BHARAT COKING COAL LIMITED
(A Mini Ratna Company)
(A Subsidiary of Coal India Limited – A Maharatna Company)
Regd.Off: Koyla Bhawan, Koyla Nagar, Dhanbad-826005
CIN: U10101JH1972GOI000918

OFFICE OF THE GENERAL MANAGER
SIJUA AREA

Ref. No.-GM/SA/SPA/F-41/2021/ 57 Date- 29.11.2021

To,
The Director(s)
Ministry of Environment, Forest & Climate Change
Govt. of India
Integrated Regional Office (ECZ)
Bunglaw No. A-2, Shyamali Colony
Ranchi-834002

Subject- Half yearly compliance report of the Environmental Clearance Conditions for the period from 1st April, 2021 to 30th Sept. 2021 in respect of Cluster V group of mines of Bharat Coking Coal Limited, Dhanbad

EC Order No. - J-11015/01/2011-IA.II (M) dated 11.02.2013, amended on 30.05.2018 & 30.09.2020

Dear Sir,

Please find enclosed herewith the half yearly compliance report of the Environmental Clearance conditions for the period from 1st April, 2021 to 30th Sept. 2021 in respect of Cluster V group of mines i.e. Sijua Area of Bharat Coking Coal Limited, Dhanbad in soft copy(pdf format).

Yours Faithfully

29/11/21
General Manager
Sijua Area

Cc:
1. Scientist & In-charge, Zonal Office, Central Pollution Control Board, 5th Floor 502, Hous & Conclave, 1582, Rajdanga Main Road, Kolkata-700107
2. Member Secretary, Jharkhand State Pollution Control Board, TA Division Building, H.E.C.,Dhurwa, Ranchi-834004
3. Regional Officer, Jharkhand State Pollution Control Board, Sardar Patel Nagar, Dhanbad
4. HoD (Env.), BCCL, Level-II,Koyla Bhawan
5. Project Officers- Nichitpur, Tetulmari, Kankanee, Mudidih, Sendra Bansjora, Bansdeopur, Loyabad
6. AM(Env.), Sijua Area
7. File

CLUSTER V

Half Yearly EC Compliance Report

APR.-SEP. 2021

S. N.	Specific Condition	Compliance
1	The maximum production shall not exceed beyond that for which the environmental clearance has been granted for the mine of cluster V.	The production of coal from the mines of Cluster V is within the granted EC limit for the period Apr.-Sept. 2021 and was so in the last FY 2020-21. **Annexure 1- Coal Production details of Cluster V vis-a-vis EC Capacity**
2	The road transportation of coal during phase–I should be by mechanically covered trucks. The road used for coal transportation should be developed with avenue plantation on both sides.	No mechanically covered OEM is available as of now. Presently, road transportation is being done by covering vehicle with tarpaulin. Coal transportation is mostly internal in nature in Cluster V. 1320 nos. of avenue plantation have been done alongside road on both sides from Shakti Chowk to Mohlidih. 560 nos. of bamboo gabion plantations on both sides of the road from Subhash Chowk to Naya More and from Sendra More to Kerkend More has been done in 2021-22.  ➢ **Tarpaulin covered coal transportation in Cluster V of Bharat Coking Coal Limited**

		 ➢ **Plantation on both sides of the road from Subhash Chowk to Naya More and from Sendra More to Kerkend More done in 2021-22**  ➢ **Avenue plantation alongside the road from Shakti Chowk to Mohlidih in Cluster V.**
3	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.	Training in the fields ranging from ecological restoration/plantation/Nursery Development/IMS to health & safety apart from the regular job related training are being imparted to the employees within the company. Capacity building in activities such as Computer operating skills, Stitching skills, Handloom, etc. is being carried out among the local populace. **Annexure 2- Details and pictures of**

		special training programs conducted for employees and capacity building activities being imparted to the local people
4	The 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.	Transportation Details, CSR Details, R&R Details and details of the implementation of the Environmental Action Plan have been maintained and updated in booklet form for Cluster V. **Annexure 3- Transportation Booklet** **Annexure 4- CSR Booklet** **Annexure 5- R&R Booklet** **Annexure 6- Implementation of Environmental Action Plan Booklet**
5	A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.	The study to analyze extent of reduction in pollution load by reducing road transport for cluster V has been conducted by CMPDIL. **Annexure 7- Report of study on reduction in pollution load by reducing road transport for cluster V**
6	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.	A Global EOI was floated for the award of work to international experts for control of fire. However, no eligible bidders qualified. As of now, no such advanced technology has emerged to be effective in fire dealing in Jharia Coalfields. Presently, fire dealing of fiery coal is being done by excavating fiery coal through Open cast mining. To speed up the process of fire dealing so that the spread of fire can be minimized/eliminated, amendment in EC of Cluster V has been secured vide J-11015/01/2011-IA.II (M) dated 30.05.2018 to increase the EC capacity of Sendra Bansjora Colliery from 0.975 MTPA to 2.340 MTPA and that of Kankanee Colliery from 0.624 MTPA to 1.190 MTPA.
7	The abandoned pits and voids should be backfilled with OB and reclaimed with plantation and or may be used for pisciculture.	The abandoned pits and voids are being backfilled with OB. Some of the abandoned pits are used by the surrounding community as

		water reservoir and for aquaculture.  ➢ **Abandoned void being utilized for aquaculture by the local community**
8	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.	A full-fledged Environment Department, headed by HoD (Environment) along with a suitable qualified multidisciplinary team of executives has been established at the Headquarters. At the area level, one Executive in each area has been nominated as Nodal Officer (Environment). Management Trainees / Asst. Managers (Environment)/Dy. Managers (Environment) have also been deputed at the area level. An executive of Community Development cadre is also deputed at the area level. Inter-area inspection mechanism for monitoring of EC/FC Compliances has been introduced and an Environmental committee has been formed at the area level. At the Headquarters level, an Environmental Advisory Committee has been formed. Capacity building at both corporate and operating level is being done through regular training programmes conducted within the company and at the leading centers and institutes of the country. **Annexure 8- Environmental Management Structure at BCCL & the list of the personnel involved in**

		environmental management and the composition of Area Level Environmental Committee along with their qualifications in cluster V
9	The locations of monitoring stations in the Jharia Coalfields should be finalized in consultation with the Jharkhand State Pollution Control Board.	The locations of the monitoring stations in cluster V have been finalized and approved by the Jharkhand State Pollution Control Board. **Annexure 9- Plan and Letter ratified by the Regional Officer, Jharkhand State Pollution Control Board**
10	The smoke/dust emissions vary from source to source (fuel wood, coal, fly ash from TPPs, silica from natural dust, etc) and a Source Apportionment Study should be carried out for the entire Jharia Coalfield.	The work for “Source Apportionment Study” has been conducted by NEERI, Nagpur. Draft final report has been submitted and is under examination. **Annexure 10- Draft Final Report of NEERI, Nagpur for source apportionment Study**
11	Mineralogical composition study should be undertaken on the composition of the suspended particulate matter (PM10 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.	Mineralogical Composition Study has been carried out as a part of the Source Apportionment Study.
12	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.	Time series mapping of Jharia Coal Fields to monitor fire is being conducted by NRSA. Two time–series maps have been prepared in 2014 & 2018. Work has been awarded to NRSA for preparation of the third time series map. **Annexure 11– Last Time-series map (2018) of Jharia Coal-Fields to monitor fire**
13	Measures to prevent ingress of air (Ventilation) in such areas, to prevent restart fresh/spread fires in other areas including in mines of cluster V shall be undertaken.	Presently fire dealing of fiery coal in cluster V is being done by excavating fiery coal through Open cast mining. To speed up the process of fire dealing so that the spread of fire can be minimized/eliminated, amendment in EC of Cluster V has been secured vide J-11015/01/2011-IA.II (M) dated

		30.05.2018 to increase the EC capacity of Sendra Bansjora Colliery from 0.975 MTPA to 2.34 MTPA and that of Kankanee colliery from 0.624 MTPA to 1.19 MTPA. Additionally, techniques such as sealing with soil, trench cutting, water pool construction over fiery areas, nitrogen flushing, etc. are used for immediate control of fire.
14	Permanent /regular ambient air monitoring is required for CO, CO2, Methane and its homologues. Monitoring station, mobile monitoring, should be established at suitable location as the temp in the mine is high, in the presence of CH4, the coal may catch fire. Presence of Aromatic compounds should be investigated as most of the aromatic compounds are carcinogenic.	Regular monitoring for CO, CO_2, Methane and its homologues is done in the UG mines of Cluster V. Further, IIT (ISM), Dhanbad has been approached for the analysis of the same in all the mines of Cluster V which will be conducted in this FY 2021-22 itself. The report will be submitted to MoEF&CC.
15	Local institution/university should be contacted for such type of study. Exact measurement for the presence of above gases and their potential danger/harmful effect on human should be assessed. ISM Dhanbad and any local university could be contacted for monitoring.	IIT(ISM), Dhanbad has been engaged at times in Cluster V for monitoring of CO, CO_2, Methane and its homologues in the UG mines of Cluster V. Further, IIT (ISM), Dhanbad has been approached for the exact measurement for the presence of above gases and their potential danger/harmful effect on human in all the mines of Cluster V which will be conducted in this FY 2021-22 itself. The report will be submitted to MoEF&CC. **Annexure 12- Report of IIT (ISM), Dhanbad for Tetulmari & Mudidih UG mines of cluster V**
16	The road transportation should be of bigger/high capacity trucks. The road should be strengthened to carry the load of high capacity trucks. Railway siding with silo loading will be completed by December, 2015 as informed by the proponents.	Transportation of coal in Cluster V is mostly internal. Coal from OCPs is transported to Bansjora railway siding which is located within the leasehold of Sendra Bansjora Colliery in Cluster V itself. Some amount of coal transportation to local and other consumers is done through road. The road transportation is being done by high capacity trucks. The road is

		strengthened to carry the load of high capacity trucks. The work order for installation of silo loading system in Cluster V had been issued however the work couldn't be done due to problems of land acquisition and the work order has been cancelled. **Annexure 13- Copy of the work Order cancellation of the installation of Silo Loading System**
17	Master Plan for dealing with fire for next 12 year which is under implementation, Details of same from August 2011 till date year-wise should be provided. An Action Plan which is in progress should be submitted to the Ministry.	Fire in Jharia Coalfields is dynamic in nature and the rehabilitation of the affected families from the State Govt. is delayed. Keeping in view the fire dynamics, liquidation of fire is being done through excavation of fiery coal through Open cast mining. To speed up the process of fire dealing so that the spread of fire can be minimized/eliminated, amendment in EC of Cluster V has been secured vide J-11015/01/2011-IA.II (M) dated 30.05.2018 to increase the peak EC capacity of Sendra Bansjora from 0.975 MTPA to 2.34 MTPA and that of Kankanee from 0.624 MTPA to 1.19 MTPA. Govt. of India approved Master Plan for fire dealing in Jharia Coalfields is under implementation. The status of action taken is uploaded on the official website of BCCL - http://www.bcclweb.in/?page_id=25902
18	Underground mining should be taken up after completion of reclamation of Opencast mine area after 15 years.	As of now, no such UG mining is in operation which covers the area where Opencast mining is operational or was operational in past 15 years. In future, if any proposal comes, the condition will be complied and it will be ensured that the underground mining is taken up only after completion of 15 years from reclamation of Opencast mine.

<table>
<tr><td>19</td><td>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.</td><td>No Underground mine is in operation in underground fire condition. Open-cast mining is in operation to deal with fire by excavating out fiery coal.
Water quenching, grassing and biological reclamation is done to control fires in old OB dump areas.</td></tr>
<tr><td>20</td><td>The rejects of washeries in Cluster –V should be sent to FBC based plant.</td><td>There is no coal washery in cluster V.</td></tr>
<tr><td>21</td><td>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.</td><td>There shall be no external OB dump at the end of the final mine closure. End stage of the mine is yet to be reached. Mining is being done in Cluster V as per the approved Mining Plan & Mine Closure Plan. Progressive mine closure plan is being implemented.

Life of the mines of Cluster V as per EC amendment granted on 30.09.2020 is as below:
<table>
<tr><th>S.No.</th><th>Name of the mine</th><th>Balance Life of Mine as per EC (in yrs.)</th></tr>
<tr><td>1</td><td>Nichitpur</td><td>5</td></tr>
<tr><td>2</td><td>Teulmari</td><td>>30</td></tr>
<tr><td>3</td><td>Mudididh</td><td>>30</td></tr>
<tr><td>4</td><td>Sendra Bansjora</td><td>14</td></tr>
<tr><td>5</td><td>Kankanee</td><td>6</td></tr>
<tr><td>6</td><td>Bnasdeopur</td><td>>30</td></tr>
<tr><td>7</td><td>Loyabad</td><td>-</td></tr>
</table>
Progressive backfilling and reclamation is being done in the mined out areas.
Annexure 14- Mine-wise data regarding progressive backfilling and reclamation for Cluster V for 2020-21 as submitted to the Coal Controller Office</td></tr>
<tr><td>22</td><td>There shall be no water body left at the end of mining.</td><td>It is a post-closure requirement. End stage of the mines is yet to be reached.</td></tr>
<tr><td>23</td><td>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-V shall be drawn up and implemented.</td><td>Mining plans consisting of detailed calendar plan of production with plan for OB dumping and backfilling (for OC mines) and reclamation for four collieries, Sendra Bansjora,</td></tr>
</table>

		Bansdeopur, Nichitpur and Kankanee, have been prepared and approved by the BCCL Board. For the rest of the mines Tetulmari & Mudidih, Mining Plans are under preparation by CMPDIL. However, Feasibility reports of all the mines have been prepared and approved. Progressive Mine closure plans as per the guidelines of the Ministry of Coal have been prepared by Central Mine Planning and Design Institute (CMPDI) for all the mines of cluster V and are being implemented.
24	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 will be done at the time of the final closure of the mines. Mines in the cluster V are at present active and concurrent backfilling and reclamation is being done. The abandoned pits and voids are being backfilled with OB. Some of the abandoned pits are used as water reservoir and for aquaculture by the surrounding community.
25	Mining shall be carried out as per statuette 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 along water body shall be strengthened with stone pitching.	Streams/Nalas, which are seasonal, flowing within the lease, are being protected to the extent feasible through check dams, stone-pitching, embankments, regular cleaning/de-siltation and proper gradient maintenance to keep the natural flow in the monsoon. OB dumps are being stabilized biologically so that the erosion of the loose materials can be minimized and the transportation of eroded material in the streams/naalas can be avoided. Three OB dumps in Cluster V covering total area of 13.1 Ha have been biologically stabilized. Three other OB dumps of total 32.0 Ha have been taken up for biological reclamation in 2018-19 where the plantation work is being done.

		
26	Active OB dumps near water bodies and rivers should be re-handled for backfilling abandoned mine voids. However, those which have been biologically reclaimed need not be disturbed.	Active OB dumps near water bodies shall be re-handled for backfilling in the mine voids. Two OB dumps of 8.0 Ha and 2.3 Ha areas at Tetulmari and one OB dump of 2.8 Ha area at Nichitpur have been biologically reclaimed through the technique of three-tier ecological restoration and shall not be disturbed. 
27	Thick green belt shall be developed along undisturbed areas, mine boundary and in mine reclamation. During post mining stage, a total of 1957.08 ha area would be reclaimed. The total additional area under plantation would be 939.17 ha (green belt of 76 ha, Ext. OB dump 73.07 ha, backfilled area 300.35 ha, other undisturbed area 489.77 ha) by planting 1878380 plants in 939.19 ha at a total cost Rs. 7202.46 lakhs.	Three OB dumps covering total area of 13.1 Ha have been ecologically restored to create thick green belts in Tetulmari & Nichitpur collieries. In 2018-19. Three OB dumps covering total area of 32.0 Ha in Loyabad & Bansdeopur Collieries have been taken up for biological reclamation. 1320 nos. of avenue plantation have been done alongside road on both sides from Shakti Chowk to Mohlidih. 560 nos. of bamboo gabion plantations on both sides of the road

		from Subhash Chowk to Naya More and from Sendra More to Kerkend More has been done in 2021-22. Plantation has also been carried out along the quarry edges and at the mine view-points. Dormant OB dumps covering total area of 75.61 Ha in Sendra Bansjora, Nichitpur, Bansdeopur, Mudidih & Loyabad Collieries have been taken up for greening through grasses and native shrubs. 18,000 plants have been planted along the banks of Ekra Jore in Cluster V. A park-cum-nursery is being developed at Kankanee Colliery. An area of total 13.1 Ha has been taken up for biological reclamation in 2021-22 at Nichitpur Colliery where the preparatory works are being done. Plantation drives have also been conducted in colonies and in schools within and peripheral to the leasehold of Cluster V to increase tree cover.  

		
28	The road should be provided with avenue plantation on both sides as trees act as sink of carbon and other pollutant.	1320 nos. of avenue plantation have been done alongside road on both sides from Shakti Chowk to Mohlidih. 560 nos. of bamboo gabion plantations on both sides of the road from Subhash Chowk to Naya More and from Sendra More to Kerkend More has been done in 2021-22.  
29	Specific mitigative measures identified for the Jharia Coalfields in the Environmental Action Plan prepared for Dhanbad as a critically polluted area and relevant for Cluster V shall be implemented.	An action plan has been prepared for implementing measures to bring down the pollution level in response to Dhanbad being listed as a critically polluted area. The action plan and its current implementation status in Cluster V are annexed as **Annexure 6**.
30	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	The locations of monitoring stations in cluster V have been approved by Jharkhand State Pollution Control Board.

	from source to source (fuel wood, coal, fly ash from TPPs, silica from natural dust, etc) and a Source Apportionment Study should be got carried out for the entire Jharia Coalfields. Mineralogical composition study should be undertaken on the composition of the suspended particulate matter (PM10 and PM2.5) in Jharia Coalfields and also quantified. These studies would help ascertain source and extent of the air pollution, based on which appropriate mitigative measures could be taken.	The work for the "Source Apportionment Study" has been conducted by NEERI, Nagpur. Draft final report has been submitted and is under examination. Mineralogical Composition Study has been carried out as a part of Source Apportionment Study.
31	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 due to dewatering of mine.	Groundwater is not being used for mining activities. Mine water is being used for industrial purposes (water sprinkling for dust suppression, wet drilling, fire dealing, washing of vehicles, plantation, etc.) Water is also being supplied to nearby villages for domestic uses.
32	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.	Regular monitoring of ground water is being done in Cluster V through existing wells. To collect the representative groundwater level in the JCF area and its buffer zone, CMPDI has established a monitoring network of 210 hydrograph stations (Dug wells). 4 dug wells (Well Nos. A-3, A-16, A-27 & D-23) are located in and around Cluster V area. The study of CMPDIL revealed that water table is in shallow depth and there is no significant stress in the water table due to coal mining activity. Further, constant action was taken for installation of Piezometer and tenders were floated three times. However, the tenders were not successful in the award of work as bidders could not qualify the criteria. Accordingly, the proposal cost estimate was completely revised and tender was floated on 05.07.2021. The tender has opened on 28.07.2021 and four bidders have participated. Tender committee has concluded the technical scrutiny, opened the price

		bid and recommended L1 bidder for the award of the work. The proposal is under competent approval and the work will be awarded tentatively by Jan 2022 with 6 months' timeline for completion of the work. **(Annexure-15)** **Annexure 16– Latest Ground Water Monitoring Report**
33	Mine discharge water shall be treated to meet 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.	Mine water discharge parameters in Cluster V are mostly in compliance with the prescribed standards. The mine discharge water quality is monitored regularly at the stations approved by Jharkhand State Pollution Control Board and records are maintained thereof. It is also uploaded on the company website. Additionally, mine discharge water quality is being periodically monitored and analyzed at all the mines in Cluster V. **Annexure 17- Analysis report of the Mine discharge water**
34	ETP shall also be provided for workshop and CHP, if any. Effluents shall be treated to confirm to prescribed standards in case discharge into the natural water course.	Oil & Grease Trap-cum-settling tanks have been Constructed at Nichitpur & Tetulmari workshops to treat workshop effluents.
35	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.	At present only development districts are operational at UG mines in Cluster V and no depillaring is taken up. Regular monitoring of subsidence will be undertaken on the commencement of depillaring. Cracks developed due to the fire under earth's surface are filled with soil/suitable material.
36	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.	Sufficient coal pillars have been left around air shafts as per the statuettes and DGMS guidelines.
37	High root density tree species shall be selected and	Plantation of high root density tree

	planted over areas likely to be affected by subsidence.	species has been taken up in Cluster V. **Annexure 18- High root density tree plantation certification by FRI, Dehradun**
38	Depression due to subsidence resulting in water accumulating within the low lying areas shall be filled up or drained out by cutting drains.	It will be compiled in case of water accumulation due to subsidence in Cluster V**.**
39	Solid barriers shall be left below the roads falling within the blocks to avoid any damage to the roads.	Sufficient barriers are left below the roads to avoid any damage to the surface installations and infrastructures as per the statuette and DGMS guidelines.
40	No depillaring operation shall be carried out below the township/colony.	At present only development districts are operational at UG mines in Cluster V and no depillaring has been taken up. The condition will be complied at the time of de-pillaring.
41	The Transportation Plan for conveyor cum–rail for Cluster-V 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 V should be dovetailed with Jharia Action Plan. The road transportation of coal during phase–I should be by mechanically covered trucks.	No mechanically covered OEM is available as of now. Presently, road transportation is being done by covering vehicle with tarpaulin.
42	A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.	The study to analyze extent of reduction in pollution load by reducing road transport in Cluster V has been conducted by CMPDIL.
43	R&R of 5835 nos. of PAFs involved. They should be rehabilitated at cost of shifting to safe areas at the cost of Rs 104024.9 Lakhs as per the approved Jharia Action Plan.	Rehabilitation of affected families is being done as per Jharia Master plan for fire & subsidence affected sites and BCCL R&R Policy. BCCL employees' families from fire affected areas in cluster V are being shifted to Karmik Nagar, Kusum Vihar and East Bassuriya colonies which have been provided with the basic amenities. For, non-BCCL families, a fresh survey of houses situated in fire and subsidence affected areas has been carried out by Jharia Rehabilitation and Development Authority (JRDA) for allotment of houses for shifting. Total

		78 such sites are located in Cluster V. All 78 sites have been surveyed. The process of the verification and the allotment of houses is being done by JRDA. The details are annexed in R&R Booklet as **Annexure 5.**
44	A detailed CSR Action Plan shall be prepared for Cluster V group of mines. Specific activities shall be identified for CSR the budget of Rs. 242.7 Lakhs per year@ Rs 5/T of coal as recurring expenditure. The 265.25 ha of area within Cluster V 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 V 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. Issues 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. Social audit should be carried out for CSR for its actual implementation.	CSR Action Plan of BCCL as a whole has been prepared. An impact assessment study of CSR works and evaluation of Project "Swablamban"-Reeling & spinning training project under CSR have been done by National CSR Hub, Tata Institute of Social Sciences, Mumbai. CSR activities are also being undertaken at area level in cluster V. The status of implementation of the issues raised in the public hearing of cluster V is attached as **Annexure 19.**
45	Mine Closure Plan of Cluster –V is in draft stage, the same should be submitted to ministry.	Progressive Mine closure plans prepared as per the guidelines of the Ministry of Coal and approved by the company Board have been submitted to MoEF&CC for all the collieries of Cluster V.
46	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: 50000) 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.	Land use pattern monitoring based on satellite data is being done by CMPDIL every three years. The last monitoring was done in 2020-21 for cluster V. **Annexure 21- Land Use pattern map of cluster V**

47	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 re-introduction in the mine during mine reclamation and at the post mining stage for habitat restoration.	Final Mine Closure Plan will be prepared 5 years before the final closure of the mines. Presently, approved progressive mine closure plan is under implementation. A roadmap for ecological restoration of the degraded area for BCCL has been prepared by Forest Research Institute, Dehradun which is being implemented in cluster V. **Annexure 22- Ecological Restoration Roadmap**
48	A separate environmental management cell with suitable qualified personnel shall be setup 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.	A full-fledged Environment Department, headed by HoD (Environment) along with a suitable qualified multidisciplinary team of executives has been established at the Headquarters. At the area level, one Executive in each area has been nominated as Nodal Officer (Environment). Management Trainees / Asst. Managers (Environment)/Dy. Managers (Environment) have also been deputed at the area level. An executive of Community Development cadre is also deputed at the area level. Inter-area inspection mechanism for monitoring of EC/FC Compliances has been introduced and an Environmental committee has been formed at the area level. At the Headquarters level, an Environmental Advisory Committee has been formed. Capacity building at both corporate and operating level is being done through regular training programmes conducted within the company and at the leading centers and institutes of the country. **Annexure 8- Environmental Management Structure at BCCL & the**

		list of the personnel involved in environmental management and the composition of Area Level Environmental Committee along with their qualifications in cluster V
49	Implementation of final mine closure plan for Cluster V, subject to obtaining prior approval of the DGMS in regard to mine safety issues	Final Mine Closure Plan will be prepared 5 years before final closure of the mines.
50	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 Corporate Environment Policy has been formulated and approved and has also been uploaded on the website. **Annexure 23- Updated Corporate Environment Policy**
B	**General Conditions by MOEF:**	
1	No change in mining technology and scope of working shall be made without prior approval of the Ministry of Environment and Forests	Mining technology and scope of working have not been changed in Cluster V.
2	No change in the calendar plan of production for quantum of mineral coal shall be made.	Mining plans consisting of detailed calendar plan of production with plan for OB dumping and backfilling (for OC mines) and reclamation for four collieries, Sendra Bansjora, Bansdeopur, Nichitpur and Kankanee, have been prepared and approved by BCCL Board. For the rest of the mines Tetulmari and Mudidih, mining plans are under preparation by CMPDIL. However, Feasibility reports of all the mines have been prepared and approved.

3	Four ambient air quality monitoring stations shall be established in the core zone as well as in the buffer zone for PM10, PM2.5, SO2 and NOx monitoring. Location of the stations shall be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr, etc. carried out at least once in six months.	The locations of monitoring stations for ambient air quality (PM10, PM2.5, SO2 and NOx) in cluster V have been approved by Jharkhand State Pollution Control Board. One location is in core zone whereas three are in buffer zone. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr, etc. is also conducted.
4	Data on ambient air quality (PM10, PM 2.5, SO2 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.	Monitoring and analysis Data on ambient air quality (PM10, PM 2.5, SO2 and NOx) and heavy metals such as Hg, As, Ni, Cd, Cr and other monitoring data are submitted to the Regional Office of MoEF&CC at Ranchi (Earlier at Bhubaneswar) and to the State Pollution Control Board and the Central Pollution Control Board in six months along with the half yearly compliance report of the EC conditions. Independent random verification of air samples from all the four stations in core and buffer zones of Cluster V have been carried out by IIT(ISM), Dhanbad in 2019-20. Another random verification is being conducted in this FY 2021-22. The report will be submitted once the study is completed. **Annexure 24- Latest Ambient Air quality Monitoring Report of Cluster V and heavy metal analysis for ambient air** **Annexure 25:- Report of the random analysis of air samples by IIT(ISM), Dhanbad**
5	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.	Proper blasting techniques by designing a suitable blasting pattern after actual field observation is followed to minimize adverse effects of noise. Development of green belt around

		infrastructure, colonies and in vacant spaces have also been undertaken for arresting noise propagation. Ear plugs are provided to the workers engaged in high noise prone activities.
6	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.	Oil & Grease Trap-cum-settling tanks have been Constructed at Nichitpur & Tetulmari workshops to treat workshop effluents.
7	Vehicular emissions shall be kept under control and regularly monitored. Vehicles used for transporting the mineral shall be covered with tarpaulins and optimally loaded.	PUC (Pollution Under Control) certificates of vehicles engaged in transportation are checked and monitored. Road transportation is being done by covering vehicle with tarpaulin with no overloading being allowed. ***Sample PUC Copy***: 
8	Monitoring of environmental quality parameters shall be carried out through establishment of adequate number and type of pollution monitoring and analysis equipment in consultation with the State Pollution Control Board and data got analyzed through a laboratory recognized under EPA Rules, 1986.	Monitoring of environmental quality parameters at the stations approved by Jharkhand State Pollution Control Board is being done by CMPDIL which is having a NABET accredited laboratory.
9	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.	Dust masks have been provided to the personnel working in dusty areas. Regular training is provided to the workers on health & safety aspects at

		Group Vocational Training Centre, Sendra in Cluster V. **Annexure 26- Details of PPEs in FY 20-21**
10	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.	IME and PME is done for the workers to observe any contractions due to exposure to dust and to take corrective measures and records are maintained thereof. **Annexure 27- Details of IME/PME done in 2020-21**
11	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.	A full-fledged Environment Department, headed by HoD (Environment) along with a suitable qualified multidisciplinary team of executives has been established at the Headquarters. At the area level, one Executive in each area has been nominated as Nodal Officer (Environment). Management Trainees / Asst. Managers (Environment)/Dy. Managers (Environment) have also been deputed at the area level. An executive of Community Development cadre is also deputed at the area level. Inter-area inspection mechanism for monitoring of EC/FC Compliances has been introduced and an Environmental committee has been formed at the area level. At the Headquarters level, an Environmental Advisory Committee has been formed. Capacity building at both corporate and operating level is being done through regular training programmes conducted within the company and at the leading centers and institutes of the country. **Annexure 8- Environmental Management Structure at BCCL & the list of the personnel involved in environmental management and the composition of Area Level**

		Environmental Committee along with their qualifications in cluster V
12	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.	The funds earmarked for environmental protection measures for cluster V are allocated at area level and are kept in a separate head. Year wise expenditure details are reported. **Annexure 28- Environmental Expenditure Details**
13	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.	Complied. **Annexure 33- Copies of Newspaper Advertisements** 
14	A copy of the environmental clearance letter shall be marked to concern Panchayat/ZilaParishad, Municipal corporation or Urban local body and local NGO, if any, from whom any suggestion /representation has been received while processing the proposal. A copy of the clearance letter shall also be displayed on company's website.	Complied Copy of the Environmental Clearance letter is also displayed at Company's website ***(www.bcclweb.in)***

		
15	A copy of the environmental clearance letter shall be shall also be displayed on the website of the concerned State Pollution Control Board. The EC letter shall also be displayed at the Regional Office, District Industry Sector and Collector's Office/Tehsildar's Office for 30 days.	Complied.
16	The clearance letter shall be uploaded on the company's website. The compliance status of the stipulated environmental clearance conditions shall also be uploaded by the project authorities on their website and updated at least once every six months so as to bring the same in public domain. The monitoring data of environmental quality parameter (air, water, noise and soil) and critical pollutant such as PM10, PM2.5, SO2 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.	Copy of the Environmental Clearance letter & six monthly compliance reports of Cluster V are uploaded and updated at every 6 months on Company's website. http://www.bcclweb.in/?page_id=25895. The monitoring data of environmental quality parameters is displayed at the entrance of the mine office and in corporate office and on company's website.

		 
17	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.	Six monthly compliance reports on status of compliance of the stipulated environmental clearance conditions of cluster V is being submitted regularly on time to the Integrated Regional Office, East-Central Zone of the MoEF&CC, respective Zonal Office of the CPCB and the SPCB.
18	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.	Full co-operation is extended to the integrated regional office of the MoEF&CC in monitoring of the compliance of the stipulated conditions.
19	The Environmental statement for each financial year ending 31 March in For –V is mandated to be submitted by the project proponent for the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be uploaded on the company's website along with the status of compliance of EC conditions and shall be sent to the respective Regional Offices of the MoEF by E-mail.	The Environmental statement for each financial year ending 31st March in Form V is submitted to the Jharkhand State Pollution Control Board regularly on time. The environmental statements along with the half yearly compliance report are uploaded on company's website and are submitted to the Integrated Regional Office, ECZ of the MoEF&CC.

		Annexure 29- Copies of the last Environmental Statement submitted
C	**Other Conditions by MOEF:**	
1	The above conditions will be enforced inter-alia, under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and Rules. The proponent shall ensure to undertake and provide for the costs incurred for taking up remedial measures in case of soil contamination, contamination of groundwater and surface water, and occupational and other diseases due to the mining operations.	Agreed. However, the storage of material is below the threshold limit attracting the Public Liability Insurance Act, 1991.
D	**Conditions of the amended EC vide J-11015/01/2011-IA.II(M) dated 30.09.2020**	
1	Mitigating measures shall be undertaken to control dust and other fugitive emissions all along the roads by providing sufficient water sprinklers. Adequate corrective measures shall be undertaken to control dust emissions which would include mechanized sweeping, water sprinkling/mist spraying on haul roads and loading sites, long range misting/fogging arrangement, wind barrier wall and vertical greenery system, green belt, dust suppression arrangement at loading and unloading points, etc.	The measures taken for control of dust and other fugitive emissions in Cluster V are- (i) Rotating fixed water sprinklers along railway siding (ii) Water spraying on haul roads and other dusty area by mobile water sprinklers (iii) Water spraying on haul roads and other dusty area by mobile mist water sprinklers (iv) Manual sprinkling at coal dumps (v) Green Belt **Annexure 30- Details of water and mist type sprinklers in Cluster V**
2	Continuous monitoring of occupational safety and other health hazards and the corrective actions needed to be ensured.	Occupational safety and other health hazards are monitored and corrective actions taken. IME and PME is done for the workers to observe any contractions due to exposure to dust and to take corrective measures and records are maintained thereof.
3	Persons of nearby villages shall be given training on livelihood and skill development to make them employable.	Capacity building in activities such as Computer Skills, Stitching Skills, Handloom, etc. is being carried out

		among the local populace.
4	Thick green belt of adequate width at the final boundary in the downwind direction of the project site shall be developed to mitigate/check the dust pollution.	Three OB dumps covering total area of 13.1 Ha have been ecologically restored to create thick green belts in Tetulmari & Nichitpur collieries. In 2018-19. Three OB dumps covering total area of 32.0 Ha in Loyabad & Bansdeopur Collieries have been taken up for biological reclamation. 1320 nos. of avenue plantation have been done alongside road on both sides from Shakti Chowk to Mohlidih. 560 nos. of bamboo gabion plantations on both sides of the road from Subhash Chowk to Naya More and from Sendra More to Kerkend More has been done in 2021-22. Plantation has also been carried out along the quarry edges and at the mine view-points. Dormant OB dumps covering total area of 75.61 Ha in Sendra Bansjora, Nichitpur, Bansdeopur, Mudidih & Loyabad Collieries have been taken up for greening through grasses and native shrubs. 18,000 plants have been planted along the banks of Ekra Jore in Cluster V. A park-cum-nursery is being developed at Kankanee Colliery. An area of total 13.1 Ha has been taken up for biological reclamation in 2021-22 at Nichitpur Colliery where the preparatory works are being done. Plantation drives have also been conducted in colonies and in schools within and peripheral to the leasehold of Cluster V to increase tree cover.
5	Efforts shall be made for utilizing alternate sources of surface water, abandoned mines or else whatsoever and thus minimizing the dependability on a single source.	Mine water is being used for industrial purposes (water sprinkling for dust suppression, wet drilling, fire dealing, washing of vehicles, plantation, etc.) Water is also being supplied to nearby

		villages for domestic uses. **Annexure 31- Mine water utilization report for Cluster V**
6	Continuous monitoring of occupational safety and other health hazards, and the corrective actions need to be ensured.	Occupational safety and other health hazards are monitored and corrective actions taken. IME and PME is done for the workers to observe any contractions due to exposure to dust and to take corrective measures and records are maintained thereof.
7	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.	Will be complied. Earlier, third party assessment of EC compliance was conducted in Tetulmari Colliery of Cluster V by ICFRE, Dehradun in 2016-17.
8	Active OB Dump should not be kept barren/open and should be covered by temporary grass to avoid air born of particles.	Grassing work on 43.61 Ha OB dump has been taken up in 2021-22. Grass seed-ball broadcasting has been done in the concluded monsoon season.
9	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	Dormant OB dumps covering total area of 32 Ha in Mudidih & Loyabad Collieries have been taken up for greening through grasses and native shrubs in 2019-20. Further, an OB dump area of total 13.1 Ha has been taken up for biological reclamation in 2021-22 at Nichitpur Colliery where the preparatory works are being done.
10	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 very near to villages. There shall be no damages caused to habitation/structures due to blasting activity.	Vibration study is conducted for blasting activities to evaluate the impact of blasting on habitations. The adoption of ripper is being considered in Cluster V. Controlled blasting is being practiced and monitored to avoid impact of blasting on nearby habitation.
11	The Project Proponent shall comply with all the statutory requirements and judgment 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	Agreed

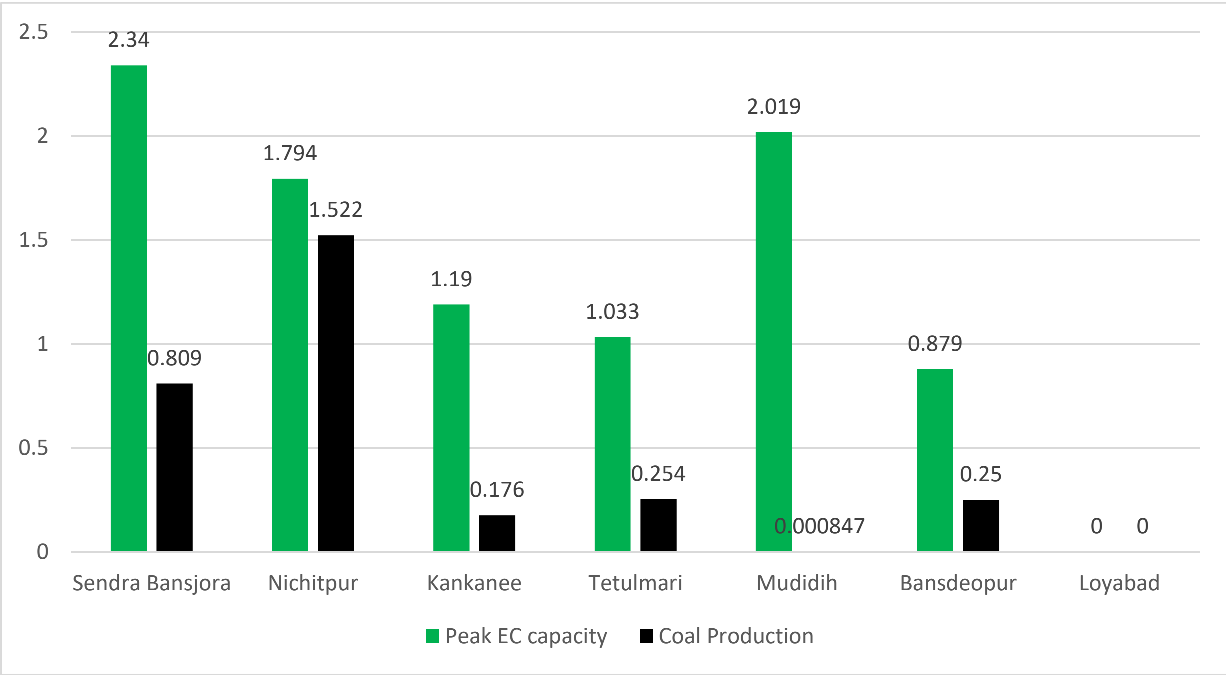
	the Project Proponent through their respective Department in strict compliance of judgment of Hon'ble Supreme Court dated the 2nd August 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of Common Cause versus Union of India and Ors.	
12	Proponent shall appoint an Occupational Health Specialist 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 months and necessary remedial preventive measures taken accordingly. The Recommendations of National Institute 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 safeguards may be ensured before initiating the mining activities.	IME and PME is done for the workers to observe any contractions due to exposure to dust and to take corrective measures and records are maintained thereof. There is a 10-bedded regional hospital at Loyabad in Cluster V having 4 doctors and paramedic staffs. There is also a central hospital in Dhanbad at the company level.
13	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".	The status of implementation of 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" is attached as **Annexure 32**
14	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 levels 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.	The floodlights/ masks in the mines are oriented away from the villages. Noise level is monitored in Cluster V on fortnightly basis.
15	The project proponent shall take all precautionary measures during mining operation for conservation and protection of endangered fauna, if any, spotted in the study area. Action plan for conservation of flora and fauna shall be prepared and implemented in	Measures are being taken for conservation and protection of endangered fauna if spotted in Cluster V. A roadmap for ecological restoration of the degraded area for BCCL has

	consultation with the State Forest and Wildlife Department. A copy of action plan shall be submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office.	been prepared by Forest Research Institute, Dehradun which is being implemented in cluster V. **Annexure 22: Roadmap for ecological restoration of the degraded area**
16	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 operations, undertake re-grassing of 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". The implementation report of the above said condition shall be sent to the Regional Office of the MoEFCC.	The condition will be complied at the end of the mining operations in Cluster V. Mines in the cluster V are at present active. However, concurrent grassing and ecological restoration is being carried out in Cluster V. Three OB dumps covering total area of 13.1 Ha have been ecologically restored to create thick green belts in Tetulmari & Nichitpur collieries. In 2018-19, three OB dumps covering total area of 32.0 Ha in Loyabad & Bansdeopur Collieries have been taken up for biological reclamation. Dormant OB dumps covering total area of 32 Ha in Mudidih & Loyabad Collieries have been taken up for greening through grasses and native shrubs in 2019-20. Further, an OB dump area of total 13.1 Ha has been taken up for biological reclamation in 2021-22 at Nichitpur Colliery where the preparatory works are being done. Grassing work on 43.61 Ha OB dump has been taken up in 2021-22. Grass seed-ball broadcasting has been done in the concluded monsoon season.

ANNEXURE 1: COAL PRODUCTION OF CLUSTER V VIS-A-VIS EC CAPACITY

Mine-wise Coal Production in 2020-21:

Name of the Mine	Peak EC capacity (In MTPA)	Coal Production (In MT)
Sendra Bansjora	2.34	0.809
Nichitpur	1.794	1.522
Kankanee	1.19	0.176
Tetulmari	1.033	0.254
Mudidih	2.019	0.000847
Bansdeopur	0.879	0.250
Loyabad	0.00	0.000
Cluster V	**6.311**	**3.014**



Mine-wise Coal Production in the period Apr.-Sept. 2021:

Name of the Mine	Peak EC capacity (In MTPA)	Coal Production (In MT)
Sendra Bansjora	2.340	0.316
Nichitpur	1.794	0.779
Kankanee	1.190	0.034
Tetulmari	1.033	0.110

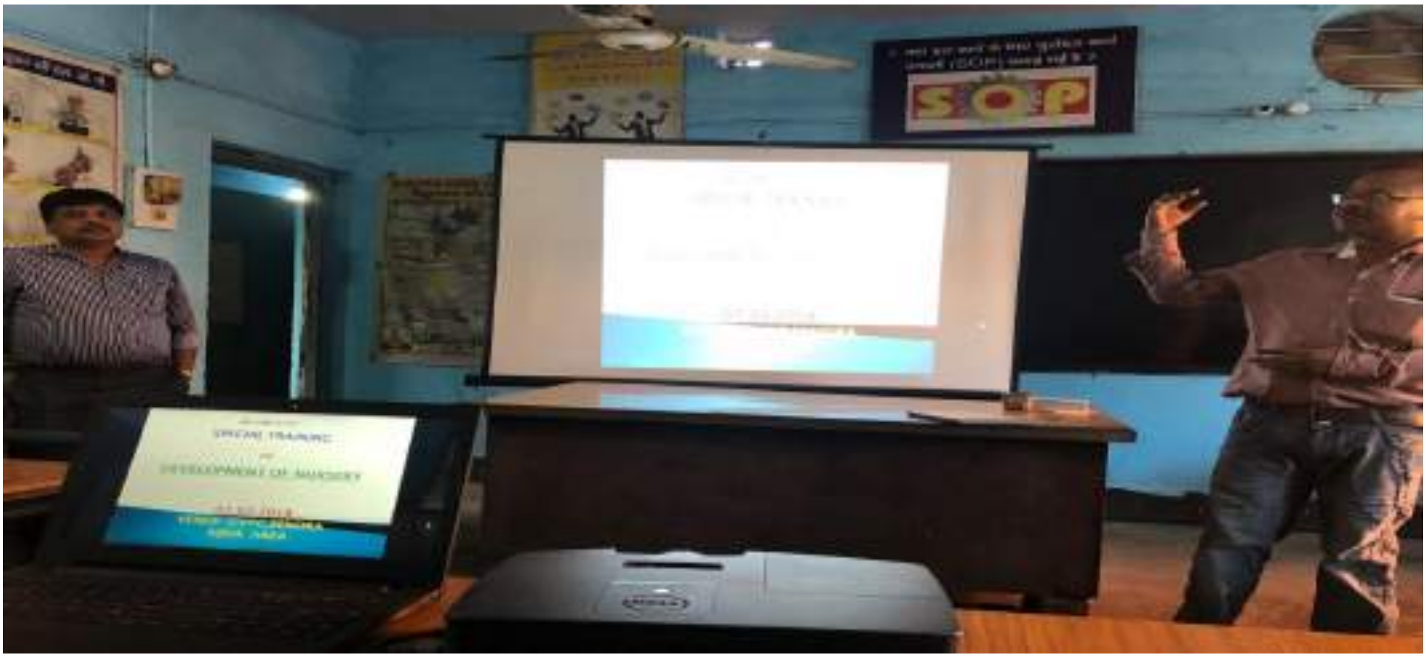
Mudidih	2.019	0.000
Bansdeopur	0.879	0.069
Loyabad	0.000	0.000
Cluster V	**6.311**	**1.308**

ANNEXURE 2: DETAILS OF SPECIAL TRAINING PROGRAMS FOR EMPLOYEES & CAPACITY BUILDING ACTIVITIES FOR LOCAL POPULATION

Date	Subject of Training	Venue	No. of Trainees	Trainers/Faculty
07.03.2018	Nursery Development	GVTC, Sendra, Sijua Area , BCCL	19	Officials from Environment Deptt.,BCCL
24.04.2019-25.04.2019	Ecological Restoration for Integrated Environmental Management in Coal Mines	Sijua Guest House, Sijua Area, BCCL	100	Scientists from Forest Research Institute, Dehradun
11.02.2020	Air-borne dust in Mines	GVTC, Sendra, Sijua Area , BCCL	24	Officials from BCCL

Stitching Skills Training

Handloom Training Centre at Nichitpur



<u>Special Training on "Nursery Development" at GVTC, Sendra</u>

<u>Special Training on "Ecological Restoration for Integrated Environmental Management in Coal Mines"</u>

Training on Safety aspects at GVTC, Sendra

Special Training on "First Aid" at GVTC, Sendra

ANNEXURE 3:

TRANSPORTATION DETAILS OF CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED, DHANBAD

Updated for 2020-21

CATEGORIES OF TRANSPORTING VEHICLES IN CLUSTER V:

A. HEAVY VEHICLES:

1. Trucks/dumpers transporting coal
2. Dumpers transporting OB material
3. Fuel Tankers, Magazine carriers, etc.

B. LIGHT MOTOR VEHICLES:

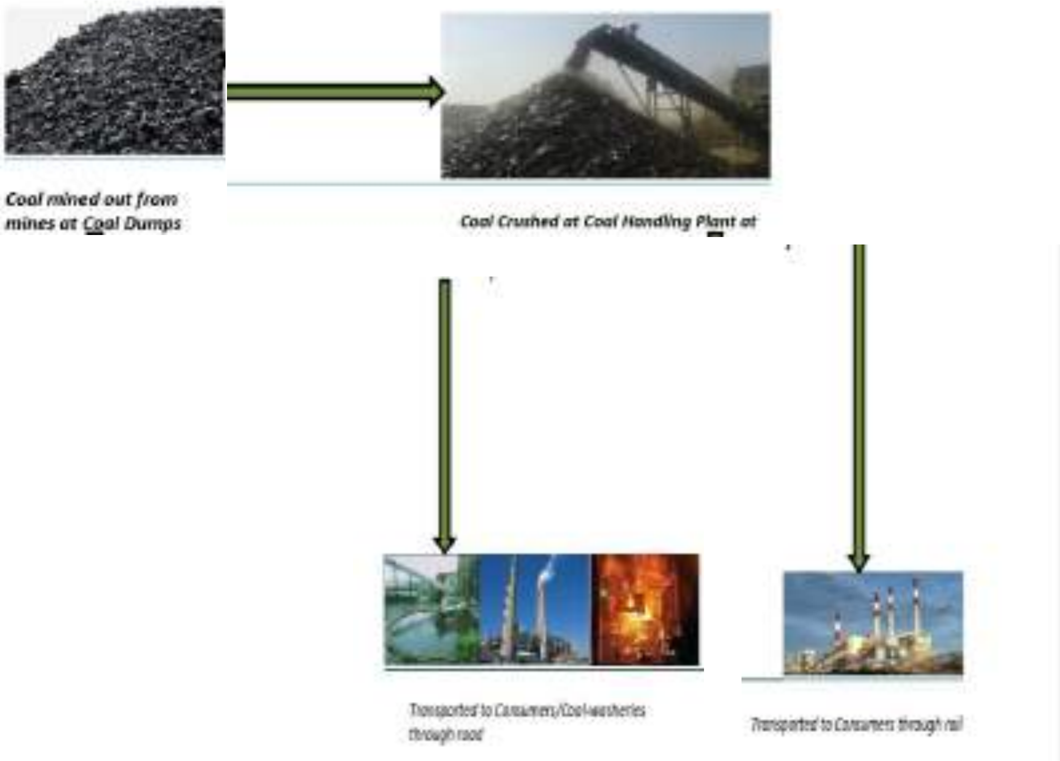
1. Official movement Vehicles
2. Personal Vehicles

COAL TRANSPORTATION:

Coal produced from the mines of Cluster V is dispatched in two modes-

1. Road Transport
2. Rail transport through railway siding

Life Cycle of Coal in Cluster V



Consumers- NTPC, Maithon Power Limited, Tata Power, DVC, SAIL, Adhunik Group of Industries, Jai Balaji Steel, Haldia Power, CESC, Hard Coke & allied industries.

Weighbridges in Cluster V:

Three weighbridges are in operation in Cluster V of Bharat Coking Coal Limited -

1. Tetulmari electronic road weighbridge
2. Sendra Bansjora electronic road weighbridge
3. Kankanee electronic road weighbridge

Railway Sidings in Cluster V:

There is only one railway siding in operation in Cluster V of Bharat Coking Coal Limited-

1. Bansjora Railway Siding

OB TRANSPORTATION: OB (Over-burden) generated is utilized in backfilling of quarried out areas or dumping within the leasehold areas in cluster V. OB is not transported out. OB carrying vehicles generally ply only on internal roads in coal-bearing areas.

MEASURES ADOPTED FOR ABATEMENT OF POLLUTION FROM TRANSPORTATION ACTIVITIES:

Major Pollutants- Particulate matter, SO_X, NOx, HC

<u>Pollution Monitoring & Control measures adopted in Cluster V-</u>

1. Use of high capacity trucks in coal transportation to reduce the no. of trips.
2. Tarpaulin covered coal transportation to arrest the emission of particulate matter from loaded coal.

3. Strengthening and grading of temporary roads in coal-bearing areas to arrest dust emission from the roads.
4. Regular water spraying on transportation roads through mobile water tankers to arrest dust emission from the roads.

Details of Mobile Water and Mist type sprinklers in Cluster V:

Name of Unit	No. of Mobile water and mist sprinklers	Capacity
Tetulmari	2	1 water sprinkler of 28 KL and 1 mist sprinkler of 28 KL
Nichitpur	2	1 water sprinkler of 12 KL and 1 mist sprinkler of 28 KL
Sendra Bansjora	3	2 units of 15 KL and 1 unit of 20 KL
Kankanee	2	1 unit of 12 KL and 1 unit of 20 KL
Bansdeopur	1	1 unit of 18 KL

5.Avenue plantation alongside the roads.

6. Plantation along Bansjora railway siding to arrest dust emission from loading activities.

7. Monitoring study through Central Mine Planning & Design Institute to analyze extent of reduction of pollution load by reducing coal transportation by road.

8. Checks to ensure vehicles engaged in transportation are having valid "Pollution Under Control" certificates.

Future Planned Pollution Monitoring and Control Measures in Cluster V:

1. Construction of wheel washing ditch-cum-settling tank at Sendra Bansjora.

2. Installation of real time PM_{10} analyzers at Bansjora railway siding for measuring particulate matter emission.

OFF-TAKE DETAILS 2020-21

CONSUMERS	MUDIDIH	KANKANEE	BASDEOPUR	
	W-III	W-II	W-III	W-II
	ROAD	ROAD	ROAD	ROAD
A. STEEL				
CHASNALA(WASHERY) SAIL		10899.710		39580.4
TATA STEEL LIMITED		61235.100		1155.150
BHELATAND WASHERY (TSL)		22486.150		28491.480
JAMADOBA WASHERY (TSL)		230.000		25877.090
TOTAL STEEL	**0.000**	**94850.960**		**95104.120**
B. PVT. COKERIES(LW)				
C. POWER HOUSES				
MPL				
DVC RAGHUNATHPUR				
ADHUNIK				
CTPS				
DSTPS				
PARICHHA				
LHM				
KPSH				
NTPCFARAKKA				
NTKS KAHALGAON				
NTKS BARH				

NTPC RIHAND				
NTPC VINDHYACHAL				
NTPC LARA				
OBRA				
NTPC KORBA				
ANPARA				
DPL				
BAKESHWAR TPS				
SAGARDIGI TPS				
MTPS (FSA)				
TOTAL POWER	**0.000**			
D. FERTILIZER				
DIWANA				
TOTAL FERTILIZER	**0.000**			
E. BRK & OTHRS.				
SPOT E_AUCTION				
LINKAGE E AUCTION/COKERIES				
E AUCTION/ROM WIV				
COKERIES ROM WIV/V				
EXCLUSIVE E A ROM IV				
SPOT EAUCTION /ROM				
SPECIAL SPOT EAUCTION				8204.360
LKG JAMADOBA		19986.370		

LKG BHELATAND		919.590		
TOTAL BRK & OTHRS	**0.000**	**20905.960**		**8204.360**
F. OWN WASH.				
MAHUDA	1844.680	31738.700		12564.940
MOONIDIH		47486.350	105.000	159303.320
TOTAL OWN WASH.	**1844.680**	**79225.050**	**105.000**	**171868.260**
G INT. CONSUMPTION				
HARD COKE				
TOTAL INT. CONS.	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL OFFTAKE	**1844.680**	**194981.970**	**105.000**	**275176.740**
HARC COKE	AUG	SEPT	OCT	NOV
E AUCTION	1668.72	256.45	825.312	1397.53
TRANSFER TO ECL	0	12	0	0

CONSUMERS	**SENDRA BANSJORA COLLIERY**				
	Stm-III	**W-V**		**W-IV**	
	ROAD	**RAIL**	**ROAD**	**RAIL**	**ROAD**
A. STEEL					
CHASNALA(WASHERY) SAIL					
TATA STEEL LIMITED					
BHELATAND WASHERY (TSL)					
JAMADOBA WASHERY (TSL)					
TOTAL STEEL	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
B. PVT. COKERIES(LW)					
C. POWER HOUSES					
MPL			203597.300		
DVC RAGHUNATHPUR					
ADHUNIK					12000.000

CTPS				3928.410	
DSTPS		4602.65		7797.45	
PARICHHA		3761.790			
LHM				2368.400	
KPSH		32429.310		1225.560	
NTPCFARAKKA		17608.270		41903.190	
NTKS KAHALGAON		4166.500		31728.870	
NTKS BARH		3882.59		18147.70	
NTPC RIHAND				7844.340	
NTPC VINDHYACHAL				6820.190	
NTPC LARA		7258.660			
OBRA		2643.440		5662.910	
NTPC KORBA				11226.320	
ANPARA					
DPL		10819.090		7725.630	
BAKESHWAR TPS		2794.160			
SAGARDIGI TPS				1605.150	
MTPS (FSA)		179822.300		135413.950	
TOTAL POWER	**0.000**	**269788.760**	**203597.300**	**283398.070**	**12000.000**
D. FERTILIZER					
DIWANA					
TOTAL FERTILIZER	**0.000**	**0.000**		**0.000**	**0.000**
E. BRK & OTHRS.					

SPOT E_AUCTION	16328.460				
LINKAGE E AUCTION/COKERIES	9104.800				
E AUCTION/ROM WIV					4361.500
COKERIES ROM WIV/V			781.800		2646.480
EXCLUSIVE E A ROM IV					10477.32
SPOT EAUCTION /ROM			13339.30		
SPECIAL SPOT EAUCTION					
LKG JAMADOBA					
LKG BHELATAND					
TOTAL BRK & OTHRS	**25433.260**	**0.000**	**14121.100**	**0.000**	**17485.300**
F. OWN WASH.					
MAHUDA					
MOONIDIH					
TOTAL OWN WASH.	**0**			**0**	**0**
G INT. CONSUMPTION					
HARD COKE					
TOTAL INT. CONS.	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL OFFTAKE	**25433.260**	**269788.760**	**217718.400**	**283398.070**	**29485.300**

HARC COKE	DEC	JAN	FEB	MAR	TOTAL
E AUCTION	1389.49	0	15.62	502.44	1907.55
TRANSFER TO ECL	0	0	0	0	0

CONSUMERS	**TETULMARI COLLIERY**						
	Stm-WIV	**W-V**		**W-VI**		**W-IV**	
	ROAD	**RAIL**	**ROAD**	**RAIL**	**ROAD**	**RAIL**	**ROAD**
A. STEEL							
CHASNALA(WASHERY) SAIL							
TATA STEEL LIMITED							

BHELATAND WASHERY (TSL)							
JAMADOBA WASHERY (TSL)							
TOTAL STEEL	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
B. PVT. COKERIES(LW)							
C. POWER HOUSES							
MPL					15170.550		
DVC RAGHUNATHPUR					6588.100		76121.100
ADHUNIK							
CTPS							
DSTPS							
PARICHHA							
LHM							
KPSH						16549.360	
NTPCFARAKKA						13663.980	
NTKS KAHALGAON							
NTKS BARH						4084.63	
NTPC RIHAND							
NTPC VINDHYACHAL						2970.650	
NTPC LARA						498.660	
OBRA						2734.600	
NTPC KORBA							
ANPARA							
DPL						3704.710	

BAKESHWAR TPS						963.550	
SAGARDIGI TPS						2254.650	
MTPS (FSA)						55822.970	
TOTAL POWER	**0.000**	**0.000**	**0.000**	**0.000**	**21758.650**	**103247.760**	**76121.100**
D. FERTILIZER							
DIWANA							
TOTAL FERTILIZER			**0.000**		**0.000**	**0.000**	**0.000**
E. BRK & OTHRS.							
SPOT E_AUCTION	11620.970						
LINKAGE E AUCTION/COKERIES	4003.440						
E AUCTION/ROM WIV							9296.030
COKERIES ROM WIV/V							1545.66
EXCLUSIVE E A ROM IV							
SPOT EAUCTION /ROM							11156.09
SPECIAL SPOT EAUCTION							
LKG JAMADOBA							
LKG BHELATAND							
TOTAL BRK & OTHRS	**15624.410**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**21997.780**
F. OWN WASH.							
MAHUDA							
MOONIDIH							
TOTAL OWN WASH.						**0**	**0**
G INT. CONSUMPTION							
HARD COKE							
TOTAL INT. CONS.	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

TOTAL OFFTAKE	15624.410	0.000	0.000	0.000	21758.650	103247.760	98118.880

CONSUMERS	NICHITPUR COLLIERY		
	Stm-III	W-IV	
	ROAD	RAIL	ROAD
A. STEEL			
CHASNALA(WASHERY) SAIL			
TATA STEEL LIMITED			
BHELATAND WASHERY (TSL)			
JAMADOBA WASHERY (TSL)			
TOTAL STEEL	**0.000**	**0.000**	**0.000**
B. PVT. COKERIES(LW)			
C. POWER HOUSES			
MPL			
DVC RAGHUNATHPUR			244393.440
ADHUNIK			
CTPS			
DSTPS		36202.78	
PARICHHA			
LHM		1689.000	
KPSH		21636.750	
NTPCFARAKKA		2220.750	
NTKS KAHALGAON		60589.970	
NTKS BARH		85111.14	
NTPC RIHAND		16050.950	

NTPC VINDHYACHAL		24095.790	
NTPC LARA		10701.480	
OBRA		24381.900	
NTPC KORBA		21863.820	
ANPARA		3943.700	
DPL		54863.460	
BAKESHWAR TPS			
SAGARDIGI TPS		15262.250	
MTPS (FSA)		520018.070	
TOTAL POWER	**0.000**	**898631.810**	**244393.440**
D. FERTILIZER			
DIWANA			
TOTAL FERTILIZER	**0.000**	**0.000**	**0.000**
E. BRK & OTHRS.			
SPOT E_AUCTION	18184.790		
LINKAGE E AUCTION/COKERIES	6460.410		
E AUCTION/ROM WIV			3049.820
COKERIES ROM WIV/V			2594.740
EXCLUSIVE E A ROM IV			73426.24
SPOT EAUCTION /ROM			5614.76
SPECIAL SPOT EAUCTION			
LKG JAMADOBA			
LKG BHELATAND			

TOTAL BRK & OTHRS	**24645.200**	**0.000**	**84685.560**
F. OWN WASH.			
MAHUDA			
MOONIDIH			
TOTAL OWN WASH.	**0**	**0**	**0**
G INT. CONSUMPTION			
HARD COKE			
TOTAL INT. CONS.	**0.000**	**0.000**	**0.000**
TOTAL OFFTAKE	**24645.200**	**898631.810**	**329079.000**

ANNEXURE 4

CORPORATE SOCIAL RESPONSIBILITY

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED, DHANBAD

2020-21

BHARAT COKING COAL LIMITED (BCCL)

Bharat Coking Coal Limited (BCCL) is a Public Sector Undertaking engaged in mining of coal and allied activities. It occupies an important place in as much as it produces bulk of the coking coal mined in the country. BCCL meets almost 50% of the total prime coking coal requirement of the integrated steel sector. BCCL was incorporated in January, 1972 to operate coking coal mines (214 Nos operating in the Jharia & Raniganj Coalfields, taken over by the Govt. of India on 16th Oct, 1971) to ensure planned development of the scarce coking coal resources in the country.

SCOPE

As per **Schedule VII of New Companies Act 2013,** the following should be the Scope of Activities under Corporate Social Activities:

i) Eradicating hunger, poverty and malnutrition, promoting healthcare including preventive health care and sanitation and making available safe drinking water.

ii) Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently abled and livelihood enhancement projects;

iii) Promoting gender equality, empowering women, setting up homes and hostels for women and orphans, setting up old age homes, day care centres and such other facilities for senior citizens and measures for reducing inequalities faced by socially and economically backward groups;

iv) Ensuring environmental sustainability, ecological balance, protection of Flora and Fauna, animal welfare, agro-forestry, conservation of natural resources and maintaining quality of soil, air and water;

v) Protection of national heritage, art and culture including restoration of buildings and sites of historical importance and works of art; setting up public libraries, promotion and development of traditional arts and handicrafts;

vi) Measures for the benefit of armed forces veterans, war widows and their dependents

vii) Training to promote rural sports, nationally recognized sports, Paralympics sports and Olympic sports;

viii) Contribution to the Prime Minister's National Relief Fund or any other fund set up by the Central Government for socio-economic development and relief and welfare of the Scheduled Castes, the Scheduled Tribes, other backward classes, minorities and women;

ix) Contributions or funds provided to technology incubators located within academic institutions which are approved by the Central Government;

x) Rural development projects.

MAJOR CSR ACTIVITIES OF BCCL

Bharat Coking Coal Limited (BCCL) is committed to good corporate citizenship and makes constant efforts to build and nurture long lasting relationships with members of the society in general and its peripheral communities in particular.

