling stations

The Water sampling stations were selected for mine discharge water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM₁₀), Fine Particulate Matter (PM_{2.5}), Sulphur Di-oxide

(SO₂) and Nitrogen Oxides (NO_x). Respirable Dust Samplers (RDS) were used for sampling of PM₁₀, SO₂, & NO_x and Fine Dust Sampler (PM_{2.5} sampler) were used for sampling of PM_{2.5} at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

Water samples were collected as per standard practice. The Mine effluent samples were collected and analysed for four parameters on fortnightly basis. Thereafter the samples were preserved and analysed at the Environmental Laboratory of CMPDI, RI- II, Dhanbad.

3.3 Noise level monitoring

Noise level measurements in form of 'LEQ' were taken using Integrated Data Logging Sound Level Meter. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB(A).

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like PM₁₀, PM_{2.5}, SO₂ and NO_x are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM₁₀& PM_{2.5} exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

The following preventive and suppressive mitigative measures can be undertaken to contain the pollution level within prescribed level:-

- Wet drilling and controlled blasting should be practice.
- Explosive used should be optimised to restrict the dust generation.
- Transportation roads should be permanently asphalted free of ruts, potholes etc.
- Water should be sprayed on coal transportation road, service road more frequently and at regular interval.
- Dust from roads should be removed physically or mechanically.
- Greenbelts around industrial sites, service building area besides Avenue plantation along roads should be created.
- Coal dust should be suppressed by using fixed sprinklers.
- Regular maintenance of plant and machinery should be undertaken.

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, are within permissible limits.

4.3 Noise Level

During the noise level survey it has been observed that the noise level in the sampling locations is within the permissible limits prescribed as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines for Industrial Area and Noise pollution (Regulation and Control) Rules, 2000.

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdih. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Katri River & Damodar River..

- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

Ministry of Environment, Forests and Climate Change while granting environmental clearance has given one of the General conditions that “ Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM₁₀, PM_{2.5}, SO₂, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board.” And other conditions regarding water / effluent and noise level monitoring.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC& SPCB and other statutory authorities.

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Murlidih 20/21 (A19): Industrial Area

The location of the sampling station is 23°43' 51.82" N & 86° 16' 21.17" E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

II. BUFFER ZONE Monitoring Location

i) Lohapatti (A20)

The location of the sampling station is 23°44'29.42" N & 86°16'49.96" E. The sampler was placed at a height of approx. 1.5m above ground level at Safety Office.

ii) Kharkharee CISF Office (A21)

The location of the sampling station is 23°46' 29.00" N 86° 14' 37.08"E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

ii) Dumarda (A31)

The location of the sampling station is 23° 42' 50.00" N 86° 15' 4.00"E. The location was selected for studying the impact of the mining activity on the DuAPRILda village as it lies in the buffer zone for the Cluster

AMBIENT AIR QUALITY DATA

 		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report TC14321251300002252F				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in	
Test Report for Ambient Air Samples							
Month & Year	11/2024	Cluster	Cluster XIII			ULR No.	TC14321251300002252F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	12.01.2025
Project	Murlidih 20/21	Sample Ref. No.	REM/BCCL/2025/11		Sampling Method	CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling	13.11.25	27.11.25	Period of Analysis	13.11.25	25.12.25	Zone of Station:	Core Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)
			A4803	A4881			NAAQS, 2009
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	81	90	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300
2	PM _{2.5}	IS -5182(Part 24):2019	35	34	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	33	24	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120
<i>Environmental Condition : Sunny</i>							
<i>* LDL indicates Lower Detection Limit,</i>							
<i>**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,</i>							
 ANALYSED BY		 (Gaurav Kant) REVIEWED BY		 (Kumar vaibhav) Authorised Signatory			
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.							
---- End of Report ---- Page -1 of 1							



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

Test Report for Ambient Air Samples

Month & Year		11/2025	Cluster	Cluster XIII			ULR No.		TC14321251300002252F	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue		12.01.2025	
Project		Lohapatti		Sample Ref. No.	REM/BCCL/2025/11	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)		
Date of Sampling		07.11.25		21.11.25	Period of Analysis	08.10.25	25.12.25	Zone of Station:		Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009		
			A4815	A4893						
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	120	94	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100		
2	PM _{2.5}	IS -5182(Part 24):2019	61	48	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60		
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80		
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	32	28	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80		

Environmental Condition : Sunny

** LDL indicates Lower Detection Limit,*

***All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,*

(Signature)

ANALYSED BY

(Signature)

REVIEWED BY

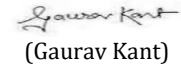
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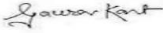
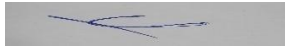
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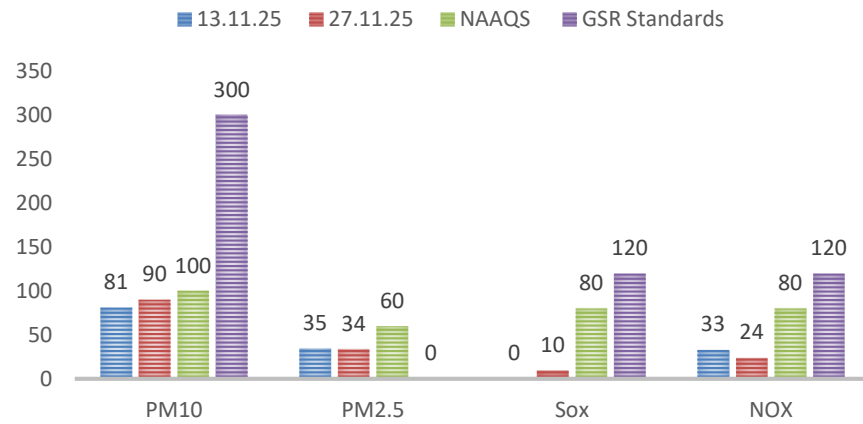
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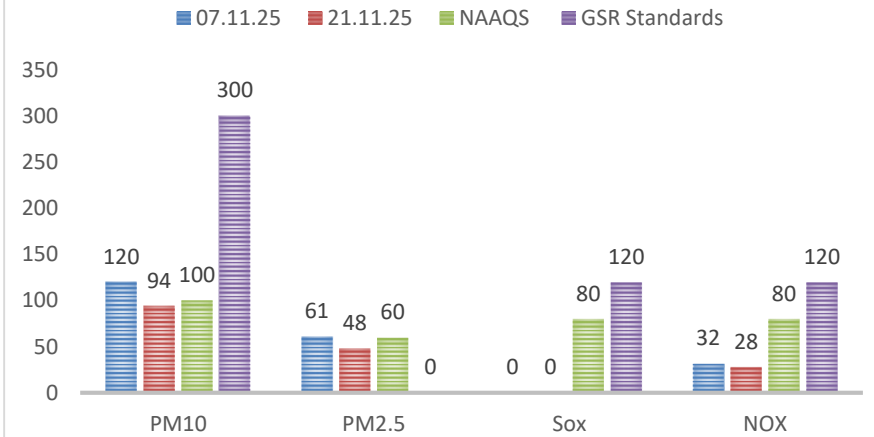
  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in											
Test Report for Ambient Air Samples											
Month & Year		11/2025		Cluster		Cluster XIII		ULR No.		TC14321251300002252F	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue		12.01.2025	
Project		Kharkharee		Sample Ref. No.		REM/BCCL/2025/11		Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		06.11.25		20.11.25		Period of Analysis		06.11.25		25.12.2025	
Zone of Station:		Buffer Zone <th colspan="2">MoEF Standards Notification dated 25th September,2000 (GSR 742 E)</th> <td colspan="2">NAAQS, 2009 <th colspan="4"></th> </td>		MoEF Standards Notification dated 25th September,2000 (GSR 742 E)		NAAQS, 2009 <th colspan="4"></th>					
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL					
			A4808	A4886							
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	90	91	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100			
2	PM _{2.5}	IS -5182(Part 24):2019	46	48	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60			
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	12	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80			
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	27	22	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80			
Environmental Condition : Sunny											
* LDL indicates Lower Detection Limit,											
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,											
 ANALYSED BY			 REVIEWED BY			 Authorised Signatory					
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.											
---- End of Report ---- Page -1 of 1											

  cmpdi <i>A Mini Ratna Company</i>		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in		
Test Report for Ambient Air Samples								
Month & Year	11/2025	Cluster	XIII			ULR No.	TC14321251300002252F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	12.01.2025	
Project	Dumarda	Sample Ref. No.	REM/BCCL/2025/11		Sampling Method	CMPDI/RI-II/LPM 11 , (IS 5182)		
Date of Sampling	11.11.25		25.11.25	Period of Analysis	11.11.25	25.12.25	Zone of Station:	Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			A4831	A4909				
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	88	90	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100
2	PM _{2.5}	IS -5182(Part 24):2019	50	52	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	25	24	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80
<i>Environmental Condition : Sunny</i>								
<i>* LDL indicates Lower Detection Limit,</i>								
<i>**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,</i>								
 ANALYSED BY		 (Gaurav Kant) REVIEWED BY		 (Kumar vaibhav) Authorised Signatory				
Note: The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.								
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Page -1 of 1								

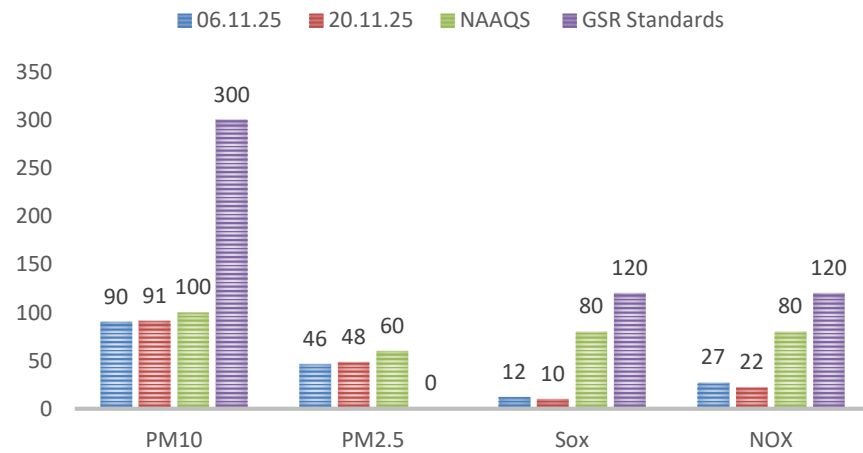
AMBIENT AIR QUALITY AT MURLIDIH 20/21



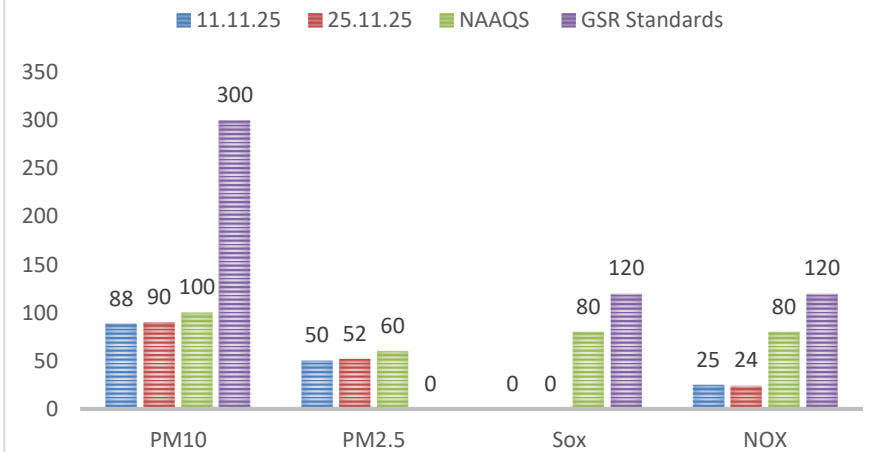
AMBIENT AIR QUALITY AT LOHAPATTI



AMBIENT AIR QUALITY AT KHARKHAREE



AMBIENT AIR QUALITY AT DUMARDA



WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Murlidih 20/21 (MW13)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jamunia.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Test Report for Mine Effluent samples

Month & Year	11/2025	Cluster	Cluster XIII	ULR No.	TC14321253000002269F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue 12.01.2025
Project		Sampling Ref. No.	REM/BCCL/2025/11	Sampling Method	IS 3025 (Part-1) CMPDI/RI-II/LPM 13
Sampling Stations	i)	Murlidih 20/21	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent		Period of Analysis 03.11.2025 TO 30.11.2025
			Date of Sampling	03.11.25 24.11.25	
Sl. No.	Parameter	Method of Analysis	Observed Values		STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)
			M1829	M1856	LDL
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	40	44	41
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.86	7.88	8.06
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<4.0	<4.0	<4.0
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	44	40	44

**Grab sampling carried out for water samples **All units in mg/L unless specified otherwise *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

ANALYSED BY

(Gaurav Kant)

REVIEWED BY

(Kumar vaibhav)

Authorised Signatory

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites

- i) **Murlidih (N19)**
- ii) **Lohapatti (N20)**
- iii) **Kharkharee CISF Office (N21)**
- iv) **Dumarda (N31)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of ' L_{EQ} ' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented. The observed values at all the monitoring locations are found to be within permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Month & Year	11/2025	Cluster	Cluster XIII					ULR No.	TC14321254700002286F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)								Date of Issue	12.01.2025
Project			Sample Ref. No.		REM/BCCL/2025/11		Sampling Method		CMPDI/RI-II/LPM 22	
Sampling Stations	i	Murlidih		Date of Sampling		13.11.25	27.11.25	Zone Category of Station:		Core Zone
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards		
			First Fortnight	Second Fortnight				Zones	Limits in dB	
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	47.6	47.5	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50	
2		07:00 - 08:00	47.7	47.9						
3		08:00 - 09:00	49.7	50.7						
4		09:00 - 10:00	49	49.9						
5		10:00 - 11:00	51.8	51.8						
6		11:00 - 12:00	52.2	51.9						
7		12:00 - 13:00	53.7	54.7						
8		13:00 - 14:00	51.3	54.3						
9		14:00 - 15:00	54.5	54.7						
10		15:00 - 16:00	55.7	56.6						
11		16:00 - 17:00	55.5	55						
12		17:00 - 18:00	53.1	53.1						
13		18:00 - 19:00	48.2	50.7						
14		19:00 - 20:00	49.6	49.9						
15		20:00 - 21:00	48.6	48.6						
16		21:00 - 22:00	47.1	48.3						
		Leq DAY	51.9	52.5						
1	Noise Level dB(A)Leq -Night	22:00-23:00	36.7	36.9	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50	
2		23:00- 00:00	36.3	36.8						
3		00:00- 01:00	36	36.5						
4		01:00-02.00	36	36.4						
5		02:00-03.00	35.9	36						
6		03:00-04.00	36.3	35.9						
7		04:00-05.00	36.5	36.3						
8		05:00-06:00	36.7	36.4						
		Leq Night	36.3	36.4						

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants

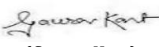
(Gaurav Kant)
REVIEWED BY

(Kumar vaibhav)
Authorised Signatory

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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	11/2025	Cluster	Cluster XIII				ULR No.	TC14321254700002286F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	12.01.2025	
Project		Sample Ref. No.	REM/BCCL/2025/11			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Lohapatti	Date of Sampling	07.11.25	21.11.25	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	35.1	35.7	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	45.3	44.5					
3		08:00 - 09:00	40.1	45					
4		09:00 - 10:00	37.5	39.9					
5		10:00 - 11:00	40.1	41.6					
6		11:00 - 12:00	38.9	40					
7		12:00 - 13:00	39.9	42.4					
8		13:00 - 14:00	41.2	43.9					
9		14:00 - 15:00	40.5	42					
10		15:00 - 16:00	43	43.4					
11		16:00 - 17:00	43.1	43.2					
12		17:00 - 18:00	42.9	43.9					
13		18:00 - 19:00	42.9	46					
14		19:00 - 20:00	42.4	42					
15		20:00 - 21:00	42.3	42.1					
16		21:00 - 22:00	42.1	42					
		Leq Day	41.7	42.9					
1	Noise Level dB(A)Leq - Night	22:00-23:00	40.1	40.1	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	40	39.5					
3		00:00- 01:00	39.7	39.6					
4		01:00-02:00	39.3	40.2					
5		02:00-03:00	39.2	39.5					
6		03:00-04:00	39.1	39.2					
7		04:00-05:00	38.8	39.3					
8		05:00-06:00	39.5	39.8					
		Leq Night	39.5	39.7					
**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit									
Sampling Assistants		 (Gaurav Kant)				 (Kumar vaibhav)			
ANALYSED BY		REVIEWED BY				Authorised Signatory			
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.									
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 		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report				CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in			
Month & Year	11/2025	Cluster	Cluster XIII				ULR No.	TC14321254700002286F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	12.01.2025	
Project		Sample Ref. No.	REM/BCCL/2025/11			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Kharkharee	Date of Sampling	06.11.25	20.11.25	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	42	42.8	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	56.8	56.7					
3		08:00 - 09:00	67.6	67.8					
4		09:00 - 10:00	69	67.2					
5		10:00 - 11:00	64	62.9					
6		11:00 - 12:00	61.3	60.8					
7		12:00 - 13:00	58.9	59.8					
8		13:00 - 14:00	57.4	56.6					
9		14:00 - 15:00	55.2	54.5					
10		15:00 - 16:00	53.7	54.1					
11		16:00 - 17:00	53.1	54.6					
12		17:00 - 18:00	53.8	54.4					
13		18:00 - 19:00	51.3	51.3					
14		19:00 - 20:00	49.6	49.7					
15		20:00 - 21:00	45.3	47.9					
16		21:00 - 22:00	45	47.5					
		Leq Day	61.1	60.5					
1	Noise Level dB(A)Leq -Night	22:00-23:00	42.7	40.6	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	40.1	40.6					
3		00:00- 01:00	40.2	40.6					
4		01:00-02:00	38.5	39.6					
5		02:00-03:00	38.3	35.3					
6		03:00-04:00	37.8	38.9					
7		04:00-05:00	37.6	36.5					
8		05:00-06:00	36.3	34.4					
		Leq Night	39.4	38.9					
**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit									
Sampling Assistants		 (Gaurav Kant) ANALYSED BY				 (Kumar vaibhav) REVIEWED BY Authorised Signatory			
Note: The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.									
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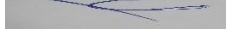
  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in										
Month & Year	11/2025	Cluster	XIII					ULR No.	TC14321254700002286F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)								Date of Issue	12.01.2025
Project		Sample Ref. No.	REM/BCCL/2025/11				Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Dumarda	Date of Sampling		11.11.25	25.11.25	Zone Category of Station:		Buffer Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards		
			First Fortnight	Second Fortnight				Zones	Limits in dB	
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	43.4	43.8	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50	
2		07:00 - 08:00	47.2	48.3						
3		08:00 - 09:00	48.2	49						
4		09:00 - 10:00	48.6	49.4						
5		10:00 - 11:00	53.7	51						
6		11:00 - 12:00	59.2	58.6						
7		12:00 - 13:00	62	61.1						
8		13:00 - 14:00	63.3	61.9						
9		14:00 - 15:00	57.9	56.8						
10		15:00 - 16:00	49.2	49.1						
11		16:00 - 17:00	50.7	49.1						
12		17:00 - 18:00	48.1	48.3						
13		18:00 - 19:00	55.1	56.2						
14		19:00 - 20:00	49.8	54.1						
15		20:00 - 21:00	48.3	53.4						
16		21:00 - 22:00	43.3	43.9						
		Leq Day	56.0	55.4						
1	Noise Level dB(A)Leq - Night	22:00-23:00	41.6	42.1	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50	
2		23:00- 00:00	41.3	42						
3		00:00- 01:00	41.2	41.7						
4		01:00-02:00	41.1	41.3						
5		02:00-03:00	40.7	41.2						
6		03:00-04:00	40.3	40.6						
7		04:00-05:00	40	40.3						
8		05:00-06:00	41.6	41.7						
		Leq Night	41.0	41.4						

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants

ANALYSED BY


 (Gaurav Kant)
REVIEWED BY


 (Kumar vaibhav)
Authorised Signatory

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

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Ambient Air Quality Standards for Jharia Coal Field
As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R. 742(E), dated 25.9.2000.

