Office of the General Manager, Bastacolla Area, Dhanbad-828111

Ref. No: BCCL/BA/IX/GM/EC Compliance/2023-24/ 105 Date: 31.05.2022

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

Subject: Six Monthly Report on Compliance of Environmental Clearance Conditions for the period of October'2022 to March'2023 in respect of Cluster VIII Coal Mining Project of M/s BCCL.

Ref. No.: EC Order No. J-11015/298/2010-IA. (M) Dated 15.02.2013 later amended on 15.11.2020 and 28.03.2023.

Dear Sir,

Please find enclosed herewith six monthly report on compliance conditions laid down in Environmental Clearance for the period from October'2022 to March'2023 in respect of Cluster VIII Coal Mining Project of M/s BCCL.

Thanking You,

Yours faithfully,

31/5/23

General Manager
Bastacolla Area
(Cluster VIII)

General Manager
Bastacolla Area-IX

Encl: As above

Copy to:

1. The Director I A, Monitoring Cell, Paryavaran Bhawan, CGO Complex, New Delhi-110003.
2. The Member Secretary, Jharkhand State Pollution Control Board, Ranchi.
3. The Scientist "E"/In-Charge, Zonal Office Kolkata, Central Pollution Control Board, Kolkata.

Six Monthly Environmental Clearance Compliance Report of Cluster VIII Coal Mining Project
EC No: J-11015/298/2010-IA.II(M) Dated 15.02.2013/15.06.2018/15.11.2020/28.03.2023
Period: October 2022 to March 2023

<table>
<tr><th colspan="3">A. Specific Conditions</th></tr>
<tr><th>Sl. No.</th><th>Condition</th><th>Compliance/ Action Taken Report</th></tr>
<tr><td>i</td><td>The Maximum production shall not exceed beyond that for which environmental clearance has been granted.</td><td>It is being complied.
The production from the cluster is within the limit for which environmental clearance has been granted. Month wise production of reporting period i.e. October 2022 to March 2023 is enclosed as Annexure-I.
<table>
<tr><th>Year</th><th>Peak Production Capacity (MTPA)</th><th>Actual Production (MTPA)</th></tr>
<tr><td>2017-18</td><td>5.603</td><td>4.02</td></tr>
<tr><td>2018-19</td><td>5.603</td><td>2.44</td></tr>
<tr><td>2019-20</td><td>5.603</td><td>2.05</td></tr>
<tr><td>2020-21</td><td>5.603</td><td>2.23</td></tr>
<tr><td>2021-22</td><td>5.603</td><td>3.35</td></tr>
<tr><td>2022-23</td><td>5.603</td><td>2.40*</td></tr>
</table>
* Production from October 2022 to March 2023</td></tr>
<tr><td>ii</td><td>The road transportation of coal during Phase-I should be done by mechanically covered trucks. The road used for coal transportation should be developed with avenue plantation on both sides.</td><td>It is being complied.
▪ Presently coal transportation has been done by trucks with tarpaulin cover. Covering of truck has been made mandatory in the transportation contract.
▪ Avenue Plantation has been done along the roads and it shall be continuously carried out as per availability of space.
▪ Avenue Plantation has been developed along major coal transporting route to BNR Railway Siding (Photographs enclosed as Annexure XX).</td></tr>
<tr><td>iii</td><td>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.</td><td>It is being complied.
▪ Company is organizing training on regular basis through Vocational Training Centre at Area Level and Human Resource Department at Company Level.</td></tr>
<tr><td>iv</td><td>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 form.</td><td>It is being complied.
Details of Transportation, CSR, R&R and Implementation of Environmental Action Plan is submitted regularly on Annual Basis (October to March- Compliance Period).</td></tr>
<tr><td>v</td><td>A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.</td><td>It has been complied.
▪ The study has been completed by the CMPDIL to analyze the extent of reduction in pollution load every year by reducing road transport. Enclosed as Annexure II.</td></tr>
<tr><td>vi</td><td>The expertise available internationally should be utilized for control of fire in Jharia Coalfields and for their reclamation and to further minimize time for fire and subsidence control.</td><td>Compliance is under process.
▪ Global Expression of Interest had been opened for the international experts/ firms/ consultants/ agencies to deal with coal mine fire in Jharia Coalfield with vision of reclamation, further</td></tr>
</table>

		minimization of spread of fire & subsidence control for which no bidder has qualified to take up the work. **Enclosed as Annexure-III.** ▪ Recommendations of NRSC is being implemented to control fire in JCF.
vii	The abandoned pits and voids should be backfilled with OB and reclaimed with plantation and or may be used for pisciculture.	**It is being complied.** ▪ Backfilling process in abandoned pits and voids are continuously carried out along with the mining operation. ▪ Ecological restoration and Plantation is being carried out at the stable/finalized OB dumps. ▪ Grass Seed Balls are broadcasted on slopes of OB Dumps for stabilization and further taking it up for Biological Reclamation. ▪ Abandoned Pits (If any) shall be utilized for Pisciculture in Post Mining Phase.
viii	BCCL may consider setting up a separate management structure for implementing environment policy and socio-economic issues and the capacity building required in this regard.	**It has been complied.** ▪ A full-fledged Environment Department, headed by a HoD (Environment) along with a suitable qualified multi-disciplinary team of executives have been established at Company Headquarters for implementation of Environment Policy of the company. ▪ One Executive in each area has also been nominated as Nodal Officer (Environment) for looking after routine environment related jobs along with an Environment Management Cell at Area Level. ▪ For implementing and look after Socio-Economic Issues, an executive of Community Development Cadre is also posted at area level.
ix	The locations of monitoring stations in the Jharia Coalfields should be finalized in consultation with the Jharkhand State Pollution Control Board.	**It has been complied.** ▪ The optimum location of monitoring stations in Jharia Coal Field has been finalized with the approval of Jharkhand State Pollution Control Board. **Enclosed as Annexure IV.**
x	The 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.	**Compliance is under progress.** ▪ Source Apportionment Study has been completed by NEERI. ▪ Final Report is enclosed as **Annexure V**

xi	Mineralogical composition study should be undertaken on the composition of the suspended particulate matter (PM_{10} and $PM_{2.5}$) 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.	**Compliance is under progress.** ▪ Source Apportionment Study has been completed by NEERI. ▪ Final Report is enclosed as **Annexure V** ▪ Mineralogical Composition Study is also a part of Source Apportionment Study. Details enclosed as **Annexure V**.
xii	The proponent shall prepare time-series maps of the Jharia Coalfields through NRSA to monitor and prevent fire problems in the Jharia Coalfields by Isothermal mapping/imaging and monitoring temperatures of the coal seams (whether they are close to spontaneous ignition temperatures) and based on which, areas with potential fire problems shall be identified.	**It has been complied.** ▪ NRSC has been engaged for preparation of time series maps to monitor and prevent fire problems of Jharia Coalfield by Isothermal mapping/imaging and monitoring temperatures of the coal seams. ▪ NRSC has delineated surface fire and associated land subsidence in Jharia Coalfield using satellite based remote sensing techniques. ▪ NRSC has submitted its latest Report on 31st August'2021. ▪ Conclusions of study have been enclosed as **Annexure VI.**
xiii	Measures to prevent ingress of air (Ventilation) in such areas, to prevent restart fresh/spread fires in other areas including in mines of cluster VIII shall be undertaken.	**It is being complied.** ▪ Action is being taken as per Jharia Master Plan approved by GOI and State Govt. of Jharkhand. Excavation/ Open Cast mining is being done in the fire/subsidence affected mines to dig out combustible materials to save the coal from burning and to prevent further spread of the fire. ▪ Old UG Workings have been sealed off to prevent ingress of Air in other areas.
xiv	Underground mining should be taken up after completion of reclamation of Opencast mine area after 15 years.	**It shall be complied.** ▪ Underground Mining will be done after extraction of Coal from overlying seams having feasibility of Open Cast Mining. ▪ UG Mining shall be taken up at backfilled and reclaimed area by analyzing detailed feasibility of Project.
xv	No mining shall be undertaken where underground fires continue. Measure shall be taken to prevent/check such fire including in old OB dump areas where the fire could start due to presence of coal/shale with sufficient carbon content.	**It is being complied.** ▪ Mining is being carried out by OC Method where UG fire is present with due permission from DGMS. ▪ Action is being taken to control, mine fires including old OB dump & areas as specified in Jharia Master Plan.
xvi	The rejects of washeries in Cluster –VIII should be send to FBC based plant.	**Not applicable.** ▪ Coal washery does not exist in this cluster.

xvii	There shall be no external OB dumps. 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.	**It shall be complied.** ▪ Progressive mine closure activities are being carried out as per approved Mine Closure Plan and present geo-mining conditions. ▪ At the end of the mining, there shall be no void and area will be re-claimed as per approved Mine Closure Plan.
xviii	A detailed calendar plan of production with plan for OB dumping and backfilling (for OC mines) and reclamation and final mine closure plan for each mine of cluster-VIII shall be drawn up and implemented.	**It is being complied.** ▪ Mining operation is being done as vegetated and reclaimed with the proper reclamation techniques as per approved Calendar Plan. Internal as well as External Targets are also being maintained in order to achieve Energy Security of the Nation. ▪ Mine closure plan as per the guidelines of Ministry of Coal has been prepared by Central Mine Planning and Design Institute (CMPDI). ▪ Progressive mine closure activities is being implemented regularly as per approved Mine Closure Plan considering present geo-mining conditions.
xix	The void shall be converted into a water reservoir of a maximum depth of 15-20 m and shall be gently sloped and the upper benches of the reservoir shall be stabilized with plantation and the periphery of the reservoir fenced. The abandoned pits and voids should be backfilled with OB and biologically reclaimed with plantation and or may be used for Pisciculture.	**It is being complied.** ▪ Abandoned pits are regularly filled with over burden. The steps are also being taken rigorously to prevent occurrence of Illegal Mining. ▪ Plantation has been done on periphery of voids converted into reservoir. ▪ Old quarries where coal is already extracted is converted into water reservoir. Water from these old quarries/water reservoir is being used by local community. ▪ Abandoned Pits/Voids will be utilized for Pisciculture in Post Mining Phase.
xx	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 60 m width shall be maintained along the Nalas/water bodies. The small water bodies in OC shall be protected to the extent feasible and the embankment proposed long water body shall be strengthened with stone pitching.	**It is being complied.** Mining is being done as per the guidelines and permissions of Directorate General of Mines Safety (DGMS) in accordance with Coal Mines Regulation, 2017. ▪ Embankment has been constructed in some areas and further embankment and stone pitching work will be carried out. 

		▪ Proposal has been approved for Current financial year 2023-24, it will be soon tendered for award of work.
xxi	Active OB dumps near water bodies and rivers should be rehandled for backfilling of abandoned mine voids. However, those which have been biologically reclaimed need not be disturbed.	**It is being complied.** ▪ Active OB dumps near water bodies and rivers shall be re-handled for backfilling of abandoned mine voids as per approved Mine Closure Plan. ▪ The OB dumps created earlier near water body are already stabilized and biologically reclaimed and it shall be protected and maintained.
xxii	Thick green belt shall be developed along undisturbed areas, mine boundary and in mine reclamation. During post mining stage, a total of 704.48 Ha area would be reclaimed. The total additional area under plantation would be 345.06ha (67.79 Ha abandoned quarry area, 277.27 Ha active quarry area, 48.55 ha OB dump outside quarry area, 6.30 ha service building/mine infrastructure area/coal dump etc, 108.26 ha green belt around OCP, 196.31 ha barren area), by planting 1761200 plants in 704.48 ha at a total cost Rs. 7202.46 lakhs.	**It is being complied.** ▪ Plantation has been regularly done on mined out areas, OB dumps in scientific manner as per availability of de-coaled area. At present, Plantation is established over 47.10 Ha. Land. ▪ There is constraint of encroachment in entire Cluster due to which mining and its allied activities are also hindered. ▪ Plantation shall be continuously carried out in line with availability of Land as per geo-mining conditions.
xxiii	The road should be provided with avenue plantation on both side as trees act as sink of carbon and other pollutant.	**Compliance is under progress.** ▪ Avenue plantation has been done in non-coal bearing areas as well as in colonies. ▪ 1500 Nos of Avenue Plantation has been raised through State Forest Department on Major Coal Transportation Route to BNR Railway Siding. ▪ Plantation work is going on with departmentally available manpower and resources. ▪ State Forest Department is also engaged to explore the feasibility of Planation within Cluster as per the Geo-Mining Conditions and future of open cast mining. Photographs enclosed as **Annexure XX**.
xxiv	Specific mitigative measures identified for Jharia Coalfields in the Environmental Action plan prepared for Dhanbad as a Critically polluted are and relevant for Cluster VIII shall be implemented.	**It is being complied.** Action Plan has been prepared in consultation with Jharkhand Pollution Control Board for entire BCCL and not on cluster basis. It is being implemented comprehensively. Some of the salient actions of this cluster are as under: 1. Covered Truck Transport 2. Construction of Pucca Road wherever feasible. 3. Mine water utilization 4. Plantation. Etc.

xxv	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 the entire Jharia Coalfields. Mineralogical composition study should be undertaken on the composition for 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.	**It is being complied.** ▪ The locations of monitoring stations have been finalized in consultation with JSPCB. Approval of locations is attached as **Annexure IV**. ▪ Source Apportionment Study has been completed by NEERI. ▪ Final Report is enclosed as **Annexure V**. ▪ Mineralogical Composition Study is also a part of Source Apportionment Study. Details enclosed as **Annexure V**. ▪ MoU with NEERI, Nagpur and Work Order issued to NEERI, Nagpur is attached as **Annexure V**.
xxvi	No groundwater shall be used for the mining activities. Additional water required, if any, shall be met from mine water or by recycling/reuse of the water from the existing activities and from rainwater harvesting measures. The project authorities shall meet water requirement of nearby village(s) in case the village wells go dry to dewatering of mine.	**It is being complied.** ▪ Mine water is being used for the industrial as well as domestic purpose. Mine water is also supplied to colonies and community after filtration through pressure filters, slow sand filters and rapid sand filters. ▪ A MoU has been signed between Coal India Ltd. & Govt. of Jharkhand for providing mine water to nearby villages. A copy of MoU has been enclosed as **Annexure VII.**
xxvii	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 peizometers. 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.	**Compliance under progress.** ▪ Two Number of Piezometers were constructed in Cluster VIII. Photographs enclosed as **Annexure VIII**. ▪ CMPDI is regularly conducting study of groundwater level and quality of areas within Cluster VIII. Groundwater monitoring data has been enclosed as **Annexure IX.** ▪ Procurement of Digital Water Level Recorder for Ground Water Level Monitoring is under process. It shall be installed in constructed Piezometers within Cluster.
xxviii	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.	**It is being complied.** ▪ Mine water is being allowed to settle down in the mine sumps before filtration through various types of filter viz. Pressure Filter, Slow Sand Filter & Rapid Sand Filter. ▪ The monitoring of water quality parameters is regularly carried out by CMPDIL. Mine water quality data has been enclosed as **Annexure XVI.**

xxix	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.	**Complied** ▪ Effluent Treatment Plant for HEMM Workshop is constructed. Photographs Enclosed as **Annexure XXIV**.
xxx	Regular monitoring of subsidence movement on the surface over and around the working area and impact on natural drainage pattern, water bodies, vegetation, structure, roads, and surroundings shall be continued till movement ceases completely. In case of observation of any high rate of subsidence movement, appropriate effective corrective measures shall be taken to avoid loss of life and material. Cracks shall be effectively plugged with ballast and clayey soil/suitable material.	**It is being complied.** ▪ Regular subsidence monitoring is being done at operational underground mines. Currently, UG Mines under Cluster VIII is not operational.
xxxi	Sufficient coal pillars shall be left un extracted around the air shaft (within the subsidence influence area) to protect from any damage from subsidence, if any.	**It is being complied**. ▪ Sufficient coal pillars have been left around air shafts as per Coal Mines Regulations 2017 and DGMS Orders.
xxxii	High root density tree species shall be selected and planted over areas likely to be affected by subsidence.	**It is being complied.** ▪ Plantation is regularly done in leasehold area of Cluster VIII. High root density plants are regularly planted as per the roadmap prepared by Forest Research Institute, Dehradun. All work order issued for plantation through State Forest Department also incorporates plantation of High Root Density Plants.
xxxiii	Depression due to subsidence resulting in water accumulating within the low lying areas shall be filled up or drained out by cutting drains.	**It is being complied.** ▪ Time to time depression created by the mining operations have been filled by the locally available material and over burden.
xxxiv	Solid barriers shall be left below the roads falling within the blocks to avoid any damage to the roads.	**It is being complied.** ▪ Sufficient barriers are left for saving the surface installation and infra structures as per Coal Mines regulation 2017 and DGMS Standing Orders.
xxxv	No depillaring operation shall be carried out below the township/colony.	**It shall be complied.** ▪ Prior permission is always obtained from DGMS for depillaring (if required).

xxxvi	The Transportation Plan for conveyor-cum-rail for Cluster-VIII 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-VII should be dovetailed with Jharia Action Plan. The road transpiration of coal during phase-I should be by mechanically covered trucks.	**It shall be complied.** ▪ Action has been taken for the transportation plan for conveyor cum rail system of dispatch. CMPDIL, RI-II has been requested to conduct study and prepare the plan in this regard. ▪ Deployment of mechanically covered trucks is under consideration at corporate level and after finalization of OEM, it shall be implemented at mines. ▪ At present, Transportation is being done by covering vehicle with tarpaulin cover and it is made mandatory in Transportation Contracts. **Annexure X.**
xxxvii	A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.	**Complied.** ▪ The study has been completed by the CMPDIL to analyze the extent of reduction in pollution load every year by reducing road transport. **Enclosed as Annexure II.**
xxxviii	R&R of 4959 nos of PAF's involved. They should be rehabilitated at cost of shifting to safe areas at the cost of Rs 29948 Lakhs as per the approved Jharia Action Plan.	**Compliance is under progress.** ▪ Implementation of master plan has already been started through Jharia Rehabilitation and Development Authority (JRDA), Dhanbad PAFs (Non-BCCL) have been rehabilitated at well-established Jharia Vihar Township located at Belgoria and other places. Till date 1269 Nos of PAFs have been rehabilitated. **Enclosed as Annexure XI.**

xxxix	A detailed CSR Action Plan shall be prepared for Cluster VIII croup of mines. Specific activities shall be identified for CSR the budget of Rs. 215.5 Lakhs per year@ Rs. 5/T of coal as recurring expenditure. The 265.25 ha of area within Cluster VIIII ML existing as 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. In addition to afforesting 250.57 ha of area at the post-mining stage, the waste land/barren land within Cluster VIII ML shall be rehabilitated/reclaimed as forest/agricultural land under CSR Plan in consultation with local communities. Third party evaluation shall be got carried out regularly for the proper implementation of activities undertaken in the project area under CSR. Issue raised in the Public Hearing shall 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 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.	**It is being complied.** ▪ BCCL is implementing CSR activities at various scale. A separate CSR committee has been formed at area level, which is looking after the works being executed under CSR. Bastacolla area is constructing 238 Nos. of toilets under CSR activity in different schools in Simdega district of Jharkhand under flagship program (Swachch Bharat Abhiyan) initiated by Hon'ble Prime Minister of India. ▪ Under CSR Initiatives, preventive health care of public living in command area has been undertaken extensively through Company as well as State Govt. Self-Protection Kit including Mask, Hand wash, Soap, Detergent etc were provided to needy villagers around the coal mines. ▪    
xL	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.	**It is being complied.** ▪ Land Use Map of Cluster VIII has been prepared by CMPDIL using remote sensing data for monitoring of land use pattern. **Enclosed as Annexure XII.**
xLi	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	**It is being complied.** ▪ CMPDI has prepared "Mine Closure Plan" for all the mines of Cluster VIII. ▪ Plantation has been regularly done on mined out areas, OB dumps in scientific manner as per availability of de-coaled area. At present, Plantation is established over 47.10 Ha. Land.

	the mine during mine reclamation and at the post mining stage for habitat restoration.	▪ Plantation shall be continuously carried out in line with availability of Land as per geo-mining conditions. ▪ There are two numbers of Eco-Parks are also under development at Bera Colliery and Kuya Colliery to promote mine tourism and conservation of native species of original ecosystem. Photographs enclosed as **Annexure XXI.**
xLii	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 company for implementing environment policy and socio-economic issues and the capacity building required in this regard.	**Complied.** ▪ A full-fledged Environment Department, headed by a HoD (Environment) along with a suitable qualified multi-disciplinary team of executives have been established at Company Headquarters for implementation of Environment Policy of the company. ▪ One Executive in each area has also been nominated as Nodal Officer (Environment) for looking after routine environment related jobs along with an Environment Management Cell at Area Level. ▪ For implementing and look after Socio-Economic Issues, an executive of Community Development Cadre is also posted at area level.
xLiii	Implementation of final mine closure plan for Cluster VIII, subject to obtaining prior approval of the DGMS in regard to mine safety issues.	**It shall be complied.** ▪ Prior approval from DGMS shall be obtained before final mine closure with due regard to mine safety issues.

xLiv	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 bring into focus any infringements/ deviation/ violation of the environmental or forest norms/ conditions. c) 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. 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.	A well-defined Corporate Environment Policy has already been laid down and approved by the Board of Directors. This is also uploaded on company's website. **Enclosed as Annexure XIII.** **Complied.** **Complied.** **Complied.**
B. General Conditions:		
i	No change in mining technology and scope of working shall be made without prior approval of the Ministry of Environment and Forests.	**It shall be complied.** ▪ Prior approval shall be sought from MoEFCC in case of any such requirement arises due to change in geo-mining conditions.
ii	No change in the calendar plan of production for quantum of mineral coal shall be made.	**It shall be complied.** ▪ Production is being done as per the approved calendar program/ MoU target.
iii	Four ambient air quality monitoring stations shall be established in the core zone as well as in the buffer zone for PM_{10}, $PM_{2.5}$, 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.	**It has been complied**. ▪ The optimum location of monitoring stations in Jharia Coal Field has been finalized with the approval of Jharkhand State Pollution Control Board. **Enclosed as Annexure IV.** ▪ Air quality Monitoring report has been enclosed as **Annexure XIV**.

iv	Data on ambient air quality (PM_{10}, $PM_{2.5}$, SO_2 and NOx) 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.	**It is being complied.** ▪ Data is regularly submitted to ministry along with six monthly compliance report.
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.	**It is being complied.** ▪ Personnel operating HEMMs, drilling machine and other machines comply with safety regulation and are equipped with Personal Protective Equipment. Noise monitoring data has been enclosed as **Annexure XV**.
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.	**It is being complied.** ▪ Effluents discharge standards are regularly monitored by CMPDIL for cluster VIII group of mines. Mine water is being treated using filter plants (Pressure, Sand filters etc.) for its further use in industrial purpose and supply to the community. Mine water monitoring report has been enclosed as **Annexure XVI.**
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.	**It is being complied.** ▪ Vehicles used for transportation of coal are always covered by tarpaulin and being monitored for the vehicular emission by the transporter and BCCL. ▪ As per directives of Motor Vehicle Act, All transportation vehicles are registered on https://parivahan.gov.in and https://portal.jharkhandminerals.gov.in
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 analysed through a laboratory recognized under EPA Rules, 1986.	**It is being complied.** ▪ Ambient environmental monitoring is being done by CMPDIL. Monitoring data have been enclosed as **Annexure XIV, XV & XVI**.

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.	**It is being complied.** ▪ A separate full-fledged Human Resource Development Department is conducting regular training program on these issues. ▪ Apart from this Vocational Training Centers are existing in all the Areas of BCCL, which provides periodical training on the safety and occupational health issue to the workers working in the mines. Enclosed as **Annexure XVII.**
x	Occupational health surveillance programme 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.	**It is being Complied.** ▪ Periodical medical Examination (PME) of all the mining and other personnel is being carried out regularly at Area Hospital, Tisra as per the Coal Mines Regulation 2017 and Director General of Mines Safety (DGMS) guidelines. Enclosed as **Annexure XVIII.**
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 Company.	**Complied.** ▪ A full-fledged Environment Department, headed by a HoD (Environment) along with a suitable qualified multi-disciplinary team of executives have been established at Company Headquarters for implementation of Environment Policy of the company. ▪ One Executive in each area has also been nominated as Nodal Officer (Environment) for looking after routine environment related jobs along with an Environment Management Cell at Area Level.
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 compiled.** ▪ Funds for environmental protection measures area kept in separate head which is only used in environmental management activities.

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.** ▪ Advertisement in local newspaper has also been done.
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.	**It has been complied.** Enclosed as **Annexure XIX.**
xv	A copy of the environmental clearance letter 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.	**It has been 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 PM_{10}, $PM_{2.5}$, 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.	**It has been complied.** ▪ Environmental clearance and six monthly compliance of the EC conditions of the cluster have been uploaded on the company's website (www.bcclweb.in).

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 Offices of CPCB and the SPCB.	**It is being complied.** ▪ Six monthly compliance report is regularly send to (twice in a year) the Regional Office of MoEFCC, Ranchi along with required data and information and also uploaded on Parivesh Portal.
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.**
xix	The Environment statement for each financial year ending 31 March in Form-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.	**It is being complied.** ▪ It is being submitted for all the mines of cluster VIII to Head Office of Jharkhand State Pollution Control Board for every Financial Year ending on 31st March
C. Other Conditions by MOEF		
i	The Ministry or any other Competent Authority may stipulate any further condition(s) for environmental protection.	**Agree**
ii	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.	**Agree**

iii	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.	**Agree**
iv	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.	**Agree.**
D. Other Conditions by MOEF (Ref. EC Amendment dated 15.11.2020)		
i.	Adequate number of Fog Canon/Mist Sprinkler shall be installed in six months for dust suppressions at Bastacolla Colliery.	**Complied** • 100 m throw capacity trolley mounted fog canon has been installed for dust suppressions at Bastacolla OCP. (Photographs enclosed as **Annexure XXIII**) • A Truck Mounted Fog Canon has been procured and under operation at Bastacolla Colliery. (Photographs enclosed as **Annexure XXIII**) • Two Nos of 100 m throw capacity fog canon have been procured and under operation at Kuya Colliery. (Photographs enclosed as **Annexure XXIII)**
ii.	Fixed Long range sprinkling system along the railway siding shall be implemented.	**Compliance is under progress.** The Coal from Bastacolla Colliery is being dispatched through BNR Railway Siding. The work order has been issued for "Installation of fixed water sprinkler system at BNR Siding with pipe line works and other associated civil works under administrative control of Rajapuer/S-Jharia OCP under Bastacolla Area" Vide WO No. BCCL/BA/ACE/WO/20-21/30 Dated 02-03-2021 Enclosed as **Annexure XXII.**

iii.	As proposed, three Thousand (3000) Avenue Plantation and Twelve Thousand Block Plantation through State Forest Department will be done along transport route, residential colonies road, railway siding etc. in year 2020-21 (Total 15000)	**Compliance is under progress.** ▪ Plantation is being done through available manpower and resources.
iv.	Development of Greenbelt around quarry. Grassing of OB Dump slopes shall be done using grasses for stabilizing inactive OB Dump. Plantation will be done on external dump and reclaimed area.	**Compliance is under Progress.** ▪ Green Belt shall be developed as per present Geo-Mining Conditions. ▪ Grassing on finalized Slopes of OB Dumps is being carried out in Monsoon. ▪ Plantation is being done at OB Dumps which are finalized and there is no scope of further Open Cast Mining.
v.	Controlled Blasting shall be carried out using Electronic Detonator with appropriate design of the geometry of blast holes in daytime period to minimize ground vibration and dust generation.	**It is being complied.**
vi.	One Continuous Online PM_{10} Analyzer shall be installed for monitoring the quality of air in Bastacolla Colliery and its data should be displayed for public domain through display panel at appropriate location.	**Complied** Three Continuous Online PM_{10} Analyzer machines have been installed at Bastacolla Colliery, Bera Colliery, Kuya Colliery. All machines are working and connected with JSPCB server. https://jsac.jharkhand.gov.in/pm10/ .
vii.	Coal transportation will be done through covered trucks with turpline sheets.	**It is being complied.** Presently coal transportation has been done by trucks with tarpaulin cover. Covering of truck has been made mandatory in the transportation contract.
viii.	Persons of nearby villages shall be given training on livelihood and skill development to make them employable.	**It is being complied.** Company is organizing training on regular basis through Vocational Training Centre and Human Resource Department
ix.	Continuous monitoring of occupational safety and other health hazards, and the corrective actions need to be ensured.	**It is being complied.** Periodical medical Examination (PME) of all the mining and other personnel is being carried out regularly at Area Hospital, Tisra as per the Coal Mines Regulation 2017 and Director General of Mines Safety (DGMS) guidelines. Enclosed as **Annexure XVIII.**
x.	A third party assessment of EC compliance shall be undertaken once in three years through reputed Government Institutes or any other expert agency identified by the Ministry.	**Agreed.**

xi.	Active OB Dump should not be kept barren/open and should be covered by temporary grass to avoid air born of particles.	**Compliance is under progress.** The finalized part of OB Dump (Slopes/ Benches etc.) are continuously vegetated by grassing.
xii.	In-active OB dump shall not be kept barren/open. They should be immediately reclaimed and re-graded to improve the land form and covered by temporary grass etc. for better land use post mine closure.	**Compliance is under progress.** The finalized part of OB Dump (Slopes/ Benches etc.) are vegetated by grassing.
xiii.	Project proponent shall obtain blasting permission from DGMS for conducting mining operation near villages and also explore deployment of rock breakers of suitable capacity in the project to avoid blasting near to villages. There shall be no damages caused to habitation/structures due to blasting activity.	**It is being Complied.**
xiv.	The Project Proponent shall comply with all the statutory requirements and judgement of Hon'ble Supreme Court dated the 2nd August 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of Common Cause versus Union of India and Ors. State Government shall ensure that the entire compensation levied, if any, for illegal mining paid by the Project Proponent through their respective Department in strict compliance of judgement of Hon'ble Supreme Court dated the 2nd August 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of Common Cause versus Union of India and Ors.	**It is being Complied.**
xv.	Proponent shall appoint an Occupational Health Specialist for Regular and Periodical medical examination of the workers engaged in the Project and maintain records accordingly; also, Occupational health check-ups for workers having some ailments like BP, diabetes, habitual smoking etc. shall be undertaken once in six month and necessary remedial/preventive measures taken accordingly. The Recommendations of NIOH for ensuring good occupational environment for mine workers shall be implemented; The prevention measure for burns, malaria and provision of anti-snake venom including all other paramedical	

Six Monthly **Environmental Clearance Compliance Report of Cluster VIII Coal Mining Project**
EC No: J-11015/298/2010-IA.II(M) Dated 15.02.2013/15.06.2018/15.11.2020
Period: October 2022 to March 2023

	safeguards may be ensured before initiating the mining activities.	
xvi.	Project Proponent shall follow the mitigation measures provided in Office Memorandum No. Z-11013/57/2014.IA.II (M), dated 29th October, 2014, titled "Impact of mining activities on Habitations-Issues related to the mining Projects wherein Habitations and villages are the part of mine lease areas or Habitations and villages are surrounded by the mine lease area.	**Agree**
xvii.	The illumination and sound at night at project sites disturb the villages in respect of both human and animal population. Consequent sleeping disorders and stress may affect the health in the villages located close to mining operations. Habitations have a right for darkness and minimal noise level at night. PPs must ensure that the biological clock of the villages is not disturbed; by orienting the floodlights/masks away from the villagers and keeping the noise levels well within the prescribed limits for day light/night hours.	**Agree**
xviii.	Hon'ble Supreme Court in an Writ Petition(s) Civil No. 114/2014, Common Cause vs Union of India & Ors vide its judgement dated 8th January, 2020 has directed the Union of India to impose a condition in the mining lease and a similar condition in the environmental clearance and the mining plan to the effect that the mining lease holders shall, after ceasing mining, undertake re-grassing the mining area and any other area which may have been disturbed due to their mining activities and restore the land to a condition which is fit for growth of fodder, flora, fauna etc. Compliance of this condition after the mining activity is over at the cost of the mining lease holders/Project Proponent."	**Agree**

30/5/2023.