The following activities have been carried out under the Corporation's CSR Programme-

1. **Drinking Water Facilities**: Provided deep bore wells, tube wells, pumps/motors, open wells, in the peripheral villages of BCCL. Water supply through pipeline & through water tanker is also provided to the villages.
2. **Education:** BCCL adopts a multi-pronged approach to promote quality education in backward areas. The measures taken by BCCL comprise Construction, Extension, and Renovation of school buildings etc to promote quality education in the nearby villages. BCCL is Extending financial aid for educational facilities to Private Committee Managed schools. Measures are taken to promote women literacy and career development.

3. **Health Care**: BCCL Conducts medical/health camps for dwellers of peripheral villages rendering free medical consultancy. CSR Clinics, wellness clinics, artificial limbs centres are organised for the benefit of the needy section of the society. Mobile medical vans are deployed as special arrangement for medical services.
4. **AIDS awareness camps** are organized as special drive to develop awareness and to render free consultancy.
5. **"Ek Jagaran Jeevan Shaili"-** A Life style Management Programme is being organised for de-addiction from ill habits of life style such as consuming tobacco, alcohol etc. Occupational health awareness programmes are also organised.

6. **Sports & Culture**: Various activities are organised to propagate sports and culture. Sports/games items and instruments are also provided. To promote sports, children parks have been constructed.
7. **Village adoption**: Lahbera, a SC/ST village in Dhanbad has been adopted for its all-round development and a number of development activities have been carried out.
8. **Other Welfare Activities**: This includes Construction / renovation of Community Halls, construction / repair of roads, construction of Health-sub centres, construction of drain, construction of Chhat Ghat in the ponds, Construction of Boundary wall, providing Choupal for community gatherings, Installation of road side Water Kiosks during summer etc. During winter, Blankets are distributed among poor sections of the society.

SOURCE OF FUND

The fund for the CSR should be allocated based on 2% of the average net profit of the Company for the three immediate preceding financial years or Rs. 2.00 per tonne of Coal Production of previous year whichever is higher.

ACTION PLAN FOR CORPORATE SOCIAL RESPONSIBILITY

As per the EC Granted to Cluster V:

"A detailed CSR Action Plan shall be prepared for Cluster V group of mines. Specific activities shall be identified for CSR the budget of Rs. 242.7 Lakhs per year@ Rs 5/T of coal as recurring expenditure. The 265.25 ha of area within Cluster V 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 V 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. CSR should be Rs 4.6 Lakh for cluster-V for year 2012-13 and thereafter. Social Audit should be carried out for CSR for its actual implementation."

The EMP (Environment Management Plan) contained the following:

S.N	HEAD OF WORKS	CSR expenditure to be done per year in Rs. lakhs				
		2011-12	2012-13	2013-14	2014-15	2015-16
1	Education facilities including grant of schools, providing education kits, running of schools etc.	40.00	45.00	35.00	40.00	40.00
2	Water Supply and rain-water harvesting works, wells, ponds, hand pumps and tube wells	30.00	35.00	45.00	30.00	30.00
3	Health Care and vaccination, awareness camps, mobile medical camp, Immunization, medicine etc.	20.00	20.00	10.00	20.00	20.00
4	Environment Protection i.e. plantation etc.	8.25	8.25	18.25	8.25	8.25
5	Social Empowerment Like Community centre, Literacy drive, shopping complex.	10.00	10.00	10.00	10.00	10.00

6	Infrastructure Development like road, bridge, repairing of school, drains, electric line etc.	20.00	10.00	10.00	20.00	20.00
7	Sports Culture like village stadium, grant to village sports body, organizing sports meet	3.00	3.00	3.00	3.00	3.00
8	Grant to NGO for community development	5.00	6.30	6.30	5.00	5.00

Implementation Status

Health Care: 2020-21 & 2021-22

BHARAT COKING COAL LIMITED
REGIONAL HOSPITAL LOYABAD
SIJUA AREA-V
CSR CAMP REPORT

Month	Date	Camp	Benificiries	Reason
April-2020	NIL	NIL	NIL	Due to covid pandamic, it was not possible to organise any type of Medical Camp.
May-2020	NIL	NIL	NIL	
June-2020	NIL	NIL	NIL	
July-2020	NIL	NIL	NIL	
Auguest-2020	NIL	NIL	NIL	
September-2020	NIL	NIL	NIL	
October-2020	NIL	NIL	NIL	
November-2020	NIL	NIL	NIL	
December-2020	NIL	NIL	NIL	
January-2021	NIL	NIL	NIL	
February-2021	11.02.2021	Free Mega Medical Checkup Camp at Mohlidih Panchayat Bhawan	206	
February-2021	27.02.2021	Free Mega Medical Checkup Camp at Nagrikala Panchayat Bhawan.	204	
		Total no. of patients	410	
March-2021	NIL	NIL	NIL	Due to Covid pandamic (2nd wave)
April-2021	NIL	NIL	NIL	
May-2021	NIL	NIL	NIL	
June-2021	NIL	NIL	NIL	
July-2021	NIL	NIL	NIL	
August-2021	NIL	NIL	NIL	
September-2021	NIL	NIL	NIL	
October-2021	NIL	NIL	NIL	

DY. CMO/AMO(I/C)
Sijua Area-V

Health Care:2019-20

BHARAT COKING COAL LIMITED

CSR CAMP AT REGIONAL HOSPITAL LOYABAD / DISPENSARY OF SIJUA AREA

April-2019 to March 2020

SL No	Month	Date	Camp	Benificiries
1	April-2019	04.05.2019	Diabetic camp	9
2	May-2019	23.05.2019	Lipid profile camp	16
3	June-2019	10.06.2019	Uric Acid camp	23
4	July-2019	18.07.2019	Pulmonary function test Camp	Nil
5	Auguest-2019	05.08.2019	Blood uria test camp	25
	August-2019	15.08.2019	Camp of Sijua Stadium	22
6	September-2019	24.09.2019	Cardiology Camp at R.H.Loyabad	97
7	October-2019	NIL	NIL	0
8	November-2019	NIL	NIL	0
9	December-2019	NIL	NIL	0
10	January-2020	NIL	NIL	0
11	February-2020	18.02.2020	Diagnostic Camp by RHL in Loyabad, Lipid profile, Blood Sugar, Spirography, General Health Check-up	75
12	February-2020	29.02.2020	School Health Check-up Camp, Blood grouping, Eye check-up, Dental Check-up & General Health Check-up	83
13	March-2020	NIL	NIL	0
			Total of Beneficires	350

Kamal Saha

CMO/AMO I/C

RHL, Sijua Area-V

Education: Grant to PCM Schools for the year 2018-19

भारत कोकिंग कोल लिमिटेड एक मिनीरत्न कंपनी (कोल इंडिया लिमिटेड की एक अंग) कल्याण विभाग, कोयला भवन कोयला नगर धनबाद-826005	Bharat Coking Coal Limited A Mini Ratna Company (A Subsidiary of Coal India Ltd) Welfare Deptt., Koyla Bhawan, Koyla Nagar, Dhanbad-826005

2545
16.11.19

पत्रांक सं.: बीसीसीएल/कल्याण/वि.स.प.वि.स्वीकृति आदेश/2019/1402-23 (W/H) दिनांक 11.11.2019

1744
15/11/19

4335
15/11/19

स्वीकृति आदेश

सेवा में,

महाप्रबंधक,

पश्चिमी झरिया क्षेत्र/ गोविन्दपुर क्षेत्र/ बरोरा क्षेत्र/ सिजुआ क्षेत्र/ कुसुण्डा क्षेत्र/ पुटकी बलिहारी एरिया/ कुस्तौर क्षेत्र/ बस्ताकोला क्षेत्र/ लोदना क्षेत्र/ पूर्वी झरिया क्षेत्र/ चाँच विक्टोरिया क्षेत्र/ सी.वी.ए मुग्मा क्षेत्र।

विषय:- निजी प्रबंधकीय विद्यालयों को आर्थिक सहायता हेतु F/Y 2018-19 (4th Qtr.) की स्वीकृति।

महोदय,

कल्याण उपसमिति (शिक्षा) के अनुशंसा के आधार पर वर्ष 2018-19 के लिए (Jan. 2019 to Mar. 2019 तक) निजी समिति प्रबंधकीय विद्यालयों को आर्थिक सहायता की 4th Qtr. किश्ती की स्वीकृति सक्षम पदाधिकारी द्वारा दी गई है।

आपसे अनुरोध है कि कृपया संलग्न सूचि में उल्लेखित विद्यालयों के सामने अंकित राशि को RTGS/ अकाउन्ट पेयी चेक के माध्यम से वितरण करें। निधि वितरण करने से पूर्व यह सुनिश्चित कर लें कि :-

1. आज की तारीख में विद्यालय सुचारू रूप से संचालित है।

एवं संबंधित विद्यालयों से निम्नलिखित दस्तावेजों की जाँच कर लें जैसे :-

2. Utilization certificate (Oct. 2018 to Dec. 2018).
3. Strength of currently working teachers vis-à-vis no. of teachers eligible for financial assistance.

यह सक्षम प्राधिकारी के अनुमोदन के पश्चात E.B.C.Sl.No.-BCCL/REV/2700/19-20/Educational Grant/-1488 dated-21.08.2019 एवं F.C.Sl.No.-BCCL/REV/2700/19-20/Educational Grant/2107-dated-09.11.2019 के द्वारा निर्गत किया जाता है।

अनुलग्नक : यथोक्त।

नोट: वित्तीय सहायता की राशि का भुगतान 15 दिनों के अंदर अवश्य ही करने की व्यवस्था करें और इस कार्यालय को अविलम्ब सूचित करें।

ह० ...
(अदिति सिंह)
महाप्रबंधक(का0) कल्याण।

प्रतिलिपि:

1. अध्यक्ष-सह-प्रबंध निदेशक/ निदेशक तकनीकी/ मुख्य सतर्कता पदाधिकारी के तकनीकी सचिव अधिकारी (सचिवीय)।
2. महाप्रबंधक (कल्याण), सीआईएल, कोलकाता को सूचनार्थ प्रेषित।
3. मुख्य प्रबंधक (वित्त) निधि, बीसीसीएल, कोयला भवन- निधि विमुक्ति संबंधित आवश्यक कार्रवाई हेतु।
4. महाप्रबंधक(वित्त)/ महाप्रबंधक(मी एण्ड सी), कोयला भवन को सूचनार्थ प्रेषित।
5. महाप्रबंधक(का0 एवं औ0सं0), कोयला भवन को सूचनार्थ प्रेषित।
6. विभागाध्यक्ष (वित्त), केन्द्रीय लेखा, बीसीसीएल, कोयला भवन को सूचनार्थ प्रेषित।

FINANCIAL ASSISTANCE TO PCM SHOOLS FOR THE PERIOD Jan 2019 TO March 2019 (FY 2018-19)

Sl.No.	Name & Location of Private Committee Managed Schools	No.of eligible Teachers for getting fin.assistance	Rate of financial asst. & No. of teachers				Amt of 4th Qrt of FY 2018-19
			Under Graduate Rs.5000/-PM/PT	Graduate Rs.5500/-PM/PT-	Graduate with BT Rs.6500/-PM/PT	Graduate with B.Ed Rs.7000/-PM/PT	
1	2	3	4	5	6	7	8
	Sijua Area						
1	AdarshHarijanShishu Pathshala,Sendra-10	2	1	1	0	0	31500
2	S.S.S. Gyan Kunj, Loyabad.	6	4	2	0	0	93000
3	Saraswati Bal Vidya Mandir,Nichitpur.	2	2	0	0	0	30000
4	Panday Madhya Vidyalaya, Kankanee	5	2	3	0	0	79500
5	Shishu Vidya Mandir,Tetulmari .	5	4	1	0	0	76500
6	Sarvodaya Shishu Mandir, Sendra Bansjora	4	4	0	0	0	60000
7	Saraswati Sewa Sadan Vidyalaya Kankanee.	3	0	3	0	0	49500
8	Primary Janta School, Sendra No5	1	1	0	0	0	15000
9	Laxmi Devi Vidya Mandir,Loyabad	4	2	2	0	0	63000
10	Panda Karali Madhya Vidyalaya Loyabad Coke Plant	2	2	0	0	0	30000
11	Bangla Primary School, Loyabad	3	3	0	0	0	45000
12	Urdu Primary School Kankanee	1	1	0	0	0	15000

R.K. Mishra 11-11-19

CONT.

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13	Shishu Shiksha Niketan Loyabad,	3	3	0	0	0	45000
14	Gandhi Smarak Primary School	4	4	0	0	0	60000
15	Saraswati Vidya Mandir, Tetulmari	3	3	6	0	0	45000
16	Janta Janardan Dal Vidya Mandir,Tetulmari	3	2	1	0	0	46500
17	Indira Gandhi Smarak Vidya Mandir,Tetulmari	3	3	0	0	0	45000
	Total	64	41	93	0	0	829500

EBC Sl No. BCCL/REV/2700/19-20/Educational Grant/1488 dated 21.08.2019 and
FC SL. No. BCCL/REV/HOD(PAYII)/C/E.F.C/19-20/2700/Educational Grant/2107 dated 09.11.2019

R.K. Mishra
11.11.19

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FINANCIAL ASSISTANCE TO PCM SHOOLS FOR THE PERIOD Apr 2018 TO Sep 2018 (FY 2018-19)

			Rate of financial asst. & No. of teachers				
Sl.No.	Name & Location of Private Committee Managed Schools	No. of eligible Teachers for getting fin.assistance	Under Graduate Rs.5000/- PM/PT	Graduate Rs.5500/- PM/PT	Graduate with BT Rs.6500/- PM/PT	Graduate with B.Ed Rs.7000/- PM/PT	Amt. of 1st & 2nd Qtr of FY 2018-19
1	2	3	4	5	6	7	8
	Sijua Area						
1	Adarsh Har[illegible] Shishu Pathshala Sendra ??	2	1	1	0	0	63000
2	S.S.S. Gyan Kunj, Loyabad	6	4	2	0	0	186000
3	Saraswati Bal Vidya Mandir Nichitpur	2	2	0	0	0	60000
4	Pandey Madhya Vidyalaya, Kankanee	5	2	3	0	0	159000
5	Shishu Vidya Mandir Tetulmari	5	4	1	0	0	153000
6	Sarvodaya Shishu Mandir, Sendra Bansjora	4	4	0	0	0	120000
7	Saraswati Sewa Sadan Vidyalaya, Kankanee	3	0	3	0	0	99000
8	Primary Janta School Sendra Nol	1	1	0	0	0	30000
9	Laxmi Devi Vidya Mandir Loyabad	4	2	2	0	0	126000
10	Panda Kanal Madhya Vidyalaya Loyabad Coke Plant	2	2	0	0	0	60000
11	Bangla Primary School, Loyabad	3	3	0	0	0	90000
12	Urdu Primary School Kankanee	1	1	0	0	0	30000

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13	Bhatu Shiksha Kalyan [illegible]	1	1	[illegible]	0	0	30000
14	[illegible] Shiksha Primary School	4	4	[illegible]	6	4	120000
15	Saraswati Vidya Mandir [illegible]	1	1	[illegible]	0	0	50000
16	[illegible] Vidya Mandir, [illegible]	3	2	1	0	0	[illegible]
17	[illegible] Vidya Mandir, [illegible]	3	3	[illegible]	6	0	[illegible]
	Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] BCCL/[illegible]/Educational Grant/[illegible] dated 30.10.2018 and
[illegible] No. BCCL/[illegible]/Educational Grant/[illegible] dated [illegible]

BD 951
12/3/19

APM [illegible]
13/3/19

Major CSR activities undertaken in Sijua Area (Cluster V) in previous Years:

2013-2014:

1. Construction of one library hall for Nehru Mahavidyalaya, Tetulmari
2. Construction of two classrooms for Nehru Balika Uchha Vidyalay, Tetulmari
3. Financial assistance for providing computer at Ambedkar School, Loyabad
4. Repair & Maintenance- Balika Uchaa Vidyalay Mudidih, Sijua Area

2014-2015:

1. One day Sustainable Development Awareness programme at Sijua area

2015-2016:

1. Construction of toilets in various schools in Paschimi Singhbhum including subsequent maintenance of 5 years under **Swachh Vidyalaya Abhiyan** by BCCL under CSR
2. Construction of two classrooms of Saraswathi Shishu Vidya Mandir, Tetulmari

YEAR-WISE CSR EXPENDITURE IN CLUSTER V:

REVENUE EXPENDITURE IN CLUSTER V ON CSR AND WELFARE ACTIVITIES

2014-15

Sr. No	Item	Amount (In Thousand Rs.)
1	CLEANING OF POND AT CHHAT TALAB, NICHITPUR	19.043
2	REPAIR AND MAINTENNACE WORK OF MASJID AT 22/12 COLONY	38.787
3	WHITE WASHING AND PAINTING AT SSBM SCHOOL AT TMC	35.630
4	MAINTENANCE OF YAGYASHALA AT TETULMARI	44.556
5	WHITEWASHING OF SHAHEED SHAKTI NATH MAHTO SMARAK AT MDC	49.147
6	MAINTENANCE OF KALI MANDIR AT NCP	13.336
7	MAINTENANCE OF KALI MANDIR AT TOCP	13.757
8	HEALTH CAMP AT REGIONAL HOSPITAL, LOYABAD	24.000
9	PROCUREMENT OF MEDICINES FOR CSR ACTIVITIES	300.464
	TOTAL	538.72

2015-16

Sr. No	Item	Amount (In Thousand Rs.)
1	REPAIR OF 3 NOS OF COMMUNITY LATRINES AND SEPTIC TANK AT BANSDEOPUR	50.208
2	MAINTENANCE WORK OF SHIV MANDIR AT TMC	35.621
3	MAINTENANCE WORK OF HANUMAN MANDIR AND DURGA MANDIR IN SIJUA AREA	43.198
4	CLEANING AND REPAIR OF DRAIN AT TMC	116.951
5	MAINTENANCE WORK OF SHIV MANDIR AT LOYABAD	34.597
6	MAINTENANCE WORK OF MAZAR SHARIF AT LOYABD	172.958
7	RENOVATION OF BOUNDARY WALL OF SHIV MANDIR AT PANDEDIH	138.661
8	CLEANING OF DRAIN AT LOYABAD	55.526
	TOTAL	647.72

2016-17

Sr. No	Item	Amount (In Thousand Rs.)
1	MAINTENANCE WORK OF VARIOUS PLACES OF SHIV MANDIR AT MDC	20.87
2	REPAIR & CLEANING OF DRAIN NEAR SHIV MANDIR AT LOY.COLL.	21.48
3	MAINTENANCE OF DURGA & KALI MANDIR OF NEW DRIFT AT LOY.COLL.	2.92
4	MAINTENANCE WORK OF KRISHNA MANDIR & HANUMAN MANDIR AT TMC	10.95
5	REPAIR OF 03 NO. COMMUNITY LATRINE ROOM & SEPTIC TANK AT BASUDEOPUR COLL.	18.26
6	MAINTENANCE WORK OF SHIV MANDIR & CHAITI DURGA MANDIR AT SIJUA AREA	14.90
7	MAINTENANCE WORK OF LOY. DURGA MANDIR AT LOY. COLL.	11.65
8	RENOVATION OF STONE SHED & CULVERT OF SHIV MANDIR NEAR KITS SIJUA AT TMC	41.33
9	RENOVATION OF B.WALL AROUND SHIV MANDIR NEAR ADARSH NAGAR PANDEYDIH AT TMC	57.70
10	RENOVATION OF DRAIN DAMAGED OF HONO. NEAR SINUA COLONY OF QTR.JAGARNATH SINGH AT MDC	23.95
11	WHITE WASHING & COLOUR WASHING & MAINT.WORK OF 03 NO. KALI MANDIR AT NPC	6.76
12	MAINTENANCE OF KALI MANDIR NEAR 04 NO. SENDRA AT KKC	1.61
13	PROVIDING OF STEPS IN SENDRA JORE NEAR OCP KKC CHHAT GHATH A SIJUA AREA	35.785
14	RENOVATION OF SHED OF ABDUL KALAM CHOWK AT NCP	29.054
15	RENOVATION OF AMBEDKAR ACADEMY SCHOOL AT LOYABAD	31.933
	TOTAL	329.152

2017-18

Sr. No	Item	Amount (In Thousand Rs.)
1	RENOVATION OF AMBEDKAR ACADEMY SCHOOL AT LOYABAD	376.455
2	MAINTENANCE OF KRISHNA MANDIR AT TMC	29.105
3	PROVIDING STAIRCASE AT NEHRU BALIKA VIDYA MANDIR AT TMC	144.313
4	REPAIR OF KALI AND HANUMAN MANDIR AT MDC	225.671
5	MAINTENANCE OF CHILDREN PARK AT MDC	234.519
	TOTAL	1010.063

2018-19

Sr. No	Item	Amount (In Thousand Rs.)
1	WHITE AND COLOUR WASHING OF COMMUNITY CENTER AT MDC	20.90
2	PROV.OF STAIR CASE UP TO 1St.FLOOR TN NEHRU BALIKA VIDYALAYA AT TMC	66.38
3	REPAIRING, PAINTING OF KALI MANDIR AT NP TSHIP	12.22
4	MAINTENANCE OF COMMUNITY CENTRE AT NCP	216.174
5	MAINTENANCE OF SEWING CENTRE AT SJUA	24.365
	TOTAL	340.039

2019-20

Sr. No	Item	Amount (In Thousand Rs.)
1	REPAIR AND MAINTENANCE OF JAMA MASJID 7 NO.COLONY AT MDC	56.32
2	REPAIR AND MAINTENANCE OF MAHARANI DEVI MANDIR AT NPTS	225.42
3	MAINTENANCE WORK OF SHIV MANDIR AND HANUMAN MANDIR AT MUDIDIH	53.382
4	MAINTENANCE WORK OF YAGYASHALA AT MUDIDIH	85.675
	TOTAL	420.797

2020-21

Sr. No	Item	Amount (In Thousand Rs.)
1	CLEANING AND RENOVATION OF SURYA MANDIR AND CHHAT TALAB AT TMC PST-2 UNDER SA	70.30
2	RENOVATION OF AMBEDKAR SHED AT LOY	92.895
3	MAINTENACE OF JAMA MASJID AT 22/12 COLONY	97.879
4	WHITEWASHING AND PAINTING OF SARASWATI VIDYA MANDIR SCHOOL AT TMC	79.029
5	REPAIR OF STEPS AND TOILETS AT NCP	368.167
	TOTAL	708.27

2021-22

Sr. No	Item	Amount (In Thousand Rs.)
1	CLEANING AND RENOVATION OF SURYA MANDIR AND CHHAT TALAB AT TMC PST-2 UNDER SA	70.30
	TOTAL	**70.30**

CAPITAL EXPENDITURE IN CLUSTER V ON CSR AND WELFARE ACTIVITIES

YEAR	ITEM	Amount (In Thousand Rs.)
2013-14	CONSTRUCTION OF WASTE DISPOSAL TANK	69.910
2013-14	CONSTRUCTION OF SMALL KALI TEMPLE AT NEW INCLINE	123.094
2013-14	CONSTRUCTION OF COMMUNITY HALL AT NEW PANDEDIH	590.577
2013-14	CONSTRUCTION OF COMMUNITY HALL AT TETULMARI	585.117
2017-18	CONSTRUCTION OF COMMUNITY HALL AT NICHITPUR	1200.000
	TOTAL	**2568.698**

STATUS OF ISSUES RAISED IN PUBLIC HEARING

S. No.	Issues Raised	Status
1	Trees are planted but not cared for and saved	Both the gabion plantation and block plantation done in Cluster V area cared for and has been well preserved as can be verified through the pictures and inspection report of gabion plantation by the forest Officials. The preservation and maintenance of all the plantations done is continuous till they become self-sustaining.  
2	Public awareness should be generated to preserve the trees planted by BCCL.	Various initiatives have been taken such as awareness programmes in nearby schools on the occasions such as Environment Day & Swachhta Pakhwada to generate awareness. Moreover trees have also been planted by Cluster V in nearby schools, grounds and other areas. 
3	Water Sprinkling	The frequency of water sprinkling by mobile sprinklers has been

	frequency should be increased including in the night time.	increased for more effective dust suppression. Records are being maintained in the water sprinkler movement register. 
4	The no. of water tankers should be increased.	Sufficient no. of water tankers have been provided in Cluster V. Details are included in the transportation booklet attached.
5	Arrangements should be made for Drinking water.	Cluster V supplies water for domestic usage in the nearby villages. A MoU has been signed between BCCL and Jharkhand Govt. for mine water utilization by converting Mine water to Drinking water.
6	BCCL spends too much money on CSR activities. There should be improvement in it.	CSR activities are carried out as per the CSR policy of BCCL. 
7	Arrangements should be made for control of dust emissions during drilling operations.	Drill machines are fitted with wetting system and/or dust extractor system to control the emission of dust during the drilling operation.
8	No work has	Two eco-restoration parks have been constructed near Chandour

	been done for environmental protection near Chandour Bastee in Tetulmari. The residents of Chandour Bastee should be rehabilitated as it is close to Tetulmari mine.	Bastee in Tetulmari Collliery covering total area of 10.3 Ha. Water sprinkling is done on the roads and other dust prone areas to suppress dust. The rehabilitation work is under process as per Jharia Master Plan. Currently verification of the affected families surveyed is being done by the Jharia Rehabilitation and Development Authority.  
9	Proper water spraying should be done in Nichitpur Township. Controlled blasting operation which is carried out in Nichitpur should be continued. The quarried out area should be backfilled with OB and trees planted thereon.	Regular water spraying is done in Nichitpur. The roads in Nichitpur Township are also paved. Controlled blasting is being done. Backfilling and reclamation is being done in the quarried out areas in Nichitpur. An OB dump area of 2.8 Ha has been biologically reclaimed in Nichitpur. Road lights, water supply arrangements, Yoga centre have been provided in Nichitpur. Road from Subhash Chowk to Azad chowk is bitumen topped and well maintained. An ambulance is available in Nichitpur.

	Road lights, community centres, water arrangements, high schools roads(from Subhash Chowk to Azad chowk), ambulance should be provided in Nichitpur.	
10	Electricty, water and healthcare facilities should be provided.	Electricity, water and healthcare facilities are provided in Cluster V. Healthcare and wellness camps are also organized in nearby villages from time to time. 
11	Sporting activities should be promoted.	Games and sports are duly funded and promoted in cluster V. There is a well maintained football stadium in Sijua in Cluster V.

		 
12	Dust pollution from blasting activities should be controlled.	Controlled blasting and water spraying is done to control dust pollution.
13	Covered transportation should be done.	Tarpaulin covered transportation is being ensured to control dust pollution. 
14	Closed UG mines should be reopened.	Operation of mines is guided by company policy, economic feasibility, safety and operational convenience, etc.
15	Water should be ensured in Chandour Pond.	Water is sufficiently available in Chandour pond.

		
16	Loyabad weighbridge should be shifted.	Loyabad weighbridge has been closed.
17	There should be no shortage of Doctors and paramedic staffs	Doctors, paramedic staffs and other healthcare personnel are deputed in Regional Hospital, Loyabad in cluster V.

ANNEXURE 5:

REHABILITATION & RESETTLEMENT BOOKLET

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED, DHANBAD

2020-21

1. REHABILITATION AND RESETTLEMENT PLAN

The cluster of mines has been dovetailed with the approved Jharia Action Plan for dealing with fire, subsidence and rehabilitation of people. Master Plan for dealing with fire, subsidence and rehabilitation within the leasehold area of BCCL has already been approved by Government of Jharkhand & Government of India.

As per EC granted to Cluster V, R&R of 5835 nos. of PAFs are involved. They should be rehabilitated to safe areas at the cost of Rs. 104024.9 Lakhs as per the approved Jharia Action Plan.

2. Requirement of land at Resettlement site:

A) For BCCL houses

The BCCL houses will be resettled in satellite townships with equivalent type of houses in triple storey building. The weighted average plinth area of the houses proposed to be rehabilitated has been estimated at 48.09 sq m /house. Considering the amenities, infrastructure, internal roads etc. to be provided in the township, requirement of land for BCCL houses has been estimated at 34.30 Ha. (@ 160 m^2 /House)

B) For Non BCCL Houses

(i) Private (Authorized)

Head of every family will be provided a plot of land measuring 100 sq.m. Considering the amenities, infrastructure, internal roads etc to be provided in the township, requirement of land for private authorized houses has been estimated at 82.94 Ha. (@ 270 m^2/house)

(ii) Private Houses (Encroachers)

Encroachers will be provided with a house constructed on about 27 sq.m land in triple storied building in the resettlement site. However provision of 11 sq. m of land has been considered for construction of another room in future. Considering the amenities, infrastructure, internal roads etc to be provided in the township, requirement of land for encroachers has been estimated at 22.74 Ha. (@ 130 m^2/house).

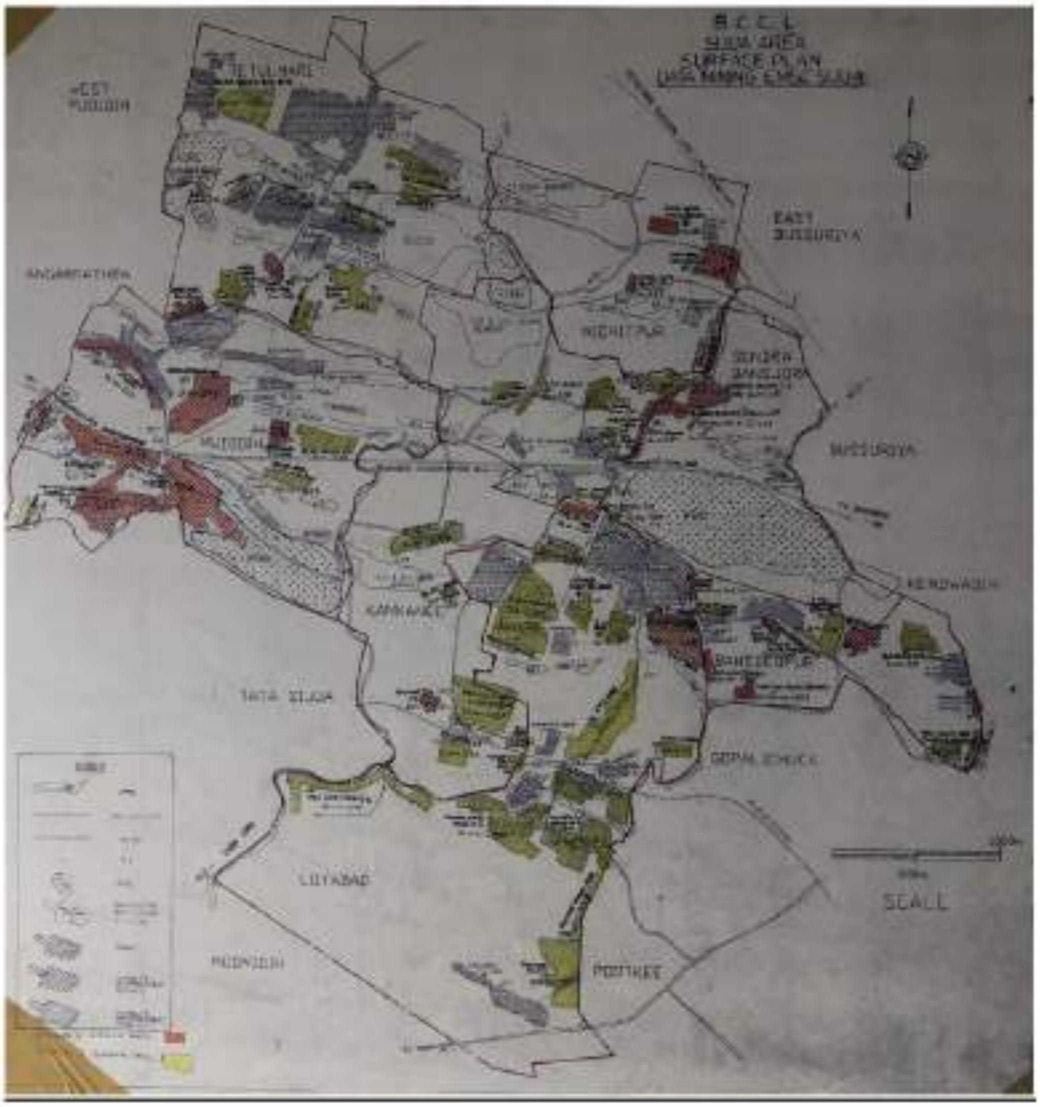
3. **CURRENT STATUS:**

- BCCL families from cluster V are being shifted to Karmik Nagar, Kusum Vihar and East Bassuriya colonies which have been provided with the basic amenities. So far 66 families have been shifted to these quarters.

Karmik Nagar Rehabilitation Township for BCCL families

- For, non-BCCL families, a fresh survey of houses situated in fire and subsidence affected areas has been carried out by Jharia Rehabilitation and Development Authority for allotment of houses for shifting. Total 78 such sites are located in Cluster V. All 78 sites have been surveyed.

JRDA Site plan of Cluster V:



Site Survey Report of Sijua Area Conducted by JRDA

S.No.	COLLIERY	SITE NAME	SITE NO	No. of Hoseholds Surveyed	No. of LTH	No. of Encroachers
1	**TETULMARI**	DIRECTOR'S BUNGLOW/14	1/288	89	0	89
2		HIRAK & PVT.	2/289	118	0	118
3		NAYA MORE BASTI	2/271	70	5	65
4		BELDARI BASTI/11	2/264	23	19	4
5		CHANDORE BASTI/O8	2/265	19	19	0
6		CHANDORE WEST NO1/17	2/266	188	0	188
7		CHANDORE WEST NO2/18	2/267	418	0	418
8		DALAHI BASTI & BCCL QRS/O1	2/268	113	0	113
9		HUTMENTS OF RNS/15	2/269	27	0	27
10		MALLAH DHAWRA	2/270	236	0	236
11		PONDIHDIH BASTI/10	2/273	NA		
12		SUBSTATION RNS/16	2/274	24	0	24
13		NIMIAH DHOWRAH	2/272	33	0	33
14		WORKSHOP/06	2/275	30	0	30
15	**BANSDEOPUR**	8 NO. DHOWRA/08	1/261	272	0	272
16		BSP OH OFFICE/14	1/262	48	0	48
17		ELEC.SUB-STATION/12	1/263	208	0	208
18		HARIJAN BASTI/01	1/264	90	56	34
19		INDIRA AWAS/11	1/265	73	0	73
20		MALLAH BASTI/02	1/266	80	24	56
21		15 NO. DHOWRA/13	2/227	59	0	59
22		4 NO COLONY/04	2/228	20	0	20
23		40 NO. DHOWRA/10	2/229	44	0	44
24		7 NO BSP/07	2/230	92	0	92
25		BANSDEOPUR COLLIERY/06	2/231	48	0	48
26		NEW COLONY/03	2/232	56	0	56
27	**KANKANEE**	5 PIT AREA/01	2/233	66	0	66
28		7 PIT AREA/03	2/234	92	0	92
29		LOYABAD STATION /05	2/236	29	2	27
30		RAILWAY QRS/06	2/237	42	0	42
31		SENDRA 07 PIT/07	2/238	203	0	203
32		HANUMAN BAZAR	2/235	138	0	138
33		SOUTH OF 07 PIT/O2	1/267	12	0	12
34	**LOYABAD**	7/8 AREA/01	1/269	342	0	342
35		5 PIT AREA/09	1/268	466	0	466
36		8 PIT AREA/02	1/270	108	0	108
37		3 NO.AREA/08	2/239	63	0	63
38		6PIT AREA/10	2/240	354	0	354
39		CENTRAL HOSPITAL/06	2/241	48	0	48
40		COKE PLANT-1/14	2/242	170	0	170
41		COKE PLANT-2/15	2/243	482	0	482
42		IDGAH AREA/12	2/244	37	0	37
43		KANKANE BASTI/05	2/245	365	132	233
44		MADNADIH/03	2/246	503	114	389
45		NEW DRIFT /18	2/247	184	0	184
46		POOTKEE BARRIER/19	2/248	95	0	95
47		POOTKEE COLONY/20	2/249	250	0	250
48		POWER HOUSE-2/17	2/250	194	0	194
49	**SENDRA BANSJORA**	11 NO. COLONY/11	1/283	11	0	11
50		13 NO. COLONY/13	1/284	70	0	70
51		GARERIA COLONY/15	1/285	65	7	58

52		GARERIA COLONY1/14	1/286	120	0	120
53		HABITATION WEST OF DB ROAD/12	1/287	59	0	59
54		19 NO. COLONY/19	2/256	NA		
55		21 NO. COLONY/21	2/257			
56		6PIT COLONY/04	2/258			
57		6 PIT COLONY/PAST/09	2/260	20	0	20
58		6 PIT COLONY/08	2/259	7	0	7
59		BANSJORA VILLAGE/16	2/261	56	56	0
60		OFFICE COLONY	2/263	34	0	34
61		10 No. COLONY	2/255	91	0	91
62		OCP OFFICE/02	2/262	NA		
63	**MUDIDIH**	10 PIT COLONY/07	1/271	200	0	200
64		JOGTA COLONY/13	1/272	289	0	289
65		LIPROSY AREA/09	1/273	15	0	15
66		NEW SHYAM BAJAR/12	1/275	351	0	351
67		NO. 04 PIT AREA/11	1/276	NA		
68		SHYAM BAZAR/08	1/277	362	0	362
69		TETULMARI VILL./04	1/278	309	161	148
70		22/12 COLONY/05	2/252	287	4	283
71		KAJRI BAGAN	2/254	14	0	14
72		JOGTA UPPER	2/253	204	0	204
73		6/10 COLONY	2/251	105	0	105
74		NEPAI DHOWRAH	1/274	193	0	193
75	**NICHITPUR**	NICHITPUR BASTEE	1/280	153	0	153
76		HARD COKE BHATTA/03	1/279	NA		
77		STAFF QTRS./04	1/281	NA		
78		STAFF QTRS./05	1/282	NA		
		Total		**9736**	**599**	**9137**

ANNEXURE 6:

ENVIRONMENTAL ACTION PLAN & ITS IMPLEMENTATION

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED, DHANBAD

An action plan has been formulated for all the clusters of Bharat Coking Coal Limited. The salient features and its implementation status for Sijua Area are tabulated below: -

IMPLEMENTATION STATUS OF ACTION PLAN FOR SIJUA AREA

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
1	Air Pollution Control measures	*Covered Transportation* A) Responsibility of CISF personnel appointed at weigh-bridge will be to maintain a Register for tarpaulin covering of coal loaded trucks. B) GMs of respective areas will insure the implementation of the above within 15 days of order/Action Plan released. C) **CMC Deptt:** New contracts should have penal provisions for violation of Environmental Guidelines	• Letter for ensuring tarpaulin covered transportation of coal-loaded trucks by maintaining a register for the same by the CISF personnel appointed at weigh bridges has been sent to Assistant Commandant (CISF), Sijua Area. • Letter has been sent to all the transporters engaged in coal transportation in Sijua Area to ensure 100% covered coal transportation.	NA	Tarpaulin-covered Coal transportation is being done. 
2		*Permanent Pucca Transportation Road* *A)* Roads under BCCL will be Paved/Black topped in Non-Coal Bearing Area *B) Cost Estimate:* Area Civil Engineer (4 Months) *C) Capital Indent:* Area Civil Engineer (3 Months) *D) Approvals/Tender/ Work start and completion:* Area Civil Deptt. & CED, HQ (**12 Months**)	• Transportation roads in Sijua Area are mostly located above coal bearing areas. • The roads over coal bearing areas are regularly graded and strengthened. • Roads are paved/black-topped wherever feasible as in Bansdeopur, Loyabad, etc.	NA	NA

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
3		***Drilling with Dust extractor/wet drilling*** ***A)*** All Existing drills are equipped with dust containment or water injection system. All new procurements of drills shall be with dust containment system. ***B)*** *Cost Estimate*:Excavation Deptt. ***C)*** *Capital Indent*: Excavation Deptt. ***D)*** *Approvals/Tender/ Work start and completion*: E&M Deptt.	• Wet drilling is being done in the OCPs of Sijua Area.	NA	
4		***Fixed Sprinkling arrangements at Siding (preferably at height)*** ***A)*** Fixed sprinklers shall be installed ***B)*** *Cost Estimate*: Siding in-charge & Area E&M Manager, E&M In-charge Washery (3 **Months**) ***C)*** *Capital Indent*: Colliery Manager & Area E&M Manager, Area Env. Engineer/ Project officer (Washery) (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: Area E&M Deptt. & MM deptt, HQ (7 **Months**)	• 34 nos. of rotating fixed water sprinklers have been installed at Bansjora Railway siding. Presently, the water pipeline for the sprinklers are under repair and maintenance.		

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
5		*Overhead sprinklers at Loading site* *A)* At loading points overhead water showering arrangement shall be provided. *B)* *Cost Estimate:* Colliery Engineer& Area E&M Manager (**2 Months**) *C)* *Capital Indent:* Colliery Manager &Area E&M Manager (**2Months**) *D)* *Approvals/Tender/ Work start and completion:* Area E&M Deptt.& Project officer (**7 Months**)	• Overhead water showering arrangements have been installed at Sendra Bansjora Colliery to wet the coal loaded vehicles going to both the CHP as well as the weighbridge. Presently, the water pipeline for the same is under repair and maintenance.	NA	
6		***Mobile sprinklers/ Mist Sprinkler*** *A)* Mobile sprinklers trips will be increased and Mist sprinklers will be done *B)* *Cost Estimate:* E&M Deptt., HQ(**3 Months**) *C)* *Capital Indent:* Area E&M Manager (**2Months**) *D)* *Approvals/Tender/ Work start and completion:* MM deptt, HQ (**6 Months**)	• Two Mobile Mist Sprinklers are operational in Nichitpur and Tetulmari Collieries.	NA	
7		***Wheel washing ditches after weigh-bridge for tire cleansing*** *A)* Wheel washing arrangement shall be provided at Weigh- Bridge site *B)* *Cost Estimate:* Colliery Manager & Area Civil Engineer (32 **Months**) *C)* *Capital Indent:* Colliery Manager, Project officer & Area Civil Engineer (**2Months**) *D)* *Approvals/Tender/ Work start and completion:* Area E&M Deptt. & MM deptt, HQ (**6 Months**)	• The construction of wheel-washing ditch facility is in progress at Sendra Bansjora.	NA	

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
8		***Enclosure of CHP/covered crushing*** **A)** CHP/Crushers shall be covered **B)** *Cost Estimate:* Area Manager Transport & Area E&M Manager (**2 Months**) **C)** *Capital Indent:* Colliery Manager & Project officer (**2Months**) **D)** *Approvals/Tender/ Work start and completion:* Area E&M Deptt. & MM deptt, HQ (**6 Months**)	• CHPs have been enclosed at Sendra Bansjora.	NA	
9		***Grass covering over inactive OB dumps.*** **A)** Inactive OB dumps shall be identified and will be covered with grass **B)** *Cost Estimate:* Area Environment Engineer (**2 Months**) **C)** *Proposal:* HQ Env Deptt. (**2Months**) **D)** *Approvals/Tender/ Work start and completion:* HQ, Env Deptt. (**6 Months**)	• Grass covering work on dormant OB dumps is being done.	NA	
10		***Building boundaries around railway siding made of coconut choirs or GI sheets.*** **A)** Railway sidings will be surrounded with boundaries of GI Sheets/Coconut coir/Jute Cloths B) *Cost Estimate:* Siding in-charge & Area Civil Manager (**2 Months**) C) *Capital Indent:* Colliery Manager & Project officer (**2Months**) **D)** *Approvals/Tender/ Work start and completion:* Area E&M Deptt. & MM deptt, HQ (**6 Months**)	• Railway siding at Bansjora were provided with fabric wind barrier. However, the structure has fallen down due to heavy winds and rains. Permission has been sought from DRM, ECR, Dhanbad for installation of wind breaking wall at Bansjora Siding.	NA	

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
11		***Introducing Bioswale as Pilot Project*** A) Cost Estimate: GM Civil, CED, HQ B) Capital Indent: GM Civil, CED,HQ C) Approval/Tender/Work start and completion: CED, HQ	• The work of Bioswale is a pilot project and it has been planned in two other areas of BCCL.	NA	NA
12		***Fiery coal/OB should be dumped in-pit/ wetted completely before transporting*** *A)* Fiery coal shall not be transported on elevated OB dumps and shall be dumped in-pit/ transported after complete wetting B) Project officer & Area manager planning to site the location prior to excavating fiery coal/OB. *C)* Water Pools to be used for drenching of fire and wetting of fiery coal/OB *D)* Strict instructions to be issued from Functional Technical Directors.	• Water quenching arrangement has been made on the benches of Coal and OB at Sendra Bansjora, Bansdeopur & Kankanee OCPs.	NA	
13		***Pollution under control Certificate to be ensured by Transporter/ BCCL transport in-charge*** A) *CMC Deptt: To be included in contracts of transporter* B) *Area Transport in-Charge shall ensure PUC is issued to all plying vehicles*	• PUC certificates for the vehicles are being collected to ensure their existing validity dates.	NA	
14	Inspection / Monitoring measures / Complaint	***AAQ Monitoring*** A) 39 Air and Noise Monitoring Stations in JCF B) Stations established in consultation with JSPCB	• AAQ monitoring is being done in Sijua area by CMPDIL at the stations established in consultation with JSPCB.	NA	NA

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
	Redressal				
15		***COAAQMS,*** A) COAAQMS shall be installed at Jagjeevan Nagar B) *Cost Estimate:* CMPDIL, RI-II, Dhanbad **(2 Months)** C) *Capital Indent:* CMPDIL, RI-II, Dhanbad **(2Months)** *D) Approvals/Tender/ Work start and completion:* CMPDIL, RI-II, Dhanbad **(6 Months)** ***Online PM10 Analyser*** Online PM10 Analyzer shall be installed at Mines and Railway sidings *A) Cost Estimate:* Area Environment Manager **(2 Months)** *B) Capital Indent:* Colliery Manager **(2Months)** *C) Approvals/Tender/ Work start and completion:* MM Deptt, HQ **(6 Months)**	• The installation of PM_{10} analyzers in Cluster V is in process.	NA	
16		***Source Apportionment Study*** Work awarded to NEERI, Nagpur on 12.05.2018. Monitoring work started Final report shall be submitted in One year	• The work of Source Apportionment Study for the entire BCCL has been done by NEERI, Nagpur. A draft final report has been submitted.	NA	NA

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
17		***HQ Environment Deptt. review and report the status of compliances to FDs and Board*** • Structured Meetings with All Areas/washeries • Inspection of Areas by HQ, Compliance Team	• The review and reporting of the status of compliances to FDs and Board is being done at HQ level.	NA	
18		***All the areas to inspect each other's progress monitored under Environment Department, HQ*** A) Schedule and teams already formulated for inspections	• Inter-Area inspection of EC compliances has been done.	NA	• Inter- Area Inspection in Sijua Area(Cluster V) being done by Katras Environmental Committee. 
19		***An Inspecting team to be formed consisting local activist/NGO for regular inspection of above practices*** A) Area Environment Committee to be formulated for monitoring of Environment Compliances (1 Month)	• A modification in **Serial no.-19** of the action plan has been sought.	NA	NA

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
20	Water Environment	***Township wise STP/ETP*** **A)** STP will be installed in Koyla Nagar, Jagjeevan Nagar with 2 MLD capacity **DMC will collect septage for whole Jharia and Koyla Nagar, Bhuli Township** B) *Cost Estimate:* CED, HQ (3 **Months**) C) *Capital Indent:* CED, HQ (**2Months**) **D)** *Approvals/Tender/ Work start and completion:* CED,HQ (12 **Months**)	NA	NA	NA
21		***Workshop effluents treatment*** **A)** Oil & Grease Trap B) *Cost Estimate:* Workshop In-charge (2 **Months**) C) *Capital Indent:* Workshop in-charge & Area Civil Engineer (**2Months**) **D)** *Approvals/Tender/ Work start and completion:* CED, HQ (8 **Months**)	• Oil & Grease traps have been installed at Tetulmari and Nichitpur Workshops.	NA	
22		***Garland Drains/Retaining Walls around OB Dumps*** A) *Cost Estimate:* Area Civil Engineer & Area Survey officer (2 **Months**) B) *Capital Indent:* Area Civil Engineer, Area Environment Manager & Area Survey Officer (**2Months**) **C)** *Approvals/Tender/ Work start and completion:* CED, HQ (8 **Months**)	• The proposal for construction of retaining wall and garland drain-cum-settling ponds around OB dumps and Coal dumps is in process.	NA	

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
23	Others	***Biodiversity*** Plantation over OB dumps/Backfilled Areas/ Avenue & Boundary Plantation स्नेह स्मृति उपवन shall be developed in all areas	Plantation is being carried out in the available spaces for creation of thick green belt and to increase tree cover in Cluster V. Three OB dumps covering total area of 13.1 Ha have been ecologically restored to create thick green belts in Tetulmari & Nichitpur collieries. In 2018-19. Three OB dumps covering total area of 32.0 Ha in Loyabad & Bansdeopur Collieries have been taken up for biological reclamation. 1320 nos. of avenue plantation have been done alongside road on both sides from Shakti Chowk to Mohlidih. 560 nos. of bamboo gabion plantations on both sides of the road from Subhash Chowk to Naya More and from Sendra More to Kerkend More has been done in 2021-22. Plantation has also been carried out along the quarry edges and at the mine view-points. Dormant OB dumps covering total area of 75.61 Ha in Sendra Bansjora, Nichitpur, Bansdeopur, Mudidih & Loyabad Collieries have been taken up for greening through grasses and native shrubs.		  

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
			18,000 plants have been planted along the banks of Ekra Jore in Cluster V. A park-cum-nursery is being developed at Kankanee Colliery. An area of total 13.1 Ha has been taken up for biological reclamation in 2021-22 at Nichitpur Colliery where the preparatory works are being done. Plantation drives have also been conducted in colonies and in schools within and peripheral to the leasehold of Cluster V to increase tree cover.		 

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 30.09.2021	Moved Proposal No. (If any)	Proposal status
24		**Mechanical Sweeper** Proposal: CSR Deptt. Handed over to Dhanbad Municipal Corporation	• To be done under CSR through Dhanbad Municipal Corporation.	NA	NA

ANNEXURE 7:

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Study to Analyze the Extent of Reduction of Pollution Load Every Year by reducing Coal Transportation by Road

CLUSTER V GROUP OF MINES

(Tetulmari(UG&OC), Mudidih(UG&OC), Nichitpur OC, Sendra Bansjora(UG&OC) , Basdeopur(UG&OC) , Loyabad , Kankanee(UG&OC)

Normative Production	: 4.854 MTPA
Peak Production	: 6.311 MTPA
Lease Hold Area	: 1957.08 Ha

Bharat Coking Coal Limited

(October, 2017)

Prepared by

Environment Division

Central Mine Planning & Design Institute Limited

CMPDI (HQ)

Gondwana Place

Kanke Road, Ranchi-834008

CONTENTS

Chapter – I

Introduction

1.1 Genesis:

MOEF provided Environmental Clearance to the various mines of the Cluster J-11015/01/2011-IA.II (M) dated 11 Feb 13

As per the Environmental Clearance Conditions given by the Ministry of Environment & Forest "A study should be initiated to analyse extent of reduction in pollution load every year by reducing road transport of coal". Therefore the present study has been carried out to quantify the pollution load due to coal transportation.

1.2 Methodology:

In order to find out the pollution load due to coal transportation a Questionnaire was developed by the Environment Division of CMPDI Headquarter and Regional Institute –II, Dhanbad. The Questionnaire was circulated to the various mines of BCCL for collection of the requisite inputs for this study. The quantification of pollution load for PM-10 has been carried out on the basis of the field visit, data provided by BCCL officials and interaction with them.

1.3 General Information about the Cluster:

1.3.1 Brief Description:

Cluster V (7 mines of 4.854 MTPA (Normative) and 6.311 MTPA (Peak) production of MTPA in a combined ML area of 1957.08 ha consists of Tetulmari(UG&OC), Mudidih(UG&OC), Nichitpur OC, Sendra Bansjora(UG&OC) , Basdeopur(UG&OC) , Loyabad , Kankanee(UG&OC) . These mines are taken over by BCCL from private mine owners after nationalization through Coal Mines Nationalization Act, 1972-73. BCCL is the proponent of the cluster and it is under the administrative control of Coal India Limited.

1.3.2 Nature and Size of the Cluster:

Cluster-V group of mines of BCCL is a group of seven mines consisting of one opencast mine, one underground mine with proposed OCP in the same leasehold, four mixed operating mines and one closed mine in the Jharia Coalfield of the Bharat Coking Coal Limited in the Dhanbad District of Jharkhand State.

The details of the mines showing normative/ peak productions, lease hold areas and life are given in Table no. 1.1.

Table 1.1: Details of the Mines of Cluster –V

Sl No	Name of Mine	Production Capacity (MTY)		Lease Hold Area (Ha)
		Normative	Peak	
	Tetulmari(UG&OC)	0.795	1.033	317.00
	Mudidih(UG&OC)	1.553	2.019	378.05
	Nichitpur OC	0.600	0.780	249.63
	Sendra Bansjora(UG&OC)	0.750	0.975	258.12
	Basdeopur(UG&OC)	0.678	0.879	104.72
	Loyabad	0.000	0.000	499.56
	Kankanee(UG&OC)	0.480	0.624	150.00
		4.854	6.311	1957.08

1.3.3 Impact of Fire Control on Ambient Air Quality:

Due to unscientific mining prior to nationalization there are unstable sites identified in the BCCL. Out of 595 unstable sites identified in the Master Plan, 77 sites with an area of 138.34 ha consisting of 5835 nos. of houses/families are affected. The affected families will be rehabilitated in adjacent non coal bearing area at a cost of Rs. 104024.9 lakhs.

1.3.4 Impact of Resettlement on Ambient Air Quality:

As per Jharia Action Plan (JAP) household will be shifted for implementation of master plan. The reduction in number of households within the leasehold area of Cluster will lead to reduction in generation of air pollutants due to reduction in movement of man & materials apart from decrease in consumption of coal as a domestic fuel. As per Jharia Action Plan (JAP) household will be shifted as per for implementation.

1.4 Meteorological Data

A meteorological data generated during 1st January 16 to 31st March 2016 has been presented in this report .The micro meteorological set up was established at the roof of BCCL Dugda Guest house and parameters like temperature, relative humidity, wind speed and directions, cloud cover and rainfall were recorded. The data were collected on hourly basis during the entire study period.

Generally, moderate winds prevailed throughout the study period. The wind velocity ranged between ≤ 0.5 m/s to 13.2 m/s. The seasonal average wind speed was observed to be 0.69 m/s. Wind-roses were made by using latest WRPLOT View of Lakes Environmental Software.

The analysis of wind pattern during the season showed that the predominant wind directions were from North-West & West followed by North-East having frequencies 15.71%, 11.45% & 4.67% respectively.The receptors located in the Downwind directions i.e. SE and East from the dust generating sources are likely to be affected. The dispersion of air borne dust during calm period (45% of time) will be very poor and buildup of pollutant concentration during this period will occur.

The maximum temperature recorded was 39.3^{0}C and the minimum was 6.2^{0}C. The daily average relative humidity values were in the range of 32.2 to 65.0%. The sky was mostly clear during the study period. The average atmospheric pressure value has been found to be around 732.3 mm Hg. Total 94.5mm rainfall was recorded during the study period. The average rainfall during the season was found to be 1.04 mm.

Table 1.2: SEASONAL WIND DISTRIBUTION

Period: 01st JAN.'2016 – 31stMAR.'2016

Wind Direction	Wind Velocity (m/s) & Duration (%)				
	< 0.5	0.6 -1.5	1.6 -3.5	>3.5	Total
N		1.61	0.78	0.00	2.38
NNE		0.83	0.37	0.00	1.19
NE		3.17	1.47	0.05	4.67
ENE		0.41	0.14	0.00	0.55
E		1.10	0.69	0.00	1.79
ESE		0.50	0.37	0.00	0.87
SE		1.28	0.41	0.05	1.74
SSE		0.64	0.18	0.00	0.82
S		0.41	0.09	0.00	0.50
SSW		0.28	0.05	0.00	0.32
SW		2.29	0.60	0.00	2.88
WSW		1.06	0.41	0.00	1.47
W		8.99	2.48	0.00	11.45
WNW		1.24	1.01	0.00	2.24
NW		11.47	4.22	0.05	15.71
NNW		2.11	0.73	0.00	2.84
CALM	48.40	-	-	-	48.40
Total	48.40	37.32	13.97	0.15	100

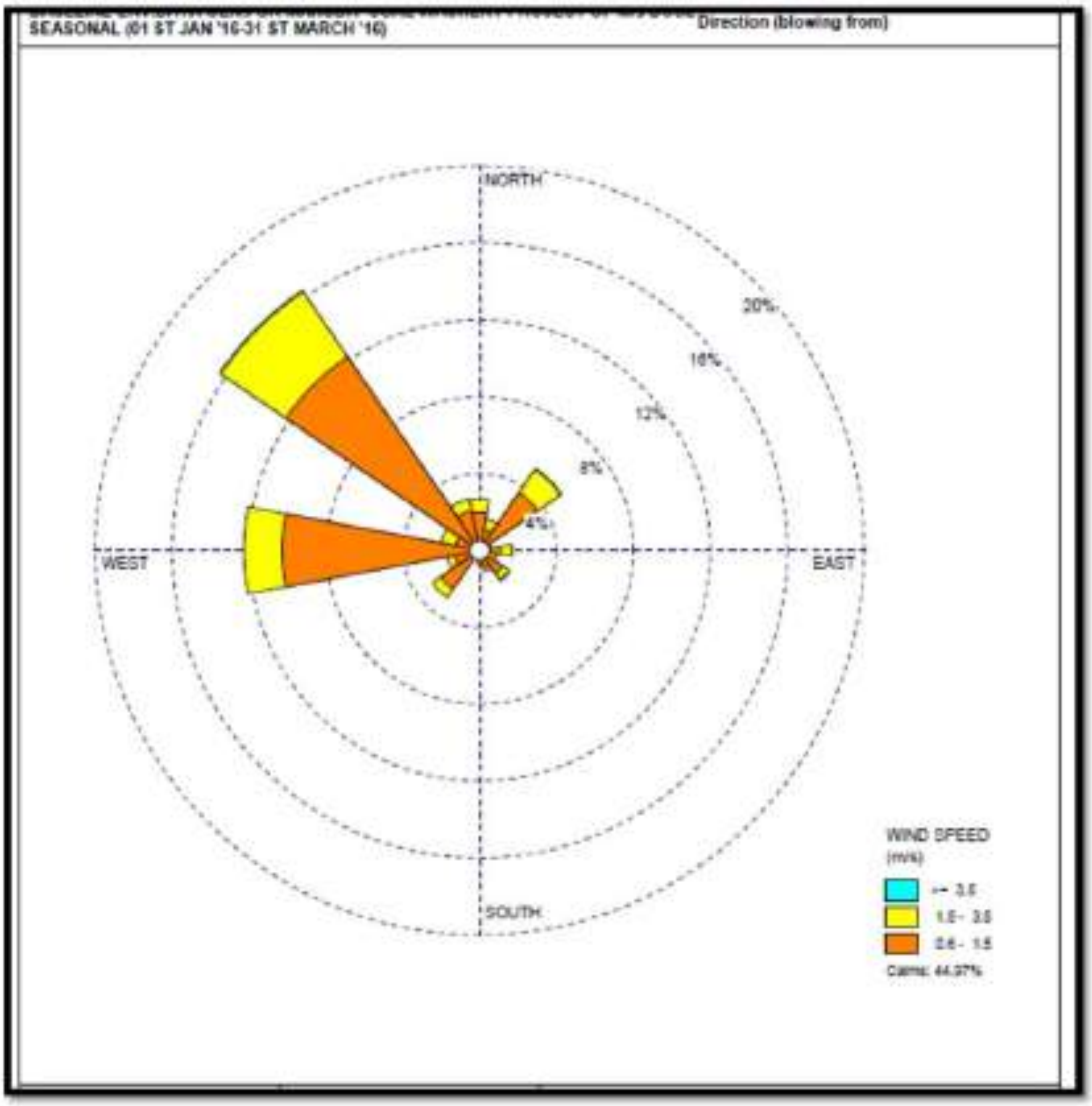


Figure No.-1.1 Wind Rose diagram for the period 1St Jan to 31St March 2016

Chapter – II

Fugitive Dust Generation Due To Movement of Coal

2.1 Introduction

The coal produced moves to the consumers via Road & Rail. Coal from the mine face is brought to the surface dumps and bulk of it goes to the nearby railway sidings for further movement to the consumer- end through rail. The journey from the mine face to the railway siding is covered by road. A portion of the coal produced by the mine directly goes to the consumers via road. Transportation of coal by rail is an environmentally better option than the road transportation. Road Transportation results in generation of fugitive dust from road surface apart from other pollutants released due to consumption of Diesel.

The fugitive dust generated due to coal transportation through road depend upon the following factors:

1. Speed and Weight of the moving vehicles.
2. Silt Content of the Road Dust (Particles less than 200 mesh size is considered as silt)
3. Silt loading of the road dust (Kg/m^2).
4. Moisture Content of the dust lying on the road surface.
5. Ambient Temperature, Humidity & wind velocity.

The dust generation will be lower if the quantity of dust (silt loading) lying on the road surface is minimum and the moisture content of the loose material lying on the road surface is high.

2.2 Movement of Coal

Distance travelled by coal and subsequent release of fugitive dust during its journey towards the consumer end has been described and dust load has been worked out for the year 2013-14, 2014-15 and 2015-16.

2.2.1 Dust generated per day (Kg/Day)

Table: 2.1 Dust Generation (Kg/day)

Name of the Mine	Year	Location	Distance from Face to Siding (Km)	Coal Transferred (Te)	Daily Coal Production (Te/Day)	Capacity of the Dumper	Vehicle Kilometer Travelled	Emission Rate for PM 10 (kg/VKT)	Pollution Load * Dust Generated Per Day (Kg/day)	Dust generated Kg/per tonne
Tetulmari(UG&OC)	13-14	Bansjora Railway Siding	1.80	1260031	3818.00	20.00	687.24	0.53	364.237	
		Total for 13-14			**3818.00**				**364.237**	0.10
	14-15	Bansjora Railway Siding	1.80	1218852	3693.00	20.00	664.74	0.53	352.312	
		Total for 14-15			**3693.00**				**352.312**	0.10
	15-16	Bansjora Railway Siding	1.80	731352	2216.00	20.00	398.88	0.53	211.406	
		Total for 15-16			**2216.00**				**211.406**	0.10
Mudidih Colliery	13-14	Bansjora Railway Siding	2.50	506882	1536.00	20.00	384.00	0.53	203.520	
		Total for 13-14			**1536.00**				**203.520**	0.13
	14-15	Bansjora Railway Siding	2.50	451164	1367.00	20.00	341.75	0.53	181.128	
		Total for 14-15			**1367.00**				**181.128**	0.13

Name of the Mine	Year	Location	Distance from Face to Siding (Km)	Coal Transferred (Te)	Daily Coal Production (Te/Day)	Capacity of the Dumper	Vehicle Kilometer Travelled	Emission Rate for PM 10 (kg/VKT)	Pollution Load * Dust Generated Per Day (Kg/day)	Dust generated Kg/per tonne
	15-16	Bansjora Railway Siding	2.50	48517	147.00	20.00	36.75	0.53	19.478	
		Total for 15-16			**147.00**				**19.478**	0.13
Nichitpur Colliery	13-14	Bansjora Railway Siding	2.80	363228	1101.00	20.00	308.28	0.53	163.388	
		Total for 13-14			**1101.00**				**163.388**	0.15
	14-15	Bansjora Railway Siding	2.80	286570	868.00	20.00	243.04	0.53	128.811	
		Total for 14-15			**868.00**				**128.811**	0.15
	15-16	Bansjora Railway Siding	2.80	618578	1874.00	20.00	524.72	0.53	278.102	
		Total for 15-16			**1874.00**				**278.102**	0.15
Sendra Bansjora(UG&OC)	13-14	Bansjora Railway Siding	0.20	557703	1690.00	20.00	33.80	0.53	17.914	
		Total for 13-14			**1690.00**				**17.914**	0.01
	14-15	Bansjora Railway Siding	0.20	638280	1934.00	20.00	38.68	0.53	20.500	
		Total for 14-15			**1934.00**				**20.500**	0.01
	15-16	Bansjora Railway Siding	0.20	831701	2520.00	20.00	50.40	0.53	26.712	
		Total for 15-16			**2520.00**				**26.712**	0.01
Ka nk	13-14	Jogta Railway Siding	0.20	0	0.00	20.00	0.00	0.53	0.000	

Name of the Mine	Year	Location	Distance from Face to Siding (Km)	Coal Transferred (Te)	Daily Coal Production (Te/Day)	Capacity of the Dumper	Vehicle Kilometer Travelled	Emission Rate for PM 10 (kg/VKT)	Pollution Load * Dust Generated Per Day (Kg/day)	Dust generated Kg/per tonne
		Total for 13-14			**0.00**				**0.000**	0.00
	14-15	Jogta Railway Siding	0.20	83425	253.00	20.00	5.06	0.53	2.682	
		Total for 14-15			**253.00**				**2.682**	0.01
	15-16	Jogta Railway Siding	0.20	561658	1702.00	20.00	34.04	0.53	18.041	
		Total for 15-16			**1702.00**				**18.041**	0.01

* In terms of PM 10 expressed as kg/day, ** Average distance has been considered, *** Capacities of Dumpers used in transportation of coal from face to siding taken as 30Te, to Washery 20Te, and Outside Transport 15 Te. ..## Emission rate for PM_{10} has been taken from the S&T work (funded by MoC) carried out by CMPDI during 2002-2007.