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m ³ 700 µg/m ³	- High Volume Sampling (Average flow rate not less than 1.1 m ³ /min)
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m ³ 300 µg/m ³	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO ₂)	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO ₂	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause 2.

** 24hourly/8hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th NOVEMBER 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

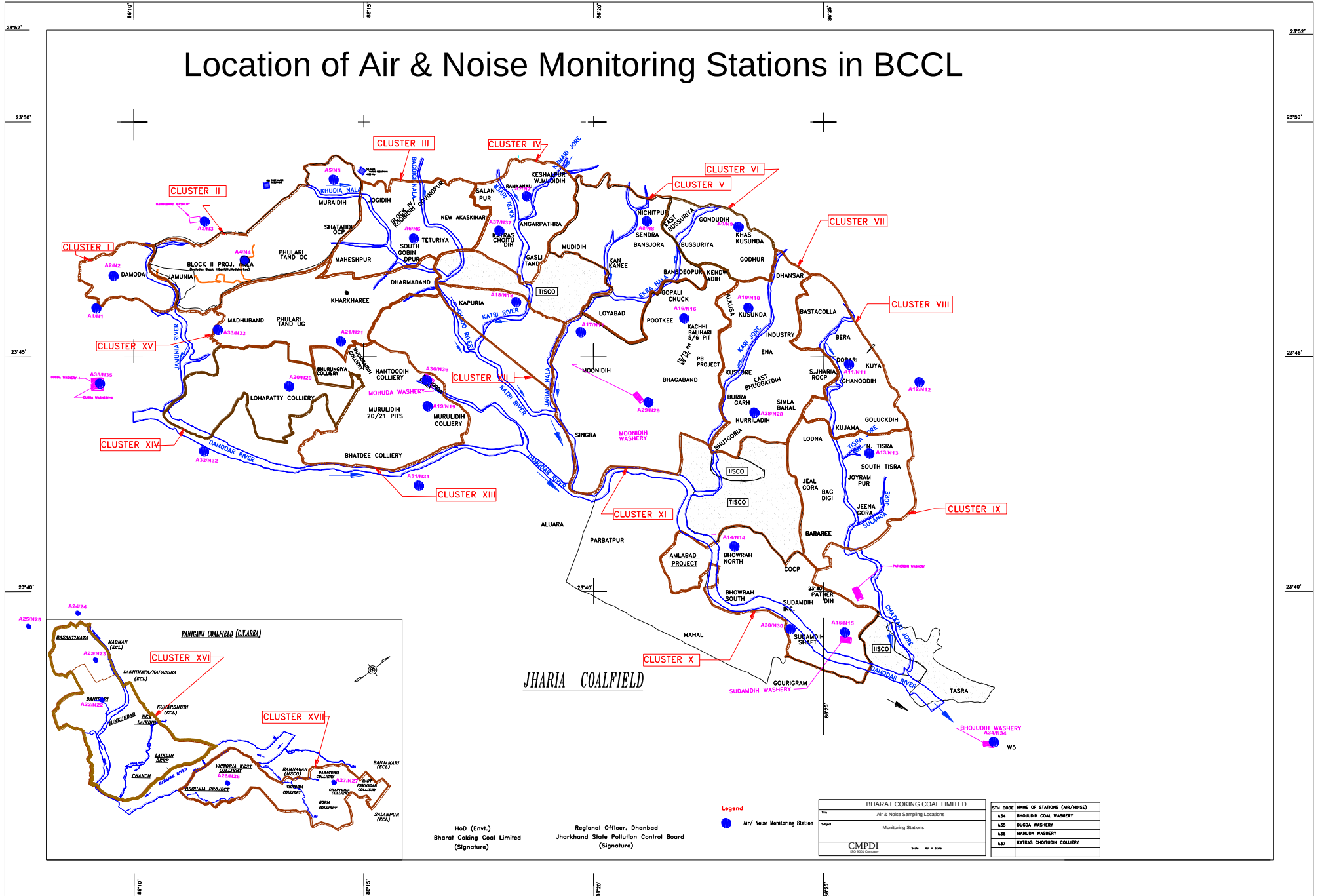
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO₂), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogen dioxide (NO₂), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob & Hochheiser modified (NaOH-NaAsO ₂) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM₁₀, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or PM_{2.5}, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O₃), µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb), µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH₃), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C₆H₆), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed by HPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

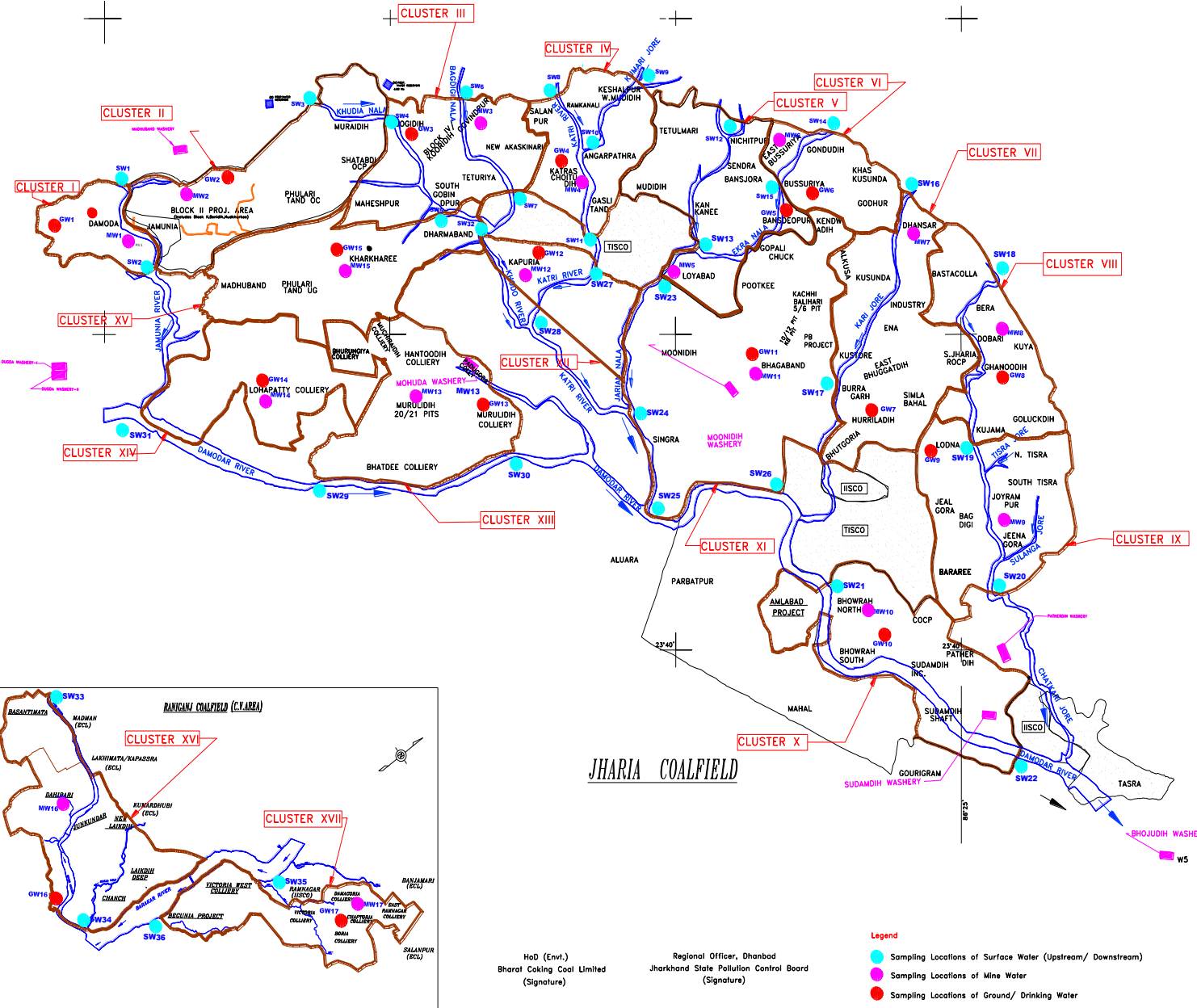
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, the area shall be treated as non-attainment area.

Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL



INDEX

Cluster	Surface Water (JUS, DIS)	Name of River/Nala	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Damodar River	MW1	Damoda Area	GW1	Chutkai Village
II	SW3, SW4	Khudra Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudra Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogdih Village
IV	SW8, SW11, SW9, SW10	Kain River, Kuman Jore	MW4	Chotudih	GW4	Kankaneer Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansora Borewell
VII	SW16, SW17	Kain Jore	MW7	Bhansar UGP	GW7	Huriladih
VIII	SW18, SW19	Kain Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kain Jore	MW9	Jewagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband UGP	GW11	Bhagaband
XII	SW27, SW28	Kain River	MW12	Kapura	GW12	Kapura
XIII	SW29, SW30	Damodar River	MW13	Murudih (20/21)	GW13	Murudih
XIV	SW31, SW32	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW33, SW34	Khudra Nala	MW15	Kharkharee UGP	GW15	Kharkharee
XVI	SW35, SW36	Khudra River	MW16	Dahibani OCP	GW16	Palabani Village
XVII	SW37, SW38	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria

Legend

- Sampling Locations of Surface Water (Upstream/ Downstream)
- Sampling Locations of Mine Water
- Sampling Locations of Ground/ Drinking Water

HoD (Env.)
Bharat Coking Coal Limited
(Signature)

Regional Officer, Dhanbad
Jharkhand State Pollution Control Board
(Signature)

Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS
Scale	Not to Scale

CMPDI
COAL MINING PROJECTS DEVELOPMENT INSTITUTE

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CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

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EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the fauna and flora. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

2.2 Water sampling stations

The Water sampling stations were selected for mine discharge water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM₁₀), Fine Particulate Matter (PM_{2.5}), Sulphur Di-oxide

(SO₂) and Nitrogen Oxides (NO_x). Respirable Dust Samplers (RDS) were used for sampling of PM₁₀, SO₂, & NO_x and Fine Dust Sampler (PM_{2.5} sampler) were used for sampling of PM_{2.5} at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

Water samples were collected as per standard practice. The Mine effluent samples were collected and analysed for four parameters on fortnightly basis. Thereafter the samples were preserved and analysed at the Environmental Laboratory of CMPDI, RI- II, Dhanbad.

3.3 Noise level monitoring

Noise level measurements in form of 'LEQ' were taken using Integrated Data Logging Sound Level Meter. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB(A).

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like PM₁₀, PM_{2.5}, SO₂ and NO_x are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM₁₀& PM_{2.5} exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

The following preventive and suppressive mitigative measures can be undertaken to contain the pollution level within prescribed level:-

- Wet drilling and controlled blasting should be practice.
- Explosive used should be optimised to restrict the dust generation.
- Transportation roads should be permanently asphalted free of ruts, potholes etc.
- Water should be sprayed on coal transportation road, service road more frequently and at regular interval.
- Dust from roads should be removed physically or mechanically.
- Greenbelts around industrial sites, service building area besides Avenue plantation along roads should be created.
- Coal dust should be suppressed by using fixed sprinklers.
- Regular maintenance of plant and machinery should be undertaken.

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, are within permissible limits.

4.3 Noise Level

During the noise level survey it has been observed that the noise level in the sampling locations is within the permissible limits prescribed as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines for Industrial Area and Noise pollution (Regulation and Control) Rules, 2000.

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdih. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Katri River & Damodar River..

- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

Ministry of Environment, Forests and Climate Change while granting environmental clearance has given one of the General conditions that “ Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM₁₀, PM_{2.5}, SO₂, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board.” And other conditions regarding water / effluent and noise level monitoring.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC& SPCB and other statutory authorities.

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Murlidih 20/21 (A19): Industrial Area

The location of the sampling station is 23°43' 51.82" N & 86° 16' 21.17" E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

II. BUFFER ZONE Monitoring Location

i) Lohapatti (A20)

The location of the sampling station is 23°44'29.42" N & 86°16'49.96" E. The sampler was placed at a height of approx. 1.5m above ground level at Safety Office.

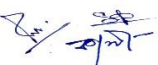
ii) Kharkharee CISF Office (A21)

The location of the sampling station is 23°46' 29.00" N 86° 14' 37.08"E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

ii) Dumarda (A31)

The location of the sampling station is 23° 42' 50.00" N 86° 15' 4.00"E. The location was selected for studying the impact of the mining activity on the DuAPRILda village as it lies in the buffer zone for the Cluster

AMBIENT AIR QUALITY DATA

 		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in		
Test Report for Ambient Air Samples								
Month & Year	12/2024	Cluster	Cluster XIII			ULR No.	TC14321266900002308F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	13.02.2026	
Project	Murlidih 20/21	Sample Ref. No.	REM/BCCL/2025/12		Sampling Method	CMPDI/RI-II/LPM 11 , (IS 5182)		
Date of Sampling	04.12.25	19.12.25	Period of Analysis	04.12.25	25.01.26	Zone of Station:	Core Zone	
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			A4808	A4886				
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	74	88	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100
2	PM _{2.5}	IS -5182(Part 24):2019	32	31	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	24	27	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80
Environmental Condition : Sunny								
* LDL indicates Lower Detection Limit,								
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,								
 ANALYSED BY		 (Gaurav Kant) REVIEWED BY				 (Kumar vaibhav) Authorised Signatory		
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.								
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

Test Report for Ambient Air Samples

Month & Year		12/2025	Cluster	Cluster XIII				ULR No.	TC14321266900002308F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	13.02.2026
Project		Lohapatti		Sample Ref. No.	REM/BCCL/2025/12	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		02.12.25		17.12.25	Period of Analysis	02.12.25	25.01.26	Zone of Station:	Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009	
			A4793	A4871					
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	106	86	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100	
2	PM _{2.5}	IS -5182(Part 24):2019	57	47	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60	
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80	
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	29	30	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80	

Environmental Condition : Sunny

** LDL indicates Lower Detection Limit,*

***All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,*

[Signature]

ANALYSED BY

[Signature]

(Gaurav Kant)
REVIEWED BY

[Signature]

(Kumar vaibhav)
Authorised Signatory

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 TC-14321  cmpdi A Mini Ratna Company CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in										
Test Report for Ambient Air Samples										
Month & Year		12/2025	Cluster		Cluster XIII			ULR No.		TC14321266900002308F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue		13.02.26	
Project		Kharkharee	Sample Ref. No.		REM/BCCL/2025/12	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)		
Date of Sampling		01.12.25	Sample Ref. No.		16.12.25	Period of Analysis		01.12.25	25.1.2026	
Zone of Station:		Buffer Zone								
MoEF Standards Notification dated 25th September,2000 (GSR 742 E)		NAAQS, 2009								
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL				
			A4785	A4863						
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	88	87	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100		
2	PM _{2.5}	IS -5182(Part 24):2019	42	47	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60		
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	10	11	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80		
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	30	36	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80		
Environmental Condition : Sunny										
* LDL indicates Lower Detection Limit,										
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,										
 ANALYSED BY			 REVIEWED BY (Gaurav Kant)			 Authorised Signatory (Kumar vaibhav)				
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
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DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

Test Report for Ambient Air Samples

Month & Year		12/2025	Cluster	XIII				ULR No.	TC14321266900002308F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	13.02.2026
Project		Dumarda		Sample Ref. No.	REM/BCCL/2025/12	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		10.12.25		26.12.25	Period of Analysis	10.12.25	25.01.2026	Zone of Station:	Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009	
			A4840	A4925					
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	84	82	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100	
2	PM _{2.5}	IS -5182(Part 24):2019	48	47	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60	
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	10	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80	
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	31	26	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80	