30/5/23

Project Officer
Basantadih Colliery

Project Officer
Bera Colliery/ Dobari Colliery/ Kuya Colliery/ Ghanoodih Colliery

Project Officer
Kujama Colliery

Annexure- I

Coal Production from Cluster VIII (October 2022 to March 2023)

Name of Colliery	Production (In Tonnes)
Bastacolla Colliery	961780.00
Bera Colliery	0.00
Dobari Colliery	0.00
Ghanoodih Colliery	0.00
Kuya Colliery	1447500.00
Kujama Colliery	0.00
Total	2409280.00

Annexure-II

Study to Analyze the Extent of Pollution Reduction

सेन्ट्रल माईन प्लानिंग एण्ड डिजाइन इन्स्टीच्यूट लिमिटेड
(कोल इण्डिया लिमिटेड की अनुषंगी कम्पनी / भारत सरकार का एक लघु उद्यम)
गोंडवाना प्लेस, कांके रोड, रांची - 834 031, झारखण्ड (भारत)
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited / Govt. of India Public Sector Undertaking)
Gondwana Place, Kanke Road, Ranchi - 834 031, Jharkhand (INDIA)
CORPORATE IDENTITY NUMBER - U14292JH1975GOI001223

Letter No.: पर्यावरण/ 8/BCCL/ E-196651 Dated: 20/07/2018

सेवा में,

उप महाप्रबन्धक (पर्यावरण)
बी. सी. सी. एल.
कोयला भवन
धनबाद-826005

विषय: **Study to analyze the Extent of Reduction of Pollution Load every year by reducing coal transportation by Road (Job No.-094214112).**
(BCCL/Dy.GM(Env.)/F-/14/713 dated 21/23.08.2014)

महोदय,

Please find attached soft copy of the report on "Study to analyze the Extent of reduction of pollution load every year by reducing coal transportation by Road" for the **cluster VII and Cluster-VIII**:

Sl. No.	Name of the Cluster	Peak Production (MTY)
1.	Cluster –VII	8.161
2.	Cluster –VIII	5.603

The above report has been prepared based on the data provided by BCCL and meeting held in the first week of November 2018 at BCCL (HQ) Dhanbad.
You are requested to provide data of remaining clusters (CLUSTER WISE) at the earliest to enable us to submit the remaining reports.

सधन्यवाद,

संलग्नक: यथोक्त

भवदीय
(पुष्कर) 20.7.18
महाप्रबन्धक (पर्यावरण)

प्रतिलिपि:
1. क्षेत्रीय निदेशक, आर.आई- II, कोयला भवन, धनबाद- For Kind information.

फोन नम्बर /Phone No. : +91 651 2230055 फैक्स नम्बर/ Fax No. : +91 651 2231447
ई-मेल /e-mail: gmenv.cmpdi@coalindia.in, gmenv.cmpdi@gmail.com
वेबसाईट / Website Address: www.cmpdi.co.in

Annexure-III

Global Expression of Interest (EoI)

For

Dealing with coal mine fires in lease hold of BCCL in Jharia Coalfield, Dhanbad, Jharkhand, India. Detailed scope of work as given in the document.

LAST DATE OF SUBMISSION : 28.04.2014

1. BHARAT COKING COAL LIMITED: A PROFILE

Bharat Coking Coal Limited incorporated in January, 1972 is a fully owned subsidiary of Coal India Limited a 'Maharatna' Public Sector Undertaking under the Ministry of Coal, Government of India. Being the sole repository of prime coking coal in the country, BCCL, at present operates 66 coal mines spread over in Jharia Coalfield and part of Raniganj Coalfield apart from 6 coking coal washeries & 2 non-coking coal washeries. The mines are grouped under 12 areas for administrative convenience. BCCL has some unique inherent and perennial characteristics which are adversely affect the normal operation of the Company. Difficult geo-mining conditions involving large number of overlaying coal seams, preponderance of old workings, high degree of gassiness, coal fires affecting working seams, water logged upper seams above current places of working, etc, restricts coal production and productivity. Besides, high density of population in the coal bearing areas limits the equipment size of opencast operations apart from being an impediment to acquisition of land for uninterrupted operations. In the year 2012-13, the company achieved a coal production of 31.21 million tone and offtake of 32.99 million tone thereby registering the highest ever the Turnover and Profitability (PAT) of Rs 10176.62 Cr. and Rs 1709.06 respectively. A brief description of the organizational structure and the detailed activities of Bharat Coking Coal Limited can be viewed in the website http://www.bccl.gov.in.

The mission is to produce planned quantity of coal efficiently and economically in an Eco-friendly manner with due regard to Safety, Conservation & Quality. The company strives to meet the growing demand of thermal as well as metallurgical coal in the country in a environmentally and socially sustainable manner.

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SC-10

2.2. Bidder's Credential Requirement

i) The bidder(s) must have successfully dealt with mine fire in at least two coal mines, one open cast and one underground mine. The annual capacity of opencast and underground mines should be at least 2 Mt and 0.5 Mt respectively during last seven years of last financial year. The documentary proof of successful dealing with fire shall be submitted along with the bid.

ii) The bidders in their name must have achieved a minimum average annual financial turnover of INR One Hundred Million or equivalent USD during last 3 years ending 31st March of previous financial year. The documentary evidence to this effect would be copies of audited Balance Sheet and Profit & Loss A/c duly countersigned by the authorized representative of bidding company and a declaration to the above affect duly signed by the authorized representative of bidding company & counter signed by a Chartered Accountant or equivalent.

iii) The bidder must possess "key personnel" (minimum number) of the following categories with requisite qualification and experience :-

Sl. No	Skill of key personnel	Requisite Qualification	Minimum Experience	Minimum Nos. for eligibility
1.	Technical Expert (Mining/ Fire dealing/ Mine Rescue)	B.E /B.Tech (Mining) or equivalent	10 years.	10
2.	Technical Expert (Geology/Remote Sensing)	M. Sc (Geology) or equivalent	10 years	2
3	Technical expert (Environment)	B. Tech/BE/M.Sc.(Envr) or equivalent	10 years	1
4.	Technical Expert (Infrastructure)	B.E /B.Tech (Mechanical / Electrical / Civil) or equivalent	10 years	3
5.	IT Expert	B.E /B.Tech/ M.Sc (Computer) or equivalent	10 years	1
6.	Financial Expert	MBA(Finance)/Chartered Accountant/ICWA or equivalent	10 years	1

Note :- The bidder shall designate one of the team members as the team leader.

The documentary evidence to this effect would be self-attested CVs including necessary competency certificate for working in Indian mines duly countersigned by the authorized representative of bidding company.

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iv) Copy of PAN (Permanent Account Number) with Income Tax Authority in India for bidder(s) from India.
v) Copy of PAN Based Service Tax Registration Number in India for bidder (s) from India.

3.0 Availability of details for EOI :

Details for EOI including Terms and Conditions of EOI can be collected from the following place during the period as stated below:

Date: From **27.01.2014 to 26.02.2014.**

Time: **10.00 AM to 1.00 PM** (on all working days)

Office of the GM (CMC)
Contract Management Cell, BCCL
Level-V, Koyla Bhawan,
Dhanbad - 826005

Details for EOI including Terms and Conditions of EOI can also be downloaded directly from the BCCL web-site http://www.bccl.gov.in and NIC Portal, website http://www.tenders.gov.in during the period as mentioned above.

4.0 Pre - EOI submission meeting :
Pre - EOI submission meeting will be held on **14.02.2014 at 11:00AM** in the office of GM (CMC), BCCL, Level-V, Koyla Bhawan, Dhanbad for clarifications and discussion.

5.0 GENERAL INSTRUCTIONS FOR SUBMISSION OF EOI :

Expression of Interest (EOI) shall be submitted by the Consultants / agencies / firms / organizations in a sealed envelope superscribed with "**EOI for Dealing with coal mine fires in lease hold of BCCL in Jharia Coalfield, Dhanbad, Jharkhand, India. Detailed scope of work as given in the document.**" giving EOI reference no. with date and full postal address & telephone nos. on the envelope.

6.0 RECEIPT OF EOI

EOI will be received in sealed envelopes up to **28.04.2014** at the following address only:

Office of the GM (CMC)
Contract Management Cell, BCCL
Level-V, Koyla Bhawan,
Dhanbad - 826005

The offers may be submitted through post also. BCCL takes no responsibility for delay, loss or non receipt of the offers send by post. Fax offers or offers sent through e-mail shall not be accepted.

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7.0 OPENING OF THE EOI :

EOI shall be opened **on 29.04.2014 at 04.00 PM** in the office of the GM (CMC), BCCL, Level-V, Koyla Bhawan, Dhanbad-826005.

8.0 Bidders are requested to go through the details of EOI document & enclose all the required documents along with the proposal. Each page of the proposal shall be signed with seal.

9.0 Prospective parties may note that mere submission of EOI and / or submission of additional information do not automatically entitle them to claim for pre-qualification. BCCL reserves the right to seek for any other information during the process of evaluation, if required.

10.0 BCCL reserves the right to reject any / all the applications to EOI without assigning any reason(s) whatsoever thereof.

Sd/-
General Manager
(Contract Management Cell)

Distribution :

1. PRO – With a request to publish the abridged EOI as enclosed in local as well as National dailies as per norms of the Company and also arrange to send the paper cutting of publication to the Contract Management Cell.
2. D(T)OP / D(T)P&P / D(F) / D(P) / CVO.
3. GM(Co-ordn) / GM(S&M) / GM(F)I/C / GM(M&M) / GM(E&M) / GM(Excv) / GM(P&P) / GM(IE) / GM(System) / Dy. GM (Envt.), BCCL
4. Sr.ES to CMD - for kind information of CMD.
5. HOD (Admn) with a request to display this EOI in Koyla Bhawan Notice Boards.
6. All CGMs/GMs of the Areas including Washery Zones for wide circulation through display in the Notice Boards.
7. Inspector, CISF- with a request to deploy security personnel at the office of GM (CMC), Level-V, Koyla Bhawan on 28.04.2014 from 9:30A.M to 4:00P.M and on 29.04.2014 from 3:30 PM till completion of the meeting.
8. Desk In-Charge, BCCL, M M Division, 4th floor, 6, Lyons Range, Kolkata.
9. CGM / GM (Contract Management Cell), WCL/SECL/NCL/MCL/ECL/CCL & CIL
10. Sri R.K. Choubey, Sr.DEO / Sri B N Banerjee, DEO, CMC Deptt. - to upload this EOI in BCCL Website and forward soft copy of NIC format to GM (System) for uploading the same at NIC portal website (soft copy of the same is enclosed for needful).

Sd/-
General Manager
(Contract Management Cell)

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Annexure-IV

(7)

Ph: 0326-2204933

झारखण्ड राज्य प्रदूषण नियंत्रण पर्षद्
Jharkhand State Pollution Control Board
HIG-1, Housing Colony, Dhanbad-826001

Letter No.... 2650 Dated ..... 6/7/13 .....

From,

Regional Officer,
Dhanbad

To,

HOD (Envt.),
M/s. B.C.C.L.,
Koyla Bhawan, Koyla Nagar,
Dhanbad.

Sub: **Fixing up monitoring station/Sampling location of Air, Water & Noise.**

Sir,

With reference to you letter no. GM(Env.)/F-JSPCB/2013/783, dt. 06.07.2013 We have approved Air, Water & Noise monitoring Station/Sampling location after verification and return a copy of the map.

Encl-A/a.

Your's faithfully,

6/7/13

(Dinesh Prasad Singh)
Regional Officer.

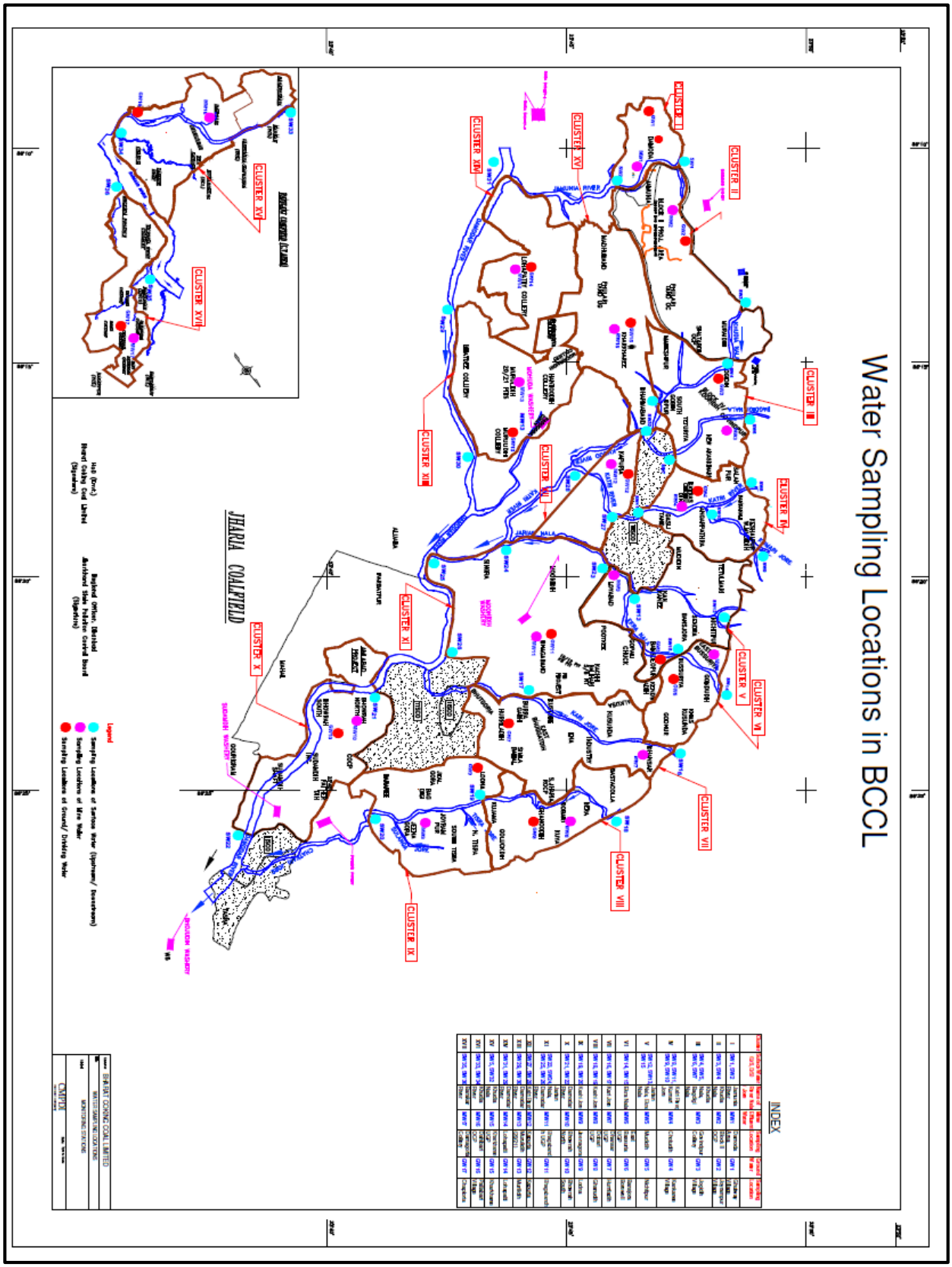
Memo..... Dhanbad, dated.....

Copy to: The Member Secretary, Jharkhand State Pollution Control Board for information & enclose a copy of the map for necessary action.

Encl-A/a.

(Dinesh Pd. Singh)
Regional Officer.

Printed by Sandip


Water Sampling Locations in BCCL
JHARIA COALFIELD
CLUSTER I
CLUSTER II
CLUSTER III
CLUSTER IV
CLUSTER V
CLUSTER VI
CLUSTER VII
CLUSTER VIII
CLUSTER IX
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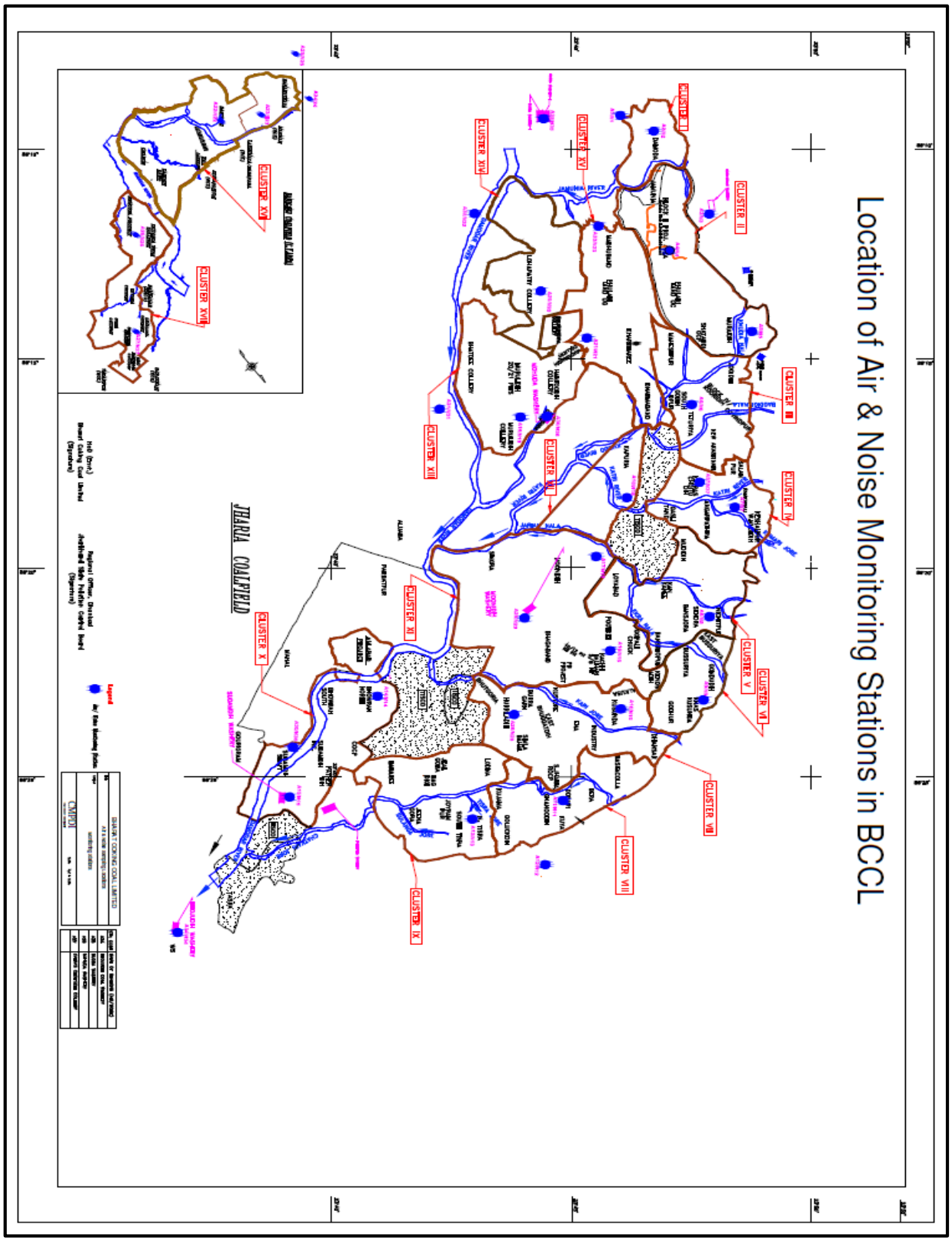
Location of Air & Noise Monitoring Stations in BCCL
JHARIA COALFIELD
CLUSTER I
CLUSTER II
CLUSTER III
CLUSTER IV
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CLUSTER VIII
CLUSTER IX
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CLUSTER XVI
CLUSTER XVII
CMPDI
BHARAT COKING COAL LIMITED

Annexure-V

COAL INDIA LIMITED
कोल इण्डिया लिमिटेड
ENVIRONMENT DIVISION
पर्यावरण बिभाग
Corporate Identity Number: L23109WB1973GOI028844
COAL BHAWAN, Premises No -04MAR Plot no - AF-III, Action Area- IA
RAJARHAT , NEW TOWN KOLKATA - 700156,
E-mail: cgmenv.cil@gov.in, Web:www.coalindia.in
TEL: 033-23246638 / FAX: 033-23244232

CIL/ENV/2015-16/ 7000

09//12/2015

प्रति,

General Manager(Environment)/ HOD (Environment),
ECL,BCCL,CCL,NCL,SECL,WCL,CMPDIL,NEC,MCL,

Sub: MoU between Coal India Ltd.& NEERI for "Sustainable Coal Mining in Coal India Ltd."

महोदय,

In view of the directive of 321 th CIL Board held on 15 th October 2015 pertaining to enter into a long tern. MoU between CIL and CSIR -NEERI for identification of environmental issues through assessment of monitoring data of CIL and preparing an action plan for implementing the same in coal mining, MoU has been signed between Coal India Ltd and National Environmental Engineering Research Institute Ranchi, on 3/12/2015.
Copy of the MoU is enclosed herewith for your information.

9/11/2015

मुख्यप्रबंधक /पर्यावरण
सी. आई. एल.,

संलग्न : उपर्युक्त

भारत कोकिंग कोल लिमिटेड
एक मिनी रत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
उप महाप्रबंधक (पर्यावरण) का कार्यालय
कोयला भवन,कोयला नगर, धनबाद–826005

Bharat Coking Coal Limited
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Office of the Dy. GM (Environment)
Koyla Bhawan, Koyla Nagar, Dhanbad -826005

CIN : U10101JH1972GOI000918

पत्र संख्या :भाकोकोलि/उपमहाप्रबंधक)पर्या/(SOURCE APPORTIONMENT (MoU) /NEERI /2018/
दिनांक:12.05.2018

To,
The Director,
CSIR-NEERI,
Nehru Marg,
Nagpur– 440020
Maharashtra

Sub.: Work Order for the Project "Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand".

Ref: **(i)Memorandum of Understanding between CIL & NEERI dated 03.12.2015**
(ii)your proposal vide email dated 12.09.2016 and subsequent amendment including GST rates
(iii) "Terms of reference for the Project "Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" dated 09.03.2018.
(iv) NEERI's acceptance of "TOR" vide email dated 08.05.2018

Dear Sir,
This has reference to proposal **"Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" vide email** dated 12.09.2016. The Competent Authority has approved the award of work to NEERI namely **"Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" for One Crore forty one Lakh and sixty thousand only inclusive of GST(Rs. 1,41,60,000/-)** for a period of Twelve(12) months under the MOU dated 03.12.2015 between CIL & NEERI, extended to all subsidiaries of CIL & the terms of reference. The Project-in-charge will be HOD(Environment) or any of his authorized representative.

You are required to comply the scope, objective & terms and conditions in respect of above mentioned work as agreed in the "Terms of Reference" as given below.

1. Scope of the Work:

- To conduct Source Apportionment Study for varying sources of gasses/smoke/dust emission from source to source (fuel wood, coal, fly-ash, TPPs, coke plants, traffic, silica from natural dust etc., but not limited to this) for the entire Jharia Coalfields (within and up to 10 Km from the periphery / boundary of BCCL mines)

- Study of Mineralogical composition of the suspended particulate matter (PM10 and PM2.5) with their characterization and quantification.
- Ascertaining sources(fuel wood, coal, fly-ash, TPPs, coke plants, traffic, silica from natural dust etc., but not limited to this) and extent of the air pollution of Jharia coalfield with suggesting cluster-wise appropriate techno-economically viable, mitigation management plan including action plan for the control of pollution level.
- The Environment Clearance has been granted to mines of BCCL on Cluster Basis, the final report must be submitted to BCCL on Cluster Basis. JCF has been divided into Clusters. The study to include the entire Jharia Coalfield along with area up to 10 Km from the periphery / boundary of BCCL mines (Key Plan showing Clusters in Jharia Coalfield enclosed)
- Two Presentations to be made by NEERI- One to BCCL Management before submission of Final report & another to the various stake holders including regulatory agencies after submission of the report.
- The dispersion Model should be on GIS platform
- The Hotspots/bottleneck points to be identified where there is increased pollution on GIS platform.
- Skill transfer and capacity building training for BCCL personnel.
- Accomodation , travel , local transport, other incidental cost and anciallary expenditures to be borne by NEERI.

2. Objectives of the study:

The major objective of the study 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 to include the entire Jharia Coalfield along with area up to 10 Km from the periphery / boundary of BCCL mines. The detailed objectives are as following;

A) Ambient Air Monitoring related

- Monitoring of ambient air quality at selected receptor locations for pollutants including PM10, PM 2.5(limited), SO2, NOx, PAHs to establish the current status of the air quality in Jharia Coalfields along with 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 calibrate dispersion modelling predictions using measured air quality parameters
- To draw supportive data through 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 micro meteorological conditions of the Jharia Coalfileds.

B) Emission Inventory related of Jharia Coalfields along with area up to 10 Km from the periphery / boundary of BCCL mines

- 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.

C) Source apportionment related

- To identify and apportion the pollution load at receptor level to various sources in the Jharia Coalfields along with 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 period of the day and day-of-the-week.

D) Any other item in consensus between both BCCL/CIL & NEERI evolved during the study

3. TERMS & CONDITIONS:

- You would assist BCCL in clarifying/defending/justifying data of report submitted to regulatory authority or information under RTI, Act or reply of parliamentary Questions or any other litigations if required by Dy. GM (Env).
- CSIR-National Environmental Engineering Research Institute (NEERI) shall associate BCCL in projecting the reports/findings at various national & international forums, Conferences, Seminars, CSIR-National Environmental Engineering Research Institute (NEERI) newsletters & annual reports, meetings of regulatory authorities etc.
- All the materials required with regard to monitoring/analysis, videography, photography and presentation for the work shall be arranged by NEERI at its own cost and shall be of appropriate quality.
- The responsibility for the arrangement of the all equipment tools and plants etc. required for monitoring/analysis, videography, photography and presentation for the work lies on NEERI.
- GST and cess as applicable shall be paid as per rule. The Duration of the project is 12 Months.
- The progress report of the work should be submitted every 3 months. These reports shall be in the form of a booklet and soft copies along with videography and photography. Reports should be in line with the scope of work.
- BCCL shall not have any liability in case of any accident etc. towards CSIR-National Environmental Engineering Research Institute (NEERI)'s personnel/ staffs during filed visits
- Child labour is prohibited under Mines Act, therefore, NEERI Nagpur shall not deploy any child labour in the aforesaid work.

- Reports /findings shall be sole property of BCCL and hence the publishing of the reports /findings in any forum (i.e. hard copy / electronic or in any other form) shall be done only with prior permission of BCCL and shall acknowledge BCCL in all such activities.

- Matter relating to any dispute or difference arising out of this work order and subsequent contract awarded based on this work order shall be subject to the jurisdiction of Dhanbad court only

- All other terms and conditions of the MoU executed between CIL and CSIR-National Environmental Engineering Research Institute (NEERI) on 03.12.2015 and extended to its subsidiaries shall be applicable.

4. **ARBITRATION:**

Disputes between the parties arising from this agreement shall be settled amicably through negotiations in good faith. Failing the above, the dispute shall be referred to arbitration of three arbitrators one each to be appointed by each party and the two arbitrator shall appoint *a* third arbitrator in accordance with the provisions of Arbitration and Conciliation Act, 1996 or any subsequent *amendment* thereof. The decision of the three arbitrators shall be final and binding on the parties hereto. The place of arbitration shall be at Nagpur and shall be conducted in English language

5. FORCE MAJEURE :

Force majeure is herein defined as any cause which is beyond the reasonable control of BCCL or CSIR/NEERl as the case may be, which with a reasonable amount of diligence could not have been foreseen and which substantially affects the performance of the respective obligations of the parties, such as but not limited to :

- Act of God such as flood, drought cyclone, lighting, earthquake, etc.
- Rebellion, civil mutiny, commotion, riot, accident by fire, explosion, epidemic, or any other cause beyond the control of parties.
- Acts of any Government including but not limited to war, declared or undeclared priorities, quarantines.
- Any direction, order of any court or Authority adversely affecting the enforcement of this agreement in any manner.
- Strikes and Lockouts for a continuous period of 30 days

Provided that either party shall within 7 days from the occurrence or cessation of such a cause notify the other in writing of the same.

In the event Force Majeure event continue for more than 30 days, the parties shall mutually discuss and decide the future course of action. If not mutually agreed, the parties shall have the right to terminate this agreement.