2.3 Optimum Coal Transportation scheme in the Present Scenario:

Phase – I (for 10 + 05 Years)

As suggested by the Environmental Appraisal Committee, it is proposed to continue the existing Road–Rail transport network system in view of the implementation of the Jharia Action Plan(JAP) for 10 years and another 05 years gestation period after the completion of the JAP for consolidation of the backfilled dug out fire areas and unstable areas is required. Thus the period of 15 years, make the Phase – I. All mitigation measures like covered trucks, green belting on either side of the road, enhanced water sprinkling, proper maintenance of roads, removal of spilled materials etc shall be adopted for 15 years with the existing road – rails transport system.

2.4 Conceptual Plan of Proposed Integrated Coal Transportation Network forthe Cluster:

Phase – II (after 15 Years):

As suggested by the EAC Members, BCCL shall implement conveyor –cum-rail transport to avoid movement of trucks within the cluster for coal transportation in Phase –II. Loading of coal by pay–loaders shall be discontinued.

During 2015-16, the combined daily coal production of the Cluster was 8459.00 tones resulting in 3362 kg of daily fugitive dust generation. The dust (PM-10) generation rate at present is 0.40 kg/te.

As a result of replacement of existing road transportation of coal by Conveyor to railway siding will result in reduction of fugitive dust generation to the extent of 760189 kg/day for daily coal production of 1912424 tonnes (6.311 MTY) during Phase –II.

Table 2.2: Proposed Infrastructure for Coal Transportation (phase – II)

Cluster	Mines in Operation in Phase - II	Production Capacity (MTY)	Proposed Transport Infrastructure in Phase – II
V	Cluster -V	6.311	**Coal transport by Conveyor to Railway Siding**
	Total	6.311= 1912424 tonnes /Day	

2.5 Conclusion:

On the basis of the study undertaken to assess the impact of coal transportation on pollution load, the followings may be concluded:

Phase – I :(2013-14 to 2028 -29):

1. During Phase – I, business as usual (BAU) scenario will prevail and the existing road cum rail transport network system will be used for coal dispatch to the consumers. During 2015-16, the combined daily coal production of the Cluster was 8459.00 tones resulting in 3362 kg of daily fugitive dust generation. The dust (PM-10) generation rate at present is 0.40 kg/te.
2. The generation of fugitive dust due to transportation of coal by road can be further reduced by enforcing covering of loaded trucks, periodical removal of loose materials lying on the road surface and black topping of coal transportation roads.
3. Avenue plantation, effective wetting of the road surface and proper maintenance of roads will further result in mitigation of the impact of road generated dust on ambient air quality.
4. Better road condition, by the use of Mechanical Sweeper or vacuum cleaner dust generation may be minimized.

Phase – II :(From 2029-30 Onwards):

1. As a result of replacement of existing road transportation of coal by Conveyor to railway siding will result in reduction of fugitive dust generation to the extent of 760189 kg/day for daily coal production of 1912424 tonnes (6.311 MTY) during Phase –II.
2. During Phase –II, dust load will further reduce due to quenching of mine fire and domestic coal consumption after resettlement of general population dwelling within the command area of cluster, as a result of implementation of Jharia Action Plan. It will result in significant improvement in ambient air quality.
3. **Coal Production Vs. Dust Generation due to Road Transportation is presented below:**

Table2.3: Coal Production Vs. Dust Generation due to Road Transportation

Year	Coal Production (Te/day)	Dust Generation(Kg/Day)
2015-16 (By Road transportation)	8459.00	3362
2029-30 (Considering peak production and all the coal transported through Road)	1912424	760189
2029-30(By Conveyor Transportation)	1912424	0

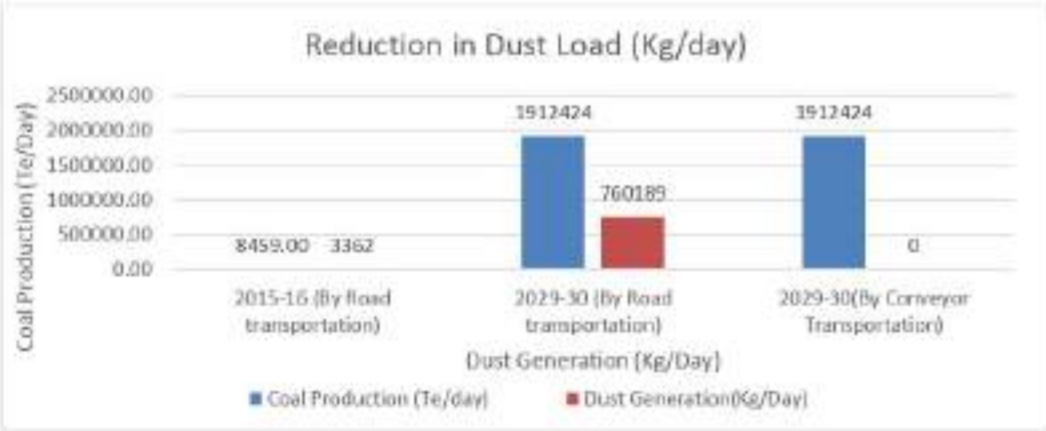
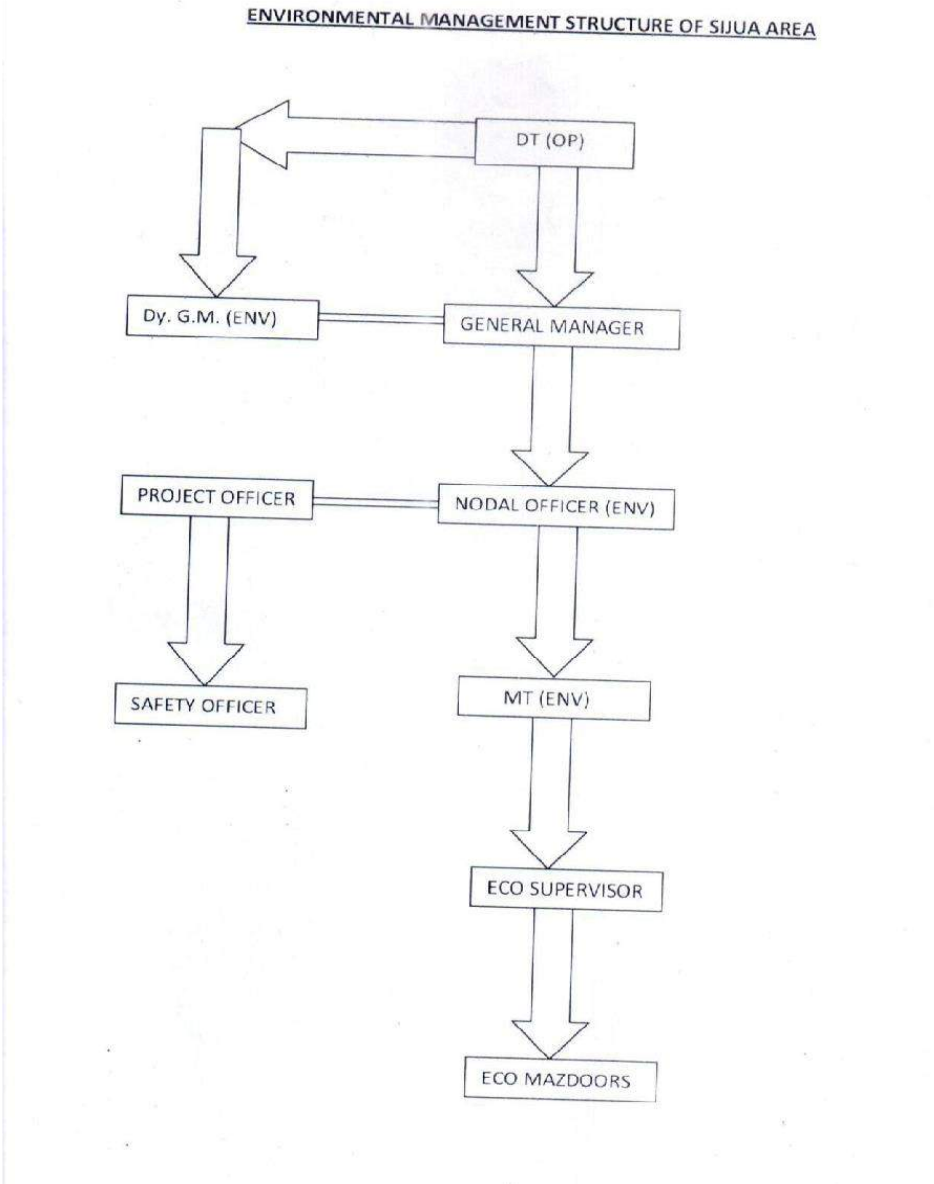


Figure 2.1: Presentation of reduction in dust generation due to replacement of Road transportation by Conveyor system.

ANNEXURE 8:


ENVIRONMENTAL MANAGEMENT STRUCTURE OF SIJUA AREA
DT (OP)
Dy. G.M. (ENV)
GENERAL MANAGER
PROJECT OFFICER
NODAL OFFICER (ENV)
SAFETY OFFICER
MT (ENV)
ECO SUPERVISOR
ECO MAZDOORS

List of officers associated with the Environmental Management and Community Development activities in Cluster V:

S. No.	Name	Designation	Educational Qualification
1	Sri Rajesh Ranjan	Dy. Manager (Env.)	B. Tech (Environmental Engineering)
2	Sri Anant Vijay Kumar	Asst. Manager (Env.)	M. Tech (Environmental Engineering)
3	Sri Paramjeet Ranjan	Asst. Manager (Community Development)	Masters (Rural Development)
4	Sri Binod Sinha	Manager (Mining)	Diploma (Mining)
5	Sri Manoj Kumar Sharma	Manager (Mining)	Diploma (Mining)
6	Sri S.K. Chaudhary	Manager(Mining)	Diploma (Mining)
7	Sri A.K. Mehta	Manager(Mining)	Diploma (Mining)
8	Sri Mehul Solanki	Asst. Manager(Mining)	B.Tech (Mining)

Composition of Area Level Environmental Committee of Cluster V

S. No.	Designation of the member
1	General Manager
2	Addl. General Manager
3	Area Manager (Environment)
4	Area Manager (Safety)
5	Area Manager (Planning)
6	Area Manager (Excavation)
7	Area Manager (Personnel)
8	Area Manager (Civil)
9	Area Manager (E&M)

ANNEXURE 9- PLAN AND LETTER RATIFIED BY THE REGIONAL OFFICER, JHARKHAND STATE POLLUTION CONTROL BOARD

(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.

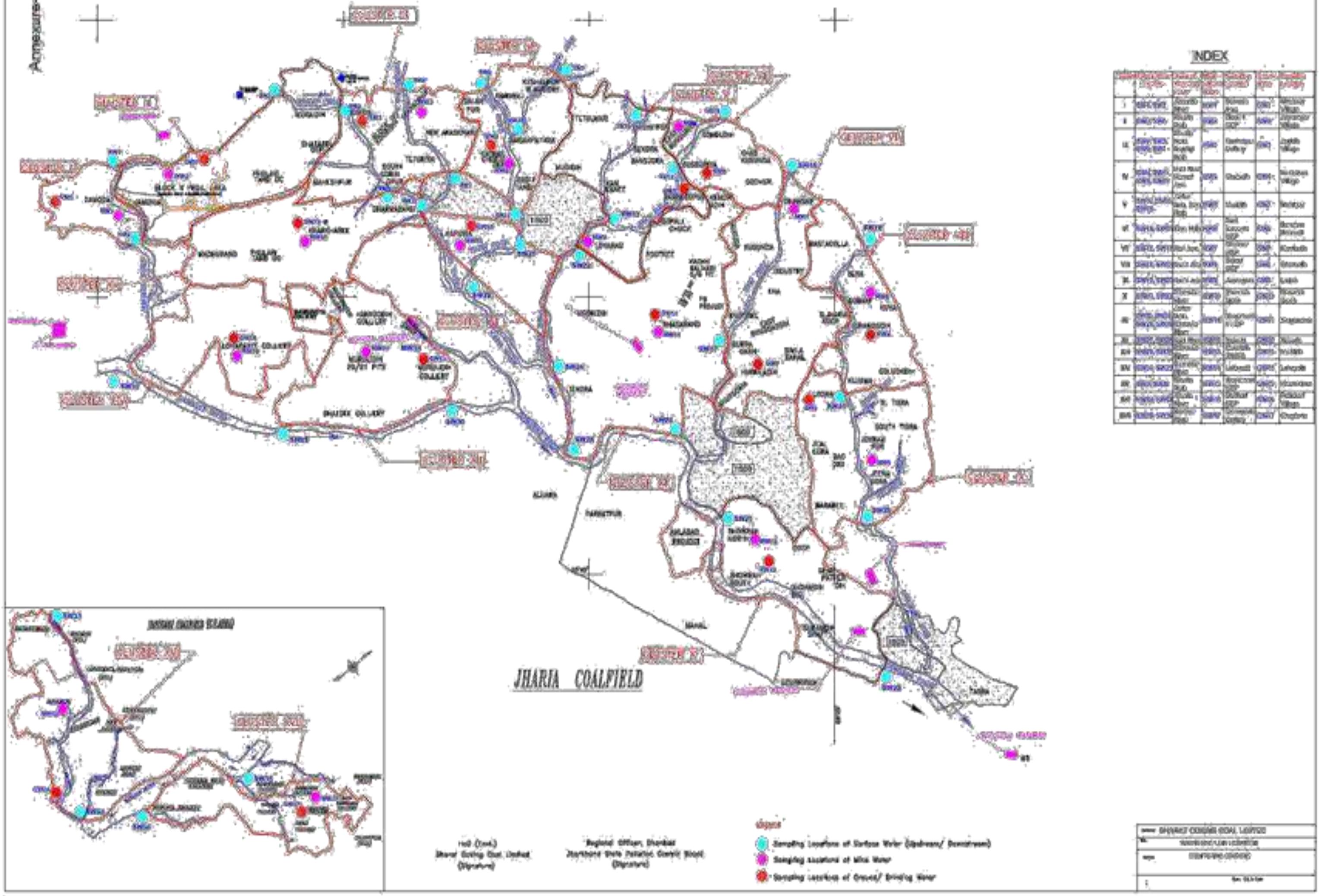
Encl-A/a.

(Dinesh Pd. Singh)
Regional Officer.

Printed by Sandip

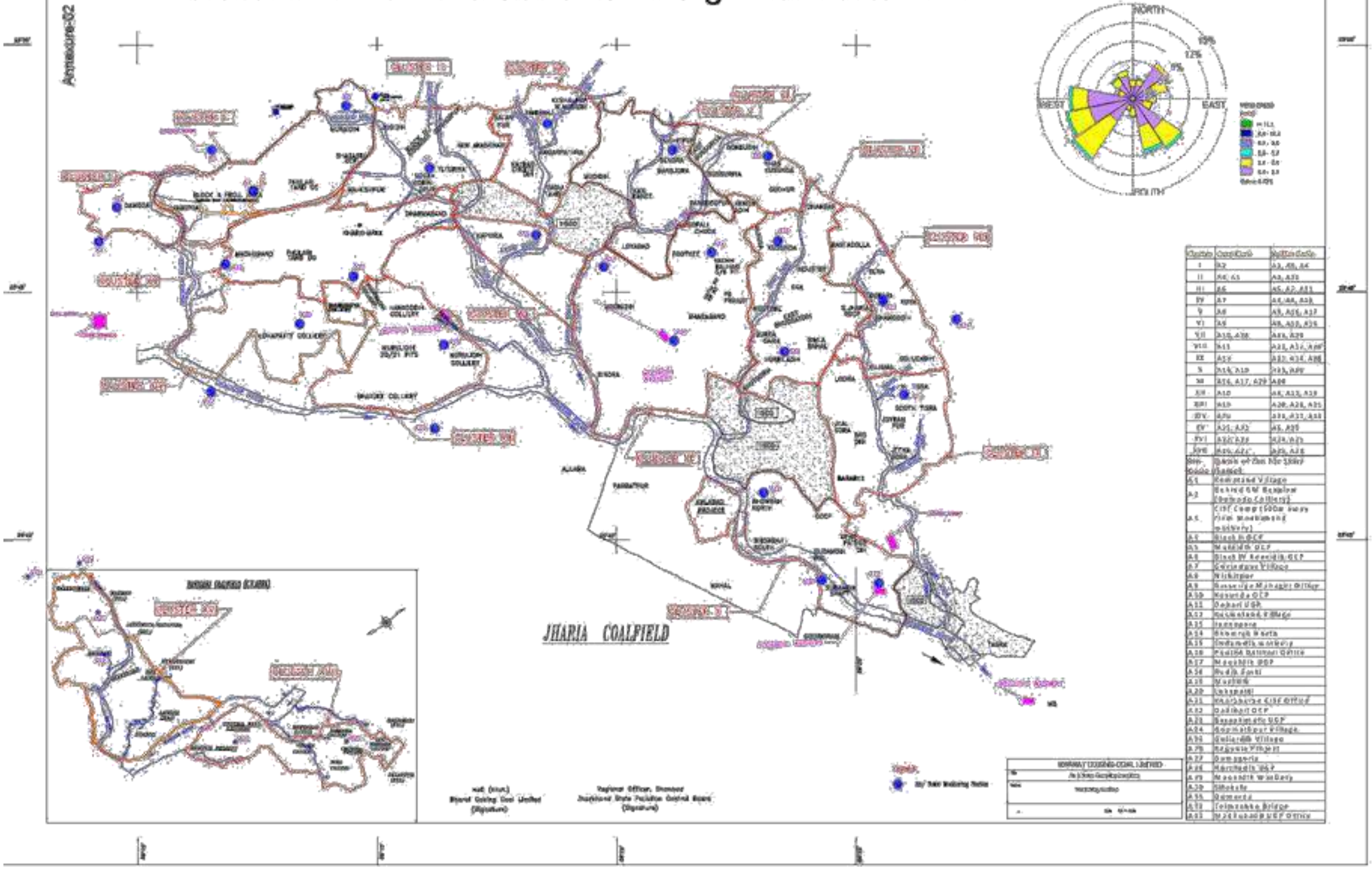
Annexure-03

Water Sampling Locations in BCCL



Annexure-02

Location of Air & Noise Monitoring Stations in BCCL



ANNEXURE 10- DRAFT FINAL REPORT OF NEERI, NAGPUR FOR SOURCE APPORTIONMENT STUDY

"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

Contents

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Chapter 1
Introduction

Dhanbad lies between 23°37'3" N and 24°4' N latitude and between 86°6'30" E and 86°50' E longitude (Figure 1.1). It has 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 part, Dumka and Giridih in the North, Bokaro in the West. It is the administrative headquarter of the district and Dhanbad Municipal Corporation (DMC). Dhanbad comes under Chota–Nagpur plateau. It is mainly known as "the Coal Capital of India" or "Coal City" and is the third largest city in Jharkhand State. Tata Steel, BCCL, ECL and IISCO are some of the companies having coal mines in the district. These companies have developed townships for their employees. Besides, there is a number of rural areas where ethnic people are residing. It comes under the Grand Chord rail line in between Delhi to Kolkata. Road Link is on Grand Trunk road (NH–2), which is now converted into Four Lane Golden Quadrilateral.

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 Dhanbad in India

1.1. Climate

Dhanbad city 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 averages temperature 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%) (shown in Figure 1.2).

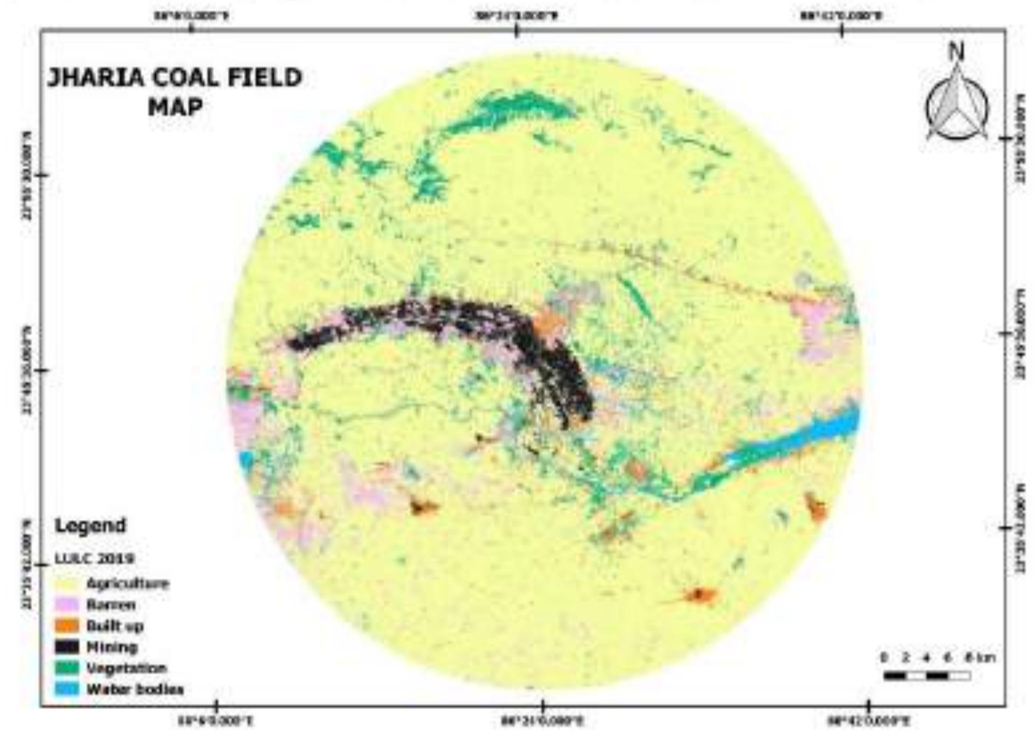


Figure 1.2: Land Use land cover map of Jharia coal field area.

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 (1710.2 sq km), Bokaro (620.43sq km), Giridih 29.8 (sq km) in Jharkhand and Puruliya 465.85 (sq 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 the natural resource 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, etc. The percentage contribution of these factors in the ambient depends exclusively on particular region's economic activities. In order 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 in order 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 following:

i. Ambient Air Monitoring
   - Monitoring of ambient air quality at selected receptor locations for pollutants including PM_{10}, $PM_{2.5}$(limited), SO_2, NOx, 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 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 own 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 of air pollutants at 13 locations at Jharia Coalfield using various instruments and multiple analyses. These locations were selected on the basis of land use and activity profile. All monitoring was carried out using varied instruments and all attributes were analyzed 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.

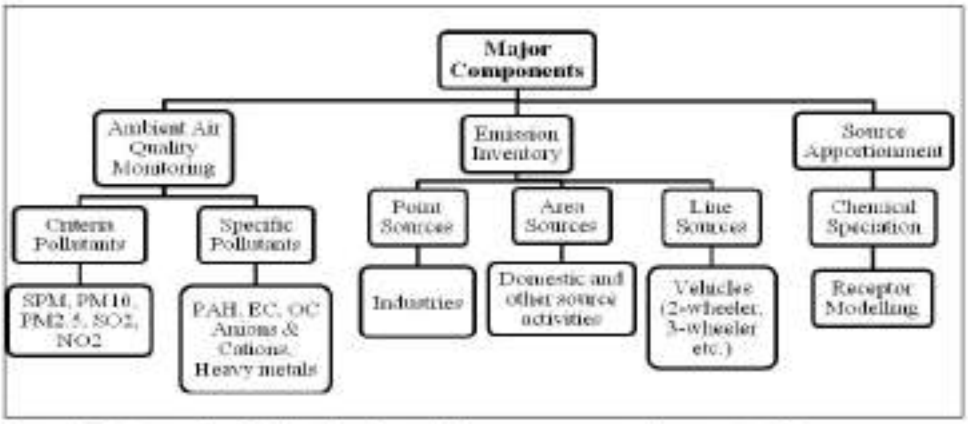


Figure 1.3: Air quality Monitoring & emission source apportionment studies

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 in 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 the 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_2, 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 liter 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 NOx 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 2.1: Daily average vehicle activity on different road network considered during the field survey

	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

The vehicle utilization factors (km traveled 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).

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
HCV	45.5

2.4. Methodology

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

(2.1)

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

N_v is the number of vehicle of a particular type

VKT is the vehicle km traveled

E_i, km is the emission factor for a specific vehicle

Table 2.3: 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 a paved road can be appraised by the following equation:

(2.2)

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

SL is silt load (g/m2);

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

k is constant (the function of particle size) in g VKT^{-1} (Vehicle Kilometer Travel)

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 a 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 2.5 as per emission inventory.

Table 2.5: Emission factor for coal

E F	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 Dhanbad

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 the purpose of emission inventory for Dhanbad city 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 thus obtained.

➢ **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 2.7.

Table 2.7: 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 2.8).

Table 2.8: Emission from 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)	28.354	18.856	5.657	35.330	0.709

➢ **Emissions from crematorium**

In order to calculate emission from crematoria data were obtained from crematoriums in Dhanbad. Emission from the burning of bodies using woods mainly produces PM10, CO and HC majorly as depicted in Table 2.9.

Table 2.9: 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 (kg/day)	7.178	0.083	0.537	52.183	47.308

- **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 2.10.

Table 2.10: 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 of hotels/restaurants were using a combination of coal and LPG as cooking fuel. Emission from coal and LPG were calculated and depicted in

Table 2.11 and Table 2.12.

Table 2.11: 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)	8.110	5.393	1.618	10.105	0.203

Table 2.12: 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 2.13).

Table 2.13: 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)	14.07	9.36	2.81	17.54	0.35

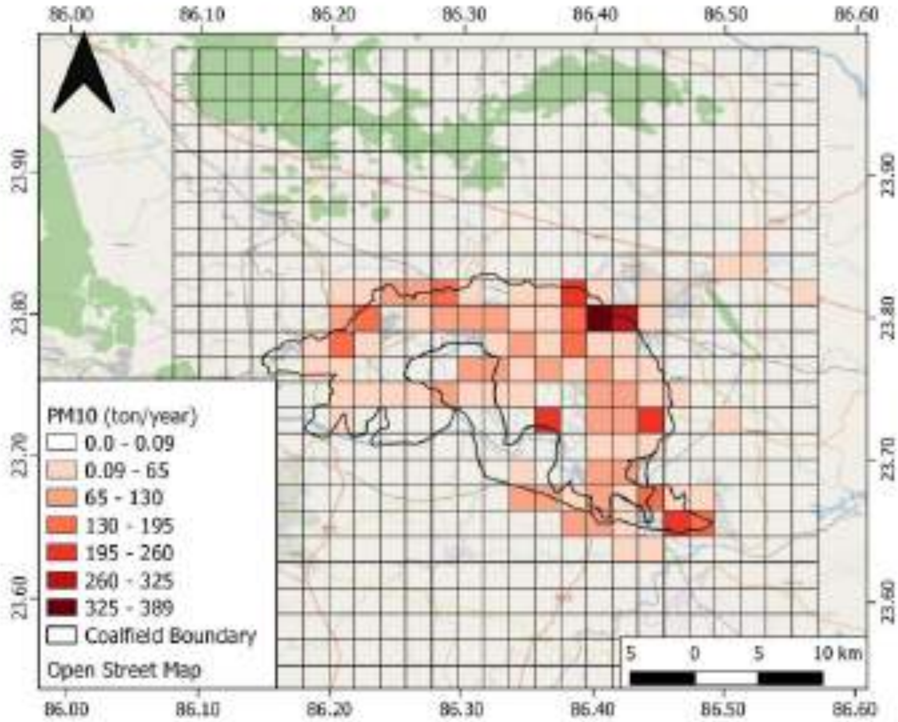


Figure 2.1: Grid-wise emission inventory of PM10 in tons/year over the study area

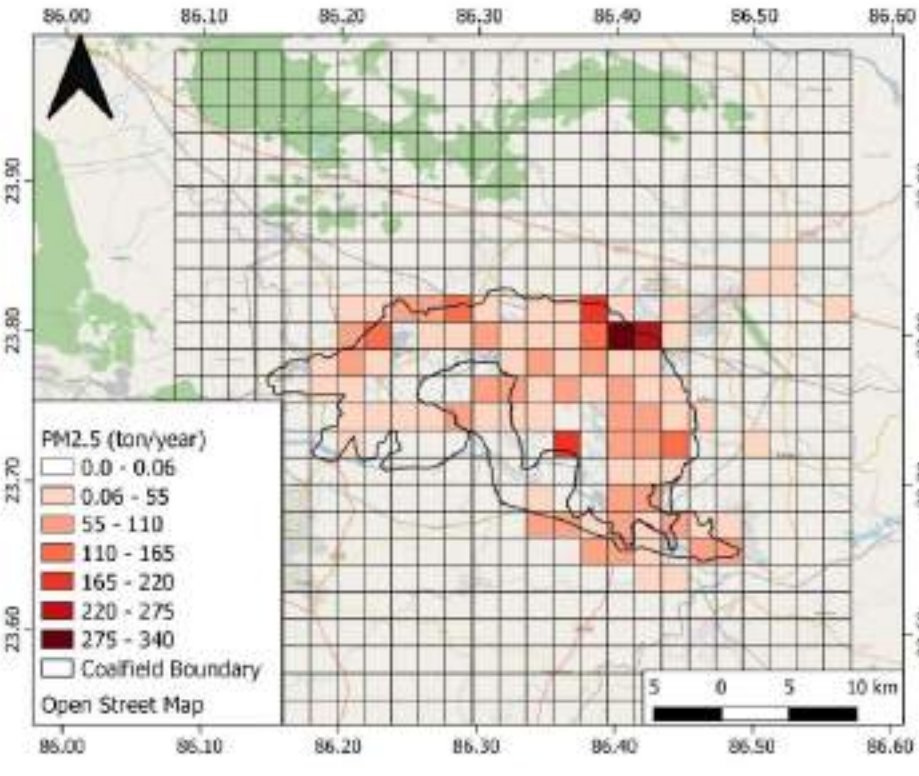
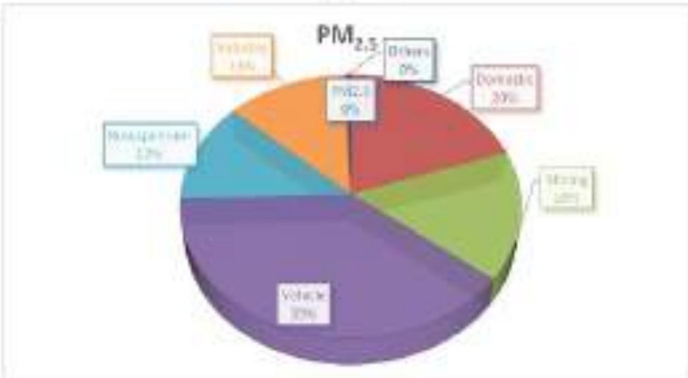


Figure 2.2: Grid-wise emission inventory of $PM_{2.5}$ in tons/year over the study area

(a)



(b)

Figure 2.3: (a) and (b) represents emission load from various sectors over JCF region for PM_{10} and $PM_{2.5}$ respectivel

References

Automotive Research Association of India (ARAI), CPCB/MoEF. (2007). *EF development for Indian vehicles, as a part of ambient air quality monitoring and emission source apportionment studies.* AFL/2006-07/IOCL/Emission Factor Project/Final Rep. https ://www.cpcb.nic.in/DRAFT REPOR T-on-efdiv .pdf

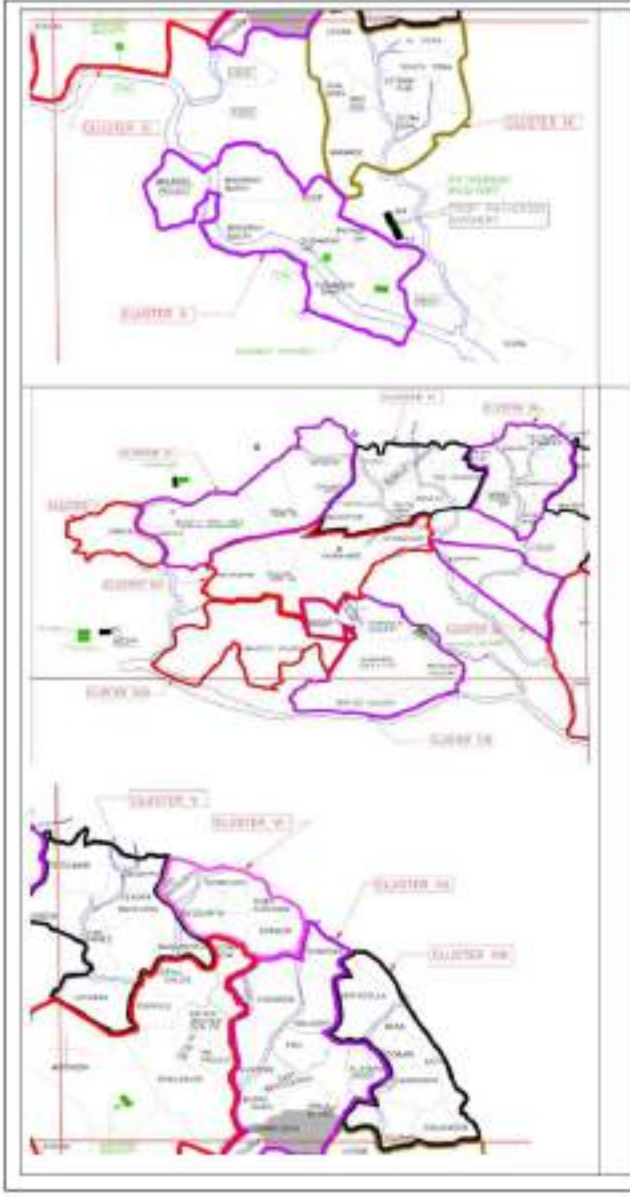
Central Pollution Control Board, Delhi, India. (2008–2010). Air quality monitoring, emission inventory and source apportionment studies for Indian cities. https ://cpcb.nic

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 0.1. 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 own 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 0.1: The details of mine cluster in Jharia Coalfield



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

Based on preliminary field visit by NEERI Scientists along with BCCL staffs, the following locations (Figure 0.1) 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

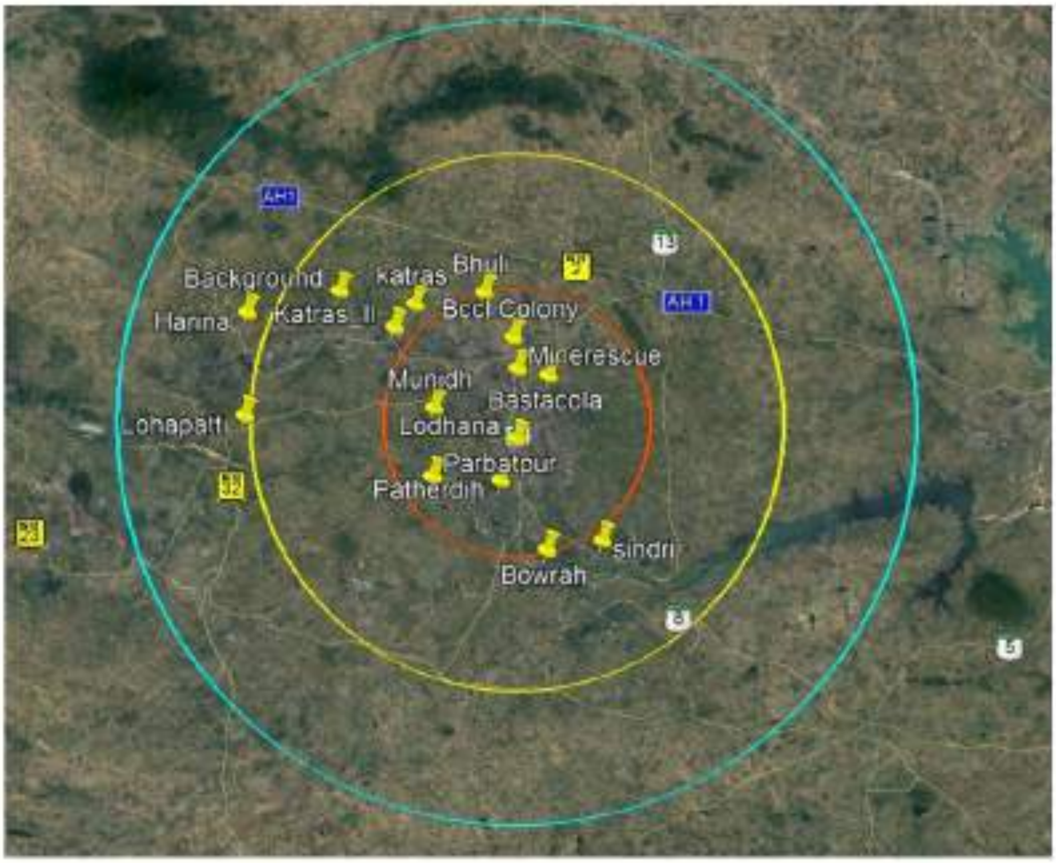


Figure 0.1: Air monitoring sites under 30 km buffer area

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 glass fiber filters (Whatman GF/A 20.3 x 25.4 cm) 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 24 h 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 0.2 and Table 0.3. National Ambient Air Quality Standards (2009) and Standard for coal mines are presented in Table 0.4 and Table 3.5.

Table 0.2: 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 0.3: 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	Spectrophotomete r
Analytical Method	Gravimetric	Gravimetric	Modified Jacob and Hochheiser method	Colorimetric Improved West & Gaeke Method
Minimum reportable value	5µg/m³	5µg/m³	9µg/m³	4µg/m³

Table 0.4: 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 PM10	Annual*	60	60	Gravimetric,TOEM,Beta attenuation
		24Hours**	100	100	
4	Particulate matter (Size less than 2.5µm) or PM2.5	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	Chemiluminiscence,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 3.5 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	360 µg/m3	430 µg/m3
	24 hours	500 µg/m3	600 µg/m3
Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average	180 µg/m3	215 µg/m3
	24 hours	250 µg/m3	300 µg/m3
Sulphur Dioxide (SO_2)	Annual Average	80 µg/m3	80µg/m3
	24 hours	120 µg/m3	120 µg/m3
Oxides of Nitrogen as NO_2	Annual Average	80 µg/m3	80µg/m3
	24 hours	120 µg/m3	120 µg/m3

3.2. Chemical Analysis

3.2.1. Gravimetric analysis

The exposed filters were analysed using a 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 50 ml 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 15 mL 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 tetrachololo-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 (25 mm, 0.45 mm) 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) added. The samples were extracted with DCM using an ultra sonic 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 300C and FID temperature 320C.

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 74-184 µg/m³ with the highest concentration of 184 µg/m³ at Mine rescue site and lowest concentration of 74 µg/m³ at Bastacola site. Also, the mean mass concentration of $PM_{2.5}$ particles was found in the range of 49-117µg/m³ with the highest concentration of 117µg/m³ and the lowest concentration of 49 µg/m³ recorded at Harina and Lohapatti site respectively.

The average concentration of PM_{10} and $PM_{2.5}$ in two seasons are described in Table 0.6 and

Table 0.7. Results revealed that the average concentrations of PM_{10} are within the prescribed limits of MoEF notification guidelines for coal mine area. In the case of $PM_{2.5}$, there is no Govt. notified standard for mining area but in 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 0.2 and Figure 0.3).

Table 0.6: Average concentration of PM_{10} and $PM_{2.5}$ in Summer of Jharia Coalfield

Monitoring Sites		Average Concentration (µg/m³)-Summer	
	Site Description	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
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	74.21	62.85
		(52 -209)	(36-96)
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)

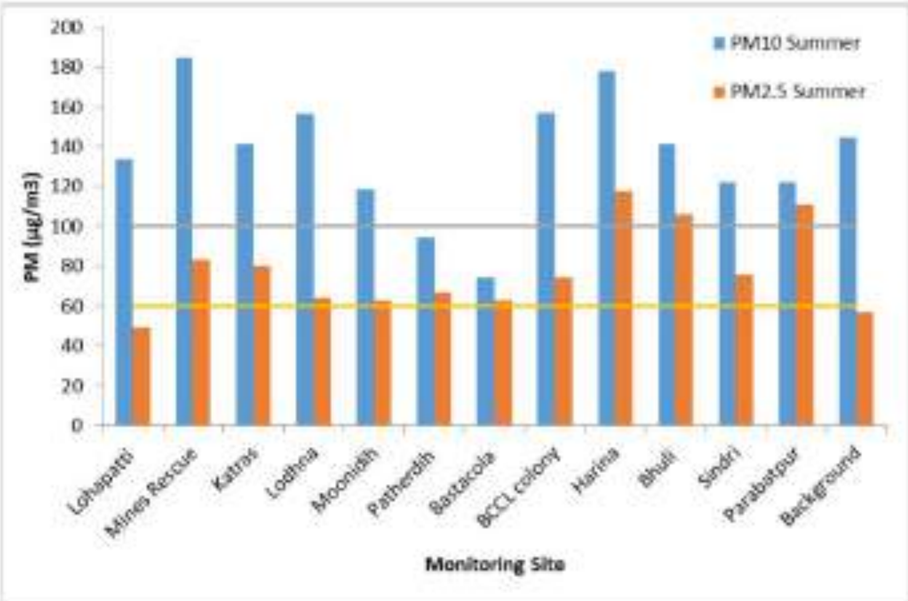


Figure 0.2: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region in Summer compared to NAAQS (2009)

Whereas in winter monitoring, highest PM_{10} mass concentration was found to be 332 $\mu g/m^3$ at Bastacola site (exceeding the prescribed limit of **GSR 742(E)**) along with other core mining zones like Mines Rescue, Moonidih. The lowest PM_{10} average concentration was found in Katras II (107 $\mu g/m^3$).

Table 0.7: Average concentration of PM_{10} and $PM_{2.5}$ in winter of Jharia Coalfield.

		Average Concentration ($\mu g/m^3$)-Winter	
Monitoring Sites	**Site Description**	**PM_{10} ($\mu g/m^3$)**	**$PM_{2.5}$ ($\mu g/m^3$)**
Lohapatti	Core Zone	174.28	139.59
		(122-241)	(114-236)
Mines Rescue	Core Zone	303.49	176.97
		(175-350)	(114-233)
Katras	Core Zone	230.06	50.87
		(134-332)	(24-78)
Lodhna	Core Zone	322.8	112.17
		(243-412)	(98-209)
Moonidih	Core Zone	300.16	188.27

		(128-728)	(64-600)
Patherdih	Core Zone	222.71	113.23
		(182-246)	(111-167)
Bastacola	Core Zone	332.05	176.48
		(251-663)	(54-425)
BCCL colony	Buffer Zone	219.98	128.79
		(155-300)	(94-175)
Harina	Buffer Zone	130.73	42.93
		(65-215)	(44-98)
Bholi	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)

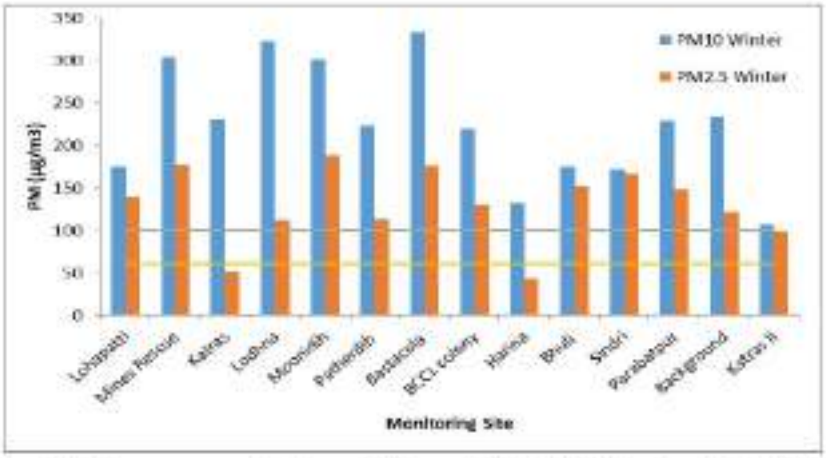


Figure 0.3: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region during Winter compared to NAAQS (2009)

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 has been found to be the most abundant element. The concentration of Al was detected in the range of 31.60-213.01 $\mu g/m^3$. Maximum Al concentration was found at BCCL colony i.e. 213.01 $\mu g/m^3$. The concentrations of Fe and Cr were estimated as 0.78-7.74 $\mu g/m^3$ and 0.075-1.32 $\mu g/m^3$ respectively. The highest concentrations of both Fe (7.74 $\mu g/m^3$) & Cr (1.32 $\mu g/m^3$) were found at the Bastacola site Figure 0.4.

Similarly, in case of $PM_{2.5}$ particles the concentrations of Al (9.74-47.59 $\mu g/m^3$), Fe (0.44-11.77 $\mu g/m^3$) and Cr (0.066-2.17 $\mu g/m^3$) were found higher than other elements. For $PM_{2.5}$ particles, maximum concentrations of all the three elements i.e. Al (47.59 $\mu g/m^3$), Fe (11.77 μg/m3) and Cr (2.17 $\mu g/m^3$) were obtained as at the Mine Rescue site. Since, the elements such as Al, Fe and Cr possess higher concentrations in the PM_{10} elemental composition, Al would have been emitted from road dust, whereas Fe would have been emitted from the resuspension of dust containing deposits from the emissions of vehicular and other anthropogenic activities Figure 0.5.

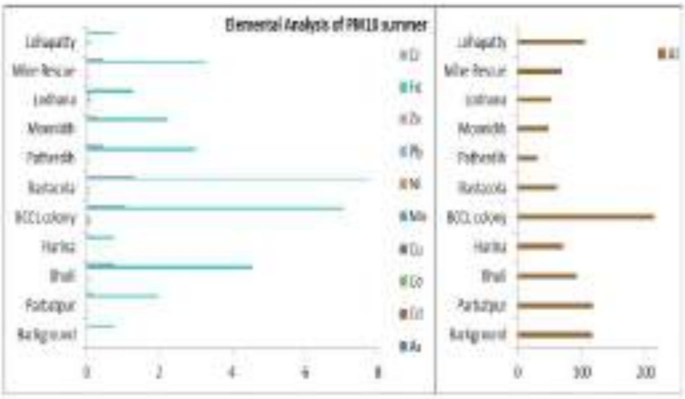


Figure 0.4: Metal concentration of PM_{10} in the summer season

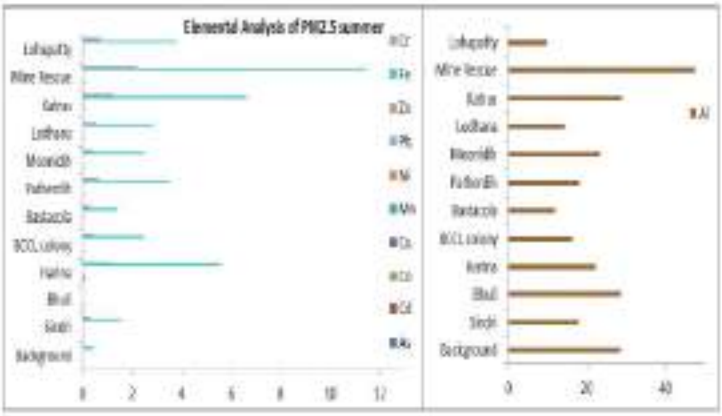


Figure 0.5: Metal concentration of $PM_{2.5}$ in the summer season

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 2.02-10.77 µg/m3 followed by Fe (0.79-9.26 µg/m3) and K (0.90-4.19 µg/m3). Maximum Al concentration (10.77 µg/m3) was observed at the BCCL colony, followed by Lodhna (10.29 µg/m3). The Highest Fe concentration (9.26 µg/m3) was observed at Bastacola while K (4.19 µg/m3) at the Lodhna site. This may be due to vehicular emissions, paved roads, construction dust, coal combustion, soil dust, etc. The concentration of As, Ni, Pb were found within the limits of CPCB standards. The remaining elements i.e. Cd, Cr, Cu, Mn, and Zn were found very low (Figure 0.6).

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 0.11-2.91 µg/m3, 0.05-1.93 µg/m3 and 0.08-2.12 µg/m3. For PM2.5 particles, maximum Al and K were found at the Munidih site, which was 2.91 µg/m3 and 2.12 µg/m3, respectively. The highest concentration of Fe i.e. 1.93 µg/m3 was detected at Lodhna. The concentrations of all other analysed elements were low (Figure 0.7).

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 the winter season. In contrast, the average concentration of Cr was more in the winter season.

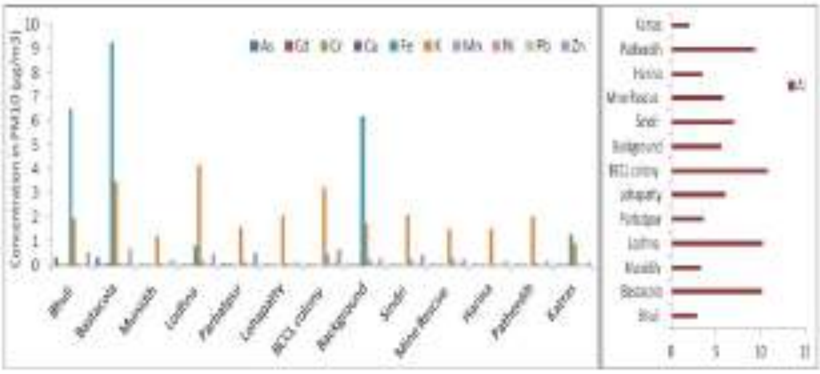


Figure 8.6: Metal concentration of PM_{10} in winter season

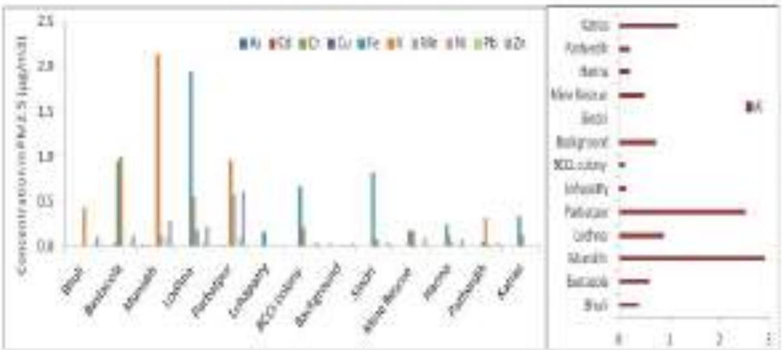
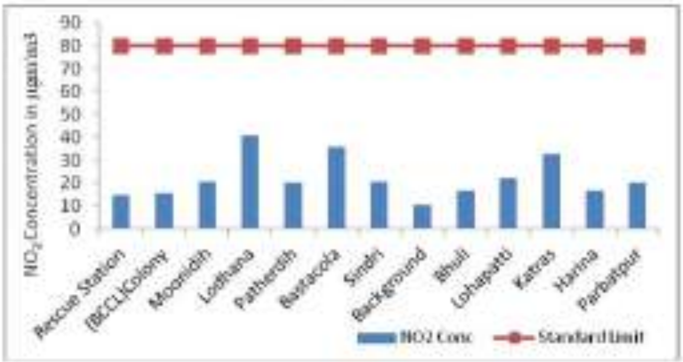


Figure 8.7: Metal concentration of PM 2.5 in winter season

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 11 $\mu g/m^3$ (Harina & Bastacola) and 24.5 $\mu g/m^3$ (Moonidih), being well below the threshold limits of 80 $\mu g/m^3$ (residential or industrial). The 8-hour average NO_2 concentrations were between 10.3 $\mu g/m^3$ (Background) and 40.9 $\mu g/m^3$ (Lodhana), well within the standard limits of 80 $\mu g/m^3$ (residential or industrial) Figure 0.8. The SO_2 in the residential areas may be received from the open burning of raw coal and other domestic and commercial activities.



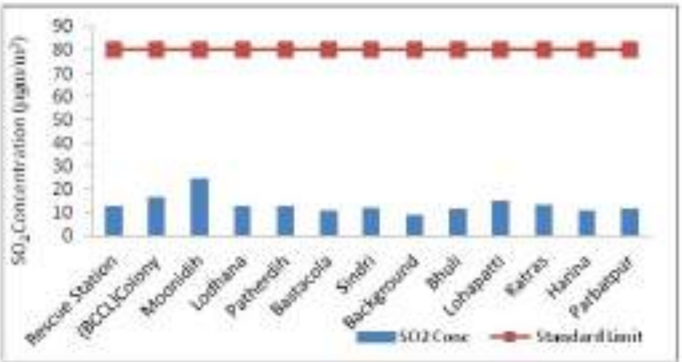
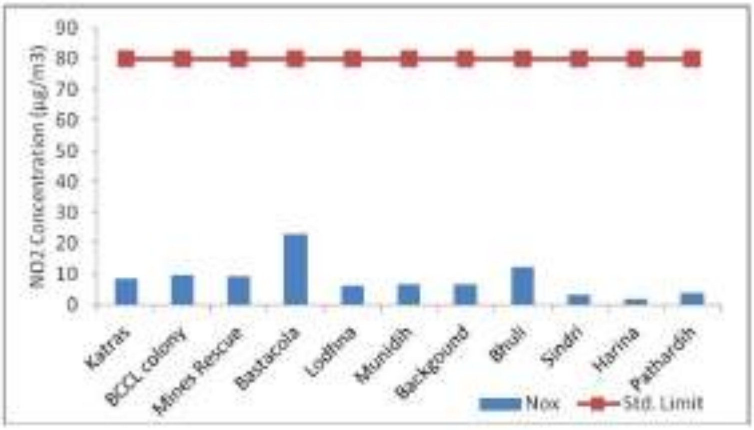


Figure 0.8: NO_2 and SO_2 Concentration of all monitoring sites in summer season

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. 80 $\mu g/m^3$. The concentration of SO_2 was below 10 $\mu g/m^3$ in Katra, BCCL colony, Mine Rescue, Bastacola, Lodhana and Munidih. Bastacola and Bhuli site has a concentration of NO_2 above 10 $\mu g/m^3$ (Figure 0.9)

It has been observed that concentration of NO_2 and SO_2 in winter and summer season were below the standard limit. But the average concentration of NO_2 and SO_2 in summer season was higher than the winter season.



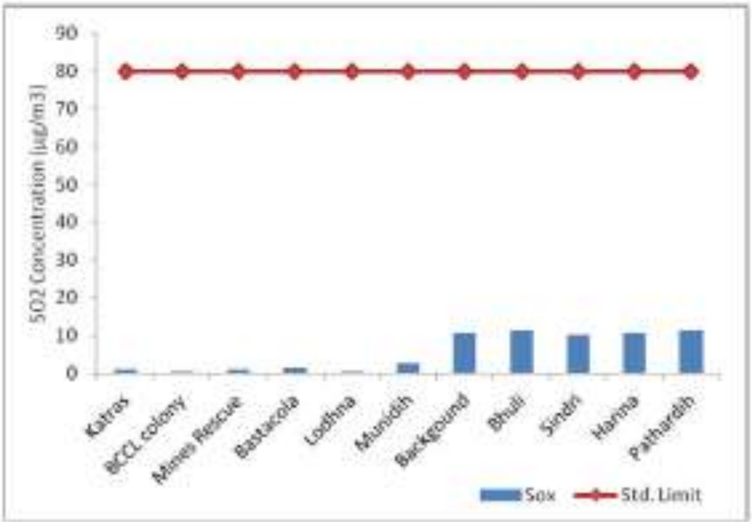


Figure 0.9: NO_2 and SO_2 Concentration of all monitoring sites in Winter season

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 42.33 µg/m3, respectively, and the lowest OC concentration was 15.36 µg/m3 and EC was 13.08 µg/m3 in Sindri site. In comparison, the concentration of OC (67.35 µg/m3) and EC (81.67 µg/m3) in PM_{10} were higher in the BCCL colony among all the sites. The lowest OC concentration as 17.95 µg/m3 was in Bastacola and EC in Parbatpur i.e. 15.44 µg/m^3 (Figure 0.10)

3.3.7. Carbonaceous Aerosol/EC & OC in winter

The mass concentration of EC and OC in PM10 and $PM_{2.5}$ are more significant than 100 µg/m3 and 70 µg/m3, 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 PM10 mass concentration was lowest in Harina followed by Lohapatti and Patherdih. In the case of $PM_{2.5}$, Parbatpur was found to have the lowest concentration among other sites.

The higher mean concentration of EC and OC in winter were likely related to the influence of emissions from residential heating (in addition to traffic source) and, on the other hand, to the unfavorable 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 0.11).

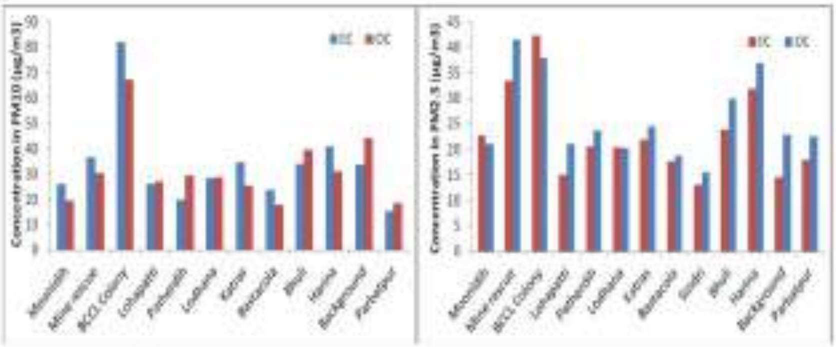


Figure 0.10: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Summer season

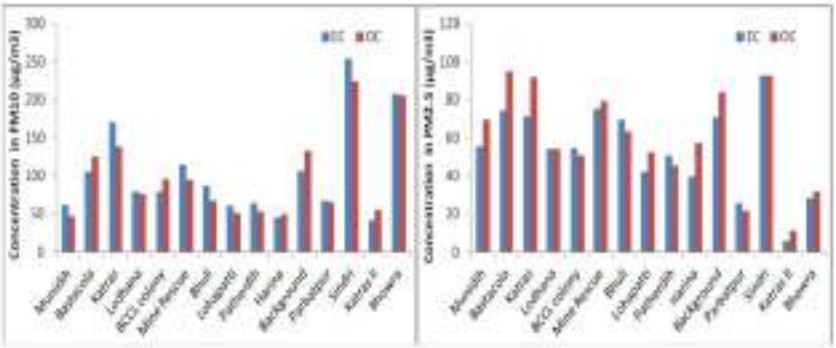


Figure 0.11: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Winter Season

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 1.06-20.17 µg/m³ where higher concentration was observed in Harina, BCCL colony, and Lodhana sites. Likewise, NO_3^- was in the range of 0.32-19.2 µg/m³ with the highest in Harina site. PO_4^{3-} and Cl^- concentration was highest in Harina and <2 µg/m³ in other locations. NH4+ was in the range of 0.75-16.24 µg/m³, Harina with the highest concentration, and Bastacola with the lowest concentration. Na+ concentration (0.18-8.6 µg/m³) was highest in Harina followed by BCCL colony and less than 2 µg/m³ in remaining sites. Ca2+ concentration (1.5-11.77 µg/m³) highest in Lohapatti and BCCL colony while lowest in Katras. K+ ion was also observed in the Harina site with a concentration of 5.85 µg/m³ (Figure 0.12)

The mass concentration of SO_4^{2-} in $PM_{2.5}$ was highest in Patherdih with a concentration of 15.13 µg/m³ and lowest in Bhuli. In Bastacola site, the concentration of NO_3^- (2.85 µg/m³), Cl- (2.04 µg/m³), K+ (1.84 µg/m³) was the highest among the other sites. Ca^{2+} (6.17 µg/m³) and Mg2+ (0.57 µg/m³) concentration was highest in Lohaptti site (Figure 0.13).

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 0.14.

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. SO42-, NO3- and NH4+ ions contribute mainly in PM2.5 mass concentration. The average concentration of SO_4^{2-} and NO_3^- in winter was higher than in summer Figure 0.15.

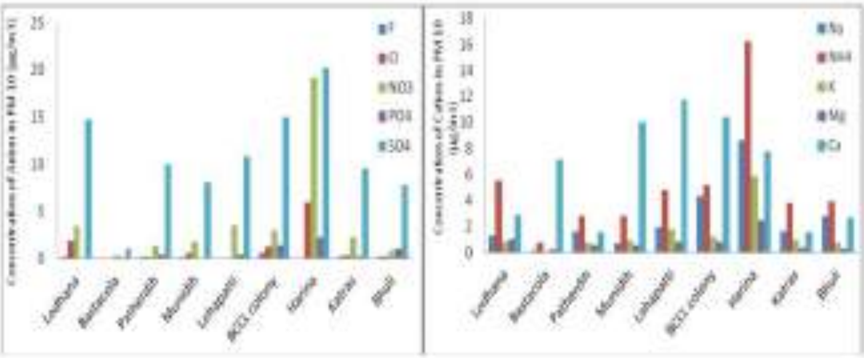


Figure 8.12: Anion and Cation concentration in PM_{10} in summer

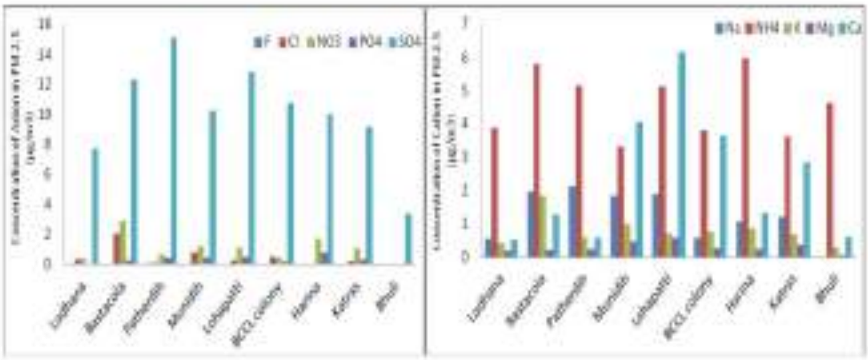


Figure 8.13: Anion and Cation concentration in $PM_{2.5}$ in summer

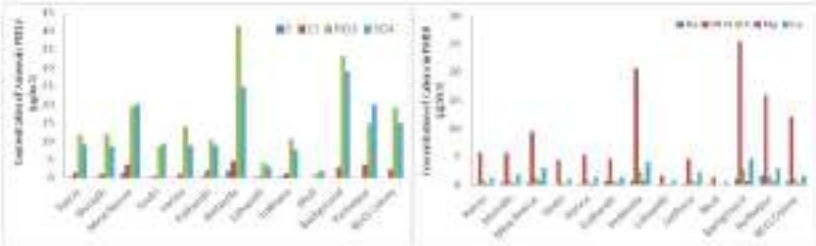


Figure 8.14: Anion and Cation concentration in PM_{10} in winter

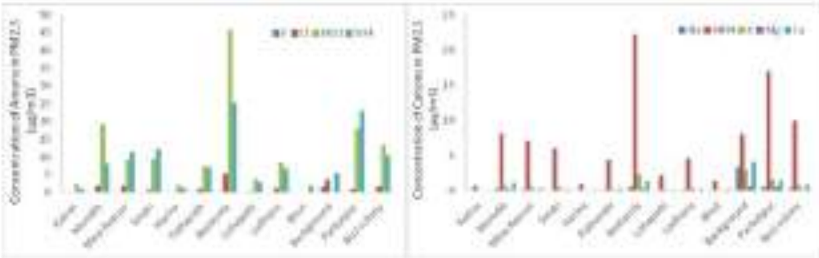


Figure 8.15: Anion and Cation concentration in $PM_{2.5}$ in winter

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 modeling approach. In receptor modeling, 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 the Figure 0.1.