Environmental Condition : Sunny

** LDL indicates Lower Detection Limit,*

***All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,*

ANALYSED BY

(Gaurav Kant)
REVIEWED BY

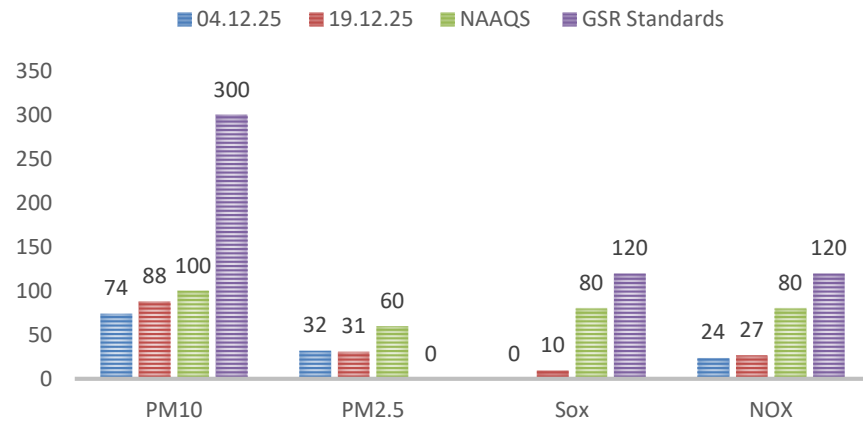
(Kumar vaibhav)
Authorised Signatory

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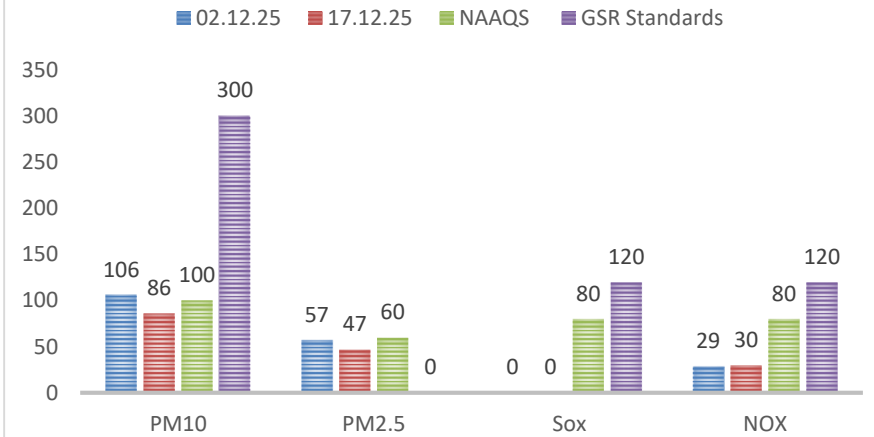
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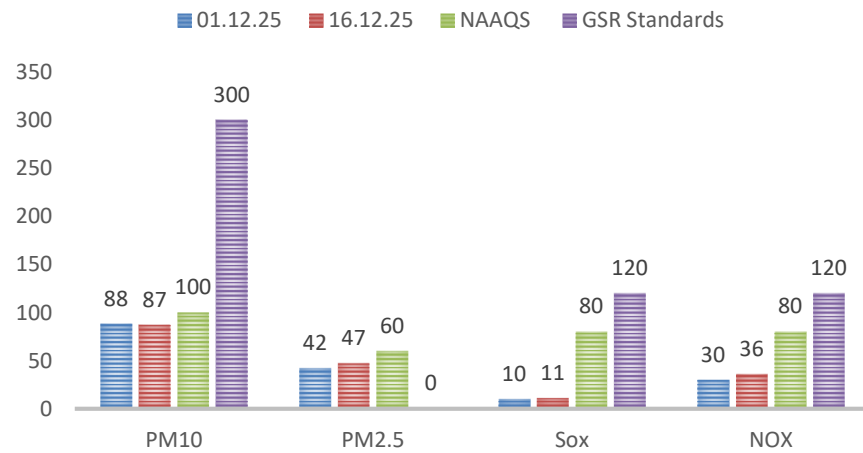
AMBIENT AIR QUALITY AT MURLIDIH 20/21



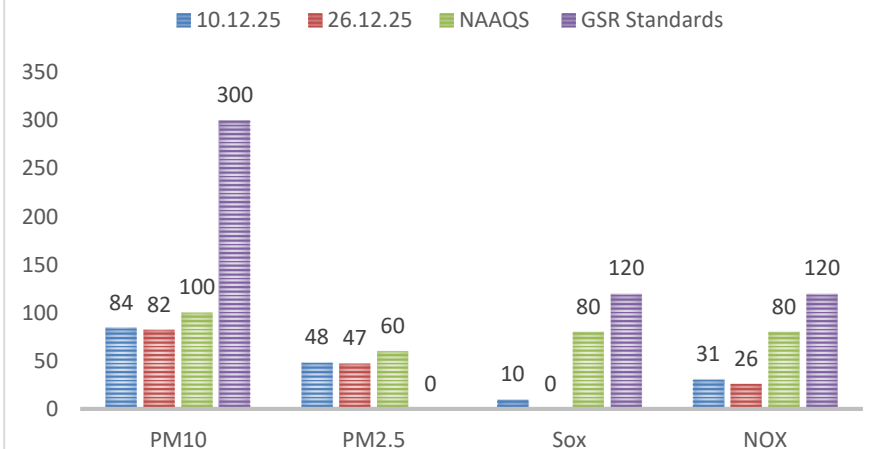
AMBIENT AIR QUALITY AT LOHAPATTI



AMBIENT AIR QUALITY AT KHARKHAREE



AMBIENT AIR QUALITY AT DUMARDA



WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Murlidih 20/21 (MW13)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jamunia.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Test Report for Mine Effluent samples

Month & Year	12/2025	Cluster	Cluster XIII	ULR No.	TC14321268600002325F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	13.02.2026
Project		Sampling Ref. No.	REM/BCCL/2025/12	Sampling Method	IS 3025 (Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations	i)	Murlidih 20/21	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent		Period of Analysis	08.12.2025 TO 30.12.2025
			Date of Sampling	08.12.25	29.12.25	
Sl. No.	Parameter	Method of Analysis	Observed Values		STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)	LDL
			M1891	M1922		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	41	45	41	40
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.88	7.82	8.06	8.02
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<4.0	<4.0	<4.0	<4.0
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	40	36	44	48

***Grab sampling carried out for water samples **All units in mg/L unless specified otherwise *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Kumar vaibhav)
Authorised Signatory

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites

- i) **Murlidih (N19)**
- ii) **Lohapatti (N20)**
- iii) **Kharkharee CISF Office (N21)**
- iv) **Dumarda (N31)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of ' L_{EQ} ' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented. The observed values at all the monitoring locations are found to be within permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Month & Year	12/2025	Cluster	Cluster XIII			ULR No.	TC143212610300002342F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	13.02.2026	
Project		Sample Ref. No.	REM/BCCL/2025/12		Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Murlidih		Date of Sampling	04.12.25	19.12.25	Zone Category of Station:	Core Zone
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards
			First Fortnight	Second Fortnight				Zones
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	47.6	47.5	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence
2		07:00 - 08:00	47.7	47.9				
3		08:00 - 09:00	49.8	50.7				
4		09:00 - 10:00	48.9	49.9				
5		10:00 - 11:00	51.7	51.7				
6		11:00 - 12:00	52.2	51.8				
7		12:00 - 13:00	53.7	54.7				
8		13:00 - 14:00	54.1	54.2				
9		14:00 - 15:00	54.5	54.7				
10		15:00 - 16:00	55.7	56.7				
11		16:00 - 17:00	55.5	55				
12		17:00 - 18:00	53.2	53.2				
13		18:00 - 19:00	49.9	50.7				
14		19:00 - 20:00	49.6	49.9				
15		20:00 - 21:00	48.6	48.6				
16		21:00 - 22:00	48.4	48.3				
		Leq DAY	52.2	52.5				
1	Noise Level dB(A)Leq -Night	22:00-23:00	36.7	36.9	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence
2		23:00- 00:00	36.3	36.8				
3		00:00- 01:00	36	36.5				
4		01:00-02:00	36	36.4				
5		02:00-03:00	35.9	36				
6		03:00-04:00	36.3	35.9				
7		04:00-05:00	36.5	36.3				
8		05:00-06:00	36.7	36.4				
		Leq Night	36.3	36.4				

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

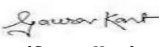
Sampling Assistants	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
ANALYSED BY		

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	12/2025	Cluster	Cluster XIII				ULR No.	TC143212610300002342F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	13.02.2026	
Project		Sample Ref. No.	REM/BCCL/2025/12			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Lohapatti	Date of Sampling	02.12.25	17.12.25	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	35	35.8	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	45.2	44.5					
3		08:00 - 09:00	40.2	45					
4		09:00 - 10:00	37.6	39.9					
5		10:00 - 11:00	40.2	41.6					
6		11:00 - 12:00	38.9	43.8					
7		12:00 - 13:00	39.9	42.4					
8		13:00 - 14:00	41.1	44.1					
9		14:00 - 15:00	40.5	41.9					
10		15:00 - 16:00	43	43.3					
11		16:00 - 17:00	43.1	43.2					
12		17:00 - 18:00	42.9	44.1					
13		18:00 - 19:00	42.9	43.8					
14		19:00 - 20:00	42.4	42.1					
15		20:00 - 21:00	42.3	42.2					
16		21:00 - 22:00	42.2	42.1					
		Leq Day	41.7	42.9					
1	Noise Level dB(A)Leq -Night	22:00-23:00	40.1	40.1	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	40	39.5					
3		00:00- 01:00	39.7	39.6					
4		01:00-02:00	39.3	40.2					
5		02:00-03:00	39.2	39.5					
6		03:00-04:00	39.1	39.2					
7		04:00-05:00	38.8	39.3					
8		05:00-06:00	39.5	39.8					
		Leq Night	39.5	39.7					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
---- End of Report ---- Page -1 of 1		

  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	12/2025	Cluster	Cluster XIII					ULR No.	TC143212610300002342F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue	13.02.2026
Project		Sample Ref. No.	REM/BCCL/2025/12			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Kharkharee		Date of Sampling	01.12.25	16.12.25	Zone Category of Station:	Buffer Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	42.1	42.8	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	56.9	56.8					
3		08:00 - 09:00	67.6	67.8					
4		09:00 - 10:00	67.5	67.3					
5		10:00 - 11:00	64	62.9					
6		11:00 - 12:00	61.3	60.8					
7		12:00 - 13:00	59	59.9					
8		13:00 - 14:00	57.3	56.7					
9		14:00 - 15:00	55.2	54.5					
10		15:00 - 16:00	53.7	54					
11		16:00 - 17:00	54	54.6					
12		17:00 - 18:00	53.8	54.4					
13		18:00 - 19:00	51.3	51.3					
14		19:00 - 20:00	49.6	49.8					
15		20:00 - 21:00	47.7	47.9					
16		21:00 - 22:00	47.1	47.5					
		Leq Day	60.6	60.5					
1	Noise Level dB(A)Leq -Night	22:00-23:00	42.7	40.6	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	40.1	40.6					
3		00:00- 01:00	40.2	40.6					
4		01:00-02:00	38.5	39.6					
5		02:00-03:00	38.3	35.3					
6		03:00-04:00	37.8	38.9					
7		04:00-05:00	37.6	36.5					
8		05:00-06:00	36.3	34.4					
		Leq Night	39.4	38.9					

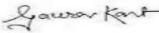
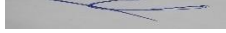
**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in										
Month & Year	12/2025	Cluster	XIII					ULR No.	TC14321261030002342F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)								Date of Issue	13.02.2026
Project		Sample Ref. No.	REM/BCCL/2025/12				Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Dumarda	Date of Sampling	10.12.25	26.12.25	Zone Category of Station:	Buffer Zone			
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards		
			First Fortnight	Second Fortnight				Zones	Limits in dB	
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	43.3	43.9	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50	
2		07:00 - 08:00	47.2	48.3						
3		08:00 - 09:00	48.2	48.9						
4		09:00 - 10:00	48.6	49.4						
5		10:00 - 11:00	53.7	51						
6		11:00 - 12:00	59.2	58.7						
7		12:00 - 13:00	62	61.1						
8		13:00 - 14:00	63.4	61.9						
9		14:00 - 15:00	57.8	56.9						
10		15:00 - 16:00	49.2	49.1						
11		16:00 - 17:00	50.7	49.1						
12		17:00 - 18:00	48.1	48.3						
13		18:00 - 19:00	55.1	56.3						
14		19:00 - 20:00	49.8	54						
15		20:00 - 21:00	48.3	53.5						
16		21:00 - 22:00	43.2	44.1						
		Leq Day	56.0	55.4						
1	Noise Level dB(A)Leq - Night	22:00-23:00	41.6	42.1	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50	
2		23:00- 00:00	41.3	42						
3		00:00- 01:00	41.2	41.7						
4		01:00-02:00	41.1	41.3						
5		02:00-03:00	40.7	41.2						
6		03:00-04:00	40.3	40.6						
7		04:00-05:00	40	40.3						
8		05:00-06:00	41.6	41.7						
		Leq Night	41.0	41.4						
**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit										
Sampling Assistants		 (Gaurav Kant) ANALYSED BY		 (Kumar vaibhav) REVIEWED BY Authorised Signatory						
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.										
---- End of Report ----										
Page -1 of 1										

Ambient Air Quality Standards for Jharia Coal Field
As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R.
742(E), dated 25.9.2000.

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m ³ 700 µg/m ³	- High Volume Sampling (Average flow rate not less than 1.1
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m ³ 300 µg/m ³	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO ₂)	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO ₂	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause 2.

** 24 hourly/8 hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th NOVEMBER 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

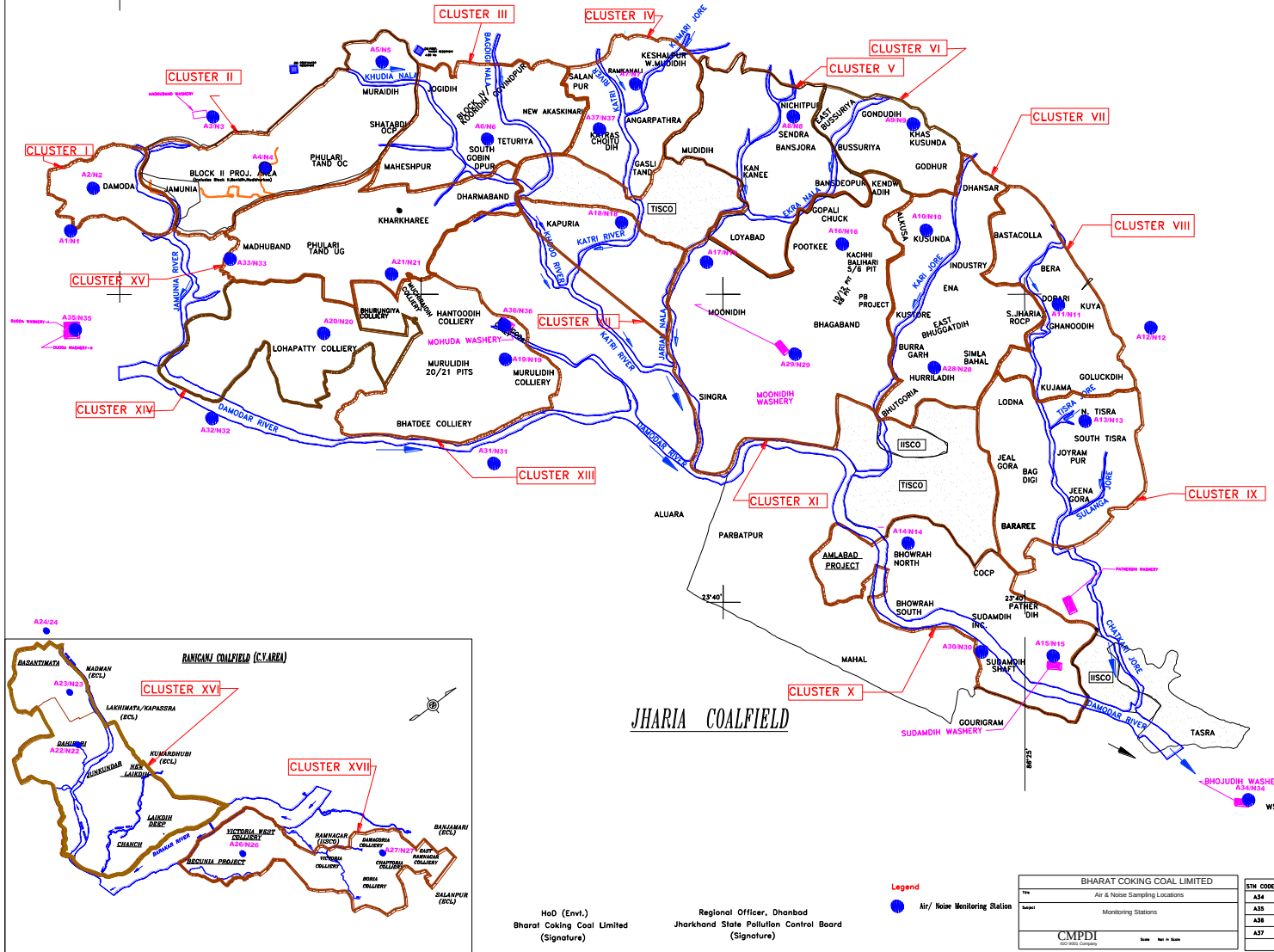
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO₂), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogen dioxide (NO₂), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob & Hochheiser modified (NaOH-NaAsO ₂) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM₁₀, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or PM_{2.5}, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O₃) , µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb) , µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH₃), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C₆H₆), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed by HPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

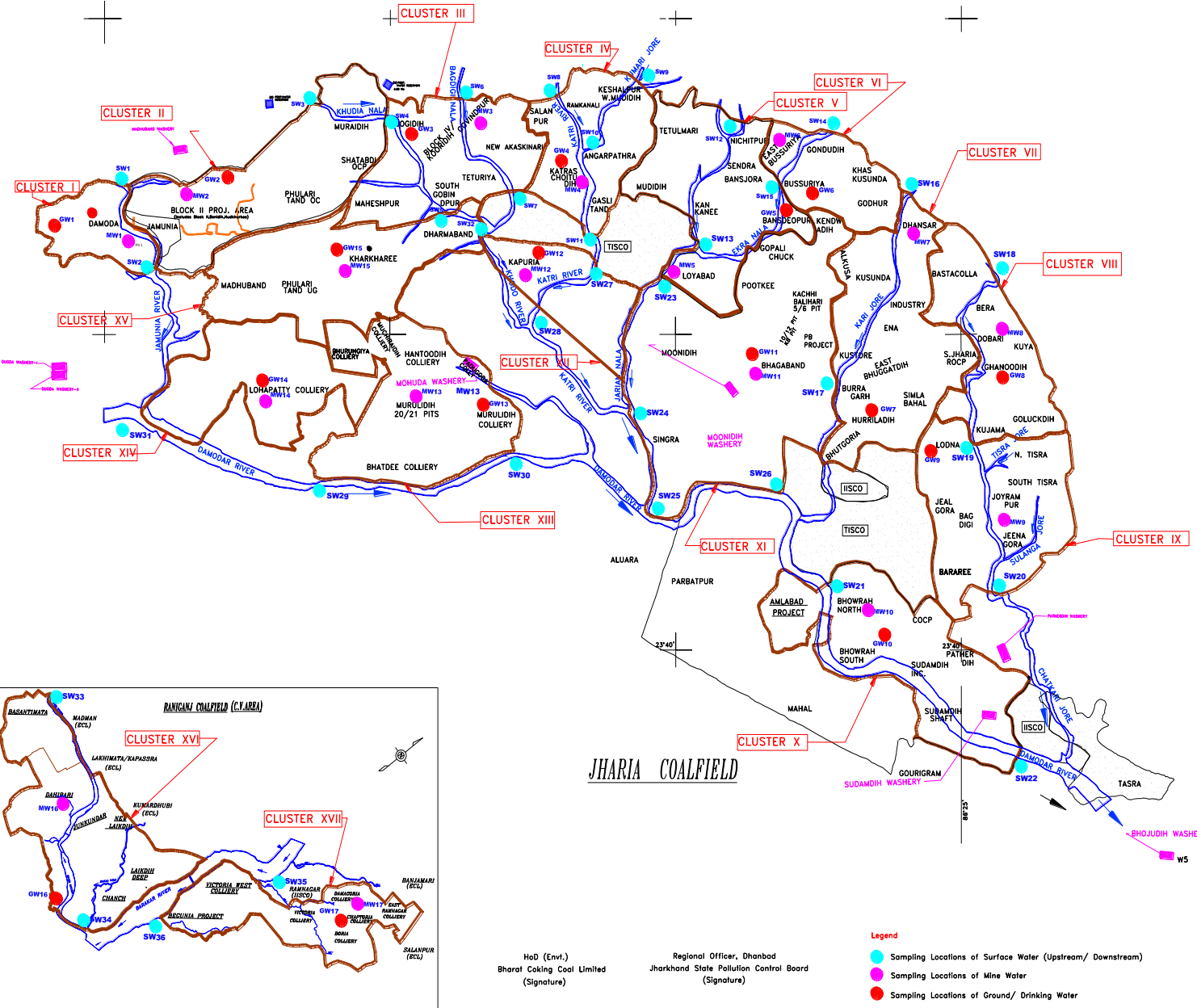
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, the area shall be treated as non-attainment area.

Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL



INDEX

Cluster	Surface Water (JUS, DIS)	Name of River/Nala	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Damunia River	MW1	Damoda Area	GW1	Chutkai Village
II	SW3, SW4	Khudra Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudra Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogdih Village
IV	SW8, SW11, SW9, SW10	Kain River, Kurnai Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kain Jore	MW7	Dhanbari UGP	GW7	Humladih
VIII	SW18, SW19	Kashi Jore	MW8	Dobani UGP	GW8	Ghanudih
IX	SW19, SW20	Kashi Jore	MW9	Jeevagrah	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagabandh UGP	GW11	Bhagabandh
XII	SW27, SW28	Kain River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Muridih (20/21)	GW13	Muridih
XIV	SW31, SW32	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW5, SW32	Kharkhar Nala	MW15	Kharkhar UGP	GW15	Kharkhar
XVI	SW33, SW34	Khudra River	MW16	Dahibani OCP	GW16	Palabani Village
XVII	SW35, SW36	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria

Legend

- Sampling Locations of Surface Water (Upstream/ Downstream)
- Sampling Locations of Mine Water
- Sampling Locations of Ground/ Drinking Water

HoD (Env.)
Bharat Coking Coal Limited
(Signature)

Regional Officer, Dhanbad
Jharkhand State Pollution Control Board
(Signature)

Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS
Scale	Not to Scale

CMPDI
CONSULTANTS

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**ENVIRONMENTAL MONITORING REPORT
OF
BHARAT COKING COAL LIMITED,
CLUSTER – XII**

(FOR THE MONTH JANUARY, 2026)

E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.



CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

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EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the fauna and flora. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

2.2 Water sampling stations

The Water sampling stations were selected for mine discharge water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM₁₀), Fine Particulate Matter (PM_{2.5}), Sulphur Di-oxide

(SO₂) and Nitrogen Oxides (NO_x). Respirable Dust Samplers (RDS) were used for sampling of PM₁₀, SO₂, & NO_x and Fine Dust Sampler (PM_{2.5} sampler) were used for sampling of PM_{2.5} at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

Water samples were collected as per standard practice. The Mine effluent samples were collected and analysed for four parameters on fortnightly basis. Thereafter the samples were preserved and analysed at the Environmental Laboratory of CMPDI, RI- II, Dhanbad.

3.3 Noise level monitoring

Noise level measurements in form of 'LEQ' were taken using Integrated Data Logging Sound Level Meter. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB(A).

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like PM₁₀, PM_{2.5}, SO₂ and NO_x are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM₁₀& PM_{2.5} exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

The following preventive and suppressive mitigative measures can be undertaken to contain the pollution level within prescribed level:-

- Wet drilling and controlled blasting should be practice.
- Explosive used should be optimised to restrict the dust generation.
- Transportation roads should be permanently asphalted free of ruts, potholes etc.
- Water should be sprayed on coal transportation road, service road more frequently and at regular interval.
- Dust from roads should be removed physically or mechanically.
- Greenbelts around industrial sites, service building area besides Avenue plantation along roads should be created.
- Coal dust should be suppressed by using fixed sprinklers.
- Regular maintenance of plant and machinery should be undertaken.

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, are within permissible limits.

4.3 Noise Level

During the noise level survey it has been observed that the noise level in the sampling locations is within the permissible limits prescribed as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines for Industrial Area and Noise pollution (Regulation and Control) Rules, 2000.

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdih. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Katri River & Damodar River..

- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

Ministry of Environment, Forests and Climate Change while granting environmental clearance has given one of the General conditions that “ Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM₁₀, PM_{2.5}, SO₂, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board.” And other conditions regarding water / effluent and noise level monitoring.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC& SPCB and other statutory authorities.

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Murlidih 20/21 (A19): Industrial Area

The location of the sampling station is 23°43' 51.82" N & 86° 16' 21.17" E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

II. BUFFER ZONE Monitoring Location

i) Lohapatti (A20)

The location of the sampling station is 23°44'29.42" N & 86°16'49.96" E. The sampler was placed at a height of approx. 1.5m above ground level at Safety Office.

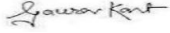
ii) Kharkharee CISF Office (A21)

The location of the sampling station is 23°46' 29.00" N 86° 14' 37.08"E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

ii) Dumarda (A31)

The location of the sampling station is 23° 42' 50.00" N 86° 15' 4.00"E. The location was selected for studying the impact of the mining activity on the DuAPRILda village as it lies in the buffer zone for the Cluster

AMBIENT AIR QUALITY DATA

  		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in											
Test Report for Ambient Air Samples																	
Month & Year		01/2026		Cluster		Cluster XIII		ULR No.		TC143212612200002362F							
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue		05.03.2026							
Project		Murlidih 20/21		Sample Ref. No.		REM/BCCL/2026/01		Sampling Method		CMPDI/RI-II/LPM 11, (IS 5182)							
Date of Sampling		06.01.26		Period of Analysis		20.01.26		06.01.26		25.01.26							
Zone of Station:		Core Zone															
Sl. No.		Parameter		Method of Analysis		Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing		LDL		MoEF Standards Notification dated 25th September,2000 (GSR 742 E)		NAAQS, 2009			
						A5125		A5197									
1		PM ₁₀		IS -5182(Part 23):2006, R-2017		74		88		10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$		10 $\mu\text{g}/\text{m}^3$		300		100	
2		PM _{2.5}		IS -5182(Part 24):2019		32		31		10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$		10 $\mu\text{g}/\text{m}^3$		Not Specified		60	
3		SO ₂		IS-5182(Part-2): 2001 , R-2017		<10		10		10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$		10 $\mu\text{g}/\text{m}^3$		120		80	
4		NO ₂		IS-5182 (Part-6): 2006 , R-2017		24		27		06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$		06 $\mu\text{g}/\text{m}^3$		120		80	
<i>Environmental Condition : Sunny</i>																	
<i>* LDL indicates Lower Detection Limit,</i>																	
<i>**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,</i>																	
 ANALYSED BY				 REVIEWED BY				 Authorised Signatory									
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.																	
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
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Test Report for Ambient Air Samples

Month & Year	01/2026	Cluster	Cluster XIII	ULR No.	TC143212612200002362F			
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)			Date of Issue	05.03.2026			
Project	Lohapatti	Sample Ref. No.	REM/BCCL/2026/01	Sampling Method	CMPDI/RI-II/LPM 11 , (IS 5182)			
Date of Sampling	02.01.26	17.01.26	Period of Analysis	02.01.26	25.02.26	Zone of Station:	Buffer Zone	
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			A5110	A5183				
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	124	141	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100
2	PM _{2.5}	IS -5182(Part 24):2019	65	72	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	24	25	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80

Environmental Condition : Sunny

** LDL indicates Lower Detection Limit,*

***All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,*

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ANALYSED BY

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(Gaurav Kant)
REVIEWED BY

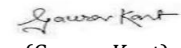
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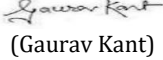
(Kumar vaibhav)
Authorised Signatory

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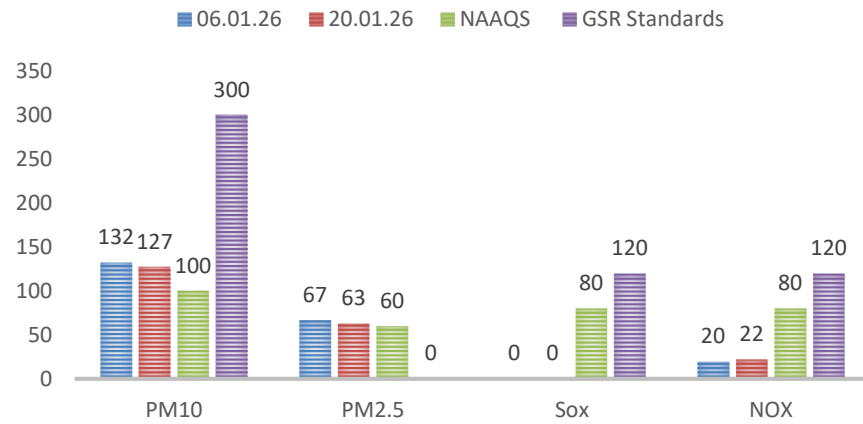
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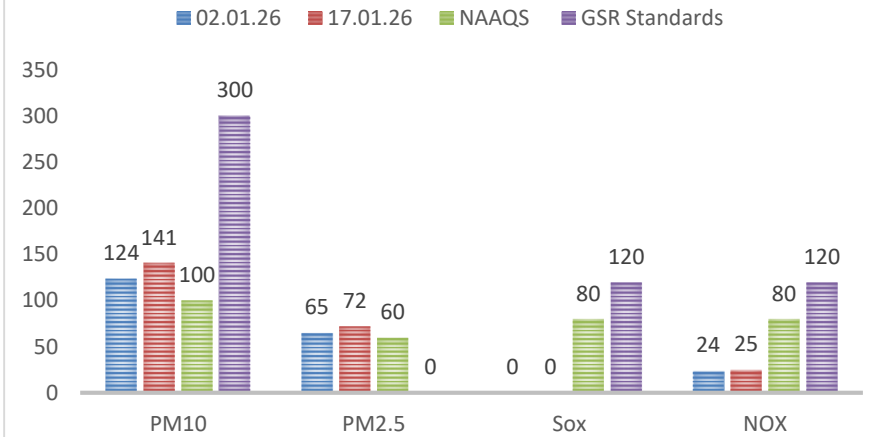
 TC-14321  cmpdi A Mine Rules Company CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in											
Test Report for Ambient Air Samples											
Month & Year		01/2026		Cluster		Cluster XIII		ULR No.		TC143212612200002362F	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue		05.03.2026	
Project		Kharkharee		Sample Ref. No.		REM/BCCL/2026/01		Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		01.01.26		16.01.26		Period of Analysis		01.01.26		25.02.2026	
Sl. No.		Parameter		Method of Analysis		Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing		LDL	
						A5101		A5178		MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	
										NAAQS, 2009	
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	115	126	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100			
2	PM _{2.5}	IS -5182(Part 24):2019	64	65	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60			
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80			
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	28	23	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80			
Environmental Condition : Sunny											
* LDL indicates Lower Detection Limit,											
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,											
 ANALYSED BY				 REVIEWED BY (Gaurav Kant)				 Authorised Signatory (Kumar vaibhav)			
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  cmpdi <i>A Mini Kailash Company</i>		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in		
Test Report for Ambient Air Samples								
Month & Year	01/2026	Cluster	XIII			ULR No.	TC143212612200002362F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	05.03.2026	
Project	Dumarda	Sample Ref. No.	REM/BCCL/2026/01		Sampling Method	CMPDI/RI-II/LPM 11 , (IS 5182)		
Date of Sampling	09.01.26	23.01.26	Period of Analysis	09.01.26	25.02.2026	Zone of Station:	Buffer Zone	
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			A5149	A5221				
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	146	135	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100
2	PM _{2.5}	IS -5182(Part 24):2019	72	65	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	26	23	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80
<i>Environmental Condition : Sunny</i>								
<i>* LDL indicates Lower Detection Limit,</i>								
<i>**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,</i>								
 ANALYSED BY			 (Gaurav Kant) REVIEWED BY			 (Kumar vaibhav) Authorised Signatory		
Note: The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.								
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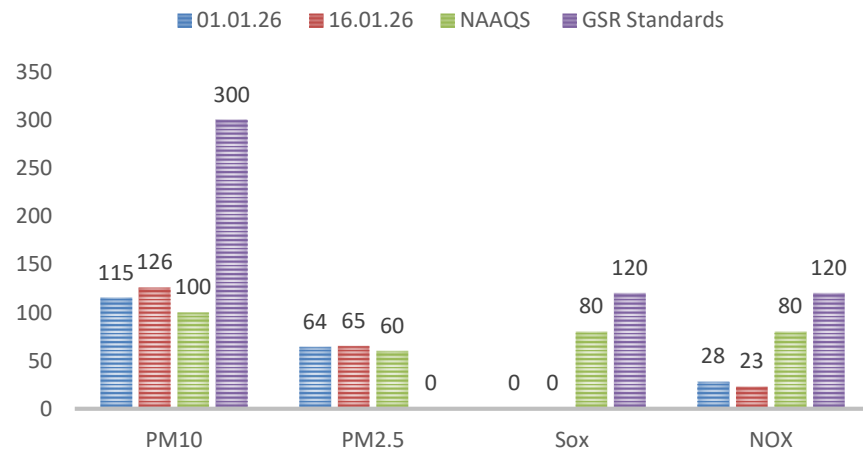
AMBIENT AIR QUALITY AT MURLIDIH 20/21



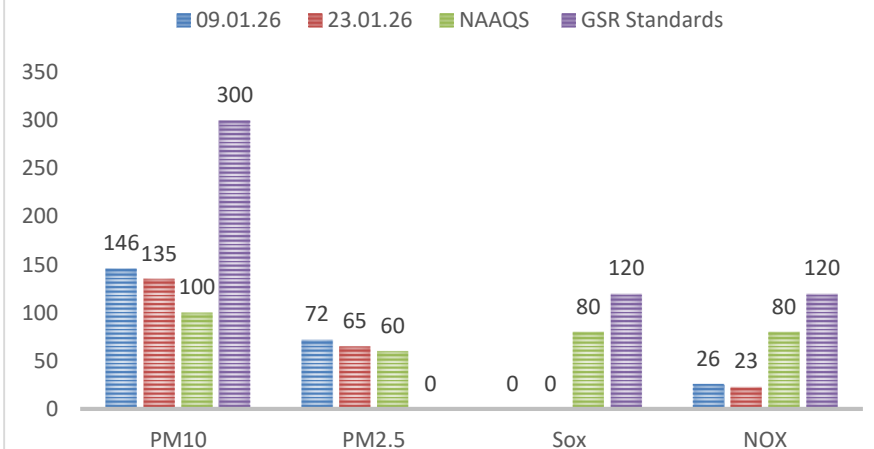
AMBIENT AIR QUALITY AT LOHAPATTI



AMBIENT AIR QUALITY AT KHARKHAREE



AMBIENT AIR QUALITY AT DUMARDA



WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Murlidih 20/21 (MW13)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jamunia.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

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Test Report for Mine Effluent samples

Month & Year	01/2026	Cluster	Cluster XIII		ULR No.		TC143212613900002379F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	05.03.2026	
Project		Sampling Ref. No.	REM/BCCL/2026/01		Sampling Method		IS 3025 (Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations		Murlidih 20/21	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			Period of Analysis	12.01.2026 TO 31.01.2026	
			Date of Sampling		12.01.2026	26.01.2026		
Sl. No.	Parameter	Method of Analysis	Observed Values		STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)	LDL		
			M1948	M1966				
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	33	36	41	40		
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.74	7.74	8.06	8.02		
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	<4.0	<4.0		
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	32	32	44	48		

**Grab sampling carried out for water samples **All units in mg/L unless specified otherwise *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,

ANALYSED BY

(Gaurav Kant)

REVIEWED BY

(Kumar vaibhav)

Authorised Signatory

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---- End of Report ----

NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites

- i) **Murlidih (N19)**
- ii) **Lohapatti (N20)**
- iii) **Kharkharee CISF Office (N21)**
- iv) **Dumarda (N31)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of ' L_{EQ} ' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented. The observed values at all the monitoring locations are found to be within permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

CMPDI, RI-II
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Month & Year	01/2026	Cluster	Cluster XIII			ULR No.	TC143212615600002396F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	05.03.2026	
Project		Sample Ref. No.	REM/BCCL/2026/01		Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Murlidih		Date of Sampling	06.01.26	20.01.26	Zone Category of Station:	Core Zone
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards
			First Fortnight	Second Fortnight				Zones
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	49.4	49.3	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence
2		07:00 - 08:00	49.5	49.7				
3		08:00 - 09:00	51.6	52.7				
4		09:00 - 10:00	50.9	51.8				
5		10:00 - 11:00	53.8	53.8				
6		11:00 - 12:00	54.3	53.9				
7		12:00 - 13:00	55.8	56.9				
8		13:00 - 14:00	56.2	56.3				
9		14:00 - 15:00	56.7	56.9				
10		15:00 - 16:00	57.8	58.9				
11		16:00 - 17:00	57.6	57.2				
12		17:00 - 18:00	55.2	55.2				
13		18:00 - 19:00	51.8	52.7				
14		19:00 - 20:00	51.5	51.8				
15		20:00 - 21:00	50.5	50.5				
16		21:00 - 22:00	50.3	50.2				
		Leq DAY	54.2	54.6				
1	Noise Level dB(A)Leq -Night	22:00-23:00	39.4	39.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence
2		23:00- 00:00	39	39.5				
3		00:00- 01:00	38.7	39.2				
4		01:00-02:00	38.6	39.1				
5		02:00-03:00	38.5	38.7				
6		03:00-04:00	39	38.5				
7		04:00-05:00	39.2	39				
8		05:00-06:00	39.4	39.1				
		Leq Night	38.3	38.4				