BCCL or NEERI shall not be liable for non-performance of their respective obligations or delays in respect thereof as a result of force majeure as referred to and / or defined above

6. INDEMNITY

- BCCL shall-indemnify and keep indemnified CSIR/NEERI from and against any and all loss damage or liability (whether criminal or civil) suffered and legal fees and costs incurred by CSIR/NEERI resulting from a breach of any of this agreement between BCCL and its licensors/consultants/contractors or any other third party.
- Notwithstanding anything in this agreement, in the event of any liability, claim or damage arising out of this agreement, the liability of CSIR/NEERI to BCCL shall under any circumstance exceed the amount received by CSIR-NEERI

7. CONFIDENTIALITY

The Parties, to the extent of their respective rights to do so, shall exchange such technical information and data as is reasonably required of each Party to perform its responsibilities under this agreement. Each Party agrees to keep in confidence and to use the same degree of care as it uses with respect to its own proprietary data to prevent the disclosure to third Parties of all technical information, data and confidential business information (hereinafter referred to as "Consolidated Data"). Exchange, use and maintenance of Confidential Data shall be mutually discussed and agreed to by the parties. The preceding provisions of confidentiality and restriction on use of Consolidated Data shall not apply to

- Information in the public domain or information, which subsequently enter into public domain without committing breach of this Article.
- Information in possession of the Party at the time of disclosure and was not acquired, directly or indirectly, from the other Party.
- Information, which a Party requires to disclose under law, rules or regulations or court orders.
- Information provided to Consultants / advisors, provided they, in turn, sign undertaking of confidentiality

8. OWNERSHIP OF INTLECTUAL PROPERTY -

- Any intellectual property rights obtained by the respective parties hereto pertaining to the PROJECT prior to signing of the agreement shall remain the property of the respective organizations. On mutual consent foreground IP shall be deployed for the project purpose.
- The intellectual property that is generated in the PROJECT shall be owned by BCCL.
- If an IP is generated the relevant IP clause shall be built in a project specific agreement mutually, as the, case arises.
- In the case of Intellectual Property developed independently by CSIR/NEERI in which BCCL has an interest, CSIR/NEERI shall grant to BCCL/CIL a non-exclusive license to manufacture and sell the product, and CSIR/NEERI reserves the right to grant similar license at its discretion to others.
- During the work as envisaged under this agreement in the event of CSIR/NEERI scientists exploring, inventing, or discovering results other than the specific objectives of the Project, CSIR/NEERI shall retain absolute rights on such results. CSIR/NEERI shall first offer such results to BCCL on negotiated terms by entering into a separate Agreement. In case BCCL does not accept the offer, CSIR/NEERI shall be free to negotiate the release of such results to other parties without any obligations to CIL.

- In case BCCL intends to renounce its interest in the Project, it shall give notice to NEERI of its intention upon receipt of which notice NEERI shall be free to work further on its own on such Projects and or enter into a licensing or joint development Agreement with any other interested third party.

9. Deliverables:

- Emission Inventory and Dispersion Modeling
- Source apportionment for identification of sources impact and prioritization of actions.
- Time-bound action plan guidelines for implementing measures for improving air quality
- 2 copies of Draft Report
- 15 copies of Final Report- Since the Environment Clearance has been granted to mines of BCCL on Cluster Basis, the final reports must be submitted to BCCL on Cluster Basis.

10. TERMS OF PAYMENT

Project Cost	**Rs. 120 Lakhs (Rupees One Crore Twenty Lakhs Only)**
GST @18%	**Rs. 21.6 Lakhs (Rupees Twenty One Lakhs Sixty Thousand Only)**
Total Cost (including GST)	**Rs. 141.6 Lakhs (Rupees One Crore Forty One Lakhs Sixty Thousand Only)**
Payment Terms	1st Installment: 50% + GST + All applicable Cess & surcharges – (After identification of stations in Jharia Coalfield and submission of its report) 2nd Installment: 30% + GST + All applicable Cess & surcharges – (After completion of field data collection) 3rd & Final Installment: 20% + GST + All applicable Cess & surcharges – (After submission of final report and its acceptance by BCCL.)
Project Duration	12 months

- All the payment will be made by ELECTRONIC MODE through bank. The CSIR-National Environmental Engineering Research Institute (NEERI) must furnish the details in the proforma as given in the Annexure-3.

11. PERFORMANCE SECURITY/SECURITY DEPOSIT

11.1 Security Deposit shall consist of two parts:

a) Performance Security to be submitted at award of work and

b) Retention Money to be recovered from running bills.

The security deposit shall bear no interest.

11.2 Performance Security should be 5% of annualized value of contract amount and should be submitted within 28 days of issue of this term of reference by NEERI in any of the form given below

- A Bank Guarantee in the form given in the bid document from any scheduled Bank payable at its Branch at Dhanbad.
- Govt. Securities, FDR (Scheduled Bank) or any other form of deposit stipulated by the owner.
- Demand Draft drawn in favour of Bharat Coking Coal Limited on any Scheduled Bank payable at its Branch at Dhanbad.

If performance security is provided by NEERI in the form of bank guarantee it shall be issued either –

(a) at Bidder's option by a Scheduled Bank payable at its branch at Dhanbad, or
(b) by a foreign bank located in India and acceptable to the employer.

(c) the validity of the Bank Guarantee shall be for a period of one year or ninety days beyond the period of contract or extended period of contract (if any), whichever is more.

Failure on the part of NEERI to comply with the requirement as above shall constitute sufficient ground for cancellation of this agreement.

11.3 All bills shall be paid at 95%. The balance 5% shall be treated as retention Money and will be second part of security deposit.

11.4 Refund of Security Deposit:

The refund of security deposit shall be subject to company's right to deduct/appropriate its dues against the NEERI under this terms of reference/any other works. On completion of the work and certified as such by the Project-in-Charge *i.e* HOD(Env) or his authorized representative, the security deposit remaining with the company shall be refunded as below:

- Performance Security (1st part of security deposit) shall be refunded within 60 days of the submission of final report and its acceptance by BCCL management (As certified by the Project-in-charge *i.e* HOD(Env) or his authorized representative)
- Retention Money (2nd part of security deposit) shall be refunded after 180 days of the submission of final report and its acceptance by BCCL management (As certified by the Project-in-charge *i.e* HOD(Env) or his authorized representative.)

You are advised to furnish Performance Security/Security Deposit in the Office of HoD (Env), BCCL in the form detailed as under within 28 (twenty eight) days from the date of receipt of this terms of reference to enable the HoD (Env), BCCL to issue a formal work order to you and sign the contract/agreement executed between the company and you (NEERI, Nagpur) with the terms and conditions including, Integrity Pact, etc.

You have to sign the Integrity Pact. This is as per the CVC guidelines. Name, address & contact No. of the Independent External Monitor(s) for this purpose is as given below:

1. Name: Prof (Dr.) L.C. Singhi, IAS (Retd.)
Address: L-31, Third Floor, Kailash Colony, New Delhi-110048
2. Name: Shri Pramod Deepak Sudhakar, IAS (Retd.)
Address: A-002, Stellar Park Apartments, C-58/24 Sector-62, Noida-201301

This terms of reference is given to you in duplicate. You are advised to submit your consent by returning second copy of the terms of referenceduly signed by you as a token of acceptance of the award within 7(seven) days from the date of receipt of this letter.

Failure to comply with the requirement as above shall constitute sufficient ground for cancellation of the award.

Enclosed:

1. Annexure-1 (Proforma of bank guarantee for performance security)
2. Annexure-2 FORMAT FOR CONTRACT AGREEMENT
3. Annexure -3 (Proforma for collecting payment through electronic mode including electronic fund transfer (ETF) & electronic clearing system (ECS))
4. Annexure -4 INTEGRITY PACT

Yours faithfully,

Dy. GM (Env.)

Copy to:

1) TS to D (T) OP/ D (F)/ D (T) P&P ..... for kind information
2) ES to CVO, BCCL ..... for kind information
3) TS to CMD, BCCL ..... for kind information
4) GM (Finance) I/C, BCCL, Koyla Bhawan
5) HOD(Fin)Pay.
6) GM(Env.), CIL ..... for kind information
7) Prof (Dr.) L.C Singhi, IAS (Retd.), L-31 Third Floor, Kailash Colony, New Delhi-1100481. Address: L-31, Third Floor, Kailash Colony, New Delhi-110048.
8) Concerned Fille.

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

Sponsor

Bharat Coking Coal Limited (BCCL)

CSIR-National Environmental Engineering Research Institute, Nagpur

April 2022

Principal Investigator

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Ms. Smita Aditya
Mr. Ankush Rai
Mr. Vijay Selvaraj

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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.

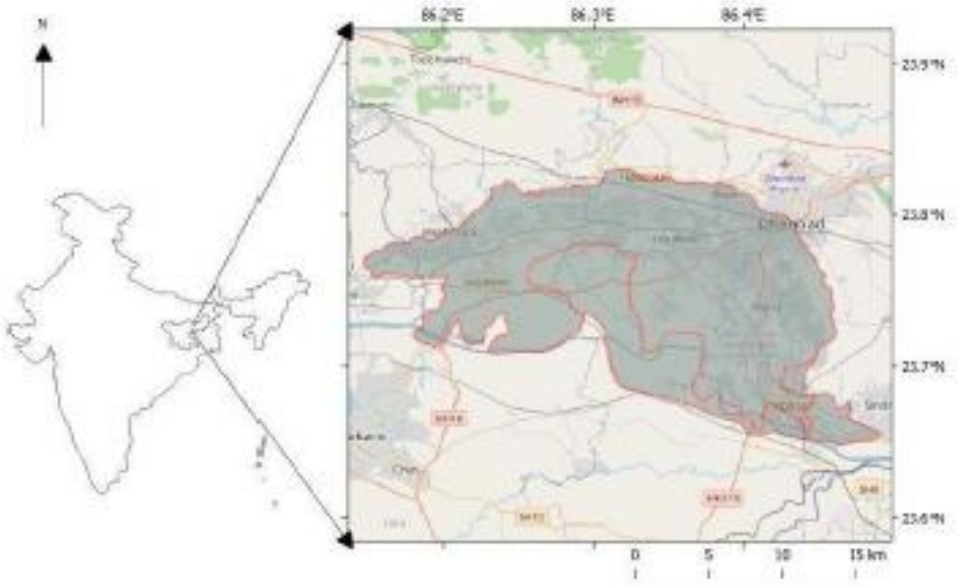


Figure 1.1: Geographical location of Jharia Coalfield in India

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).

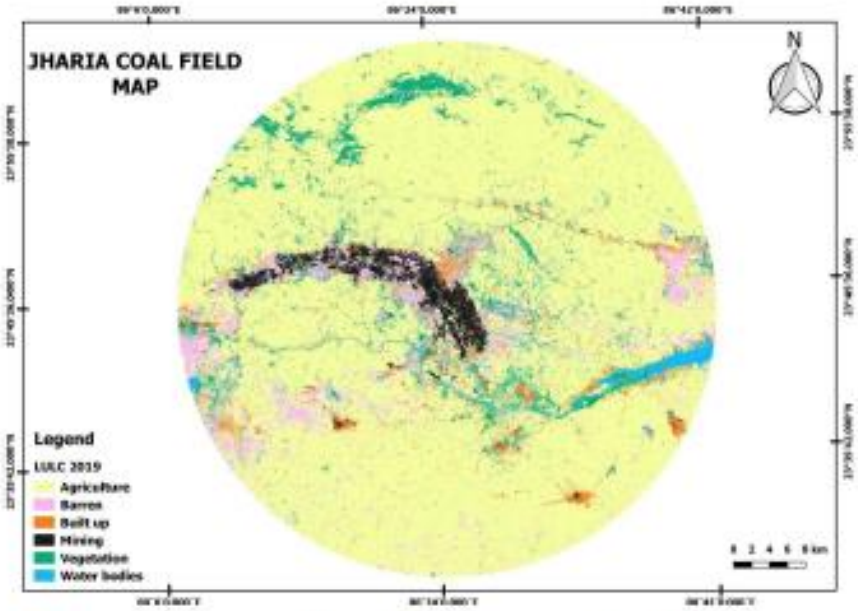


Figure 1.2: Land Use land cover map of Jharia coal field area

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 (PM_{10} and $PM_{2.5}$), NO_2, SO_2 and O_3 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 PM_{10}, $PM_{2.5}$(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.

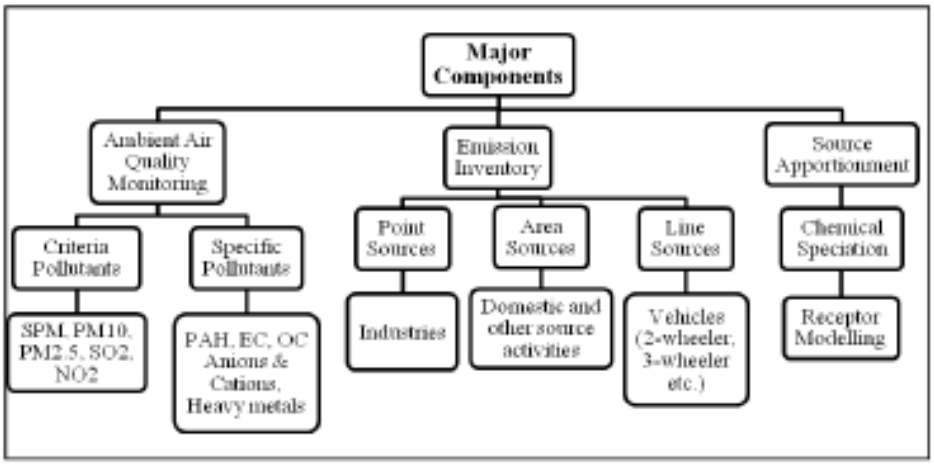


Figure 1.3: Air quality Monitoring & emission source apportionment studies

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 NO_2), 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 in 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 fieldsurvey

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 vecle 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%).

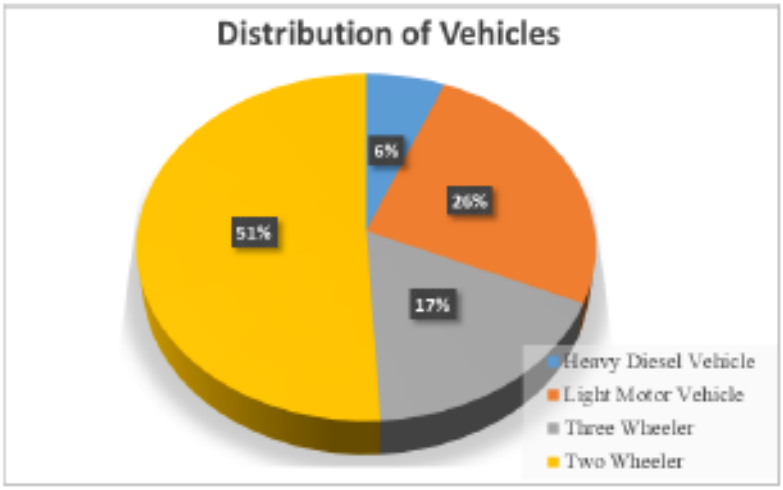


Figure 2.1 Percentage of different types of vehicle surveyed on the road network during the field survey

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

$$E_i = N_v \times VKT \times E_f \quad (2.1)$$

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_f, 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 (S_L) 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):

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

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

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

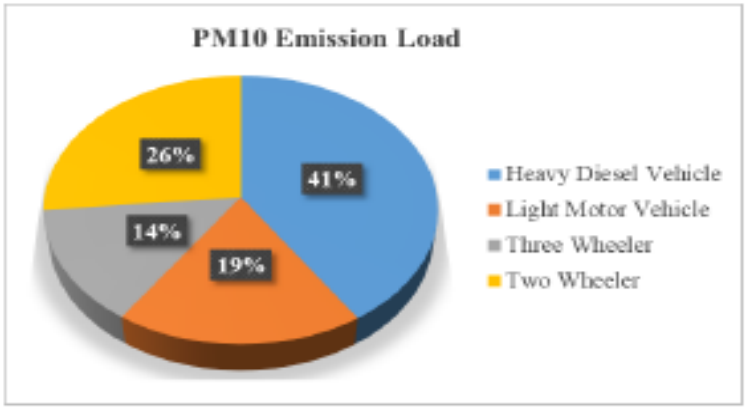


Figure 2.2 PM_{10} emission load for different categories of vehicle

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 Rate	
Emission Sector	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 PM_{10}, 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.

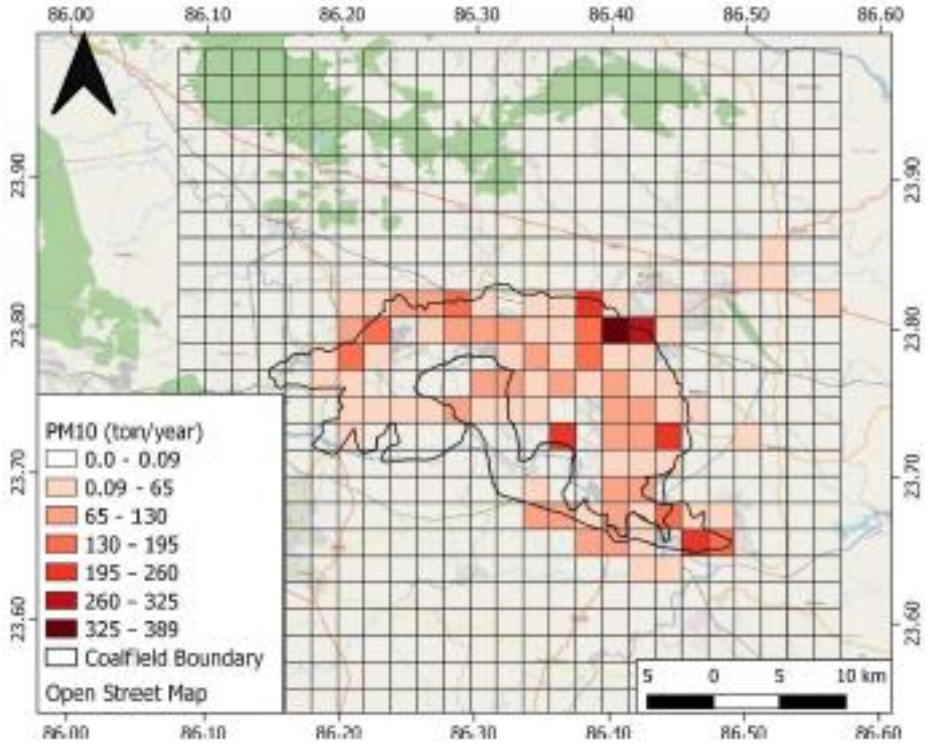


Figure 2.3 Grid-wise emission inventory of PM_{10} in tons/year over the study area

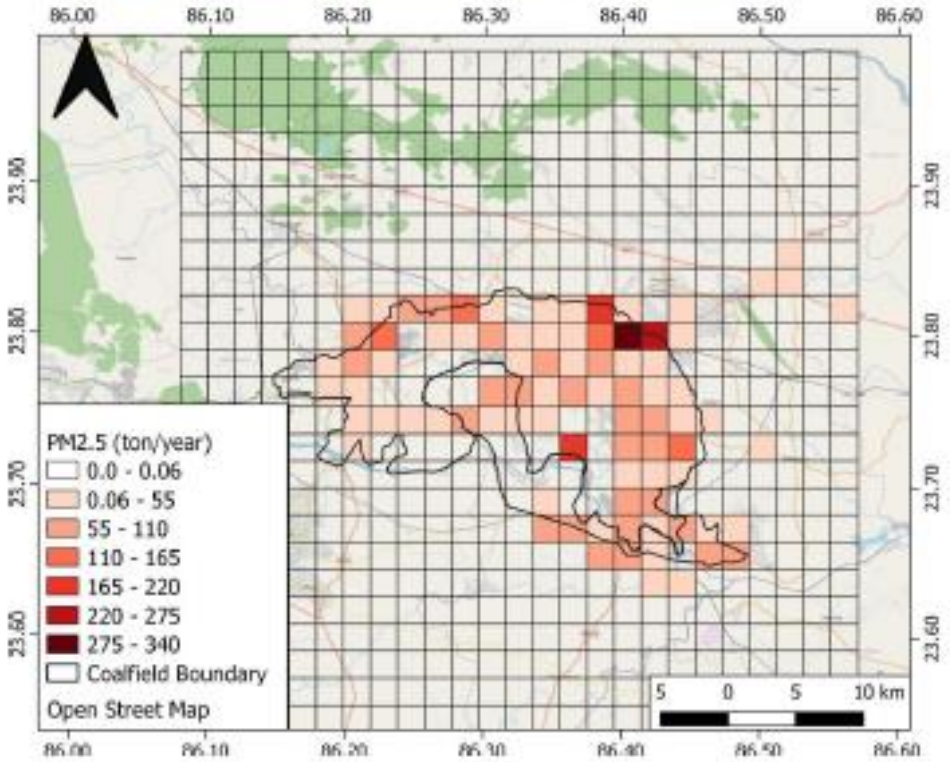
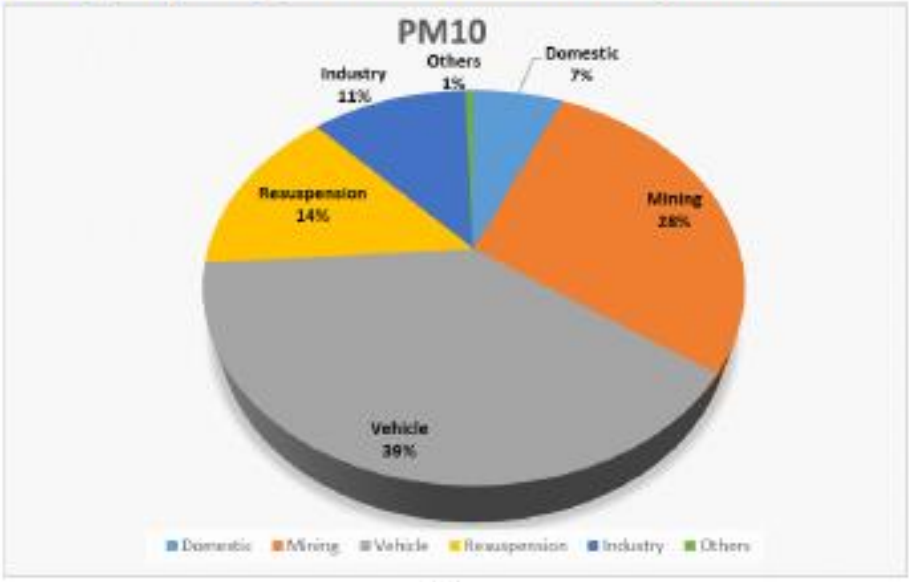


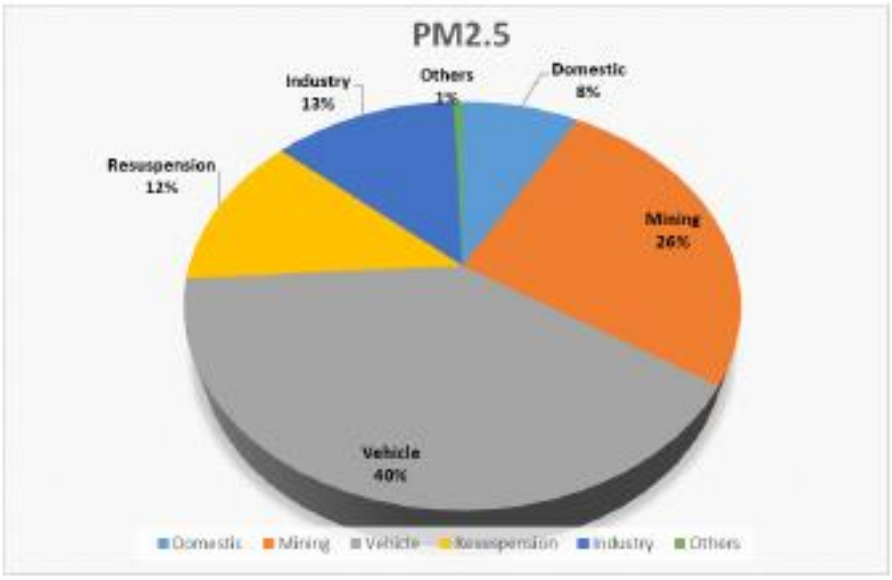
Figure 2.4 Grid-wise emission inventory of PM2.5 in tons/year over the study area

The respective share of various emission sources is represented through pie diagrams shown in Figure 2.5. Data shows that PM_{10} 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)



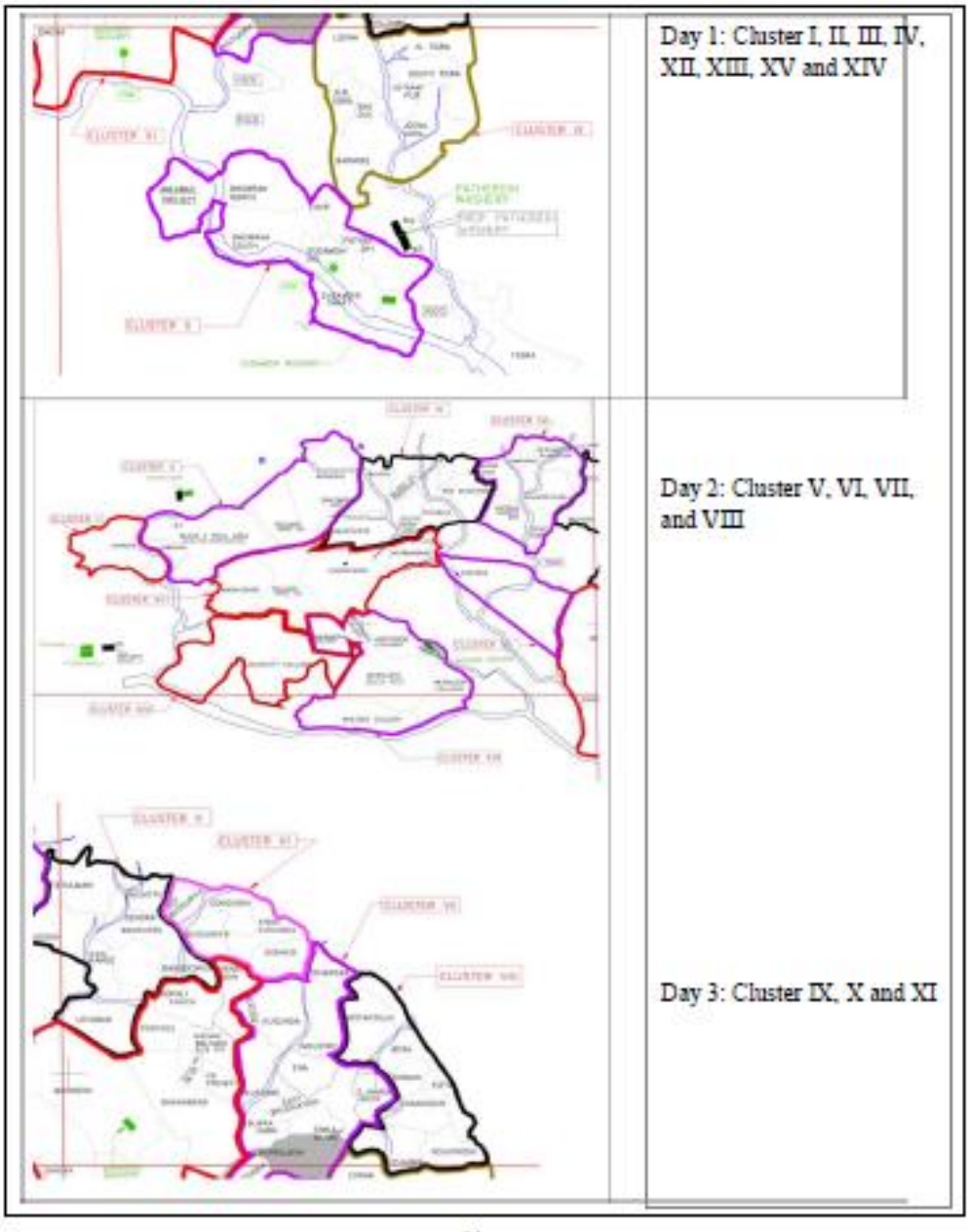
(b)

Figure 2.5 (a) and (b) represents emission load from various sectors over JCF region for PM_{10} and $PM_{2.5}$ respectively

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



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

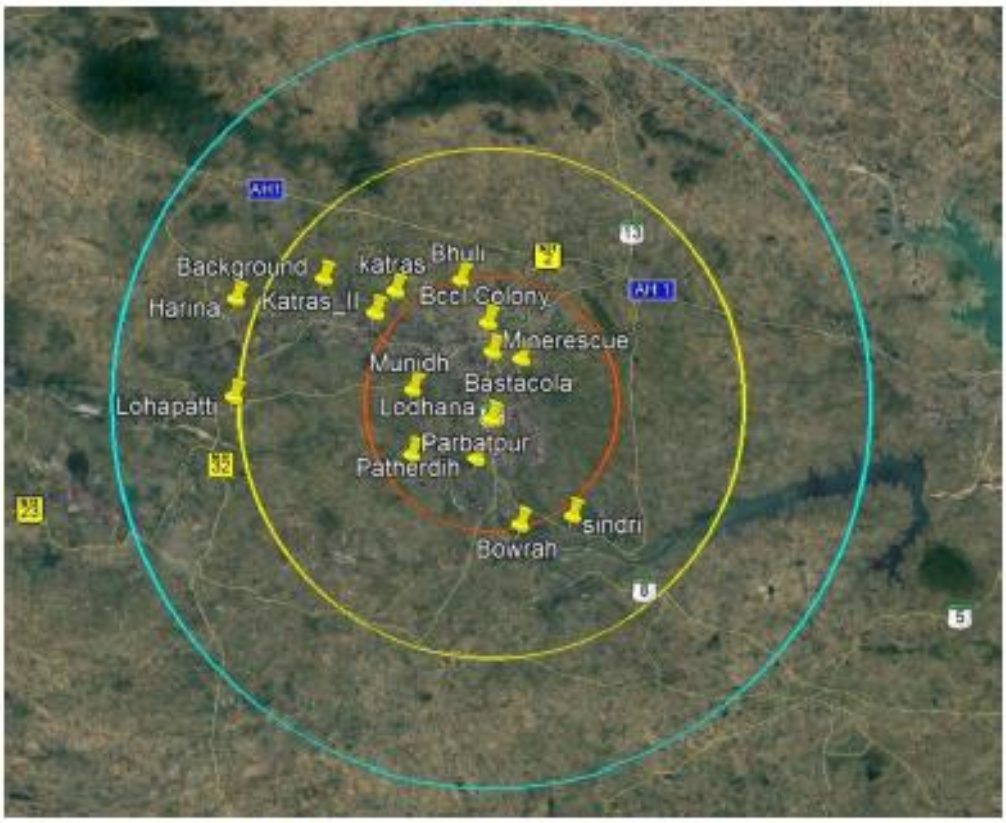


Figure 3.1: Air monitoring sites under 30 km buffer area

3.1. Sampling Method and Schedule

The PM_{10} 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 PM_{10} 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/m³) Industrial, Residential Rural & Other Areas	Concentration in ambient Air (in µg/m3) Ecologically Sensitive Area	Concentration In ambient Air (in µg/m³) 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_6H_6)	Annual*	0.5	0.5	Gas Chromatography based continuous analyzer. Adsorption and description followed by GC analysis
10	Benzo (a) Pyene (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/m3 500µg/m3	430µg/m3 600µg/m3
Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average 24 hours	180µg/m3 250µg/m3	215µg/m3 300µg/m3
Sulphur Dioxide (SO_2)	Annual Average 24 hours	80µg/m3 120µg/m3	80µg/m3 120µg/m3
Oxides of Nitrogen as NO_2	Annual Average 24 hours	80µg/m3 120µg/m3	80µg/m3 120µg/m3

3.2. Chemical Analysis

3.2.1. Gravimetric analysis

The exposed filters were analysed by gravimetric technique using a weighing balance for PM_{10} particles and using a microbalance for $PM_{2.5}$ particles with a precision of 5µg with automatic (internal) calibration.