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:

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 a 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 modeling 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 source.
- 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 much goodness 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 indicates a very good fit to 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 the <section xx>, 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:

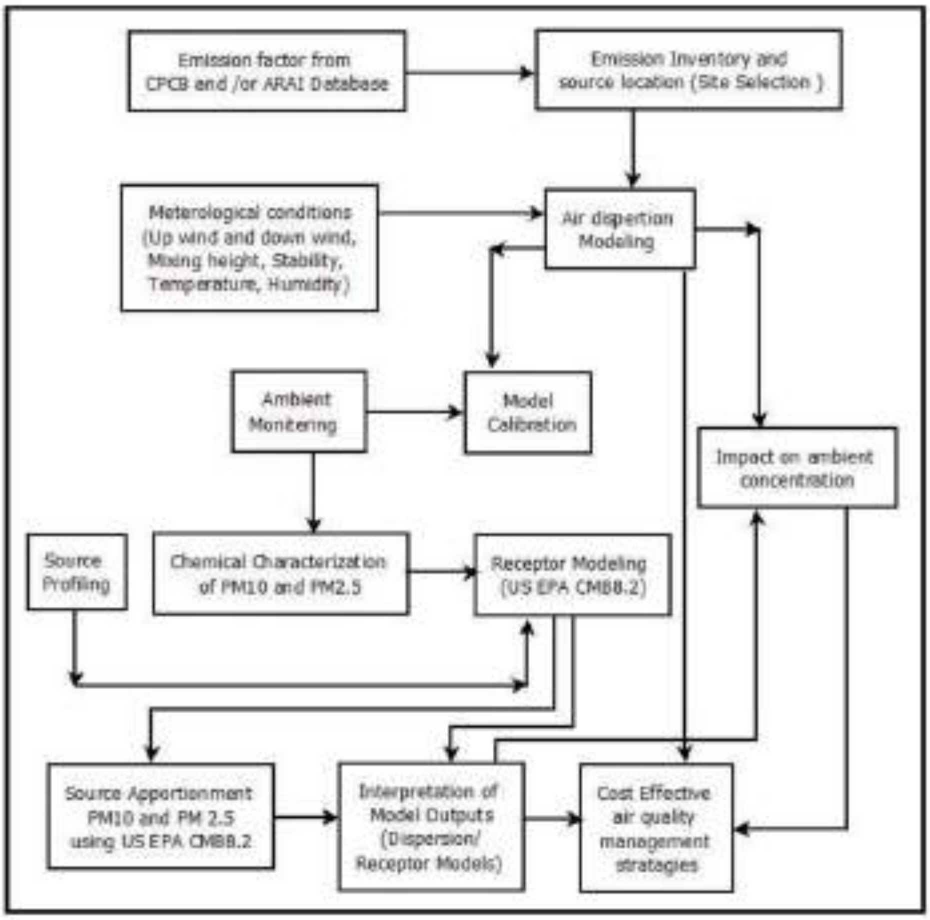


Figure 4.1: General methodology followed in the source apportionment studies

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 is 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 profiles are shown in the following Figures 4.3.

4.2.1. Domestic combustion

In the summer season, the foremost emission source was domestic combustion for PM10 and $PM_{2.5}$. The domestic combustion percentage observed 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 PM10 and 13% in PM2.5 in the summer season. In the winter season, contribution to industries is determined to be 15% in PM10 and 24% in PM2.5.

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 PM10 and 32% for $PM_{2.5}$ in the summer season. In the winter season, the transportation emission contribution is examined 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 from 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 PM10 and PM2.5 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 NOx forms the secondary nitrate. It is favored by low temperature (Li et al.2004), while high temperature and strong solar radiations favour the formation of secondary sulfates through photochemical reactions (Seinfieldand Pandis, 2016). Secondary inorganic aerosol formation from precursors (SO2 and

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

4.2.6. Agriculture

The agriculture contribution observed that 5% for PM10 and 2% for PM2.5 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 amount along with K+, indicate the biomass burning emanations (Cesari et al., 2018; Sharma et al., 2014; Jain et al., 2018).

4.2.8. Road Resuspension dust

The resuspension dust is a significant contributor to PM10. The contribution of resuspension dust is during the summer season 12% while in the winter season the emission contribution is 10% for PM10. In the summer season, resuspension dust's contribution is higher because of the high wind velocity and dry condition. The lower percentage contribution of road dust to fine particulate matter is attributed to substantial road dust particulates in coarse mode, found in other studies (Gupta et al., 2007; Masri et al., 2015). Crustal elements are significant constituents of airborne soil and resuspension 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 resuspension (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/resuspension dust due to the release of these marker elements from cars and non-exhaust sources.

4.2.9. Other emission Contribution

Other area sources contributed in the summer season is 12% for PM10 and 7% for PM2.5 during the study period. In the winter season, emission contribution is 14% for PM10 and 9% for PM2.5.

4.3 Inferences

The receptor modelling (CMB) results revealed that the transport sector and domestic combustion are the predominant emission sources contributing at the receptor levels. During summer season, contribution of 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 winter season, contribution of domestic combustion outrun the contribution of transport sector. During winter season, domestic combustion has contributed 22% (PM_{10}) and 28% ($PM_{2.5}$) whereas 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 in PM_{10} emission at receptor during 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_X) enhances the pollution burden over the vicinity. Biomass burning, presence for metal traces (Fe, Al, Mn, Zn, Cr etc.) from vehicular or industrial emission play 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 case of finer dust ($PM_{2.5}$), it contributed 17% in winter season at receptor level. This may be due to the calm winter conditions that allows finer dust ($PM_{2.5}$) to settle near to ground than that of summer conditions that allows more turbulence mixing in atmosphere.

Road resuspension 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 contributes to PM_{10} fraction and not found in $PM_{2.5}$ fraction at receptor.

After the contribution of industrial sector, coal-mining activity contributed around 8% and 6% of total PM_{10} receptor dust load during summer and winter respectively. In case of PM2.5 dust load at 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.).

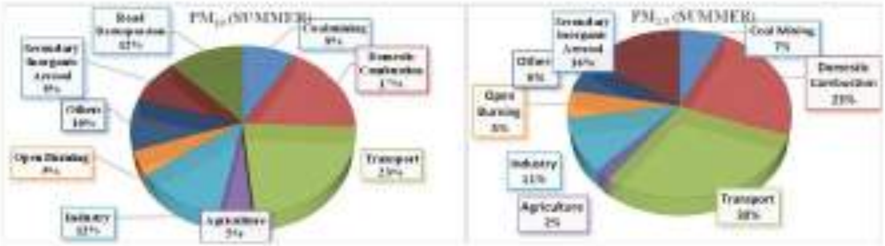


Figure 4.2: Source contribution at receptor locations of PM$_{10}$ an PM$_{2.5}$ in summer

Figure 4.3: Source contribution at receptor locations of PM$_{10}$ an 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	PM10 and PM2.5	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	PM10 and PM2.5	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	PM10 and PM2.5	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	PM2.5	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	PM2.5	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	PM2.5	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	PM10 and PM2.5	Vehicles exhaust, resuspension of dust, secondary sulfates, secondary nitrates, biomass	Na, Mg, K, Al, Si, Ca, Fe, Cl, SO4, NO3, NH_4^+	Guttikunda et al., 2013

		burning, coal burning		
Pune	PM10 and PM2.5	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	PM10 and PM2.5	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	PM10 and PM2.5	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^-, $NO2^-$, NO_3^-, SO_4^{2-}, K^+, NH_4^+, Na^+, Ca^{2+}, Mg^{2+}	CPCB, 2010a
Chennai	PM10 and PM2.5	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	PM10 and PM2.5	Petrol vehicles, diesel vehicles, secondary particulates, fuel oil burning, wood domestic wood burning, DG set, kerosene generator set, paved road dust re suspension, soil dust.	Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La, Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb. F^-, Cl^-, Br^- NO_2^-, NO_3^-, SO_4^{2-}, Na^+, K^+, Mg^{2+} and Ca^{2+}	TERI, 2010

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

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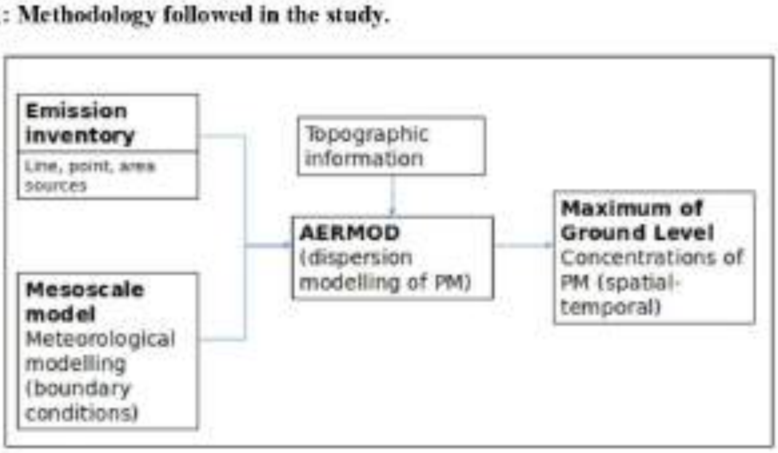
Chapter 5
Dispersion Modelling

Air quality modeling includes four major processes (a) emission of pollutants, (b) transportation of the pollutants due to mean wind profile (c) chemical transformations and (d) deposition/removal. In the present study the particulate matter emissions, transportation and dispersion is 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 south-west 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 approximately>150 km from the study area. Hence, hourly meteorological observations required for the study for AERMOD dispersion model were simulated through the Weather Research and Forecast, version-3.9 (WRF), which is a meteorological model that dynamically downscale the global NCAR/UCAR meteorological data to the regional level data (www.mmm.ucar.edu). Nested domains of grid resolution 12 km and 4 km , 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 Figure 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 11.1 m/s during the summer predominantly in the range of 2.1 to 3.6 m/s. Whereas wind speeds vary in the range of 0.5 to 8.8 m/s during the winter, predominantly in the range of 2.1 to 3.6 m/s.

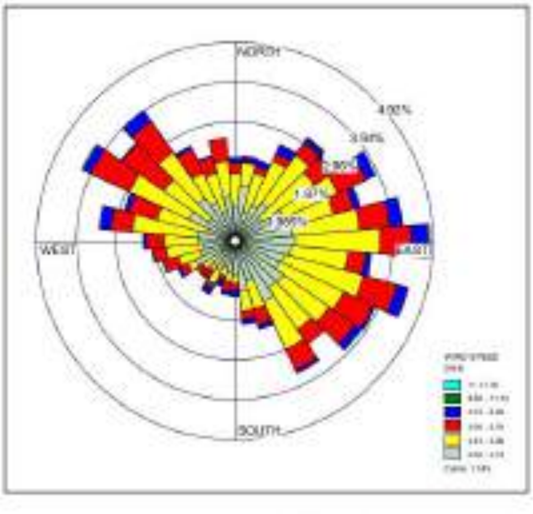


Figure 5.2: Windrose of the study area during March-June, 2019 (wind direction blowing towards the center)

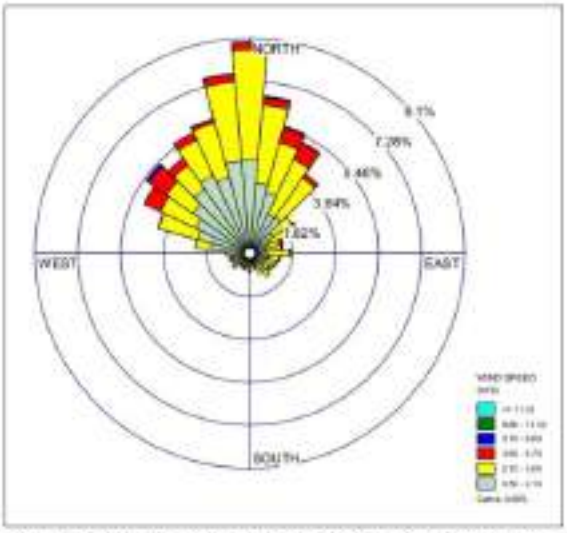


Figure 5.3: Windrose of the study area during November-December 2019 (wind direction blowing towards the center)

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-wheeler vehicles, motor bikes, etc were multiplied by the corresponding emission factors for the estimation of gaseous pollution. 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 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 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 8.8 m/s. During the monitoring period in winter (post-monsoon), the wind predominantly flowed from north-east to south-west direction having wind speeds in the range of 0.5 to 3.6 m/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 with respect to the emission rates and meteorology (wind speed, direction and atmospheric stability categories). The model simulated maximum ground level concentration of the particulate matter (PM10 and PM2.5) 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 PM10, following the open cast mines. The AERMOD model simulated value of GLC of PM_{10} due to line sources, open cast mines, and all sources are 927, 286, and 978 μg/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 μg/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 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 μg/m^3, respectively. The $PM_{2.5}$ maximum GLCs during the winter are 1004, 299, 1167 μg/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 winter season have in general contributed to the higher particulate matter than that of summer season.

Pockets of maximum concentrations of PM10 (200-1000 μg/m^3 and above) are observed in the vicinity to roads that nearer to the open cast mines south of Dhanbad City during the winter **(Figure 5.5)**. The localities of the high concentrations of PM10 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 south-west have PM10 concentration in the range of 200-900 μg/m^3. The fringes of the JCF have recorded the PM10 concentrations in the range of 100-250 μg/m^3. In contrast, the PM10 concentrations for summer season have significantly lower and the majority of the study area have PM10 < 100 μg/m^3, however the area extending from south of Dhanbad City and Sudamdih mine have relatively high PM10 concentration in the range of 100-500 μg/m^3. Baghmara and Sonardih mine area in the west of Dhanbad City have also observed to have high GLC of PM10 in range of 100-500 μg/m^3.

Similar pattern of spatial distribution of PM2.5 is reflected as of PM10. As the underlying meteorological conditions are same for both the PM10 and PM2.5 simulations the spatial pattern is nearly similar. High concentrations of $PM_{2.5}$ (100-500 µg/m³) are observed in the south-west direction of Dhanbad City (**Figure 5.6**). The maximum GLC of PM10 is found to be higher than PM2.5 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 contains 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.

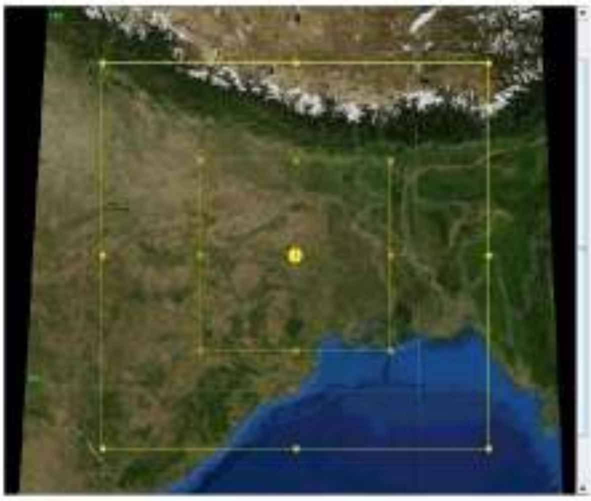


Figure 5.1: AERMOD grid covering the Jharia Coal Fields (JCF). The line, area, and point sources covered in the study are indicated in red color. The UTM coordinates of the left bottom point are x=406111 and y=2603492, and the coordinates of the right top point are x=456248 and y=2653417.

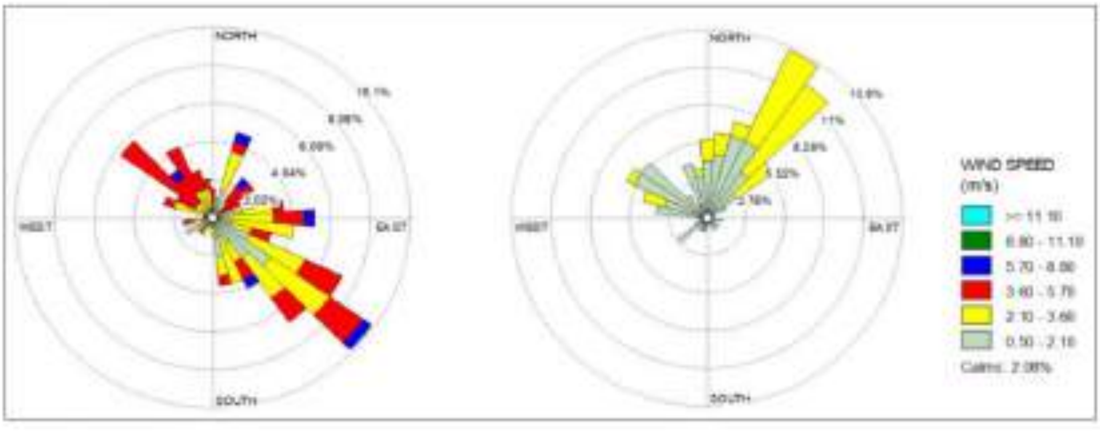


Figure 5.2 : Windrose diagram for the summer (left) and winter seasons (right) at Jharia Coal Fields during the sampling period. Wind direction is flowing towards the center.

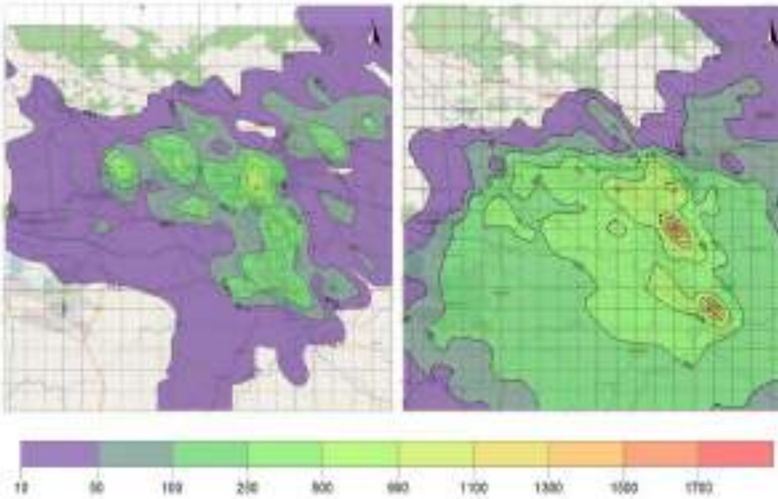


Figure 5.3 (a): 24-hour average maximum ground level concentration of PM_{10} ($\mu g/m^3$) contours in the study area simulated during the study periods in summer (left) and winter (right) seasons.

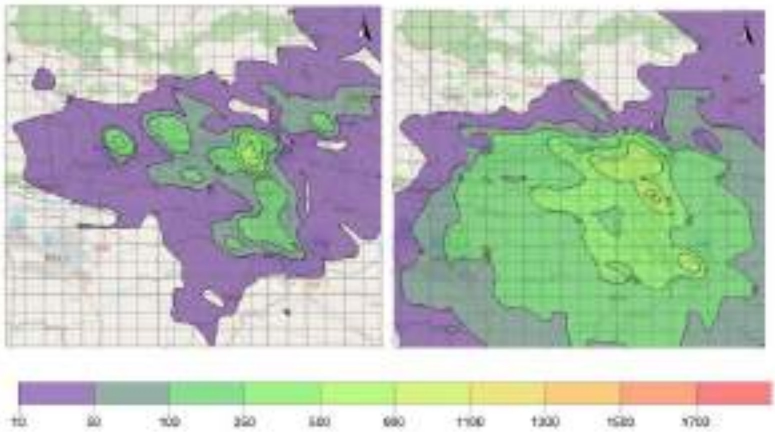


Figure 5.6 (b): 24 hour average maximum ground level concentration of $PM_{2.5}$ ($\mu g/m^3$) contours in the study area simulated during the study periods in summer (left) and winter (right) seasons.

Chapter 6: Recommendation

Mine industries

1. The project proponent might consider to install 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. 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 operation 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 curbsides. End to end covering up of curbside is essential to avoid the re-suspension of coal due to the truck movement.

Area Sources

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

1. Construction and demolition of buildings in the urban area give high local dust contribution resulting health problems. These practices need to follow compliance guidelines to reduce emissions.
2. Road and pavement should be well constructed to suppress road dust. The standard specifications and code of practice for road construction should be followed and implemented as per the Indian Road Congress (IRC) guidelines or international standard guidelines.
3. Strategically placed green cover in urban and semi-urban areas can help to improve local air quality.
4. Manage agricultural residues, including strict enforcement of bans on open burning
5. Strictly enforce bans on 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, it contains all mix of plastics and thermocol. The combustion of these materials is very harmful for human health.
13. Coal depot pollution is due to open storages and unregulated buying, selling and transportation. These coal depots are responsible for nearby air pollution peak. However, the contribution of the same need to be assessed.

Line Source

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

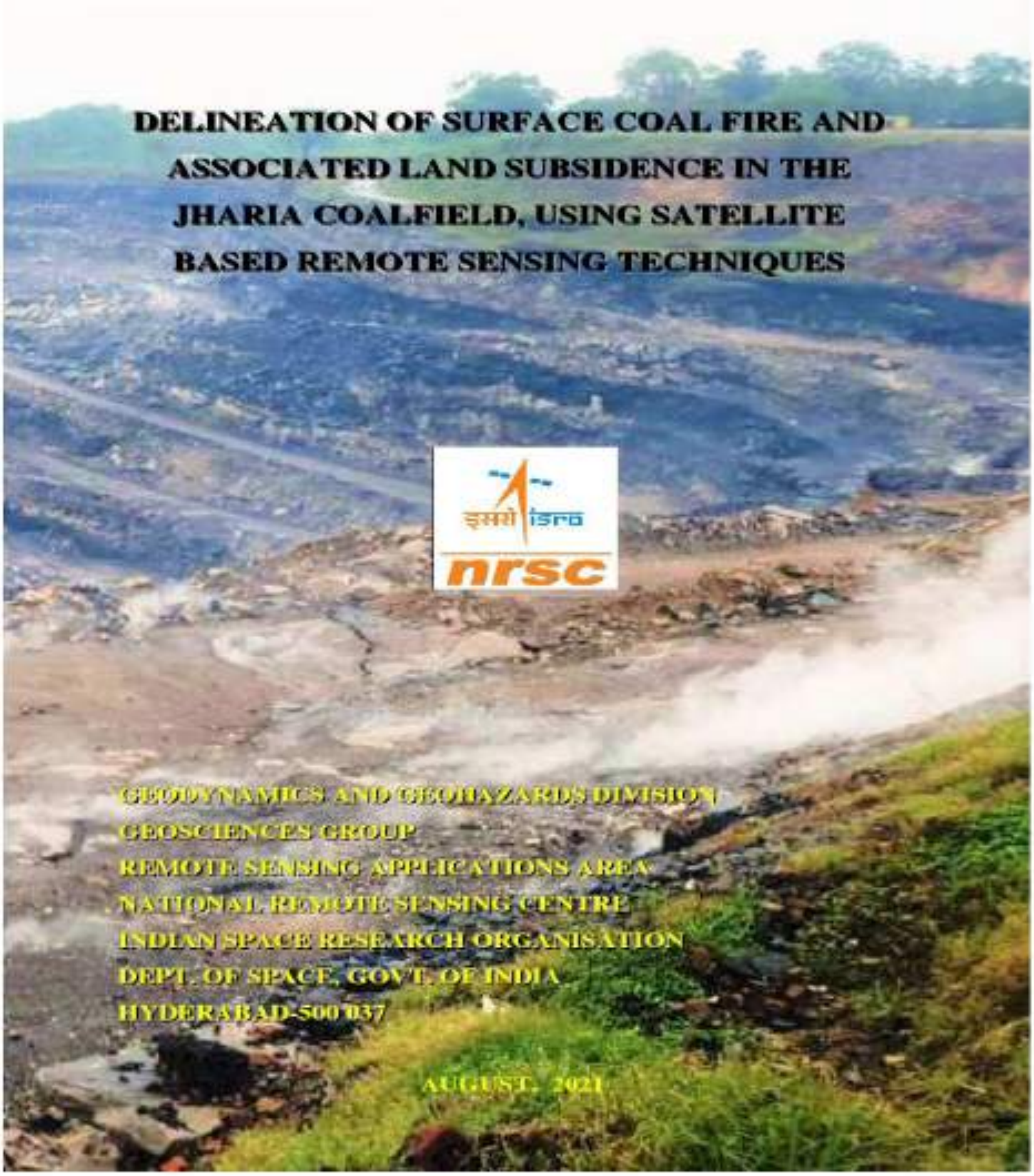
1. Vehicle inspection and maintenance: Enforce mandatory checks and repairs for vehicles.
2. Improved public transport: Encourage a shift from private passenger vehicles to public transport.
3. Set up a mechanism of Inspection and Maintenance programme for all vehicles in the district through RTO with automated system assessment.
4. The Inspection & Maintenance (I & M) centre shall also test all vehicles for their in built 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 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.

Others:

- There is a need to explore various options for controlling air pollutants to tackle increased emissions in future.

- The local authority should stress on 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 11:


DELINEATION OF SURFACE COAL FIRE AND
ASSOCIATED LAND SUBSIDENCE IN THE
JHARIA COALFIELD, USING SATELLITE
BASED REMOTE SENSING TECHNIQUES
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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

data is difficult as it requires visible signatures of subsidence in the form of cracks on the ground and damage to anthropogenic structures. In this study, data analysis and consequent field verification resulted in identification is 4 subsidence areas, within the BCCL mine boundary. Of these, the major area where considerable ground subsidence is occurring is the Moonidih UG project. Long term underground mining has resulted in continuous subsidence in the area. Apart from this, the other three areas are south of South Govindpur, Bagdigi and Bhagaband mines, however, the field evidences of the same are not conclusive. No quantitative estimates of the subsidence have been carried out in the study.

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.

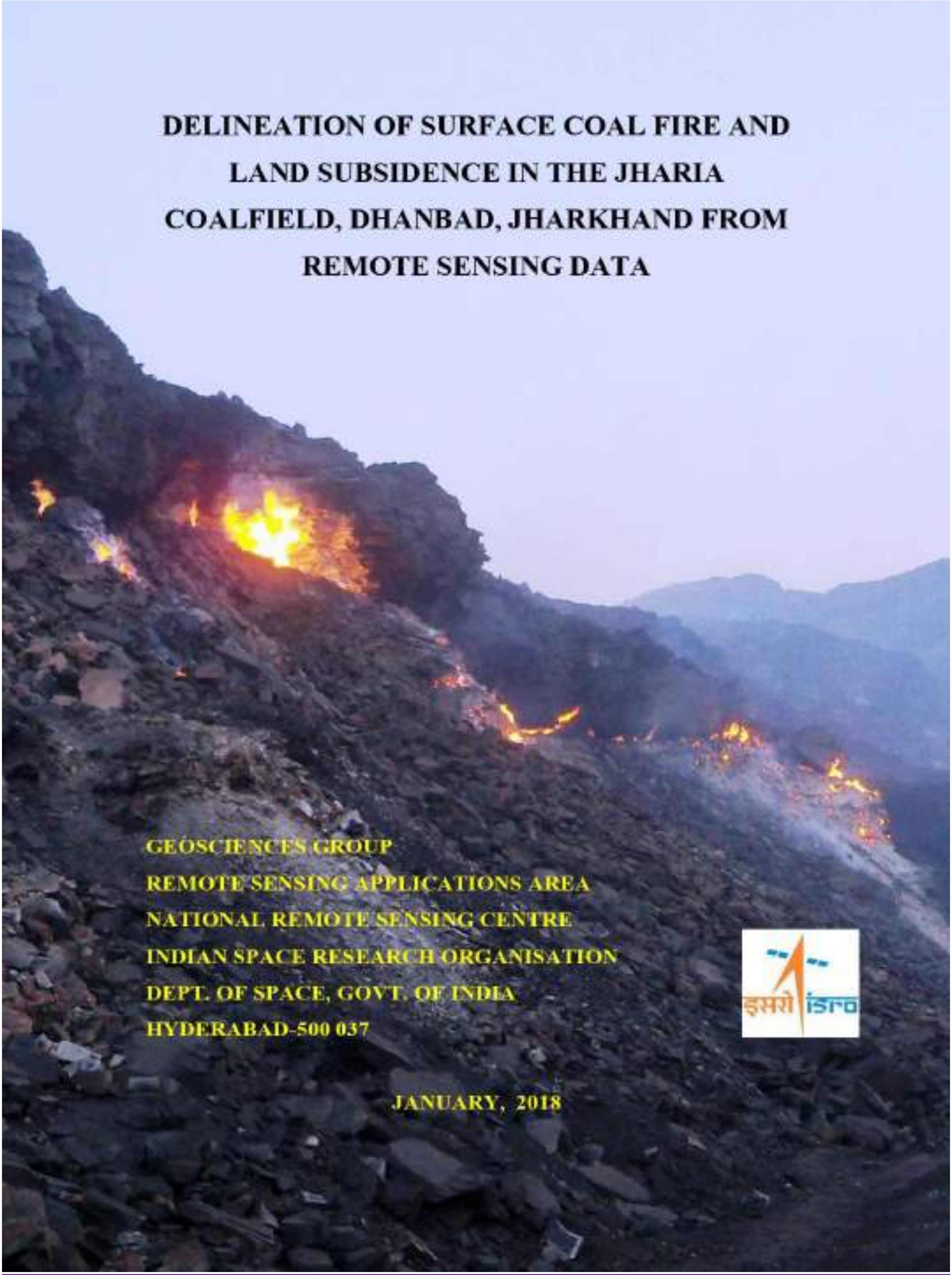
3. The fires are continuation of existing fire affected areas as seen in the 2017 study.

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 it 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.*

DELINEATION OF SURFACE COAL FIRE AND LAND SUBSIDENCE IN THE JHARIA COALFIELD, DHANBAD, JHARKHAND FROM REMOTE SENSING DATA



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JANUARY, 2018

DELINEATION OF SURFACE COAL FIRE **AND** LAND SUBSIDENCE IN THE JHARIA COALFIELD, DHANBAD, JHARKHAND FROM REMOTE SENSING DATA

Report for

BHARAT COKING COAL LIMITED (BCCL)
(A SUBSIDIARY OF COAL INDIA LTD.)
ENVIRONMENT DEPARTMENT, KOYLA BHAWAN
KOYLA NAGAR, DHANBAD – 826 005, JHARKHAND

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JANUARY, 2018

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CONTENTS

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EXECUTIVE SUMMARY

Coal fire is a serious problem in Jharia coal field, where high ranking coals are gradually burnt due to these fires. The combined effect of surface and sub-surface fires and mining related subsidence has endangered the environmental stability of Jharia coal field. Coupled with the ecological changes instigated by open cast mining, the landscape in and around Jharia have changed drastically over the years. In the present study, delineation of coal fire and mining related land subsidence have been addressed. Thermal band of Landsat-8 (100m resolution) have been used to demarcate the coal mine fire areas from non fire areas. For this study, Landsat-8 data of May, 2017 have been used. The band 10 (10.60-11.19 µm) of Landsat-8 data is used to derive the relative radiant temperature. Further ALOS-PALSAR 2, L band microwave data has been used to delineate zone of probable land subsidence (using differential interferometry) due to mining. The study reflects that, compared to 2012, the eastern flanks (Lodna and Tisra) show a larger fire area. The western flank (Nadkhurkee and Shatabdi) and the northern flank (Katras and Gaslitand) show isolated fire pockets in active mines as well as OB dumps. Among all the colliery areas, Kusunda and Lodna area is most affected by coal mine fire. The current fire area mapped is 3.28 sq.km. Apart from this, five distinctive areas of land subsidence have been identified using interferometric method. These are primarily caused by older or active underground mining. The Moonidih Project is most affected by subsidence. The coal mine fire and subsidence areas are further verified on the ground. The final coal mine fire and subsidence map of Jharia coal field is prepared by using remote sensing data analysis with field validation.

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CHAPTER I

INTRODUCTION

Coal fire is a perennial problem in Jharia coal field (JCF) covering 447 sq. km. area in the Dhanbad district of Jharkhand state. Subsurface and surface coal fires are a serious problem in many coal-producing countries. The severity and extent of mine fires in some of the Indian coalfields, particularly Jharia and Raniganj coalfields, are quite alarming. Combustion can occur either within coal or in coal dumps on the surface. Considerable economic loss and environmental problem arises due to the coal fire. Coal fire burns valuable coal and also creates difficulties in mining by increasing the cost of production or making existing operations difficult. Noxious gases like sulphur dioxide, nitrogen oxide, carbon monoxide, carbon dioxides, which are the result of coal burning processes, often affect the immediate surroundings of an active coal fire area (Gangopadhyay, 2003). These greenhouse gases not only affect local atmosphere but also play a crucial role in the damages, found associated with coal fire such as land surface subsidence and surface cracking. Coal fires are caused by oxidation of coal but the reaction involved in oxidation of coal is not understood till date. Broadly, the potential for spontaneous combustion lies in its ability to react with oxygen at ambient temperature. This occurs through the reaction of oxygen at the surface of the coal resulting in an exothermic reaction. As a consequence, the temperature of coal rises and if temperature reaches the threshold temperature, ranging between 80^0 to 120^0C, a steady reaction starts, which produces carbon dioxide. Temperature keeps on increasing once CO_2 started to form and at 2300°C, the exothermic reaction becomes rapid. It is known that high grade coals (high carbon content) are more fire prone, though the reason behind this is not well understood. Another important parameter, which controls fire, is the size of the particles. Larger the effective area of coal (fire particles), more rapidly the reaction proceeds. Cracks, fissures play a role like positive catalysts to coal oxidation by slowly supplying oxygen / air through their conduits.

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

1.1 Background

Remote sensing technique in thermal band offers a cost-effective and time-saving technology for mapping various geoenvironmental / hazardous features such as coal fires, forest fires, oil well fires, volcanic eruptions etc. NRSC has carried out coal fire mapping projects in the past; conducting an airborne campaign in 1989 and using Landsat-5 TM data in 1995 (Bhattacharya *et. al.*, 1995), over Jharia coalfield, Jharkhand and using Landsat-5 TM data for 2001 over Raniganj coalfield, West Bengal. Further, projects were executed in 2006 and 2012 in which coal fires of the JCF were mapped using Landsat-7 ETM+ and ASTER data, respectively. Additionally, a R&D study was taken up in 2013 to delineate subsidence areas using differential interferomteric (DInSAR) technique. In view of the past experiences, based on the letter (Ref. no. NRSC/16/76) from Director (Tech.), Operations, BCCL addressed to Director, NRSC on 01 February 2016. a project was formulated to take up Coal fire and Land Subsidence study of the Jharia Coal Field using space-borne remote sensing technique. The formal Memorandum of Understanding between BCCL and NRSC was signed on 23rd of Dec, 2016.

1.2 Objectives

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

I. To map Coal fire in the study area based on pixel integrated relative radiant temperature derived from latest available Landsat-8 data of 2016-17 time period.

II. To compare the change in the coal fire distribution in the Jharia coalfield within the period of 2012 and 2016-17.

III. To delineate probable subsidence areas in the region using differential interferometry method.

1.3 Study Area

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

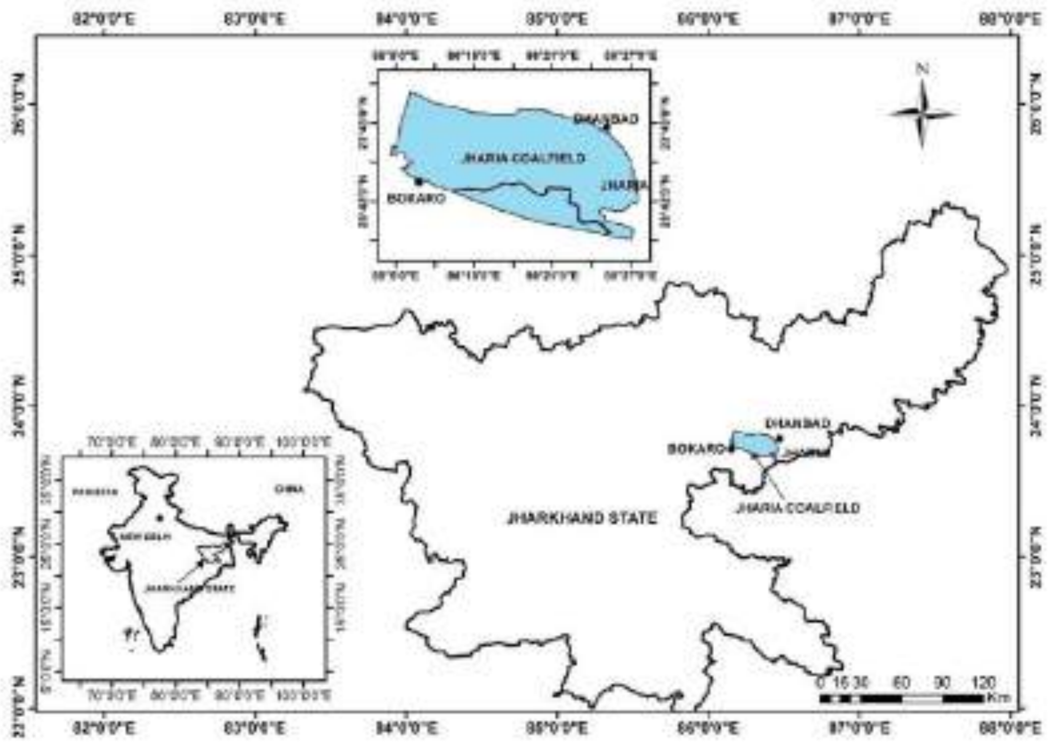

Figure 1: Study area map of Jharia Coalfied, Jharkhand

CHAPTER II

GENERAL DESCRIPTION OF THE STUDY AREA

2.1 Location and Accessibility

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

2.2 Physiography, Drainage and Climate

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

2.3 General Geology

Gondwana Super Groups of rocks of Up. Carboniferous to Lr. Cretaceous age (i.e. from 320 MY to 98 MY) are exposed here. Gondwana Super Group rocks unconformably overlie Archaean rocks. In Gondwana Rocks, Raniganj and Barakar Formations of Permian age have more potential as far as the coal production is concerned. Barakar Formation is exposed in north and north eastern part of the basin (Figure 2). Most of the coal mines are confined to the Barakar Formation in JCF. Barakars consists of coarse, medium grey and white sandstones, shales and coal seams. Raniganj consists of grey and greenish soft feldspathic sandstones, shales and coal seams. Faults are prevalent in this portion of basins (Figure 2). NW trending faults are conspicuous north to Jharia. Many lamprophyre and dolerite dykes are also exposed in this area in a criss-cross manner. The Raniganj Formation though coal bearing, has suffered much deformation due to faulting, thus causing difficulty for mining in the area. The generalised stratigraphy of JCF is mentioned below (after Saraf, et al., 1995).

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

Table 1: Generalised stratigraphy of JCF.

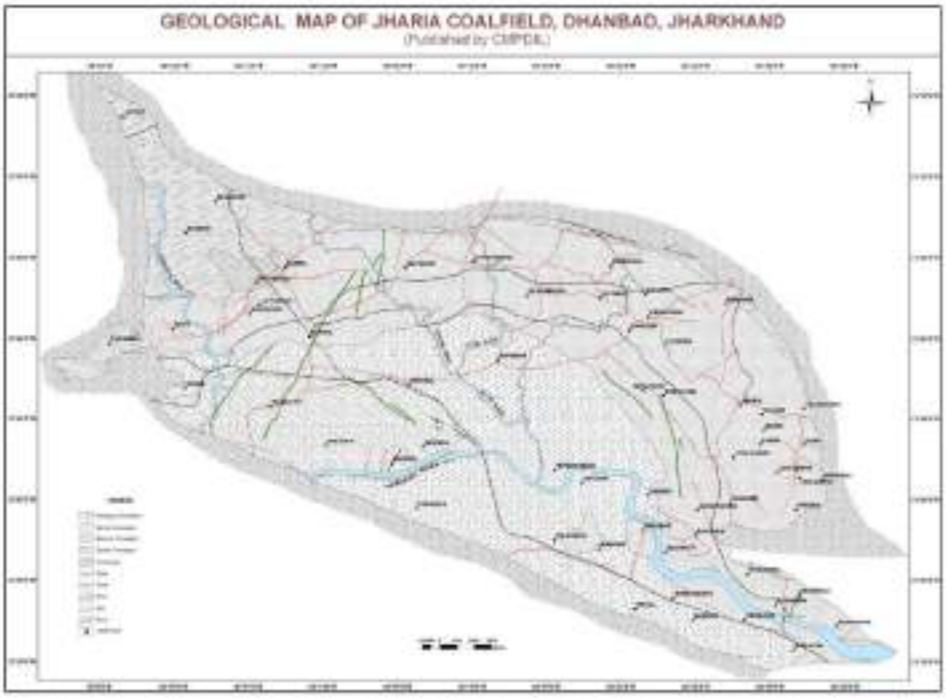

Figure 2 : Geological map of Jharia coal field, Dhanbad, Jharkhand (published by CMPIDL)

CHAPTER III

DATA REQUIREMENTS

3.1 Remote Sensing Data

The most recent available thermal satellite data was used in conjunction with the fieldwork for mapping coal fire in JCF. A coal fire map generated from the same, would serve as a reference for the fieldwork, as the observations can be verified in the field. For this purpose, a coal fire map was created from LANDSAT 8 TIRS data of 14-May 2017 .

Further, the coal fire map of 2012 prepared by NRSC (NRSC, 2012) from ASTER data was used as a reference to identify the changes that has occurred in the extent and disposition of the fires from 2012 to 2017.

For the land subsidence study, L-band microwave data from ALOS-PALSAR satellite (JAXA) were used. Five scenes of "Fine mode" SLC data were taken from PALSAR-2 archives over a period from October, 2014 to February, 2017. This was done to identify long term terrain changes and differentiate the same from short term changes due to mining excavations and overburden dumping.

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

Sl. No	Satellite	Sensor	Time	Date	Data source
1	LANDSAT-8	TIRS	Daytime	14 May 2017	USGS, USA
2	ALOS-PALSAR-2 (Fine mode)	PALSAR-2	-	4 October. 2014	JAXA, Japan
3				3 October, 2015	
4				20 February. 2016	
5				01 October, 2016	
6				18 February. 2017	

3.2 Ancillary data

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

CHAPTER IV

REMOTE SENSING DATA ANALYSIS

4.1 Methodology

4.1.1 Processing of Landsat 8 Data

With the launch of the LANDSAT-8 mission in February, 2013; thermal space borne data is available from its thermal infrared sensor (TIRS). This has enabled monitoring of the earth with a spatial resolution of 100 m in the thermal domain with a repeat cycle of 16 days. The LANDSAT-8 has two channels (Band 10 and Band 11) in the thermal infrared region (Table 1) which ranges from 10.4 micrometer to 12.5 micrometer. In present study, band 10 of TIRS sensor (acquired on 14 May, 2017) has been used coal fire mapping (Gangopadhyay et al. 2012). The spectral domain of the band is known for its maximum transmittance (Chatterjee et al. 2007; Martha et al. 2010). The data are freely accessible through USGS portal (Landsat 8 download source: http://landsatlook.usgs.gov).

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

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

Where:

L_λ = Spectral radiance (Watts/ (m2 * srad * μm)).

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

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

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

Once the spectral radiance (Lλ) for ASTER Band 13 and Landsat-8 band 10 data is generated, it is possible to calculate radiant (brightness) temperature directly using equation 2. Planck's radiation function (Planck, 1914) forms the basis of radiant temperature derivation from spectral radiances and the theory is discussed in detail in existing literatures (Gupta, 2003).

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

T_R = Radiant (brightness) temperature,

K_1 = Calibration constant (1260.56 K),

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

L_λ = Spectral radiance

4.1.2 Thresholding of radiant temperature image

Once the Landsat-8 data are converted to radiant temperature image, the next step was to segregate fire pixels from the background, which requires the estimation of the cut-off temperature (Roy et al. 2015). This has been attempted by the statistical analysis of sensor derived radiant temperature to delineate clusters (in the scatter-plot) indicative for fire and non-fire pixels. Mean and maximum radiant temperatures are derived from randomly sampled uniform sized pixel blocks distributed in entire spatial extent of Barakar formation (Figure 3) known for fire bearing coal seams. The pixel block sizes are chosen to adequately represent the overall areal extent of the coalfield and homogeneously encompass all the mining blocks (27x27 pixels for Landsat-8, Figure 3). The maximum temperature value recorded in each representative area, derived from each of the datasets, is plotted against the mean temperature. The maximum temperature represents that of fire (wherever present), whereas the mean temperature represents the average background temperature, for normalization. The fire and background populations show considerable variance, separating coal fire and background radiant temperatures. The cut-off temperature derived is the maximum temperature of the background cluster, above which all temperatures represent coal fires. In the case of the Landsat-8 data used in this study, the cut-off temperature was determined around 39°C (Figure 4). Based on this cut-offs, regional coal fire map was prepared (Figure 5).

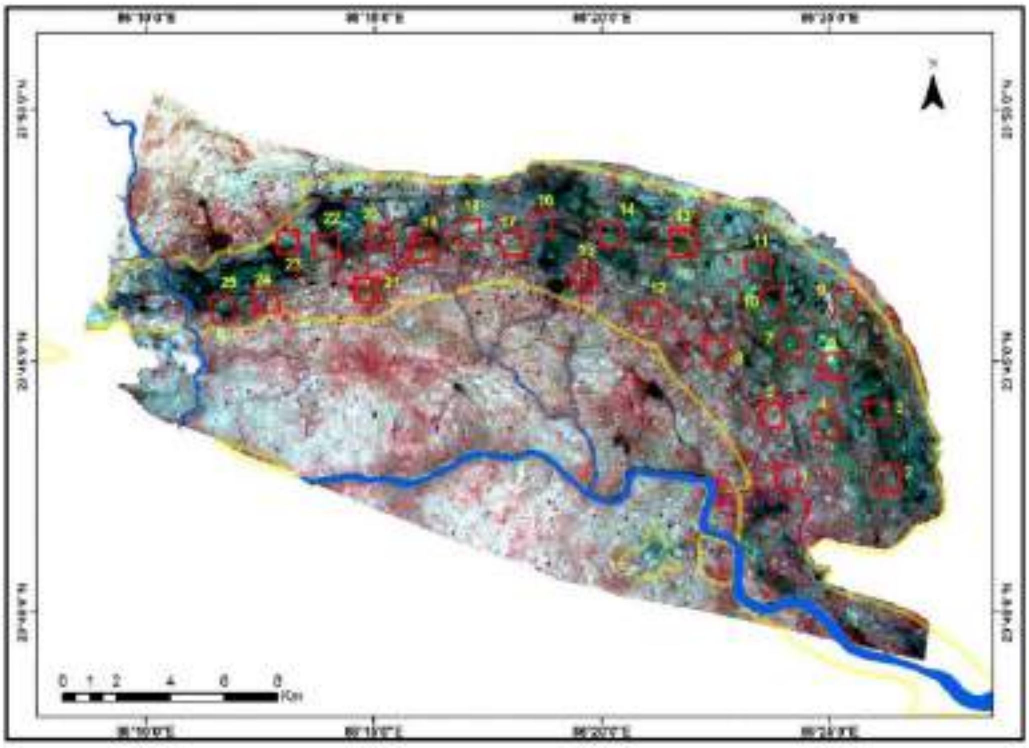

Figure 3. False colour composite image of Jharia Coalfield, with subset blocks (in red boxes) to obtain temperature values (from radiant temperature image) within the Barakar formation across the Jharia coalfield.

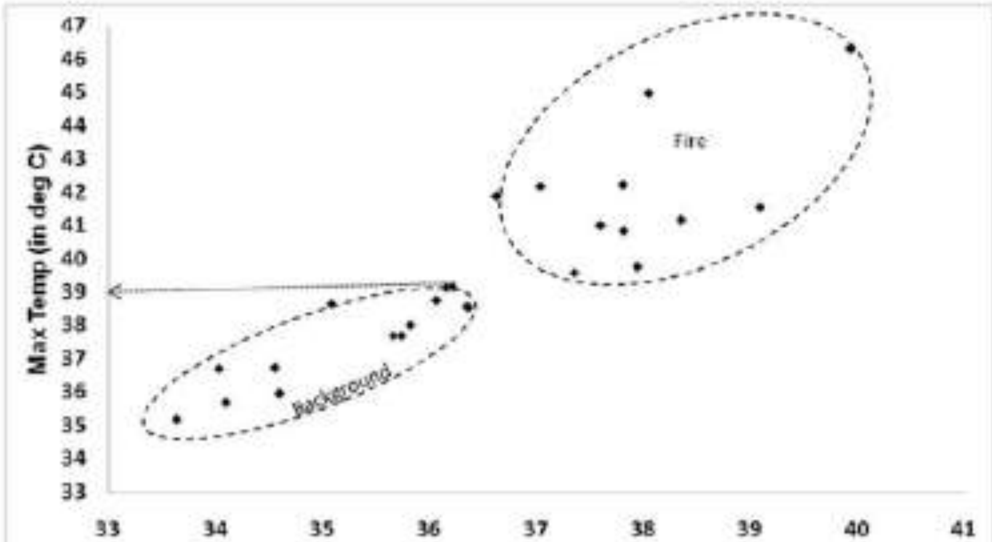

Figure 4. Maximum temperature plotted against mean temperature for various locations; cluster separation observed around 39 °C (marked with arrow)

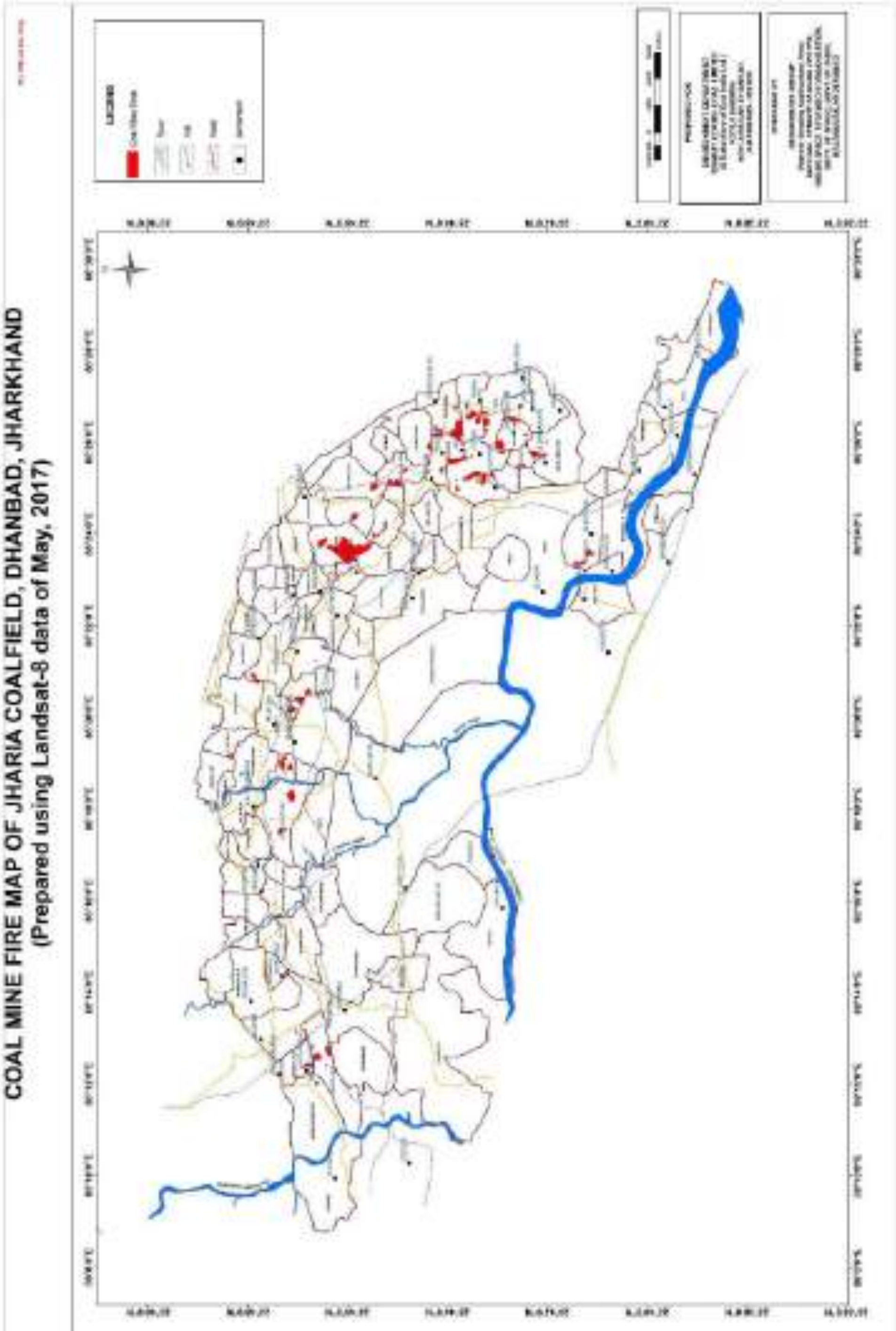

Figure 5: Coal mine fire map (May, 2017) of Jharia coal field, Dhanbad. The fire areas shown in this map have been verified in the field as per field points in figure 13.

4.2 Methodology For Subsidence Detection

4.2.1 Processing of ALOS-PALSAR 2 Data

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

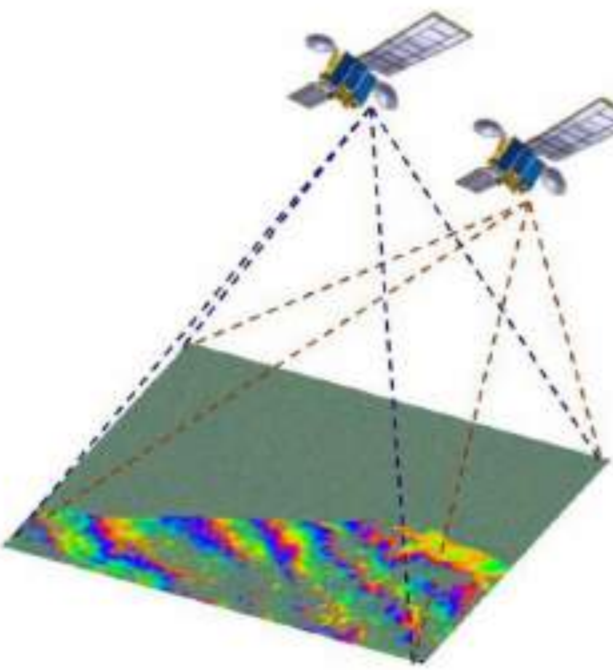

Figure 6. DInSAR acquisition scheme.

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

$$\Delta\Phi Int = \Phi Topo + \Phi Mov + \Phi Atm + \Phi Noise \quad (3)$$

where, ΦTopo denotes the topographic component, ΦMov denotes the terrain deformation/ displacement component, ΦAtm is the noise component and ΦNoise is the thermal noise.

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

$$\Delta\Phi dif = \Phi ErrorTopo + \Phi Mov + \Phi Atm + \Phi Noise \qquad (ii)$$

Since the coal mine area is very dynamic in terms of its surfacial changes (open cast mine, abandoned mine, fire affected waste/reclaimed land, over burden dumps) over time, it is proposed to utilize an advanced DInSAR technique. It is a recent remarkable improvements in SAR differential interferometry that has led to an innovative approach based on the use of a large dataset of SAR images over the same area to overcome the intrinsic limitations of conventional DInSAR in terms of temporal and geometrical decorrelation as well as atmospheric disturbances (Ferretti et al 2001; Hooper et al 2004; Kampes, 2006; Lanari et al 2004; Mora et al 2003;Werner et al 2003).

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

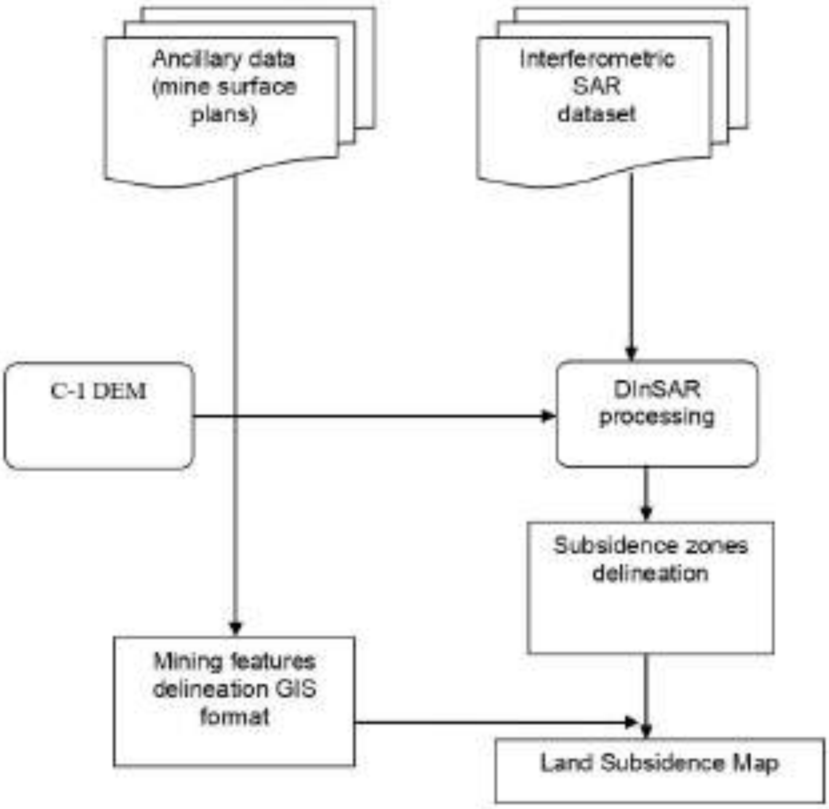

Figure 7. Work flow diagram for generating land subsidence map using DInSAR technique.

In the present study, 5 sets of ALOS-PALSAR L-band microwave data (as mentioned in table 1) were procured. The datasets were paired into master-slave pairs as per short and long temporal baselines. The short temporal baseslines include master slave pairs of time difference of six months or less, whereas long temporal baselines include data pairs of time difference of one year or more. This has been illustrated in figure 8.

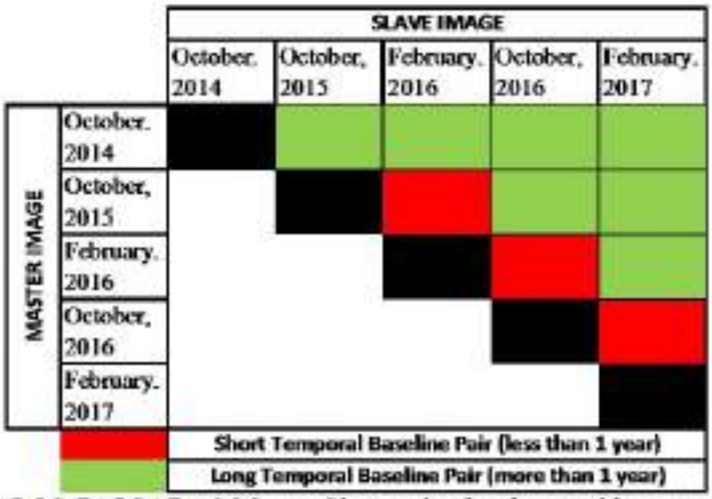

Figure 8. ALOS-PALSAR - 2 Master-Slave pairs for short and long temporal base line processing

The interferometric fringes generating from short baseline pairs will generally indicate terrain changes due to mining activity happening over a short period of time. This will include mining excavations and creation of new OB dumps adjacent to the mining area. Any incidences of slow land subsidence will not be demarcated in the results (figure 9).

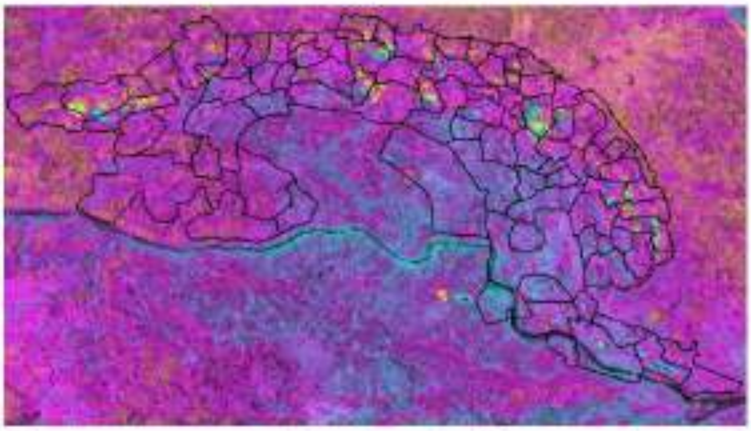

Figure 9. Fringe patterns generated from short baseline processing (e.g. Master: Oct, 16, Slave: Feb, 17).

On the other hand, master-slave pairs of long temporal baseline (one year or more, as shown in figure 8) will incorporate terrain changes due to mining activities as well, as long term ground subsidence from underground mining where ever present (figure 10).

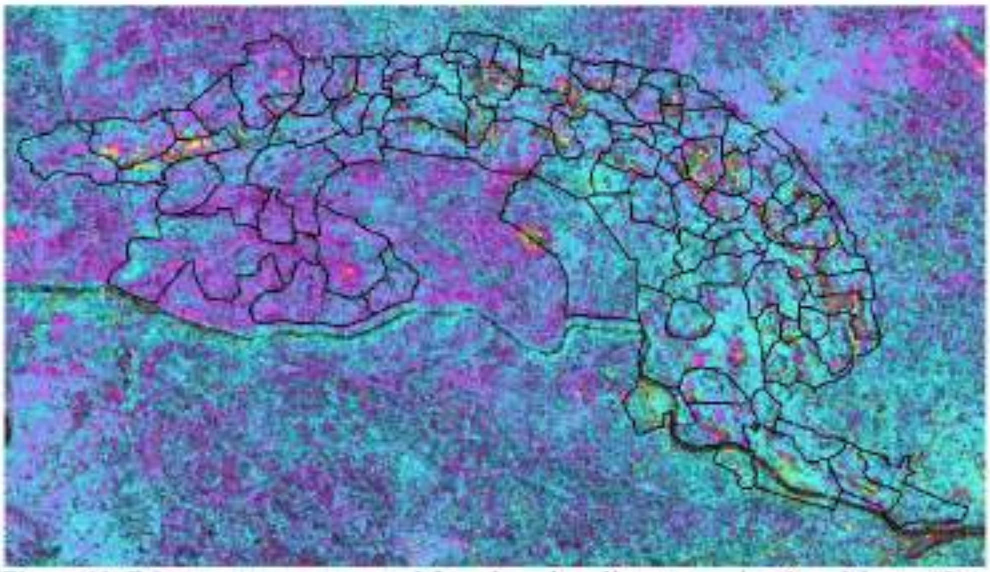

Figure 10. Fringe patterns generated from long baseline processing (e.g. Master: Oct, 15, Slave: Feb, 17).