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
ANALYSED BY		

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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in										
Month & Year	01/2026	Cluster	Cluster XIII					ULR No.	TC143212615600002396F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)								Date of Issue	05.03.2026
Project		Sample Ref. No.	REM/BCCL/2026/01			Sampling Method		CMPDI/RI-II/LPM 22		
Sampling Stations	i	Lohapatti	Date of Sampling	02.01.26	17.01.26	Zone Category of Station:		Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards		
								Zones	Limits in dB	
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	36.4	37.1	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50	
2		07:00 - 08:00	47	46.2						
3		08:00 - 09:00	41.8	46.7						
4		09:00 - 10:00	39	41.5						
5		10:00 - 11:00	41.8	43.2						
6		11:00 - 12:00	40.4	45.5						
7		12:00 - 13:00	41.5	44.1						
8		13:00 - 14:00	42.7	45.7						
9		14:00 - 15:00	42.1	43.5						
10		15:00 - 16:00	44.7	45						
11		16:00 - 17:00	44.8	44.9						
12		17:00 - 18:00	44.6	45.7						
13		18:00 - 19:00	44.6	45.5						
14		19:00 - 20:00	44.1	43.7						
15		20:00 - 21:00	44	43.8						
16		21:00 - 22:00	43.8	43.7						
		Leq Day	43.3	44.5						
1	Noise Level dB(A)Leq - Night	22:00-23:00	43	43	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50	
2		23:00- 00:00	42.9	42.4						
3		00:00- 01:00	42.6	42.5						
4		01:00-02:00	42.2	43.1						
5		02:00-03:00	42.1	42.4						
6		03:00-04:00	42	42.1						
7		04:00-05:00	41.6	42.2						
8		05:00-06:00	42.4	42.7						
		Leq Night	41.7	41.9						

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	01/2026	Cluster	Cluster XIII				ULR No.	TC143212615600002396F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)								
Project		Sample Ref. No.	REM/BCCL/2026/01			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Kharkharee		Date of Sampling	01.01.26	16.01.26	Zone Category of Station:	Buffer Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	43.7	44.5	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	59.1	59					
3		08:00 - 09:00	70.2	70.4					
4		09:00 - 10:00	70.1	69.8					
5		10:00 - 11:00	66.5	65.4					
6		11:00 - 12:00	63.6	63.2					
7		12:00 - 13:00	61.2	62.2					
8		13:00 - 14:00	59.6	58.9					
9		14:00 - 15:00	57.4	56.7					
10		15:00 - 16:00	55.8	56.1					
11		16:00 - 17:00	56.1	56.8					
12		17:00 - 18:00	55.9	56.5					
13		18:00 - 19:00	53.3	53.3					
14		19:00 - 20:00	51.5	51.6					
15		20:00 - 21:00	49.5	49.7					
16		21:00 - 22:00	48.9	49.3					
		Leq Day	63.1	63.0					
1	Noise Level dB(A)Leq -Night	22:00-23:00	45.7	43.6	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	43	43.5					
3		00:00- 01:00	43.1	43.5					
4		01:00-02:00	41.3	42.5					
5		02:00-03:00	41	37.9					
6		03:00-04:00	40.5	41.8					
7		04:00-05:00	40.3	39.2					
8		05:00-06:00	39	36.9					
		Leq Night	40.8	40.8					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants

ANALYSED BY


 (Gaurav Kant)
REVIEWED BY


 (Kumar vaibhav)
Authorised Signatory

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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	01/2026	Cluster	XIII	ULR No.	TC143212615600002396F				
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	05.03.2026			
Project		Sample Ref. No.	REM/BCCL/2026/01	Sampling Method	CMPDI/RI-II/LPM 22				
Sampling Stations	i	Dumarda		Date of Sampling	09.01.26	23.01.26	Zone Category of Station:	Buffer Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	45.6	45	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	50.2	49					
3		08:00 - 09:00	50.9	50.1					
4		09:00 - 10:00	51.3	50.5					
5		10:00 - 11:00	53	55.8					
6		11:00 - 12:00	60.9	61.5					
7		12:00 - 13:00	63.5	64.4					
8		13:00 - 14:00	64.3	65.9					
9		14:00 - 15:00	59.1	60.1					
10		15:00 - 16:00	51.1	51.2					
11		16:00 - 17:00	51.1	52.7					
12		17:00 - 18:00	50.2	50					
13		18:00 - 19:00	58.4	57.3					
14		19:00 - 20:00	56.1	51.7					
15		20:00 - 21:00	55.5	50.2					
16		21:00 - 22:00	45.7	45					
		Leq Day	57.7	58.4					
1	Noise Level dB(A)Leq -Night	22:00-23:00	44.6	45.1	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	44.3	45					
3		00:00- 01:00	44.2	44.7					
4		01:00-02:00	44.1	44.3					
5		02:00-03:00	43.7	44.2					
6		03:00-04:00	43.2	43.6					
7		04:00-05:00	42.9	43.2					
8		05:00-06:00	44.6	44.7					
		Leq Night	43.3	43.7					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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Ambient Air Quality Standards for Jharia Coal Field
As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R.
742(E), dated 25.9.2000.

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m ³ 700 µg/m ³	- High Volume Sampling (Average flow rate not less than 1.1
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m ³ 300 µg/m ³	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO ₂)	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO ₂	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause 2.

** 24 hourly/8 hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

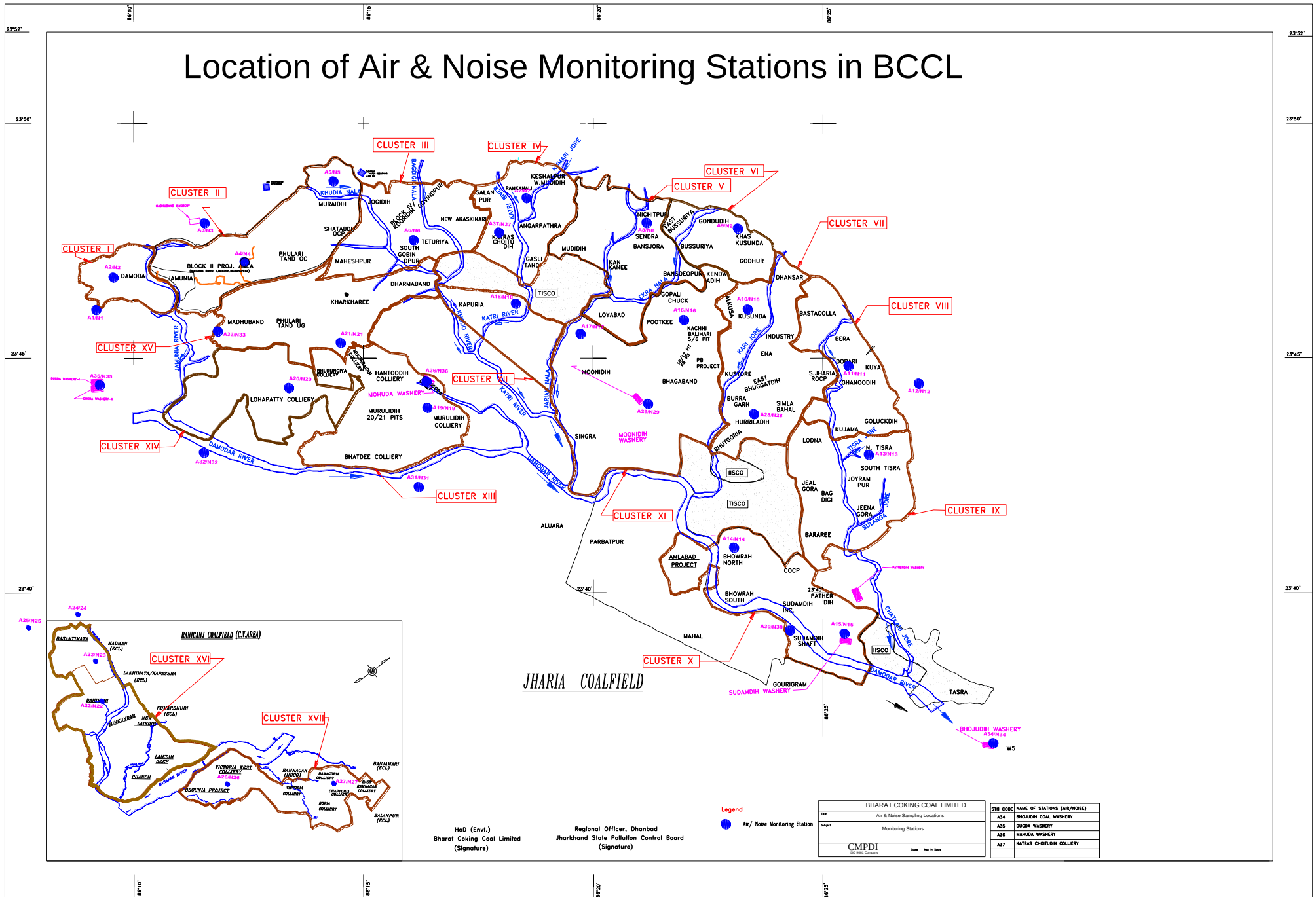
In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th NOVEMBER 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO₂), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogendioxide (NO₂), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob &Hochheiser modified (NaOH-NaAsO ₂) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM₁₀, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or PM_{2.5}, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O₃) , µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb) , µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH₃), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C₆H₆), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed byHPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they JUNE exceed the limits but not on two consecutive days of monitoring.

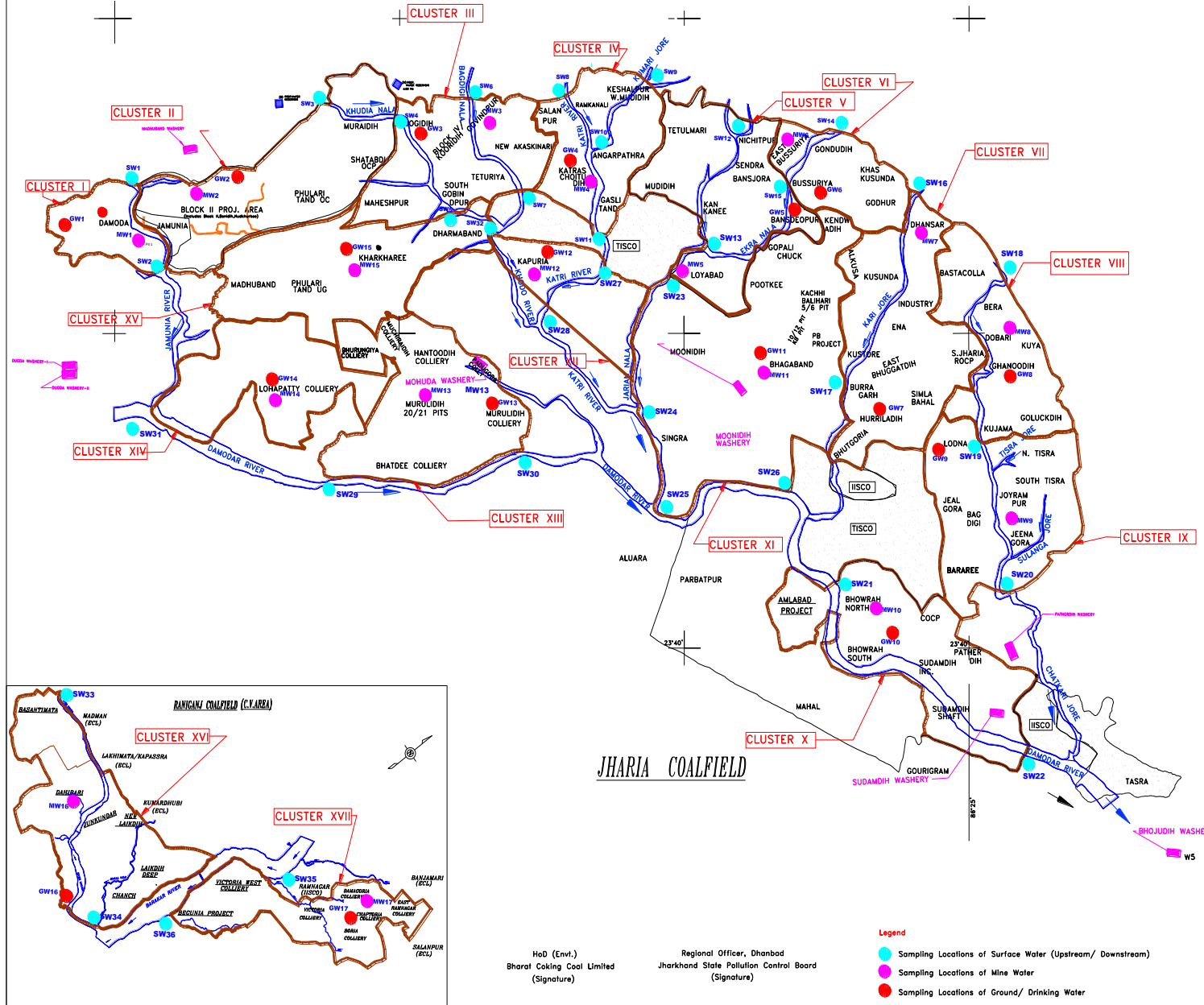
NOTE:Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category



Water Sampling Locations in BCCL

INDEX

Cluster	Surface Water (JUS, DIS)	Name of River/ Nala / Jore	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Damunia River	MW1	Damoda Area	GW1	Chutkai Village
II	SW3, SW4	Khudia Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudia Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogdih Village
IV	SW8, SW11, SW9, SW10	Kain River, Kuman Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichtipur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kain Jore	MW7	Dhanbari UGP	GW7	Huriladih
VIII	SW18, SW19	Kain Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kain Jore	MW9	Jewagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband UGP	GW11	Bhagabandh
XII	SW27, SW28	Kain River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Muridih (20/21)	GW13	Muridih
XIV	SW31, SW32	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW5, SW32	Kharkhar Nala	MW15	Kharkhar UGP	GW15	Kharkhar
XVI	SW33, SW34	Khudia River	MW16	Dahibani OCP	GW16	Palabani Village
XVII	SW35, SW36	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria



Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS
Scale	Not to Scale

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The information given in this report is not to be person not communicated either directly or indirectly to the press or to any holding an official position in the CIL /GOVERNMENT.

**ENVIRONMENTAL MONITORING REPORT
OF
BHARAT COKING COAL LIMITED,
CLUSTER – XIII**

(FOR THE MONTH FEBRAURY, 2025)

E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.



CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

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3.	CHAPTER-III	RESULTS	7-19
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EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the fauna and flora. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23°37' N to 23°52' N latitudes and 86°09' E to 86°30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

2.2 Water sampling stations

The Water sampling stations were selected for mine discharge water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM₁₀), Fine Particulate Matter (PM_{2.5}), Sulphur Di-oxide

(SO₂) and Nitrogen Oxides (NO_x). Respirable Dust Samplers (RDS) were used for sampling of PM₁₀, SO₂, & NO_x and Fine Dust Sampler (PM_{2.5} sampler) were used for sampling of PM_{2.5} at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

Water samples were collected as per standard practice. The Mine effluent samples were collected and analysed for four parameters on fortnightly basis. Thereafter the samples were preserved and analysed at the Environmental Laboratory of CMPDI, RI- II, Dhanbad.

3.3 Noise level monitoring

Noise level measurements in form of 'LEQ' were taken using Integrated Data Logging Sound Level Meter. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB(A).

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like PM₁₀, PM_{2.5}, SO₂ and NO_x are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM₁₀& PM_{2.5} exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

The following preventive and suppressive mitigative measures can be undertaken to contain the pollution level within prescribed level:-

- Wet drilling and controlled blasting should be practice.
- Explosive used should be optimised to restrict the dust generation.
- Transportation roads should be permanently asphalted free of ruts, potholes etc.
- Water should be sprayed on coal transportation road, service road more frequently and at regular interval.
- Dust from roads should be removed physically or mechanically.
- Greenbelts around industrial sites, service building area besides Avenue plantation along roads should be created.
- Coal dust should be suppressed by using fixed sprinklers.
- Regular maintenance of plant and machinery should be undertaken.

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, are within permissible limits.

4.3 Noise Level

During the noise level survey it has been observed that the noise level in the sampling locations is within the permissible limits prescribed as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines for Industrial Area and Noise pollution (Regulation and Control) Rules, 2000.

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdih. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Katri River & Damodar River..

- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

Ministry of Environment, Forests and Climate Change while granting environmental clearance has given one of the General conditions that “ Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM₁₀, PM_{2.5}, SO₂, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board.” And other conditions regarding water / effluent and noise level monitoring.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC& SPCB and other statutory authorities.

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Murlidih 20/21 (A19): Industrial Area

The location of the sampling station is 23°43' 51.82" N & 86° 16' 21.17" E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

II. BUFFER ZONE Monitoring Location

i) Lohapatti (A20)

The location of the sampling station is 23°44'29.42" N & 86°16'49.96" E. The sampler was placed at a height of approx. 1.5m above ground level at Safety Office.