3.2.2. Elemental analysis

PM_{10} 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 PM_{10} 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 SO_2 and NO_2

SO_2 analysis: Modified West and Gaeke method was followed for sampling and analysis of Sulfur dioxide in ambient air. SO_2 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 pararosanline methylsulphonic acid. The absorbance of the solution was measured by means of a suitable spectrophotometer.

NO_2 analysis: Modified Jacobs and Hochheiser method was followed for sampling and analysis of NO_2 in ambient air. Ambient NO_2 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-napthyl)-ethlylenediamine 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 PM_{10} 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 300ôC and FID temperature 320ôC.

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/O_2). 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 CO_2 in an oxidizing oven immediately downstream from the desorption oven, and the CO_2 is converted to methane (CH_4) 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 PM_{10} and $PM_{2.5}$

In summer monitoring, the mean mass concentrations of PM_{10} particles in all 13 sampling sites were found to be in the range of 74-184µg/m^3 with the highest concentration of 184µg/m^3 at mine rescue site and lowest concentration of 74µg/m^3 at Bastacola site. Also, the mean mass concentration of $PM_{2.5}$ particles was found in the range of 49-117µg/m^3 with the highest concentration of 117µg/m^3 and the lowest concentration of 49µg/m^3 recorded at Harina and Lohapatti site respectively.

The average concentrations of PM_{10} and $PM_{2.5}$ in two seasons are described in Table 3.6 and 3.7. Results revealed that the average concentrations of PM_{10} 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 PM_{10} and $PM_{2.5}$ concentrations were found in Mine rescue and Harina (Figure 3.2 and 3.3).

Table 3.6: Average concentration of PM_{10} 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)

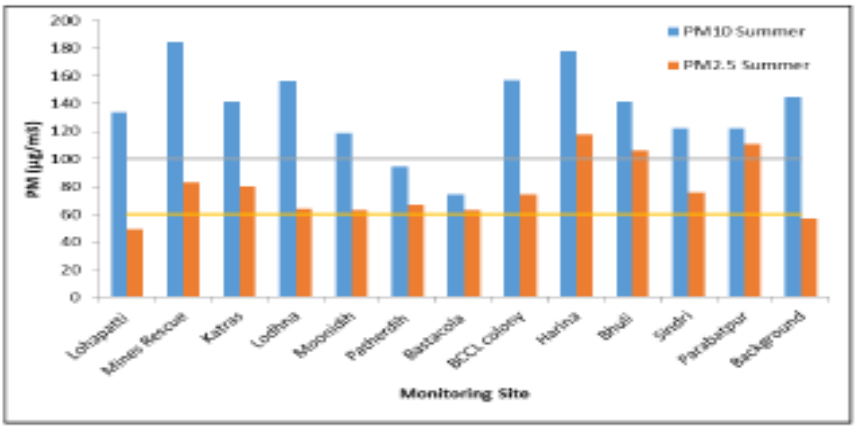


Figure 3.2: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region in summer compared to NAAQS (2009)

Table 3.7: Average concentration of PM_{10} and $PM_{2.5}$ in winter of Jharia Coalfield.

Monitoring Sites	Site Description	Average Concentration (µg/m³)-Winter	
		PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
Lohaparti	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 PM_{10} mass concentration was found to be 332µg/m^3 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 PM_{10} was found in Katras II (Table 3.7).

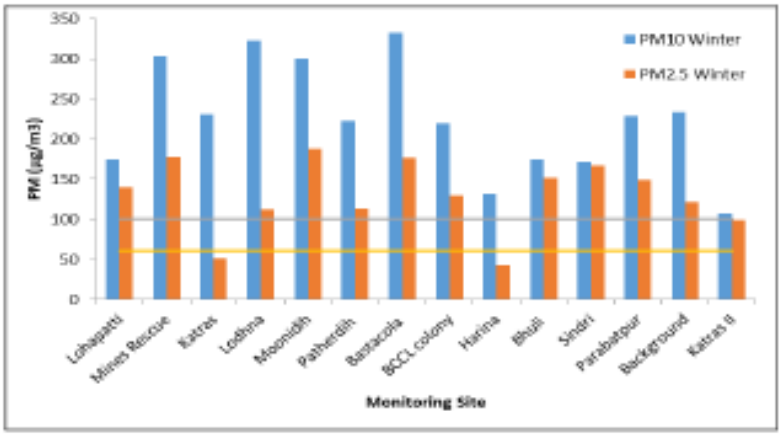


Figure 3.3: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region during Winter compared to NAAQS (2009)

3.3.2. Elemental concentration of PM_{10} and $PM_{2.5}$ in summer

The digested samples of PM_{10} and $PM_{2.5}$ particles from all the 13 sampling sites were subjected to estimate the elemental composition using ICP-OES. The analysis of PM_{10} 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 PM_{10}. It was observed that Al and Fe were found to be higher for both PM_{10} 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/m^3. 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 PM2.5 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 PM2.5 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.

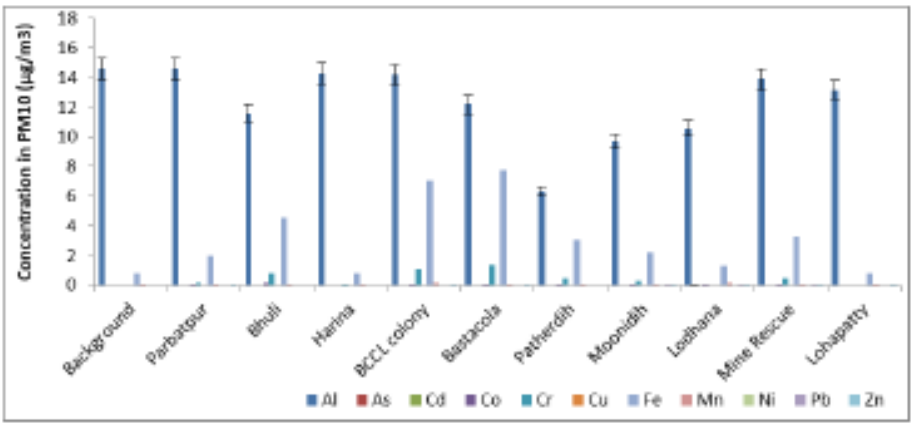


Figure 3.4: Metal concentration of PM_{10} in the summer season

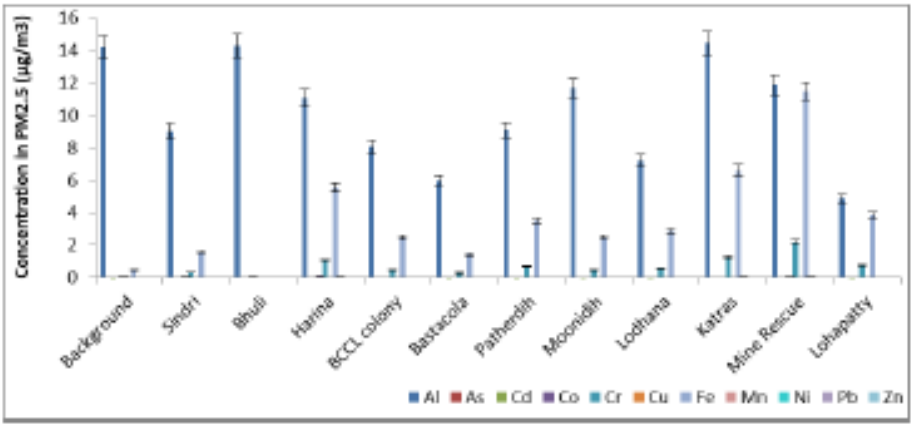


Figure 3.5: Metal concentration of $PM_{2.5}$ in the summer season

3.3.3. Elemental Concentration of PM_{10} 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 PM_{10} and $PM_{2.5}$ samples, were measured. Among all the elements, Al, Fe, and K concentrations were found considerably higher for PM_{10} 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/m^3) was observed at the BCCL colony, followed by Lodhna (10.29µg/m^3). The Highest Fe concentration (9.26µg/m^3) was observed at Bastacola while K (4.19µg/m^3) 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/m^3, 0.05-1.93µg/m^3 and 0.08-2.12µg/m^3. For $PM_{2.5}$ particles, maximum Al and K were found at the Munidih site, which were 2.91µg/m^3 and 2.12µg/m^3 respectively. The highest concentration of

Fe i.e. 1.93µg/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.

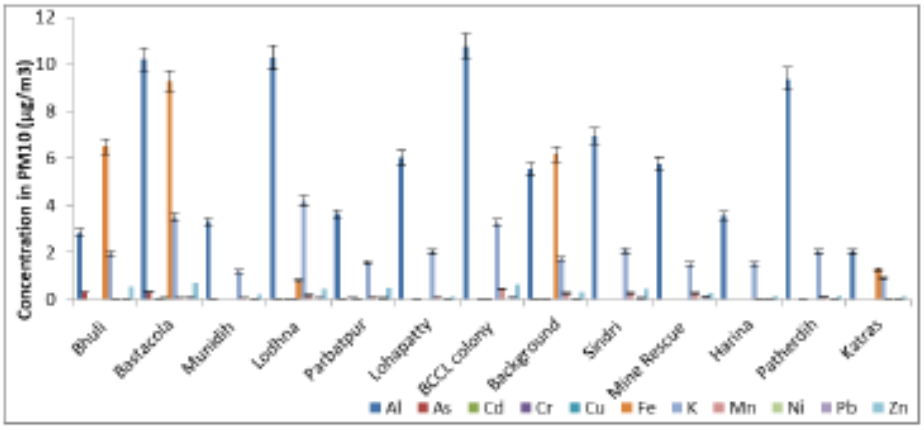


Figure 3.6: Metal concentration of PM_{10} in winter season

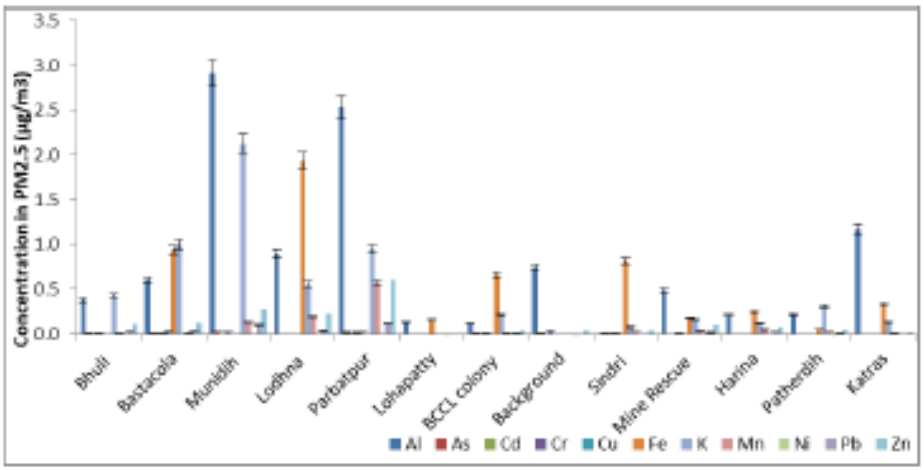


Figure 3.7: Metal concentration of PM 2.5 in winter season

3.3.4. SO_2 and NO_2 concentration in ambient air in the Summer season

The mean average SO_2 concentration in the summer season among all the monitoring stations ranged between 11µg/m^3 (Harina & Bastacola) and 24.5µg/m^3 (Moonidih), being well below the threshold limits of 80µg/m^3 (residential or industrial). The 8-hour average NO_2 concentrations were between 10.3µg/m^3 (Background) and 40.9µg/m^3 (Lodhana), well within the standard limits of 80µg/m^3 (residential or industrial) Figure 3.8. The SO_2 in the residential areas may be received from the open burning of raw coal and other domestic and commercial activities.

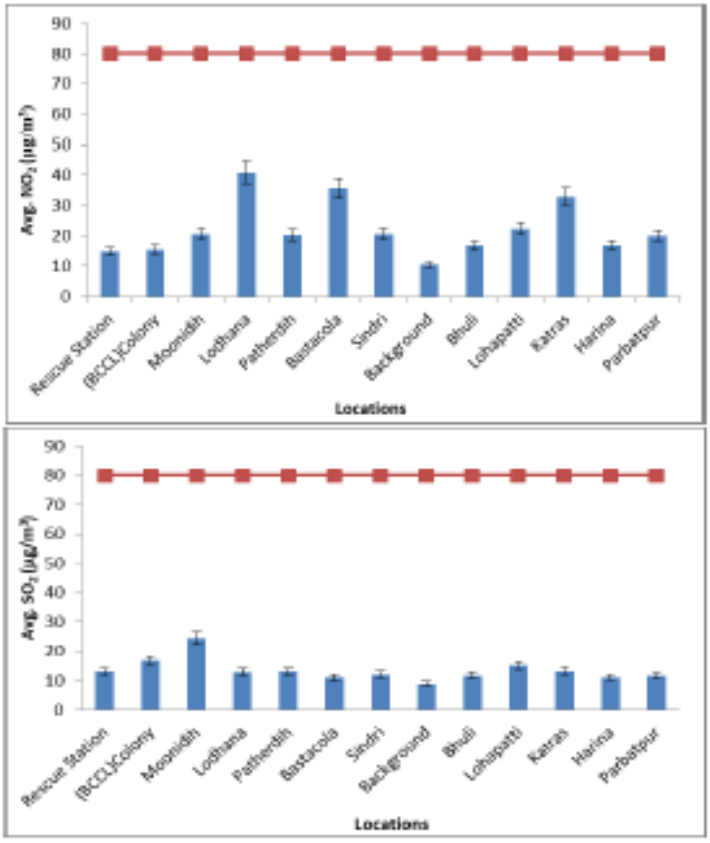


Figure 3.8: NO_2 and SO_2 Concentration of all monitoring sites in summer season

3.3.5. SO_2 and NO_2 concentration in ambient air in Winter season

The mean concentration of NO_2 and SO_2 in the winter season was found below the threshold limit i.e. 80µg/m^3. The concentration of SO_2 was below 10µg/m^3 in Katra, BCCL colony, Mine Rescue, Bastacola, Lodhana and Munidih. Bastacola and Bhuli site has a NO_2 concentration above 10µg/m^3 (Figure 3.9). It has been observed that the concentration of NO_2 and SO_2 in the winter and summer seasons were below the standard limit. But the average concentration of NO_2 and SO_2 in the summer season was higher than in the winter season.

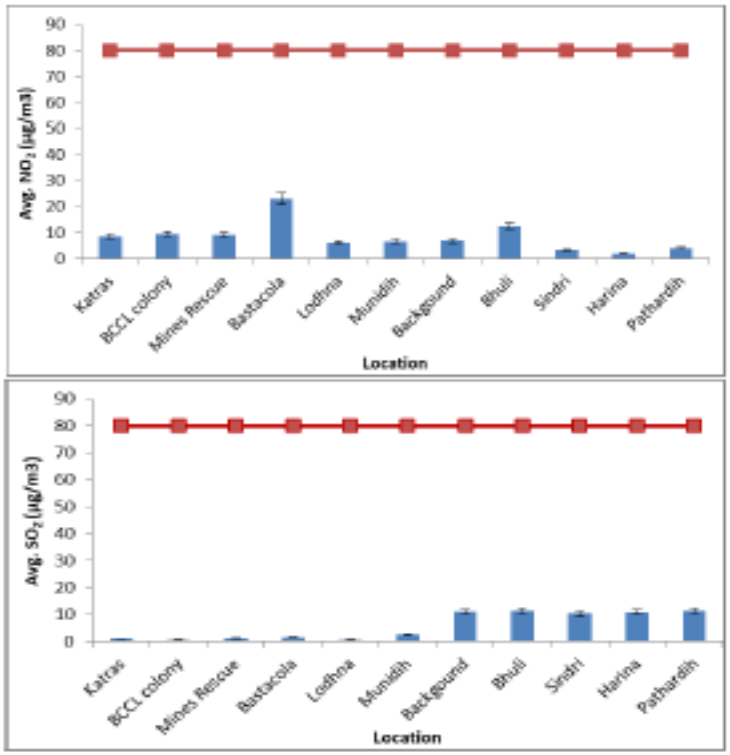


Figure 3.9: NO_2 and SO_2 Concentration of all monitoring sites in Winter season

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/m^3, respectively, and the lowest OC concentration was 15.36µg/m^3 and EC was 13.08µg/m^3 in Sindri site. In comparison, the concentration of OC (67.35µg/m3) and EC (81.67µg/m^3) in PM_{10} were higher in the BCCL colony among all the sites. The lowest OC concentration as 17.95µg/m^3 was in Bastacola and EC in Parbatpur i.e. 15.44µg/m^3 (Figure 3.10).

3.3.7. Carbonaceous Aerosol/EC & OC in winter

The mass concentration of EC and OC in PM_{10} and $PM_{2.5}$ are more significant than 100µg/m^3 and 70µg/m^3, respectively in Bastacola, Katras, Mine Rescue, Background, and Sindri. The highest concentration of EC in PM_{10} and $PM_{2.5}$ was observed in the Sindri site, whereas OC was found higher in Sindri and Bastacola. OC contributing to PM_{10} 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).

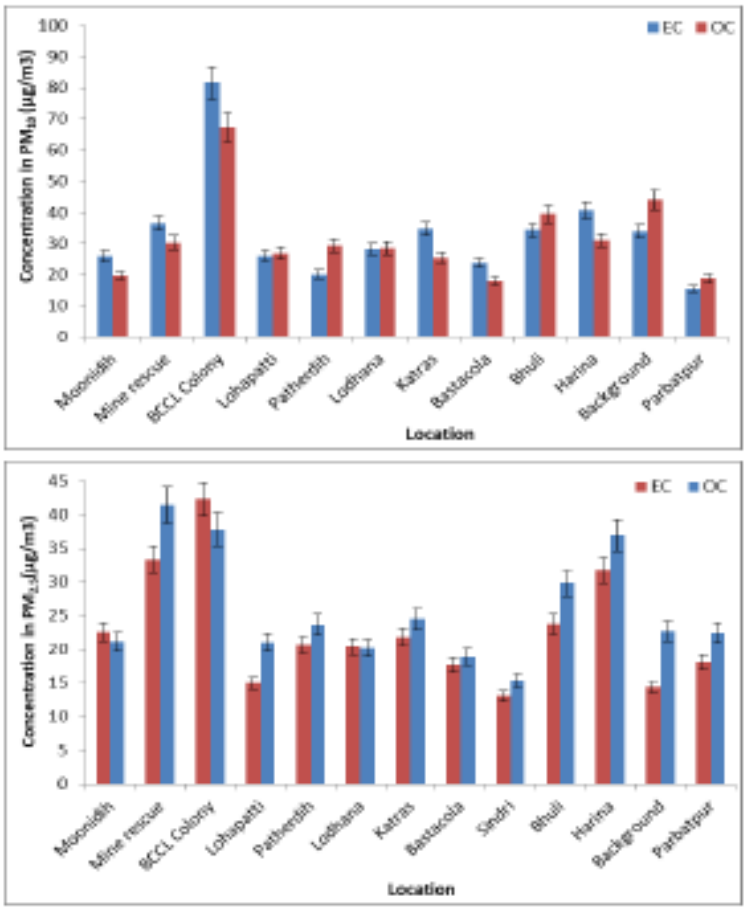


Figure 3.10: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Summer season

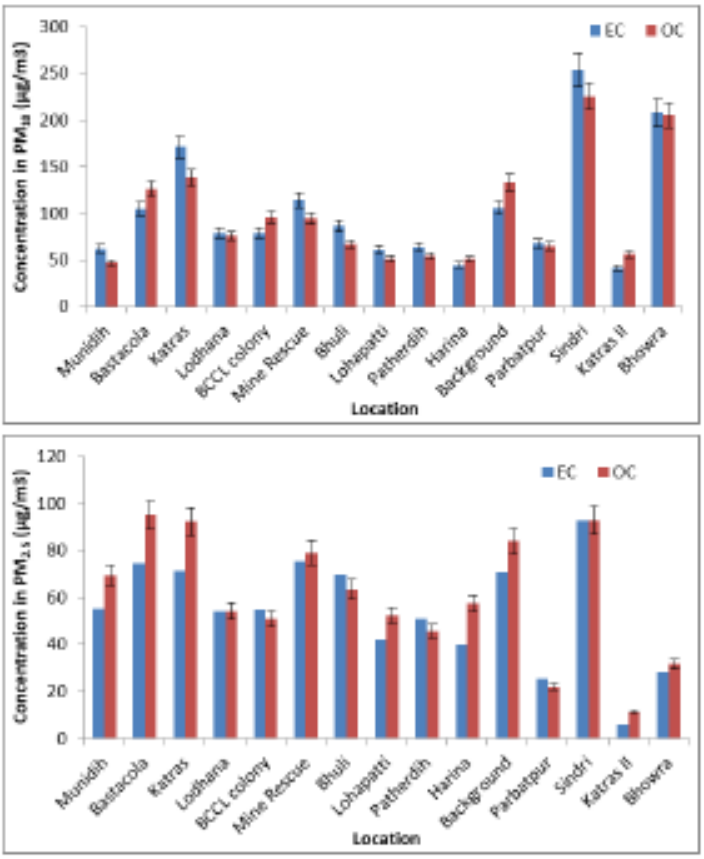


Figure 3.11: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Winter Season

3.3.8. Ionic composition of PM_{10} 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 1.06-20.17µg/m^3 where a higher concentration was observed in Harina, BCCL colony, and Lodhana sites. Likewise, NO_3^- was in the range of 0.32-19.2µg/m^3 with the highest in the Harina site. PO_4^{3-} and Cl^- concentration was highest in Harina and < 2µg/m^3 in other locations. NH_4^+ was in the range of 0.75-16.24µg/m^3, Harina with the highest concentration, and Bastacola with the lowest concentration. Na^+ concentration (0.18-8.6µg/m^3) was highest in Harina followed by BCCL colony and less than 2µg/m^3 in remaining sites. Ca^{2+} concentration (1.5-11.77µg/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 5.85µg/m^3 (Figure 3.12).

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

3.3.9. Ionic composition of PM_{10} 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 $Na^+ < Mg^{2+} < F^+ < K^+ < Ca^{2+} < Cl^- < NH_4^+ < SO_4^{2-} < NO_3^-$. 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 $PM_{2.5}$ 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: $Mg^{2+} < Na^+ < Ca^{2+} < K^+ < Cl^- < NH_4^+ < SO_4^{2-} < NO_3^-$. The same trend has been observed i.e. SO_4^{2-}, NO_3^- and NH_4^+ ions contribute mainly in $PM_{2.5}$ mass concentration. The average concentration of SO_4^{2-} and NO_3^- in winter was higher than in summer.

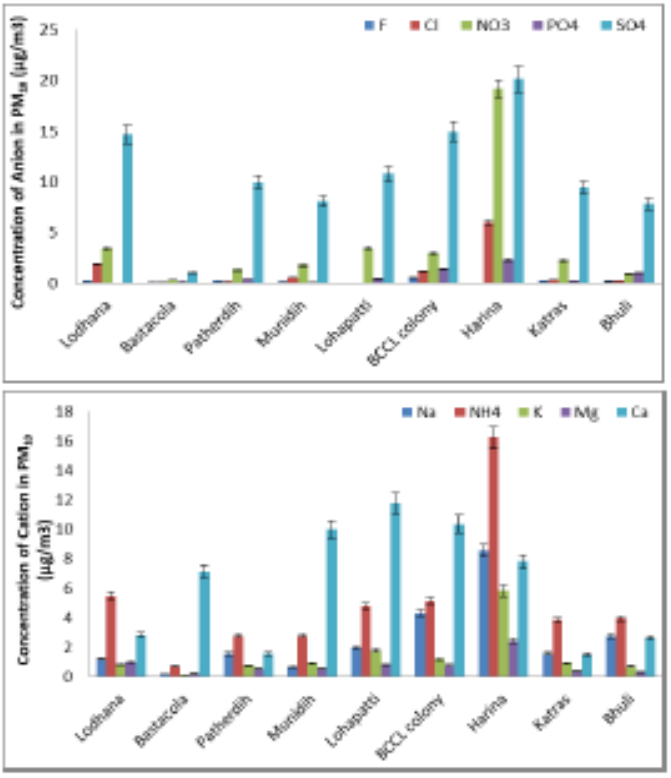


Figure 3.12: Anion and Cation concentration in PM_{10} in summer

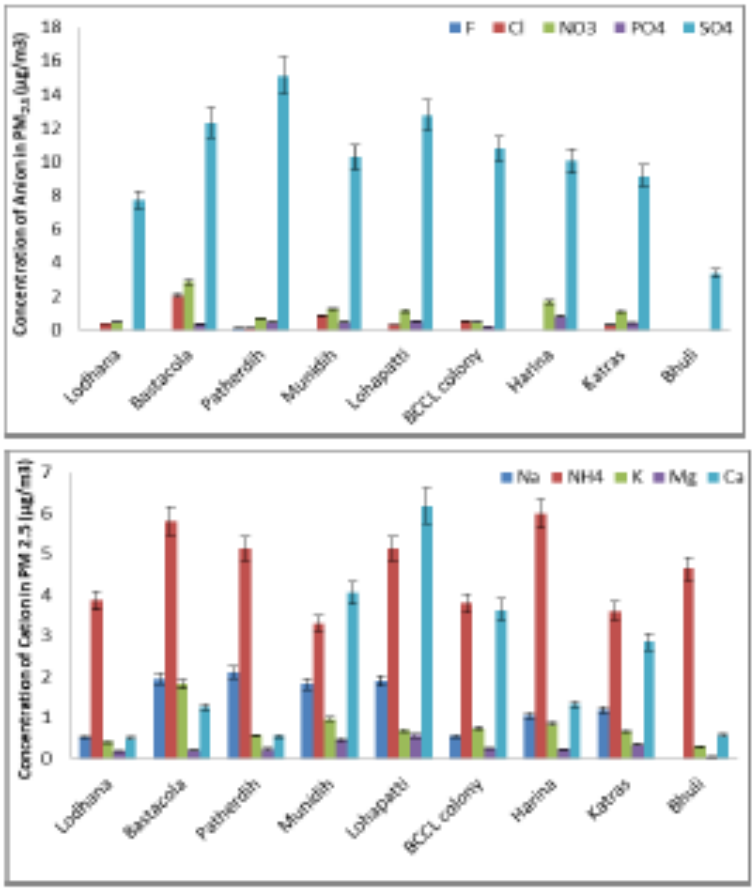


Figure 3.13: Anion and Cation concentration in $PM_{2.5}$ in summer

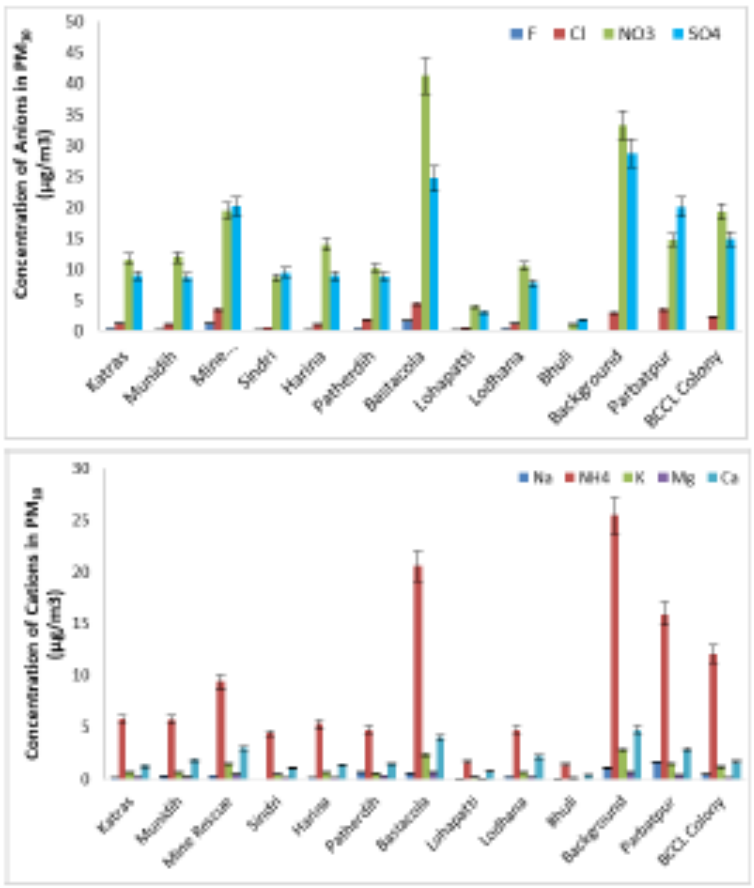


Figure 3.14: Anion and Cation concentration in PM_{10} in winter

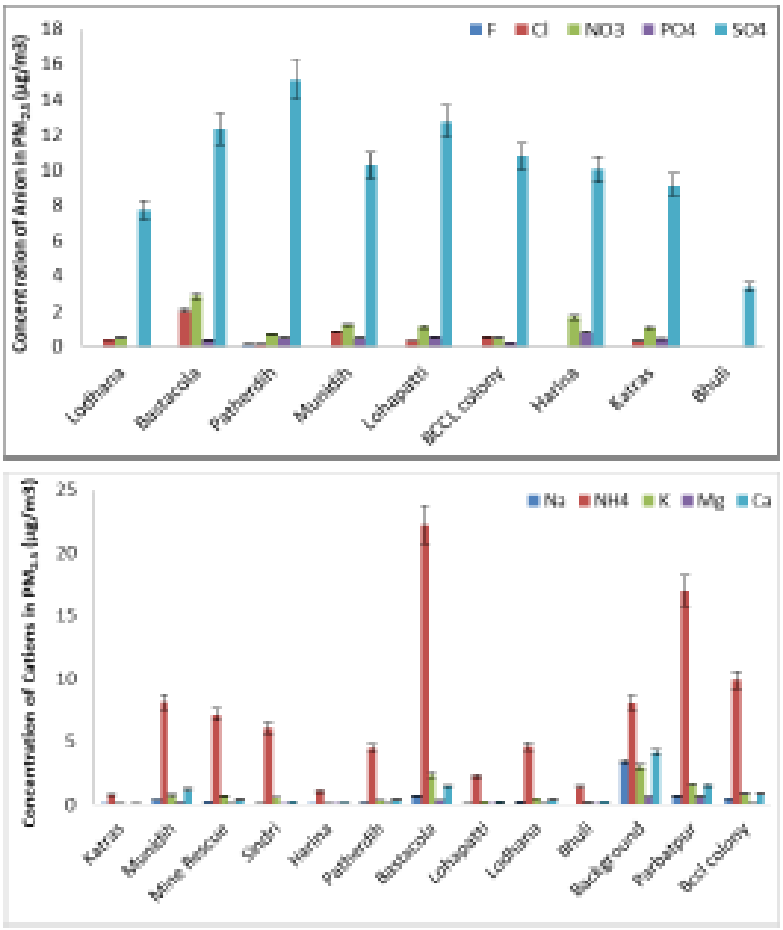


Figure 3.15: Anion and Cation concentration in $PM_{2.5}$ in winter

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°37''3''' N and 24°4'' N latitude and between 86°6''30'' E and 86°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:

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

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:

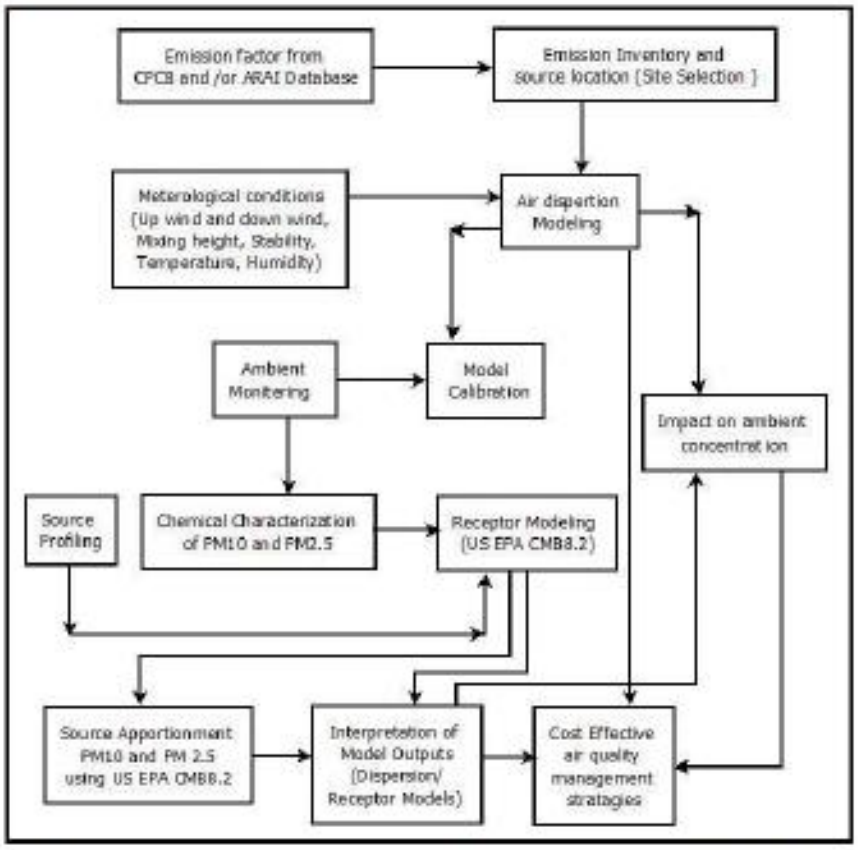


Figure 4.1: General methodology followed in the source apportionment studies

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 PM_{10} and $PM_{2.5}$. The domestic combustion percentage was observed at 22% and 25% for PM_{10} and $PM_{2.5}$ in the summer season. In the winter season, domestic combustion contribution was the second most percentage contributor for PM_{10} and $PM_{2.5}$. The PM_{10} 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 $PM_{2.5}$ in the summer season. In the winter season, contribution to industries is determined to be 15% in PM_{10} and 24% in $PM_{2.5}$. 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 $PM_{2.5}$ is observed to be 8% and 7% respectively while in the winter season it contributes somewhat 6% and 5% in PM_{10} and $PM_{2.5}$ respectively.