The results from the long and short baseline processing can be compared and zone where fringes have been developed due to terrain changes due to mining excavation and dumping, can be systematically identified and demarcated. The remaining fringes from the long temporal baseline processing will then indicated towards zones where subsidence has taken place due to underground mining. Using this, a terrain change map of the Jharia Coalfield was generated demarcating terrain changes due to mining activities and subsidence areas (Figure 11).

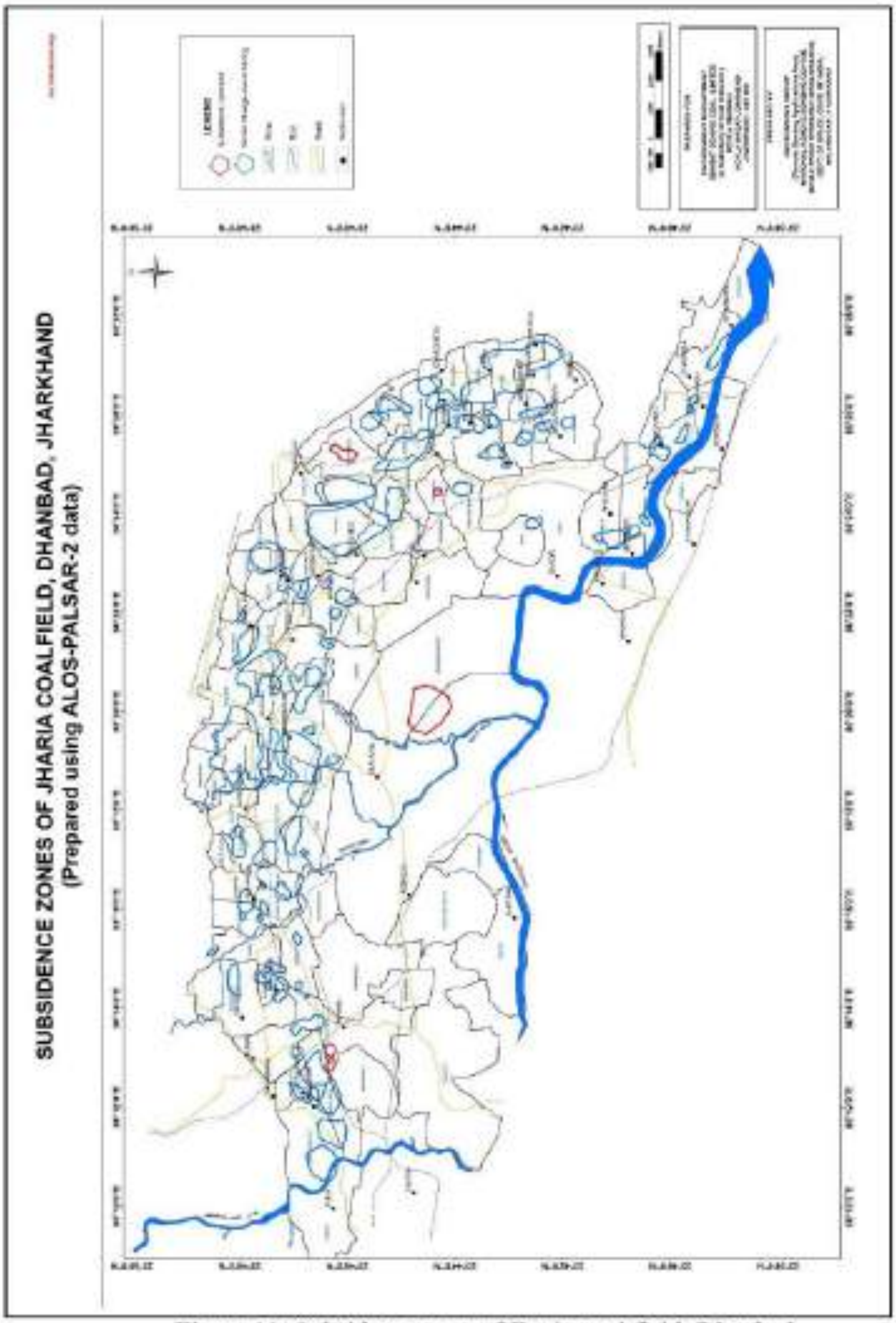

Figure 11: Subsidence map of Jharia coal field, Dhanbad.

CHAPTER V

FIELD WORK

A field work for verification of the coal fire locations and the subsidence zones as identified by the satellite data were taken up in December, 2017. A total of 53 coal fire points and 37 land subsidence locations were identified from the satellite data analysis. The locations of these points along with geographic coordinates were given to BCCL prior to the December, 2017 field work for their feedback on the status of these points. Out of the 53 coal fire locations identified, 52 points were confirmed to be fire bearing as per the present masterplan of the Jharia coalfield created by BCCL Both the coal fire and the subsidence locations were further independently verified by NRSC during the fieldwork in December, 2017. The locations and the observations are coal fire and subsidence are provided in annexure 1 and annexure 2 of this report respectively.

The salient overview of the field observations are as follows:

Coal-fire observations:

1. The coal fires as observed identified by the Landsat-8 data are mostly accurately delineated. Fires have been identified in the western, northern and eastern flank of the coalfield with considerable accuracy in the spatial locations.
2. In the eastern flank, the main fire affected mines are Kusunda, Lodna and Tisra. Active fires area present in the mines and fumes can be seen from the OB dumps. The Bhowra and Bhulanbarari mines also show presence of fire, however, the extent of the fire area appears to be underestimated in the data. Similarly, the extent of fires in Lodna and Tisra appears to have been overestimated in the data. The largest extent of fire in the single mine block is that in Kusunda.
3. In the northern flank, the main fire bearing mines are Katras, Gaslitand and Mudidih, However, it is seen that in these areas, the fires appears in pockets and are not pervasively present. The spatial extent of the fires on the ground and as estimated in the data can be correlated.

4. In the western flank, the Block II OCP is the primary fire affected region. However, it is seen that the Shatabdi OCP also bears fire pockets along semi-vertical mine walls, This is not identified in the data.

Subsidence location observations:

1. Subsidence locations as identified by the data area difficult to verify in the field, unless there are tell-tale signatures like large cracks or fissures on the ground or damage to anthropogenic constructions like vertical cracks on building cracks etc.
2. Out of the 37 identified subsidence locations from the microwave data, it is seen that 32 are due to terrain changes resulting from mining activities like ongoing excavations or formation of new mining dump. These decrease or increase in elevations has resulted in forming of interferometric fringes in the data thus creating false positives.
3. Five areas were firmly established as subsidence zones. Out of these, the main area where subsidence is occurring in a pervasive scale, is that in the Moonidih Underground Project. The Moonidih Project is an underground long wall mine where excavations are going on for over decades. This may have resulted in pervasive subsidence in the region. The signatures of subsidence such as ground cracks are observed in the area.
4. Two adjacent locations are observed south of the Block II OCP and in Phularitand mining block. This may be resulted due to older underground mining in the area. Signatures such as sagging of ground is seen.
5. Another minor subsidence region was identified around the Simlabahal underground mining project. This is again due to active underground mining in the area. A similar region was also observed in the northern part of the Bastacolla mines where active underground mining is ongoing.

In lieu of the observations in field on the fire and subsidence locations, few post field work correction in the coal fire and subsidence maps was necessitated and has been discussed in the next chapter.

CHAPTER VI

POST FIELDWORK ANALYSIS

As observed in the fieldwork, there were certain mine areas where the presence of fire was not detected by the satellite data. For example in Shatabdi and Bhulanbarari mine areas, the fire appears in small pockets on mine faces and was possibly not detected by the threshold temperature calculated for the entire mine area. On the other hand, in the Bhowra, Lodna and Tisra mine areas, the spatial extent of fire appears to have been overestimated by the regional threshold temperature use to separate the fire and the background areas.

Therefore, mine specific threshold temperature analysis was carried out for Shatabdi, Bhulanbarari, Bhowra, Lodna and Tisra mine areas to correctly depict the fire areas on the ground. The threshold temperature selected from each of these mine areas are given in Table 3.

Table 3: Threshold temperature for fire area estimation of individual mines.

Name of the Mine Block	Threshold Temperature (in °C)
Bhowra	38.5
Tisra (north and south)	North : 41; South : 40.5
Lodna	41
Bhulanbarari	38.5
Shatabdi	38

Using the threshold temperatures as mentioned in the table 3, the previously undetected fire areas in the Shatabdi and Bhulanbarari mines were detected. Further the spatial extent of the fire areas in Bhowra, Lodna and Tisra mines were changed to adequately represent the actual extent of the fire on the ground. These were incorporated in the coalfire map shown in figure 5.

CHAPTER VII

DISCUSSIONS AND CONCLUSIONS

7.1 Discussions

7.1.1 Coal fire analysis

The present study is aimed to provide the status of coal fire in the Jharia coal field for the period of 2017. Landsat-8 data of May, 2012 was used to prepare the coal mine fire map (Figure 5) for the year 2017. The data have 100 m spatial resolution in the thermal bands and is as on study date, the best thermal satellite data available. The Coal fire maps of 2017 when compared to map of 2012 (NRSC, 2014) depicts the dynamics of coal fire. Coal fire is difficult to mitigate because of its dynamic nature. But the understanding the trend in the shift of coal fire zones and over all distribution of coal fire will help in environmental and risk management related to coal mining activities.

The coal mine fire map for the year 2017 (Figure 5 illustrates the overall fire distribution in the area). The maps reveal that the coal fires are distributed across the Jharia coal field in pockets associated with major open cast mining activities. All most all the coal mine fires are restricted to the Barakar Formation where coal seams are exposed. In the eastern flank of the arcuate shaped mining extent, the collieries in Lodna and Tisra (North and South) is the highest fire affected mining blocks and Bhowra, Bhulanbarari, Kujama and Jharia are also affected by multiple smaller fire pockets. The fire in the areas is mostly manifested by high temperature fume cracks with occasional presence of active flames especially the the Lodna-Tisra area. Further, towards the north east, in Ena and Kusunda active fires are more prevalent and the area is extensively affected. The highest radiant temperatures (in order of ~50°C) are recorded by the satellite sensors in these areas. In the north, a large number of moderate to small fire pockets are seen in the areas around Shyambazar (Figure 5 & 6). These are related to the mining areas of Katras, Gaslitand, Mudidih and Kankanee. Mining activity, over the last few of years has exposed new, isolated and discontinuous fires in these regions.

In the western flank, three distinguishable fire affected zones are seen. Toward the western end of the mining area, the Benedih and Block II OCP are affected by smaller fires from isolated coal seams. These again are surfacialy manifested in the form of fume cracks with smoke emanating from them. The Shatabdi OCP are also affected but fire is manifested in the along vertical mining wall sections.

Comparison of the 2017 coal fire map with that of 2012 (NRSC, 2014) indicated the dynamism in the spatial extent and distribution of the coal fires. The changes are highlighted as follows:

i. In reference to the map generated in 2012, the 2017 map shows that the emergence/re-emergence of fires in the eastern flank, namely Kujama, Tisra, Lodna and Jharia etc. The entire zone has been affected by multiple fire occurrences. The spatial disposition of fires in Bastacolla, Jharia and Bhulanbarari appear to have a minor increase.

ii. The areal extent of major fire zone around Kusunda/Kenduadih and Ena appears to remain the same, though here again the spatial location of the anomalies has changed. This is probably due to the mitigation and active mining in this region.

iii. The fire zones in Benedih/Block II OCP and Shatabdi OCP have also changed/diminished in areal extent with presence of isolated smaller anomalies. There has been a considerable reduction in fire areas in and around the Shatabdi OCP.

iv. The spatial disposition of fire areas around Katras, Gaslitand and Mudidih show minor change. In 2012, a number of small fire pockets were seen, however presently those fire pockets have given away to a few fire zones of moderate disposition.

v. It needs to be noted that the 2012 study was carried out using ASTER data whereas the present study is carried out using Landsat-8 data. Therefore, the difference of sensor sensitivities will have a influence on the way the fires are sensed on the ground. Difference of sensor sensitivities will influence the number of fires identified as well as the areal extent of the fires in the data.

In summary, there is a change in the areal disposition of the fires from 2012 to 2017. Observations suggest the emergence/re-emergence of new areas in the eastern flanks in areas around Lodna and Tisra. Concurrently, there is a decrease in extent of fire areas Shatabdi, Nadkhurkee area in the western flank from 2012 to 2017. A quantitative comparison of the 2012 and 2017 data was carried out. As compared

2012, when the total fire affected extent of about 2.18 km^2; in 2017 total fire affected extent is about 3.28 km^2. The colliery wise break-up of change in fire area from 2012 to 2017 is given in Annexure III.

7.1.2 Subsidence analysis

An attempt to identify subsidence zones in the Jharia Coalfield was also carried out using ALOS-PALSAR-2 L band microwave data using differential interferometric technique. 5 scenes of PALSAR-2 data spanning over a period of 2014 to 2017 were used to delineate the subsidence if any in the region and separately identify them from the terrain changes due to mining. Verification of the subsidence zones as seen from data is difficult as it requires visible signatures of subsidence in the form of cracks on the ground and damage to anthropogenic structures. In this study, data analysis and consequent field verification resulted in identification is 5 prominent subsidence areas. Of these, the major area where considerable ground subsidence is occurring is the Moonidih UG project. Long term underground mining has resulted in continuous subsidence in the area. Apart from this, the other four areas are south of Block II OCP, Simlabahal and Bastacolla. No quantitative estimates of the subsidence has been carried out in the study.

7.2 Conclusions

The following conclusions can be made:

1. As of the date of study in the year 2017 and in comparison with the previous study done in 2012, there has been a change in areal extent and disposition of the fire affected areas.

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

3. The major new fire areas are observed in the northern flank in the areas around Lodna and Tisra etc. These areas were not mapped as fire in the 2012 study.

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

5. There is a increase in areal extent of the fire (Figure 12) from 2012 to 2017.

Note: *Estimations of fire extent (in terms of sq.km.) both in 2012 and in the present 2017 study are pixel based. They do not represent 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.*

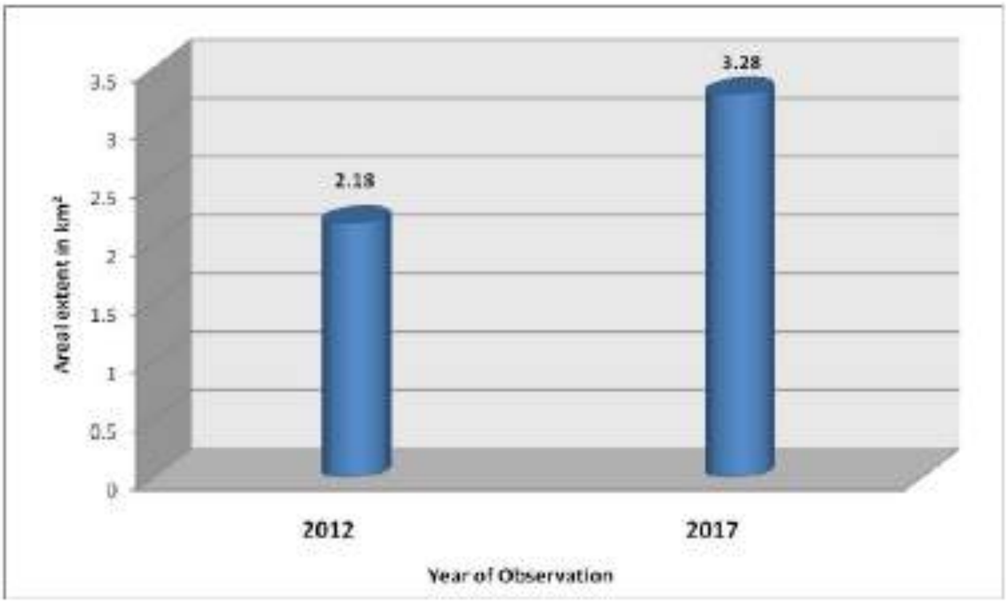

Figure 12: Total fire area statistics

CHAPTER VIII

LIMITATIONS

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

1) An anomalous pixel from LANDSAT data represents an area of 30m x 30m (resampled from spatial resolution of 100m) on the ground whose temperature is considerably higher than its surroundings. This can be attributed to two circumstances, namely the area has a very high intensity fire located within a smaller pocket or there are a number of low intensity fires spread across it. In both the mentioned cases the actual areal extent of the fire on the surface differs, but appears as a single anomalous pixel in the data. Hence, representation of fire affected ground area by means of pixel area is ambiguous and hence should be considered with caution.

2) There are locations as observed during the fieldwork, where coal seams are affected by active fires along vertical/semi-vertical sections of open cast mines (see cover page). In such cases, the actual areal expression of the fire affected area as seen by the sensor changes considerably and the representation from the same is not accurate.

3) As discussed in section 4.2.1, thresholding the data to separate the fires from the non fire areas, is a statistical technique. However, this method is dependent on how the temperature of non-fire background area is distinctive from the fire temperature.

4) The background temperatures vary with the time of the day when the data is collected, topography, and season of the year when the data is acquired. Night-time data has lower background temperature as compared to day-time. Similarly a data collected in October-November will have a considerably lower background temperature than that collected in May-June due to seasonal temperature variations. Hence, identification of the background temperature range becomes essential in

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

5) Generally, a constant threshold temperature is estimated over the entire study area, and the same is applied to delineate the fire areas from those of non-fire. However, it is seen that the application of such global thresholding may mask fires which are in turn seen in the field and that the threshold temperature value may vary locally. In the current scenario, it is seen that the fire locations as verified in the fieldwork at Bhulanbarari and Shatabdi were not identified in the data on application of a global threshold of 39°C. However, a subset of the data within the Bulanbarari area only, is analyzed with a lower threshold of 38.5°C, the fire pixels are manifested in the data. Hence, the appropriateness of a singular thresholding temperature value may need to be relooked upon. Future studies can be carried out using colliery wise statistical local thresholding to create a composite coal fire map.

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

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

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

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Annexure –I

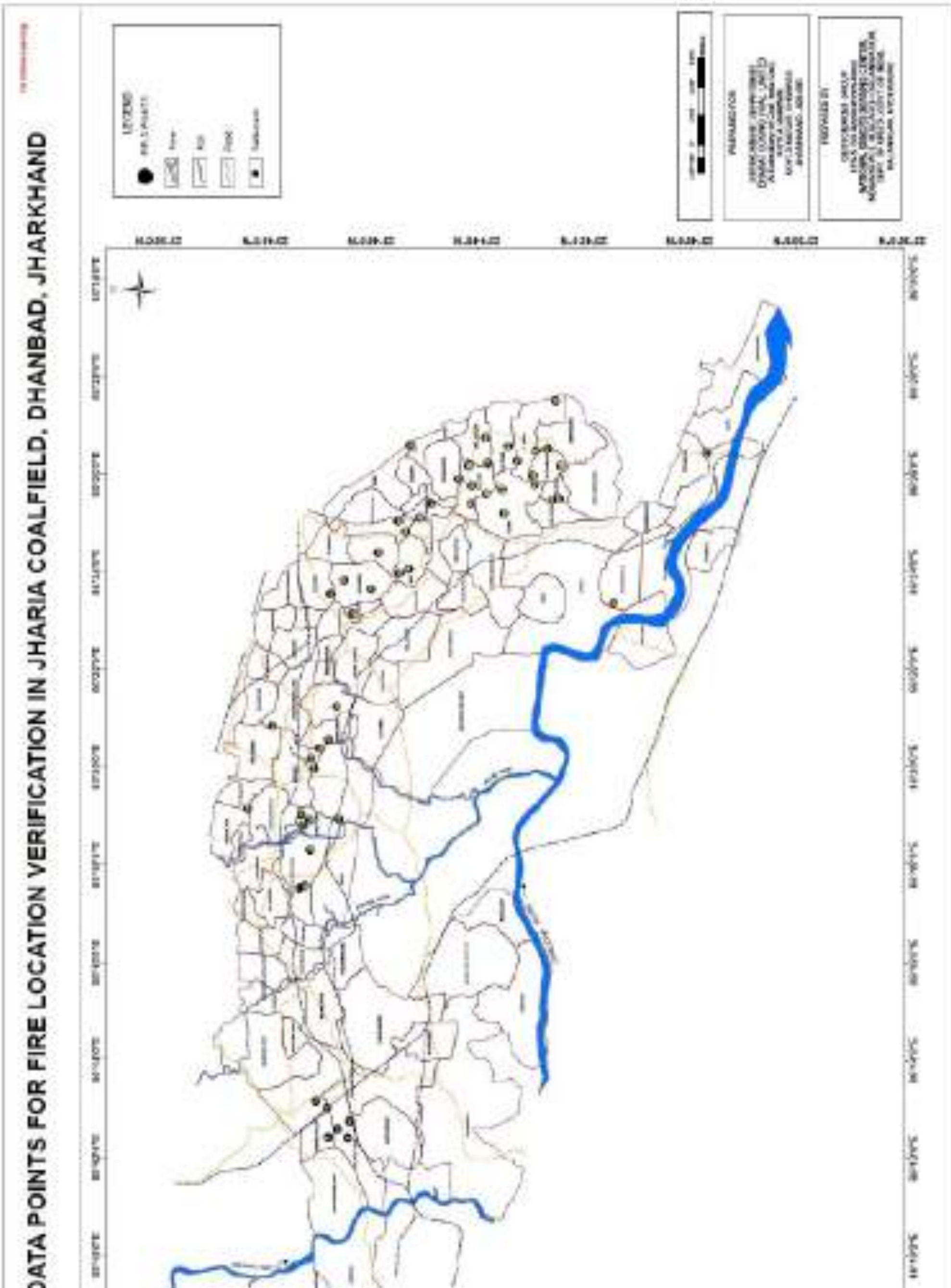


Figure 13. Field data points for coal fire verification

Table – 4: Coal Fire observations during fieldwork (see figure 13 for reference)

SL. No.	Point of Observations		Comments		
	Latitude	Longitude	Type of Mining Activity	Presence of Coal Fire	Mine name and Any other Comments
1	23.7801	86.2068	OB Dump	Fire	ABOCP
2	23.7771	86.2097	Active Mine	Fire	ABOCP
3	23.7739	86.2066	Active Mine	Fire	ABOCP
4	23.7733	86.2124	OB Dump	Fire	ABOCP
5	23.7806	86.2168	No Working	Fire	ABOCP
6	23.7841	86.2192	No Working	Fire	Phularitand
7	23.7893	86.2919	No Working	Fire	Katras Chatudih
8	23.7875	86.2926	No Working	Fire	Katras Chatudih
9	23.7857	86.3049	Working	Fire	Gaslitand
10	23.7768	86.3157	Outside Jharia Mines		Tata
11	23.7887	86.3170	OB Dump	Fire	Gaslitand
12	23.7862	86.3151	OB Dump	Fire	Gaslitand
13	23.7880	86.3133	OB Dump	Fire	Gaslitand
14	23.8054	86.3191	Working	Fire	AKWMC
15	23.7855	86.3363	OB Dump	Fire	Mudidh
16	23.7826	86.3397	Working	Fire	Kankanee
17	23.7800	86.3427	Working	Fire	Kankanee
18	23.7848	86.3327	OB Dump	Fire	Mudidih
19	23.7977	86.3473	OB Dump	Fire	Sendra Bansjora
20	23.7775	86.3540	OB Dump	Fire	Loyabad
21	23.7793	86.3924	No Working	No fire	Kusunda (Domestic coal burning)
22	23.7753	86.3970	Working	Fire	Kusunda
23	23.7724	86.3858	Working	Fire	Kusunda
24	23.7669	86.3940	OB Dump	Fire	Kusunda
25	23.7578	86.3993	OB Dump	Fire	Ena
26	23.7550	86.4009	OB Dump	Fire	Ena
27	23.7645	86.4065	Working	Fire	ADKC
28	23.7580	86.4172	Old Quarry	Fire	ROCP
29	23.7515	86.4184	OB Dump	Fire	ROCP
30	23.7559	86.4137	OB Dump	Fire	ROCP
31	23.7476	86.4232	Working	Fire	ROCP
32	23.7543	86.4431	Outside Jharia Mines		Unknown site (Out side of Kuya)
33	23.7394	86.4317	Active Mine	Fire	Ghanoodih
34	23.7360	86.4362	OB dump	Fire	Goluckdih
35	23.7349	86.4293	OB Dump	Fire	Kujama
36	23.7354	86.4232	No Working	Fire	Kujama
37	23.7301	86.4369	Working	Fire	NT-ST
38	23.7305	86.4265	OB dump	Fire	Kujama
39	23.7249	86.4200	No Working	Fire	Lodna
40	23.7159	86.4327	Working	Fire	Joyrampur
41	23.7254	86.4280	No Working	No fire	Lodna
42	23.7209	86.4376	Working	Fire	NT-ST
43	23.7154	86.4296	Working	Fire	Lodna
44	23.7238	86.4427	Working	Fire	NT-ST
45	23.7309	86.4457	OB dump	Fire	NT-ST
46	23.7151	86.4412	Active Mine	Yes	NT-ST
47	23.7114	86.4419	OB Dump	Fire	NT-ST
48	23.7073	86.4360	Active Mine	Fire	Joyrampur
49	23.7097	86.4243	Working	Fire	Bagdigi/Joyrampur
50	23.7079	86.4249	Active Mine	Fire	Bagdigi/Joyrampur
51	23.7086	86.4582	Outside Jharia Mines		Unknown site (Out side of NT-ST)
52	23.6614	86.4404	Outside Jharia Mines		Chasnala
53	23.6906	86.3892	OB dump	Fire	Bhowrah (North)

Annexure –II

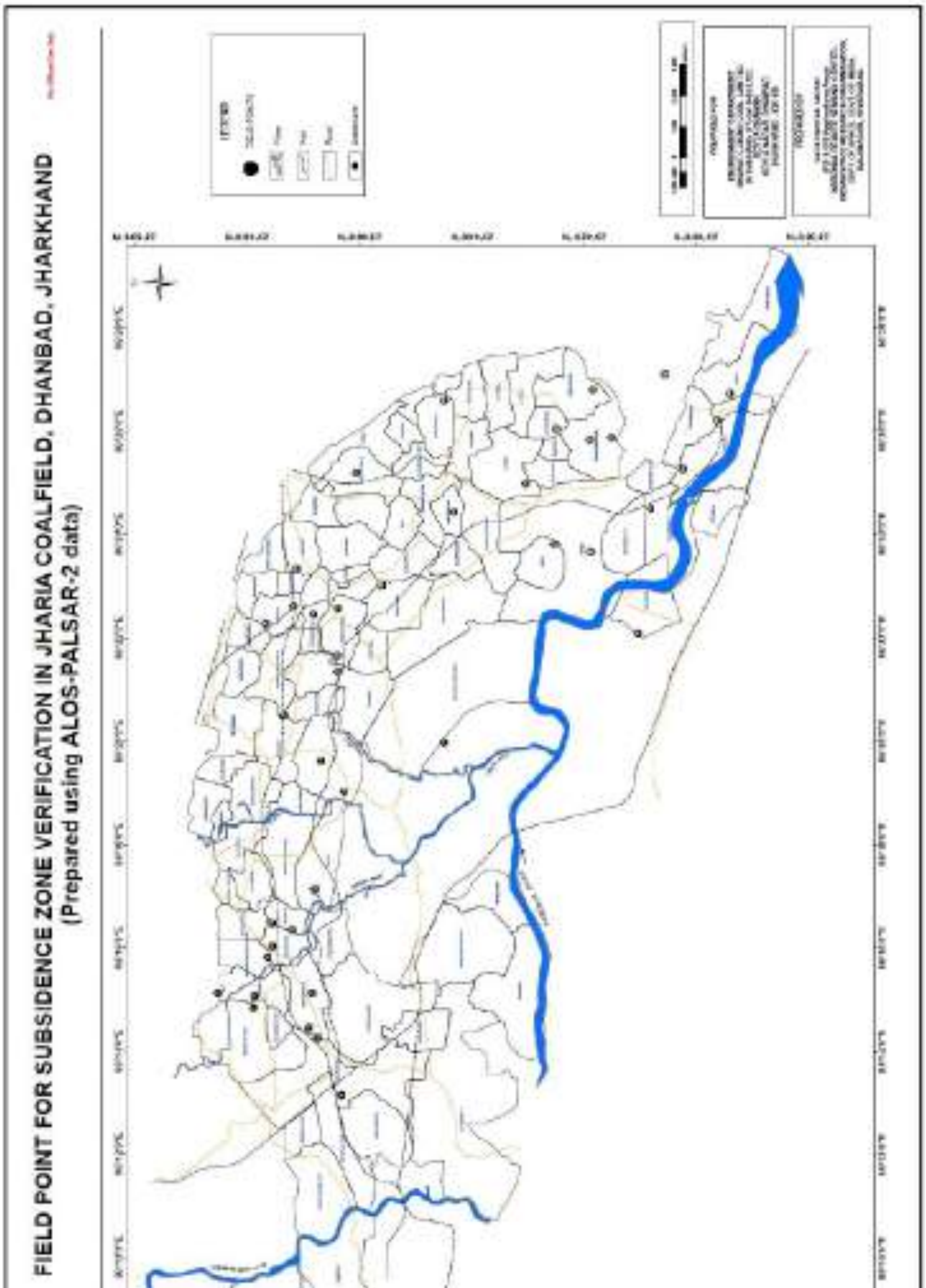


Figure 14. Field data points for subsidence verification

Table – 5: Coal Fire observations during fieldwork (see figure 14 for reference)

	Point of Observations		Comments	
Sr. no.	Latitude	Longitude	Mine name and Any other Comments	Signs of Subsidence (crack on building/ground crack etc.)
0	23.7416	86.3338	Moonidih UG Project	Sagged area, Building damage
1	23.7722	86.2192	South of Block II (2 areas)	Cracks on the ground
2	23.7817	86.2409	Terrain Change due to mining	
3	23.7811	86.2521	Terrain Change due to mining	
4	23.7792	86.2376	Terrain Change due to mining	
5	23.7983	86.2473	Terrain Change due to mining	
6	23.7981	86.2510	Terrain Change due to mining	
7	23.8088	86.2521	Terrain Change due to mining	
8	23.7941	86.2636	Terrain Change due to mining	
9	23.7926	86.2671	Terrain Change due to mining	
10	23.7868	86.2724	Terrain Change due to mining	
11	23.7928	86.2746	Terrain Change due to mining	
12	23.7800	86.2857	Terrain Change due to mining	
13	23.7713	86.3171	Terrain Change due to mining	
14	23.7783	86.3270	Terrain Change due to mining	
15	23.7893	86.3419	Terrain Change due to mining	
16	23.7734	86.3556	Terrain Change due to mining	
17	23.7734	86.3762	Terrain Change due to mining	
18	23.7804	86.3742	Terrain Change due to mining	
19	23.7865	86.3769	Terrain Change due to mining	
20	23.7855	86.3890	Terrain Change due to mining	
21	23.7679	86.4199	Bastacolla	Sagged areas
22	23.7390	86.4071	Simlabahal UG	Sagged areas
23	23.7417	86.4431	Terrain Change due to mining	
24	23.7176	86.4163	Terrain Change due to mining	
25	23.7085	86.4339	Terrain Change due to mining	
26	23.6986	86.4304	Terrain Change due to mining	
27	23.6923	86.4312	Terrain Change due to mining	
28	23.6977	86.4466	Terrain Change due to mining	
29	23.7092	86.3967	Terrain Change due to mining	
30	23.6985	86.3942	Terrain Change due to mining	
31	23.6845	86.3681	Terrain Change due to mining	
32	23.6804	86.4083	Terrain Change due to mining	
33	23.6685	86.4110	Terrain Change due to mining	
34	23.6706	86.4211	Terrain Change due to mining	
35	23.6603	86.4366	Terrain Change due to mining	
36	23.6568	86.4454	Terrain Change due to mining	
37	23.6760	86.4516	Terrain Change due to mining	
38	23.7603	86.3836	Terrain Change due to mining	
39	23.7734	86.3609	Terrain Change due to mining	
40	23.7948	86.3715	Terrain Change due to mining	

Annexure –III

SL. NO.	COLLIERY AREA NAME	FIRE AREA 2012 (SQ. KM.)	FIRE AREA 2017 (SQ. KM.)	AREA CHANGE (SQ. KM.)	Increase/Decrease
1	DAMODA	0.0000	0.0000	0.000	NO FIRE
2	TISCO (west)	0.0000	0.0000	0.000	NO FIRE
3	IISCO	0.0000	0.0000	0.000	NO FIRE
4	TISCO (north)	0.0885	0.0153	-0.073	DECREASE
5	NUDKHURKEE OCP	0.0000	0.0000	0.000	NO FIRE
6	BENEDIH OCP	0.0530	0.0453	-0.008	DECREASE
7	BLOCK-II OCP	0.0530	0.1353	0.082	INCREASE
8	MURAIDIH OCP	0.1478	0.0022	-0.146	DECREASE
9	SHATABDI OCP	0.0378	0.0361	-0.002	DECREASE
10	TETURIA	0.0000	0.0000	0.000	NO FIRE
11	S.GOVINDPUR	0.0000	0.0000	0.000	NO FIRE
12	KORIDIH BLOCK-IV OCP	0.0000	0.0000	0.000	NO FIRE
13	JOGIDIH	0.0000	0.0000	0.000	NO FIRE
14	DHARAMABAND	0.0000	0.0000	0.000	NO FIRE
15	MAHESHPUR	0.0000	0.0000	0.000	NO FIRE
16	PHULARITAND	0.0133	0.0205	0.007	INCREASE
17	MADHUBAND	0.0000	0.0000	0.000	NO FIRE
18	AKASH KINARI	0.0000	0.0000	0.000	NO FIRE
19	GOVINDPUR	0.0000	0.0000	0.000	NO FIRE
20	E. KATRAS	0.0133	0.0000	-0.013	DECREASE
21	KATRAS-CHOITUDIH	0.1021	0.1368	0.035	INCREASE
22	KESHALPUR	0.0000	0.0013	0.001	INCREASE
23	RAMKANALI	0.0000	0.0000	0.000	NO FIRE
24	NICHITPUR	0.0000	0.0000	0.000	NO FIRE
25	E. BASURIA	0.0000	0.0000	0.000	NO FIRE
26	KHAS KUSUNDA	0.0000	0.0000	0.000	NO FIRE
27	GONDUDIH	0.0000	0.0000	0.000	NO FIRE
28	W. GODHAR	0.0012	0.0000	-0.001	DECREASE
29	BASURIA	0.0000	0.0000	0.000	NO FIRE
30	TETULMARI	0.0223	0.0220	0.000	DECREASE
31	DHANSAR	0.0000	0.0000	0.000	NO FIRE
32	GODHAR	0.1073	0.0000	-0.107	DECREASE
33	INDUSTRY	0.0119	0.0513	0.039	INCREASE
34	KUSUNDA	0.4243	0.7398	0.315	INCREASE
35	SENDRA-BANSJORA	0.0796	0.0275	-0.052	DECREASE
36	BASTACOLLA	0.0663	0.0810	0.015	INCREASE
37	BERA	0.0000	0.0000	0.000	NO FIRE
38	KUYA	0.0000	0.0000	0.000	NO FIRE
39	GOLUCKDIH	0.0301	0.1122	0.082	INCREASE
40	KUJAMA	0.0398	0.2404	0.201	INCREASE

41	S. JHARIA-R. OCP	0.0244	0.1118	0.087	INCREASE
42	DOBARI	0.0000	0.0000	0.000	NO FIRE
43	GONHOODIH	0.0398	0.0322	-0.008	DECREASE
44	SIMLABAHAL	0.0000	0.0000	0.000	NO FIRE
45	HURRILADIH&STD	0.0000	0.0000	0.000	NO FIRE
46	ENA	0.0918	0.0432	-0.049	DECREASE
47	BURRAGARH	0.0000	0.0000	0.000	NO FIRE
48	N. TISRA	0.0098	0.1802	0.170	INCREASE
49	LODNA	0.0000	0.3527	0.353	INCREASE
50	S. TISRA	0.0000	0.1015	0.102	INCREASE
51	BARAREE	0.1037	0.1074	0.004	INCREASE
52	AMLABAD	0.0000	0.0000	0.000	NO FIRE
53	PATHERDIH	0.0000	0.0000	0.000	NO FIRE
54	SUDAMDIH	0.0000	0.0000	0.000	NO FIRE
55	SITANALA	0.0000	0.0000	0.000	NO FIRE
56	MURULIDIH 20/21 PIT	0.0000	0.0000	0.000	NO FIRE
57	MURULIDIH	0.0000	0.0000	0.000	NO FIRE
58	BHATDIH	0.0000	0.0000	0.000	NO FIRE
59	LOHAPATTY	0.0000	0.0000	0.000	NO FIRE
60	IISCO	0.0000	0.0000	0.000	NO FIRE
61	TASRA-IISCO	0.0000	0.0000	0.000	NO FIRE
62	KENDUADIH	0.0610	0.0000	-0.061	DECREASE
63	BULLIHARY	0.0000	0.0000	0.000	NO FIRE
64	GOPALICHUCK	0.0000	0.0000	0.000	NO FIRE
65	POOTKEE	0.0000	0.0000	0.000	NO FIRE
66	BHURUNGIA	0.0000	0.0000	0.000	NO FIRE
67	KHARKHAREE	0.0000	0.0000	0.000	NO FIRE
68	GASLITAND	0.1194	0.1215	0.002	INCREASE
69	KANKANEE	0.0530	0.0525	-0.001	DECREASE
70	MUDIDIH	0.1141	0.1104	-0.004	DECREASE
71	W. MUDIDIH	0.0171	0.0000	-0.017	DECREASE
72	LOYABAD	0.0133	0.0063	-0.007	DECREASE
73	BHAGABAND	0.0000	0.0000	0.000	NO FIRE
74	MOONIDIH PROJECT	0.0000	0.0000	0.000	NO FIRE
75	E.BHUGGATDIH	0.0022	0.0214	0.019	INCREASE
76	ALKUSHA	0.0326	0.0294	-0.003	DECREASE
77	KUSTORE	0.0524	0.0463	-0.006	DECREASE
78	ANGARAPATRA	0.1331	0.0149	-0.118	DECREASE
79	SALANPUR	0.0000	0.0000	0.000	NO FIRE
80	BHOWRAH. N	0.0133	0.0980	0.085	INCREASE
81	BHOWRAH. S	0.0000	0.0000	0.000	NO FIRE
82	BAGDIGI	0.0000	0.0209	0.021	INCREASE
83	JEALGORA	0.0000	0.0067	0.007	INCREASE
84	JEENAGORA	0.0000	0.0470	0.047	NO FIRE

85	JOYRAMPUR	0.0099	0.1042	0.094	INCREASE
86	CHANDAN OCP	0.0000	0.0000	0.000	NO FIRE
87	BANSDEOPUR	0.0000	0.0000	0.000	NO FIRE
	TOTAL AREA	**2.18**	**3.28**	**1.10**	**INCREASE**

Table 6: Colliery wise break-up of change in fire area from 2012 to 2017

Note:
1) "**NO FIRE**" implicates that the fire has not been identified satellite data *(either absent or below sensor resolution)*
2) "**INCREASE**" implies, increase in fire area OR emergence of fire areas not identified in 2012 study.
3) "**DECREASE**" implies, decrease in fire area OR fire areas of 2012, which are not identified in present study *(either absent or below sensor resolution)*.
4) Estimations of fire extent (in terms of sq.km.) both 2012 and in present 2017 study are pixel based. They do not represent 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 –IV

Figure 15: Fume cracks in Lodna-Tisra Area. (point 39 in figure 13 and table 4)

Figure 16: Burnt area near OB dump in Lodna area (point 41 in figure 13 and table 4)

Figure 17: Coalfries in active seams in Kusunda (point 23 in figure 13 and table 4)

Figure 18: Sagged area due to subsidence, south of Block II OCP. (point 1 in figure 14 and table 5)

Figure 19: Fire in OB dumps in Kusunda area. (point 24 in figure 13 and table 4)

Figure 20: Fume cracks in the Bhulanbarari area.

ANNEXURE 12:

भारतीय प्रौद्योगिकी संस्थान
(भारतीय खनि विद्यापीठ)

Mine Ventilation Laboratory
Department of Mining Engineering
INDIAN INSTITUTE OF TECHNOLOGY
(Indian School of Mines)
DHANBAD - 826004, JHARKHAND, INDIA

Air Sample Analysis Report of Tetulmari Colliery, Sijua Area, BCCL

Sample No. 9 & 10
Date of Sample Collection: 20.02.2019
Dated: 21.02.2019
Samples collected by: Colliery Management
Ref. No. TMC/112
Project no.
Dated: 21.02.2019
Date of Sample Analysis: 21.02.2019

Sl. No.	Details of the sample	CO%	CO_2%	CH_4%	C_2H_6%	C_2H_4%	O_2%	H_2S%	H_2%	N_2%
9	New borehole sample 31st L/S 'D(west), PST-2 (top) Seam at 12.15 p.m.	Nil	0.1882	Nil	Nil	Nil	20.7965	Nil	Nil	79.0153
10	GB of air (Junction) 26th L/S 'D', PST-2 (top) Seam at 12.40 p.m.	Nil	0.1508	Nil	Nil	Nil	20.8506	Nil	Nil	78.9986

Note: Samples were supplied to IIT (ISM) laboratory on 21.02.2019

(B. Munshi) 21.2.19
Senior Technical Assistant

21/02/19
(D. C. Panigrahi)
Professor & Incharge

Mine Ventilation Laboratory
Department of Mining Engineering
INDIAN INSTITUTE OF TECHNOLOGY
(Indian School of Mines)
DHANBAD

Air Sample Analysis Report of Tetulmari Colliery, BCCL

Sample No.: [illegible]
Date of Sample Collection: [illegible]
Dated: [illegible]
Samples collected by: Colliery Management
Date: [illegible]
Date of Sample Analysis: [illegible]

Sl. No.	Details of the sample	CO%	CO_2%	CH_4%	C_2H_6%	C_2H_4%	O_2%	H_2%	H_2S%	N_2%
1	[illegible] at 12:[illegible] p.m.	Nil	1.2074	Nil	Nil	Nil	19.2175	Nil	Nil	[illegible]
2	[illegible] at 12:20 p.m.	Nil	0.6017	Nil	Nil	Nil	19.[illegible]	Nil	Nil	[illegible]
3	[illegible] at [illegible] p.m.	Nil	0.1426	Nil	Nil	Nil	20.[illegible]	Nil	Nil	[illegible]

Note: [illegible] on 30.03.2018

(R. K. [illegible])
Senior Technical Assistant

(B. Mandal) 20.3.18
Senior Technical Assistant

(D. C. Panigrahi)
Professor & Incharge

In the service of Nation since 1926
Phone: [illegible] // Fax [illegible] // Website: [illegible]
Mining Dept. [illegible] // Mine Ventilation Lab: [illegible]

खान संवातन प्रयोगशाला
खनन अभियांत्रिक विभाग
भारतीय प्रौद्योगिकी संस्थान
(भारतीय खनि विद्यापीठ)
धनबाद - ८२६००४ झारखण्ड, भारत

Mine Ventilation Laboratory
Department of Mining Engineering
INDIAN INSTITUTE OF TECHNOLOGY
(Indian School of Mines)
DHANBAD – 826004, JHARKHAND, INDIA

Air Sample Analysis Report of Mudidih Colliery, Sijua Area, BCCL

Ref. No. Nil

Dated : 17.05.2018

Sample No.: 13 to 15 Dated : 17.05.2018

Date of Sample Collection : 17.05.2018 Samples collected by : Colliery Management

Date of Sample Analysis : 17.05.2018

Sl. No.	Details of the sample	CO%	CO_2%	CH_4%	C_2H_6%	C_2H_4%	O_2%	H_2S%	H_2%	N_2%
13	EP stopping VIIIA seam at 11:50 a.m.	Nil	0.1876	Nil	Nil	Nil	20.4178	Nil	Nil	79.3946
14	EP stopping VIII seam at 11.05 a.m.	Nil	0.1389	Nil	Nil	Nil	20.8814	Nil	Nil	78.9797
15	Main return ½ Incline at 12:35 p.m.	Nil	0.1634	Nil	Nil	Nil	20.8603	Nil	Nil	78.9763

17/5/2018

(N. K. Hembram)
Senior Technical Assistant

17-5-18
(B. Munshi)
Senior Technical Assistant

(D. C. Panigrahi)
Professor & Incharge

ANNEXURE 13:

भारत कोकिंग कोल लिमिटेड

(कोल इंडिया लिमिटेड का एक अंग)

BHARAT COKING COAL LIMITED

(A Subsidiary of Coal India Limited)

Corporate Identity No. (CIN): U10101JH1972GOI000918

Office of the General Manager Sijua Area, Dhanbad- 828121 (JH)

Phone no.- 0326 2372204: 0326 2372516 (PBX)

Ref No: GM/SA/2020/ F-17/281

Date: 20.03.2020

Work Order cancellation order

Work order vide ref no. BCCL/GM (Sijua Area)/CHP/WO/Supply/2015/102 dated 31.08 2015 and BCCL/GM (Sijua Area)/CHP/WO/W&S/2015/103 dated 31.08 2015 was issued in the name of M/S Heavy Engineering Corporation Ltd., Project Division, Plant Plaza Road, Dhurwa, Ranchi, Jharkhand-834004, for the work of " Planning, Design, Engineering, Construction, Fabrication, supply, erection, Trial run, Commissioning and testing of Coal handling Plant with Silo loading arrangement (5 Mtpa) consisting of all civil, structural, Electrical, mechanical works and all other accessories and facilities required to make it complete in all respects on turnkey basis at Tetulmari, Sijua area, BCCL". BCCL Board in its 361st meet held on 06.03.2020, vide item no. 361.6K, approved for cancellation of LOA for the aforementioned work and accordingly the corresponding work orders as mentioned above stand cancelled.

20/3/2020

General Manager
Sijua Area

Copy to:

1. D(T)OP/D(T)P&P/D(F)/D(P)/CVO - for kind information.
2. TS to CMD- for kind information to CMD, BCCL.
3. GM (Co-ordn)/HOD(P&P)/RD(RI-II), CMPDIL/GM(System)/GM(M&S)/GM(F)I/C/GM(Estate)/GM(Exvn.)/GM(E&M)/ GM(M&M)/ GM(IE)/HOD(Env.)/HOD(Survey), Koyla Bhawan
4. Area Manager (E&M), Sijua Area.
5. Area Manager (Plg.), Sijua Area
6. M/S Heavy Engineering Corporation Ltd., Project Division, Plant Plaza Road, Dhurwa, Ranchi, Jharkhand-834004,

ANNEXURE 14: LAST SUBMITTED ANNUAL MINE CLOSURE RETURN FOR 2020-21

YEARLY REPORT OF MINE CLOSURE ACTIVITIES

(As per clause 7 of annexure of the Guidelines for preparation of Mine Closure Plan: No.55011-01-2009-CPAM dated 07.01.2013 to be submitted before 1st July of every year)

Ref. no:- BCP/PO/2021/594

Date: 26.6.2021

To
The Coal Controller,
Office of the Coal Controller,
1, Council House Street,
Kolkata – 700001

Sir,

Please find herewith the yearly report of Mine Closure Activities for the year 2020-21 for the **Bansdeopur** mine of **Sijua Area, BCCL** company as given below:-

1	Name of the coal/lignite mine/block:	Bansdeopur Colliery, Sijua Area, BCCL
	a) Type: OCP/UG/Mixed	OCP
	b) Total life of the mine:	11 Years as per Progressive Mine Closure plan approved in Jan., 2020
	c) Balance life of the mine:	09 Years
2	Name of the Owner:	Shri Chanchal Goswami Director (Technical), BCCL
3	Address of the Owner:	Koyla Bhawan, Koyla Nagar, Dhanbad-826005
4	i) Leasehold Area of the Mine: ii) Project Area of the Mine:	104.72 Ha (As per approved MCP) 70.50 Ha (As per approved MCP)
5	Mine Closure Plan approved by..................on (date):	BCCL Board, dated: Jan.,2020
6	Escrow Account number:	00150100011831
7	Name & address of Escrow Agent:	Bank of Baroda, Jharia Road, Dhanbad
8	Closure Cost deposited for the year 2020-21.	Rs. 91.36 lakhs
9	Cumulative Balance including interest in the account:	Rs. 223.86 lakhs
10	Report being submitted for:	Progressive Mine Closure
11	Specific condition imposed. (if any, by Government agency):	NA
12	Reserves of Coal/Lignite(as per Mining Plan): Coal/Lignite actually mined out during last year (2020-21):	89.52 Mte. 250275 te.
13	Method of Mining:	Shovel-Dumper Combination
14	Area Mined out (Ha):	8.75 Ha
15	Area reclaimed	i. Physical: NIL ii. Biological: Plantation at old OB dump of 6.0 Ha through District Forest Dept. is in progress.

16	Details of afforestation:	Afforestation at 6.0 Ha of old OB dump area through District Forest Department is in progress.
17	Water Quality Management	
	a) Water bodies available in leasehold area:	Ekra Jore, Local drains and ponds.
	b) Measures taken for Protection: (Control of erosion, sedimentation, siltation, water treatment, diversion of water courses if any, measure for protection of contamination of ground water from leaching etc shall be described)	Drain Cleaning, Pond Cleaning, Check dam, Proper Gradient maintenance, Biological reclamation of OB dump slopes.
	c) Quantity of water pumped out from mine/Quarry:	72 Million Gallon
	d) Quality of water (as per test result):	Report of water quality monitoring in Cluster V is attached
	e) Corrective measures taken confronting to the permissible limit:	The parameters are mostly within the limit
	f) Is there any acid mine drainage? If yes, the treatment method taken:	No
18	Air Quality Management	
	i) Existing air quality parameters:	Report of ambient air quality monitoring in Cluster V is attached
	ii) Corrective measures taken for prevention of air pollution:	Water sprinkling through mobile water sprinklers, Greenery of dormant OB dumps by native seeds of grasses and shrubs, Covered transportation, plantation, Wet drilling, Controlled blasting.
19	Waste Management	
	a) Quantity of overburden removal:	2,31,3362 Cum
	b) Quantity of Coal/Lignite reject generated:	NIL
	c) Utilization of Waste Material done:	OB is utilized in backfilling
	d) Protective Measures taken for prevention of siltation, erosion and dust generator for waste material:	Biological reclamation and grassing of OB Dumps including slopes to prevent erosion
	e) Quantity of waste material re-handled/back-filled:	3,96,684.14 Cum (Re-handled)
	f) Height of dump and its stability measures taken:	Less than 60m from surface: Slope Stability and benching
	g) After backfilling if left out area is filled with water or not (at the time of final closure)	Final Closure stage yet to be reached

20	Top Soil Management	
	a) Top Soil available at site:	NIL (Fire Affected)
	b) Utilization of the top soil during 2020-21:	NIL

21	a) Coal Beneficiation facilities adopted:	NA
	b) Maintenance of coal washeries being done:	No coal washery is located at Bansdeopur Colliery
	c) Dismantling of structure of washery (describe briefly if any):	NA

22. Subsidence management (for UG mine): Only OCP is in Operation in Bansdeopur Colliery.

23. Infrastructure:

Existing infrastructural facilities available	Future Utilization	Maintenance
Roads	DB Road (Dhanbad-Katras)	Being maintained
Aerial Ropeways	NA	
Conveyor Belts	NA	
Railways	NA	
Bridge, Culverts	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Power lines	Will be utilized for neighboring projects.	Being maintained
Building & Structures	Will be handed over to state govt. if fit to use or will be dismantled.	Being maintained
Water Treatment Plant	NA	
Water Supply Sources	Water storage Tank of MADA- Will be utilized for neighboring Project. Water supply pipeline of mine will be utilized for neighboring Project.	Being maintained
Gas Pipeline	NA	
Sewer Line	Will be utilized for neighboring Project.	Being maintained
Telephone Cables	Will be utilized for neighboring Project.	Being maintained
Underground Tanks	Will be utilized for neighboring Project.	Being maintained
Electric Cable	Will be utilized for neighboring Project.	Being maintained
Transformers	Will be utilized for neighboring Project.	Being maintained

Describe if decommissioning, dismantling or disposal is done of the above items during 2020-21 (if any): No

24. Disposal of Machinery:

Decommissioning of Mining Machinery and their possible post mining utilization:	Final Closure yet to be reached

25 Safety and Security:

a	Safety measures implemented to prevent access to surface opening for Underground working (barbed wire fencing done):	All Underground opening sealed
b	Safety measures implemented to prevent access to surface opening for excavation:	Berm of sufficient height provided along the quarry edge to prevent access
c	Arrangement made up to the site being opened for general public:	No
D	Sealing of mine entries:	Not Applicable at Present

26. Economic Repercussions of Closure of Mine

a	Number of local residents employed in the mine:	Final closure stage yet to be reached. Will be assessed before final closure.
b	Compensation given to the employees concerning their sustenance:	Final closure stage yet to be reached. Will be assessed before final closure
c	Vocational / skill development training for sustainable income of affected people:	Being imparted (Handloom Training, Stitching Skills, Etc.)

26. Any other closure activities as per approved Mine Closure Plan: NA

27. Post Environmental Monitoring for 3 years (to be given after closing of mine): Final Closure yet to be reached.

The above information given is true to the best of my knowledge.

28/6/21

Project Officer
Bansdeopur Colliery

(Signature of Competent Authority)

Name: Bishnu kant Jha

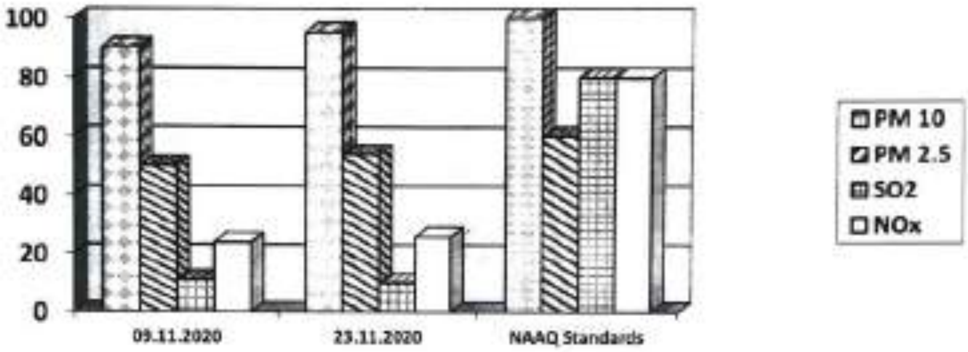
Designation: chief manager (Min)

Date with seal: 26.6.21

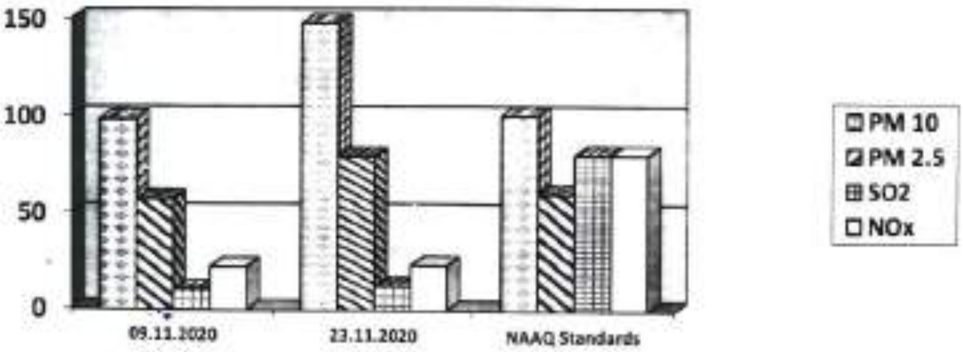
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited Month: **NOV. 2020** Year: **2020-21.**

Station Name: A8, Nichitpur		**Zone: Core**		**Category: Industrial**	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_x**
1	09.11.2020	90	50	11	24
2	23.11.2020	95	54	10	26
	NAAQ Standard	100	60	80	80



Station Name: A9, Basseriya Managers office		**Zone: Buffer**		**Category: Industrial**	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_x**
1	09.11.2020	98	57	10	22
2	23.11.2020	147	79	12	23
	NAAQ Standard	100	60	80	80

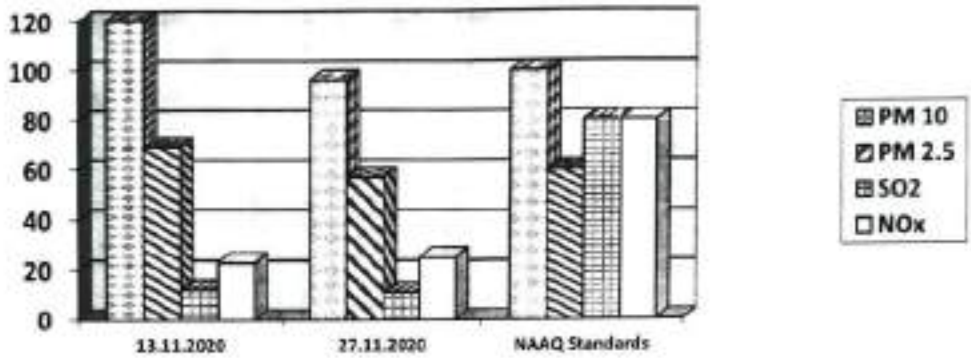


Analysed By

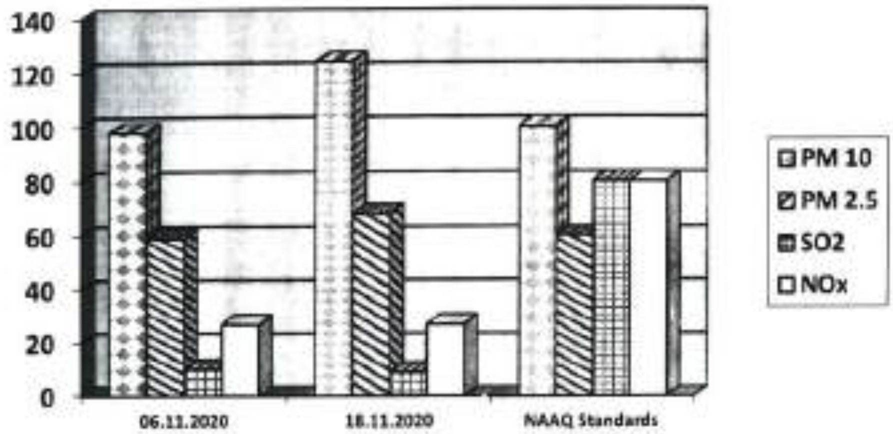
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

Station Name: A16 Pootki Balihari office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	13.11.2020	120	69	12	23
2	27.11.2020	96	57	11	25
	NAAQ Standards	100	60	80	80



Station Name: A17 – Moonidih UGP		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	06.11.2020	98	59	10	27
2	18.11.2020	124	68	9	27
	NAAQ Standards	100	60	80	80



- *All values are expressed in microgram per cubic meter.*
- *24 hours duration*

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Mudidih (MW5)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jarian Nala and Ekra Nala.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analysed 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 parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -V**		Month: **NOV. 2020**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	**MW5** First Fortnight	**MW5** Second Fortnight	**As per MOEF General Standards for schedule VI**
		09.11.2020	30.11.2020	
1	Total Suspended Solids	38	40	*100 (Max)*
2	pH	7.92	8.32	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	32	36	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

YEARLY REPORT OF MINE CLOSURE ACTIVITIES

(As per clause 7 of annexure of the Guidelines for preparation of Mine Closure Plan; No.55011-01-2009-CPAM dated 07.01.2013 to be submitted before 1st July of every year).

Date: - 14-06-2021

To
The Coal Controller,
Office of the Coal Controller,
1, Council House Street,
Kolkata – 700 001.

Sir,

Please find herewith the yearly report of Mine Closure Activities for the year 2020-21 for the **Kankanee** mine of **Sijua Area, BCCL** company as given below:-

1	Name of the coal/lignite mine/block:	Kankanee Colliery, Sijua Area, BCCL
	a) Type: OPC/UG/Mixed	OCP
	b) Total life of the mine:	11 Years as per Progressive Mine Closure plan approved in Dec., 2019
	c) Balance life of the mine:	09 Years
2	Name of the Owner:	Sri. Chanchal Goswami, Director (Technical), BCCL
3	Address of the Owner:	Koyla Bhawan, Koyla Nagar, Dhanbad-826005
4	i) Leasehold Area of the Mine: ii) Project Area of the Mine:	201.08 Ha (As per approved MCP) 152.19 Ha (As per approved MCP)
5	Mine Closure Plan approved by .... on (date):	CMPDI, dated: Feb., 2017
6	Escrow Account number:	00150100010973
7	Name & address of Escrow Agent:	Bank of Baroda, Jharia Road, Dhanbad
8	Closure Cost deposited for the year 2020-21.	Rs. 186.88 lakhs
9	Cumulative Balance including interest in the account:	Rs. 763.70 lakhs
10	Report being submitted for:	Progressive Mine Closure
11	Specific condition imposed. (if any, by Government agency):	NA
12	Reserves of Coal/Lignite(as per Mining Plan): Coal/Lignite actually mined out during last year (2020-21):	Geological: 12.60 Mte. Mineable: 4.65 Mte. 176985 te.
13	Method of Mining:	Shovel-Dumper Combination
14	Area Mined out (Ha):	NIL
15	Area reclaimed	i. Physical: NIL ii. Biological: NIL

16	Details of afforestation:	NIL
17	Water Quality Management	
	a) Water bodies available in leasehold area:	Sendra Jore, Local drains and ponds.
	b) Measures taken for Protection: (Control of erosion, sedimentation, siltation, water treatment, diversion of water courses if any, measure for protection of contamination of ground water from leaching etc shall be described)	Drain Cleaning, Pond Cleaning, Check dam, Proper Gradient maintenance, Biological reclamation of OB dump slopes, Oil & Grease trap-cum-settling tank to treat workshop effluent.
	c) Quantity of water pumped out from mine/Quarry:	1500 cum./day as per approved MCP
	d) Quality of water (as per test result):	Report of water quality monitoring in Cluster V is attached
	e) Corrective measures taken confronting to the permissible limit:	The parameters are mostly within the limit
	f) Is there any acid mine drainage? If yes, the treatment method taken:	No
18	Air Quality Management	
	i) Existing air quality parameters:	Report of ambient air quality monitoring in Cluster V is attached
	ii) Corrective measures taken for prevention of air pollution:	Water sprinkling through mobile water sprinklers, Greenery of dormant OB dumps by native seeds of grasses and bushes, Covered transportation, plantation, Wet drilling, Controlled blasting.
19	Waste Management	
	a) Quantity of overburden removal:	2990370 Cum.
	b) Quantity of Coal/Lignite reject generated:	NIL
	c) Utilization of Waste Material done:	OB is utilized in backfilling
	d) Protective Measures taken for prevention of siltation, erosion and dust generator for waste material:	Biological reclamation and grassing of OB Dumps including slopes to prevent erosion
	e) Quantity of waste material re-handled/back-filled:	2990370 Cum (including internal dump area)
	f) Height of dump and its stability measures taken:	Less than 60 m from surface; Slope Stability and benching
	g) After backfilling if left out area is filled with water or not (at the time of final closure)	Final Closure stage yet to be reached

20	Top Soil Management	
	a) Top Soil available at site:	NIL (Fire Affected)
	b) Utilization of the top soil during 2020-21:	NIL

21	a) Coal Beneficiation facilities adopted:	NA
	b) Maintenance of coal washeries being done:	No coal washery is located at Kankanee Colliery
	c) Dismantling of structure of washery (describe briefly if any):	NA

22. Subsidence management (for UG mine): Only OCP is in Operation in Kankanee Colliery.

23. Infrastructure:

Existing infrastructural facilities available	Future Utilization	Maintenance
Roads	DB Road (Dhanbad-Katras)	Being maintained
Aerial Ropeways	NA	
Conveyor Belts	NA	
Railways	Dhanbad-Chandrapura line Gomoh-Adra line	Being maintained
Bridge, Culverts	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Power lines	Will be utilized for neighboring projects.	Being maintained
Building & Structures	Will be handed over to state govt. if fit to use or will be dismantled.	Being maintained
Water Treatment Plant	NA	
Water Supply Sources	Water storage Tank of MADA- Will be utilized for neighboring Project. Water supply pipeline of mine will be utilized for neighboring Project.	Being maintained
Gas Pipeline	NA	
Sewer Line	Will be utilized for neighboring Project.	Being maintained
Telephone Cables	Will be utilized for neighboring Project.	Being maintained
Underground Tanks	Will be utilized for neighboring Project.	Being maintained
Electric Cable	Will be utilized for neighboring Project.	Being maintained
Transformers	Will be utilized for neighboring Project.	Being maintained

Describe if decommissioning, dismantling or disposal is done of the above items during 2020-21 (if any): No

24. Disposal of Machinery:

Decommissioning of Mining Machinery and their possible post mining utilization:	Final Closure yet to be reached

25 Safety and Security:

a	Safety measures implemented to prevent access to surface opening for Underground working (barbed wire fencing done):	All Underground opening sealed
b	Safety measures implemented to prevent access to surface opening for excavation:	Berm of sufficient height provided along the quarry edge to prevent access
c	Arrangement made up to the site being opened for general public:	No
D	Sealing of mine entries:	Not Applicable at Present

26. Economic Repercussions of Closure of Mine

a	Number of local residents employed in the mine:	Final closure stage yet to be reached. Will be assessed before final closure.
b	Compensation given to the employees concerning their sustenance:	Final closure stage yet to be reached. Will be assessed before final closure
c	Vocational / skill development training for sustainable income of affected people:	Being imparted (Handloom Training, Stitching Skills, Etc.)