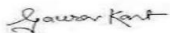
ii) Kharkharee CISF Office (A21)

The location of the sampling station is 23°46' 29.00" N 86° 14' 37.08"E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

ii) Dumarda (A31)

The location of the sampling station is 23° 42' 50.00" N 86° 15' 4.00"E. The location was selected for studying the impact of the mining activity on the DuAPRILda village as it lies in the buffer zone for the Cluster

AMBIENT AIR QUALITY DATA

 		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in		
Test Report for Ambient Air Samples								
Month & Year	02/2026	Cluster	Cluster XIII			ULR No.	TC1432126000002414F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	20.03.2026	
Project	Murlidih 20/21	Sample Ref. No.	REM/BCCL/2026/02		Sampling Method	CMPDI/RI-II/LPM 11, (IS 5182)		
Date of Sampling	05.02.26	19.02.26	Period of Analysis	05.02.26	10.03.2026	Zone of Station:	Core Zone	
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			A5276	A5354				
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	140	130	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100
2	PM _{2.5}	IS -5182(Part 24):2019	71	66	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	12	19	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80
Environmental Condition : Sunny								
* LDL indicates Lower Detection Limit,								
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,								
 ANALYSED BY		 REVIEWED BY		 Authorised Signatory				
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

Test Report for Ambient Air Samples

Month & Year		02/2026	Cluster	Cluster XIII				ULR No.	TC1432126000002414F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026
Project		Lohapatti		Sample Ref. No.	REM/BCCL/2026/02	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		03.02.26		17.02.26	Period of Analysis	03.02.26	10.03.2026	Zone of Station:	Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009	
			A5261	A5339					
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	131	135	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100	
2	PM _{2.5}	IS -5182(Part 24):2019	68	71	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60	
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80	
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	21	30	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80	

Environmental Condition : Sunny

** LDL indicates Lower Detection Limit,*

***All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,*

[Signature]

ANALYSED BY

[Signature]

(Gaurav Kant)

REVIEWED BY

[Signature]

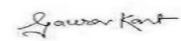
(Kumar vaibhav)

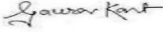
Authorised Signatory

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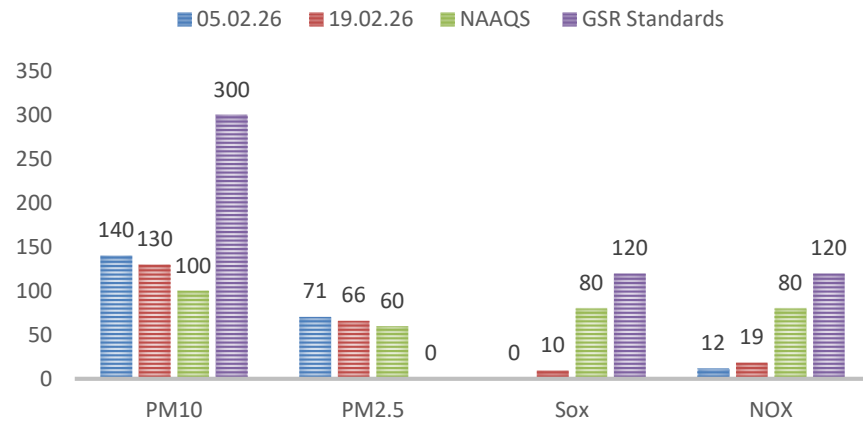
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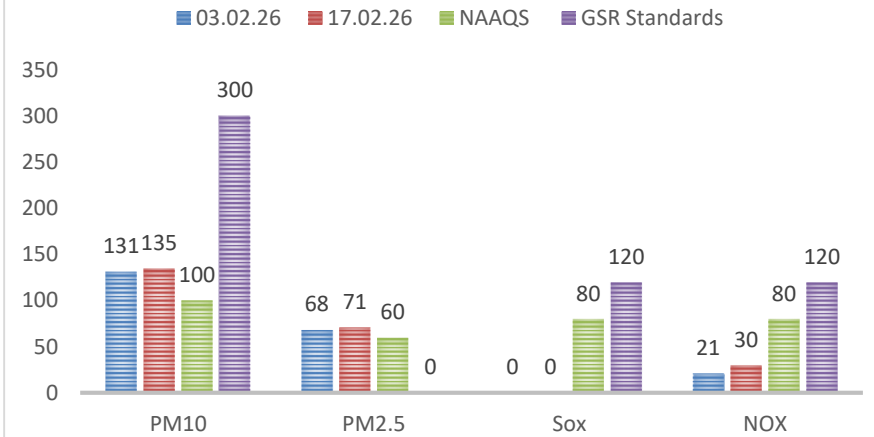
  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in										
Test Report for Ambient Air Samples										
Month & Year		02/2026		Cluster		Cluster XIII		ULR No.		TC143212600002414F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue		20.03.2026
Project		Kharkharee		Sample Ref. No.		REM/BCCL/2026/02		Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)
Date of Sampling		02.02.26		16.02.26		Period of Analysis		02.02.26		10.03.2026
Zone of Station:		Buffer Zone								
MoEF Standards Notification dated 25th September,2000 (GSR 742 E)		NAAQS, 2009								
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL				
			A5253	A5331						
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	121	129	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300			100
2	PM _{2.5}	IS -5182(Part 24):2019	67	68	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified			60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120			80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	21	25	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120			80
Environmental Condition : Sunny										
* LDL indicates Lower Detection Limit,										
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,										
 ANALYSED BY			 REVIEWED BY			 Authorised Signatory				
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.										
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  cmpdi <i>A Mini Ratna Company</i>		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in		
Test Report for Ambient Air Samples								
Month & Year	02/2026	Cluster	XIII				ULR No.	TC1432126000002414F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026
Project	Dumarda	Sample Ref. No.	REM/BCCL/2026/02		Sampling Method	CMPDI/RI-II/LPM 11 , (IS 5182)		
Date of Sampling	11.02.26	26.02.26	Period of Analysis	11.02.2026	10.03.2026	Zone of Station:	Buffer Zone	
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			A5310	A5388				
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	139	143	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100
2	PM _{2.5}	IS -5182(Part 24):2019	68	71	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	15	22	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80
<i>Environmental Condition : Sunny</i>								
<i>* LDL indicates Lower Detection Limit,</i>								
<i>**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,</i>								
 ANALYSED BY		 (Gaurav Kant) REVIEWED BY		 (Kumar vaibhav) Authorised Signatory				
Note: The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.								
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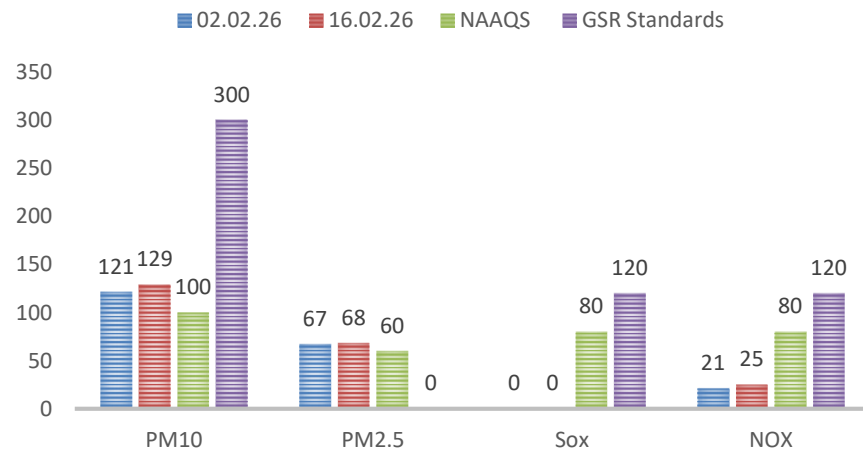
AMBIENT AIR QUALITY AT MURLIDIH 20/21



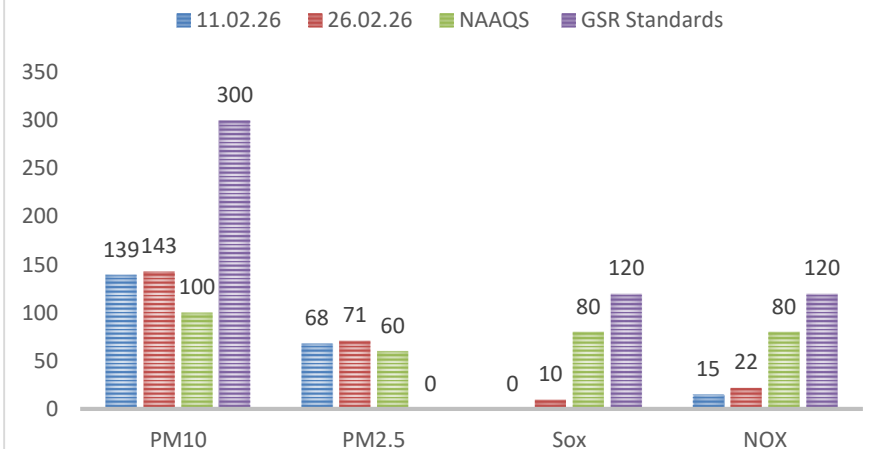
AMBIENT AIR QUALITY AT LOHAPATTI



AMBIENT AIR QUALITY AT KHARKHAREE



AMBIENT AIR QUALITY AT DUMARDA



WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Murlidih 20/21 (MW13)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jamunia.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Test Report for Mine Effluent samples

Month & Year	02/2026	Cluster	Cluster XIII		ULR No.		TC1432126000002431F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026
Project		Sampling Ref. No.	REM/BCCL/2026/02		Sampling Method		IS 3025 (Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations		Murlidih 20/21	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			Period of Analysis	09.02.2026 TO 28.02.2026	
			Date of Sampling		09.02.2026	23.02.26		
Sl. No.	Parameter	Method of Analysis	Observed Values		STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)	LDL		
			M2002	M2029				
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	38	41	41	40		
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.54	7.56	8.06	8.02		
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<4.0	<4.0	<4.0	<4.0		
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	40	44	44	48		

***Grab sampling carried out for water samples **All units in mg/L unless specified otherwise *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

ANALYSED BY

(Gaurav Kant)

REVIEWED BY

(Kumar vaibhav)

Authorised Signatory

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NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites

- i) **Murlidih (N19)**
- ii) **Lohapatti (N20)**
- iii) **Kharkharee CISF Office (N21)**
- iv) **Dumarda (N31)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of ' L_{EQ} ' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented. The observed values at all the monitoring locations are found to be within permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
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 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Month & Year	02/2026	Cluster	Cluster XIII				ULR No.	TC143212600002448F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026	
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Murlidih		Date of Sampling	05.02.26	19.02.26	Zone Category of Station:	Core Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	45.6	45.5	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	48.6	45.9					
3		08:00 - 09:00	51.9	48.6					
4		09:00 - 10:00	50.6	47.9					
5		10:00 - 11:00	52.1	49.7					
6		11:00 - 12:00	54.7	49.7					
7		12:00 - 13:00	51.5	52.5					
8		13:00 - 14:00	55.9	52					
9		14:00 - 15:00	52.3	52.5					
10		15:00 - 16:00	56.7	54.3					
11		16:00 - 17:00	53.2	52.7					
12		17:00 - 18:00	51	51					
13		18:00 - 19:00	47.9	48.6					
14		19:00 - 20:00	47.6	47.9					
15		20:00 - 21:00	46.6	46.6					
16		21:00 - 22:00	46.4	46.3					
		Leq DAY	52.0	50.3					
1	Noise Level dB(A)Leq -Night	22:00-23:00	40.7	38.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	39.8	38.5					
3		00:00- 01:00	42.6	38.2					
4		01:00-02:00	41.8	38.1					
5		02:00-03:00	39.7	37.7					
6		03:00-04:00	38	37.5					
7		04:00-05:00	38.2	38					
8		05:00-06:00	38.4	38.1					
		Leq Night	40.2	38.1					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

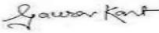
Sampling Assistants	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
ANALYSED BY		

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Month & Year	02/2026	Cluster	Cluster XIII					ULR No.	TC143212600002448F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026	
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Lohapatti	Date of Sampling	03.02.26	17.02.26	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones Limits in dB	
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	33.6	34.2	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	43.4	42.6					
3		08:00 - 09:00	38.5	43.1					
4		09:00 - 10:00	36	38.2					
5		10:00 - 11:00	38.5	39.8					
6		11:00 - 12:00	37.3	42					
7		12:00 - 13:00	38.2	40.7					
8		13:00 - 14:00	39.4	42.2					
9		14:00 - 15:00	38.9	40.1					
10		15:00 - 16:00	41.2	41.6					
11		16:00 - 17:00	41.3	41.4					
12		17:00 - 18:00	41.1	42.2					
13		18:00 - 19:00	41.1	42					
14		19:00 - 20:00	40.7	40.3					
15		20:00 - 21:00	40.6	40.4					
16		21:00 - 22:00	40.4	40.3					
		Leq Day	39.9	41.1					
1	Noise Level dB(A)Leq - Night	22:00-23:00	43.7	41.9	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	42.6	41.3					
3		00:00- 01:00	44.5	41.4					
4		01:00-02:00	45.8	42					
5		02:00-03:00	43.1	41.3					
6		03:00-04:00	40.9	41					
7		04:00-05:00	40.5	41.1					
8		05:00-06:00	41.3	41.6					
		Leq Night	43.2	41.5					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	02/2026	Cluster	Cluster XIII					ULR No.	TC143212600002448F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue	20.03.2026
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Kharkharee		Date of Sampling	02.02.26	16.02.26	Zone Category of Station:	Buffer Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	46.5	43	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	55.4	54.4					
3		08:00 - 09:00	64.7	64.9					
4		09:00 - 10:00	66.4	64.4					
5		10:00 - 11:00	62.4	60.3					
6		11:00 - 12:00	58.7	58.3					
7		12:00 - 13:00	59.8	57.4					
8		13:00 - 14:00	56.7	54.3					
9		14:00 - 15:00	54.6	52.3					
10		15:00 - 16:00	52.7	51.8					
11		16:00 - 17:00	51.8	52.4					
12		17:00 - 18:00	50.8	52.1					
13		18:00 - 19:00	49.2	49.2					
14		19:00 - 20:00	47.6	47.7					
15		20:00 - 21:00	45.7	45.9					
16		21:00 - 22:00	45.2	45.5					
		Leq Day	59.0	57.8					
1	Noise Level dB(A)Leq -Night	22:00-23:00	44.6	42.4	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	41.9	42.3					
3		00:00- 01:00	42	42.3					
4		01:00-02:00	40.2	41.4					
5		02:00-03:00	39.9	36.9					
6		03:00-04:00	39.4	40.7					
7		04:00-05:00	39.2	38.2					
8		05:00-06:00	38	35.9					
		Leq Night	41.1	40.6					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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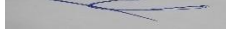
  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850									
Month & Year	02/2026	Cluster	XIII				ULR No.	TC1432126000002448F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026	
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Dumarda	Date of Sampling	11.02.26	26.02.26	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	41.6	41.4	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	45.3	43.6					
3		08:00 - 09:00	46.2	45.7					
4		09:00 - 10:00	46.6	49.6					
5		10:00 - 11:00	51.5	59.8					
6		11:00 - 12:00	56.8	60.3					
7		12:00 - 13:00	59.5	55.4					
8		13:00 - 14:00	60.8	53.8					
9		14:00 - 15:00	55.5	52.3					
10		15:00 - 16:00	47.2	56.7					
11		16:00 - 17:00	48.6	55.4					
12		17:00 - 18:00	46.1	51.7					
13		18:00 - 19:00	52.8	52					
14		19:00 - 20:00	47.8	51.5					
15		20:00 - 21:00	46.3	51.1					
16		21:00 - 22:00	41.5	48.9					
		Leq Day	53.6	54.4					
1	Noise Level dB(A)Leq - Night	22:00-23:00	43.4	44	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	43.1	43.9					
3		00:00- 01:00	43	43.5					
4		01:00-02:00	42.9	43.1					
5		02:00-03:00	42.5	43					
6		03:00-04:00	42.1	42.4					
7		04:00-05:00	41.8	42.1					
8		05:00-06:00	43.4	43.5					
		Leq Night	42.8	43.2					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants

ANALYSED BY


 (Gaurav Kant)
REVIEWED BY


 (Kumar vaibhav)
Authorised Signatory

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Ambient Air Quality Standards for Jharia Coal Field
As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R.
742(E), dated 25.9.2000.

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m ³ 700 µg/m ³	- High Volume Sampling (Average flow rate not less than 1.1
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m ³ 300 µg/m ³	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO ₂)	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO ₂	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause 2.

** 24 hourly/8 hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th NOVEMBER 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

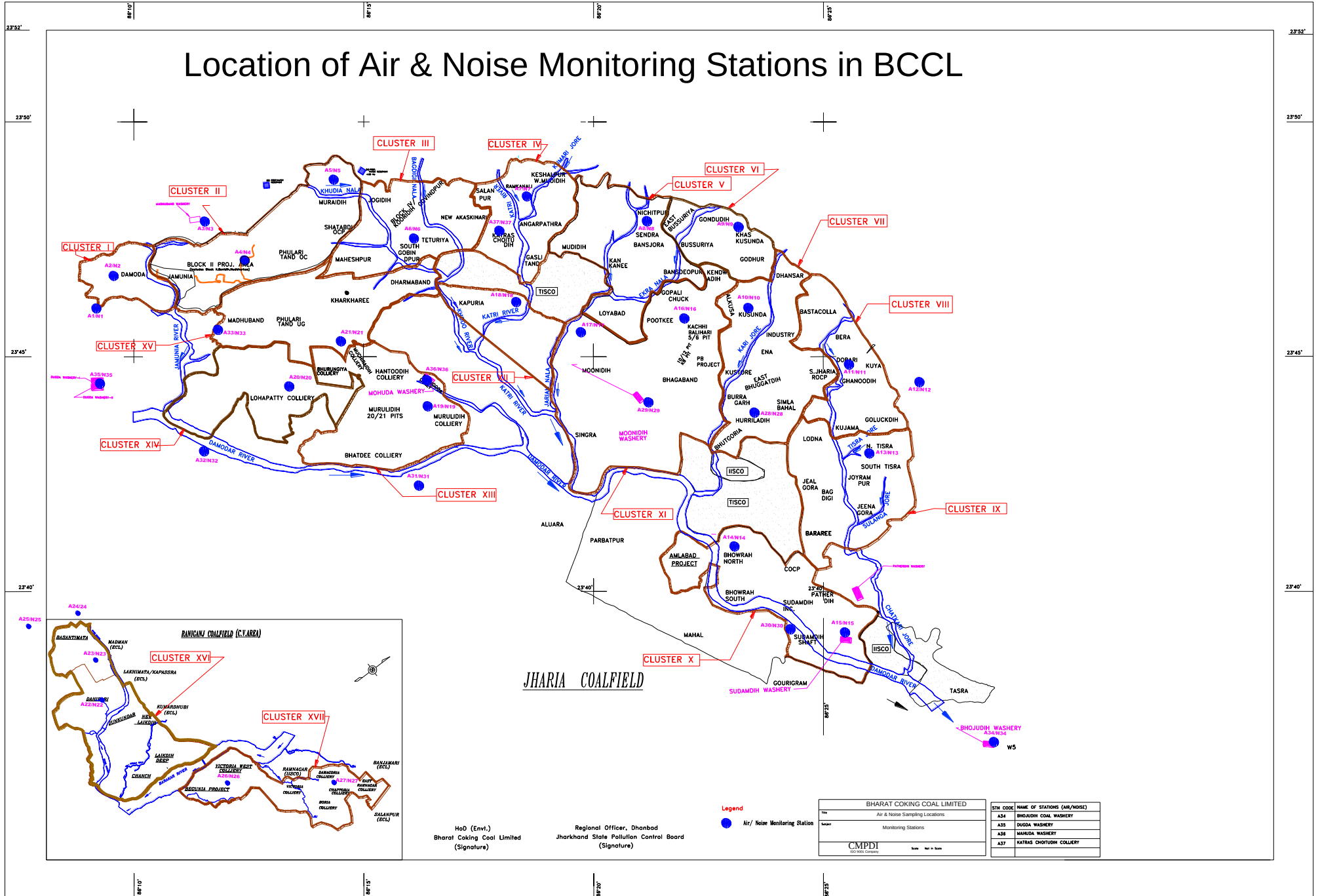
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO₂), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogen dioxide (NO₂), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob & Hochheiser modified (NaOH-NaAsO ₂) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM₁₀, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or PM_{2.5}, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O₃), µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb), µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH₃), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C₆H₆), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed by HPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