4.2.4. Transportation

The overall transportation contribution is 25% for PM_{10} and 32% for $PM_{2.5}$ in the summer season. In the winter season, the transportation emission contribution is examined at 16% for PM_{10} and 18% for $PM_{2.5}$. 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 nss-K+/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 K+- 0.129Na+) (Andreae and Merlet, 2001).

4.2.5. Secondary Inorganic Aerosol

During summer, the secondary inorganic aerosol contribution to PM_{10} and $PM_{2.5}$ is about 8% and 16%, respectively. Secondary inorganic aerosols contribution found in winter is about 14% and 17%, respectively for PM_{10} and $PM_{2.5}$. 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 (Seinfeldand 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 PM_{10} 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 PM_{10} 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 PM_{10} and $PM_{2.5}$. In winter, the garbage burning contribution is 6% and 2% for PM_{10} and $PM_{2.5}$ respectively during study time. The abundance of tracers like K^+, Pb, Br and consider-able 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 PM_{10}. The contribution of resuspension dust is during the summer season 12% while in the winter season the emission contribution is 10% for PM_{10}. 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 PM_{10} and 7% for $PM_{2.5}$ during the study period. In the winter season, emission contribution is 14% for PM_{10} 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 PM_{10} (23%) and $PM_{2.5}$ (30%) followed by the contribution of domestic combustion (17% and 23% for PM_{10} & $PM_{2.5}$ 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% (PM_{10}) and 28% ($PM_{2.5}$) whereas the transport sector has contributed 16% (PM_{10}) and 21% ($PM_{2.5}$) of the total emission.

After transport sector and domestic combustion, Industrial emission (12% of PM_{10} emission) and Road Resuspension (12% of PM_{10} emission) followed by Coal mining activity and secondary inorganic aerosol formation (both 8%) are contributing majorly to PM_{10} 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 (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.

Industrial activity contributed 12% and 11% of total PM_{10} 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 PM_{10} load at receptor both in summer (12%) and in winter (8%). As these are larger and heavier particles, they contribute to PM_{10} 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 PM_{10} 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.).

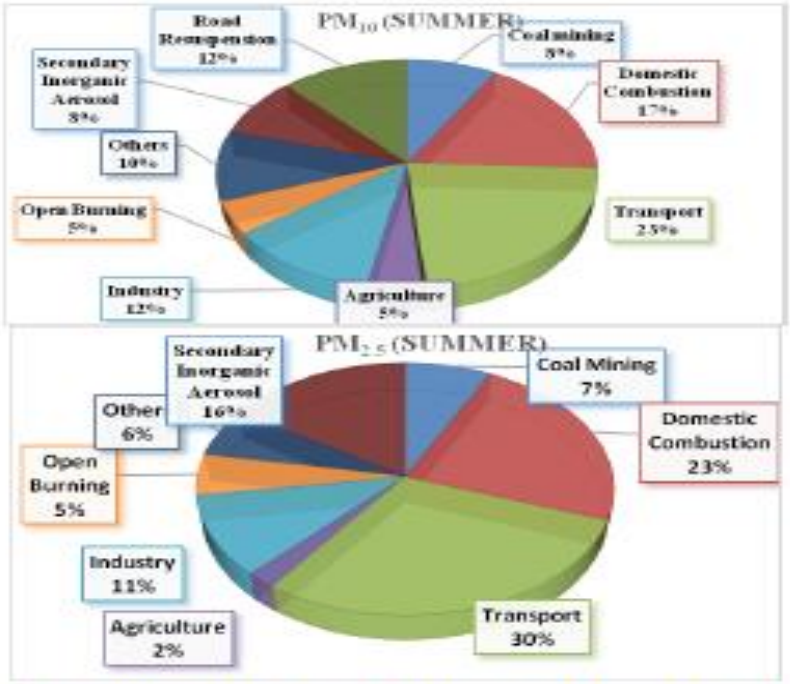


Figure 4.2: Source contribution at receptor locations of PM_{10} and $PM_{2.5}$ in summer

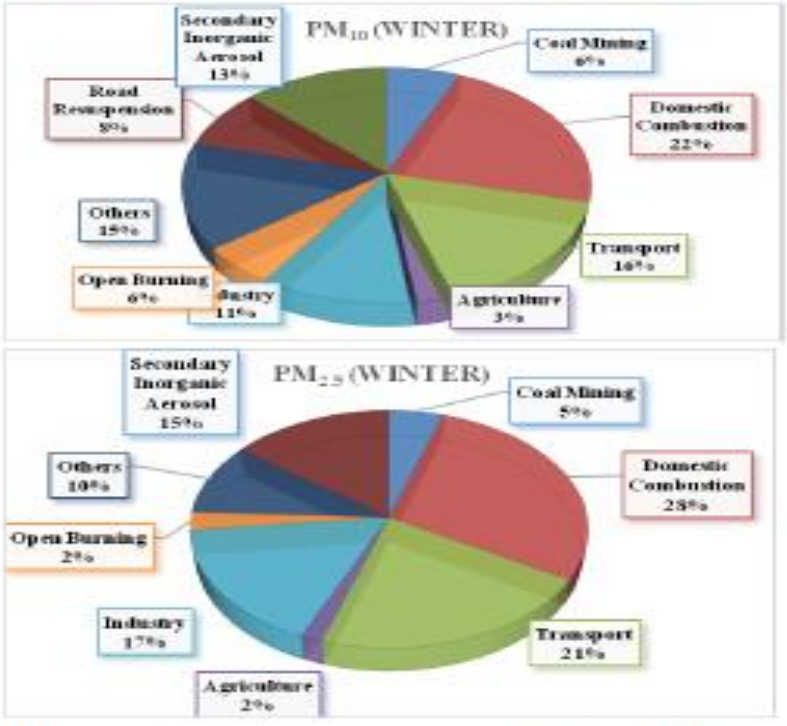


Figure 4.3: Source contribution at receptor locations of PM_{10} and $PM_{2.5}$ in winter

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^-, $NO3^-$, $SO4^{2-}$, 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.

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.

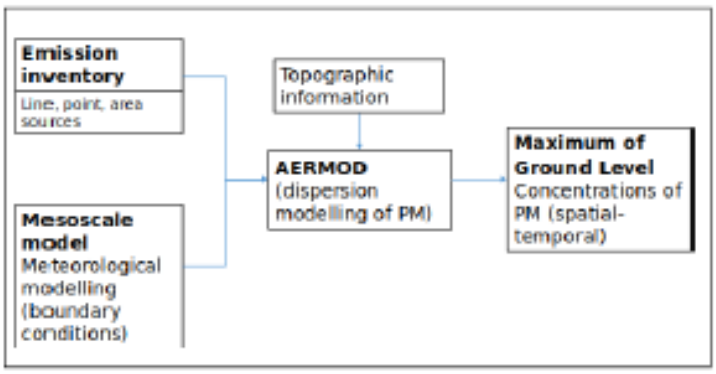


Figure 5.1: Methodology followed in the study.

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.

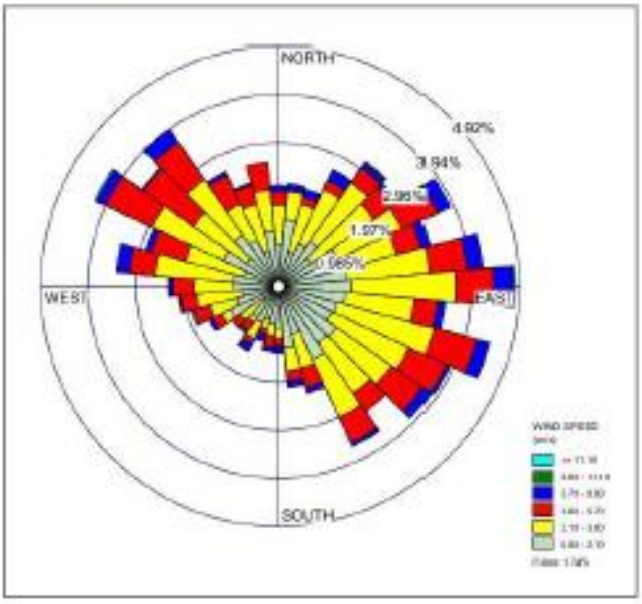


Figure 5.2: Windrose of the study area during March-June, 2019 (wind direction blowing towards the center)

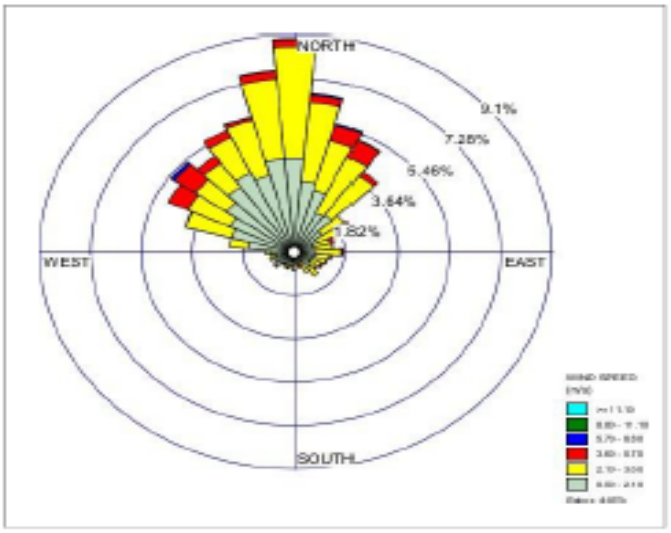


Figure 5.3: Windrose of the study area during November-December 2019 (wind direction blowing towards the centre)

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$\mu g/m^3$, 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$\mu g/m^3$, 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$\mu g/m^3$, respectively. The $PM_{2.5}$ maximum GLCs during the winter are 1004, 299, 1167$\mu g/m^3$ 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 $\mu g/m^3$ 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$\mu g/m^3$. The fringes of the JCF have recorded the PM_{10} concentrations in the range of 100-250$\mu g/m^3$. In contrast, the PM_{10} concentrations for the summer season have significantly lower and the majority of the study area have $PM_{10} < 100\mu g/m^3$, however, the area extending from south of Dhanbad City and Sudamdih mine have relatively high PM_{10} concentration in the range of 100-500$\mu g/m^3$. 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$\mu g/m^3$.

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 $PM_{2.5}$ (100-500µg/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.

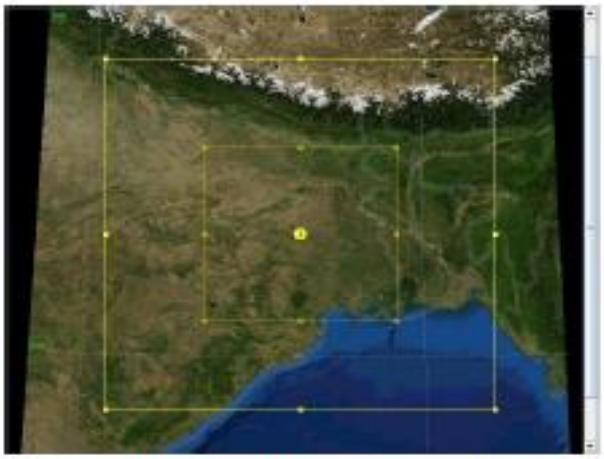


Figure 5.4: AERMOD grid covering the Jharia Coal Fields (JCF). The line, area, and point sources covered in the study are indicated in red color. The UTM coordinates of the left bottom point are x=406111 and y=2603492, and the coordinates of the right top point are x=456248 and y=2653417.

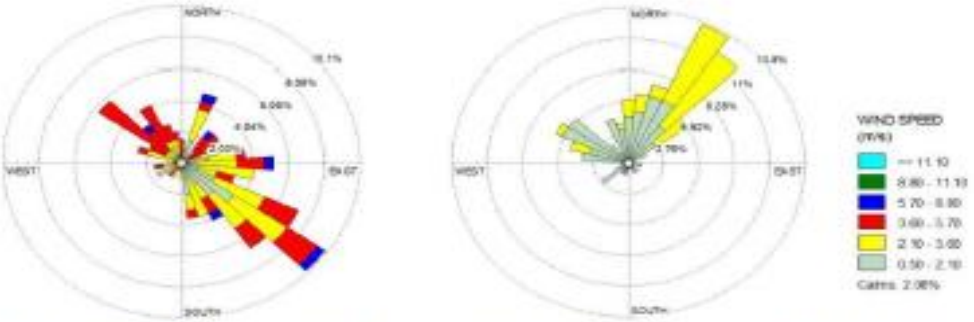


Figure 5.5: Windrose diagram for the summer (left) and winter seasons (right) at Jharia Coal Fields during the sampling period. Wind direction is flowing towards the centre.

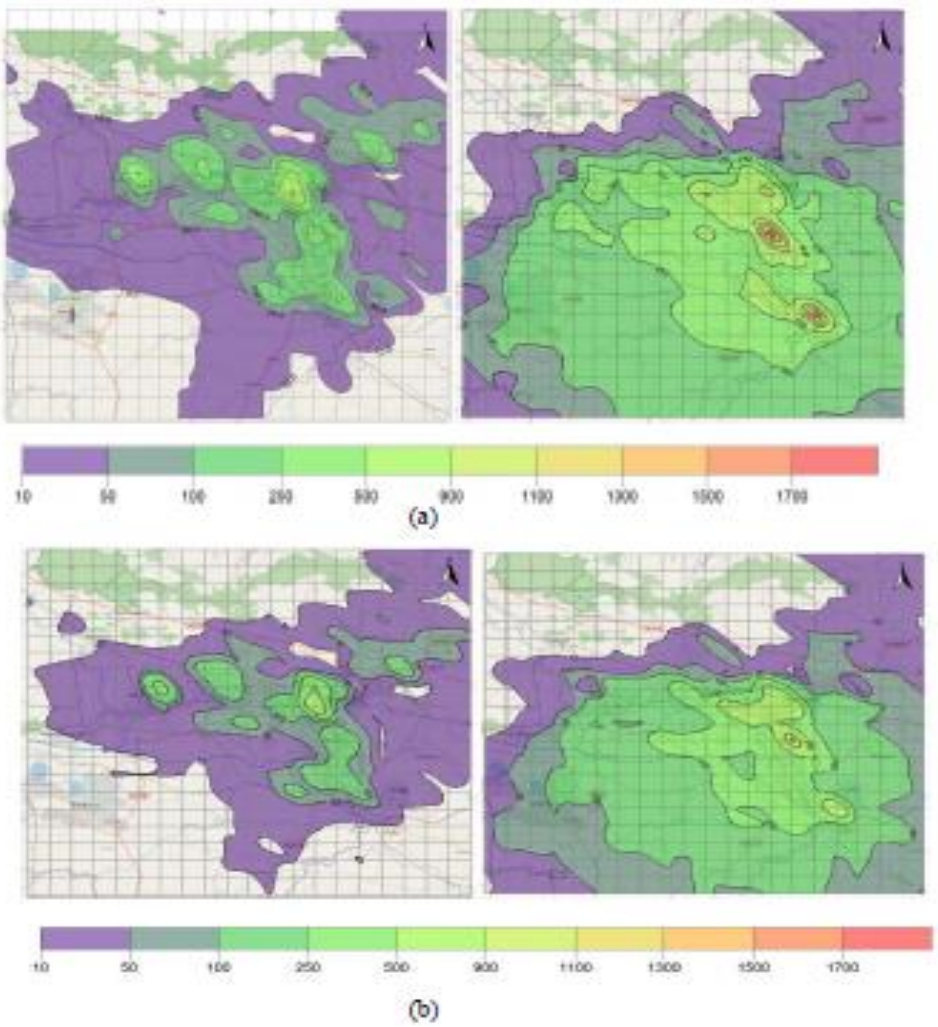


Figure 5.6: 24-hour average maximum ground level concentration of PM contours in the study area simulated during the study periods in summer (left) and winter (right) seasons (a) PM_{10} ($\mu g/m^3$) and (b) $PM_{2.5}$ ($\mu g/m^3$)

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 PM_{10} 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 PM_{10} 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 localair 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 PM_{10} 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 :——

Annexure-VI

भारत सरकार
अन्तरिक्ष विभाग
राष्ट्रीय सुदूर संवेदन केन्द्र
बालानगर, हैदराबाद-500 625, आं.प्र, भारत
टेलिफोन : +040-23879572-76
+040-23879261-65
फैक्स : +040-23878648

सत्यमेव जयते

Government of India
Department of Space
National Remote Sensing Centre
Balanagar, Hyderabad - 500 625, A P, India
Telephone : +040-23879572-76
+040-23879261-65
Fax : +040-23878648

Dt. 07-Oct-2021
Hyderabad.

To,
Director (Tech),
Bharat Coking of Coal Limited (BCCL),
Environment Department, Koyla Bhawan,
Koyla Nagar, Dhanbad – 826 005.
JHARKHAND.

Dear Sir,

The project titled "DELINEATION OF SURFACE COAL FIRE AND ASSOCIATED LAND SUBSIDENCE IN THE JHARIA COALFIELD, JHARKHAND USING SATELLITE BASED REMOTE SENSING TECHNIQUES" is now completed. Please find enclosed the final project report and the necessary supporting files as per the MoU, in soft and hard copy format.

Kindly send confirmation after receipt of Data and Report which will help us to close Project. Your feedback on the project work is highly appreciated.

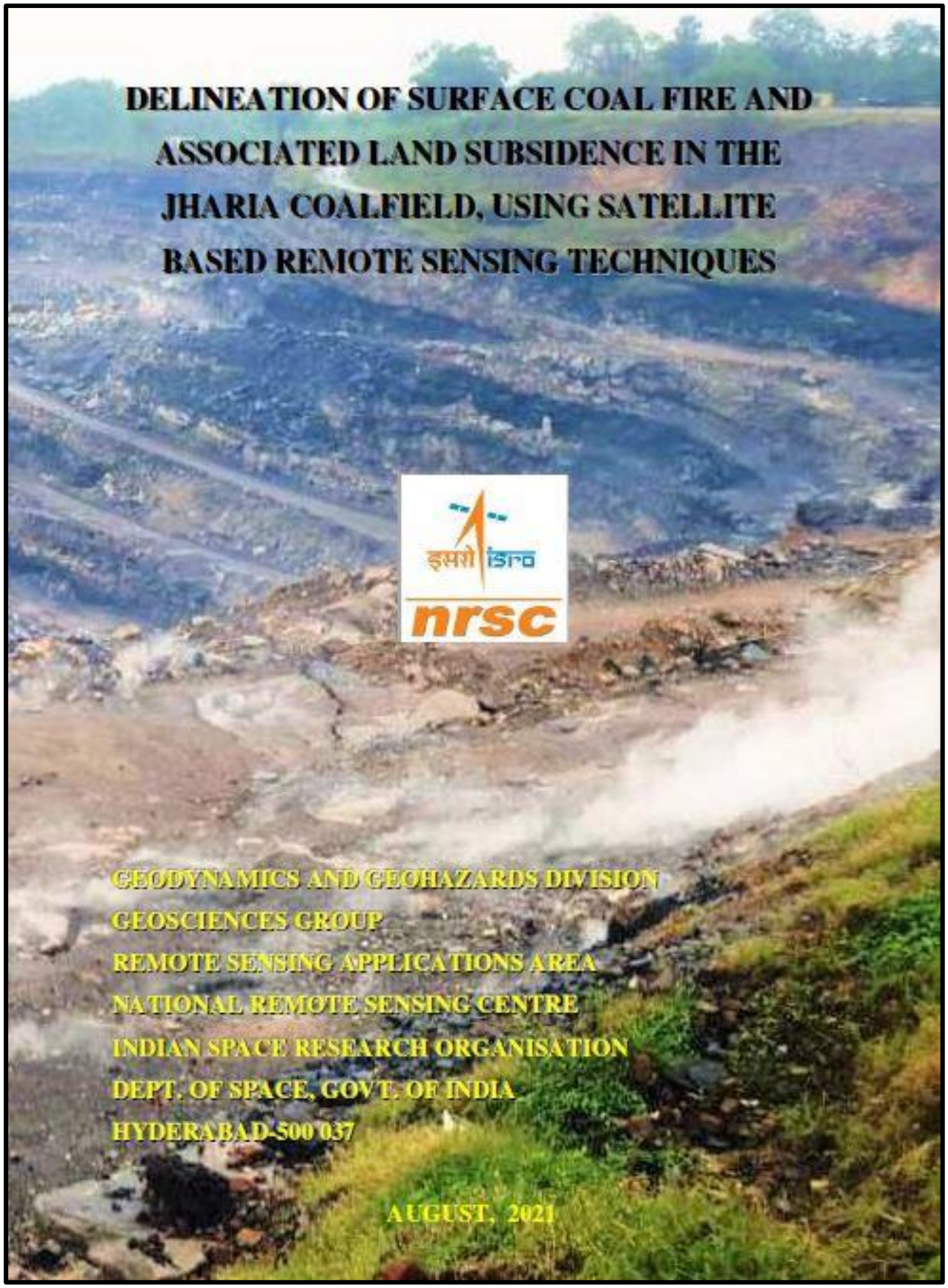
Yours faithfully

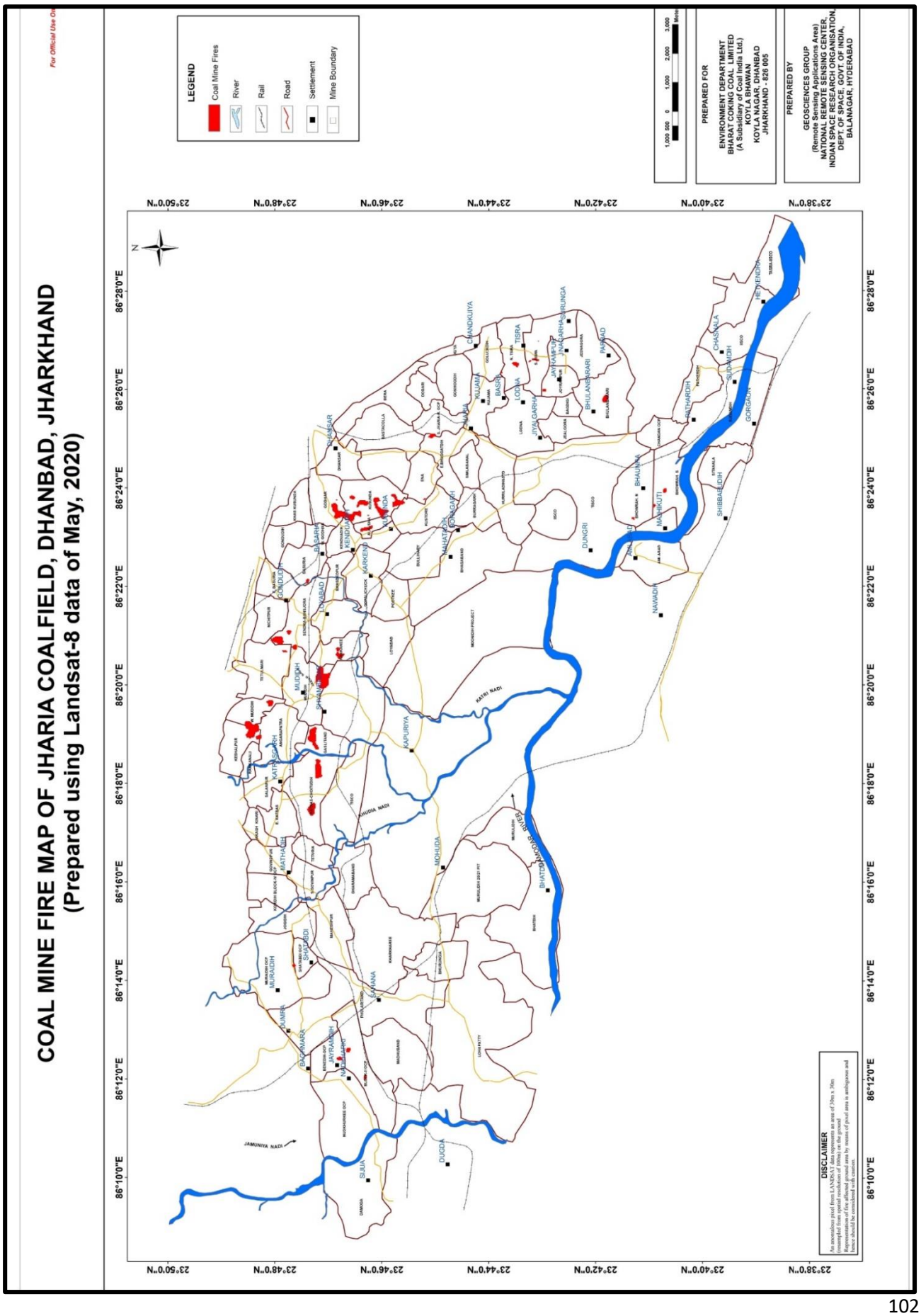
(Dr. K. Vinod Kumar)
Group Director,
Geosciences Group / RSAA.

Enclosed:

1) CD
2) Reports
3) Maps.