26. Any other closure activities as per approved Mine Closure Plan: NA

27. Post Environmental Monitoring for 3 years (to be given after closing of mine): Final Closure yet to be reached.

The above information given is true to the best of my knowledge.

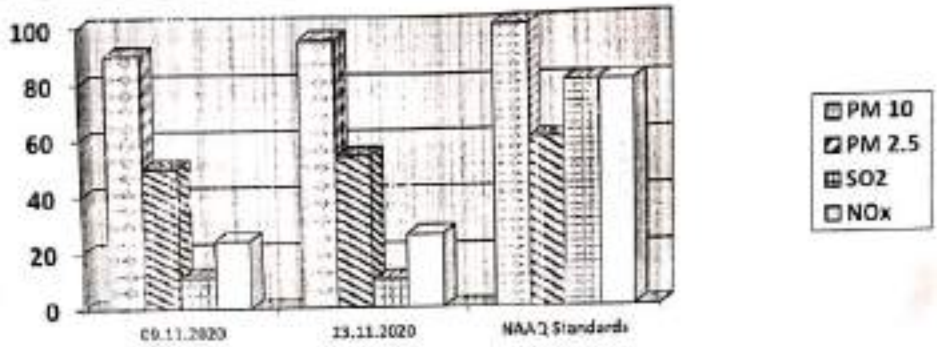
(Signature of Competent Authority)
Name:
Designation:
Date with seal: 14/6/2021

परियोजना पदाधिकारी
Project Officer
कनकनी कोलियरी
Kankanee Colliery
सिजुआ क्षेत्र
Sijua Area

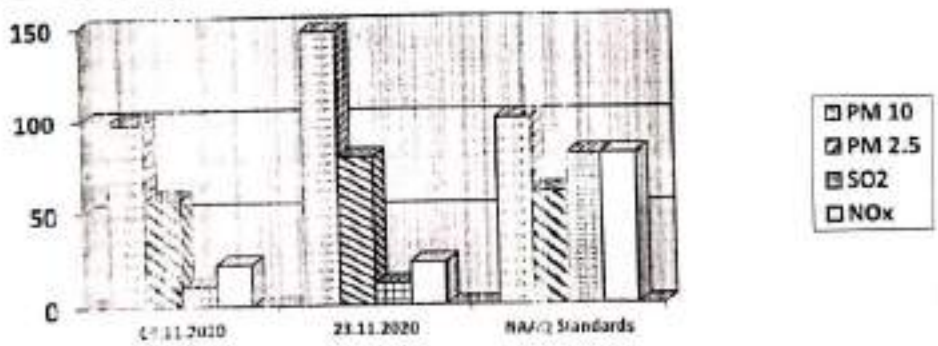
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited Month: **NOV. 2020** Year: **2020-21.**

Station Name: A8, Nichitpur		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	09.11.2020	90	50	11	24
2	23.11.2020	95	54	10	26
	NAAQ Standard	100	60	80	80



Station Name: A9, Basseriya Managers office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	09.11.2020	98	57	10	22
2	23.11.2020	147	79	12	23
	NAAQ Standard	100	60	80	80

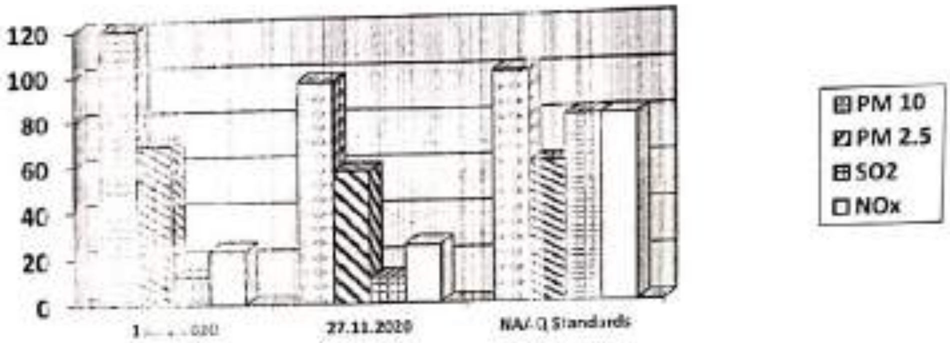


Analysed B

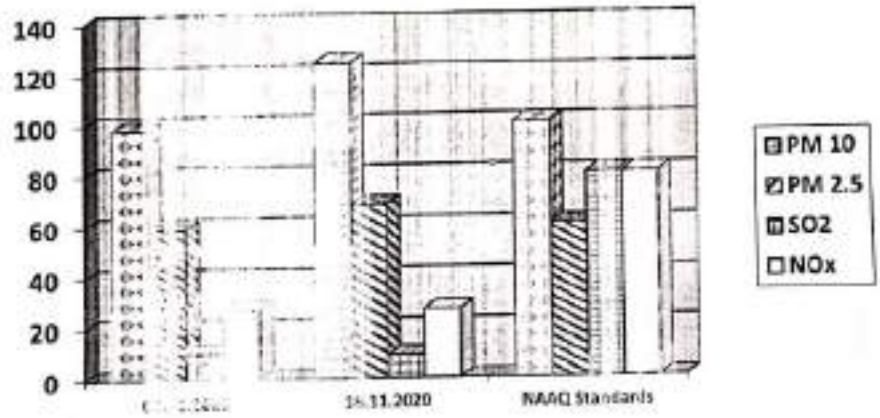
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

Station Name: A11 Pootki Balihari office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	13.11.2020	120	69	12	23
2	27.11.2020	96	57	11	25
	NAAQ Standards	100	60	80	80



Station Name: A17 - Moonidih UGP		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	05.11.2020	98	59	10	27
2	18.11.2020	124	68	9	27
	NAAQ Standards	100	60	80	80



- All values are expressed in microgram per cubic meter.
- 24 hours duration

Analysed By
JSA/SA SS

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer Plate No. - II)

i) **Mine Discharge of Mudidih (MW5)**

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jarian Nala and Ekra Nala.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analysed 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 parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -V**		Month: **NOV. 2020**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	MW5 First Fortnight 09.11.2020	MW5 Second Fortnight 30.11.2020	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	38	40	*100 (Max)*
2	pH	7.92	8.32	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	32	36	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

YEARLY REPORT OF MINE CLOSURE ACTIVITIES

(As per clause 7 of annexure of the Guidelines for preparation of Mine Closure Plan; No.55011-01-2009-CPAM dated 07.01.2013 to be submitted before 1st July of every year).

Ref No - SBC/SA/SUR/2021/29

Date: 16.06.2021

To
The Coal Controller,
Office of the Coal Controller,
1, Council House Street,
Kolkata – 700 001.

Sir,

Please find herewith the yearly report of Mine Closure Activities for the year 2020-21 for the **Sendra Bansjora** mine of **Sijua Area, BCCL** company as given below:-

1	Name of the coal/lignite mine/block:	Sendra Bansjora Colliery, Sijua Area, BCCL
	a) Type: OPC/UG/Mixed	OCP
	b) Total life of the mine:	16 Years as per Progressive Mine Closure plan approved in 2017
	c) Balance life of the mine:	12Years
2	Name of the Owner:	Director (Technical), BCCL
3	Address of the Owner:	Koyla Bhawan, Koyla Nagar, Dhanbad-826005
4	i) Leasehold Area of the Mine: ii) Project Area of the Mine:	249.63 Ha (As per approved MCP) 150.00 Ha (As per approved MCP)
5	Mine Closure Plan approved by..................on (date):	December 2017
6	Escrow Account number:	00150100008832
7	Name & address of Escrow Agent:	Bank of Baroda, Jharia Road, Dhanbad
8	Closure Cost deposited for the year 2020-21:	Rs. 73.52 lakhs
9	Cumulative Balance including interest in the account:	Rs. 627.33 lakhs
10	Report being submitted for:	Progressive Mine Closure
11	Specific condition imposed. (if any, by Government agency):	NA
12	Reserves of Coal/Lignite(as per Mining Plan): Coal/Lignite actually mined out during last year (2020-21):	Geological: 75.7495 Mte. Extractable: 15.8175 Mte. 809270 te
13	Method of Mining:	Shovel-Dumper Combination
14	Area Mined out (Ha):	60.00 Ha
15	Area reclaimed	i. Physical: NIL ii. Biological: NIL

16	Details of afforestation:	NIL
17	Water Quality Management	
	a) Water bodies available in leasehold area:	Ekra Jore, Local drains and ponds.
	b) Measures taken for Protection. (Control of erosion, sedimentation, siltation, water treatment, diversion of water courses if any, measure for protection of contamination of ground water from leaching etc shall be described)	Drain Cleaning, Pond Cleaning, Check dam, Proper Gradient maintenance, Biological reclamation of OB dump slopes, Oil & Grease trap-cum-settling tank to treat workshop effluent.
	c) Quantity of water pumped out from mine/Quarry:	173 Million Gallon
	d) Quality of water (as per test result)	Report of water quality monitoring in Cluster V is attached
	e) Corrective measures taken confronting to the permissible limit:	The parameters are mostly within the limit
	f) Is there any acid mine drainage? If yes, the treatment method taken:	No
18	Air Quality Management	
	i) Existing air quality parameters	Report of ambient air quality monitoring in Cluster V is attached
	ii) Corrective measures taken for prevention of air pollution:	Water sprinkling through mobile water sprinklers. Greenery of dormant OB dumps by native seeds of grasses and bushes. Covered transportation, plantation, Wet drilling, Controlled blasting.
19	Waste Management	
	a) Quantity of overburden removal:	2264510 Cum
	b) Quantity of Coal/Lignite reject generated:	NIL
	c) Utilization of Waste Material done	OB is utilized in backfilling
	d) Protective Measures taken for prevention of siltation, erosion and dust generator for waste material:	Biological reclamation and grassing of OB Dumps including slopes to prevent erosion
	e) Quantity of waste material re-handled/back-filled:	2264510 Cum
	f) Height of dump and its stability measures taken:	Less than 90 m from surface; Slope Stability and benching
	g) After backfilling if left out area is filled with water or not (at the time of final closure)	Final Closure stage yet to be reached

20	Top Soil Management	
	a) Top Soil available at site:	NIL (Fire Affected)
	b) Utilization of the top soil during 2020-21:	NIL

21	a) Coal Beneficiation facilities adopted:	NA
	b) Maintenance of coal washeries being done:	No coal washery is located at Sendra Bansjora Colliery
	c) Dismantling of structure of washery (describe briefly if any):	NA

22. Subsidence management (for UG mine): Only OCP is in Operation in Sendra Bansjora Colliery.

23. Infrastructure:

Existing infrastructural facilities available	Future Utilization	Maintenance
Roads	DB Road (Dhanbad-Katras)	Being maintained
Aerial Ropeways	NA	
Conveyor Belts	NA	
Railways	Dhanbad-Chandrapura Line	Being maintained
Bridge, Culverts	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Power lines	Will be utilized for neighboring projects.	Being maintained
Building & Structures	Will be handed over to state govt. if fit to use or will be dismantled.	Being maintained
Water Treatment Plant	NA	
Water Supply Sources	Water storage Tank of MADA- Will be utilized for neighboring Project. Water supply pipeline of mine will be utilized for neighboring Project.	Being maintained
Gas Pipeline	NA	
Sewer Line	Will be utilized for neighboring Project.	Being maintained
Telephone Cables	Will be utilized for neighboring Project.	Being maintained
Underground Tanks	Will be utilized icr neighboring Project.	Being maintained
Electric Cable	Will be utilized for neighboring Project.	Being maintained
Transformers	Will be utilized for neighboring Project.	Being maintained

Describe if decommissioning, dismantling or disposal is done of the above items during 2020-21 (if any): No

24. Disposal of Machinery:

Decommissioning of Mining Machinery and their possible post mining utilization:	Final Closure yet to be reached

25 Safety and Security:

a	Safety measures implemented to prevent access to surface opening for Underground working (barbed wire fencing done):	All Underground opening sealed
b	Safety measures implemented to prevent access to surface opening for excavation:	Berm of sufficient height provided along the quarry edge to prevent access
c	Arrangement made up to the site being opened for general public:	No
D	Sealing of mine entries:	Not Applicable at Present

26. Economic Repercussions of Closure of Mine

a	Number of local residents employed in the mine:	Final closure stage yet to be reached. Will be assessed before final closure.
b	Compensation given to the employees concerning their sustenance:	Final closure stage yet to be reached. Will be assessed before final closure
c	Vocational / skill development training for sustainable income of affected people:	Being imparted (Handloom Training, Stitching Skills, Etc.)

26. Any other closure activities as per approved Mine Closure Plan: NA

27. Post Environmental Monitoring for 3 years (to be given after closing of mine): Final Closure yet to be reached.

The above information given is true to the best of my knowledge.

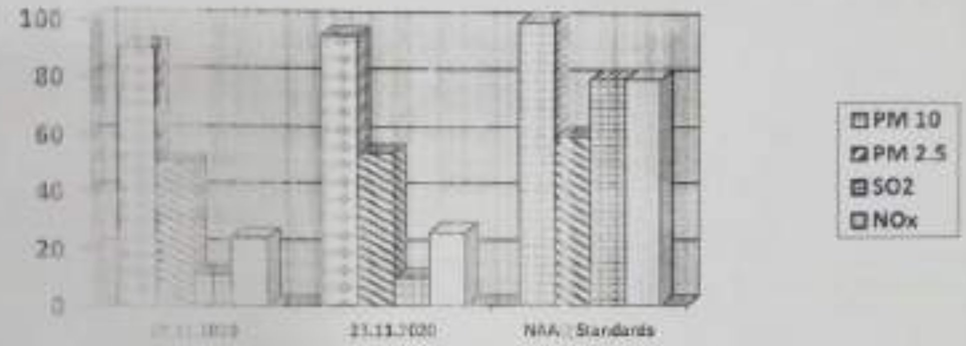
16/6/2021

(Signature of Competent Authority)
Name: K. SARKAR
Designation: SR. MANAGER.
Date with seal:
Manager
Sendra Bansjora Colliery

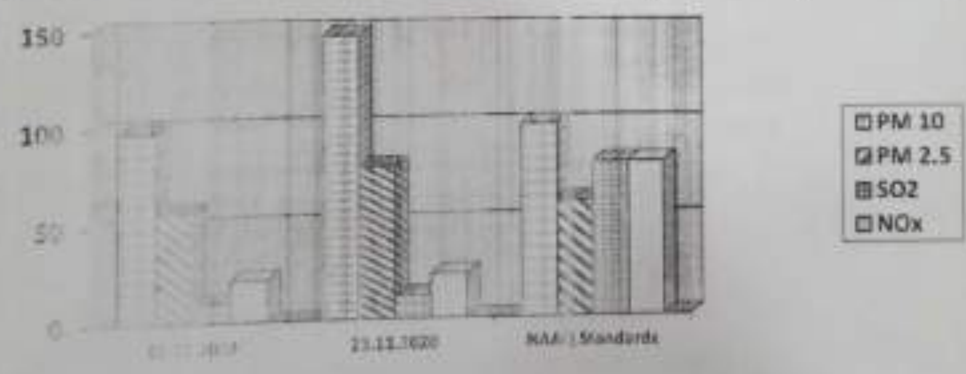
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited Month: **NOV. 2020** Year: **2020-21.**

Station Name: A8. Nichitpur		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	09.11.2020	90	50	11	24
2	23.11.2020	95	54	10	26
	NAAQ Standard	100	60	80	80

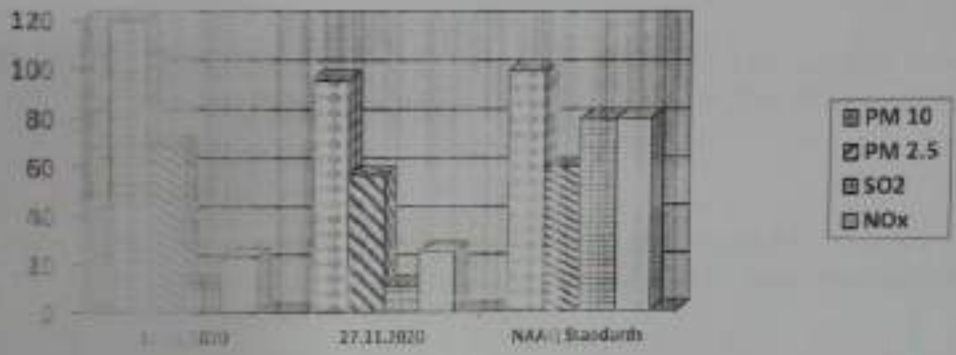


Station Name: A9. Basseriya Management office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	09.11.2020	98	57	10	22
2	23.11.2020	147	79	12	23
	NAAQ Standard	100	60	80	80

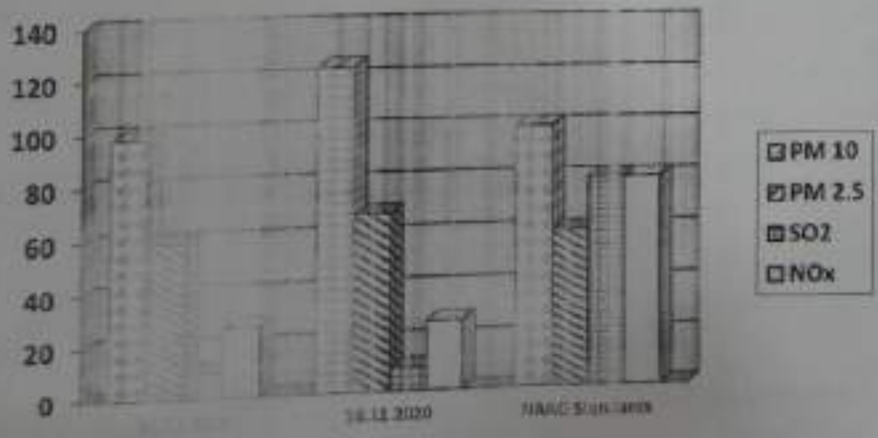


Approved By
HOD(Environment)
RI-2, CMPDI, Dhanbad

Station Name: [illegible] Balihari office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	[illegible].2020	120	69	12	23
2	[illegible].2020	96	57	11	25
	NAAQ Standards	100	60	80	80



Station Name: [illegible] oonidih UGP		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	[illegible].2020	98	59	10	27
2	[illegible] 2020	124	68	9	27
	NAAQ Standards	100	60	80	80



[illegible] are expressed in microgram per cubic meter.
[illegible]

Approved By

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer Plate No. - II)

i) **Mine Discharge of Mudidih (MW5)**

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Janan Nala and Ekra Nala.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analysed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI (HQ), 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 parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -V**		Month: **NOV, 2020**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	MW5 First Fortnight	MW5 Second Fortnight	**As per MOEF General Standards for schedule VI**
		09.11.2020	30.11.2020	
1	Total Suspended Solids	38	40	*100 (Max)*
2	pH	7.92	8.32	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	32	36	*250 (Max)*

All values are expressed in mg/lit unless specified.

Checked By
Lab In-Charge

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

o/c

YEARLY REPORT OF MINE CLOSURE ACTIVITIES

(As per clause 7 of annexure of the Guidelines for preparation of Mine Closure Plan; No.55011-01-2009-CPAM dated 07.01.2013 to be submitted before 1st July of every year).

LC/PS/21/78

Date 25/6/21

To
The Coal Controller
Office of the Coal Controller,
1, Council House Street,
Kolkata – 700 001.

Sir,

Please find herewith the yearly report of Mine Closure Activities for the year 2020-21 for the **Loyabad** mine of **Sijua Area, BCCL** company as given below -

1	Name of the coal/lignite mine/block	Loyabad Colliery, Sijua Area, BCCL
	a) Type: OPC/UG/Mixed	UG
	b) Total life of the mine:	17 Years as per Mine Closure plan for UG
	c) Balance life of the mine:	09 Years
2	Name of the Owner:	Shri Chanchal Goswami Director (Technical), BCCL
3	Address of the Owner:	Koyla Bhawan, Koyla Nagar, Dhanbad-826005
4	i) Leasehold Area of the Mine: ii) Project Area of the Mine:	499.56 Ha (As per approved MCP) 424.56 Ha (As per approved MCP)
5	Mine Closure Plan approved by.................. on (date):	September, 2013
6	Escrow Account number:	00150100008826
7	Name & address of Escrow Agent:	Bank of Baroda, Jharia Road, Dhanbad
8	Closure Cost deposited for the year 2020-21.	Rs. 26.44 lakhs
9	Cumulative Balance including interest in the account:	Rs. 335.14 lakhs
10	Report being submitted for:	Progressive Mine Closure
11	Specific condition imposed. (if any, by Government agency):	NA
12	Reserves of Coal/Lignite(as per Mining Plan): Coal/Lignite actually mined out during last year (2020-21)	i. Mining Plan of Loyabad is under preparation ii. NIL
13	Method of Mining:	Closed for production
14	Area Mined out (Ha):	NIL
15	Area reclaimed	i. Physical: NIL ii. Biological: 26 Ha in progress

Counter No:1,25/06/2021,11:41
To:THE COAL CONT,OFFICE OF THE CO
PIN:700001, KOLKATA GPO
From:PROJECT OFF,LOYABAD COLLIERY
Wt:32gms

16	Details of afforestation:	Afforestation activity for two old OB Dumps (in total 26 Ha.) is in progress.
17	Water Quality Management	
	a) Water bodies available in leasehold area:	Ekra Jore, Local drains and ponds.
	b) Measures taken for Protection: (Control of erosion, sedimentation, siltation, water treatment, diversion of water courses if any, measure for protection of contamination of ground water from leaching etc shall be described)	Drain Cleaning, Pond Cleaning, Biological reclamation of Old OB dump slopes, Embankment Strengthening.
	c) Quantity of water pumped out from mine/Quarry:	NIL (closed for Production)
	d) Quality of water (as per test result):	Report of Mine water quality for Cluster V is attached
	e) Corrective measures taken confronting to the permissible limit:	The parameters are mostly within the limit
	f) Is there any acid mine drainage? If yes, the treatment method taken:	No
18	Air Quality Management	
	i) Existing air quality parameters:	Report of ambient air quality for Cluster V is attached
	ii) Corrective measures taken for prevention of air pollution:	Water sprinkling through mobile water sprinklers, Greenery of dormant OB dumps by native seeds of grasses and bushes, Covered transportation, plantation.
19	Waste Management	
	a) Quantity of overburden removal:	NIL
	b) Quantity of Coal/Lignite reject generated:	NIL
	c) Utilization of Waste Material done:	NA
	d) Protective Measures taken for prevention of siltation, erosion and dust generator for waste material:	Biological reclamation and grassing of OB Dumps including slopes to prevent erosion.
	e) Quantity of waste material re-handled/back-filled:	NIL
	f) Height of dump and its stability measures taken:	NA
	g) After backfilling if left out area is filled with water or not (at the time of final closure)	Final Closure stage yet to be reached

20	Top Soil Management	
	a) Top Soil available at site:	NA
	b) Utilization of the top soil during 2020-21:	NA

21	a) Coal Beneficiation facilities adopted:	NA
	b) Maintenance of coal washeries being done:	No coal washery is located at Loyabad Colliery
	c) Dismantling of structure of washery (describe briefly if any):	NA

22. Subsidence management (for UG mine): Only development was carried out not depillaring.

23. Infrastructure:

Existing infrastructural facilities available	Future Utilization	Maintenance
Roads	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Aerial Ropeways	NA	
Conveyor Belts	NA	
Railways	Gomoh-Adra line	Being maintained
Bridge, Culverts	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Power lines	Will be utilized for neighboring projects.	Being maintained
Building & Structures	Will be handed over to state govt. if fit to use or will be dismantled.	Being maintained
Water Treatment Plant	NA	
Water Supply Sources	Water storage Tank of MADA-Will be utilized for neighboring Project. Water supply pipeline of mine will be utilized for neighboring Project.	Being maintained
Gas Pipeline	NA	
Sewer Line	Will be utilized for neighboring Project.	Being maintained
Telephone Cables	Will be utilized for neighboring Project.	Being maintained
Underground Tanks	Will be utilized for neighboring Project.	Being maintained
Electric Cable	Will be utilized for neighboring Project.	Being maintained
Transformers	Will be utilized for neighboring Project.	Being maintained

Describe if decommissioning, dismantling or disposal is done of the above items during 2020-21 (if any): No

24. Disposal of Machinery:	
Decommissioning of Mining Machinery and their possible post mining utilization:	Final Closure yet to be reached

25 Safety and Security:

a	Safety measures implemented to prevent access to surface opening for Underground working (barbed wire fencing done):	Final closure yet to be reached
b	Safety measures implemented to prevent access to surface opening for excavation:	NA
c	Arrangement made up to the site being opened for general public:	No
D	Sealing of mine entries:	Not Applicable at Present

26. Economic Repercussions of Closure of Mine

a	Number of local residents employed in the mine:	Final closure stage yet to be reached. Will be assessed before final closure.
b	Compensation given to the employees concerning their sustenance:	Final closure stage yet to be reached. Will be assessed before final closure
c	Vocational / skill development training for sustainable income of affected people:	Being imparted (Handloom Training, Stitching Skills, Etc.)

26. Any other closure activities as per approved Mine Closure Plan: NA

27. Post Environmental Monitoring for 3 years (to be given after closing of mine): Final Closure yet to be reached.

The above information given is true to the best of my knowledge.

18/6/2021

(Signature of Competent Authority)

Name:

Designation:

Date with seal:

PROJECT OFFICER
LOYABAD COLLIERY
SIJUA AREA

18/6/21

Environment officer
Sijua area

YEARLY REPORT OF MINE CLOSURE ACTIVITIES

(As per clause 7 of annexure of the Guidelines for preparation of Mine Closure Plan; No.55011-01-2009-CPAM dated 07.01.2013 to be submitted before 1st July of every year).

Ref No- MPC/PO/2021/76

To

Date: 15/06/2021

The Coal Controller,
Office of the Coal Controller,
1, Council House Street,
Kolkata – 700 001.

Sir,

Please find herewith the yearly report of Mine Closure Activities for the year 2020-21 for the **Mudidih** mine of **Sijua Area, BCCL** company as given below:-

1	Name of the coal/lignite mine/block:	Mudidih Colliery, Sijua Area, BCCL
	a) Type: OPC/UG/Mixed	Mixed
	b) Total life of the mine:	17 Years as per Mine Closure plan for UG
	c) Balance life of the mine:	09 Years
2	Name of the Owner:	Director (Technical), BCCL
3	Address of the Owner:	Koyla Bhawan, Koyla Nagar, Dhanbad-826005
4	i) Leasehold Area of the Mine: ii) Project Area of the Mine:	378.05 Ha (As per approved MCP) 191.33 Ha (for UG;As per approved MCP)
5	Mine Closure Plan approved by..................on (date):	September, 2013
6	Escrow Account number:	00150100008829
7	Name & address of Escrow Agent:	Bank of Baroda, Jharia Road, Dhanbad
8	Closure Cost deposited for the year 2020-21.	Rs. 166.37 lakhs
9	Cumulative Balance including interest in the account:	Rs. 1418.88 lakhs
10	Report being submitted for:	Progressive Mine Closure
11	Specific condition imposed. (if any, by Government agency):	NA
12	Reserves of Coal/Lignite(as per Mining Plan): Coal/Lignite actually mined out during last year (2020-21):	Mineable: 1.47 Mte. (for UG as per approved Mine Closure Plan) 847 te.
13	Method of Mining:	Board & Pillar method with SDL and Tub
14	Area Mined out (Ha):	120 m^2
15	Area reclaimed	i. Physical: NIL ii. Biological: NIL

16	Details of afforestation:	Greenery of 20 Ha. (approx.) Old OB dump through native seeds of grasses and shrubs is in progress.
17	Water Quality Management	
	a) Water bodies available in leasehold area:	Sendra Jore, Local drains and ponds.
	b) Measures taken for Protection: (Control of erosion, sedimentation, siltation, water treatment, diversion of water courses if any, measure for protection of contamination of ground water from leaching etc shall be described)	Drain Cleaning, Pond Cleaning, Proper Gradient maintenance, Greenery of Old OB dump slopes through native seeds of grasses and shrubs, Embankment Strengthening.
	c) Quantity of water pumped out from mine/Quarry:	250 million gallon
	d) Quality of water (as per test result):	Report of Mine water quality for Cluster V is attached
	e) Corrective measures taken confronting to the permissible limit:	The parameters are mostly within the limit
	f) Is there any acid mine drainage? If yes, the treatment method taken:	No
18	Air Quality Management	
	i) Existing air quality parameters:	Report of ambient air quality for Cluster V is attached
	ii) Corrective measures taken for prevention of air pollution:	Water sprinkling through mobile water sprinklers, Greenery of dormant OB dumps by native seeds of grasses and bushes, Covered transportation, plantation, Controlled blasting.
19	Waste Management	
	a) Quantity of overburden removal:	NIL
	b) Quantity of Coal/Lignite reject generated:	NIL
	c) Utilization of Waste Material done:	NA
	d) Protective Measures taken for prevention of siltation, erosion and dust generator for waste material:	Biological reclamation and grassing of OB Dumps including slopes to prevent erosion. Proper Benching & Slope maintenance.
	e) Quantity of waste material re-handled/back-filled:	NIL
	f) Height of dump and its stability measures taken:	Less than 60 m from surface; Slope Stability and benching
	g) After backfilling if left out area is filled with water or not (at the time of final closure)	Final Closure stage yet to be reached

20	Top Soil Management	
	a) Top Soil available at site:	NA
	b) Utilization of the top soil during 2020-21:	NA

21	a) Coal Beneficiation facilities adopted:	NA
	b) Maintenance of coal washeries being done:	No coal washery is located at Mudidih Colliery
	c) Dismantling of structure of washery (describe briefly if any):	NA

22. Subsidence management (for UG mine): Only development was carried out not depillaring.

23. Infrastructure:

Existing infrastructural facilities available	Future Utilization	Maintenance
Roads	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Aerial Ropeways	NA	
Conveyor Belts	NA	
Railways	NA	
Bridge, Culverts	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Power lines	Will be utilized for neighboring projects.	Being maintained
Building & Structures	Will be handed over to state govt. if fit to use or will be dismantled.	Being maintained
Water Treatment Plant	NA	
Water Supply Sources	Water storage Tank of MADA-Will be utilized for neighboring Project. Water supply pipeline of mine will be utilized for neighboring Project.	Being maintained
Gas Pipeline	NA	
Sewer Line	Will be utilized for neighboring Project.	Being maintained
Telephone Cables	Will be utilized for neighboring Project.	Being maintained
Underground Tanks	Will be utilized for neighboring Project.	Being maintained
Electric Cable	Will be utilized for neighboring Project.	Being maintained
Transformers	Will be utilized for neighboring Project.	Being maintained

Describe if decommissioning, dismantling or disposal is done of the above items during 2020-21 (if any): No

24. Disposal of Machinery:

Decommissioning of Mining Machinery and their possible post mining utilization:	Final Closure yet to be reached

25 Safety and Security:

a	Safety measures implemented to prevent access to surface opening for Underground working (barbed wire fencing done):	Final closure yet to be reached
b	Safety measures implemented to prevent access to surface opening for excavation:	NA
c	Arrangement made up to the site being opened for general public:	No
D	Sealing of mine entries:	Not Applicable at Present

26. Economic Repercussions of Closure of Mine

a	Number of local residents employed in the mine:	Final closure stage yet to be reached. Will be assessed before final closure.
b	Compensation given to the employees concerning their sustenance:	Final closure stage yet to be reached. Will be assessed before final closure
c	Vocational / skill development training for sustainable income of affected people:	Being imparted (Handloom Training, Stitching Skills, Etc.)

26. Any other closure activities as per approved Mine Closure Plan: NA

27. Post Environmental Monitoring for 3 years (to be given after closing of mine): Final Closure yet to be reached.

The above information given is true to the best of my knowledge.

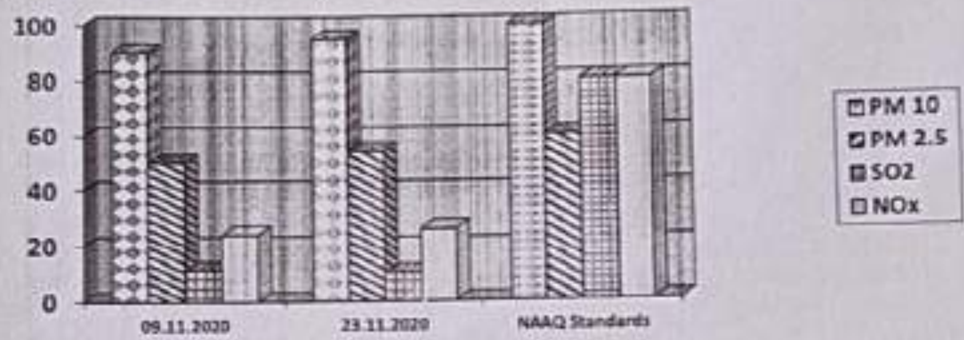
14.6.20

(Signature of Competent Authority)
Name:
Designation:
Date with seal:

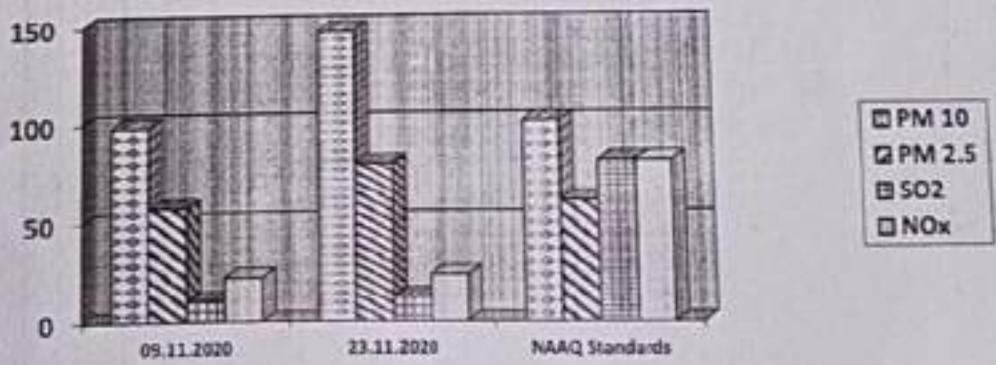
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited Month: **NOV. 2020** Year: **2020-21.**

Station Name: A8, Nichitpur		Zone: Core		Category: Industrial	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_x**
1	09.11.2020	90	50	11	24
2	23.11.2020	95	54	10	26
	NAAQ Standard	100	60	80	80



Station Name: A9, Basseriya Managers office		Zone: Buffer		Category: Industrial	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_x**
1	09.11.2020	98	57	10	22
2	23.11.2020	147	79	12	23
	NAAQ Standard	100	60	80	80

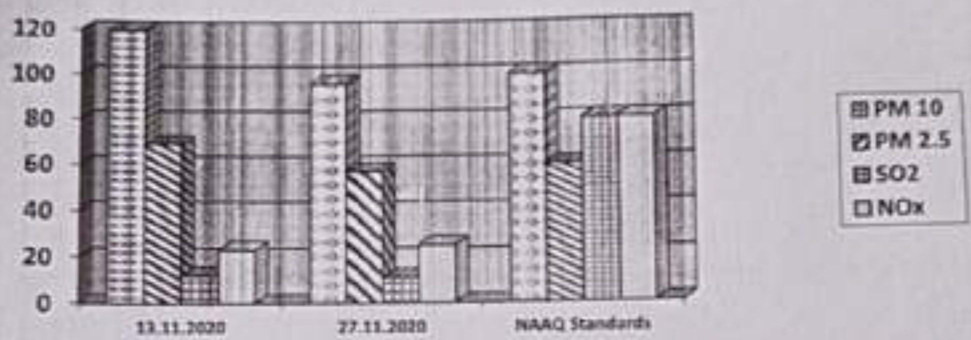


Analysed By JSA/SA/ASA

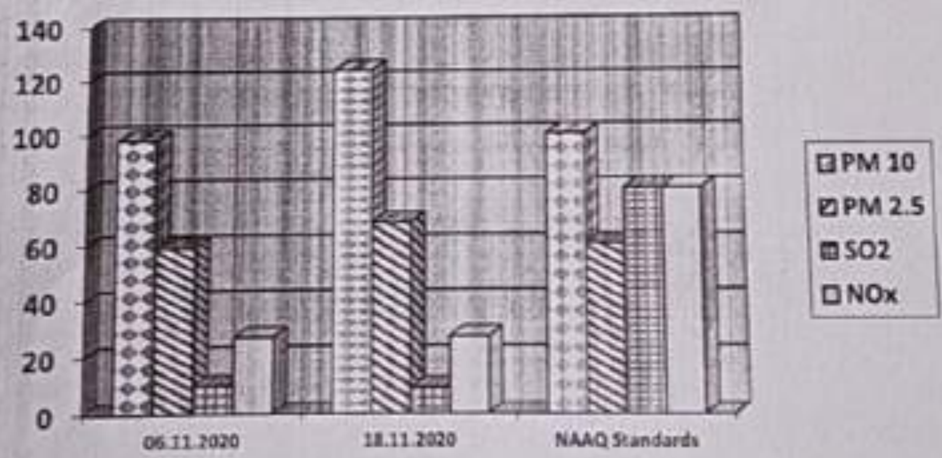
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

Station Name: A16 Pootki Balihari office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	13.11.2020	120	69	12	23
2	27.11.2020	96	57	11	25
	NAAQ Standards	100	60	80	80



Station Name: A17 – Moonidih UGP		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	06.11.2020	98	59	10	27
2	18.11.2020	124	68	9	27
	NAAQ Standards	100	60	80	80



- *All values are expressed in microgram per cubic meter.*
- *24 hours duration*

Analysed By
JRA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY MONITORING

3.1 **Location of sampling sites**
(Refer **Plate No. – II**)
i) **Mine Discharge of Mudidih (MW5)**

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jarian Nala and Ekra Nala.

3.2 **Methodology of sampling and analysis**

Water samples were collected as per standard practice. The effluent samples were collected and analysed 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 parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -V**		Month: **NOV. 2020**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	**MW5** First Fortnight 09.11.2020	**MW5** Second Fortnight 30.11.2020	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	38	40	*100 (Max)*
2	pH	7.92	8.32	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	32	36	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By JSA/SA/SSA

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

Approved By HOD(In-charge) Environment RI-2, CMPDI, Dhanbad

YEARLY REPORT OF MINE CLOSURE ACTIVITIES

(As per clause 7 of annexure of the Guidelines for preparation of Mine Closure Plan; No.55011-01-2009-CPAM dated 07.01.2013 to be submitted before 1st July of every year).

Ref. No.: TC/PD/47 SUR/104.A/2021

Date: 18.06.2021

To
The Coal Controller,
Office of the Coal Controller,
1, Council House Street,
Kolkata – 700 001.

Sir,

Please find herewith the yearly report of Mine Closure Activities for the year 2020-21 for the Tetulmari mine of Sijua Area, BCCL company as given below:-

1	Name of the coal/lignite mine/block:	Tetulmari Colliery, Sijua Area, BCCL
	a) Type: OPC/UG/Mixed	Mixed
	b) Total life of the mine:	>30 Years as per EC
	c) Balance life of the mine:	>22 Years
2	Name of the Owner:	Shri Chanchal Goswami, Director (Technical), BCCL
3	Address of the Owner:	Koyla Bhawan, Koyla Nagar, Dhanbad
4	i) Leasehold Area of the Mine: ii) Project Area of the Mine:	178.90 Ha (as per Mine Closure Plan) 165.00 Ha (as per Mine Closure Plan)
5	Mine Closure Plan approved by.................on (date):	September 2013
6	Escrow Account number:	00150100008833
7	Name & address of Escrow Agent:	Bank of Baroda, Jharia Road, Dhanbad
8	Closure Cost deposited for the year 2020-21.	Rs. 181.74 Lakhs
9	Cumulative Balance including interest in the account:	Rs. 1544.56 Lakhs
10	Report being submitted for:	Progressive Mine Closure
11	Specific condition imposed. (if any, by Government agency):	NA
12	Reserves of Coal/Lignite(as per Mining Plan): Coal/Lignite actually mined out during last year (2020-21):	Minning Plan of Tetulmari is under Preparation. 254855 te.
13	Method of Mining:	Shovel Dumper Combination (OCP) Board and Pillar Method with SDL & Tub (UG)
14	Area Mined out (Ha):	
15	Area reclaimed	i. Physical: NIL. ii. Biological: Continued over 10.3 Ha

maintenance

16	Details of afforestation:	Afforestation activity for Gap filling in 10.3 Ha Area of 2 Eco-Restoration is in progress.
17	Water Quality Management	
	a) Water bodies available in leasehold area:	Nagri Jore, Local drains and ponds.
	b) Measures taken for Protection: (Control of erosion, sedimentation, siltation, water treatment, diversion of water courses if any, measure for protection of contamination of ground water from leaching etc shall be described)	Drain Cleaning, Pond Cleaning, Check dam, Proper Gradient maintenance, Biological reclamation of OB dump slopes, Oil & Grease trap-cum-settling tank to treat workshop effluent.
	c) Quantity of water pumped out from mine/Quarry:	52.5 Million Gallon (Approx.)
	d) Quality of water (as per test result):	Report of water quality monitoring in Cluster V is attached
	e) Corrective measures taken confronting to the permissible limit:	The parameters are mostly within the limit
	f) Is there any acid mine drainage? If yes, the treatment method taken:	No
18	Air Quality Management	
	i) Existing air quality parameters:	Report of ambient air quality monitoring in Cluster V is attached
	ii) Corrective measures taken for prevention of air pollution:	Water sprinkling through mobile water sprinklers, ecological restoration, Covered transportation, plantation, Wed drilling, Controlled blasting.
19	Waste Management	
	a) Quantity of overburden removal:	1136310 Cum
	b) Quantity of Coal/Lignite reject generated:	NIL
	c) Utilization of Waste Material done:	OB is utilized in backfilling
	d) Protective Measures taken for prevention of siltation, erosion and dust generator for waste material:	Biological reclamation and grassing of OB Dumps including slopes to prevent erosion
	e) Quantity of waste material rehandled/back-filled:	1136310 Cum
	f) Height of dump and its stability measures taken:	Less than 60 m; Slope Stability and benching
	g) After backfilling if left out area is filled with water or not (at the time of final closure)	Final Closure stage yet to be reached

20	Top Soil Management	
	a) Top Soil available at site:	NIL
	b) Utilization of the top soil during 2020-21:	NA

21	a) Coal Beneficiation facilities adopted:	NA
	b) Maintenance of coal washeries being done:	No coal washery is located at Tetulmari Colliery
	c) Dismantling of structure of washery (describe briefly if any):	NA

22. Subsidence management (for UG mine): Only development was carried out not depillaring.

23. Infrastructure:

Existing infrastructural facilities available	Future Utilization	Maintenance
Roads	DB Road	Being maintained
Aerial Ropeways	NA	
Conveyor Belts	NA	
Railways	Dhanbad-Chandrapura line	Being maintained
Bridge, Culverts	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Power lines	Will be utilized for neighboring projects.	Being maintained
Building & Structures	Will be handed over to state govt. if fit to use or will be dismantled.	Being maintained
Water Treatment Plant	NA	
Water Supply Sources	Water storage Tank of MADA- Will be utilized for neighboring Project. Water supply pipeline of mine will be utilized for neighboring Project.	Being maintained
Gas Pipeline	NA	
Sewer Line	Will be utilized for neighboring Project.	Being maintained
Telephone Cables	Will be utilized for neighboring Project.	Being maintained
Underground Tanks	Will be utilized for neighboring Project.	Being maintained
Electric Cable	Will be utilized for neighboring Project.	Being maintained
Transformers	Will be utilized for neighboring Project.	Being maintained

Describe if decommissioning, dismantling or disposal is done of the above items during 2020-21 (if any): No

24. Disposal of Machinery:

Decommissioning of Mining Machinery and their possible post mining utilization:	Final closure stage yet to be reached. Will be assessed before final closure.

25 Safety and Security:

a	Safety measures implemented to prevent access to surface opening for Underground working (barbed wire fencing done):	Wall of cement in brick work and gate provided
b	Safety measures implemented to prevent access to surface opening for excavation:	Berm of sufficient height provided along the quarry edge to prevent access
c	Arrangement made up to the site being opened for general public:	No
D	Sealing of mine entries:	Not Applicable at Present

26. Economic Repercussions of Closure of Mine

a	Number of local residents employed in the mine:	Final closure stage yet to be reached. Will be assessed before final closure.
b	Compensation given to the employees concerning their sustenance:	Final closure stage yet to be reached. Will be assessed before final closure.
c	Vocational / skill development training for sustainable income of affected people:	Being imparted (Handloom Training, Stitching Skills, Etc.)

26. Any other closure activities as per approved Mine Closure Plan: NA

27. Post Environmental Monitoring for 3 years (to be given after closing of mine): Final closure stage yet to be reached.

The above information given is true to the best of my knowledge.

(Signature of Competent Authority)
Name: Project Officer,
Designation: Tetulmari Colliery
Date with seal:

YEARLY REPORT OF MINE CLOSURE ACTIVITIES

(As per clause 7 of annexure of the Guidelines for preparation of Mine Closure Plan; No.55011-01-2009-CPAM dated 07.01.2013 to be submitted before 1st July of every year).

Ref No. NPC/PO/2021/917

Date: 26/06/21

To
The Coal Controller,
Office of the Coal Controller,
1, Council House Street,
Kolkata – 700 001.

Sir,

Please find herewith the yearly report of Mine Closure Activities for the year 2020-21 for the **Nichitpur** mine of **Sijua Area, BCCL** company as given below:-

1	Name of the coal/lignite mine/block:	Nichitpur Colliery, Sijua Area, BCCL
	a) Type: OPC/UG/Mixed	OCP
	b) Total life of the mine:	05 Years as per Progressive Mine Closure plan approved in 2020
	c) Balance life of the mine:	04 Years
2	Name of the Owner:	Shri Chanchal Goswami Director (Technical), BCCL
3	Address of the Owner:	Koyla Bhawan, Koyla Nagar, Dhanbad-826005
4	i) Leasehold Area of the Mine: ii) Project Area of the Mine:	150.00 Ha (As per approved MCP) 125.45 Ha (As per approved MCP)
5	Mine Closure Plan approved by..................on (date):	BCCL Board; dated: 2020
6	Escrow Account number:	00150100008825
7	Name & address of Escrow Agent:	Bank of Baroda, Jharia Road, Dhanbad
8	Closure Cost deposited for the year 2020-21	Rs. 67.81 lakhs
9	Cumulative Balance including interest in the account	Rs. 1120.61 lakhs
10	Report being submitted for:	Progressive Mine Closure
11	Specific condition imposed. (if any, by Government agency):	NA
12	Reserves of Coal/Lignite(as per Mining Plan): Coal/Lignite actually mined out during last year (2020-21):	Geo- 22.293 Mte. Mineable- 6.302 Mte. 1522058.00 te.
13	Method of Mining:	Shovel-Dumper Combination
14	Area Mined out (Ha):	51.801 Ha (de-coaled up to base seam)
15	Area reclaimed	i. Physical: NIL ii. Biological: continued over 2.8 Ha

16	Details of afforestation:	Afforestation activity for Gap filling in 2.8 Ha is in progress.
17	Water Quality Management	
	a) Water bodies available in leasehold area:	Nagri Jore, Local drains and ponds.
	b) Measures taken for Protection: (Control of erosion, sedimentation, siltation, water treatment, diversion of water courses if any, measure for protection of contamination of ground water from leaching etc shall be described)	Drain Cleaning, Pond Cleaning, Check dam, Proper Gradient maintenance, Biological reclamation of OB dump slopes, Oil & Grease trap-cum-settling tank to treat workshop effluent.
	c) Quantity of water pumped out from mine/Quarry:	35.59 Lakh m^3/Yr.
	d) Quality of water (as per test result):	Report of water quality monitoring in Cluster V is attached
	e) Corrective measures taken confronting to the permissible limit:	The parameters are mostly within the limit
	f) Is there any acid mine drainage? If yes, the treatment method taken:	No
18	Air Quality Management	
	i) Existing air quality parameters:	Report of ambient air quality monitoring in Cluster V is attached
	ii) Corrective measures taken for prevention of air pollution:	Water sprinkling through mobile water sprinklers, Greenery of dormant OB dumps by native seeds of grasses and bushes, Covered transportation, plantation, Wet drilling, Controlled blasting.
19	Waste Management	
	a) Quantity of overburden removal:	8512651.22 Cum
	b) Quantity of Coal/Lignite reject generated:	NIL
	c) Utilization of Waste Material done:	OB is utilized in backfilling
	d) Protective Measures taken for prevention of siltation, erosion and dust generator for waste material:	Biological reclamation and grassing of OB Dumps including slopes to prevent erosion
	e) Quantity of waste material re-handled/back-filled:	3710246.80 Cum
	f) Height of dump and its stability measures taken:	Less than 60 m from surface; Slope Stability and benching
	g) After backfilling if left out area is filled with water or not (at the time of final closure)	Final Closure stage yet to be reached

20	Top Soil Management	
	a) Top Soil available at site:	NIL
	b) Utilization of the top soil during 2020-21:	NIL

21	a) Coal Beneficiation facilities adopted:	NA
	b) Maintenance of coal washeries being done:	No coal washery is located at Nichitpur Colliery
	c) Dismantling of structure of washery (describe briefly if any):	NA

22. Subsidence management (for UG mine): Only OCP is in Operation in Nichitpur Colliery.

23. Infrastructure:

Existing infrastructural facilities available	Future Utilization	Maintenance
Roads	DB Road (Bansjora-Bhuli)	Being maintained
Aerial Ropeways	NA	
Conveyor Belts	NA	
Railways	Tetulmari-Kusunda link line	Being maintained
Bridge, Culverts	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Power lines	Will be utilized for neighboring projects.	Being maintained
Building & Structures	Will be handed over to state govt. if fit to use or will be dismantled	Being maintained
Water Treatment Plant	NA	
Water Supply Sources	Water storage Tank of MADA- Will be utilized for neighboring Project. Water supply pipeline of mine will be utilized for neighboring Project.	Being maintained
Gas Pipeline	NA	
Sewer Line	Will be utilized for neighboring Project	Being maintained
Telephone Cables	Will be utilized for neighboring Project	Being maintained
Underground Tanks	Will be utilized for neighboring Project.	Being maintained
Electric Cable	Will be utilized for neighboring Project.	Being maintained
Transformers	Will be utilized for neighboring Project.	Being maintained

Describe if decommissioning, dismantling or disposal is done of the above items during 2020-21 (if any): No

24. Disposal of Machinery:

Decommissioning of Mining Machinery and their possible post mining utilization:	Final Closure yet to be reached

25 Safety and Security:

a	Safety measures implemented to prevent access to surface opening for Underground working (barbed wire fencing done):	All Underground opening sealed
b	Safety measures implemented to prevent access to surface opening for excavation:	Berm of sufficient height provided along the quarry edge to prevent access
c	Arrangement made up to the site being opened for general public:	No
D	Sealing of mine entries:	Not Applicable at Present

26. Economic Repercussions of Closure of Mine

a	Number of local residents employed in the mine:	Final closure stage yet to be reached. Will be assessed before final closure.
b	Compensation given to the employees concerning their sustenance:	Final closure stage yet to be reached. Will be assessed before final closure
c	Vocational / skill development training for sustainable income of affected people:	Being imparted (Handloom Training, Stitching Skills, Etc.)

26. Any other closure activities as per approved Mine Closure Plan: NA

27. Post Environmental Monitoring for 3 years (to be given after closing of mine): Final Closure yet to be reached.

The above information given is true to the best of my knowledge.

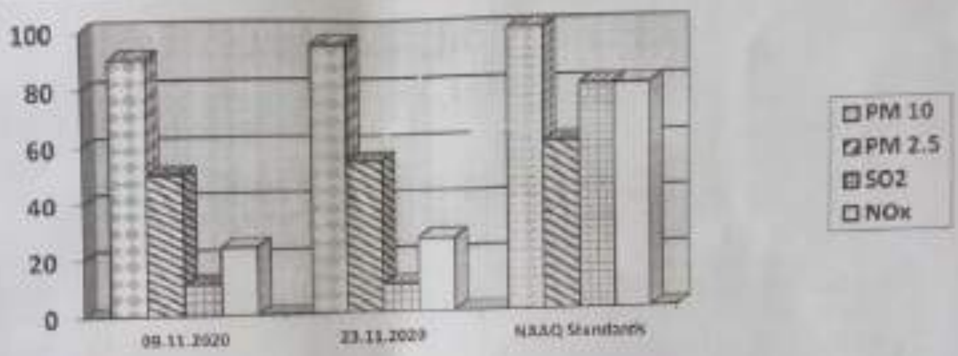
26/6/2021

(Signature of Competent Authority)
Name: Anil Kr. Bhat
Designation: Sr. Manager (Mining)
Date with seal: 26/5/2021

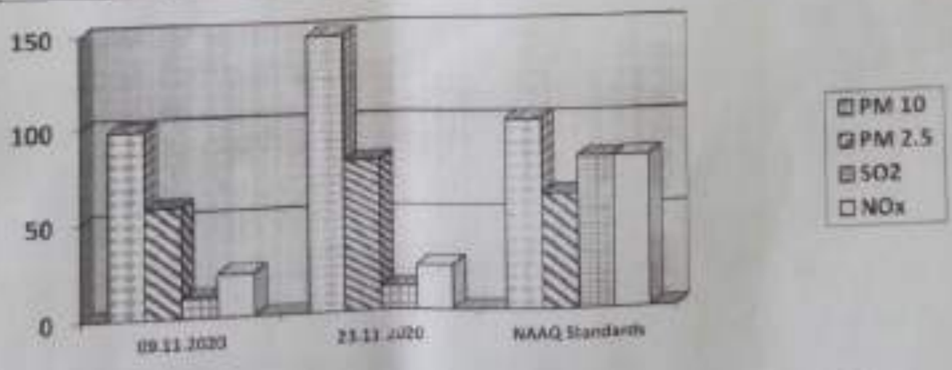
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited   Month: NOV. 2020   Year: 2020-21.

Station Name: A8, Nichitpur		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	09.11.2020	90	50	11	24
2	23.11.2020	95	54	10	26
	NAAQ Standard	100	60	80	80



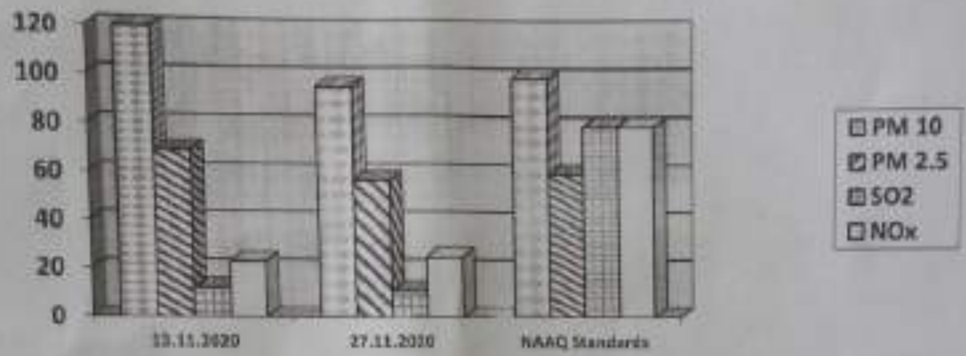
Station Name: A9, Basseriya Managers office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	09.11.2020	98	57	10	22
2	23.11.2020	147	79	12	23
	NAAQ Standard	100	60	80	80



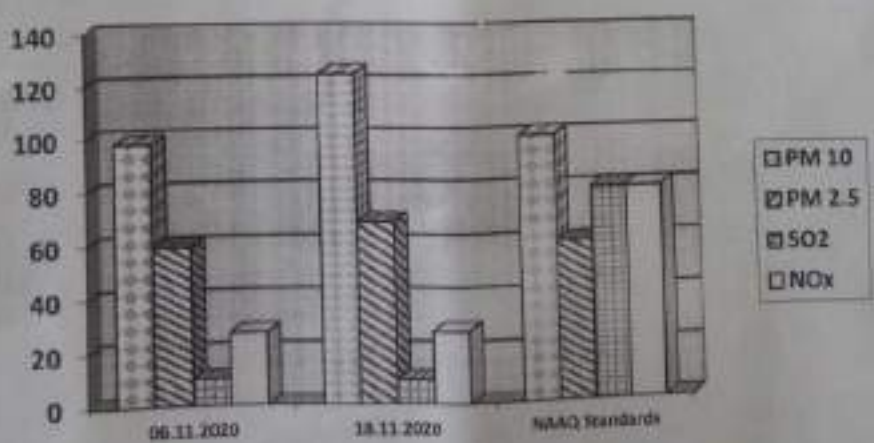
Analysed By

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

Station Name: A16 Pootki Balihari office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	13.11.2020	120	69	12	23
2	27.11.2020	96	57	11	25
	NAAQ Standards	100	60	80	80



Station Name: A17 – Moonidih UGP		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	06.11.2020	98	59	10	27
2	18.11.2020	124	68	9	27
	NAAQ Standards	100	60	80	80



- All values are expressed in microgram per cubic meter.
- 24 hours duration

Analysed By

Checked By

Approved By

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) **Mine Discharge of Mudidih (MW5)**

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jarian Nala and Ekra Nala.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analysed 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 parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -V**		Month: **NOV. 2020**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	**MW5** First Fortnight 09.11.2020	**MW5** Second Fortnight 30.11.2020	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	38	40	*100 (Max)*
2	pH	7.92	8.32	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	32	36	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By | Checked By Lab In-Charge RI-2, CMPDI, Dhanbad | Approved By HOD(In-charge) Environment RI-2, CMPDI, Dhanbad

ANNEXURE 15:

भारत कोकिंग कोल लिमिटेड

(कोल इंडिया लिमिटेड का एक अंग)

BHARAT COKING COAL LIMITED

(A Subsidiary of Coal India Limited)

Civil Engineering Department, Koyla Nagar, Dhanbad – 826 005 (JH), India
, e-mail: gmcivil.bccl@coalindia.in

NIT Ref. No.: BCCL/CED/TC/eNIT-12/2021-22/225 **Date: 05.07.2021**

E – Tender Notice

Open E-Tender invited vide BCCL/CED/TC/eNIT-12/2021-22/225 ; Date: 05.07.2021 for the work of "**Drilling and installation of 23 nos of piezometric wells in the command area of BCCL**"

Estimated Value: Rs. 2,16,19,913.33 **Period of Work: 175 days**

The tender documents can be downloaded from **09.07.2021 to 27.07.2021.** All prospective bidders are advised to visit website **https://coalindiatenders.nic.in** for further details and to participate against this tender. Full details of this tender are also available on website "**eprocure.gov.in**".

05/07/21

GM (Civil/Industrial), BCCL

Copy to:-

1) D (T) PP/ D(P)/CVO, BCCL .... for kind information
2) GM (Civil/Welfare), BCCL.
3) GM All Area..
4) GM (Geology)/HOD(Environment)/GM(P&P).
5) Area Manager (Civil), All Area
6) Assistant Manager (Civil), TC, CED.

ANNEXURE 16:

STRICTLY RESTRICTED
FOR COMPANY USE ONLY

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 – 2020-21)

[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 – 2021

Job no - 200419012

GROUNDWATER LEVEL & QUALITY REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year – 2020-21)

[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 – 2021

PERSONS ASSOCIATED

Debasis Bandyopadhyay

Manager (Geology)

Hydrogeology Section

Exploration Division

CMPDI (HQ), Ranchi

Vaibhab Kumar

Deputy Manager (Environment)

Environment Dept. / Lab

Regional Institute - II

CMPDI, Dhanbad

Dr. A. K. Panda

General Manager (Exploration)

Exploration Division

CMPDI (HQ), Ranchi

CMPDIL

CENTRAL MINE PLANING & DESIGN INSTITUTE

HYDROGEOLOGY SECTION, EXPLORATION DEPARTMENT

GONDWANA PLACE, KANKE ROAD, RANCHI, JHARKHAND– 834031

(Accredited Groundwater Professional Institutions by CGWB/CGWA)

(Accredited by NABL, valid upto: 2022)

(Accredited as a FAE in (HG) by QCI-NABET, valid upto: Aug'2021)

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DETAILS OF THE REPORT

Sl No.	ITEMS	INFORMATIONS
1	Geographical Area	Jharia Coalfield (JCF): 453 sq. km. Raniganj Coalfield (RCF part): 19.64 sq. km. (Cluster-XVI area only)
2	Major Physiographic Units	Dissected Pediplain with surface Reduced Level (RL) varies from 160 m to 220 m above mean sea level (AMSL) in JCF and 100 m to 140 m AMSL in RCF.
3	Drainage System	Damodar River is the master drainage flowing along western boundary of the JCF. Jamunia River, Khudia River, Katri River, Jarian Nala, Ekra Jore, Kari Jore, Kashi Jore, Chatkari Jore and their tributaries are flowing through the JCF area. Damodar River, Barakar River is the master drainage of the part of RCF area (CV Area).
4	Annual Rainfall	Dhanbad Dist: Bokari Dist:
5	Geological Formations	Gondwana Formation (Talchir Formation, Barakar Formation, Barren Measure Formation & Raniganj Formation)
6	Aquifer System	Unconfined/Phreatic Aquifer – thickness 25 m (Avg.) Semi-confined to confined Aquifer – thickness from 25 m upto 650 m
7	Hydrogeological properties	Unconfined Aquifer (Damoda BJ Section & Block-III): Hydraulic Conductivity – upto 0.50 m/day Transmissivity – 10 - 42 m^2/day
		Semi-confined to confined Aquifer (Sitanala & Kumari Block): Hydraulic Conductivity – 0.0006-1.44 & 0.05-0.0027 m/day Transmissivity – 0.06 – 0.573 m^2/day
8	Groundwater Level Monitoring Network	Out of total 252 nos. of monitoring stations 64 nos located within core mining area and rest comes within Buffers zone. 60 Nos. of Groundwater monitoring well (Dug Wells) network established by CMPDI to record groundwater level data in and around the Core Zone of JCF and 4 Nos. of Groundwater monitoring well (Dug Wells) in RCF (CV Area).
9	Groundwater Levels Below Ground Level (bgl)	JCF area: Pre-monsoon – 0.80 to 16.25 m (Avg. 4.95 m bgl) in '2020 Post-monsoon – 0.75 to 10.10 m (Avg. 3.26 m bgl) in '2020 RCF area (part): Pre-monsoon – 2.30 to 9.70 m (Avg. 4.30 m bgl) in '2020 Post-monsoon – 1.75 to 5.50 m (Avg. 2.70 m bgl) in '2020
10	Groundwater Quality	Potable (Annexure- VII)
11	Proposed Piezometers	Proposed piezometers (23 nos.) to monitor impact of coal mining on groundwater regime within the coalfield area (JCF & part of RCF) for maximum depth upto 290 m.
12	Stage of Groundwater Development (CGWB)	Dhanbad District-76.30% (GWRE-2017)

GROUNDWATER LEVEL & QUALITY REPORT FOR CLUSTER OF MINES OF BCCL

1.0 INTRODUCTION

1.1 LOCATION DETAILS AND BRIEF ABOUT THE PROJECT

The 15 nos. Cluster of mines (Cluster-I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XIII, XIV, XV and XVI) of BCCL is located in the Jharia coalfield in Bokaro district of and Dhanbad district of Jharkhand and part of Raniganj coalfield of Dhanbad district of Jharkhand.