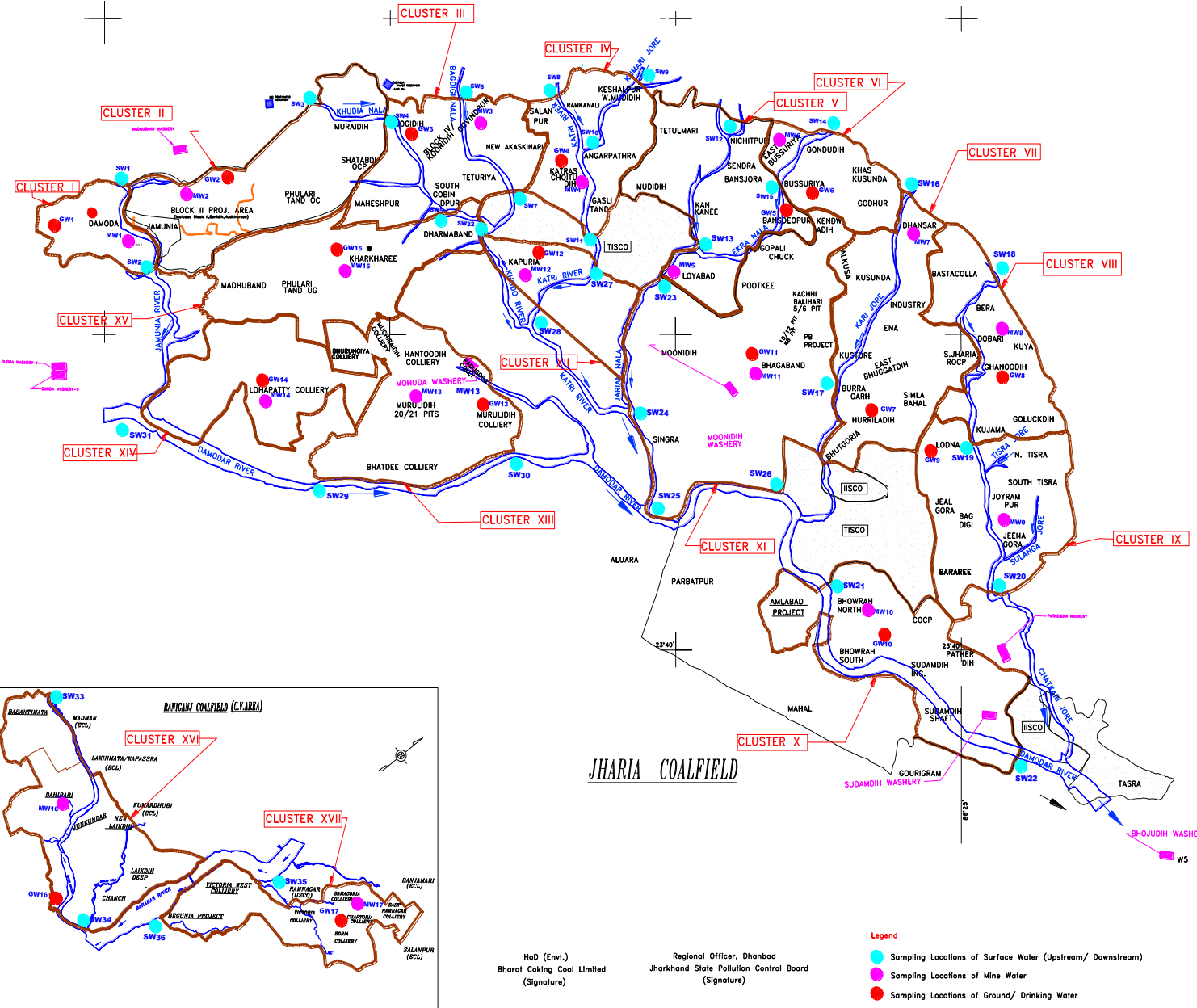
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they JUNE exceed the limits but not on two consecutive days of monitoring.

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category,

Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL



INDEX

Cluster	Surface Water (JUS, DIS)	Name of River/Nala	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Damodar River	MW1	Damoda Area	GW1	Chutkai Village
II	SW3, SW4	Khudra Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudra Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogdih Village
IV	SW8, SW11, SW9, SW10	Kain River, Kuman Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichtipur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kain Jore	MW7	Bhansar UGP	GW7	Huriladih
VIII	SW18, SW19	Kashi Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kashi Jore	MW9	Jewagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband UGP	GW11	Bhagabandh
XII	SW27, SW28	Kain River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Muridih (20/21)	GW13	Muridih
XIV	SW31, SW32	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW33, SW34	Khudra Nala	MW15	Kharkhar UGP	GW15	Kharkhar
XVI	SW35, SW36	Khudra River	MW16	Dahibani OCP	GW16	Palabani Village
XVII	SW37, SW38	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria

Legend

- Sampling Locations of Surface Water (Upstream/ Downstream)
- Sampling Locations of Mine Water
- Sampling Locations of Ground/ Drinking Water

HoD (Env.)
Bharat Coking Coal Limited
(Signature)

Regional Officer, Dhanbad
Jharkhand State Pollution Control Board
(Signature)

Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS
Scale	Not to Scale

CMPDI
COAL MINING PROJECTS DEVELOPMENT INSTITUTE

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**ENVIRONMENTAL MONITORING REPORT
OF
BHARAT COKING COAL LIMITED,
CLUSTER – XIII**

(FOR THE MONTH FEBRAURY, 2025)

E. C. no. J-11015/11/2010-IA.II (M) dated 06.06.2013.



CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CONTENTS

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4.	CHAPTER-IV	STANDARDS AND PLANS	20-21

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the fauna and flora. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. The three major attributes are air, water and noise level.

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by 23⁰37' N to 23⁰52' N latitudes and 86⁰09' E to 86⁰30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

The ambient air quality monitoring stations were selected to represent core, buffer zone area. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

2.2 Water sampling stations

The Water sampling stations were selected for mine discharge water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The rationale has been based on the guidelines stipulated by MoEF&CC, consent letter of SPCB, as well as other statutory requirements.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM₁₀), Fine Particulate Matter (PM_{2.5}), Sulphur Di-oxide

(SO₂) and Nitrogen Oxides (NO_x). Respirable Dust Samplers (RDS) were used for sampling of PM₁₀, SO₂, & NO_x and Fine Dust Sampler (PM_{2.5} sampler) were used for sampling of PM_{2.5} at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

Water samples were collected as per standard practice. The Mine effluent samples were collected and analysed for four parameters on fortnightly basis. Thereafter the samples were preserved and analysed at the Environmental Laboratory of CMPDI, RI- II, Dhanbad.

3.3 Noise level monitoring

Noise level measurements in form of 'LEQ' were taken using Integrated Data Logging Sound Level Meter. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB(A).

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like PM₁₀, PM_{2.5}, SO₂ and NO_x are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM₁₀& PM_{2.5} exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

The following preventive and suppressive mitigative measures can be undertaken to contain the pollution level within prescribed level:-

- Wet drilling and controlled blasting should be practice.
- Explosive used should be optimised to restrict the dust generation.
- Transportation roads should be permanently asphalted free of ruts, potholes etc.
- Water should be sprayed on coal transportation road, service road more frequently and at regular interval.
- Dust from roads should be removed physically or mechanically.
- Greenbelts around industrial sites, service building area besides Avenue plantation along roads should be created.
- Coal dust should be suppressed by using fixed sprinklers.
- Regular maintenance of plant and machinery should be undertaken.

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines, are within permissible limits.

4.3 Noise Level

During the noise level survey it has been observed that the noise level in the sampling locations is within the permissible limits prescribed as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines for Industrial Area and Noise pollution (Regulation and Control) Rules, 2000.

INTRODUCTION

- 1.0 Any industry and development activities including coal mining is bound to affect environmental attributes. There are positive as well as negative impacts of such operations. For controlling the adverse impacts a regular monitoring is essential. The environmental monitoring is being done as per the guide-lines stipulated by Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India.

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. CMPDI has trained manpower and well equipped laboratory to carry out monitoring, analysis and R&D work in the field of environment.

- 1.1 The Cluster-XIII is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Murlidih, Bhurungiya, Mucharadih, Hantoodih, Padugora, Murlidih 20/21 Pits & Bhatdih. The Cluster – XIII is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – XIII are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Katri River & Damodar River..

- 1.2 The Cluster-XIII is designed to produce 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 0.18 MTPA (normative) and 2.34 MTPA (peak) capacity of coal production vide letter no. J-11015/11/2010-IA.II (M) dated 06th June, 2013.

Ministry of Environment, Forests and Climate Change while granting environmental clearance has given one of the General conditions that “ Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM₁₀, PM_{2.5}, SO₂, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board.” And other conditions regarding water / effluent and noise level monitoring.

In compliance of these conditions the Environmental Monitoring has been carried out & report prepared for submission to MoEF&CC& SPCB and other statutory authorities.

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

(As per G.S.R. 742 (E) dt. 25th December, 2000)

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Murlidih 20/21 (A19): Industrial Area

The location of the sampling station is 23°43' 51.82" N & 86° 16' 21.17" E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

II. BUFFER ZONE Monitoring Location

i) Lohapatti (A20)

The location of the sampling station is 23°44'29.42" N & 86°16'49.96" E. The sampler was placed at a height of approx. 1.5m above ground level at Safety Office.

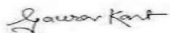
ii) Kharkharee CISF Office (A21)

The location of the sampling station is 23°46' 29.00" N 86° 14' 37.08"E. The sampler was placed at a height of approx. 1.5m above ground level at Project Office.

ii) Dumarda (A31)

The location of the sampling station is 23° 42' 50.00" N 86° 15' 4.00"E. The location was selected for studying the impact of the mining activity on the DuAPRILda village as it lies in the buffer zone for the Cluster

AMBIENT AIR QUALITY DATA

 		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report				CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in		
Test Report for Ambient Air Samples								
Month & Year	02/2026	Cluster	Cluster XIII			ULR No.	TC1432126000002414F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	20.03.2026	
Project	Murlidih 20/21	Sample Ref. No.	REM/BCCL/2026/02		Sampling Method	CMPDI/RI-II/LPM 11, (IS 5182)		
Date of Sampling	05.02.26	19.02.26	Period of Analysis	05.02.26	10.03.2026	Zone of Station:	Core Zone	
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			A5276	A5354				
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	140	130	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100
2	PM _{2.5}	IS -5182(Part 24):2019	71	66	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	12	19	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80
Environmental Condition : Sunny								
* LDL indicates Lower Detection Limit,								
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,								
 ANALYSED BY		 (Gaurav Kant) REVIEWED BY		 (Kumar vaibhav) Authorised Signatory				
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.								
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone:0326-223-850
email: rdri2cmpdi@coalindia.in

Test Report for Ambient Air Samples

Month & Year		02/2026	Cluster	Cluster XIII				ULR No.	TC1432126000002414F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026
Project		Lohapatti		Sample Ref. No.	REM/BCCL/2026/02	Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		03.02.26		17.02.26	Period of Analysis	03.02.26	10.03.2026	Zone of Station:	Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009	
			A5261	A5339					
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	131	135	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100	
2	PM _{2.5}	IS -5182(Part 24):2019	68	71	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60	
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80	
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	21	30	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80	

Environmental Condition : Sunny

** LDL indicates Lower Detection Limit,*

***All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,*

[Signature]

ANALYSED BY

[Signature]

(Gaurav Kant)

REVIEWED BY

[Signature]

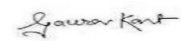
(Kumar vaibhav)

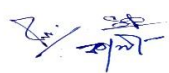
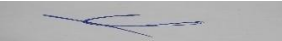
Authorised Signatory

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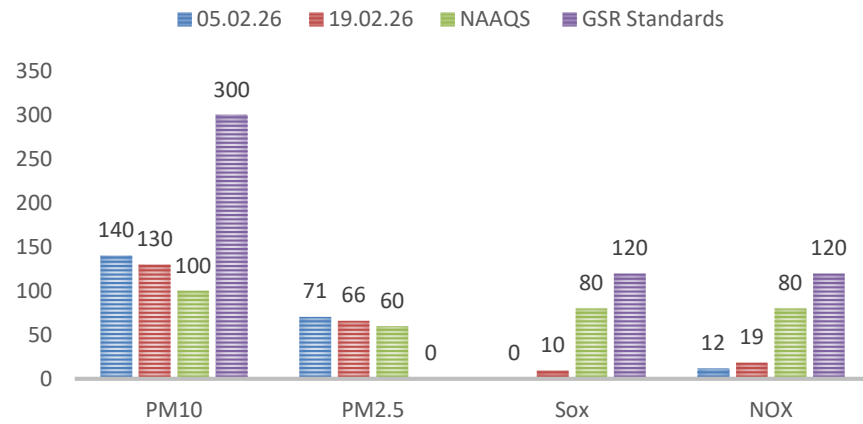
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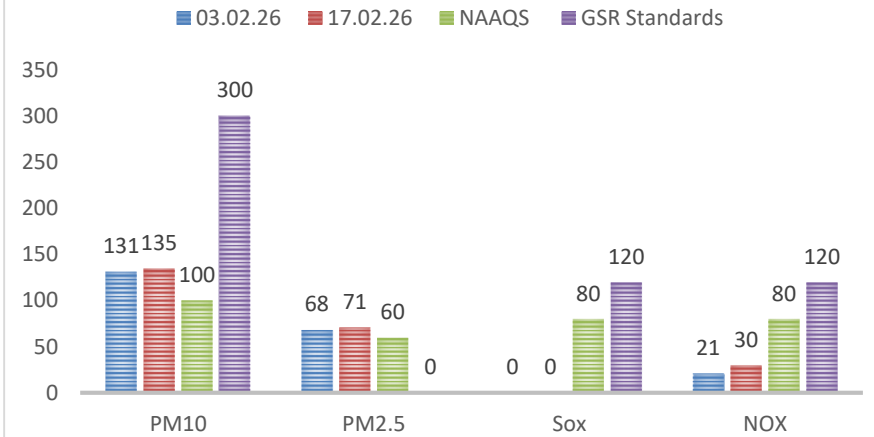
  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in										
Test Report for Ambient Air Samples										
Month & Year		02/2026		Cluster		Cluster XIII		ULR No.		TC143212600002414F
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue		20.03.2026
Project		Kharkharee		Sample Ref. No.		REM/BCCL/2026/02		Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)
Date of Sampling		02.02.26		Period of Analysis		02.02.26		10.03.2026		Zone of Station: Buffer Zone
Sl. No.	Parameter	Method of Analysis	Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009		
			A5253	A5331						
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	121	129	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100		
2	PM _{2.5}	IS -5182(Part 24):2019	67	68	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60		
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80		
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	21	25	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80		
Environmental Condition : Sunny										
* LDL indicates Lower Detection Limit,										
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,										
 ANALYSED BY			 REVIEWED BY			 Authorised Signatory				
Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.										
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in											
Test Report for Ambient Air Samples											
Month & Year		02/2026		Cluster		XIII		ULR No.		TC1432126000002414F	
Customer		Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue		20.03.2026	
Project		Dumarda		Sample Ref. No.		REM/BCCL/2026/02		Sampling Method		CMPDI/RI-II/LPM 11 , (IS 5182)	
Date of Sampling		11.02.26		26.02.26		Period of Analysis		11.02.2026		10.03.2026	
Zone of Station:		Buffer Zone		MoEF Standards Notification dated 25th September,2000 (GSR 742 E)		NAAQS, 2009					
Sl. No.		Parameter		Method of Analysis		Observed Values (in $\mu\text{g}/\text{m}^3$)		Range Of Testing		LDL	
						A5310		A5388			
1	PM ₁₀	IS -5182(Part 23):2006, R-2017	139	143	10 $\mu\text{g}/\text{m}^3$ - 1000 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	300	100			
2	PM _{2.5}	IS -5182(Part 24):2019	68	71	10 $\mu\text{g}/\text{m}^3$ - 400 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	Not Specified	60			
3	SO ₂	IS-5182(Part-2): 2001 , R-2017	<10	10	10 $\mu\text{g}/\text{m}^3$ - 1050 $\mu\text{g}/\text{m}^3$	10 $\mu\text{g}/\text{m}^3$	120	80			
4	NO ₂	IS-5182 (Part-6): 2006 , R-2017	15	22	06 $\mu\text{g}/\text{m}^3$ - 420 $\mu\text{g}/\text{m}^3$	06 $\mu\text{g}/\text{m}^3$	120	80			
Environmental Condition : Sunny											
* LDL indicates Lower Detection Limit,											
**All units are in $\mu\text{g}/\text{m}^3$, 24 hourly Average,											
 ANALYSED BY				 REVIEWED BY				 Authorised Signatory			
Note: The results above relate to the samples tested as received. This report cannot be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.											
---- End of Report ---- Page -1 of 1											

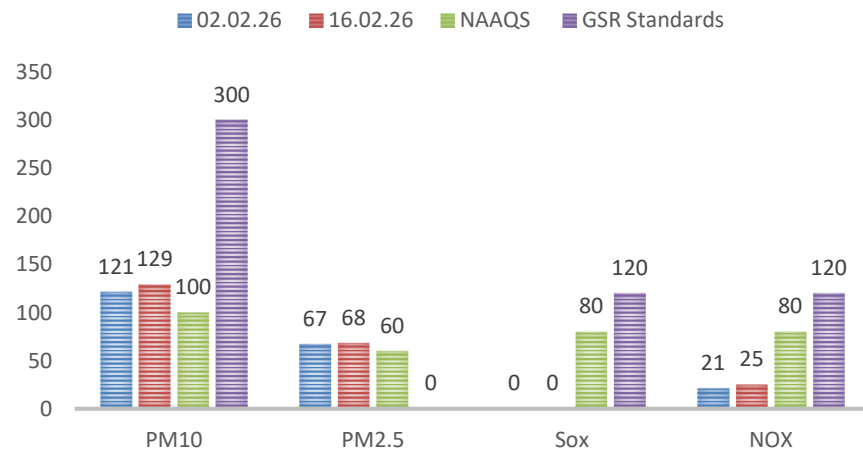
AMBIENT AIR QUALITY AT MURLIDIH 20/21



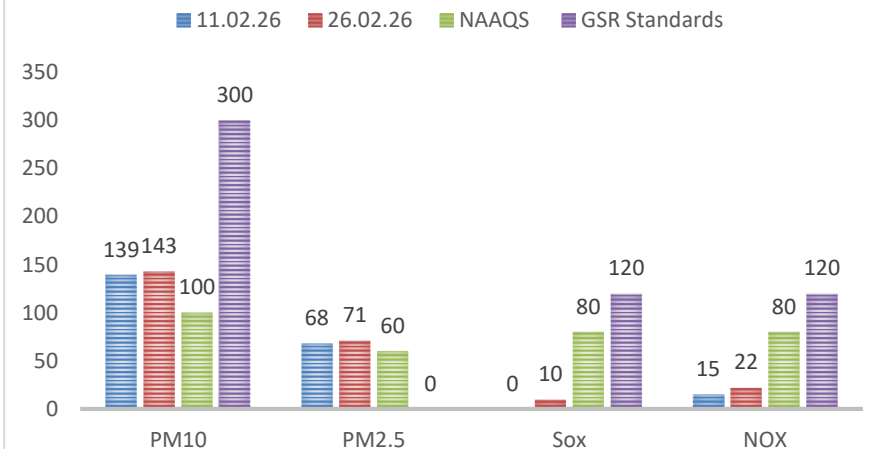
AMBIENT AIR QUALITY AT LOHAPATTI



AMBIENT AIR QUALITY AT KHARKHAREE



AMBIENT AIR QUALITY AT DUMARDA



WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Murlidih 20/21 (MW13)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jamunia.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Test Report for Mine Effluent samples

Month & Year	02/2026	Cluster	Cluster XIII		ULR No.		TC1432126000002431F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026
Project		Sampling Ref. No.	REM/BCCL/2026/02		Sampling Method		IS 3025 (Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations		Murlidih 20/21	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			Period of Analysis	09.02.2026 TO 28.02.2026	
			Date of Sampling		09.02.2026	23.02.26		
Sl. No.	Parameter	Method of Analysis	Observed Values		STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)	LDL		
			M2002	M2029				
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	38	41	41	40		
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.54	7.56	8.06	8.02		
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<4.0	<4.0	<4.0	<4.0		
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	40	44	44	48		

***Grab sampling carried out for water samples **All units in mg/L unless specified otherwise *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

ANALYSED BY

(Gaurav Kant)

REVIEWED BY

(Kumar vaibhav)

Authorised Signatory

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env), CMPDI, RI-II.