भारतीय अंतरिक्ष अनुसंदान संगठन इसरो isro Indian Space Research Organisation


DELINEATION OF SURFACE COAL FIRE AND ASSOCIATED LAND SUBSIDENCE IN THE JHARIA COALFIELD, USING SATELLITE BASED REMOTE SENSING TECHNIQUES
इसरो ISRO
nrsc
GEODYNAMICS AND GEOHAZARDS DIVISION
GEOSCIENCES GROUP
REMOTE SENSING APPLICATIONS AREA
NATIONAL REMOTE SENSING CENTRE
INDIAN SPACE RESEARCH ORGANISATION
DEPT. OF SPACE, GOVT. OF INDIA
HYDERABAD-500 037
AUGUST, 2021


COAL MINE FIRE MAP OF JHARIA COALFIELD, DHANBAD, JHARKHAND
(Prepared using Landsat-8 data of May, 2020)
LEGEND
Coal Mine Fires
River
Rail
Road
Settlement
Mine Boundary
PREPARED FOR
ENVIRONMENT DEPARTMENT
BHARAT COKING COAL LIMITED
(A Subsidiary of Coal India Ltd.)
KOYLA BHAWAN
KOYLA NAGAR, DHANBAD
JHARKHAND - 826 005
PREPARED BY
GEOSCIENCES GROUP
(Remote Sensing Applications Area)
NATIONAL REMOTE SENSING CENTER
INDIAN SPACE RESEARCH ORGANISATION
DEPT. OF SPACE, GOVT. OF INDIA,
BALANAGAR, HYDERABAD
DISCLAIMER
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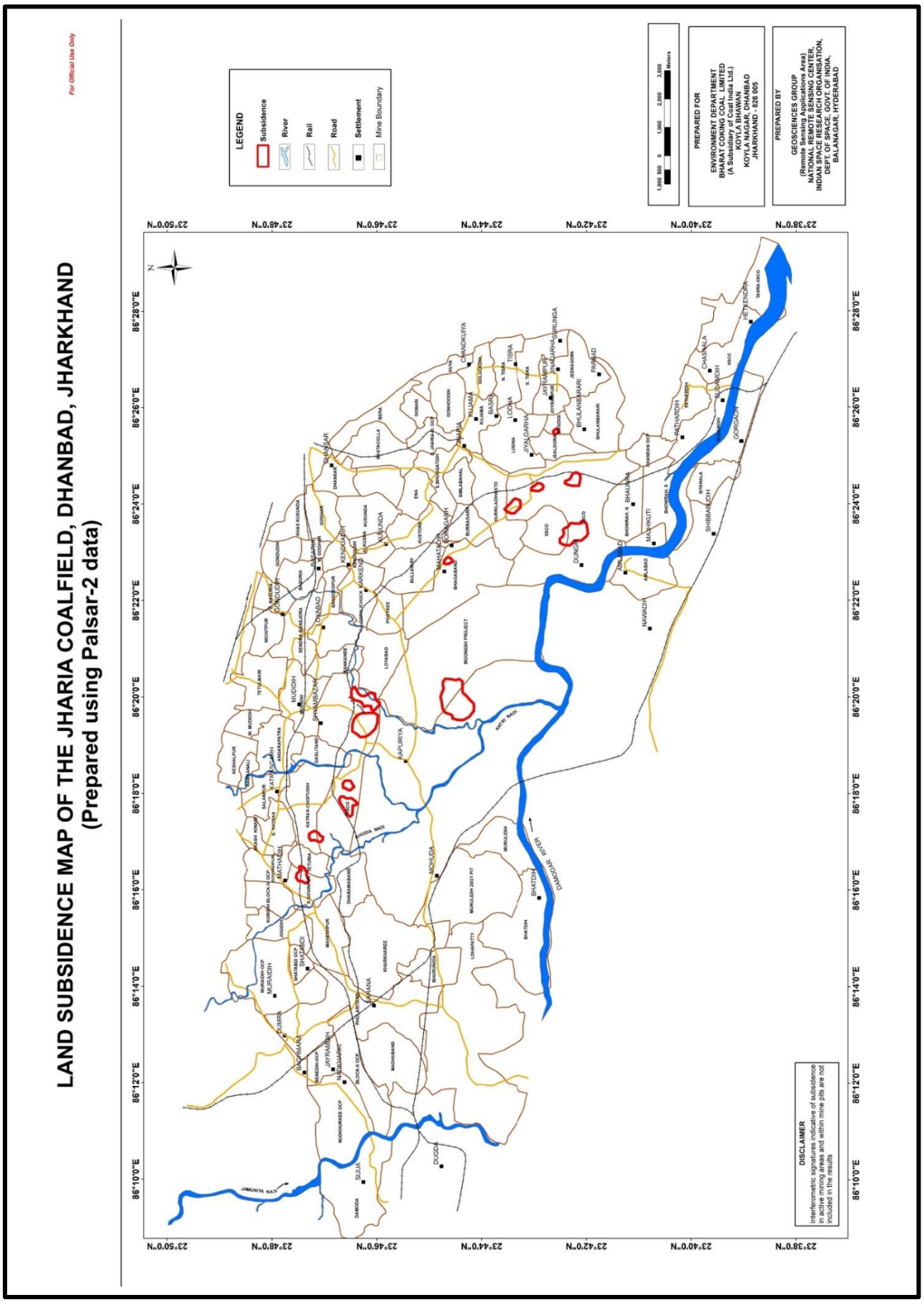
LAND SUBSIDENCE MAP OF THE JHARIA COALFIELD, DHANBAD, JHARKHAND
(Prepared using Palsar-2 data)
For Official Use Only
LEGEND
Subsidence
River
Rail
Road
Settlement
Mine Boundary
PREPARED FOR
ENVIRONMENT DEPARTMENT
BHARAT COKING COAL LIMITED
(A Subsidiary of Coal India Ltd.)
KOYLA BHAWAN
KOYLA NAGAR, DHANBAD
JHARKHAND - 826 005
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(Remote Sensing Applications Area)
NATIONAL REMOTE SENSING CENTER,
INDIAN SPACE RESEARCH ORGANISATION,
DEPT. OF SPACE, GOVT. OF INDIA,
BALANAGAR, HYDERABAD
DISCLAIMER
Interferometric signatures indicative of subsidence in active mining areas and within mine pits are not included in the results

Colliery wise break-up of change in fire area from 2017 to 2020

COLLIERY AREA NAME	FIRE AREA 2017 (SQ. KM.)	FIRE AREA 2020 (SQ. KM.)	AREA CHANGE (SQ. KM.)	Increase/Decrease
BENEDIH OCP	0.045	0.020	-0.026	DECREASE
BLOCK-II OCP	0.135	0.034	-0.101	DECREASE
MURAIDIH OCP	0.002	0.006	0.004	INCREASE
SHATABDI OCP	0.036	0.005	-0.031	DECREASE
PHULARITAND	0.021	0.000	-0.021	DECREASE
KATRAS-CHOITUDIH	0.137	0.214	0.077	INCREASE
KESHALPUR	0.001	0.134	0.132	INCREASE
BASURIA	0.000	0.012	0.012	INCREASE
TETULMARI	0.022	0.011	-0.011	DECREASE
GODHAR	0.000	0.132	0.132	INCREASE
INDUSTRY	0.051	0.000	-0.051	DECREASE
KUSUNDA	0.740	0.399	-0.340	DECREASE
SENDRA-BANSJORA	0.027	0.110	0.083	INCREASE
BASTACOLLA	0.081	0.000	-0.081	DECREASE
GOLUCKDIH	0.112	0.000	-0.112	DECREASE
KUJAMA	0.240	0.000	-0.240	DECREASE
S. JHARIA-R. OCP	0.112	0.010	-0.102	DECREASE
GONHOODIH	0.032	0.001	-0.031	DECREASE
ENA	0.043	0.004	-0.040	DECREASE
N. TISRA	0.180	0.031	-0.149	DECREASE
LODNA	0.353	0.000	-0.353	DECREASE
S. TISRA	0.102	0.021	-0.081	DECREASE
BARAREE	0.107	0.040	-0.068	DECREASE
KENDUADIH	0.000	0.001	0.001	INCREASE
GASLITAND	0.122	0.156	0.034	INCREASE
KANKANEE	0.052	0.057	0.004	INCREASE
MUDIDIH	0.110	0.220	0.110	INCREASE
LOYABAD	0.006	0.000	0.079	DECREASE
E.BHUGGATDIH	0.021	0.020	-0.001	DECREASE
ALKUSHA	0.029	0.046	0.016	INCREASE
KUSTORE	0.046	0.014	-0.032	DECREASE
ANGARAPATRA	0.015	0.036	0.021	INCREASE
BHOWRAH. N	0.098	0.006	-0.092	DECREASE
BAGDIGI	0.021	0.000	-0.021	DECREASE
JEALGORA	0.007	0.000	-0.007	DECREASE
JEENAGORA	0.047	0.000	-0.047	DECREASE
JOYRAMPUR	0.104	0.011	-0.093	DECREASE
TOTAL AREA	**3.3**	**1.8**	**1.5**	DECREASE

Note:

1) **The minimum mapable unit from satellite image it 30m by 30m or 0.0009 km^2**

2) **"INCREASE" implies, increase in fire area OR emergence of fire areas not identified in 2017 study**

3) **"DECREASE" implies, decrease in fire area OR fire areas in 2017 not identified in present study** *(either absent or below sensor resolution)*

4) **Values marked in "blue" are collieries where fire has was reported in 2017 study but presently shows no such signatures.**

7.2 Conclusions

The following conclusions can be made:

1. As of the date of study in the year 2020 and in comparison with the previous study done in 2017, there has been a change in areal extent and disposition of the fire affected areas. On the other hand, persistent subsidence is seen in the Moonidih area due to underground mining activities.

2. Compared to 2012, the eastern flanks (Lodna, Tisra, Bhulanbarai areas) show considerable decrease in fire disposition and the western flank (Shatabdi and Block II area) show diminished fire presence.

3. The fires are continuation of existing fire affected areas as seen in the 2017 study.

4. The mines in Kusunda remain to be the worst affected with maximum presence of active fires.

5. There is a decrease in areal extent of the fire from 2017 to 2020. As compared 2017, when the total fire affected extent of the JCF was about 3.28 km^2; in 2020 total fire affected extent is about 1.89 km^2 (including TISCO mines). Within the mining lease of BCCL (excluding TISCO) in comparison 2017, when the total fire affected extent of the JCF was about 3.27 km^2; in 2020 total fire affected extent is about 1.86 km^2.

Note: *The minimum mapable unit from satellite image is 30m by 30m or 0.0009 km^2. Estimations of fire extent (in terms of sq.km.) both in 2017 and in the present 2020 study are pixel based. 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 disposition of fire. Hence, they should not be quoted as fire area on the ground.*

Annexure-VII

Memorandum of Understanding

for

Utilization of mine water by villages situated near mines of CIL in command area of Central Coalfields Limited, Bharat Coking Coal Limited and Eastern Coalfields Limited in the State of Jharkhand

This Memorandum of Understanding "MoU" ("Agreement") is made on **30th day of October 2017** at Ranchi

By and Between

Government of Jharkhand (hereinafter referred to as "GoJ"), represented through Department of Industries, Mines & Geology and Department of Drinking Water & Sanitation, Government of Jharkhand having its office at Ranchi which expression shall, unless the context otherwise requires, includes its successors and assignees of the FIRST PART;

And

Coal India Limited (hereinafter referred to as "CIL"),a Government of India Enterprise having its Registered Office at Coal Bhawan, Premise No-04 MAR, Plot No- AF-III, Action Area- 1A, Newtown, Rajarhat, Kolkata-700156 and represented by General Manager, Corporate Social Responsibility, which expression shall, unless repugnant to the context or meaning thereof, be deemed to include its successors, and permitted assignees of the SECOND PART;

The expressions GoJ and CIL shall hereinafter, as the context may admit or require, be individually referred to as the 'The Party' and collectively as 'the Parties'.

Whereas:

A. The Government of Jharkhand (GoJ) and Coal India Limited (CIL), both parties have agreed in principle to the objective of achieving the common goal of providing surplus water from suitable mines for use by habitations, located in the command area of subsidiaries of CIL in the state of Jharkhand for their various needs. These subsidiaries are Central Coalfields Limited (CCL), Bharat Coking Coal Limited (BCCL) and Eastern Coalfields Limited (ECL).

B. Mine wateravailable in mine voids and from mine discharge in Central Coalfields Limited (CCL), Bharat Coking Coal Limited (BCCL) and Eastern Coalfields Limited (ECL), subsidiaries of CIL, are presently supplied to several colonies of these subsidiary companies of CIL. At some places mine water is drawn by Department of Drinking Water & Sanitation and other agencies/ organizations of Government of Jharkhand.Surplus mine water available at other mines can be used by surrounding habitations for their various needs.

C. Presently, about 25250 million gallon of water is estimated to be available in 88 opencast mine voids of CCL, and about 31million gallon/ day of water is estimated to be available as surplus/excess mine water discharge at 23 mine sites of BCCL and 07mine sites of ECL in State of Jharkhand . The list ofmines where water is available in mine voids in CCL and in mine water discharge in BCCL and ECLare enclosed at **Annexure I, Annexure II, and Annexure III respectively.**

D. The Parties hereby agree, undertake and affirm as under:-

i. That sampling and analysis of quality of water available at variousmine sites(voids ormine discharge), to assess the suitability for potability, agricultural or other uses will be done by a third party having a recognized environmental laboratory andthe party will be selected by mutual consent between CIL(represented by its subsidiaries - CCL, BCCL and ECL) and GoJ.

ii. The report of analysis of quality of water of various mine sites will be submitted by the selected third party to GoJ and CIL (represented by its subsidiaries - CCL, BCCL and ECL).

iii. That cost of sampling and analysis of quality of water of various mine sites will be borne by CIL (represented by its subsidiaries - CCL, BCCL and ECL).

iv. That CIL (represented by its subsidiaries CCL, BCCL and ECL) shall bear all initial cost for construction of civil works like foundation, platform and shed for installation of motor and pumps for drawal of water at identified mine sites.

v. That Government of Jharkhand shall bear the cost of pumps, motors, associated power supply, pipelines and their installation at identified mine sitesfrom where water is to be drawn. The cost of running these facilities would be borne byGovernment of Jharkhand or community benefitted.

vi. The construction, operation and maintenance cost for treatment and distribution facilities of water from identified mine sites will be borne by GoJ.

vii. The list of mine sites where water is available in voids or as mine discharge are placed at **Annexure I, Annexure II, and Annexure III for CCL, BCCL, and ECL** respectively. The number of mine sites may increase / decrease in future. So modalities for pumping water from the additional sites will be same as laid down at serial no D (i) to D (vi).

viii. In case of dispute, the matter shall be mutually resolved and either party will not be held responsible for non discharge of responsibility under this agreement.

ix. In case of force majeure or an Act of God, preventing the parties from fulfilling part or all the obligations, both parties shall be exonerated from carrying out further action as per MoU until the force majeure no longer exists.

x. The MoU will be in force for 30 (thirty) years.The MoU may be renewed as mutually agreed upon by CIL (represented by its subsidiaries CCL, BCCL and ECL) and GoJ beyond the mentioned period of MoU.

Provided further that in case dewatering is required to start coal production in national interest from these mines then the parties will sit together and mutually decide modalities for the same.

xi. The sustainability of mine sites in respect of future availability of water will be assessed/ studied by CIL.

xii. This MoU shall be in accordance with applicable Acts, Rules and Guidelines for coal mining including mine closure guidelines and shall not be in contravention with provisions made therein.

IN WITNESS THEREOF, both parties hereto have signed this MoU in two original copies in English on the date indicated above.

For Coal India Limited

1. Siddh Nath Singh, General Manager, CSR, Coal India Limited

(.....)

For Government of Jharkhand

Department of Industries, Mines & Geology

1. Aboobacker Siddique P., I.A.S. Mines Commissioner, Mines & Geology Department, Government of Jharkhand.

(.....)

Drinking Water & Sanitation Department

2. Ramesh Kumar, Engineer in Chief, Drinking Water & Sanitation Department, Government of Jharkhand.

(.....)

Witness 1 (Soumya Singh)

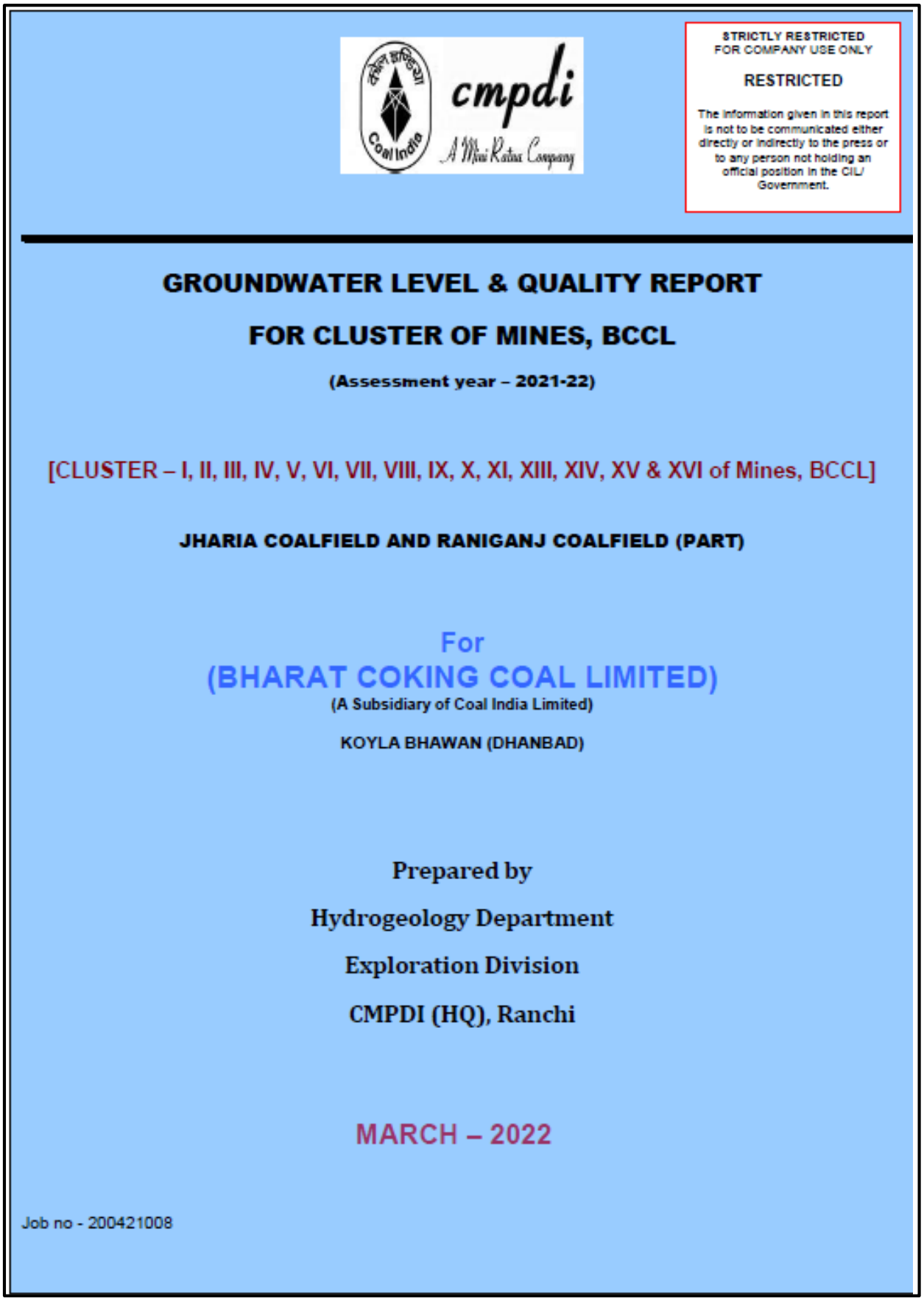
Witness 2

Witness 1 30/10/2023 (Ajay Nath Jha)

Witness 2

Annexure-VIII

Annexure-IX



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RESTRICTED

The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL/ Government.

GROUNDWATER LEVEL & QUALITY REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year – 2021-22)

[CLUSTER – I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XIII, XIV, XV & XVI of Mines, BCCL]

JHARIA COALFIELD AND RANIGANJ COALFIELD (PART)

For

(BHARAT COKING COAL LIMITED)

(A Subsidiary of Coal India Limited)

KOYLA BHAWAN (DHANBAD)

Prepared by

Hydrogeology Department

Exploration Division

CMPDI (HQ), Ranchi

MARCH – 2022

Job no - 200421008

H. GROUND WATER LEVEL OF CLUSTER-VIII

Cluster - VIII of B.C.C.L mines under administrative control of Bastacolla Area of B.C.C.L (Jharia Coalfield) is located in Dhanbad district of Jharkhand. Cluster-VIII consists of ten mines namely; Bastacolla mixed mines (OC & UG), Bera mixed mines (OC&UG), Dobari UG, Kuya mixed mines (OC&UG), Proposed Goluckdih (NC) OC mine, Ghanoodih OC mine and Kujama OC mine are under Bastacolla Area of BCCL is located in the west part of Jharia Coalfield. All above the mines are contiguous in nature and the environmental impact is overlapping in ambient environment due to cumulative effect of the mining activities. The life of the project works out upto 25 years considering annual target production of 6.383 MTPA (toposheet no. 73 I/5 and I/6).

The present leasehold area of Cluster-VIII is 1331.95 Ha. The area has a general undulating topography with general slope towards south and south-west. The ground elevation in the area ranges from 175 m to 221 m AMSL. Chatkari Jore, Tisra Jore and its tributaries controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

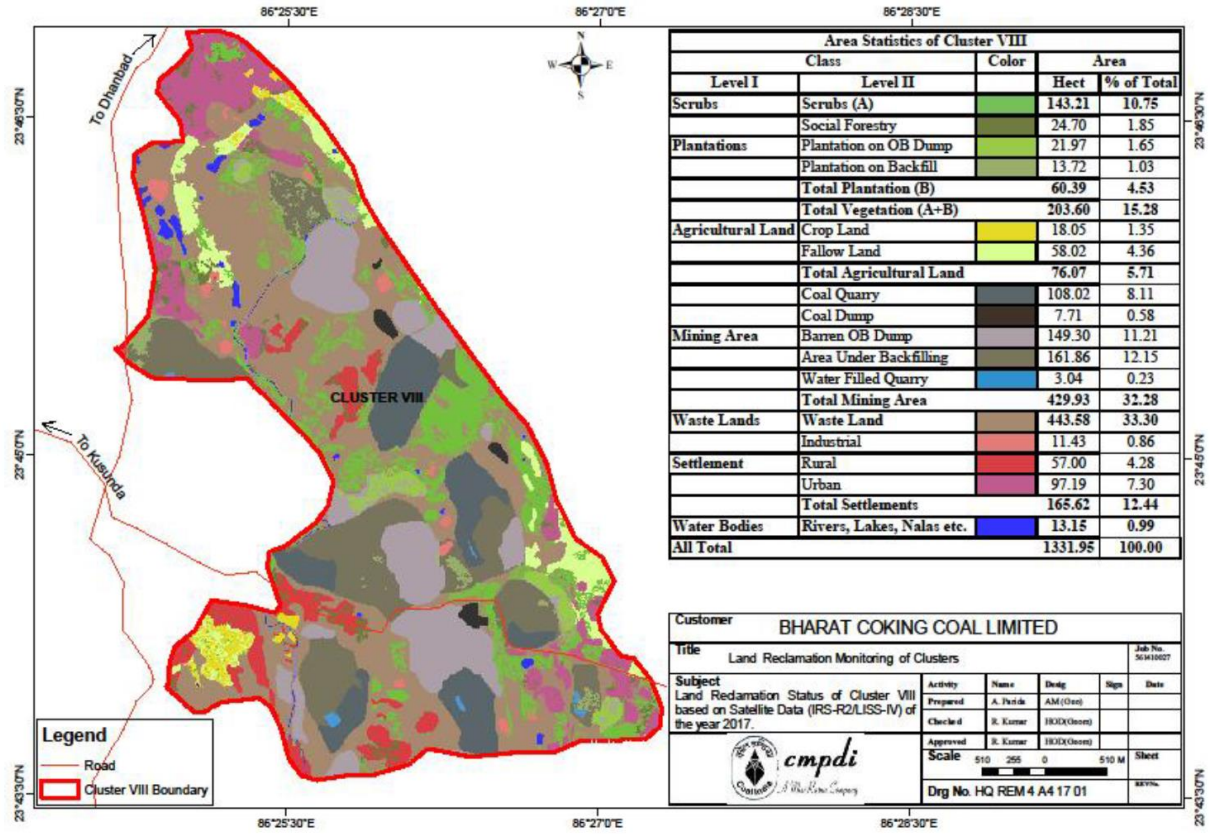
Monitoring stations (**D-8, D-43, D-49 and D-51**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'21, August'21, and Nov'21 and January'22, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2021-22				2020-21				2019-20			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	May	Aug	Nov	Jan
1	D-8	Alokdiha	4.55	1.85	2.27	3.20	5.83	1.70	2.75	3.20	4.80	1.95	2.85	4.25
2	D43	Alagdih	4.65	2.40	2.60	3.35	6.60	2.31	2.55	3.05	7.35	3.55	2.70	4.25
3	D49	Galucdih	1.40	0.73	0.85	1.00	3.25	1.41	1.65	1.98	1.75	0.60	1.50	1.25
4	D51	Chankuiya	9.43	5.65	5.65	7.50	8.45	6.03	5.70	7.35	9.95	8.05	5.75	7.75
Average WL (bgl)			5.01	2.66	2.84	3.76	6.03	2.86	3.16	3.90	5.96	3.54	3.20	4.38

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.40 m Max – 9.95 m
Post-monsoon GW Level (m): Min – 0.85 m Max – 5.75 m

LAND USE / LAND COVER MAP OF THE CLUSTER-VIII MINES, BCCL



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	279.69 x 10^4	0.0	279.69 x 10^4
2	Open Land	886.66 x 10^4	0.0	886.66 x 10^4
3	Road/ Paved Area	97.19 x 10^4	0.0	97.19 x 10^4
4	Rooftop area of building/ sheds	68.43 x 10^4	0.0	68.43 x 10^4
5	Total	1331.95 x 10^4	0.0	1331.95 x 10^4

4.0 GROUND WATER LEVEL SCENARIO

The summarized water level data of all clusters given in **Table – 7**.

Table –7: Groundwater level data Cluster-wise

Sl. No.	Cluster of BCCL	No. of Monitoring Wells	Water level fluctuation Below ground level (May, Aug, Nov'21 & Jan'22)	Avg. Fluctuation (in meters) during 2021-22	Geological Formation
1	I	4 nos.	0.25 to 8.38 m	2.93 m	Barakar
2	II	5 nos.	0.30 to 11.26 m	4.02 m	Barakar
3	III	5 nos.	0.24 to 11.26 m	2.92 m	Barakar
4	IV	4 nos.	0.30 to 9.03 m	3.87 m	Barakar
5	V	4 nos.	0.07 to 5.43 m	1.66 m	Barakar
6	VI	2 nos.	0.60 to 10.50 m	5.05 m	Barakar
7	VII	7 nos.	0.62 to 9.52 m	2.03 m	Barakar
8	VIII	4 nos.	0.73 to 9.43 m	2.17 m	Barakar
9	IX	6 nos.	1.34 to 10.70 m	2.85 m	Barakar
10	X	4 nos.	0.45 to 6.60 m	1.97 m	Barakar
11	XI	4 nos.	0.54 to 5.47 m	1.80 m	Barakar & Barren Measure
12	XIII	6 nos.	0.40 to 9.52 m	2.64 m	Raniganj
13	XIV	3 nos.	1.24 to 8.95 m	4.09 m	Raniganj
14	XV	3 nos.	0.47 to 10.13 m	4.90 m	Barakar & Barren Measure
15	XVI	3 nos.	1.01 to 6.20 m	0.90 m	Barakar

Depth to water level (in bgl) values described that water level goes down to maximum 11.26 m during pre-monsoon'2021 and maximum upto 7.62 m during post-monsoon'2021. Un-confined aquifer affected around 20 m to 30 m maximum close to active opencast mining areas, showing steep gradient towards mine void. Other than that, there is no mining effect in the water level within JCF area and RCF area (part). Historical water level data and hydrograph of permanent observation stations from CGWB shown in **Annexure–VI**. Water Table contour map and Depth to water level map shown in **Plate-IV & V**.

Monitoring groundwater (quantity & quality) to assess the present condition and resource has done regularly in the coalfield areas. Well hydrographs (**Annexure–VI**) are prepared and studied to identify long-term trends. Hydrograph trend analysis of CGWB monitoring wells and observation well reveals increasing groundwater level trends in most of the Cluster of mines. However, decline trends in both Pre

and Post-monsoon GW level in Cluster-I, Cluster-V, Cluster-VI and Cluster-VII is recorded but no significant decline trend (>1.0 m/year) of water level is noticed in any particular area for the last 10 years within the coalfield area. Regarding quality monitoring, the water sample location map (**Plate–II**) with collection points details (dug wells) given in **Annexure–V** and Quality is given in **Annexure–VII**.

5.0 GROUND WATER QUALITY

The ground water sample of the study area (15 nos. of Cluster of mines, BCCL) collected from dug wells and analyzed. Fifteen ground water samples (GW-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 & 16) analyzed during the month of June'2021 at CMPDI, RI-II, Dhanbad. The water sampling details given in **Annexure–V** and Water sample locations shown in **Plate-II**. The water quality data enclosed in **Annexure–VII.**

The study of the variations in water quality parameters described below:

The pH of the groundwater samples varies between 7.65 (GW-5) to 8.15 (GW-11), the pH is within the IS 10500 limit of drinking water standard.

The mineral constituents dissolved in water constitute the dissolved solids. The total dissolve solids vary from 425 (GW-1) to 889 mg/l (GW-9), the TDS values ranges slightly above the IS 10500:2012 standards limits of drinking water.

The alkalinity of the water samples varies from 101 (GW-14) to 182 mg/l (GW-7) and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 41 (GW-1) to 158 mg/l (GW-13) and are ***slightly above*** the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 226 (GW-8) to 638 mg/l (GW-5) and the value of total hardness in water samples are ***above*** the permissible limit (200 mg/l). The sulphate ranges between 31 (GW-1) to 187 mg/l (GW-16) and the value of sulphate in water sample are within the permissible limit (200 mg/l). The Iron, Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples found to be below the upper ISI limits for drinking water.

Table–8B: Cluster wise Groundwater development scenario

Cluster/ Area	Adminis-trative Blocks/Stage Of GW Extraction	Total Water demand (cum/day)				Avg. GW level (bgl in m) 2021-22		GW level declining trend 2005-2021		Remarks
		Mine Discharge + BH pumping	Surface Water Source	Total Use (Domestic + Industrial)	Excess Or other use	Pre-monsoon	Post-monsoon	Pre-monsoon	Post-monsoon	
Cluster-I	Bermo (SOD: Over-exploited)	2173 (2065+108)	NIL	2112 (1698+414)	61	5.10	1.07	YES	YES	Recharge structure needed
Cluster-II	Baghmara (SOD: Critical)	8350	Jamunia river	6737 (2755+3982)	1613	6.12	2.10	NO	NO	Excess mine water needed to be utilized
Cluster-III		12760 (10960+1800)	NIL	8946 (7849+1097)	3814	5.66	2.74	NO	NO	
Cluster-IV		5900	MADA	5100 (3605+1495)	800	6.08	2.21	NO	NO	
Cluster-V		12690 (11025+1665)	MADA	11063 (5710+5353)	1897	2.80	1.15	YES	YES	
Cluster-VI	Dhanbad (SOD: Over-exploited)	4150	MADA	4150 (1664+2486)	0.0	7.37	2.32	YES	NO	--
Cluster-VII		21565	MADA	20826 (17596+3230)	739	4.66	2.63	YES	YES	Excess mine water needed to be utilized water
Cluster-VIII	Jharia (SOD: Over-exploited)	9320	MADA	5294 (3730+1564)	4026	5.01	2.84	NO	NO	
Cluster-IX		12980	MADA	9358 (4549+4809)	3622	5.82	2.97	NO	NO	
Cluster-X		11825	Damodar river	6201 (4255+1946)	5624	4.48	2.51	YES	NO	
Cluster-XI	Dhanbad (SOD: Over-exploited)	24960	MADA & DVC	19425 (14015+5410)	5535	2.82	1.48	NO	NO	
Cluster-XIII	Baghmara (SOD: Critical)	750	Damodar river	692	58.0	5.47	2.83	NO	NO	--
Cluster-XIV		943	NA	668	275	6.25	2.16	NO	NO	--
Cluster-XV		6200	NA	5941 (4600+1341)	259	6.72	1.82	NO	NO	--
Cluster-XVI	Nirsa (SOD:Safe)	1910	DVC (Barakar river)	1730 (1380+350)	180	3.34	2.44	NO	NO	--

MADA – Mineral Area Development Authority, Jharkhand, Dhanbad (payment basis).

DVC – Damodar Valley Corporation, Maithon/Panchet, Jharkhand (payment basis).