The area of Jharia Coalfield (JCF) is 453 sq. km. and Raniganj Coalfield (RCF part) is 19.64 sq. km. (Cluster-XVI area only). Located about 3.0 km south-west of Dhanbad town and 10.0 km north-east of Bokaro town. The coalfield bounded by Jamunia River in the west, Damodar river in the south, and metamorphics (hard rock) in the north and east side. **(Plate-I)**

1.2 OBJECTIVE OF THE STUDY:

The objective of the report is to conducting hydrogeological study by quarterly monitoring of groundwater level and quality of the Jharia coalfield and Raniganj coalfield (part) within BCCL command area for 15 nos. Cluster of mines of BCCL. The data collected shall submitted to the MoEF&CC, CPCB & SPCB within stipulated timeframe. The work being done yearly and require d to be continued as per the specific condition mentioned invariably in Environmental Condition (EC) for all of the Clusters of BCCL.

1.3 SCOPE OF THE STUDY:

The following scope has taken into account for hydro-geological investigation of the study area.

i) The monitoring of the groundwater levels done four times/year during (May, August, Nov and Jan).
ii) The monitoring of the groundwater quality done during May including Arsenic and Fluride.
iii) To evaluate the status of ground water level condition in the area.
iv) To study the ground water flow direction in the mining areas.
v) To study the depth to ground water level condition in the mining areas.
vi) To study the ground water quality data and interpretation in the mining areas.

भारत कोकिंग कोल लिमिटेड
एक मिनी रत्न कंपनी
(कोल इंडिया लिमिटेड का एक अंग)
कोयलाभवन, कोयलानगर,धनबाद -826005

Bharat Coking Coal Limited
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Regd.Off: Koyla Bhawan, Koyla Nagar

CIN: U10101JH1972GOI000918
Environment Department

पत्र संख्या भाकोकोलि/उप महाप्रबंधक(पर्या0)/संचिका-/18/1086-1088(4) दिनांक : 14.06.2018

सेवा में,
महाप्रबंधक
व्यापार विकास
सीएमपीडीआई - कांके रोड रांची ८३४००८-

Sub: For work of Ground water level and quality monitoring

महोदय,

This is with reference to earlier letter ref no. BCCL/HOD(Env)/F-Env/13/161 dated 11.02.2014 regarding conducting hydrological study by quarterly monitoring of groundwater level and quality of the study to be carried out by establishing a network of existing wells. The monitoring for quantity shall be done four times a year in pre-monsoon (May), monsoon (August), post-monsoon (November) and winter (January) season and for quality including Arsenic and Fluoride during month of May. Data thus collected shall be submitted to the Ministry of Environment & Forest and to Central Pollution Control Board/SPCB quarterly within one month of monitoring.

The above work is being done yearly and required to be continued as per the specific condition mentioned invariably in Environment Clearance order of all clusters of BCCL.

This is for your kind information and further necessary action

भवदीय

14/6/18

उप-महाप्रबंधक (पर्यावरण)

Copy To:
१ महाप्रबंधक (गवेषण), कांके रोड रांची ८३४००८-

1.4 TOPOGRAPHY AND DRAINAGE

Northern part of the JCF area covered with hills and thin forest. In general, the altitude varies from 220 m AMSL in Barora area (Cluster-I) to 160 m above mean sea level (AMSL) in Sudamdih area (Cluster-X). Pediplains developed over sedimentary rocks or Gondwana formation consisting of Sandstone, Shale, coal, etc. Dissected pediplains developed over Gondwana formations found in Jharia, Baghmara, Katras areas etc. However, in RCF (part) areas the altitude varies from 100 m to 140 m AMSL (Cluster-XVI). The general slope of the topography is towards south, i.e. Damodar River.

The drainage pattern of the area is dendritic in nature. The drainage system of the area is the part of Damodar sub-basin. All the rivers that originate or flow through the coalfield area have an easterly or southeast course and ultimately joins Damodar River, the master drainage. The drainage of the JCF is mainly controlled by Jamuniya River (5th order), Khudia nala (3rd order), Katri River (4th) and Chatkari nala (3rd order) flowing from north to south and joins Damodar River. Whereas, Barakar River and Khudia River are controlling the drainage pattern of RCF (part) and joins Damodar River in the south. Damodar River is the main drainage channel and flows from west to east along the southern boundary of JCF and RCF.

The drainage map of the JCF and part of RCF has been prepared on topographic map of scale 1:50,000 (***Plate-II***). The watershed of all tributary rivers (Jamuniya River to Barakar River) falls within the north-western part of Damodar sub-basin which comes under Lower Ganga Basin.

Besides, a large number of ponds/tanks distributed in and around JCF, out of which one prominent lake is located at Topchanchi in the north-west part. Two reservoirs, Maithon dam in Barakar River and Panchet dam in Damodar River near to Chanch Victoria Area of BCCL (part of RCF) are the main source of water supply to the nearby area. Jharia Water Board, Damodar Water Supply Scheme and Mineral Area Development Authority (MADA) are supplying water.

1.5 DETAILS REGARDING WETLANDS

A **wetland** is a distinct ecosystem that flooded by water, either permanently or seasonally. The primary factor that distinguishes **wetlands** from other landform or water bodies is the characteristic vegetation of aquatic plants. Wetland are protective ecosystem as per new guidelines of CGWA & MoEF&CC. There are no Wetlands in and around the area (Jharia coalfield and Raniganj coalfield) as per the list given on official website of MoEF&CC, Govt. of India. The list enclosed as **Annexure-III.**

1.6 CLIMATE & RAINFALL

The Jharia Coalfield (JCF) and part of Raniganj Coalfield (RCF) area in Dhanbad District belongs to sub-humid tropical climatic region. The maximum temperature during summer shoots upto 45° C and falls between 10° C to 5° C in winter. The maximum rainfall occurs during the period between June and September. Rainfall data of IMD Dhanbad and Mine Rescue Station Dhanbad given in ***Annexure-IV***.

In Jharkhand state, Daily Rainfall data from 1989 to 2018 considered for analysis of trend variability and mean rainfall patterns. From the daily rainfall data, monthly rainfall series of each stations computed and then monthly district rainfall series has constructed by considering arithmetic average of all the station rainfall values within the district. The monthly rainfall series of the state has computed by using area weighted rainfall values of all the districts within the state. The objective of the analysis is to:

1. Identify the spatial pattern of the mean rainfall
2. Understand district wise observed rainfall trend and variability in annual and SW monsoon season (June, July, august and September).

Daily station rainfall data utilized for identification of the mean spatial patterns and rainfall intensity trends. From mean and standard deviation (SD), the coefficient of variation (CV) calculated as follows: Coefficient of variation (CV) = [Standard Deviation / Mean] × 100

The analysis has done in two parts. For identification of the spatial pattern mean rainfall and variability and observed trends we have used district rainfall series and results have been brought out for four southwest monsoon months viz. June, July, August, September, for the southwest monsoon season and also for annual.

Table shows the mean rainfall (mm) and coefficient of variation of the state for the monsoon months, southwest monsoon season and annual during the period 1989-2018. It can see that the state gets highest rainfall (31%) of southwest monsoon rainfall in July month while the August month get 28% of the southwest monsoon rainfall. June and September receive 19% and 22% of southwest monsoon rainfall. Also more than 84% of annual rainfall receives during the southwest monsoon season only. The variability of monsoon or annual rainfall is also very less.

Jharkhand State

	June	July	August	September	Sub-total	Annual
Mean	190.3	313.9	289.2	225.7	1019.1	1211.4
CV	44.4	29.0	24.8	37.0	18.7	16.9

Dhanbad District

	June	July	August	September	Sub-total	Annual
Mean	203.9	327.7	302.5	271.5	1105.6	1332.2
CV	41.0	35.0	33.5	48.7	20.8	19.4

Fig. 1 and 2 show the time series of rainfall in mm for the months of June, July, August, September and southwest monsoon season, annual respectively. The trend lines displayed for each of the series. Neither monthly rainfall nor seasonal rainfall shows any significant increasing/decreasing trend while annual rainfall shows significant decreasing trend. In the monthly rainfall June, July, August, September and seasonal rainfall shows decreasing trend. During the last 30 years highest rainfall of 390.3 mm received in June in the year 1994, 492.1 mm received in June in the year 2017, 431.5 mm received in August in the year 1997, while highest rainfall of 395.2 in September received in the year 1995. Highest annual rainfall of 1587.9 mm received in the year 1999 and highest southwest monsoon rainfall of 1364.6 mm received in the year 1994 (Climate Research and Services, IMD, Ministry of Earth Sciences, Pune, Jan'2020).

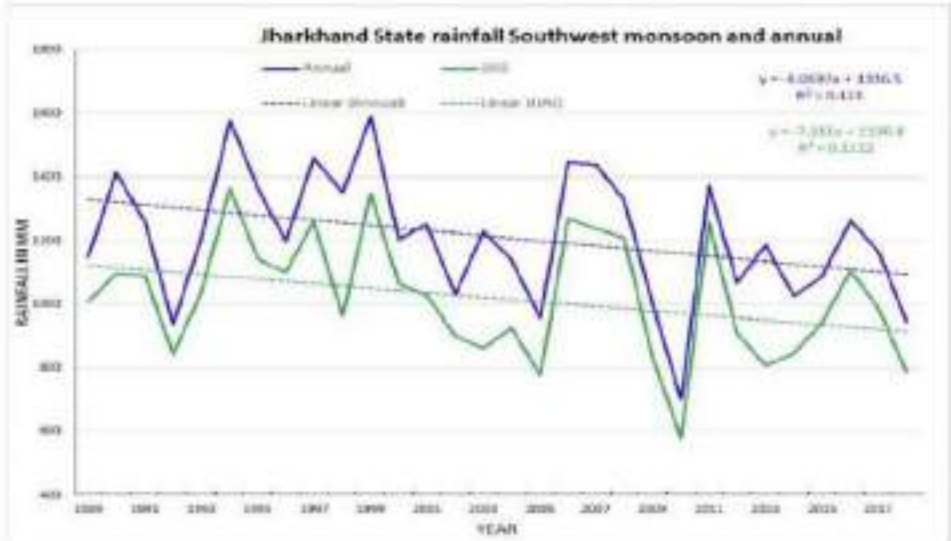


Fig-1.

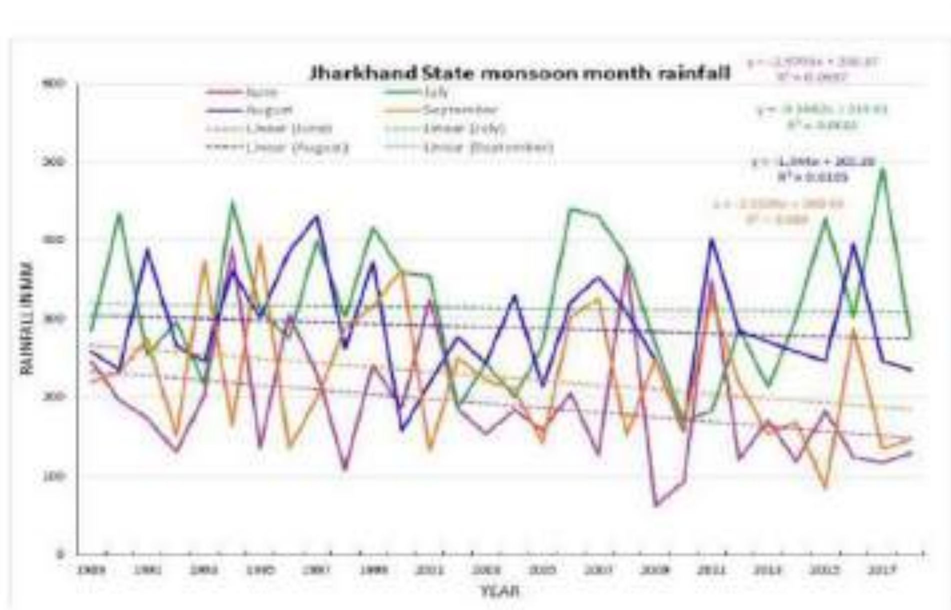


Fig-2.

2.0 GEOLOGY AND HYDROGEOLOGICAL SETUP OF THE AREA

2.1 REGIONAL GEOLOGY

The Jharia Coalfield covers an area of 453 sq. km. located in Dhanbad District, Jharkhand. The non-coal bearing Talchir Formation exposed in patches along the northern fringe of the Coalfield. The Barakar FormatioN overlies the Talchir is covering the most part of the Jharia Coalfield and having an area of 218 sq. km. This successively overlain by the non-coal bearing Barren Formation mainly exposed in the central part of the Coalfield. This, in turn, overlain by the Raniganj formation (Coal Bearing horizon) in the south-west part of the Coalfield and covers an area of 54 sq. km.

Chanch-Victoria Area is located in the western part of Raniganj Coalfield. The Raniganj coalfield represents the eastern most coal basin in the Damodar Valley Region, located in the border of Dhanbad District of Jharkhand and Bardhaman District of West Bengal. The Coalfield is almost elliptical in shape and covers an area of about 1530 sq. km. out of which only 35 sq. km. comes under leasehold area of BCCL out of which 19.64 sq. km is the study area (Cluster-XVI only). The coal bearing formations of the area belongs to Barakar Formation of the Lower Gondwana in **Table-1**.

Table – 1: Regional Geological Succession of Jharia Coalfield in the area

Geological Formations		Age
Quaternary/Recent	Soil cover/Weathered mantle	Recent
Post-Gondwana	Dolerite	Upper Cretaceous
	Lamprophyres	Jurassic
Damoda Group	Raniganj Formation	Upper Permian
	Barren Measures Formation	Middle Permian
	Barakar Formation	Lower Permian
	Karharbari	
	Talchir Formaton	Upper Carboniferous
---------------------------Unconformity---------------------------		
Metamorphics		Proterozoic

2.2 HYDROGEOLOGICAL SET- UP

The permeable formations mainly composed of sandstone behave as aquifer units. The coal seam and shales developed in the area act as impermeable beds i.e. aquiclude. The aquifer materials of Gondwana Formation constituted of fine to coarse grain sandstone having primary porosity of intergranular void space. The secondary porosity formed due to presence of faults, fracture, joints, etc. Sandstone of Gondwana formations in JCF and RCF are very hard, compact and cemented sandstone and forming less potential aquifer, particularly the deeper aquifer system. The secondary porosity along with primary porosity forms a conduit system making these formations good aquifers for movement and storage of ground water.

2.3 AQUIFERS DESCRIPTION

The aquifer system for shallow and deeper aquifer has established through hydrogeological studies, exploration, surface and subsurface geophysical studies in the JCF and RCF (part) covering all geological formations. The aquifer can be divided into two zones – Un-confined/Phreatic (shallow) and Semi-confined to confined (deeper) aquifer.

PHREATIC/UN-CONFINED AQUIFER

The top aquifer occurred above the top most coal seam/shale bed called un-confined or water table aquifer and it consists of relatively permeable formation such as weathered sandstone and loose soil. The thickness of the un-confined aquifer is varying from few meters to 50 m. This un-confined aquifer is potential than semi-confined to confined aquifer.

SEMI-CONFINED TO CONFINED AQUIFER

The semi-confined to confined aquifer consisting of sandstone bed is sandwiched with coal seams/shale beds and multiple aquifer system developed due to presence of multiple numbers of coal seams/shale beds. With the presence of intercalated shale and carbonaceous shale beds and reduction in permeability with depth, the lower aquifers are poor in potential.

Table –2 Generalized Hydrogeological Units developed in the study Area

Sl. No.	Type of Aquifer	Depth range (m)	Core zone (within 3 km)	Buffer zone (within 10 km)
1.	Unconfined	0 – 25 (Avg.)	Alluvium, weathered sandstone	Alluvium, weathered sandstone
2.	Semiconfined/ confined	Beyond 25 upto 650 m	Multiple Sandstone horizons in Barakar formation	Multiple Barakar, sandstone, Barren Measure, Raniganj sandstone and Talchir shale

2.4 GENERAL AQUIFER PARAMETERS

PHREATIC/UN-CONFINED AQUIFER

The wells tested by CMPDI for determination of aquifer parameters in Damuda (BJ Section) and Block-III area of JCF. The hydraulic conductivity of the un-confined aquifer is 0.50 m/day as computed from pumping tests on the wells. The transmissivity of the unconfined aquifer ranges from 10.68 m^2 /day to 41.48 m^2 /day.

SEMI-CONFINED TO CONFINED AQUIFER

The un-confined aquifer, the sandstone partings in-between impervious layers of shale and coal seams designated as semi-confined / confined aquifers. The sandstones in these aquifers are fine to coarse grained, hard and compact with very low porosity. Mostly groundwater occurs in the weak zones formed due to weathering, fracture, faults, which create the secondary porosity. The hydrogeological parameter has determined by CMPDI in Sitanala Block by conducting aquifer performance test (APT). The hydraulic conductivity (K) of semi-confined aquifer in Barakar Formation ranges from 0.0006 m/day to 1.44 m/day. The hydrogeological parameter has also been determined at Kumari OCP Block in the central JCF by conducting aquifer performance test. The hydraulic conductivity (K) of semi-confined aquifer in Barakar Formation in this area ranges from 0.0027 m/day to 0.05 m/day.

Table – 3: Aquifer parameters considered for the study Area

Hydraulic Parameter	Unconfined aquifer Site: Damuda (BJ Section) and Block-III area	Semi-confined aquifer Site: (1): Sitanala Block (2): Kumari Block
Transmissivity (m^2/d)	10.68 – 41.48	0.0621 – 0.573
Hydraulic conductivity (m/d)	0.5	0.05 – 0.0027
Specific yield	0.03 to 0.04 (as per GEC recommended values)	

3.0 GROUND WATER LEVEL MONITORING

To collect the representative groundwater levels in the study area, CMPDI has established a monitoring network of total 252 monitoring stations out of which 64 located within core zone and rest comes within Buffer zone. Total 60 nos. dug well within JCF and 04 nos. dug well within RCF (part) area (Details of the Hydrograph stations & water level given in **Annexure-V, VA** & **VB**) spread over the entire BCCL leasehold area, **Plate-II**. Water level monitoring in all hydrograph stations has been done in pre-monsoon as well as in post monsoon whereas in 64 stations monitoring done in quarterly (May'20, Aug'20, Nov'20 and Jan'21) basis.

Depth to water level of the water table depict the inequalities in the position of water table with respect to ground surface and is useful in delineating recharge / discharge areas, planning of artificial recharge structure and shows the overall status of the groundwater level in the area. Historical groundwater level (GWL) of entire JCF and part of RCF with fluctuation, GWL of Non-mining / Mining areas and GWL of the Cluster of Mines of BCCL are shown in this report to assess the effect of Coal mining activity in the groundwater regime in and around the Coalfield area.

Mining is a dynamic phenomenon. The mining activity creates dis-equilibrium in environmental scenario of the area and disturbs the groundwater conditions/regime in particular. The impact on shallow water regime due to mining activity can broadly viewed as under:

- Historical GWL with annual fluctuation over the years
- GWL scenario in Non-mining and Mining area (OC/UG mines)
- GWL scenario of Cluster of mines of BCCL

3.1 HISTORICAL GROUNDWATER LEVEL (GWL)

Historical GWL of JCF and part of RCF given from 2005 to 2020 of CMPDI monitoring stations (total 64 stations within Coalfield area). Pre-monsoon and Post-monsoon GWL with Fluctuation has been mentioned below in the table.

Table – 4: Historical Groundwater Level

Period		(Water level in metre below ground level)								
		Pre-Monsoon (April/May)			Post-Monsoon (Nov/Dec)			Fluctuation		
		From	To	Average	From	To	Average	From	To	Average
JCF	2005	0.07	19.08	6.29	0.84	12.13	3.20	0.12	12.45	3.21
	2007	0.40	19.27	5.66	0.35	8.21	2.87	0.02	16.15	2.96
	2008	0.45	18.35	5.42	0.35	14.20	3.62	0.03	9.22	2.45
	2010	0.85	14.47	5.24	0.10	15.88	4.48	0.02	5.55	1.54
	2012	1.27	18.68	5.58	0.15	7.80	2.72	0.08	13.45	2.96
	2013	0.70	19.20	5.65	0.45	8.35	2.77	0.29	15.88	3.17
	2014	0.70	16.28	4.92	0.75	14.98	3.27	0.25	10.15	2.17
	2015	1.38	17.20	6.00	0.45	14.58	3.92	0.28	7.62	2.15
	2016	0.78	16.73	5.64	0.30	12.43	3.19	0.23	6.35	2.88
	2017	0.67	16.28	5.61	0.15	6.97	2.41	0.10	12.10	3.25
	2018	1.20	14.58	5.55	0.40	7.17	2.83	0.20	9.45	2.68
	2019	0.95	15.88	5.46	0.45	5.95	2.34	0.20	13.40	3.05
	2020	0.80	16.25	4.95	0.75	10.10	3.26	0.25	11.05	2.15
RCF (part)	2008	5.02	10.50	7.59	2.85	4.90	3.71	1.82	6.60	3.87
	2010	2.20	8.85	4.74	2.78	9.58	4.63	0.68	1.10	0.89
	2011	3.57	8.02	4.98	2.50	6.21	3.75	0.55	1.90	1.23
	2012	3.10	7.34	4.59	1.55	7.00	3.66	0.05	2.78	0.94
	2013	1.70	9.87	6.54	2.90	8.85	4.71	1.02	5.54	2.84
	2014	3.27	6.48	4.57	2.13	3.03	2.63	0.54	3.45	1.94
	2015	3.38	9.52	5.33	2.68	8.20	5.11	1.06	1.32	1.81
	2016	3.61	10.65	6.24	0.90	6.50	3.18	1.63	4.40	3.06
	2017	1.93	5.80	3.25	1.63	3.78	2.47	1.63	3.78	0.78
	2018	2.34	8.70	4.35	1.75	5.70	2.75	0.41	2.55	1.59
	2019	1.60	9.35	5.29	0.80	3.88	2.10	0.80	5.47	3.20
	2020	2.30	9.70	4.30	1.75	5.50	2.70	0.40	2.75	1.60

3.2 GROUNDWATER LEVEL SCENARIO IN NON-MINING/MINING AREA

Depth to water level (DTW) range in different formations with respect of mining and non-mining areas summarized in the Table-5.

Table – 5: Depth to water table

Formation	*Area*		*DTW (bgl, m) [Year-2020]*		*Average GWL (m)*	
			Pre-monsoon (Apr/May)	*Post-monsoon (Nov/Dec)*	*Pre-monsoon*	*Post-monsoon*
Sedimentary (Gondwana)	Non-mining		1.40-11.35	0.75-4.60	5.45	2.55
	Mining	OC	0.90-12.50	0.55-5.85	5.15	2.24
		UG	1.20-16.25	0.55-4.75	5.85	2.75
Metamorphics (Hard rock)	Peripheral part of the Coalfield		0.45-15.10	0.45-9.50	7.25	3.85

The study revealed that water table is in shallow depth and there is no significant stress in the water table due to coal mining activity. Mining and Non-mining areas shows barely any difference in water table condition in the JCF and RCF (part) area. The average hydraulic gradient of the water table within mining and non-mining areas given in Table-6. There is no significant change in hydraulic gradient observed. Relatively steep gradient near active opencast mining areas w.r.t., Non-Mining, Underground mines and Metamorphics areas observed.

Table – 6: Average hydraulic gradient

Sl. No	*Formation*	*Area*		*Average hydraulic gradient*
1	Sedimentary (Gondwana)	Non-Mining		1.0×10^{-3} to 3.0×10^{-3}
		Mining	OC	3.0×10^{-2} to 6.0×10^{-3}
			UG	2.0×10^{-2} to 4.0×10^{-3}
2	Metamorphics (Hard rock)	Peripheral part of the Coalfield		1.0×10^{-3} to 3.0×10^{-3}

3.3 GROUND WATER LEVEL DATA OF THE CLUSTER OF MINES OF BCCL

A GROUND WATER LEVEL OF CLUSTER-I

Cluster-I (Damuda Group of Mines) consisting of (Cluster-I consisting of Damoda UG, Albion OCP, Proposed BJ Section OCP and Abandoned Gutway OCP) of Barora area, BCCL is located in the western most part of Jharia coalfield in Bokaro district of Jharkhand. The life of the project works out upto 15 years considering annual target production of 1.17 MTPA. It is located in the extreme western part of JCF in Bokaro district of Jharkhand (Toposheet no – 73 I/1).

The present leasehold area of Cluster-I is 575.0 Ha. The Damoda block area marked by more or less flat and gently undulating topography. The RL varies from 179 m to 208 m AMSL and the general slope of topography is towards east. Jamuniya River, Kari Jore, Podo Jore and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Jamuniya River.

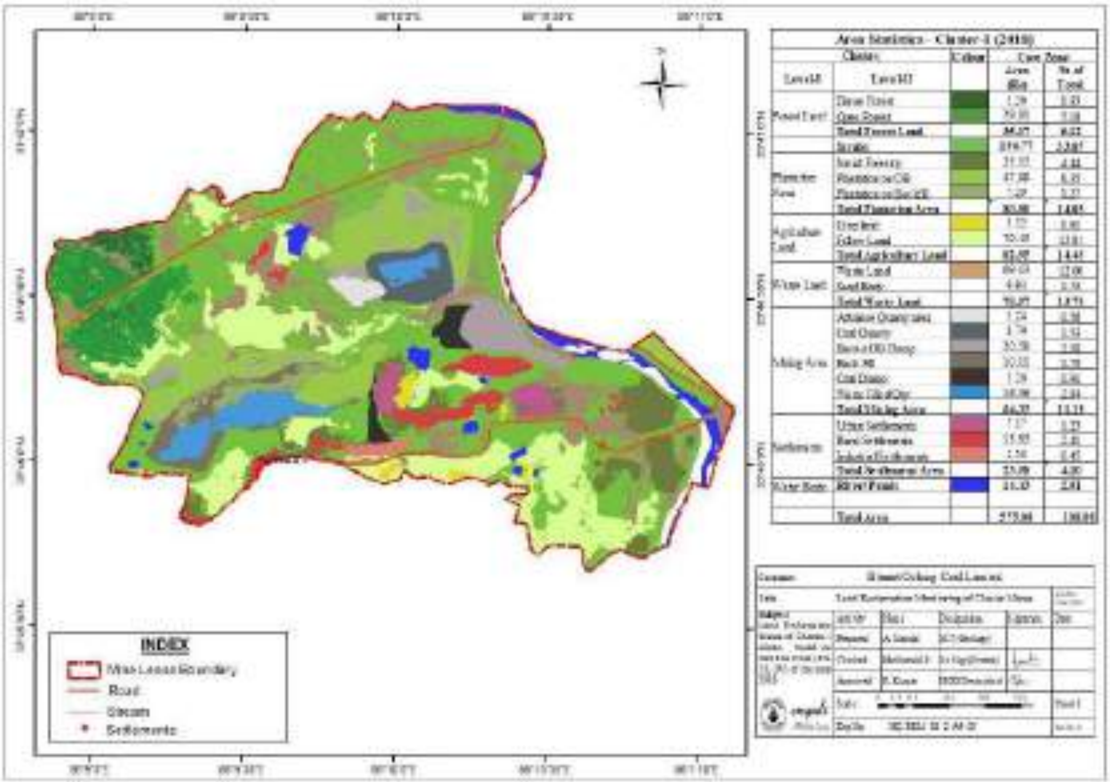
Monitoring stations (**B-15, B-21A, B51 and B-53**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	B-15	Bera Basti	3.70	0.15	1.47	1.70	1.90	0.45	1.65	2.65	1.56	1.85	0.75	0.85
2	B21A	Dugdha	10.00	4.15	5.80	6.70	9.45	1.90	-	-	6.73	9.65	3.45	2.65
3	B-51	Taranga	5.00	0.88	2.10	3.00	5.10	1.10	2.70	2.90	3.00	5.02	2.25	2.42
4	B-53	Karmatanr	3.12	1.07	1.40	1.92	3.22	0.97	1.42	2.12	2.52	3.92	1.62	1.42
Average WL (bgl)			5.46	1.56	2.69	3.33	4.92	1.11	1.92	2.56	3.45	5.11	2.02	1.84

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.85 m Max – 10.00 m
Post-monsoon GW Level (m): Min – 0.85 m Max – 5.80 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	393.69×10^4	393.69×10^4	393.69×10^4
2	Open Land	204.89×10^4	204.89×10^4	204.89×10^4
3	Road/ Paved Area	09.0×10^4	09.0×10^4	09.0×10^4
4	Rooftop area of building/ sheds	14.58×10^4	14.58×10^4	14.58×10^4
5	Total	575.00×10^4	575.00×10^4	575.00×10^4

B. GROUND WATER LEVEL OF CLUSTER-II

Cluster-II consists of seven mines namely; (Block II Mixed mines (OCP & UGP), Jamunia OCP, Shatabdi OCP, Muraidih Mixed mines (OCP & UGP), and Phularitand OCP of BCCL is located in the western most part of Jharia coalfield in Bokaro district and Dhanbad district of Jharkhand. The life of the project works out upto 30 years considering annual target production of 20.215 MTPA. It is located in the extreme western part of Jharia Coalfield in Dhanbad district of Jharkhand (Toposheet no- 73 I/1 and I/5).

The present leasehold area of Cluster-II is 2260.54 Ha. The Damoda block area marked by more or less flat and gently undulating topography. The RL varies from 176 m to 235 m AMSL. Jamuniya River, Khudia River and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Jamuniya River and Khudia River.

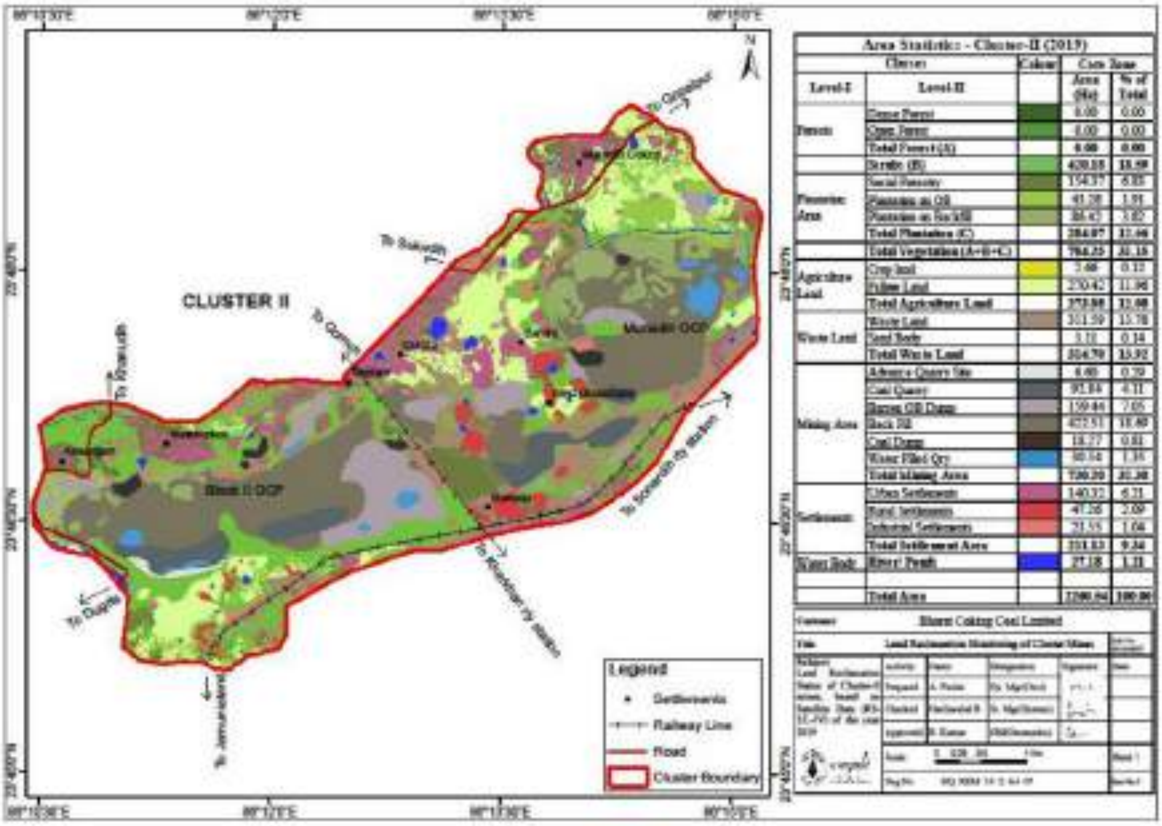
Monitoring stations (**B-1, B-59, B-60, B-61A and B-62A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	B-1	Muraidih	3.28	0.73	1.63	1.73	3.18	1.33	1.73	1.98	1.68	2.88	1.48	2.08
2	B-59	Khodovaly	5.25	0.67	1.40	2.10	6.20	0.80	0.90	1.20	1.38	5.47	0.90	1.10
3	B-60	Bahiyardih	10.33	0.91	3.21	6.13	8.13	1.23	3.23	4.93	8.21	13.68	3.13	4.23
4	B61A	Kesargora	3.32	0.85	1.60	2.07	3.32	1.39	0.52	1.12	1.27	2.57	2.62	2.02
5	B62A	Sadiyardih	6.95	2.77	3.00	4.95	7.55	2.80	3.25	4.95	5.87	8.27	4.00	4.78
Average WL (bgl)			5.83	1.19	2.17	3.40	5.68	1.51	1.93	2.84	3.68	6.57	2.43	2.84

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.57 m Max – 13.68 m
Post-monsoon GW Level (m): Min – 0.52 m Max – 4.78 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	977.33 x 10^4	977.33 x 10^4	977.33 x 10^4
2	Open Land	1072.08 x 10^4	1072.08 x 10^4	1072.08 x 10^4
3	Road/ Paved Area	140.32 x 10^4	140.32 x 10^4	140.32 x 10^4
4	Rooftop area of building/ sheds	70.81 x 10^4	70.81 x 10^4	70.81 x 10^4
5	Total	2260.54 x 10^4	2260.54 x 10^4	2260.54 x 10^4

C. GROUND WATER LEVEL OF CLUSTER-III

Cluster-III consists of nine mines namely, Jogidih UG, Govindpur UG, Maheshpur UG, Kooridih/Block-IV Mixed Mine, New Akashkinaree Mixed Mine, South Govindpur UG (closed), and Teturiya UG (closed) mines. It is located in the western most part of Jharia coalfield in Dhanbad district of Jharkhand. The life of the project works out upto 60 years considering annual target production of 3.60 MTPA. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand (Toposheet no – 73 I/5).

The present leasehold area of Cluster-III is 1552.53 Ha. The area is plain with gentle undulation with RL varies from 160 m to 208.80 m AMSL. The general slope of the area is towards south. Khudia River, Baghdihi Jore, Katri River and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Khudia River.

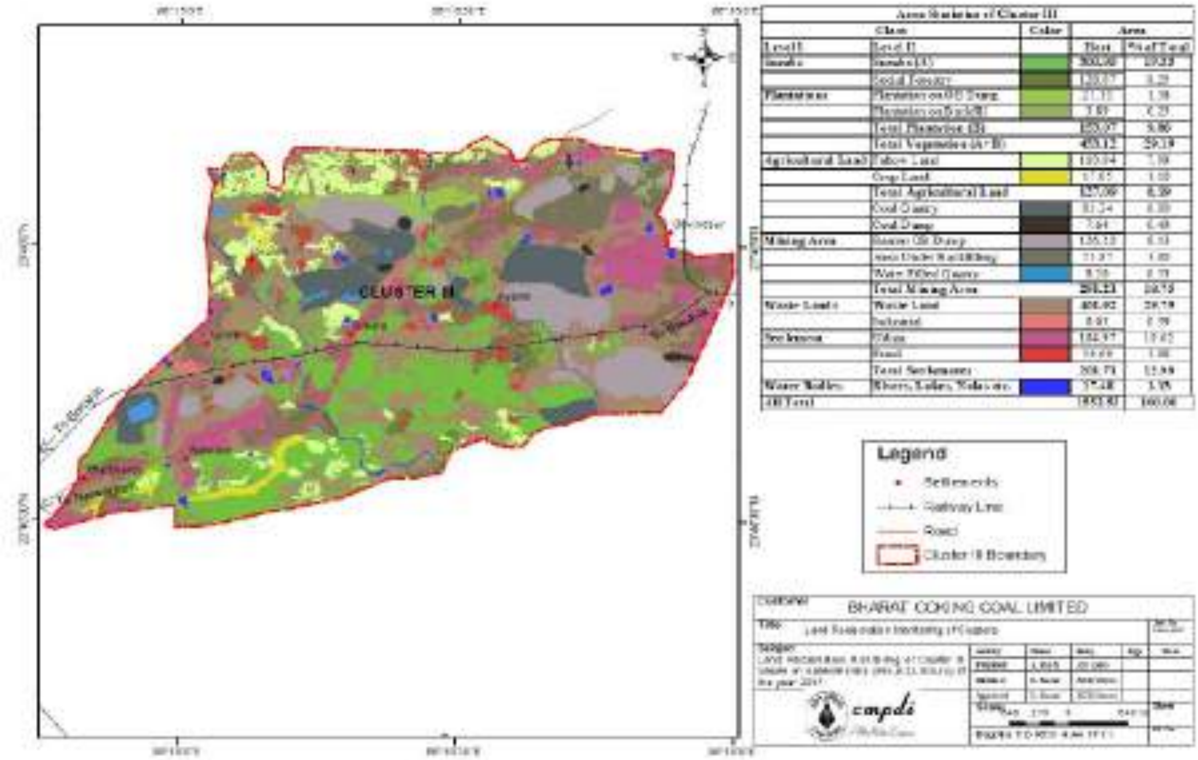
Monitoring stations (**A-12, A-25, A-29, B-14 and B-60**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	A12	Jamua	2.60	0.32	0.50	1.20	2.10	0.29	0.45	0.75	1.20	2.80	0.40	1.0
2	A25	Sinidih	2.98	1.30	1.83	2.53	6.08	1.43	1.93	2.48	4.88	6.63	2.88	3.13
3	A29	Dharmaband	6.20	1.21	3.20	3.25	4.85	1.20	3.40	3.65	3.25	6.45	2.86	2.10
4	B14	Mathadih	2.44	0.32	1.04	1.69	2.24	0.54	0.94	2.04	1.69	3.64	1.22	2.84
5	B60	Sonardih	10.33	0.91	3.21	6.13	8.13	1.23	3.23	4.93	8.21	13.68	3.13	4.23
Average WL (bgl)			4.91	0.81	1.96	2.96	4.68	0.94	1.99	2.77	3.85	6.64	2.12	2.64

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.10 m Max – 13.68 m
Post-monsoon GW Level (m): Min – 0.45 m Max – 4.23 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	580.21×10^4	580.21×10^4	580.21×10^4
2	Open Land	770.61×10^4	770.61×10^4	770.61×10^4
3	Road/ Paved Area	164.97×10^4	164.97×10^4	164.97×10^4
4	Rooftop area of building/ sheds	36.74×10^4	36.74×10^4	36.74×10^4
5	Total	1552.53×10^4	1552.53×10^4	1552.53×10^4

D. GROUND WATER LEVEL OF CLUSTER-IV

Cluster-IV consists of six mines namely, Amalgamated Keshalpur & West Mudidih colliery, Amalgamated Angarpathra & Ramkanali colliery, Katras-Choitudih Colliery, Salanpur colliery and Gaslitand colliery of Katras area, BCCL. It is located in the north-central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out more than 30 years considering annual target production of 9.55 MTPA (Toposheet no – 73 I/5).

The present leasehold area of Cluster-IV is 1123.79 Ha. The area has a general undulating topography, with an overall gentle south-westerly slope. The RL varies from 182 m to 216 m AMSL. Katri River, Kumari Jore and its tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Katri River.

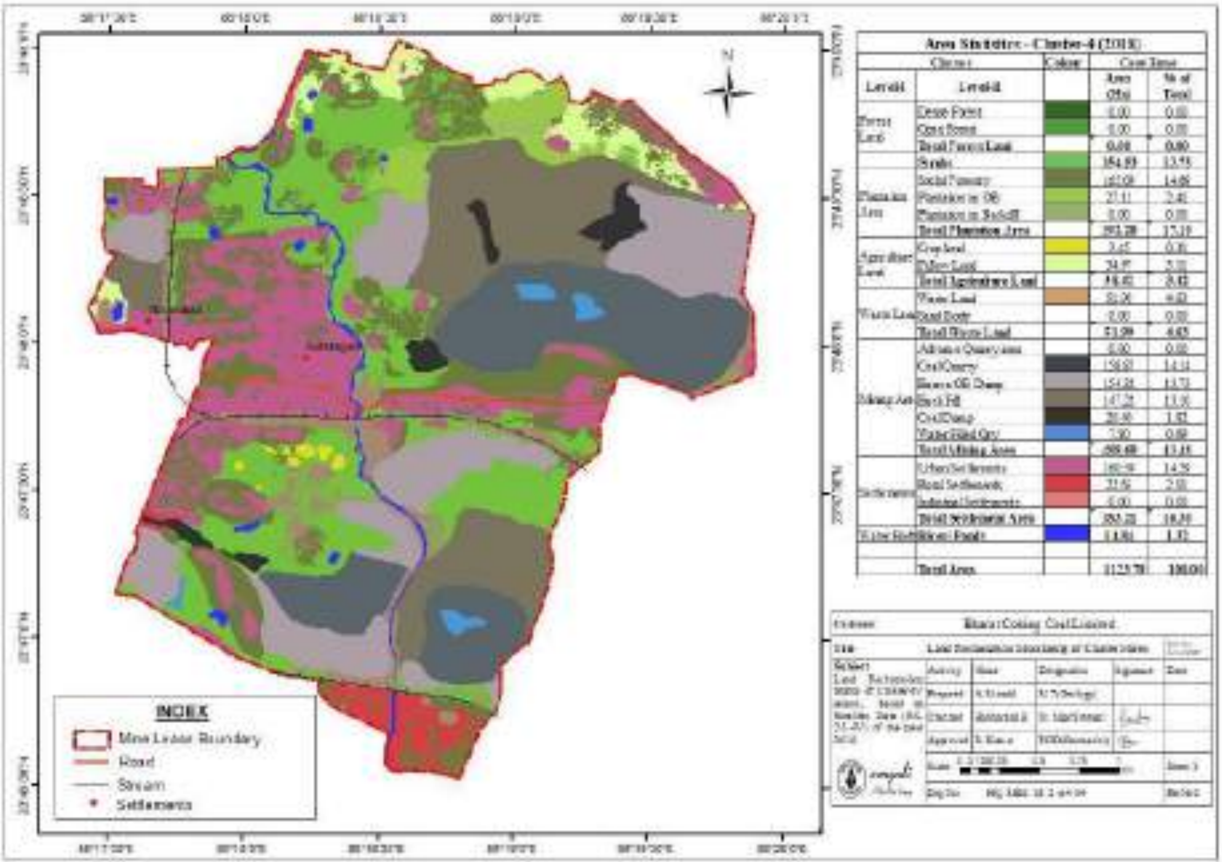
Monitoring stations (**A-26, A28A, B-64 and B-65A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	A-26	Malkhera	6.98	2.69	3.18	4.78	6.58	2.23	3.33	3.83	4.75	6.23	3.58	3.88
2	A28A	Lakarka	4.00	1.33	3.03	3.35	2.45	1.25	3.15	3.60	2.22	4.15	2.00	2.51
3	B-64	Keshalpur	1.85	0.93	0.50	1.37	0.95	0.30	0.45	1.20	1.42	2.15	0.55	1.85
4	B65A	Jhinjipahari	9.25	0.03	2.30	4.10	11.05	1.85	0.95	2.95	4.18	10.03	2.10	2.40
Average WL (bgl)			5.52	1.25	2.25	3.40	5.26	1.41	1.97	2.90	3.14	5.64	2.16	2.66

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 0.95 m Max – 11.05 m
Post-monsoon GW Level (m): Min – 0.45 m Max – 3.88 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	385.15×10^4	385.15×10^4	385.15×10^4
2	Open Land	555.43×10^4	555.43×10^4	555.43×10^4
3	Road/ Paved Area	160.59×10^4	160.59×10^4	160.59×10^4
4	Rooftop area of building/ sheds	22.63×10^4	22.63×10^4	22.63×10^4
5	Total	1123.79×10^4	1123.79×10^4	1123.79×10^4

E. GROUND WATER LEVEL OF CLUSTER-V

Cluster-V consists of twelve mines namely; Tetulmari OC & UG mines, Mudidih OC & UG mines, Nichitpur OC mine, Sendra Bansjore OC & UG mines, Bansdeopur OCP (proposed) & UG Mines, Kankanee OC & UG mines and Loyabad UG mine (closed) of Sijua area, BCCL. This Cluster of mines is located in northern part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out more than 30 years considering annual target production of 6.311 MTPA (Toposheet no – 73 I/6).

The present leasehold area of Cluster-V is 1724.52 Ha. The area has a general undulating topography, with an overall gentle south westerly slope. The RL varies from 210 m to 170 m AMSL. Jarian Nala, Nagri Jore, Ekra Jore and its tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Jarian Nala and Ekra Jore.

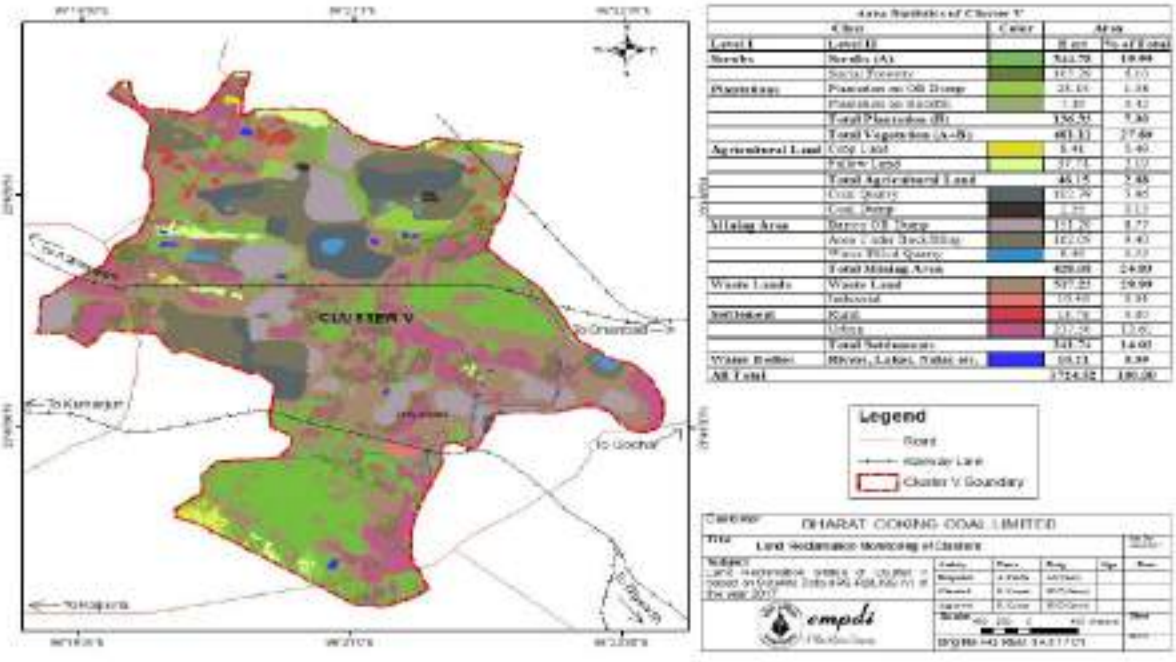
Monitoring stations (**A-3, A-16, A-27 and D-23**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	A-3	Sijua	1.57	0.02	0.47	0.77	3.47	0.32	0.47	0.62	0.77	1.27	0.37	0.47
2	A-16	Ekra	7.15	1.34	1.75	3.20	5.45	1.65	1.95	4.55	2.60	4.30	2.05	3.65
3	A-27	Tetulmari	2.40	0.03	1.10	1.90	2.40	0.15	0.92	1.30	1.90	2.90	1.49	1.00
4	D-23	Jogta	5.60	1.69	3.35	3.70	4.70	1.65	1.40	1.50	2.70	4.40	2.60	3.40
Average WL (bgl)			4.18	0.77	1.67	2.39	4.01	0.94	1.19	1.99	1.99	3.22	1.63	2.13

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.27 m Max – 5.60 m
Post-monsoon GW Level (m): Min – 0.47 m Max – 3.65 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	527.26×10^4	527.26×10^4	527.26×10^4
2	Open Land	973.52×10^4	973.52×10^4	973.52×10^4
3	Road/ Paved Area	217.50×10^4	217.50×10^4	217.50×10^4
4	Rooftop area of building/ sheds	24.24×10^4	24.24×10^4	24.24×10^4
5	Total	1724.52×10^4	1724.52×10^4	1724.52×10^4

F. GROUND WATER LEVEL OF CLUSTER-VI

Cluster–VI consists of four coal mines; East Bassuriya opencast (OC), Bassuriya underground (UG), Gondudih Khas-Kusunda OC and Godhur Mixed Mines (OC and UG) of BCCL. This Cluster of mines is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out more than 30 years considering annual target production of 7.631 MTPA (Toposheet no – 73 I/6).

The present leasehold area of Cluster-VI is 831.83 Ha. The area has a general undulating topography with general slope towards south. The RL varies from 180 m to 240 m AMSL. Ekra Jore, Kari Jore and their tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Ekra Jore and Kari Jore.

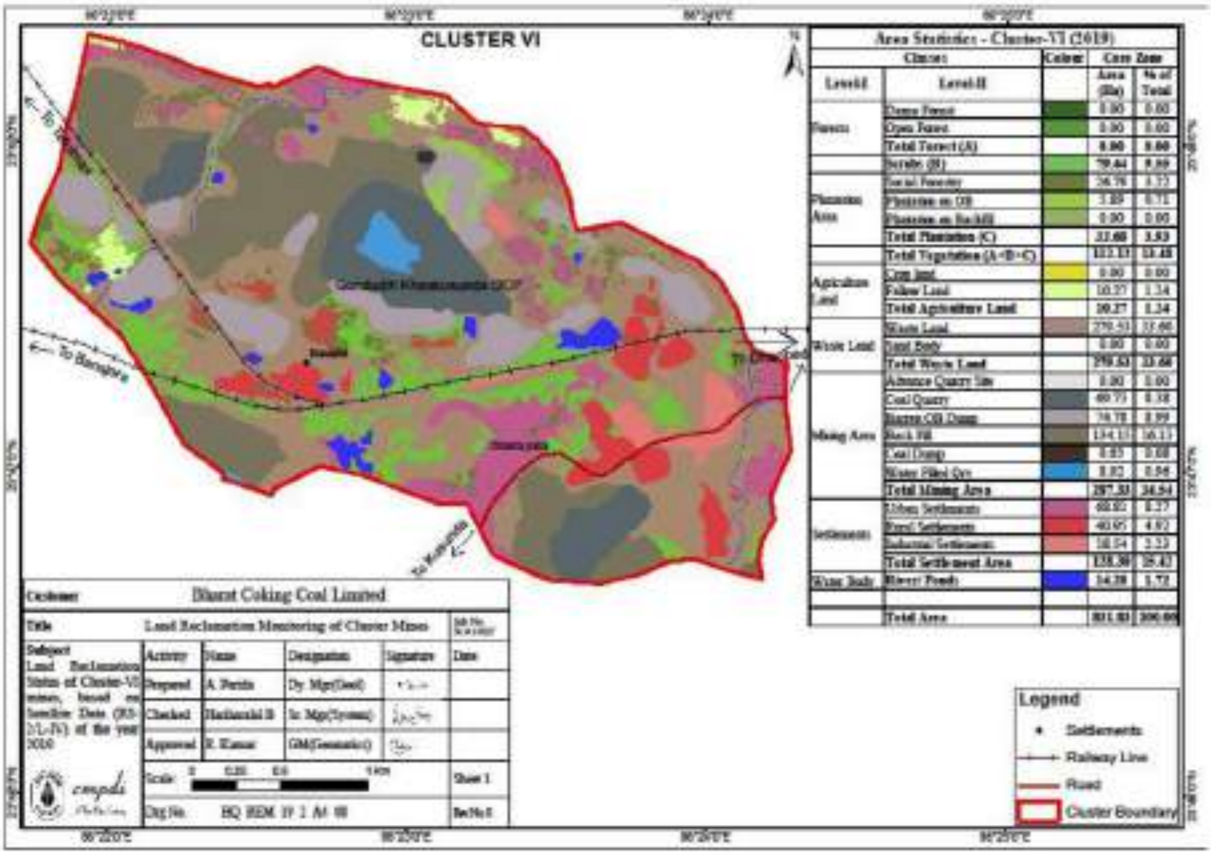
Monitoring stations (**D-25 and D-30**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	D25	Godhur	10.50	2.28	5.62	6.40	9.90	4.35	5.38	5.50	0.50	2.60	0.60	2.40
2	D30	Borkiboa	4.50	1.65	1.35	2.40	4.60	0.38	0.75	1.95	2.60	4.58	1.00	1.10
Average WL (bgl)			7.50	1.97	3.49	4.40	**7.25**	**2.37**	**3.07**	**3.73**	***1.55***	***3.59***	***0.80***	***1.75***

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.60 m Max – 10.50 m
Post-monsoon GW Level (m): Min – 0.75 m Max – 5.62 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	122.39×10^4	122.39×10^4	122.39×10^4
2	Open Land	581.14×10^4	581.14×10^4	581.14×10^4
3	Road/ Paved Area	68.81×10^4	68.81×10^4	68.81×10^4
4	Rooftop area of building/ sheds	59.49×10^4	59.49×10^4	59.49×10^4
5	Total	831.83×10^4	831.83×10^4	831.83×10^4

G. GROUND WATER LEVEL OF CLUSTER-VII

Cluster-VII consists of fourteen mines namely; Kusunda Area, Bastacolla Area and PB Area B.C.C.L (Jharia Coalfield) is located in Dhanbad district of Jharkhand. Cluster–VII consists of coal mines; Dhansar UG, Dhansar OCP, Kusunda OCP and Viswakarma OCP (proposed) are under the administrative control of Kusunda Area and Industry UG (closed), Alkusa UG, Ena OCP, S.Jharia/Rajapur OCP, Burragarh UG, Simlabahal UG, Hurriladih UG, Bhutgoria UG (Re-opening), Kustore UG (closed) and E.Bhuggatdih UG (closed) are under Bastacolla and PB Area of BCCL. This Cluster of mines is located in east central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out more than 30 years considering annual target production of 8.226 MTPA (Toposheet no – 73 I/6).

The present leasehold area of Cluster-VII is 2127.70 Ha. The area has a general undulating topography with general slope towards south. The RL varies from 172 m to 221 m above M.S.L. Kari Jore, Chatkari Jore and its tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Kari Jore and Chatkari Jore.

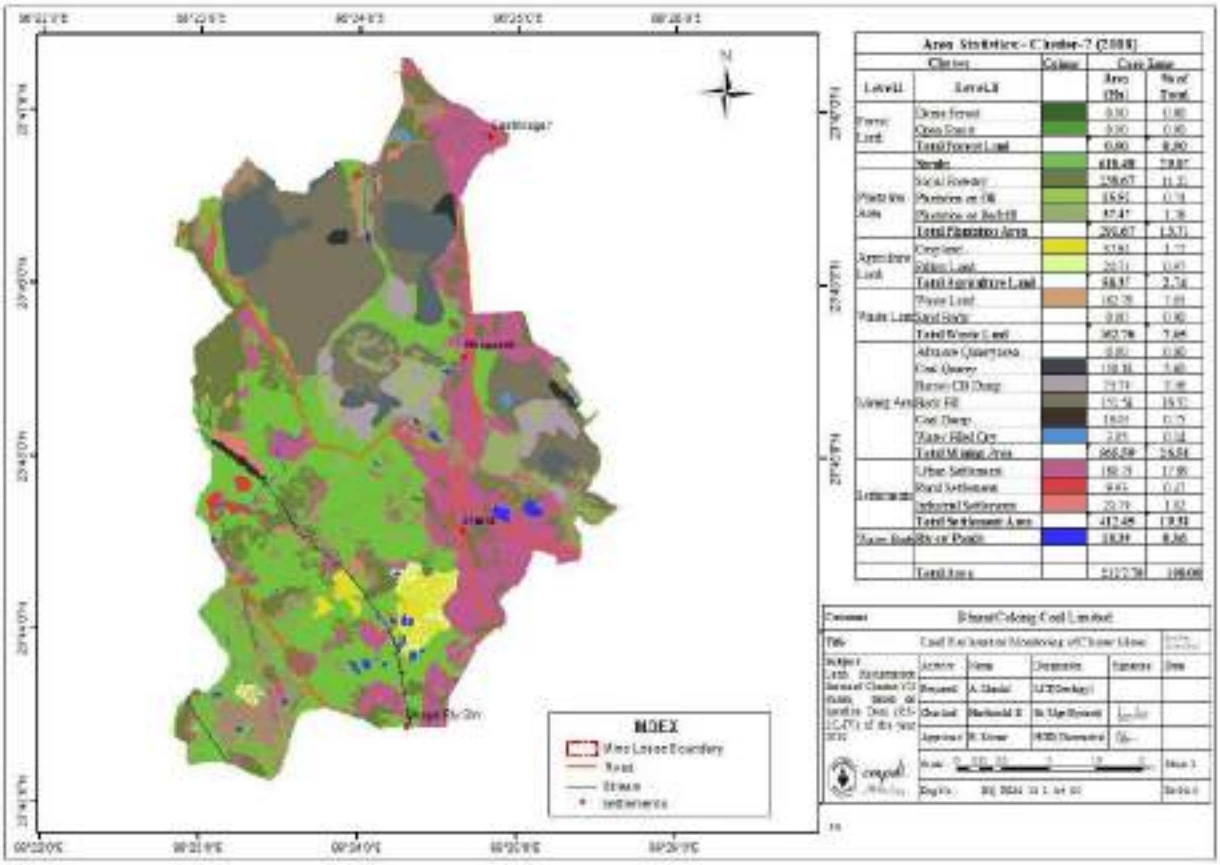
Monitoring stations (**D-3, D-4, D-33, D-34**, **D-47, D-55 and D-80**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	D-3	Dhansar	5.40	0.56	1.38	1.90	1.75	1.05	1.30	1.45	1.65	3.43	1.50	2.45
2	D-4	Jharia	3.41	0.51	1.41	2.26	2.81	1.16	1.71	2.16	1.21	1.91	0.91	1.56
3	D33	Kustore	3.65	0.48	1.45	1.80	2.35	0.25	1.65	2.35	0.55	2.85	0.55	0.95
4	D34	Kusunda	3.30	2.00	2.80	2.95	4.75	2.10	2.40	2.55	0.60	2.80	0.45	0.70
5	D47	Parastanr	9.45	3.41	5.45	5.83	4.55	1.90	4.35	4.20	3.55	5.33	2.55	3.65
6	D55	Hariladih	9.42	3.88	8.60	8.62	8.42	2.97	5.47	8.62	4.42	8.42	1.57	4.02
7	D80	Bastacolla	4.30	2.08	4.90	5.00	5.00	2.30	3.05	3.80	4.35	9.35	3.28	4.20
Average WL (bgl)			5.56	1.85	3.71	4.05	4.23	1.68	2.85	3.59	2.33	4.87	1.54	2.50

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.75 m   Max – 9.45 m
Post-monsoon GW Level (m): Min – 0.70 m   Max – 8.60 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	968.53×10^4	968.53×10^4	968.53×10^4
2	Open Land	746.72×10^4	746.72×10^4	746.72×10^4
3	Road/ Paved Area	380.73×10^4	380.73×10^4	380.73×10^4
4	Rooftop area of building/ sheds	31.71×10^4	31.71×10^4	31.71×10^4
5	Total	2127.70×10^4	2127.70×10^4	2127.70×10^4

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.