---- End of Report ----

NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites

- i) **Murlidih (N19)**
- ii) **Lohapatti (N20)**
- iii) **Kharkharee CISF Office (N21)**
- iv) **Dumarda (N31)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of ' L_{EQ} ' were taken using Integrated Data Logging Sound Level Meter during day time & night time. Noise levels were measured for the complete day & night time, the Intergration time taken was one hour or 3600 seconds. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

Ambient noise levels were recorded during day time & night time and the observed values were compared with standards prescribed by MoEF&CC. The results of Noise levels recorded during day & night time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented. The observed values at all the monitoring locations are found to be within permissible limits.



CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

CMPDI, RI-II
 KOYLA BHAWAN COMPLEX
 DHANBAD. -826005
 Phone:0326-223-850
 email: rdri2cmpdi@coalindia.in

Month & Year	02/2026	Cluster	Cluster XIII				ULR No.	TC143212600002448F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026	
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Murlidih		Date of Sampling	05.02.26	19.02.26	Zone Category of Station:	Core Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	45.6	45.5	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	48.6	45.9					
3		08:00 - 09:00	51.9	48.6					
4		09:00 - 10:00	50.6	47.9					
5		10:00 - 11:00	52.1	49.7					
6		11:00 - 12:00	54.7	49.7					
7		12:00 - 13:00	51.5	52.5					
8		13:00 - 14:00	55.9	52					
9		14:00 - 15:00	52.3	52.5					
10		15:00 - 16:00	56.7	54.3					
11		16:00 - 17:00	53.2	52.7					
12		17:00 - 18:00	51	51					
13		18:00 - 19:00	47.9	48.6					
14		19:00 - 20:00	47.6	47.9					
15		20:00 - 21:00	46.6	46.6					
16		21:00 - 22:00	46.4	46.3					
		Leq DAY	52.0	50.3					
1	Noise Level dB(A)Leq -Night	22:00-23:00	40.7	38.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	39.8	38.5					
3		00:00- 01:00	42.6	38.2					
4		01:00-02:00	41.8	38.1					
5		02:00-03:00	39.7	37.7					
6		03:00-04:00	38	37.5					
7		04:00-05:00	38.2	38					
8		05:00-06:00	38.4	38.1					
		Leq Night	40.2	38.1					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

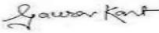
Sampling Assistants	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDI, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	02/2026	Cluster	Cluster XIII					ULR No.	TC143212600002448F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026	
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Lohapatti	Date of Sampling	03.02.26	17.02.26	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones Limits in dB	
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	33.6	34.2	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	43.4	42.6					
3		08:00 - 09:00	38.5	43.1					
4		09:00 - 10:00	36	38.2					
5		10:00 - 11:00	38.5	39.8					
6		11:00 - 12:00	37.3	42					
7		12:00 - 13:00	38.2	40.7					
8		13:00 - 14:00	39.4	42.2					
9		14:00 - 15:00	38.9	40.1					
10		15:00 - 16:00	41.2	41.6					
11		16:00 - 17:00	41.3	41.4					
12		17:00 - 18:00	41.1	42.2					
13		18:00 - 19:00	41.1	42					
14		19:00 - 20:00	40.7	40.3					
15		20:00 - 21:00	40.6	40.4					
16		21:00 - 22:00	40.4	40.3					
		Leq Day	39.9	41.1					
1	Noise Level dB(A)Leq - Night	22:00-23:00	43.7	41.9	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	42.6	41.3					
3		00:00- 01:00	44.5	41.4					
4		01:00-02:00	45.8	42					
5		02:00-03:00	43.1	41.3					
6		03:00-04:00	40.9	41					
7		04:00-05:00	40.5	41.1					
8		05:00-06:00	41.3	41.6					
		Leq Night	43.2	41.5					

**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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 TC-14321  cmpdi A Mini Ratna Company CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in									
Month & Year	02/2026	Cluster	Cluster XIII					ULR No.	TC143212600002448F
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)							Date of Issue	20.03.2026
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Kharkharee		Date of Sampling	02.02.26	16.02.26	Zone Category of Station:	Buffer Zone	
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
								Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	46.5	43	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	55.4	54.4					
3		08:00 - 09:00	64.7	64.9					
4		09:00 - 10:00	66.4	64.4					
5		10:00 - 11:00	62.4	60.3					
6		11:00 - 12:00	58.7	58.3					
7		12:00 - 13:00	59.8	57.4					
8		13:00 - 14:00	56.7	54.3					
9		14:00 - 15:00	54.6	52.3					
10		15:00 - 16:00	52.7	51.8					
11		16:00 - 17:00	51.8	52.4					
12		17:00 - 18:00	50.8	52.1					
13		18:00 - 19:00	49.2	49.2					
14		19:00 - 20:00	47.6	47.7					
15		20:00 - 21:00	45.7	45.9					
16		21:00 - 22:00	45.2	45.5					
		Leq Day	59.0	57.8					
1	Noise Level dB(A)Leq -Night	22:00-23:00	44.6	42.4	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	41.9	42.3					
3		00:00- 01:00	42	42.3					
4		01:00-02:00	40.2	41.4					
5		02:00-03:00	39.9	36.9					
6		03:00-04:00	39.4	40.7					
7		04:00-05:00	39.2	38.2					
8		05:00-06:00	38	35.9					
		Leq Night	41.1	40.6					

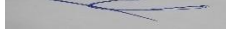
**All noise measurements are integrated for a 01 hour period, All units in dB(A) *LDL indicates Lower Detection Limit

Sampling Assistants ANALYSED BY	 (Gaurav Kant) REVIEWED BY	 (Kumar vaibhav) Authorised Signatory
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  CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Noise Level Test Report CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850									
Month & Year	02/2026	Cluster	XIII				ULR No.	TC1432126000002448F	
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	20.03.2026	
Project		Sample Ref. No.	REM/BCCL/2026/02			Sampling Method	CMPDI/RI-II/LPM 22		
Sampling Stations	i	Dumarda	Date of Sampling	11.02.26	26.02.26	Zone Category of Station:	Buffer Zone		
Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A))	Observed Values (in Leq dB(A))	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards	
			First Fortnight	Second Fortnight				Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	41.6	41.4	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	45.3	43.6					
3		08:00 - 09:00	46.2	45.7					
4		09:00 - 10:00	46.6	49.6					
5		10:00 - 11:00	51.5	59.8					
6		11:00 - 12:00	56.8	60.3					
7		12:00 - 13:00	59.5	55.4					
8		13:00 - 14:00	60.8	53.8					
9		14:00 - 15:00	55.5	52.3					
10		15:00 - 16:00	47.2	56.7					
11		16:00 - 17:00	48.6	55.4					
12		17:00 - 18:00	46.1	51.7					
13		18:00 - 19:00	52.8	52					
14		19:00 - 20:00	47.8	51.5					
15		20:00 - 21:00	46.3	51.1					
16		21:00 - 22:00	41.5	48.9					
		Leq Day	53.6	54.4					
1	Noise Level dB(A)Leq - Night	22:00-23:00	43.4	44	CPCB, Protocol for Ambient Level Noise Monitoring -2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	43.1	43.9					
3		00:00- 01:00	43	43.5					
4		01:00-02:00	42.9	43.1					
5		02:00-03:00	42.5	43					
6		03:00-04:00	42.1	42.4					
7		04:00-05:00	41.8	42.1					
8		05:00-06:00	43.4	43.5					
		Leq Night	42.8	43.2					
Sampling Assistants ANALYSED BY  (Gaurav Kant) REVIEWED BY  (Kumar vaibhav) Authorised Signatory Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II. ---- End of Report ---- Page -1 of 1									

Ambient Air Quality Standards for Jharia Coal Field
As per the Environment (Protection) Amendment Rules, 2000 notified vide notification G.S.R. 742(E), dated 25.9.2000.

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m ³ 700 µg/m ³	- High Volume Sampling (Average flow rate not less than 1.1 m ³ /min)
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m ³ 300 µg/m ³	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO ₂)	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO ₂	Annual Average * 24 hours **	80 µg/m ³ 120 µg/m ³	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause 2.

** 24hourly/8hourly values shall be met 92% of the time in a year. However, 8% of the time it may exceed but not on two consecutive days.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th NOVEMBER 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

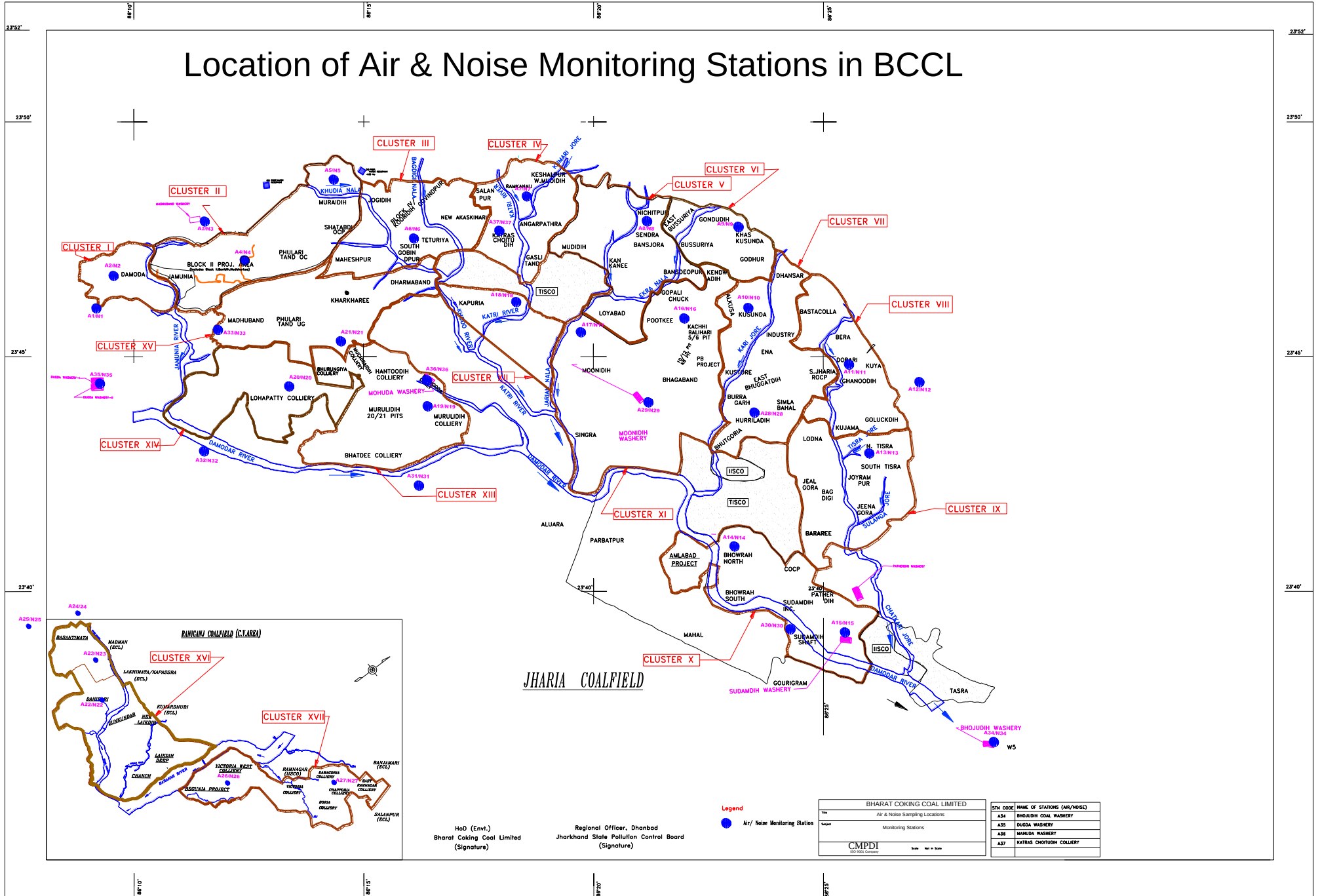
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO₂), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogen dioxide (NO₂), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob & Hochheiser modified (NaOH-NaAsO ₂) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM₁₀, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or PM_{2.5}, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O₃), µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb), µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH₃), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C₆H₆), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed by HPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they JUNE exceed the limits but not on two consecutive days of monitoring.

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category,

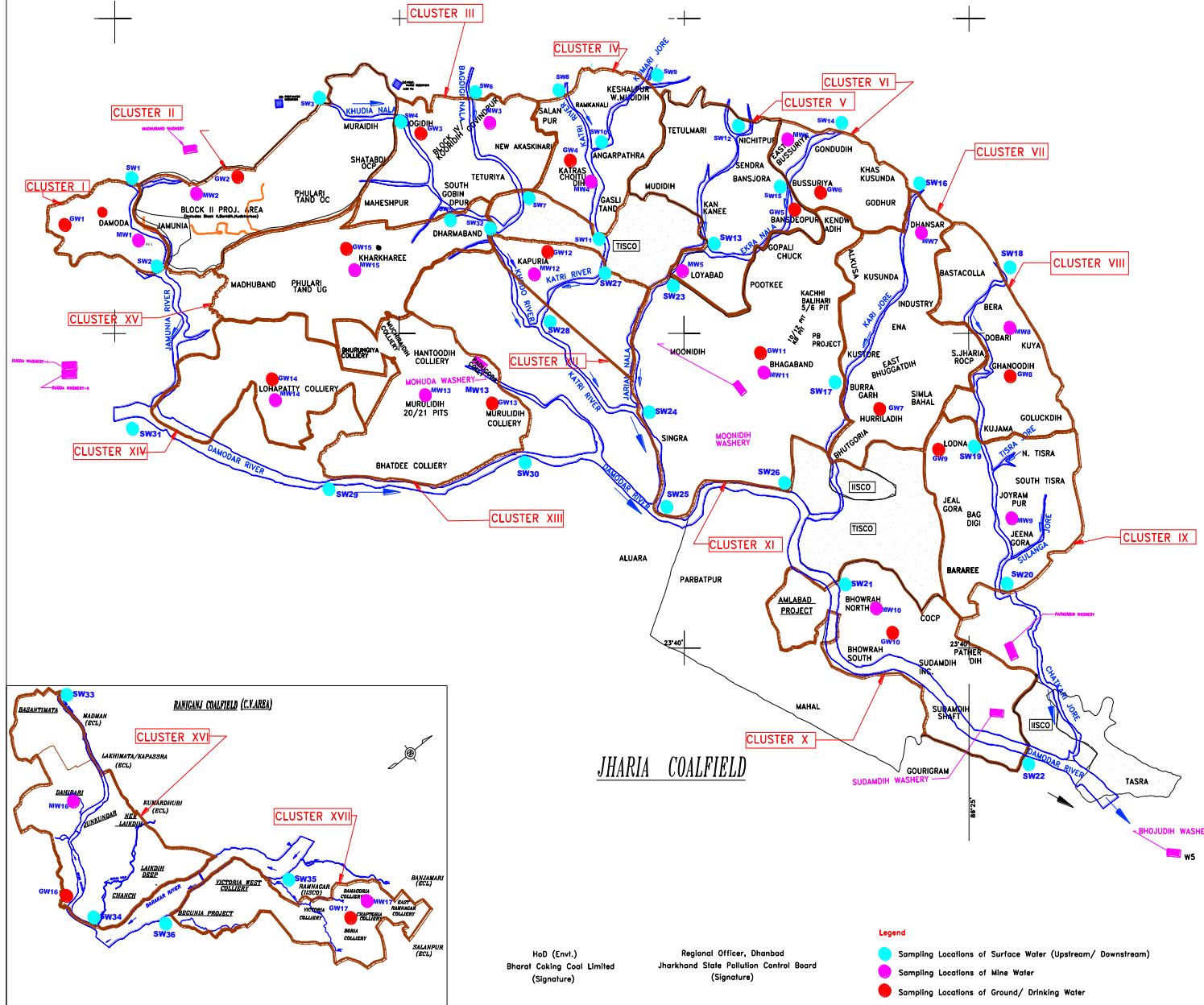
Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL

INDEX

Cluster	Surface Water (JUS, DIS)	Name of River/Nala	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Damodar River	MW1	Damodar Area	GW1	Chhatrapati Village
II	SW3, SW4	Khudra Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudra Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogdih Village
IV	SW8, SW11, SW9, SW10	Kain River, Kuman Jore	MW4	Chotudih	GW4	Kankaneer Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kain Jore	MW7	Dhanbari UGP	GW7	Humladih
VIII	SW18, SW19	Kain Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kain Jore	MW9	Jewagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband UGP	GW11	Bhagaband
XII	SW27, SW28	Kain River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Muridih	GW13	Muridih
XIV	SW31, SW32	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW33, SW34	Khudra Nala	MW15	Kharkhar UGP	GW15	Kharkhar
XVI	SW35, SW36	Khudra River	MW16	Dahibani OCP	GW16	Palabani Village
XVII	SW37, SW38	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria



Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS
Scale	Not to Scale