Annexure-X

Transportation Plan for Conveyor

सेंट्रल माईन प्लानिंग एण्ड डिज़ाइन इंस्टीच्यूट लिमिटेड
(कोल इंडिया लिमिटेड की अनुषंगी कम्पनी / भारत सरकार की एक लोक उपक्रम)
पंजीकृत कार्यालय : गोन्दवाना प्लेस, कांके रोड, राँची - 834031 (झारखण्ड) भारत
क्षेत्रीय संस्थान-2, पत्रा. बीसीसीएल टाउनशीप, कोयला नगर, धनबाद 826005 (झारखण्ड) भारत
Central Mine Planning & Design Institute Limited
(A Subsidiary of Coal India Limited / Govt. of India Public Sector Undertaking)
Registered Office : Gondwana Place, Kanke Road, Ranchi –834031(Jharkhand)
Regional Institute-II, P.O. BCCL Township, Koylanagar, Dhanbad 826005(Jharkhand) India
Corporate Identity No. U14292JH1975GOI001223

पत्रांकः आर.आई.-2/पर्यावरण/एम-30/ 1150 दिनांकः 20.06.2015

सेवा में,
उप महाप्रबंधक (पर्यावरण)
बी. सी. सी. एल.
कोयला भवन
धनबाद ।

विषयः Study of installation of Rail-cum-Conveyor System in BCCL for transportation of coal.

महोदय,

This has reference to your letter no. BCCL/GM(Env.)/F-EC/13/622, dated 25.05.2013 for conducting the study and preparation of plan for installation of Rail-cum-Conveyor System for coal transportation in BCCL as a part of compliance of environmental clearance (EC) conditions stipulated by MoEF & CC in EC orders of different clusters. In this regard, we would like to inform you the following:

a. As per EC clearance order transportation plan for Rail-cum-Conveyor system should dovetailed with Jharia Action Plan (Master Plan). The system of transportation is required to be installed in 2nd phase of EC implementation i.e. after completion of Master Plan (10 years) and 5 years of gestation period.

b. JRDA has issued direction to RITES for traffic survey and data collection to initiate feasibility study regarding Diversion of Railway lines from fire affected and subsidence prone areas

c. Coal transportation route / conveyor installation layout will be finalized after liquidation of coal mine fire, rehabilitation of 595 unstable sites, road and rail route alignment and location of Rly. Sidings of BCCL.

CMPDI will be able to submit the plan / study for installation of Rail-cum-Conveyor System in BCCL for transportation of coal only after diversions and re-alignments of roads and railway lines and relocation of railway sidings

This is for your kind information.

भवदीय
(वि. कु. सिंह)
क्षेत्रीय निदेशक

Sri Awadhesh Sir
For compliance purpose.
23/6/15

फोन : (+91) 0326-2230850 फैक्स / Fax : (+91) 0326-2230500
वेब साइट / Website : www.cmpdi.co.in
ईमेल / Email : ri2@cmpdi.co.in

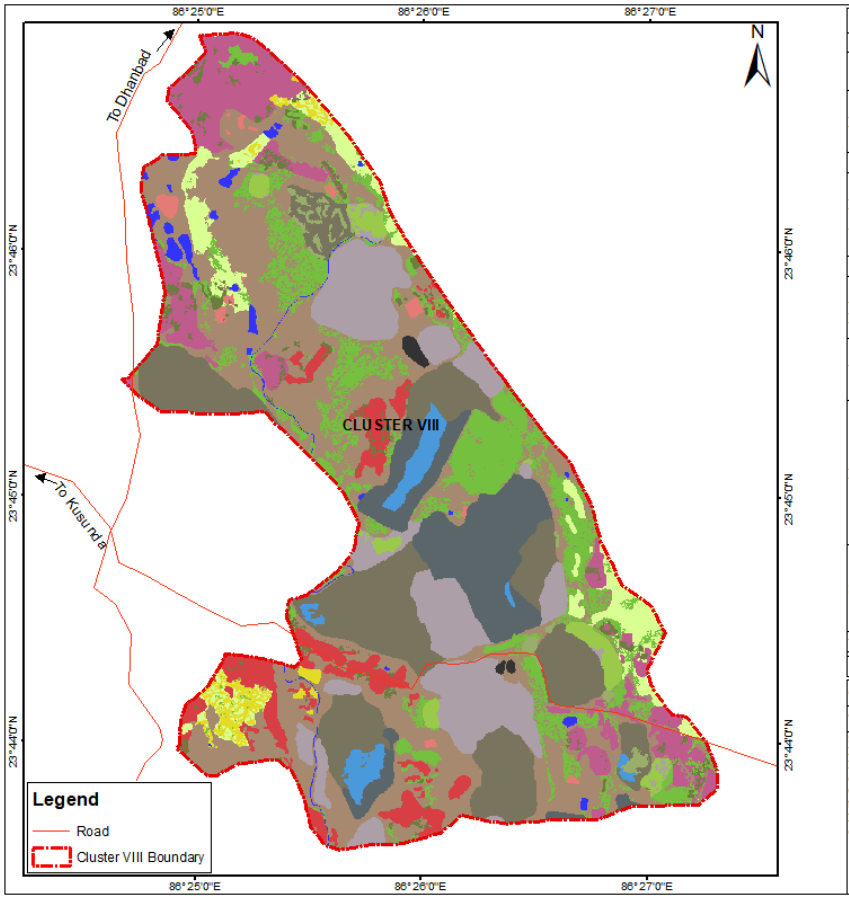
Annexure-XI

R&R of PAFs

Sl. No.	Name of Colliery	No of PAFs Rehabilitated/Shifted till date
1	Bastacolla Colliery	NIL
2	Bera Colliery	NIL
3	Dobari Colliery	139
4	Ghanoodih Colliery	572
5	Kuya Colliery	342
6	Kujama Colliery	216
Total		**1269**

Annexure-XII

Land use Map generated from Remote Sensing Data



Area Statistics - Cluster VIII (2020)				
Classes		Colour	Core Zone	
Level-I	Level-II		Area (Ha)	% of Total
Forest	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forest (A)		**0.00**	**0.00**
	Scrubs (B)		**157.58**	**11.83**
Plantation Area	Social Forestry		24.70	1.85
	Plantation on OB		21.97	1.65
	Plantation on Backfill		9.93	0.75
	Total Plantation Area (C)		**56.60**	**4.25**
	Total Vegetation (A+B+C)		**214.18**	**16.08**
Agriculture Land	Crop land		16.63	1.25
	Fallow Land		58.63	4.40
	Total Agriculture Land		**75.26**	**5.65**
Waste Land	Waste Land		373.70	28.06
	Sand Body		0.00	0.00
	Total Waste Land		**373.70**	**28.06**
Mining Area	Advance Quarry area		0.00	0.00
	Coal Quarry		101.43	7.62
	Barren OB Dump		152.06	11.42
	Back Fill		206.91	15.53
	Coal Dump		3.72	0.28
	Water Filled Qry		23.06	1.73
	Total Mining Area		**487.18**	**36.58**
Settlements	Urban Settlements		99.22	7.45
	Rural Settlements		60.71	4.56
	Industrial Settlements		7.75	0.58
	Total Settlement Area		**167.68**	**12.59**
Water Body	**River/ Ponds**		**13.95**	**1.05**
	Total Area		**1331.95**	**100.00**

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of BCCL Clusters				Job No. 501401027
Subject: Land Reclamation Monitoring Status of Cluster-VIII Group of Mines based on Satellite Data (RS-2/L-IV) of the year 2020	Activity	Name	Designation	Signature	
	Prepared	A. Parida	Dy. Mgr(Geology)		
	Checked	B.K Choudhary	Ch. Mgr(RSC)		
	Approved	R. Kumar	GM(Geomatics)		
cmpdi	Scale: 0 0.25 0.5 1 Km				Sheet 1
	Drg No. HQ/REM/20/R2/A4/CL-VIII				Rev No:0

Annexure-XIII

Corporate Environmental Policy (http://www.bcclweb.in/environment/CEP_04.11.2019.pdf)

Item No. 351.3D

Quarterly Review for the Quarter October to December, 2018 & January to March, 2019 on Safety, Environment & Quality as per the directive of MoC letter no. 23/3/2015-ASO/BA dated 26.04.2017.

Board reviewed the quarterly report of **October to December 2018** and **January to March 2019** on Safety, Environment & Quality as per the directive of MoC letter no. 23/3/2015-ASO/BA dated 26.04.2017.

Item No. 351.4G
Corporate Environment Policy (CEP) of Bharat Coking Coal Limited.

Background

Coal India Ltd. had brought out its Corporate Environment Policy (CEP) in 2012 Based on CIL Environment Policy 2012, incorporating the Jharia Master Plan, CEP of BCCL was approved by 285th BCCL board on 21.04.2012 (ANNEXURE C of the agenda note). As per the provisions of the policy, it is to be revised every 05 years as per which the policy would have been revised in 2017. However, there was delay in revising the policy at CIL's end due to which there is a delay in revising BCCL's CEP. CIL has revised its Corporate Environment Policy and approved in its 377th CIL Board Meeting dated 20th Dec., 2018(ANNEXURE D of the agenda note).

The CAG during its exit meeting held on 16.11.2018 also pointed out for the need of revising BCCL's Corporate Environment Policy adopted in 2012(ANNEXURE E of the agenda note). Modifying CIL's CEP to suit BCCL's prevailing conditions, the Corporate Environment Policy of BCCL has been revised.

Two versions of Policy was attached herewith out of which any one may be approved as deemed suitable by the Board.

a. An abridged version of the policy as adopted earlier by BCCL in 2012. (ANNEXURE A of the agenda note)
b. A detailed version of the policy similar to the CEP, 2018 of CIL with modifications suited to BCCL's condition. (ANNEXURE B of the agenda note)

Decision:
After detailed deliberation the Corporate Environment Policy, 2018 of CIL was approved by the Board.

Board further directed that the Policy as adopted above to suit the conditions in BCCL should be modified with information to Coal India.

Certified to be True Copy

B. K. Paul
Company Secretary
Bharat Coking Coal Limited
Koyla Bhawan
Dhanbad-826005

Annexure-XIV
Air Monitoring 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	11/2022	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/11	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Dobari UGP	Date of Sampling	11.11.2022	28.11.2022	Zone of Station:	Core Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	Observed Values (in µg/m³) 2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS -5182(Part 23):2006, R-2017	97	114	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	56	62	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	<10	11	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	26	27	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY (Gaurav Kant) ***CHECKED BY*** (Amit Raj Mishra) ***HOD's Signature***

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.*

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	11/2022	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/13	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Jeenagora	Date of Sampling	10.11.2022	24.11.2022	Zone of Station:	Buffer Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	Observed Values (in µg/m³) 2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS -5182(Part 23):2006, R-2017	124	114	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	69	64	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	22	23	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY (Gaurav Kant) ***CHECKED BY*** (Amit Raj Mishra) ***HOD's Signature***

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

Test Report for Ambient Air Samples

Month & Year	11/2022	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/28	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Hurriladih UGP		Date of Sampling	04.11.2022 – 25.11.2022	Zone of Station:	Buffer Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS -5182(Part 23):2006, R-2017	93	98	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	54	56	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	26	27	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average * LDL indicates Lower Detection Limit,*

(Gaurav Kant)
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(Amit Raj Mishra)
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

Test Report for Ambient Air Samples

Month & Year	11/2022	Cluster	CLUSTER VIII			Report No.	RI-II/AIR/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/12	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Kusmatand Village		Date of Sampling	10.11.2022 – 24.11.2022	Zone of Station:	Buffer Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS -5182(Part 23):2006, R-2017	97	95	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	51	52	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	20	22	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

(Gaurav Kant)
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MINE EFFLUENT TEST REPORT

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Test Report for Mine Effluent samples

Month & Year	11/2022	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	22.02.2023
Project		Sampling Ref. No.	REM/BCCL/2022/08	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Sampling Stations	(i)	Dobari UGP	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	14.11.22	28.11.22	

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	33	32	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	8.04	8.01	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	28	24	*250 (Max)*	4

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

ANALYSED BY (Kumar Vaibhav) ***CHECKED BY*** (Amit Raj Mishra) ***HOD's Signature***

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

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Test Report for Ambient Air Samples

Month & Year	12/2022	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Dobari UGP	Date of Sampling	01.12.2022	23.12.2022	Zone of Station:	Core 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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	90	138	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	48	68	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	24	25	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY (Gaurav Kant) ***CHECKED BY*** (Amit Raj Mishra) ***HOD's Signature***

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

Test Report for Ambient Air Samples

Month & Year	12/2022	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Jeenagora	Date of Sampling	10.12.2022	16.12.2022	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	129	98	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	69	57	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	23	24	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Air Quality Test Report

Test Report for Ambient Air Samples

Month & Year	12/2022	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Hurriladih UGP	Date of Sampling	02.12.2022	17.12.2022	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	96	117	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	57	62	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	25	26	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average * LDL indicates Lower Detection Limit,*

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Ambient Air Quality Test Report

Test Report for Ambient Air Samples

Month & Year	12/2022	Cluster	CLUSTER VIII			Report No.	RI-II/AIR/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Kusmatand Village	Date of Sampling	10.12.2022	16.12.2022	Zone of Station:	Buffer Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	Observed Values (in µg/m³) 2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS -5182(Part 23):2006, R-2017	97	94	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	54	50	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	19	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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MINE EFFLUENT TEST REPORT

Test Report for Mine Effluent samples

Month & Year	12/2022	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	13.03.2023
Project		Sampling Ref. No.	REM/BCCL/2022/09	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Sampling Stations	(i)	Dobari UGP	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	05.12.2022	26.12.2022	

Sl. No.	Parameter	Method of Analysis	Observed Values First Fortnight	Observed Values Second Fortnight	STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E). Dt: 25.09.2000)	LDL
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	31	29	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	8.01	8	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	36	36	*250 (Max)*	4

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

ANALYSED BY | (Kumar Vaibhav) CHECKED BY | (Amit Raj Mishra) HOD's Signature

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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Ambient Air Quality Test Report

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Test Report for Ambient Air Samples

Month & Year	1/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	23.03.2023
Project			Sample Ref. No.	REM/BCCL/2023/10	Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Dobari UGP		Date of Sampling	14.01.2023 – 29.01.2023	Zone of Station:	Core 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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	98	96	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	55	51	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	22	28	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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Ambient Air Quality Test Report

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Test Report for Ambient Air Samples

Month & Year	1/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	23.03.2023
Project			Sample Ref. No.	REM/BCCL/2023/10	Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Jeenagora		Date of Sampling	12.01.2023 – 16.01.2023	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	96	98	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	49	53	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	18	13	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

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Ambient Air Quality Test Report

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Test Report for Ambient Air Samples

Month & Year	1/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	23.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/10	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Hurriladih UGP	Date of Sampling	06.01.2023	21.01.2023	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	94	92	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	49	50	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	11	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	24	27	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average * LDL indicates Lower Detection Limit,*

ANALYSED BY (Gaurav Kant) ***CHECKED BY*** (Amit Raj Mishra) ***HOD's Signature***

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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Ambient Air Quality Test Report

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Test Report for Ambient Air Samples

Month & Year	1/2023	Cluster	CLUSTER VIII			Report No.	RI-II/AIR/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	23.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/10	Sampling Method		CMPDI/RI-II/LPM 13 , (IS 5182)	
Sampling Stations	i	Kusmatand Village	Date of Sampling	13.01.2023	28.01.2023	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	88	91	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	49	50	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	13	13	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	20	26	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

ANALYSED BY (Gaurav Kant) ***CHECKED BY*** (Amit Raj Mishra) ***HOD's Signature***

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	1/2023	Cluster	Cluster VIII	Report No.	RI-II/WATER/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue 23.03.2023
Project		Sampling Ref. No.	REM/BCCL/2023/10	Sampling Method IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Sampling Stations	(i)	Dobari UGP	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent		
			Date of Sampling 14.01.2023 – 29.01.2023		Period of analysis Jan'2023

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	98	96	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	55	51	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<10	<10	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	22	28	*250 (Max)*	4

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

ANALYSED BY (Kumar Vaibhav) ***CHECKED BY*** (Amit Raj Mishra) ***HOD's Signature***

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

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Test Report for Ambient Air Samples

Month & Year	02/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	31.03.2023
Project	Dobari UGP		REM/BCCL/2023/11		Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	10.02.2023	19.02.2023	Period of Analysis	01.03.2023	15.03.2023	Zone of Station:	Core 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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	95	90	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	48	46	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	27	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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Test Report for Ambient Air Samples

Month & Year	02/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	31.03.2023
Project	Jeenagora		Sample Ref. No.	REM/BCCL/2023/11	Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	09.02.2023		23.02.2023	Period of Analysis	01.03.2023 – 15.03.2023	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	116	95	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	62	52	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	<10	14	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	30	29	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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Test Report for Ambient Air Samples

Month & Year	2/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	31.03.2023
Project	Hurriladih UGP		Sample Ref. No.	REM/BCCL/2023/11	Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	05.02.2023		16.02.2023	Period of Analysis	01.03.2023 – 15.03.2023	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	92	84	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	49	45	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	27	26	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average * LDL indicates Lower Detection Limit,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
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Test Report for Ambient Air Samples

Month & Year	2/2023	Cluster	CLUSTER VIII			Report No.	RI-II/AIR/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	31.03.2023
Project	Kusmatand Village		Sample Ref. No.	REM/BCCL/2023/11	Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	09.02.2023		23.02.2023	Period of Analysis	01.03.2023 – 15.03.2023	Zone of Station:	Buffer Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	Observed Values (in µg/m³) 2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS -5182(Part 23):2006, R-2017	87	95	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	45	48	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	12	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	17	16	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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	02/2023	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	31.03.2023
Project	Dobari UGP	Sampling Ref. No.	REM/BCCL/2023/11	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Period of Analysis	06.02.2023 – 24.03.2023	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent				
		Date of Sampling		10.02.2023	19.02.2023	Period of analysis Feb'2023 to March'2023

Sl. No.	Parameter	Method of Analysis	Observed Values First Fortnight	Observed Values Second Fortnight	STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)	LDL
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	95	90	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	48	46	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<10	<10	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	29	27	*250 (Max)*	4

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

ANALYSED BY (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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

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Test Report for Ambient Air Samples

Month & Year	03/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	29.04.2023
Project	Dobari UGP		REM/BCCL/2023/12		Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	13.03.23	24.03.23	Period of Analysis	03.03.2023	10.04.2023	Zone of Station:	Core Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS-5182(Part 23):2006, R-2017	118	81	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS-5182(Part 24):2019	63	41	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	30	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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

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Test Report for Ambient Air Samples

Month & Year	03/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	29.04.2023
Project	Jeenagora		Sample Ref. No. REM/BCCL/2023/12		Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	13.03.23	23.03.23	Period of Analysis	03.03.2023	10.04.2023	Zone of Station:	Buffer Zone

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³) 1st FN	2nd FN	Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
1	PM_{10}	IS -5182(Part 23):2006, R-2017	95	105	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	54	62	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	28	26	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*
***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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

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Test Report for Ambient Air Samples

Month & Year	3/2023	Cluster	Cluster VIII			Report No.	RI-II/AIR/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	29.04.2023
Project	Hurriladih UGP		Sample Ref. No.	REM/BCCL/2023/12	Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	10.03.23		28.03.23	Period of Analysis	03.03.2023 – 10.04.2023	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	97	92	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	55	54	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	**28**	**30**	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average * LDL indicates Lower Detection Limit,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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

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Test Report for Ambient Air Samples

Month & Year	3/2023	Cluster	CLUSTER VIII			Report No.	RI-II/AIR/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	29.04.2023
Project	Kusmatand Village		Sample Ref. No.	REM/BCCL/2023/12	Sampling Method	CMPDI/RI-II/LPM 13 , (IS 5182)	
Date of Sampling	13.03.2023		23.03.2023	Period of Analysis	03.03.2023 – 10.04.2023	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
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	95	91	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	39	37	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	11	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	**18**	**19**	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

***All units are in µg/m3, 24 hourly Average, * LDL indicates Lower Detection Limit,*

ANALYSED BY (Gaurav Kant) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

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	03/2023	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	29.04.2023
Project	Dobari UGP	Sampling Ref. No.	REM/BCCL/2023/12	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Period of Analysis	06.03.2023	17.04.2023	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	13.03.23	27.03.23	Period of analysis Feb'2023 to March'2023

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	30	43	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.95	7.88	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	28	20	*250 (Max)*	4

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

ANALYSED BY (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

Annexure-XV

Noise Monitoring Data

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

Month & Year	11/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/12		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Kusmtand Village	Date of Sampling	10.11.2022	24.11.2022	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	45.5	44.2	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	47.8	44.2					
3		08:00 - 09:00	50.1	50.1					
4		09:00 – 10:00	55.7	52.6					
5		10:00 - 11:00	54.3	54.6					
6		11:00 - 12:00	53.0	53.4					
7		12:00 - 13:00	54.0	55.9					
8		13:00 - 14:00	56.0	57.1					
9		14:00 - 15:00	53.8	52.6					
10		15:00 - 16:00	52.9	53.1					
11		16:00 - 17:00	53.3	52.8					
12		17:00 - 18:00	53.7	53.1					
13		18:00 - 19:00	53.3	51.9					
14		19:00 - 20:00	50.7	52.0					
15		20:00 - 21:00	51.4	50.9					
16		21:00 - 22:00	51.3	50.9					
		Leq DAY	53.0	52.9					
1	Noise Level dB(A)Leq -Night	22:00-23:00	40.1	39.8	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	39.8	39.5					
3		00:00- 01:00	39.6	39.2					
4		01.00-02.00	38.4	39.0					
5		02.00-03.00	38.1	38.6					
6		03.00-04.00	39.0	38.5					
7		04.00-05.00	39.1	38.5					
8		05:00-06:00	39.5	39.2					
		Leq NIGHT	36.2	36.1					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

Month & Year	11/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/11		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Dobari UGP	Date of Sampling	11.11.2022	28.11.2022	Zone Category of Station:	Core 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	50.8	48.3	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	53.4	51.6					
3		08:00 - 09:00	55.6	54.1					
4		09:00 – 10:00	62.2	59.4					
5		10:00 - 11:00	63.7	61.5					
6		11:00 - 12:00	62.2	60.1					
7		12:00 - 13:00	66.7	63.0					
8		13:00 - 14:00	64.9	65.2					
9		14:00 - 15:00	60.7	60.2					
10		15:00 - 16:00	61.3	59.2					
11		16:00 - 17:00	60.7	67.2					
12		17:00 - 18:00	64.2	58.2					
13		18:00 - 19:00	62.5	53.4					
14		19:00 - 20:00	45.5	44.9					
15		20:00 - 21:00	45.6	44.1					
16		21:00 - 22:00	45.7	42.9					
		Leq DAY	61.4	60.3					
1	Noise Level dB(A)Leq -Night	22:00-23:00	42.6	42.9	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	42.1	42.5					
3		00:00- 01:00	40.9	42.3					
4		01.00-02.00	40.5	42.1					
5		02.00-03.00	41.2	42.6					
6		03.00-04.00	41.6	42.8					
7		04.00-05.00	42.0	43.1					
8		05:00-06:00	42.5	43.2					
		Leq NIGHT	38.7	39.7					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	11/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/13		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Jeenagora	Date of Sampling	10.11.2022	24.11.2022	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	57.5	54.2	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	66.1	60.8					
3		08:00 - 09:00	67.4	64.5					
4		09:00 – 10:00	69.1	62.0					
5		10:00 - 11:00	66.7	65.2					
6		11:00 - 12:00	65.4	63.9					
7		12:00 - 13:00	71.7	70.5					
8		13:00 - 14:00	64.3	62.8					
9		14:00 - 15:00	57.7	59.6					
10		15:00 - 16:00	49.1	48.8					
11		16:00 - 17:00	65.4	63.6					
12		17:00 - 18:00	56.8	55.8					
13		18:00 - 19:00	56.7	51.8					
14		19:00 - 20:00	57	49.5					
15		20:00 - 21:00	56.9	44.5					
16		21:00 - 22:00	56.8	45.7					
		Leq DAY	65.0	62.5					
1	Noise Level dB(A)Leq -Night	22:00-23:00	50.0	49.1	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	49.2	48.5					
3		00:00- 01:00	48.8	48.3					
4		01.00-02.00	48.8	48.0					
5		02.00-03.00	49.0	47.6					
6		03.00-04.00	48.4	47.1					
7		04.00-05.00	49.4	46.8					
8		05:00-06:00	49.4	48.1					
		Leq NIGHT	46.1	45.0					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	11/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	22.02.2023
Project		Sample Ref. No.	REM/BCCL/2022/28		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Hurriladih UGP	Date of Sampling	04.11.22	25.11.22	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	47.5	46.5	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	50.9	49.8					
3		08:00 - 09:00	53.2	53.2					
4		09:00 – 10:00	58.8	59.2					
5		10:00 - 11:00	60.0	61.0					
6		11:00 - 12:00	58.9	59.2					
7		12:00 - 13:00	61.7	60.8					
8		13:00 - 14:00	52.2	53					
9		14:00 - 15:00	43.8	44.2					
10		15:00 - 16:00	43.8	43.6					
11		16:00 - 17:00	44.4	44.5					
12		17:00 - 18:00	37.4	38.9					
13		18:00 - 19:00	45.9	45.2					
14		19:00 - 20:00	43.6	43					
15		20:00 - 21:00	45	46.5					
16		21:00 - 22:00	46.4	46					
		Leq DAY	54.8	54.9					
1	Noise Level dB(A)Leq -Night	22:00-23:00	44.0	43.3	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	43.8	43.4					
3		00:00- 01:00	43.1	43.2					
4		01.00-02.00	43.0	43.6					
5		02.00-03.00	43.3	43.9					
6		03.00-04.00	40.1	43.0					
7		04.00-05.00	40.2	39.3					
8		05:00-06:00	39.8	38.9					
		Leq NIGHT	39.5	39.7					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	12/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Dobari UGP	Date of Sampling	01.12.22	23.12.22	Zone Category of Station:	Core 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	48.1	45.7	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	50.6	48.9					
3		08:00 - 09:00	52.7	51.2					
4		09:00 – 10:00	58.9	56.3					
5		10:00 - 11:00	60.3	58.3					
6		11:00 - 12:00	58.9	56.9					
7		12:00 - 13:00	63.2	59.6					
8		13:00 - 14:00	61.5	61.7					
9		14:00 - 15:00	57.5	57.0					
10		15:00 - 16:00	58.0	56.1					
11		16:00 - 17:00	57.5	63.6					
12		17:00 - 18:00	60.8	55.1					
13		18:00 - 19:00	59.2	50.6					
14		19:00 - 20:00	43.1	42.5					
15		20:00 - 21:00	43.2	41.8					
16		21:00 - 22:00	43.3	40.6					
		Leq DAY	58.1	56.9					
1	Noise Level dB(A)Leq -Night	22:00-23:00	43.0	43.3	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	42.5	42.9					
3		00:00- 01:00	41.3	42.7					
4		01.00-02.00	40.9	42.5					
5		02.00-03.00	41.6	43.0					
6		03.00-04.00	42.0	43.2					
7		04.00-05.00	42.4	43.5					
8		05:00-06:00	42.9	43.6					
		Leq NIGHT	42.1	43.1					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
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HOD's Signature

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

Month & Year	12/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Jeenagora	Date of Sampling	10.12.22	16.12.22	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	54.5	51.3	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	62.6	57.6					
3		08:00 - 09:00	63.8	61.1					
4		09:00 – 10:00	65.4	58.7					
5		10:00 - 11:00	63.2	61.7					
6		11:00 - 12:00	61.9	60.5					
7		12:00 - 13:00	67.9	66.8					
8		13:00 - 14:00	60.9	59.5					
9		14:00 - 15:00	54.6	56.4					
10		15:00 - 16:00	46.5	46.2					
11		16:00 - 17:00	61.9	60.2					
12		17:00 - 18:00	53.8	52.8					
13		18:00 - 19:00	53.7	49.1					
14		19:00 - 20:00	54.0	46.9					
15		20:00 - 21:00	53.9	42.1					
16		21:00 - 22:00	53.8	43.3					
		Leq DAY	61.4	59.1					
1	Noise Level dB(A)Leq -Night	22:00-23:00	46.7	43.5	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	45.9	42.9					
3		00:00- 01:00	45.6	42.8					
4		01.00-02.00	45.6	42.6					
5		02.00-03.00	45.8	42.2					
6		03.00-04.00	45.2	41.7					
7		04.00-05.00	46.1	41.5					
8		05:00-06:00	46.1	42.6					
		Leq NIGHT	45.9	42.5					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	12/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Hurriladih UGP	Date of Sampling	02.12.22	17.12.22	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	45.0	44.0	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	48.2	47.2					
3		08:00 - 09:00	50.4	50.4					
4		09:00 – 10:00	55.7	56.1					
5		10:00 - 11:00	56.8	57.8					
6		11:00 - 12:00	55.8	56.1					
7		12:00 - 13:00	58.4	57.6					
8		13:00 - 14:00	49.4	50.2					
9		14:00 - 15:00	41.5	41.9					
10		15:00 - 16:00	41.5	41.3					
11		16:00 - 17:00	42.0	42.1					
12		17:00 - 18:00	35.4	36.8					
13		18:00 - 19:00	43.5	42.8					
14		19:00 - 20:00	41.3	40.7					
15		20:00 - 21:00	42.6	44.0					
16		21:00 - 22:00	43.9	43.6					
		Leq DAY	51.7	51.8					
1	Noise Level dB(A)Leq -Night	22:00-23:00	44.4	43.7	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	44.2	43.8					
3		00:00- 01:00	43.5	43.6					
4		01.00-02.00	43.4	44.0					
5		02.00-03.00	43.7	44.3					
6		03.00-04.00	40.5	43.4					
7		04.00-05.00	40.6	39.7					
8		05:00-06:00	40.2	39.3					
		Leq NIGHT	42.9	43.1					

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

Sampling Assistants
ANALYSED BY

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

Month & Year	12/2022	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	13.03.2023
Project		Sample Ref. No.	REM/BCCL/2022/09		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Kusmtand Village	Date of Sampling	10.12.22	16.12.22	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	43.0	41.9	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	45.3	41.9					
3		08:00 - 09:00	47.5	47.4					
4		09:00 – 10:00	52.7	49.8					
5		10:00 - 11:00	51.4	51.7					
6		11:00 - 12:00	50.2	50.5					
7		12:00 - 13:00	51.1	53.0					
8		13:00 - 14:00	53.0	54.1					
9		14:00 - 15:00	50.9	49.8					
10		15:00 - 16:00	50.1	50.3					
11		16:00 - 17:00	50.5	50.0					
12		17:00 - 18:00	50.9	50.3					
13		18:00 - 19:00	50.5	49.1					
14		19:00 - 20:00	48.0	49.2					
15		20:00 - 21:00	48.7	48.2					
16		21:00 - 22:00	48.6	48.2					
		Leq DAY	50.1	50.0					
1	Noise Level dB(A)Leq -Night	22:00-23:00	40.5	40.2	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	40.2	39.9					
3		00:00- 01:00	40.0	39.6					
4		01.00-02.00	38.8	39.4					
5		02.00-03.00	38.5	39.0					
6		03.00-04.00	39.4	38.9					
7		04.00-05.00	39.5	38.9					
8		05:00-06:00	39.9	39.6					
		Leq NIGHT	39.6	39.5					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	10/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	23.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/10		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Dobari UGP	Date of Sampling	14.01.2023	29.01.2023	Zone Category of Station:	Core 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	50.3	48.9	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	52.8	51.1					
3		08:00 - 09:00	55.1	53.5					
4		09:00 – 10:00	61.5	58.9					
5		10:00 - 11:00	63.0	60.9					
6		11:00 - 12:00	61.5	62.3					
7		12:00 - 13:00	66.1	64.5					
8		13:00 - 14:00	64.3	64.5					
9		14:00 - 15:00	60.0	61.2					
10		15:00 - 16:00	60.6	61.0					
11		16:00 - 17:00	60.0	60.2					
12		17:00 - 18:00	58.1	57.6					
13		18:00 - 19:00	57.2	52.8					
14		19:00 - 20:00	54.9	51.9					
15		20:00 - 21:00	53.7	50.7					
16		21:00 - 22:00	54.6	50.3					
		Leq DAY	60.4	59.6					
1	Noise Level dB(A)Leq -Night	22:00-23:00	51.2	49.7	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	50.7	49.2					
3		00:00- 01:00	45.6	45.4					
4		01.00-02.00	45.2	45.1					
5		02.00-03.00	44.8	44.9					
6		03.00-04.00	42.9	43.1					
7		04.00-05.00	42.4	43.5					
8		05:00-06:00	43.8	43.6					
		Leq NIGHT	47.1	46.3					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	1/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	23.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/10		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Jeenagora	Date of Sampling	12.01.2023	16.01.2023	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	57.0	53.6	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	65.4	60.1					
3		08:00 - 09:00	66.7	63.8					
4		09:00 – 10:00	68.3	61.3					
5		10:00 - 11:00	66.1	64.5					
6		11:00 - 12:00	64.7	63.2					
7		12:00 - 13:00	70.9	69.8					
8		13:00 - 14:00	63.6	62.1					
9		14:00 - 15:00	57.1	59.0					
10		15:00 - 16:00	48.6	48.3					
11		16:00 - 17:00	64.7	62.9					
12		17:00 - 18:00	56.2	55.2					
13		18:00 - 19:00	52.0	51.3					
14		19:00 - 20:00	48.8	49.0					
15		20:00 - 21:00	44.1	44.0					
16		21:00 - 22:00	44.7	45.2					
		Leq DAY	64.1	61.8					
1	Noise Level dB(A)Leq -Night	22:00-23:00	43.5	44.5	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	44.2					
3		00:00- 01:00	42.1	44.0					
4		01.00-02.00	42.0	43.1					
5		02.00-03.00	42.0	42.8					
6		03.00-04.00	43.9	42.0					
7		04.00-05.00	44.1	45.1					
8		05:00-06:00	46.1	45.9					
		Leq NIGHT	43.5	44.1					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	1/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	23.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/10		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Hurriladih UGP	Date of Sampling	06.01.2023	21.01.2023	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	47.0	45.9	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	50.4	49.3					
3		08:00 - 09:00	52.6	52.6					
4		09:00 - 10:00	58.2	58.6					
5		10:00 - 11:00	59.4	60.3					
6		11:00 - 12:00	58.3	58.6					
7		12:00 - 13:00	61.0	60.1					
8		13:00 - 14:00	51.7	52.4					
9		14:00 - 15:00	43.4	43.8					
10		15:00 - 16:00	43.4	43.2					
11		16:00 - 17:00	43.9	44.0					
12		17:00 - 18:00	36.9	38.4					
13		18:00 - 19:00	45.4	44.7					
14		19:00 - 20:00	43.2	42.6					
15		20:00 - 21:00	44.5	45.9					
16		21:00 - 22:00	45.8	45.5					
		Leq DAY	54.1	54.2					
1	Noise Level dB(A)Leq -Night	22:00-23:00	44.4	43.7	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	44.2	43.8					
3		00:00- 01:00	43.5	43.6					
4		01.00-02.00	43.4	44.0					
5		02.00-03.00	43.7	44.3					
6		03.00-04.00	40.5	43.4					
7		04.00-05.00	40.6	39.7					
8		05:00-06:00	40.2	39.3					
		Leq NIGHT	42.9	43.1					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

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

Month & Year	1/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	23.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/10		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Kusmtand Village	Date of Sampling	13.01.2023	28.01.2023	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	44.9	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	47.3	43.8					
3		08:00 - 09:00	49.6	49.5					
4		09:00 - 10:00	55.1	52.0					
5		10:00 - 11:00	53.7	54.0					
6		11:00 - 12:00	52.4	52.7					
7		12:00 - 13:00	53.4	55.4					
8		13:00 - 14:00	55.4	56.5					
9		14:00 - 15:00	53.1	52.0					
10		15:00 - 16:00	50.1	50.1					
11		16:00 - 17:00	48.7	48.2					
12		17:00 - 18:00	47.9	47.2					
13		18:00 - 19:00	46.5	47.1					
14		19:00 - 20:00	46.2	46.2					
15		20:00 - 21:00	46.0	46.5					
16		21:00 - 22:00	44.1	45.1					
		Leq DAY	51.1	51.1					
1	Noise Level dB(A)Leq -Night	22:00-23:00	43.2	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	43.1	43.4					
3		00:00- 01:00	42.8	42.9					
4		01.00-02.00	42.5	42.1					
5		02.00-03.00	42.0	42.0					
6		03.00-04.00	40.9	41.9					
7		04.00-05.00	40.5	41.9					
8		05:00-06:00	41.2	42.0					
		Leq NIGHT	42.1	42.5					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
CHECKED BY

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

Month & Year	02/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	31.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/11		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	1	Dobari UGP	Date of Sampling	10.02.2023	19.02.2023	Zone Category of Station:	Core 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	49.8	48.4	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	75
2		07:00 - 08:00	52.3	50.6				Commercial	65
3		08:00 - 09:00	54.5	52.9				Residential	55
4		09:00 - 10:00	60.9	58.3				Silence	50
5		10:00 - 11:00	62.4	60.3					
6		11:00 - 12:00	60.9	61.7					
7		12:00 - 13:00	65.4	63.8					
8		13:00 - 14:00	63.6	63.8					
9		14:00 - 15:00	59.4	60.6					
10		15:00 - 16:00	60	60.4					
11		16:00 - 17:00	59.4	59.6					
12		17:00 - 18:00	57.5	57					
13		18:00 - 19:00	56.6	52.3					
14		19:00 - 20:00	54.3	51.4					
15		20:00 - 21:00	53.1	50.2					
16		21:00 - 22:00	54	49.8					
		Leq DAY	59.7	59.0					
1	Noise Level dB(A)Leq -Night	22:00-23:00	51.1	49.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	70
2		23:00- 00:00	50.6	49.1				Commercial	55
3		00:00- 01:00	45.5	45.3				Residential	45
4		01.00-02.00	45.1	45				Silence	50
5		02.00-03.00	44.7	44.8					
6		03.00-04.00	42.8	43					
7		04.00-05.00	42.3	43.4					
8		05:00-06:00	43.7	43.5					
		Leq NIGHT	47.0	46.2					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
REVIEWED BY

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

Month & Year	02/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	31.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/11		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	1	Jeenagora	Date of Sampling	10.02.2023	16.02.2023	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	56.4	53	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	75
2		07:00 - 08:00	64.7	59.5				Commercial	65
3		08:00 - 09:00	66	63.1				Residential	55
4		09:00 - 10:00	67.6	60.7				Silence	50
5		10:00 - 11:00	65.4	63.8					
6		11:00 - 12:00	64	62.5					
7		12:00 - 13:00	70.2	69.1					
8		13:00 - 14:00	62.9	61.5					
9		14:00 - 15:00	56.5	58.4					
10		15:00 - 16:00	48.1	47.8					
11		16:00 - 17:00	64	62.3					
12		17:00 - 18:00	55.6	54.6					
13		18:00 - 19:00	51.5	50.8					
14		19:00 - 20:00	48.3	48.5					
15		20:00 - 21:00	43.6	43.5					
16		21:00 - 22:00	44.2	44.7					
		Leq DAY	63.4	61.2					
1	Noise Level dB(A)Leq -Night	22:00-23:00	43.4	44.4	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	70
2		23:00- 00:00	42.8	44.1				Commercial	55
3		00:00- 01:00	42	43.9				Residential	45
4		01.00-02.00	41.9	43				Silence	50
5		02.00-03.00	41.9	42.7					
6		03.00-04.00	43.8	41.9					
7		04.00-05.00	44	45					
8		05:00-06:00	46	45.8					
		Leq NIGHT	43.4	44.0					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

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

Month & Year	02/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	31.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/11		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	I	Hurriladih UGP	Date of Sampling	05.02.2023	16.02.2023	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	45.4	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	75
2		07:00 - 08:00	49.9	48.8				Commercial	65
3		08:00 - 09:00	52.1	52.1				Residential	55
4		09:00 – 10:00	57.6	58				Silence	50
5		10:00 - 11:00	58.8	59.7					
6		11:00 - 12:00	57.7	58					
7		12:00 - 13:00	60.4	59.5					
8		13:00 - 14:00	51.2	51.9					
9		14:00 - 15:00	43	43.3					
10		15:00 - 16:00	43	42.8					
11		16:00 - 17:00	43.4	43.5					
12		17:00 - 18:00	36.5	38					
13		18:00 - 19:00	44.9	44.2					
14		19:00 - 20:00	42.8	42.2					
15		20:00 - 21:00	44	45.4					
16		21:00 - 22:00	45.3	45					
		Leq DAY	53.6	53.6					
1	Noise Level dB(A)Leq -Night	22:00-23:00	44.3	43.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	70
2		23:00- 00:00	44.1	43.7				Commercial	55
3		00:00- 01:00	43.4	43.5				Residential	45
4		01.00-02.00	43.3	43.9				Silence	50
5		02.00-03.00	43.6	44.2					
6		03.00-04.00	40.4	43.3					
7		04.00-05.00	40.5	39.6					
8		05:00-06:00	40.1	39.3					
		Leq NIGHT	42.8	43.0					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

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

Month & Year	02/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	31.03.2023
Project		Sample Ref. No.	REM/BCCL/2023/11		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	I	Kusmtand Village	Date of Sampling	09.02.2023	23.02.2023	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	44.4	43.3	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	75
2		07:00 - 08:00	46.8	43.3				Commercial	65
3		08:00 - 09:00	49.1	49				Residential	55
4		09:00 – 10:00	54.5	51.5				Silence	50
5		10:00 - 11:00	53.1	53.4					
6		11:00 - 12:00	51.9	52.2					
7		12:00 - 13:00	52.8	54.8					
8		13:00 - 14:00	54.8	55.9					
9		14:00 - 15:00	52.6	51.5					
10		15:00 - 16:00	49.6	48.6					
11		16:00 - 17:00	48.2	47.7					
12		17:00 - 18:00	47.4	46.7					
13		18:00 - 19:00	46	46.6					
14		19:00 - 20:00	45.7	45.7					
15		20:00 - 21:00	45.5	46					
16		21:00 - 22:00	43.6	44.6					
		Leq DAY	50.6	50.6					
1	Noise Level dB(A)Leq -Night	22:00-23:00	43.1	43.5	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	70
2		23:00- 00:00	43	43.3				Commercial	55
3		00:00- 01:00	42.7	42.8				Residential	45
4		01.00-02.00	42.4	42				Silence	50
5		02.00-03.00	41.9	41.9					
6		03.00-04.00	40.8	41.8					
7		04.00-05.00	40.4	41.8					
8		05:00-06:00	41.1	41.9					
		Leq NIGHT	42.0	42.4					

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

Sampling Assistants
ANALYSED BY

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

Month & Year	03/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	29.04.2023
Project		Sample Ref. No.	REM/BCCL/2023/12		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Dobari UGP	Date of Sampling	13.03.23	24.03.23	Zone Category of Station:	Core 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	53.3	51.8	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	75
2		07:00 - 08:00	55.9	52.1				Commercial	65
3		08:00 - 09:00	58.3	56.6				Residential	55
4		09:00 – 10:00	65.1	62.4				Silence	50
5		10:00 - 11:00	66.7	64.5					
6		11:00 - 12:00	65.1	66					
7		12:00 - 13:00	70	68.3					
8		13:00 - 14:00	68.1	68.3					
9		14:00 - 15:00	63.5	64.8					
10		15:00 - 16:00	64.2	64.6					
11		16:00 - 17:00	63.5	63.7					
12		17:00 - 18:00	61.5	61					
13		18:00 - 19:00	60.6	55.9					
14		19:00 - 20:00	58.1	54.9					
15		20:00 - 21:00	56.9	53.7					
16		21:00 - 22:00	57.8	53.3					
		Leq DAY	64.0	63.2					
1	Noise Level dB(A)Leq -Night	22:00-23:00	49.1	47.7	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	70
2		23:00- 00:00	48.6	47.2				Commercial	55
3		00:00- 01:00	43.7	43.5				Residential	45
4		01.00-02.00	43.3	43.2				Silence	50
5		02.00-03.00	43	43.1					
6		03.00-04.00	41.1	41.3					
7		04.00-05.00	40.7	41.7					
8		05:00-06:00	42	41.8					
		Leq NIGHT	45.1	44.4					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

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

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

Month & Year	03/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	29.04.2023
Project		Sample Ref. No.	REM/BCCL/2023/12		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Jeenagora	Date of Sampling	13.03.23	23.03.23	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	60.3	56.7	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	75
2		07:00 - 08:00	69.2	57.1				Commercial	65
3		08:00 - 09:00	70.6	67.5				Residential	55
4		09:00 – 10:00	72.3	64.9				Silence	50
5		10:00 - 11:00	70	68.3					
6		11:00 - 12:00	68.5	66.9					
7		12:00 - 13:00	75.1	73.9					
8		13:00 - 14:00	67.3	65.7					
9		14:00 - 15:00	60.5	62.5					
10		15:00 - 16:00	51.5	51.1					
11		16:00 - 17:00	68.5	66.6					
12		17:00 - 18:00	59.5	58.4					
13		18:00 - 19:00	55.1	54.3					
14		19:00 - 20:00	51.7	51.9					
15		20:00 - 21:00	46.7	46.6					
16		21:00 - 22:00	47.3	47.9					
		Leq DAY	68.1	65.5					
1	Noise Level dB(A)Leq -Night	22:00-23:00	41.7	42.7	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial	70
2		23:00- 00:00	41.1	42.4				Commercial	55
3		00:00- 01:00	40.4	42.2				Residential	45
4		01.00-02.00	40.3	41.3				Silence	50
5		02.00-03.00	40.3	41					
6		03.00-04.00	42.1	40.3					
7		04.00-05.00	42.3	43.2					
8		05:00-06:00	44.2	44					
		Leq NIGHT	41.7	42.3					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
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CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
Ambient Noise Level Test Report

Month & Year	03/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	29.04.2023
Project		Sample Ref. No.	REM/BCCL/2023/12		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Hurriladih UGP	Date of Sampling	10.03.23	28.03.23	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	49.8	48.6	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	53.4	52.2					
3		08:00 - 09:00	55.7	55.7					
4		09:00 – 10:00	61.6	62					
5		10:00 - 11:00	62.9	63.8					
6		11:00 - 12:00	61.7	62					
7		12:00 - 13:00	64.6	63.6					
8		13:00 - 14:00	54.7	55.5					
9		14:00 - 15:00	45.9	46.4					
10		15:00 - 16:00	45.9	45.7					
11		16:00 - 17:00	46.5	46.6					
12		17:00 - 18:00	39.1	40.7					
13		18:00 - 19:00	48.1	47.3					
14		19:00 - 20:00	45.7	45.1					
15		20:00 - 21:00	47.1	48.6					
16		21:00 - 22:00	48.5	48.2					
		Leq DAY	57.5	57.6					
1	Noise Level dB(A)Leq -Night	22:00-23:00	42.6	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	42.4	42					
3		00:00- 01:00	41.7	41.8					
4		01.00-02.00	41.6	42.2					
5		02.00-03.00	41.9	42.5					
6		03.00-04.00	38.8	41.6					
7		04.00-05.00	38.9	38.1					
8		05:00-06:00	38.5	37.7					
		Leq NIGHT	41.1	41.3					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

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

Month & Year	03/2023	Cluster	Cluster VIII				Report No.	RI-II/NOISE/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)						Date of Issue	29.04.2023
Project		Sample Ref. No.	REM/BCCL/2023/12		Sampling Method		CMPDI/RI-II/LPM 13	
Sampling Stations	i	Kusmtand Village	Date of Sampling	13.03.23	23.03.23	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	47.5	46.4	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	50.1	43.9					
3		08:00 - 09:00	52.5	52.4					
4		09:00 – 10:00	58.3	55.1					
5		10:00 - 11:00	56.9	57.2					
6		11:00 - 12:00	55.5	55.8					
7		12:00 - 13:00	56.5	58.7					
8		13:00 - 14:00	58.7	59.8					
9		14:00 - 15:00	56.2	55.1					
10		15:00 - 16:00	53	53					
11		16:00 - 17:00	51.6	51					
12		17:00 - 18:00	50.7	50					
13		18:00 - 19:00	49.2	49.9					
14		19:00 - 20:00	48.9	48.9					
15		20:00 - 21:00	48.7	49.2					
16		21:00 - 22:00	46.7	47.7					
		Leq DAY	54.2	54.2					
1	Noise Level dB(A)Leq -Night	22:00-23:00	41.4	41.8	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	41.3	41.6					
3		00:00- 01:00	41	41.1					
4		01.00-02.00	40.8	40.4					
5		02.00-03.00	40.3	40.3					
6		03.00-04.00	39.2	40.2					
7		04.00-05.00	38.8	40.2					
8		05:00-06:00	39.5	40.3					
		Leq NIGHT	40.4	40.8					

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

Sampling Assistants
ANALYSED BY

(Gaurav Kant)
REVIEWED BY

(Amit Raj Mishra)
Authorised Signatory

Annexure-XVI

Water Quality Data

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Dobari UGP (MW8)

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

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

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

Test Report for Mine Effluent samples

Month & Year	11/2022	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/08
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	22.02.2023
Project		Sampling Ref. No.	REM/BCCL/2022/08	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Sampling Stations	(i)	Dobari UGP	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	14.11.22	28.11.22	

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	33	32	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	8.04	8.01	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	28	24	*250 (Max)*	4

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

ANALYSED BY | (Kumar Vaibhav) *CHECKED BY* | (Amit Raj Mishra) *HOD's Signature*

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Dobari UGP (MW8)

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

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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.

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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

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

Test Report for Mine Effluent samples

Month & Year	12/2022	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/09
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue 13.03.2023
Project		Sampling Ref. No.	REM/BCCL/2022/09	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Sampling Stations	(i)	Dobari UGP	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	05.12.2022	26.12.2022	

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	31	29	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	8.01	8	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	36	36	*250 (Max)*	4

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

ANALYSED BY | (Kumar Vaibhav) CHECKED BY | (Amit Raj Mishra) HOD's Signature

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Dobari UGP (MW8)

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

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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

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

Test Report for Mine Effluent samples

Month & Year	1/2023	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/10
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	23.03.2023
Project		Sampling Ref. No.	REM/BCCL/2023/10	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Sampling Stations	(i)	Dobari UGP	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	14.01.2023	29.01.2023	Period of analysis Jan'2023

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	98	96	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	55	51	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<10	<10	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	22	28	*250 (Max)*	4

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

ANALYSED BY | (Kumar Vaibhav) *CHECKED BY* | (Amit Raj Mishra) *HOD's Signature*

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Dobari UGP (MW8)

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

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

Test Report for Mine Effluent samples

Month & Year	02/2023	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/11
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	31.03.2023
Project	Dobari UGP	Sampling Ref. No.	REM/BCCL/2023/11	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Period of Analysis	06.02.2023	24.03.2023	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	10.02.2023	19.02.2023	Period of analysis Feb'2023 to March'2023

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	95	90	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	48	46	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<10	<10	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	29	27	*250 (Max)*	4

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

ANALYSED BY | (Kumar Vaibhav) REVIEWED BY | (Amit Raj Mishra) Authorised Signatory

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Dobari UGP (MW8)

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

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

Test Report for Mine Effluent samples

Month & Year	03/2023	Cluster	Cluster VIII	Report No.		RI-II/WATER/2022-23/12
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)				Date of Issue	29.04.2023
Project	Dobari UGP	Sampling Ref. No.	REM/BCCL/2023/12	Sampling Method	IS 3025 (Part-1)	CMPDI/RI-II/LPM 13
Period of Analysis	06.03.2023	17.04.2023	Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent			
			Date of Sampling	13.03.23	27.03.23	Period of analysis Feb'2023 to March'2023

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
			First Fortnight	Second Fortnight		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	30	43	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	7.95	7.88	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	28	20	*250 (Max)*	4

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

ANALYSED BY (Kumar Vaibhav) ***REVIEWED BY*** (Amit Raj Mishra) ***Authorised Signatory***

Annexure-XVII

Training

Sl. No.	Month	Refresher Training	Contractual Worker	Special Training	Change of Job
1	October	35	00	00	02
2	November	34	00	73	00
3	December	55	00	00	05
4	January	23	15	00	04
5	February	49	00	00	02
6	March	28	00	66	00
Total		224	15	139	13

Annexure-XVIII

Periodical Medical Examination

Sl. No.	Name of Area/ Mine/ Office	October'22	Nov'22	Dec'22	Jan'23	Feb'23	Mar'23
1	Bastacolla Colliery	19	16	2	21	22	35
2	Bera Colliery	10	9	4	8	8	7
3	Kuya Colliery	6	5	3	0	0	1
4	Ghanoodih Colliery	0	0	0	1	6	3
5	Dobari Colliery	0	0	0	0	0	3
Total		**35**	**30**	**9**	**30**	**36**	**49**

Annexure-XIX

Bharat Coking Coal Limited
(A Miniratna Company)
A Subsidiary of Coal India Limited
Office of the General Manager,
Bastacolla Area,
Dhanbad-828111
Fax/Tel. No. 0326-2291238,
Email: cgmbastacolla@bccl.gov.in

पर्यावरण विभाग
बस्ताकोला क्षेत्र

भारत कोकिंग कोल लिमिटेड
(एक मिनीरत्न कंपनी)
कोल इंडिया लिमिटेड का एक अंग
महाप्रबंधक का कार्यालय
बस्ताकोला क्षेत्र
धनबाद-८२८१११

Ref. No./पत्रांक: BCCL:BA:IX:GM:EC:19:124 Date/दिनांक: 17.01.2019

To
The Municipal Comissioner
Dhanbad Municipal Corporation
Dhanbad

Subject :- Regarding Environmental Clearance of Cluster VIII Coal Mining Project of M/s Bharat Coking Coal Limited.

Dear Sir,

The Ministry of Environment, Forests & Climate Change has granted Environmental Clearance to Cluster VIII group of mines vide EC No: J-11015/ 298/ 2010-IA.II(M) dated 15.02.2013 subsequently due to change in geo-mining conditions EC has been amended on 15.06.2018. Please find enclosed herewith a copy of Environmental Clearance granted to Cluster VIII Coal Mining Project.

This is for your kind information.

Yours Sincerely

General Manager
Bastacolla Area

General Manager
Bastacolla Area IX

Encl: As above

Copt to -
Dy. GM (Env), BCCL – For information (by e-mail)

कार्यालय नगर निगम
तिथि 18/1/19
धनबाद

Annexure-XX

Photographs of Avenue Plantation along Coal Transportation Routes/Other Roads

Annexure-XXI

Photographs of Eco-Restoration developed on stabilized OB Dumps


REDMI NOTE 8 PRO
RONIT

Annexure-XXII

भारतकोकिंगकोललिमिटेड
(कोलइंडियालिमिटेडकाएकअंग)
BHARAT COKING COAL LIMITED
(A Subsidiary of Coal India Limited)
Corporate Identity No. (CIN): U10101JH1972GOI000918
GST no.- 20AAACB7934MFZB (JH), 19AAACB7934M2Z7 (WB)
Civil Engineering Department, Bastacolla Area, Dhanbad – 826 005 (JH), India.
Phone: 0326-2291239, FAX: 0326-2291240, e-mail: shivrajnitkian@gmail.com

WORK ORDER

Ref: BCCL/BA/ACE/WO/20-21/630 Date: 02/03/21

To,
SANJAY KUMAR SHARMA
M.I.G-H/28,HOUSING BOARD COLONY, DHANBAD,
Dhanbad, Jharkhand, 826001.
Mob No: 9431314550

Sub: Installation of fixed water sprinkler system at BNR Siding with pipe line works and other associated civil works under administrative control of Rajapur/ S-Jharia OCP under Bastacolla Area.

Ref: 1. eNIT ref. no.- BCCL/BA/ACE/NIT/2020-21/04 dated 28.07.2020.
2. LOA Ref. : BCCL/BA-IX/CIVIL/LOA/20-21/08 dated: 12.11.2020.
3. Your Letter dated 03.12.2020.

Dear Sir,

With reference to above tender notice and LOA issued as referred above, your offer to execute the subject mentioned work has been accepted by the Competent Authority for a total value of **Rs. 17,27,099.58 (Rupees seventeen lakhs twenty seven thousand ninety nine and paisa fifty eight only) which is at 6.53% (six point five three percent) below** the Estimated Cost of work based on terms and conditions contained in the NIT & tender document subject to the following stipulations:-.

The award of work is with the stipulation that all terms and conditions as contained in the NIT &tender documents shall be operative.

1. All the materials required for the work shall be arranged by you at your own cost and shall be of appropriate quality and specification as per the NIT & tender documents.
2. The responsibility for the arrangement of the all equipment, tools and plants etc. required for the work lies on you.
3. Your GST no. no. as per submitted documents is 20ALCPS3651C2ZM.
4. ALR and AHR items will be dealt as per provision of NIT.
5. The work shall be completed within 120 **(one hundred twenty) days** from the date of commencement of the work. The date of commencement of the work shall be reckoned from the 10th day of issue of the "Letter of Acceptance" or the actual date of handing over of the site whichever is later.

1. Security Deposit shall consist of two parts & the same shall bear no interest:-
   A) **Performance Security and Additional Performance Security:-**
   Rs. 87,100.00 (Eighty seven thousand one hundred only) deposited by you vide:
      a) **Earnest Money amounting to Rs. 23100.00 (Rupees twenty three thousand one hundred only)** deposited along with the tender vide PRN No. – 184172546114.

Cont 02

b) **Rs. 64,000.00 (Rupees sixty four thousand only)** towards Balance amount of Performance security vide:- FD A/c No. 16250310033227 (UCO Bank) dated 02.12.2020 of Rs. 64,000/-.

B) Retention Money:-

All running on account bills shall be paid at 95% (ninety five percent) of work value to make total retention money deposit of **₹ 86,354.98 (Rupees eighty six thousand three hundred fifty four and paisa ninety eight only)**. Overall total security deposit (i.e. performance security, additional performance security & retention money) for the work is **Rs. 1,73,455.00 (Rupees one lakh seventy three thousand four hundred fifty five only)** i.e. **10.00 % (Ten Percent) & APS of the work value.**

2. The defect liability period will be applicable as per Clause – 4.3 of NIT.
3. The arrangement of necessary water for construction purpose shall be your responsibility (at your own cost). However, if available and feasible, the Company may arrange water at one point near the site of work for which recovery @ 1% of the contract value of work done will be made from your bills.
4. The arrangements of necessary electricity for the work will be your responsibility (at your own cost). However, if available and feasible, the Company may arrange electricity at one point near the site of work and necessary recovery of cost of energy consumed will be made at rates prescribed by the Company time to time. You shall provide energy meter for this purpose.
5. The license as per Contract Labour (Regulation & Abolition) Act 1970 and subsequent amendments there of shall have to be obtained from your end as elaborated in the tender document. Implementation of contract labour (Regulation & Abolition) Act 1970 including issuance of Form-V to the agency shall be ensured from the Head of the concerned Area/Department.
6. The payment to the workmen engaged on the work shall be made as per Minimum Wages Act in the presence of the authorized representative of the Department and necessary payment certificate shall be obtained as elaborated in the tender document.
7. You have to engage minimum 20% of required unskilled workers from local project affected people of nearby villages. The list of PAPs recommended by the concerned Mukhia is to be made available by the concerned Area GM and displayed in the Notice Board. Any further addition/ deletion is to be duly certified by the Mukhia. Authorized representative of the contractual agency is to certify regarding engagement of 20% unskilled workers from amongst the PAPs, based upon which labour payment certificate will only be issued.

8. Precautions shall be exercised at all times by you for the protection of persons and property. The safety required or recommended by all applicable laws, codes, statutes and regulations shall be observed by you. In case of accident, you will be responsible for compliance with all the requirements imposed by the Workmen's Compensation Act or any other similar laws enforce and indemnify the company against any claim on this account as elaborated in the tender document.

9. That Royalty clearance certificate should be submitted by you from the appropriate State Govt. Authorities prior to payment of final bill/release of Security Deposit as necessary.

10. The contractor will have to make payment to their workers only through bank account.

11. You are requested to contact the **Area Manager (Civil), Bastacolla Area, BCCL** for further instruction towards execution of the work.

12. The Paying Authority for the work will be **The AFM, Bastacolla Area.**

All other terms and conditions as appeared in the NIT & tender documents are applicable in the contract.

Yours faithfully,

02/03/21

Area Manager (Civil), BA

Copy to:-

1) TS to D (T) OP/ CVO/ D(P), BCCL ..... for kind information
2) General Manager Bastacolla Area, BCCL
3) GM (Civil), CED HQ, BCCL
4) AFM, BA. ..... This has reference to:
   i) Ebc No. – BCCL/C&B/Reg. PN/-94/SN-08/e-BC No.06 dated 01.07.2020 for Rs.21,80,378.40.
   ii) eFC no.- 05 dated 27.10.2020 for Rs.21,80,378.40. (Rs. 17,27,099.58 + GST 3,10,877.92).
   iii) Provision of total goods & service tax is Rs. 3,10,877.92, payment of which will be made on the bidder submitting Bill/invoice in accordance with the provision of relevant GST Act and the rules made thereunder and after online filing of valid return on GST portal.
5) APM, Bastacolla Area.
6) Dy. Manager (C), Quality control, CED HQ.
7) Assistant Manager (civil), Bastacolla Area
8) SOE (civil), Bastacolla Area.
9) Overseer, Bastacolla Area.
10) ALC (C) – I, II & III Murli Nagar, Shram Bhawan, J.J. Nagar, Dhanbad.
11) LEO (C) – I, II, III & IV Murli Nagar, Shram Bhawan, J.J. Nagar, Dhanbad.
12) Concerned File.

Annexure-XXIII

Dust Suppression Fog Canon System


12KL


12KL

Annexure-XXIV

Photographs of Construction of Effluent Treatment Plant at HEMM Workshop