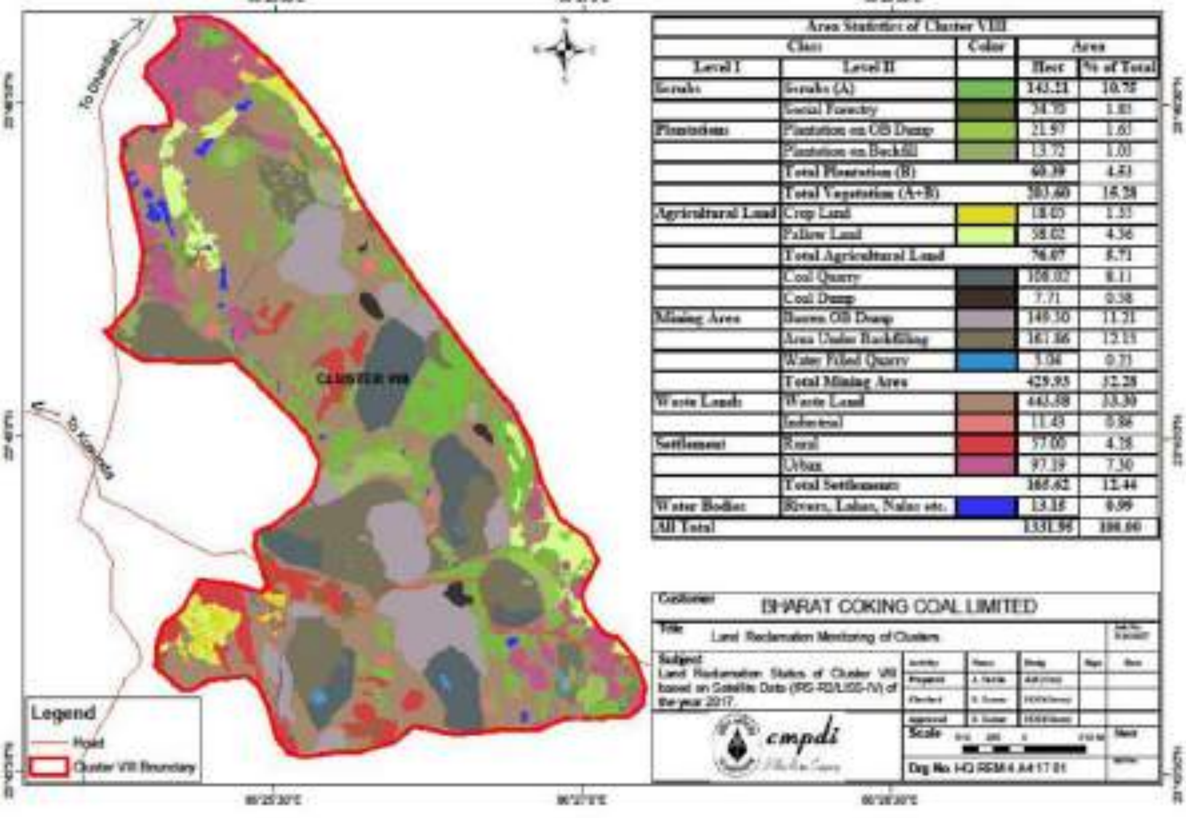
Monitoring stations (**D-8, D-43, D-49 and D-51**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	D-8	Alokdiha	5.83	1.70	2.75	3.20	4.80	1.95	2.85	4.25	3.20	5.65	1.65	1.85
2	D43	Alagdih	6.60	2.31	2.55	3.05	7.35	3.55	2.70	4.25	3.05	7.15	2.90	3.45
3	D49	Galucdih	3.25	1.41	1.65	1.98	1.75	0.60	1.50	1.25	1.98	3.45	1.45	2.45
4	D51	Chankuiya	8.45	6.03	5.70	7.35	9.95	8.05	5.75	7.75	8.26	10.93	4.80	7.10
Average WL (bgl)			6.03	2.86	3.16	3.90	5.96	3.54	3.20	4.38	4.12	6.80	2.70	3.71

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.75 m Max – 10.93 m
Post-monsoon GW Level (m): Min – 1.50 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	279.69×10^4	279.69×10^4	279.69×10^4
2	Open Land	886.66×10^4	886.66×10^4	886.66×10^4
3	Road/ Paved Area	97.19×10^4	97.19×10^4	97.19×10^4
4	Rooftop area of building/ sheds	68.43×10^4	68.43×10^4	68.43×10^4
5	Total	1331.95×10^4	1331.95×10^4	1331.95×10^4

I. GROUND WATER LEVEL OF CLUSTER-IX

Cluster - IX of B.C.C.L mines under administrative control of Lodna Area of B.C.C.L (Jharia Coalfield) is located in Dhanbad district of Jharkhand. Cluster- IX consists of eight mines namely; North Tisra/South Tisra OCP, Jeenagora OCP, North Tisra UG, Lodna UG, Bagdigi UG, Bararee UG, Joyrampur UG and Jealgora UG (closed) are under the administrative control of Lodna Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). Among them N. Tisra/S. Tisra OCP, Jeenagora OCP and N. Tisra UG mine will be amalgamated and will formed North Tisra/South Tisra Expansion OCP. North Tisra/South Tisra Expansion OCP, Lodna UG, Bagdigi UG, Bararee UG and Joyrampur UG are under Lodna 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 30 years considering annual target production of 8.513 MTPA (toposheet no. 73 I/6).

The present leasehold area of Cluster-IX is 1967.22 Ha. The topography of the area is undulating with gentle slope towards south. The RL varies from 221 m to 188.44 m AMSL. Chatkari Jore, Tisra Jore, Sulunga Jore and its tributaries controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

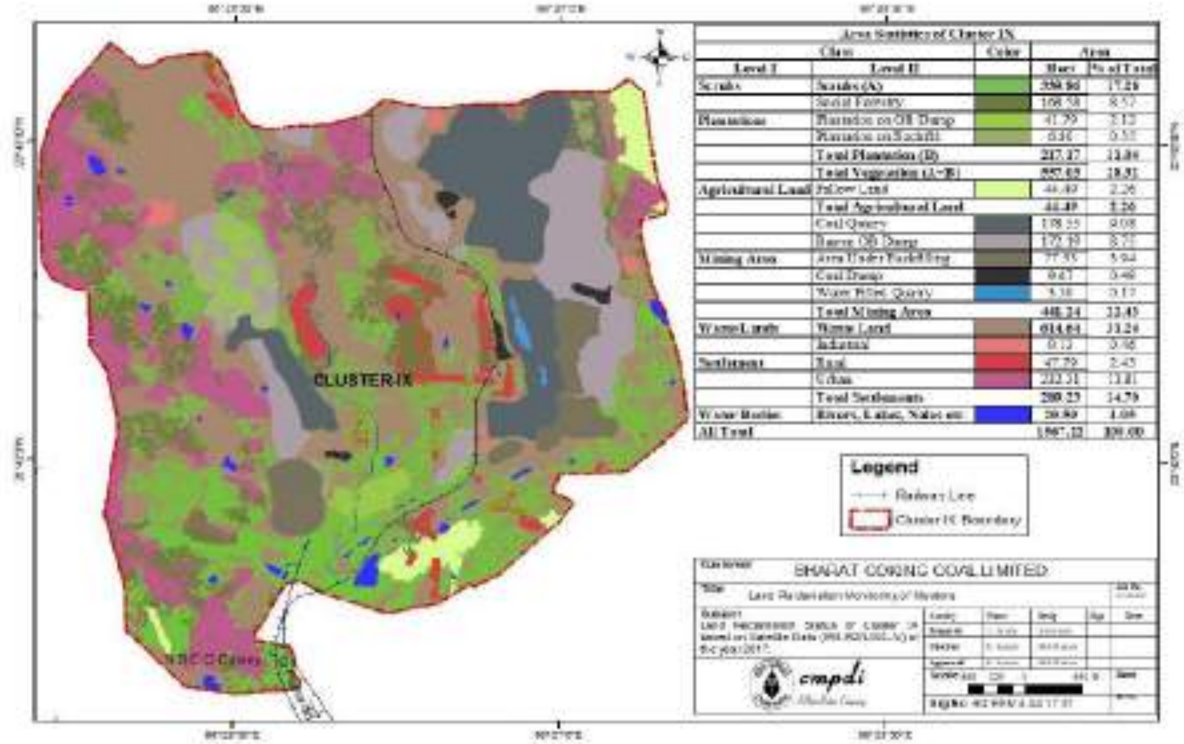
Monitoring stations (**D-5, D-7, D-39, D-40A, D-41 and D-74**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	D-5	Jiyalgora	8.60	3.20	7.70	7.90	8.25	2.90	4.85	8.20	5.80	7.80	4.39	5.30
2	D-7	Golden Pahari	7.33	2.56	5.13	5.35	8.23	1.88	3.28	4.86	5.15	7.53	2.23	2.83
3	D-39	Tilaboni	9.40	3.35	6.05	6.78	12.60	4.00	5.95	12.45	3.18	4.95	2.50	4.35
4	D40A	Khapa Dhawra	1.95	0.30	1.43	6.78	1.85	1.50	1.45	1.95	1.70	2.10	1.10	1.40
5	D-41	Joyrampur	3.30	1.43	1.45	1.80	2.30	0.70	1.25	1.40	1.30	1.59	1.08	1.32
6	D-74	Bhulan Bararee	4.30	2.58	3.93	4.00	5.80	2.35	3.57	4.95	5.80	8.60	3.40	4.80
Average WL (bgl)			5.81	2.24	4.28	4.54	6.51	2.22	3.39	5.64	3.82	5.43	2.45	3.33

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.59 m Max – 12.60 m
Post-monsoon GW Level (m): Min – 1.25 m Max – 7.70 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	601.52×10^4	601.52×10^4	601.52×10^4
2	Open Land	1076.47×10^4	1076.47×10^4	1076.47×10^4
3	Road/ Paved Area	232.31×10^4	232.31×10^4	232.31×10^4
4	Rooftop area of building/ sheds	56.92×10^4	56.92×10^4	56.92×10^4
5	Total	1967.22×10^4	1967.22×10^4	1967.22×10^4

J. GROUND WATER LEVEL OF CLUSTER-X

Cluster-X consists of Bhowrah North OC & UG, Bhowrah South OC & UG, Amalgamated Sudamdih Patherdih, Sudamdih Shaft, Amlabad UG (Closed) and Sudamdih Coal Washery comes under the administrative control of Eastern Jharia Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). This cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out is more than 30 years considering annual target production of 2.289 MTY.
Cluster-X mine involves leasehold area of about 2057.47 Ha of land. It covered in Survey of India toposheet no. 73 I/6. The area of Bhowrah North OC & UG, Bhowrah South OC & UG, Amalgamated Sudamdih Patherdih, Sudamdih Shaft, Amlabad UG (Closed) are 280.83 Ha, 571.58 Ha, 498.61 Ha, 391.50 Ha and 386.95 Ha respectively.

The present leasehold area of Cluster-X is 2057.47 Ha. The area has an undulating topography with gentle slope towards south and south east. The RL varies from 185 m to 150.0 m AMSL. Gaurkuthi Nala and few seasonal streams are controlling the drainage pattern of the area. The area comes under the watershed of Damodar River.

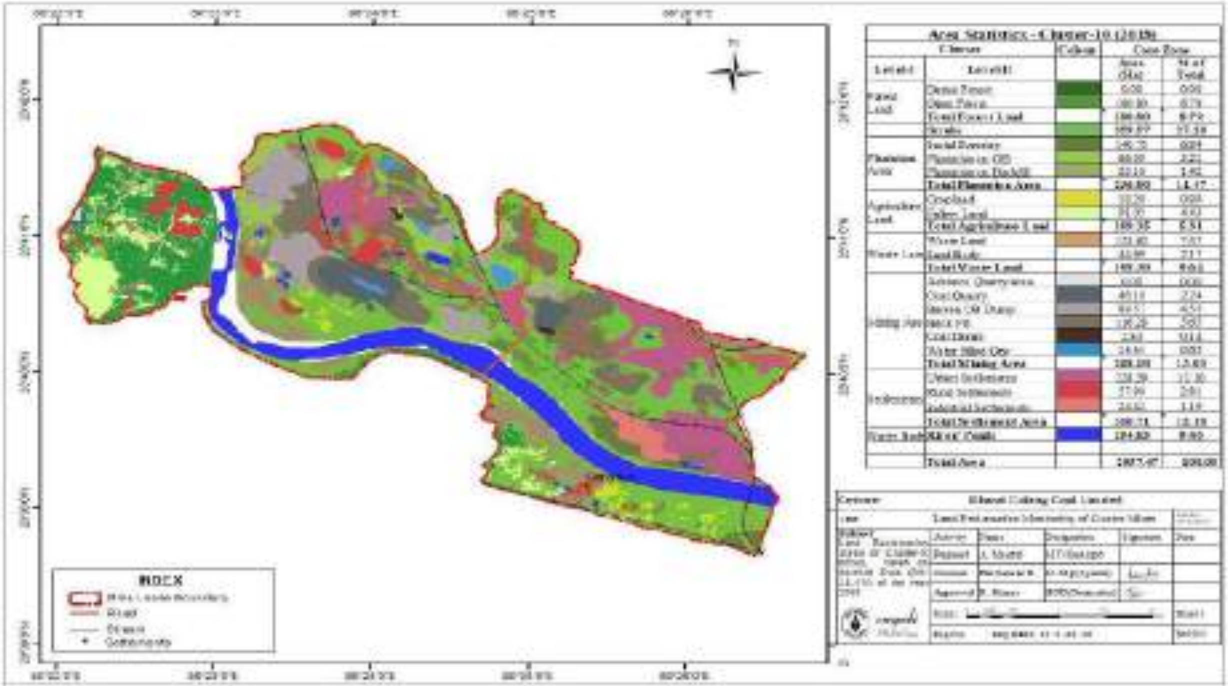
Monitoring stations (**A-19, D-35, D-36 and D-77**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	A-19	Bhowrah	6.05	2.30	3.25	3.70	4.85	0.95	3.43	4.95	2.95	5.55	1.85	2.45
2	D-35	Patherdih	8.20	2.98	5.40	5.62	8.00	3.15	3.80	5.90	6.58	8.40	3.58	4.45
3	D-36	Sudamdih	2.10	0.06	1.00	1.15	1.20	0.10	0.55	0.65	1.00	1.20	0.45	0.60
4	D-77	Amlabad	6.40	5.90	3.50	4.25	6.40	2.80	3.20	4.50	3.63	6.30	4.00	5.20
Average WL (bgl)			5.69	2.81	3.29	3.68	5.11	1.75	2.75	4.00	3.54	5.36	2.47	3.18

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.20 m Max – 8.40 m
Post-monsoon GW Level (m): Min – 0.55 m Max – 5.40 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	1085.72×10^4	1085.72×10^4	1085.72×10^4
2	Open Land	661.04×10^4	661.04×10^4	661.04×10^4
3	Road/ Paved Area	228.39×10^4	228.39×10^4	228.39×10^4
4	Rooftop area of building/ sheds	82.32×10^4	82.32×10^4	82.32×10^4
5	Total	2057.47×10^4	2057.47×10^4	2057.47×10^4

K. GROUND WATER LEVEL OF CLUSTER-XI

Cluster–XI consists of eight coal mines; Moonidih UG, Gopalichak UG Project, Kachi Balihari 10/12 Pit UG, Pootkee Balihari Project UG, Bhagaband UG, Kendwadih UG (closed), Pootkee UG (closed), Kachi Balihari 5/6 Pit UG (closed) are under the administrative control of Western Jharia Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). The Cluster- XI is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out about upto 50 years considering annual target production of 6.604 MTPA (toposheet no. no. 73 I/5 7 73 I/6).

The present leasehold area of Cluster-XI is 3527.58 Ha. The area has an undulating topography with gentle slope towards south. The RL varies from 201 m to 166 m AMSL. Katri River, Jarian Nala, Ekra Jore and Kari Jore are controlling the drainage of the area. The area comes under the watershed of Katri River and Kari Jore.

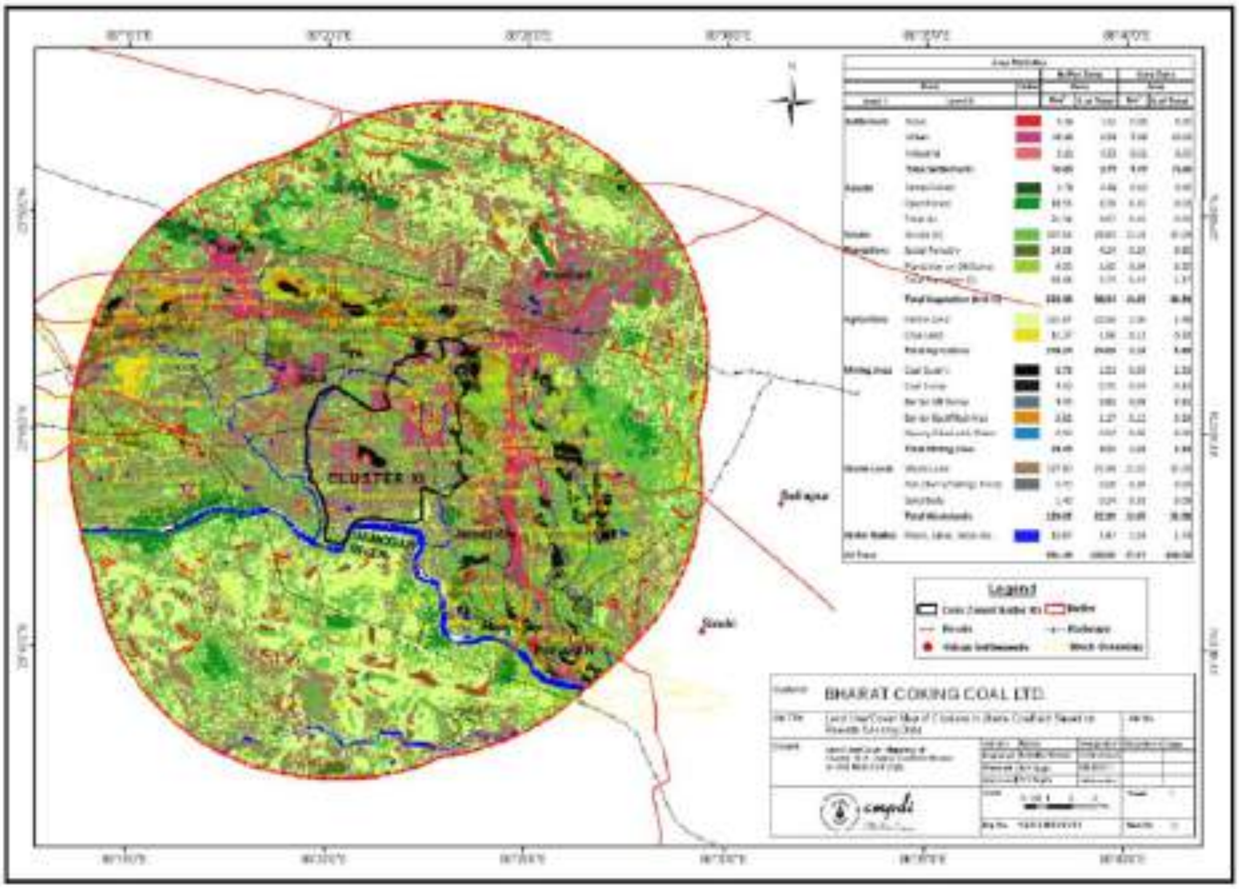
Monitoring stations (**A-17, A-18, A-20 and A-32**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	A-17	Kachi Balihari	2.14	0.64	1.69	1.79	2.94	0.34	2.24	2.42	2.07	3.34	1.64	2.84
2	A-18	Baghaband	1.09	0.39	0.34	0.89	2.29	1.09	0.69	1.09	0.89	1.24	1.34	0.99
3	A-20	Gorbudih	8.47	1.44	3.87	4.42	4.57	3.32	1.82	4.02	3.59	4.57	1.92	2.57
4	A-32	Baludih	1.90	0.36	1.75	1.80	2.75	0.62	0.95	1.65	0.60	2.80	0.45	0.70
Average WL (bgl)			3.40	0.71	1.91	2.23	3.14	1.34	1.43	2.30	2.26	3.20	1.64	2.16

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 0.62 m Max – 8.47 m
Post-monsoon GW Level (m): Min – 0.34 m Max – 3.87 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	1060.61×10^4	1293.46×10^4	1293.46×10^4
2	Open Land	1518.33×10^4	1509.06×10^4	1509.06×10^4
3	Road/ Paved Area	171.08×10^4	171.08×10^4	171.08×10^4
4	Rooftop area of building/ sheds	777.56×10^4	563.06×10^4	563.06×10^4
5	Total	3527.58×10^4	3527.58×10^4	3527.58×10^4

L. GROUND WATER LEVEL OF CLUSTER-XIII

Cluster-XIII, consists of one running mine (Murulidih 20/21 pit UG mine) and six abandoned mines i.e. Bhurungiya colliery, Muchraidih colliery, Hantoodih colliery, Padugora colliery, Murulidih colliery and Bhatdee colliery of Western Jharia area, BCCL is located in the south-western part of Jharia coal field in Dhanbad district of Jharkhand. The area is covered by Survey of India toposheet no. 73 I/6. The life of the project works out about 15 years considering annual target production of 0.234 MTPA.

The present leasehold area of Cluster-XIII is 1898.62 Ha. The area has an undulating topography with gentle slope towards south-east. The maximum RL is 224 m AMSL in the north-western part of the area whereas the minimum RL is 179 m AMSL at southern part. The area comes under the watershed area of Jamunia River and Katri River.

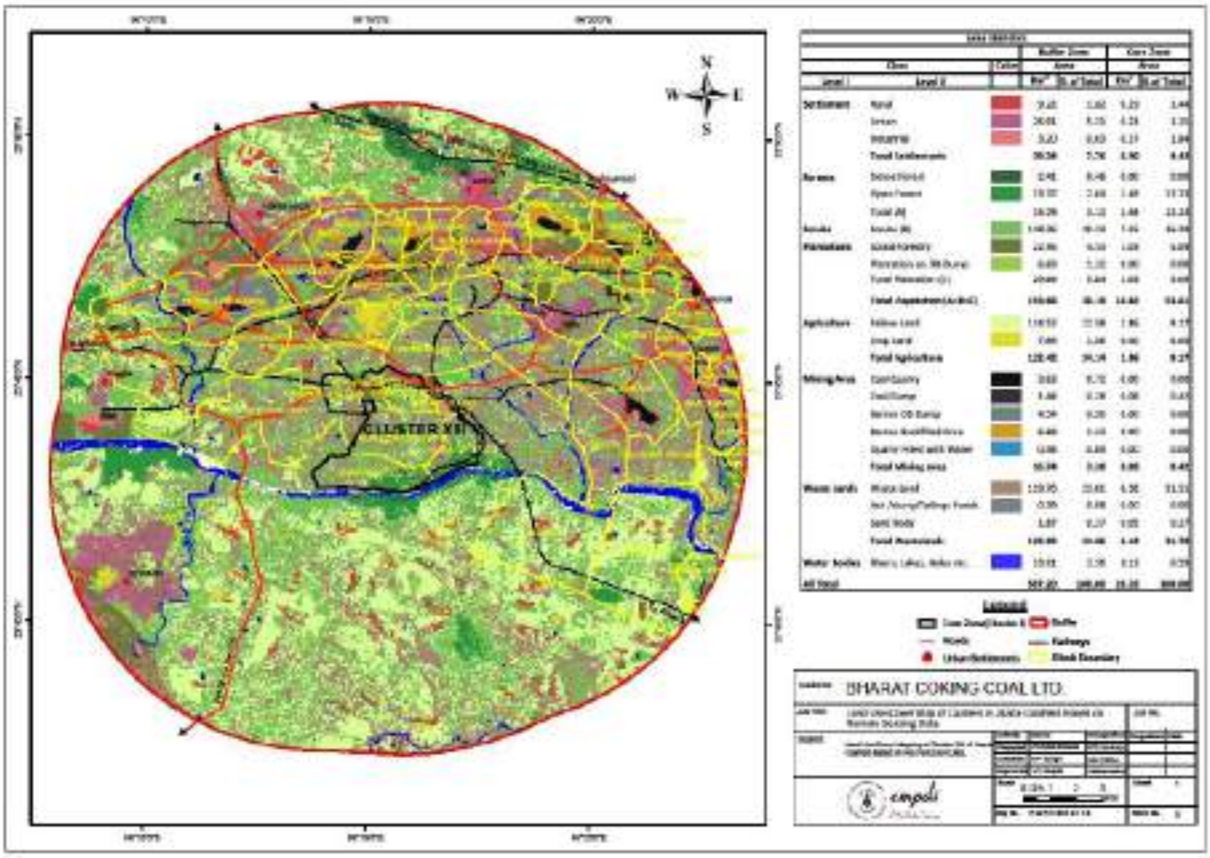
Monitoring stations (**A-22, A-23, A-33, A-34, B-25 and B-48**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	A-22A	Nagdah Basti	2.90	0.20	1.98	2.00	2.60	1.75	2.00	2.85	1.70	3.35	1.10	1.30
2	A-23	Machhayara	8.92	1.12	5.62	7.12	11.97	5.37	3.77	6.57	8.92	11.15	6.46	7.17
3	A-33	Mahuda Washery	4.55	0.38	1.85	2.85	3.65	0.55	1.25	1.55	2.24	4.07	1.26	2.35
4	A-34	Mahuda Mosque	8.35	3.43	3.45	5.35	6.35	3.45	3.95	5.45	5.32	9.45	4.75	5.35
5	B-25	Mahuda More	7.90	3.02	2.55	3.45	4.80	1.38	1.40	3.50	3.68	5.90	2.90	3.70
6	B-48	Mahuda	8.20	3.37	3.85	4.51	7.05	2.85	4.35	5.45	3.55	7.33	2.95	3.97
Average WL (bgl)			6.80	1.92	3.22	4.21	6.07	2.56	2.79	4.23	4.24	6.88	3.24	3.97

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.60 m Max – 11.15 m
Post-monsoon GW Level (m): Min – 1.25 m Max – 5.62 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	1484.41×10^4	1570.48×10^4	1570.48×10^4
2	Open Land	183.28×10^4	97.22×10^4	97.22×10^4
3	Road/ Paved Area	71.84×10^4	71.83×10^4	71.83×10^4
4	Rooftop area of building/ sheds	159.09×10^4	159.09×10^4	159.09×10^4
5	Total	1898.62×10^4	1898.62×10^4	1898.62×10^4

M. GROUND WATER LEVEL OF CLUSTER-XIV

Cluster-XIV of B.C.C.L mines under administrative control of Western Jharia Area of B.C.C.L (Jharia Coalfield) is located in Dhanbad district of Jharkhand. Lohapatty UG and Lohapatty OC patch (proposed) are under the administrative control of Western Jharia Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). The Cluster- XIV is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out upto 08 years considering annual target production of 0.526 MTPA. Cluster-XIV mine involves leasehold area of about 1418.25 Ha of land. It covered in Survey of India toposheet no. 73 I/2.

The present leasehold area of Cluster-XIV is 1418.25 Ha. The topography of the area is undulating with slope towards south west. The maximum RL is 224 m in the north-eastern part whereas the minimum RL is 170 m above mean sea level on the south-western part of the area. Jamunia River and its tributaries are controlling the drainage of the area. The area comes under the watershed area of Jamunia River.

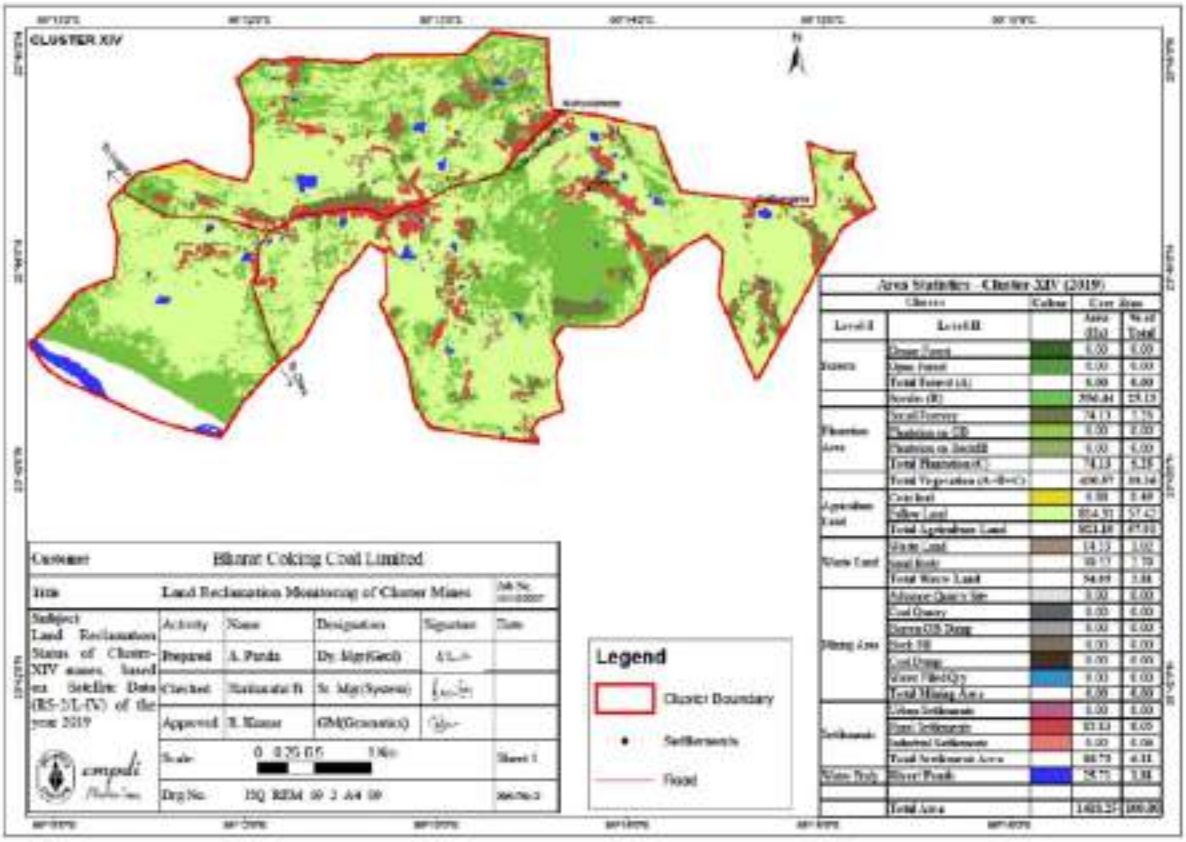
Monitoring stations (**B-23, B-24 and B-67**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	B-23	Lohapatti	3.24	0.77	1.76	2.69	2.84	1.12	1.34	2.24	3.04	6.64	1.74	2.14
2	B-24	Telmuchu	5.48	1.13	3.53	4.38	4.58	1.23	2.33	3.63	6.43	9.28	3.31	4.33
3	B-67	Simatanr	7.55	1.83	3.95	5.90	8.57	3.37	4.35	4.65	6.50	9.55	3.60	4.00
Average WL (bgl)			5.42	1.24	3.08	4.32	5.33	1.91	2.67	3.51	5.32	8.49	2.88	3.49

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.84 m   Max – 9.55 m
Post-monsoon GW Level (m): Min – 1.34 m   Max – 4.35 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	1251.76×10^4	1251.76×10^4	1251.76×10^4
2	Open Land	79.76×10^4	79.76×10^4	79.76×10^4
3	Road/ Paved Area	85.83×10^4	85.83×10^4	85.83×10^4
4	Rooftop area of building/ sheds	0.90×10^4	0.90×10^4	0.90×10^4
5	Total	1418.25×10^4	1418.25×10^4	1418.25×10^4

N. GROUND WATER LEVEL OF CLUSTER-XV

Cluster - XV of B.C.C.L mines under administrative control of Govindpur Area and barora Area of B.C.C.L (Jharia Coalfield) is located in Dhanbad district of Jharkhand. Cluster–XV consists of four coal mines; Kharkharee UG (underground mine) and Dharmaband UG are under the administrative control of Govindpur Area and Madhuband UG & Phularitand UG are under the administrative control of Barora Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). The Cluster-XV is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out upto 30 years considering annual target production of 0.423 MTPA. Cluster-XV mine involves leasehold area of about 1696.55 Ha of land. It covered in Survey of India toposheet no. 73 I/1 and 73 I/5.

The present leasehold area of Cluster-XV is 1696.55 Ha. The topography of the area is undulating with slope towards south-west. The maximum RL is 235 m in the Kharkharee mine area whereas the minimum RL is 165 m AMSL on the eastern & western part of the Cluster. Jamunia River and Khudia River are controlling the drainage of the area. The area comes under the watershed area of both Jamunia River and Khudia River.

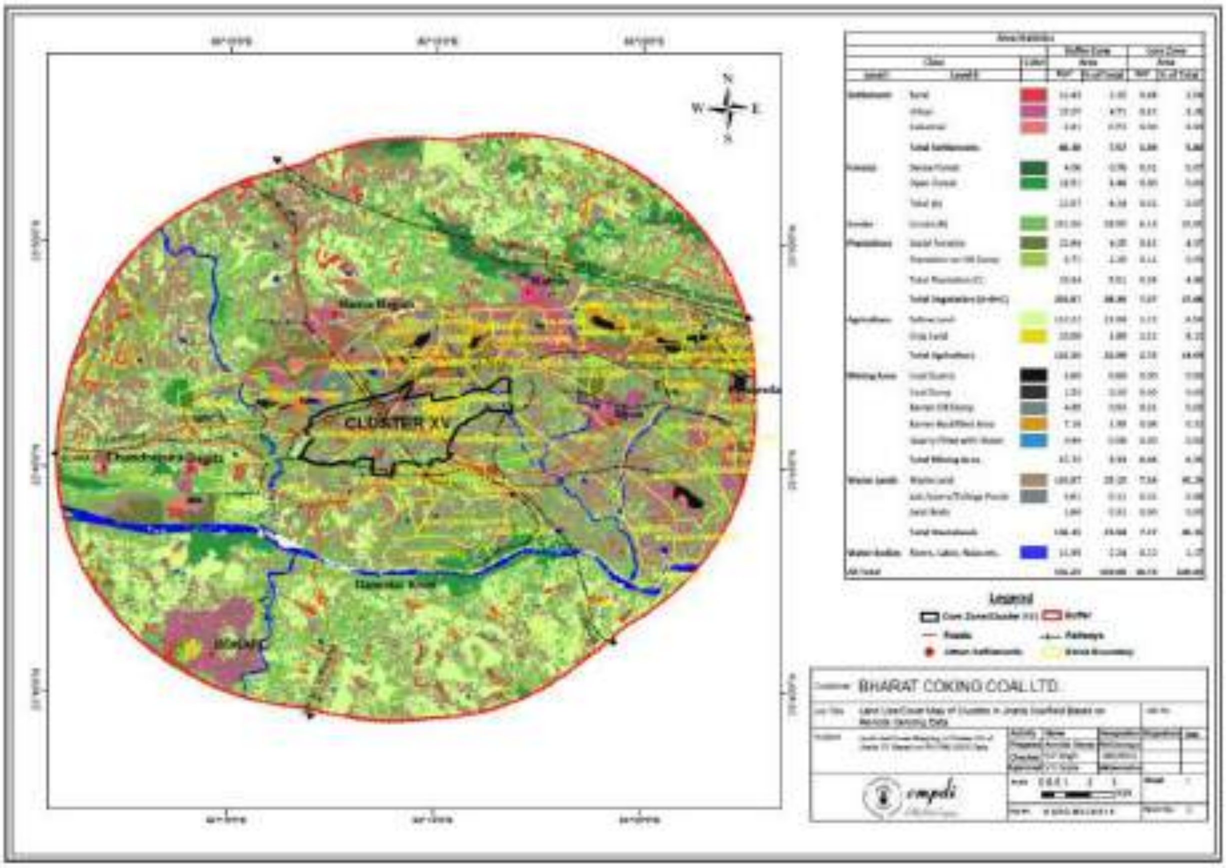
Monitoring stations (**A-24, B-32A and B-61A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	A24	Pipratanr	4.88	-	4.28	4.68	15.88	1.73	2.48	4.08	11.68	14.58	5.78	6.88
2	B32A	Madhuband	3.30	1.18	2.00	2.21	5.55	1.25	1.70	2.35	3.23	6.75	2.80	3.90
3	B61A	Kesargora	3.32	0.85	1.60	2.07	3.35	1.39	0.52	1.12	1.27	2.57	2.0	2.02
Average WL (bgl)			3.83	1.02	2.63	2.99	8.25	1.46	1.57	2.52	5.39	7.97	3.63	4.27

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 2.57 m Max – 15.88 m
Post-monsoon GW Level (m): Min – 0.52 m Max – 6.88 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	365.18×10^4	957.34×10^4	957.34×10^4
2	Open Land	1130.53×10^4	538.37×10^4	538.37×10^4
3	Road/ Paved Area	101.67×10^4	101.67×10^4	101.67×10^4
4	Rooftop area of building/ sheds	99.17×10^4	99.17×10^4	99.17×10^4
5	Total	1696.55×10^4	1696.55×10^4	1696.55×10^4

O. GROUN D WATER LEVEL OF CLUSTER-XVI

Cluster - XVI of B.C.C.L mines under administrative control of Chanch Victoria Area of B.C.C.L (Raniganj Coalfield) is located in Dhanbad district of Jharkhand. The Cluster-XVI (Dahibari-Basantimata Group of mines) is located on the western part of the Raniganj Coalfield and falls within Dhanbad district of Jharkhand. There are total five collieries within this Clusture- XVI (Dahibari-Basantimata OC, Basantimata UG, New Laikdih OC, Laikdih Deep UG and Chanch UG Colliery). 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 24 years considering annual target production of 1.963 MTPA. Cluster-XVI mine involves leasehold area of about 2008.40 Ha of land. It covered in Survey of India toposheet no. 73 I/14.

The present leasehold area of Cluster-XVI is 2008.40 Ha. The topography of the area is undulating with slope towards south west. The area is plain with gently undulating with elevation varying from 100 m to 140 m AMSL. The general slope of the area is towards southeast. Barakar River and Khudia River are controlling the drainage of the area. The area comes under the watershed area of Barakar River.

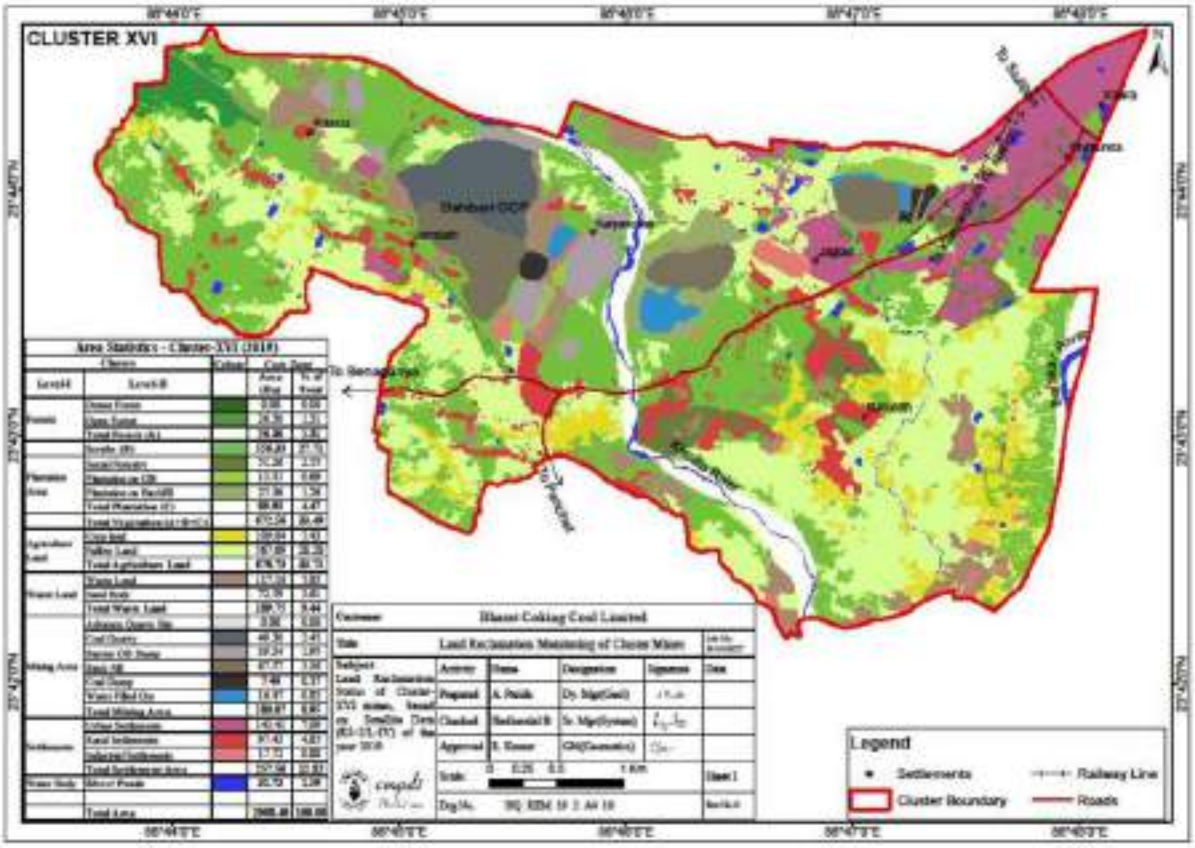
Monitoring stations (**DB-22, DB-23, DB-24 & DB-25**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'20, August'20, and Nov'20 and January'21, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2020-21				2019-20				2018-19			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	Feb	May	Aug	Nov
1	DB22	Dahibari, Niche Basti	2.63	1.30	2.25	2.38	4.93	1.38	1.63	1.73	1.98	2.34	1.35	1.93
2	DB23	Dahibari OC	2.50	0.70	1.95	2.17	1.60	0.88	0.80	1.00	2.00	2.85	1.20	1.75
3	DB24	Dahibari	3.60	1.57	5.70	5.90	9.35	3.20	3.88	4.80	8.70	8.25	4.43	5.70
4	DB25	Basantimata UG	3.98	1.19	2.63	2.68	-	-	-	-	3.23	3.93	1.41	1.63
Average WL (bgl)			3.18	1.19	3.13	3.28	4.53	1.82	2.10	2.51	3.98	4.34	2.10	2.75

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.60 m Max – 9.35 m
Post-monsoon GW Level (m): Min – 0.80 m Max – 5.70 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	1349.29 x 10^4	1349.29 x 10^4	1349.29 x 10^4
2	Open Land	401.55 x 10^4	401.55 x 10^4	401.55 x 10^4
3	Road/ Paved Area	142.41 x 10^4	142.41 x 10^4	142.41 x 10^4
4	Rooftop area of building/ sheds	115.15 x 10^4	115.15 x 10^4	115.15 x 10^4
5	Total	2008.40 x 10^4	2008.40 x 10^4	2008.40 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'20 & Jan'21)	Avg. Fluctuation (in meters) during 2020-21	Geological Formation
1	I	4 nos.	0.15 to 10.00 m	2.76 m	Barakar
2	II	5 nos.	0.67 to 10.33 m	3.66 m	Barakar
3	III	5 nos.	0.32 to 10.33 m	2.95 m	Barakar
4	IV	4 nos.	0.03 to 9.25 m	3.27 m	Barakar
5	V	4 nos.	0.02 to 5.60 m	2.51 m	Barakar
6	VI	2 nos.	1.65 to 10.50 m	4.02 m	Barakar
7	VII	7 nos.	0.48 to 9.45 m	2.26 m	Barakar
8	VIII	4 nos.	1.41 to 8.45 m	2.87 m	Barakar
9	IX	6 nos.	0.30 to 9.40 m	1.53 m	Barakar
10	X	4 nos.	0.06 to 6.40 m	2.40 m	Barakar
11	XI	4 nos.	0.36 to 8.47 m	1.50 m	Barakar & Barren Measure
12	XIII	6 nos.	0.20 to 8.92 m	3.60 m	Raniganj
13	XIV	3 nos.	0.77 to 7.55 m	2.35 m	Raniganj
14	XV	3 nos.	0.85 to 4.88 m	1.20 m	Barakar & Barren Measure
15	XVI	3 nos.	0.70 to 5.90 m	0.75 m	Barakar

Depth to water level (in bgl) values described that water level goes down to maximum 10.50 m during pre-monsoon'2020 and maximum upto 8.60 m during post-monsoon'2020. 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–VII**. 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 and VII**) are prepared and studied to identify potentially adverse trends so that appropriate action can protect groundwater resource. Hydrograph trend analysis of CGWB monitoring wells and CMPDI observation wells, reveals decline trends in both Pre and Post-monsoon GW level trends (max. upto 0.55 cm/year in Cluster-I, Cluster-V and Cluster-VII) 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'2020 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 7.81 (GW-6) to 8.21 (GW-3), 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 178 (GW-11) to 764 mg/l (GW-5), the TDS values are above the IS 10500 standards of drinking water.

The alkalinity of the water samples varies from 76 (GW-6) to 152 mg/l (GW-11) and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 32 (GW-11) to 180 mg/l (GW-15) and are ***slightly above*** the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 148 (GW-8) to 680 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 38 (GW-8) to 178 mg/l (GW-13) 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.

6.0 STAGE OF GROUNDWATER EXTRACTION

The groundwater mainly utilized for domestic needs and for irrigation purposes. The groundwater abstraction is mainly through dug wells and bore wells. The stage of groundwater development in Dhanbad District is 76.30% (as per 2017 GWRE). The highest stage of development is in Jharia Block (127.0%) & Dhanbad Block (107.50%) and lowest stage of development is in Baliapur Block (78.24%) as per GWRE-2013. The Gondwana sandstones in general, known to constitute good aquifers at many places. However, the yield potential of the area adjoining to active mines in the coal belt is poor. The active mines often act as groundwater "sinks". In contrast, the water logged abandoned mines and pits act as potential sources of groundwater. As per the assessment by Central Ground Water Board (CGWB), Patna in 2017, Block wise data of Dhanbad District given below:

Table–8A: Block wise Stage of Groundwater development

Sl No.	Administrative Unit		Stage of GW Development	Category (GWRE-2013)	Category (GWRE-2017)
	District	**Block**			
1	Bokaro	Bermo	156.30%	**Over- exploited**	**Over- exploited**
2	Dhanbad	Baghmara	91.74%	Critical	Critical
3	Dhanbad	Baliapur	78.24%	Semi- Critical	Semi- Critical
4	Dhanbad	Dhanbad	107.50%	**Over- exploited**	**Over- exploited**
5	Dhanbad	Jharia	127.0%	**Over- exploited**	**Over- exploited**
6	Dhanbad	Topchachi	98.45%	Critical	Critical

- **Dynamic Groundwater Resource Assessment, CGWB as per 2013 & 2017.**

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) 2020		GW level declining trend 2005-2020		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	5.46	2.69	YES	YES	Recharge structure needed
Cluster-II	Baghmara	8350	Jamunia river	6737 (2755+3982)	1613	5.83	2.17	NO	NO	Excess mine water needed to be utilized
Cluster-III	(SOD: Critical)	12760 (10960+1800)	NIL	8946 (7849+1097)	3814	4.91	1.96	NO	NO	
Cluster-IV		5900	MADA	5100 (3605+1495)	800	5.52	2.25	NO	NO	
Cluster-V		12690 (11025+1665)	MADA	11063 (5710+5353)	1897	4.18	1.67	YES	YES	
Cluster-VI	Dhanbad	4150	MADA	4150 (1664+2486)	0.0	7.50	3.49	YES	NO	--
Cluster-VII	(SOD: Over-exploited)	21565	MADA	20826 (17596+3230)	739	5.56	3.71	YES	YES	Excess mine water needed to be utilized water
Cluster-VIII	Jharia	9320	MADA	5294 (3730+1564)	4026	6.03	3.16	NO	NO	
Cluster-IX	(SOD: Over-exploited)	12980	MADA	9358 (4549+4809)	3622	5.81	4.28	NO	NO	
Cluster-X		11825	Damodar river	6201 (4255+1946)	5624	5.69	3.29	YES	NO	
Cluster-XI	Dhanbad (SOD: Over-exploited)	24960	MADA & DVC	19425 (14015+5410)	5535	3.40	1.91	NO	NO	
Cluster-XIII	Baghmara	4815	Damodar river	4815 (4679+136)	0.0	6.80	3.22	NO	NO	--
Cluster-XIV	(SOD: Critical)	2600	NA	2550 (2412+138)	50	5.42	3.08	NO	NO	--
Cluster-XV		6200	NA	5941 (4600+1341)	259	3.83	2.63	NO	NO	--
Cluster-XVI	Nirsa (SOD:Safe)	1910	DVC (Barakar river)	1730 (1380+350)	180	3.18	3.13	NO	NO	--

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

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

7.0 IMPACT OF MINING ON GROUND WATER REGIME

7.1 GENERAL CONSEQUENCES OF COAL MINES ON AMBIENT HYDROGEOLOGICAL REGIME

Mining of coal either by opencast or underground method is bound to incise one or more water bearing strata (aquifers) which in turn may result in depletion or draw down in water levels and a corresponding inflow of water into the mine workings. The potential effects of coal mining operations on the hydrogeological regime are as under:

- Creates disruption in formation/aquifer
- Dewatering of aquifers
- Change in hydraulic gradient
- Modification of recharge to aquifers
- Change in groundwater flow pattern

The general need in mine planning from the hydrogeological point of view is the estimation of make of water (ground water seepage) into the mine, its rate, the mine pumping capacity to meet the storm rainwater accumulation, extent of depression of water surface and management of mine effluent (mine water). It is also desirable that the consequences of mining operation on the groundwater regime be determined in advance. However, the mine pumping in most of the cases are passive dewatering for the safety of the mine pit, active mine dewatering is done in few cases for very high potential aquifers.

7.2 POTENTIAL CONSEQUENCES OF OPENCAST AND UNDERGROUND COAL MINES OF JHARIA COALFIELD ON HYDROGEOLOGICAL REGIME

Generally, in the opencast and underground mines of Jharia Coalfield, alluvium and overlying weathered mantle are the first to excavate followed by upper Barakar Formation / Aquifer. Since these formations vary in thickness, compaction and their constituents over the area, their aquifer properties also vary.

The porosity and the compactness in the sandstone controls the discharge from these aquifers. The alluvium and weathered Formation wherever loose and fragile possess more porosity and this has high groundwater potential. Due to the mine cut, the depression in the water table created. The initial discharges due to this depression is large in amount due to concentration of flow to that region. In the top zones, water table condition prevails and away from the opening in the stratified section, semi-confined conditions exist. With progress of mine operations, there is an increase in the depth of incision as a result; the semi-confined aquifers are also punctured.

During mining the hydraulic gradients generally, steeps down near mine i.e. within the mine influence area. In the up-dip region, only un-confined aquifer punctured through the mining process and thus only it affected whereas in the down-dip region both un-confined and semi-confined aquifers may be affected. The confined aquifers of lower Barakar Formation in the mining area not punctured as it lies below the working coal seams and hence normally there is no noticeable effect in the aquifer related to this formation.

7.3 ESTIMATION OF RADIUS OF MINE INFLUENCE ZONE

Radius of Influence can defined as the radial distance from the center of the borehole to the point where there is no lowering of groundwater table/potentiometric surface.

The radius of influence (R) for Opencast and UG Mines within Jharia CF calculated by using Sichardt's formula based on present mining scenario.

$$R_0 = C^*(H\text{-}h) * \sqrt{(K)}$$

Where, R_0- Radius of influence (m), C - Constant =3000,

(H-h)- Drawdown (m), K – Hydraulic conductivity (m/s).

Here, K has used for Barakar Formations i.e. 0.05 m/d or 5.7×10^{-7} m/sec.

It may be appropriate to mention here that the presence of prominent boundaries/water bodies, faults or interfringing of sandstone and shale beds may restrict propagation of the drawdown cone. With the presence of low permeable beds such as clay/shale and younger coal seams in the formation, laying above the working seams the water level in the phreatic aquifer not directly affected. During the working of board and pillar method, subsidence takes place during the extraction of total coal (depillaring), both the phreatic and semi-confined aquifers get affected. Surface vigilance and filling up subsided zone, if any, has to constantly in view. The effect on groundwater level for most of the coal mine in Jharia coalfield has been observed in the down-dip side, generally within a distance upto 500 m and becomes milder/ negligible thereafter.

8.0 CONSERVATION MEASURES & FUTURE STRATEGY

- BCCL has installed 25 Pressure Filter Plant of total capacity of 4.16 MGD to meet drinking water requirement nearby the area. At present 63 Water Treatment Plants are operational having capacity of 16.16 MGD within Jharia Coalfield area. Further installation of 28 more Pressure Filter Plants with the capacity of 5.84 MGD are in progress.

- BCCL participated in development of low cost technology for drinking water in a CSIR project along with CIMFR, Dhanbad and a pilot plant of 4000 Liters/hour is functional at PB Project site of BCCL. Similar plant has proposed at other sites of BCCL.
- A scheme entitled 'Scheme for multi-purpose utilization of surplus mine water of Barora Area, Block II and Govindpur Area of BCCL' was prepared with a view to harness the excess water discharge to take care of the persistence problem of water scarcity in the nearby villages. In the scheme, two water reservoirs of capacity 27 MG and 17 MG have been proposed in the non-coal bearing area for storage of 3250 GPM and 2000 GPM surplus mine water which will be fed through pipe line by mine discharge at mines of Barora, Block-II and Govindpur Area.
- Rooftop rainwater harvesting (RWH) will took up in the project area using the administrative buildings. 138 no. of quarters having roof-top area of about 14950 sq. m. is already prepared to harvest rainwater and around 13150 cum/annum of water is going to be recharged the nearby groundwater system through RWH structures. Proposal already made to facilitate this kind of RWH structure at suitable locations i.e. Lodna Area, Kusunda Area (Jawahar Nagar, Matkuria, Coal Board Colony), Sijua Area (Nichitpur and Tetulmari Colony) within Jharia Coalfield to augment groundwater recharge.
- After cessation of mining, with plenty rainfall and abundant ground water recharge, the water levels will recoup and attain normalcy. Thus, the impact of mining on groundwater system may considered as a temporary phenomenon. The abandoned mine workings (UG) behave as water pool and improves the resources availability in the coalfield area.
- Utilization of treated mine water discharge by both industry and local people in the mine influence area. The excess mine water can be used to recharge groundwater system through connecting pipeline to abandoned dug wells. Utilization of mine water for irrigation use will also enhance the ground water recharge potential through artificial recharge in the area.
- Increase vegetative cover by plantation in the mine area under land amelioration measures. This will contain the surface run-off and increase the groundwater recharge.
- Creation of awareness among workers and local peoples about Rainwater harvesting and artificial recharge will have priority. This aspect usually covered during the Environmental Week celebrated every year (5 to 12 June).
- 23 nos. of Piezometer proposed to install within JCF and RCF to monitor GW level (**Plate-III**).

Monitoring of water quality of mine water discharge, local River/nala and domestic water source (dug well/hand pump wells) will continued under routine monitoring (May, August, November & Jan).

9.0 EXISTING/PROPOSED RAINWATER HARVESTING STRUCTURES IN BCCL COAL MINES

Fig-3 to 4.

Proposed Rain Water Harvesting Site GVTC, Cluster-I, Barora Area

Proposed Rain Water Harvesting Site Nehru Balika Vidhalaya, Cluster-I, Barora Area

Fig-5 to 6.

Proposed Rain Water Harvesting Site Barora Area Guest House, Cluster-I, Barora Area

Proposed Rain Water Harvesting Site Regional Hospital Baghmara, Cluster-I, Barora Area

Fig-7 to 8.

Proposed Rain Water Harvesting Site – Barora Area Office, Cluster-I, Barora Area

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-9 to 10.

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-11 to 12.

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-13 to 14.

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

FILTER PLANT IN THE MINE AREA

Fig-15.

Government of India
Ministry of Environment, Forest and Climate Change
Wetlands Division

List of Ramsar Sites in India

S. No	Name of Ramsar site	State	Area in hectares	Date of designation	Coordinates
1.	Ashtamudi Wetland	Kerala	6,140	19/08/2002	08°57'N 076°34'E
2.	Beas Conservation Reserve	Punjab	6,429	26/09/2019	31°23'N 075°11'E
3.	Bhitarkanika Mangroves	Odisha	65,000	19/08/2002	20°39'N 086°54'E
4.	Bhoj Wetland	Madhya Pradesh	3,201	19/08/2002	23°13'N 077°19'E
5.	Chandertal Wetland	Himachal Pradesh	49	08/11/2005	32°28'N 077°36'E
6.	Chilika Lake	Odisha	116,500	01/10/1981	19°42'N 085°21'E
7.	Deepor Beel	Assam	4,000	19/08/2002	26°07'N 091°39'E
8.	East Calcutta Wetlands	West Bengal	12,500	19/08/2002	22°27'N 088°27'E
9.	Harike Lake	Punjab	4,100	23/03/1990	31°13'N 075°12'E
10.	Hokera Wetland	Jammu & Kashmir	1,375	08/11/2005	34°04'N 074°42'E
11.	Kanjli	Punjab	183	22/01/2002	31°25'N 075°22'E
12.	Keoladeo National Park (MR)	Rajasthan	2,873	01/10/1981	27°13'N 077°31'E
13.	Keshopur-Miani Community Reserve	Punjab	344	26/09/2019	32°05'N 075°23'E
14.	Kolleru Lake	Andhra Pradesh	90,100	19/08/2002	16°37'N 081°12'E
15.	Loktak Lake (MR)	Manipur	26,600	23/03/1990	24°25'N 093°49'E
16.	Nalsarovar	Gujarat	12,000	24/09/2012	22°46'N 072°02'E
17.	Nandur Madhameshwar	Maharashtra	1,437	21/06/2019	20°01'N 074°06'E
18.	Nangal Wildlife Sanctuary	Punjab	116	26/09/2019	31°23'N 076°22'E
19.	Nawabganj Bird Sanctuary	Uttar Pradesh	225	19/09/2019	26°36'N 080°39'E
20.	Parvati Arga Bird Sanctuary	Uttar Pradesh	722	02/12/2019	26°56'N 082°09'E
21.	Point Calimere Wildlife and Bird Sanctuary	Tamil Nadu	38,500	19/08/2002	10°19'N 079°37'E
22.	Pong Dam Lake	Himachal Pradesh	15,662	19/08/2002	32°01'N 076°04'E
23.	Renuka Wetland	Himachal Pradesh	20	08/11/2005	31°37'N 077°27'E
24.	Ropar	Punjab	1,365	22/01/2002	31°01'N 076°30'E
25.	Rudrasagar Lake	Tripura	240	08/11/2005	23°28'N 091°16'E
26.	Saman Bird Sanctuary	Uttar Pradesh	526	02/12/2019	27°00'N 079°10'E
27.	Samaspur Bird Sanctuary	Uttar Pradesh	799	03/10/2019	25°59'N 081°23'E
28.	Sambhar Lake	Rajasthan	24,000	23/03/1990	27°00'N 075°00'E
29.	Sandi Bird Sanctuary	Uttar Pradesh	309	26/09/2019	27°18'N 079°58'E
30.	Sarsai Nawar Jheel	Uttar Pradesh	161	19/09/2019	26°58'N 079°15'E

Rainfall Data (in mm) At Dhanbad Observatory Station, IMD (Source: WRIS Website data)

Year	January	February	March	April	May	June	July	August	Sep	Oct	Nov	Dec	Annual
1994	26.5	20.0	3.3	23.5	4.5	289.5	245.5	240.0	134.0	40.5	0.0	0.0	1027.3
1995	15.0	18.3	20.0	0.0	34.5	122.0	140.1	257.0	446.0	0.0	34.0	5.5	1092.4
1996	12.5	12.5	5.2	0.0	0.0	210.5	138.5	400.0	214.0	24.0	0.0	0.0	1017.2
1997	10.5	17.5	2.8	63.5	41.5	231.5	599.3	621.1	196.8	16.5	34.0	16.0	1851.0
1998	20.5	21.0	160.0	18.0	40.0	80.0	347.0	409.0	123.0	120.5	11.0	0.0	1350.0
1999	0.0	0.0	0.0	0.0	64.0	150.0	511.0	336.0	510.5	124.0	0.0	0.0	1695.5
2000	2.0	15.0	0.0	20.0	68.0	452.5	270.5	89.0	234.5	-	0.0	0.0	1151.5
2001	0.0	0.0	34.0	13.0	104.0	448.7	552.5	121.0	107.0	126.5	0.0	0.0	1506.7
2002	12.0	10.0	26.0	0.0	32.5	185.0	150.0	125.5	310.0	64.0	0.0	0.0	915.0
2003	6.0	58.5	38.5	40.0	24.0	-	366.1	279.0	145.1	151.6	0.0	2.3	1111.1
2004	18.45	2.13	1.55	53.93	9.53	95.95	408.57	261.07	174.01	63.01	51.10	12.85	1152.15
2005	44.49	23.11	26.16	17.90	28.95	272.26	388.86	158.86	69.03	117.63	0.09	1.67	1149.01
2006	0.00	0.00	3.11	12.64	86.68	113.20	505.72	316.06	339.51	9.80	3.73	0.00	1390.45
2007	0.00	58.69	35.76	21.08	25.33	139.60	666.30	416.85	383.93	43.63	1.57	0.00	1772.74
2008	16.44	1.96	6.27	6.78	37.28	180.58	422.25	275.33	198.31	27.64	0.00	0.00	1172.82
2009	0.00	0.26	5.81	0.19	105.82	78.32	232.20	370.39	429.16	68.56	11.31	0.98	1303.00
2010	0.59	19.64	7.62	38.24	93.72	146.68	157.31	198.97	239.75	78.76	5.28	40.53	1027.07
2011	0.00	1.60	18.25	12.81	102.58	294.61	174.35	445.43	214.88	30.35	0.69	0.00	1295.55
2012	18.45	2.13	1.55	53.93	9.53	95.95	408.57	261.07	174.01	63.01	51.10	12.85	1152.15
2013	0.07	17.62	0.79	15.24	105.51	176.77	170.14	276.70	135.76	304.46	0.00	0.00	1203.06
2014	9.27	35.71	21.21	8.16	62.77	112.58	283.73	223.38	214.48	30.30	0.00	0.00	1001.59
2015	12.06	3.33	26.71	45.73	32.91	162.96	385.21	239.38	71.34	15.62	0.00	0.61	995.86
2016	6.16	17.59	1.73	1.33	73.90	197.34	248.86	395.33	424.81	30.45	0.00	0.00	1397.50
2017	5.12	0.00	34.96	59.89	81.01	141.66	502.58	168.84	111.95	274.18	0.64	4.12	1384.95
2018	0.00	0.06	2.90	159.52	31.22	202.84	344.59	211.91	153.63	16.31	0.04	20.99	1144.01
2019	0.00	25.18	7.24	46.99	109.43	109.11	292.02	234.65	327.95	199.63	0.10	5.13	1357.43
2020	21.14	5.94	74.96	27.94	71.32	218.12	187.01	258.74	196.87	52.23	1.23	0.00	1115.50

Rainfall Data (in mm) At Dhansar (Rescue station) Observatory Station
State Sec Deptt of Coord, BCCL

Year	January	February	March	April	May	June	July	August	Sep	Oct	Nov	Dec	Annual
2005	34.20	22.80	41.80	32.20	33.00	193.00	542.00	107.80	185.60	39.20	0.00	2.00	1233.60
2006	0.00	0.00	34.40	33.80	87.60	214.20	477.70	246.30	172.00	0.00	1.00	0.00	1267.00
2007	0.00	22.00	37.80	0.00	78.70	167.20	545.00	426.40	351.40	52.00	0.00	0.00	1680.50
2008	5.80	4.80	17.80	18.40	18.00	216.10	433.48	183.80	297.80	85.80	0.00	0.00	1281.78
2009	0.00	0.00	1.60	2.20	112.00	72.80	269.20	192.80	333.00	98.20	10.20	0.00	1092.00
2010	0.00	12.20	7.60	9.20	64.30	206.20	199.40	212.60	230.10	45.30	3.4	----	991.90
2011	7.60	0.00	18.0	11.40	121.60	344.20	163.40	452.0	374.0	41.80	0.00	0.00	1534.20
2012	17.6	13.4	1.0	9.0	6.60	52.0	328.20	315.10	367.70	11.60	61.60	18.0	1201.80
2013	0.0	32.0	3.0	33.90	190.40	244.20	192.80	364.40	304.70	233.60	0.0	0.0	1599.0
2014	12.40	36.80	21.80	2.60	79.80	217.60	305.30	315.60	178.0	6.40	0.0	0.0	1176.0
2015	23.80	0.0	6.20	76.20	35.80	122.10	407.60	244.40	145.20	25.60	0.0	6.20	1093.10
2016	3.0	20.60	5.50	0.0	99.40	181.60	248.80	456.70	443.60	50.40	0.0	0.0	1509.60
2017	8.80	0.0	3.80	17.90	33.20	120.0	533.40	284.70	247.40	207.70	3.40	0.0	1460.30
2018	0.0	0.0	0.0	102.90	76.30	270.60	382.30	338.80	159.50	38.90	2.40	37.90	1346.60
2019	0.0	49.60	10.20	54.20	132.0	188.0	319.10	343.60	403.10	156.40	3.20	10.60	1667.00
2020	22.0	7.60	77.80	76.80	86.20	214.10	296.80	351.40	214.0	92.0	0.0	0.0	1438.70

Annexure – V

Location of Hydrograph Stations (Dug Wells)

Well No	Latitude	Longitude	Well No	Latitude	Longitude
A-3	23°47'53.35" N	86°19'55.14" E	**B-63**	Abandoned due to OCP	
A-12	23°48'20.31" N	86°16'51.64" E	**B-64**	23°48'43.14" N	86°18'44.25" E
A-16	23°46'57.00" N	86°21'38.57" E	**B-65A**	23°48'53.65" N	86°18'11.82" E
A-17	23°45'09.44" N	86°22'16.35" E	**B-67**	23°43'30.70" N	86°14'01.45" E
A-18	23°44'37.65" N	86°22'58.90" E	**D-3**	23°46'46.31" N	86°24'49.30" E
A-19	23°41'12.86" N	86°23'55.27" E	**D-4**	23°44'29.37" N	86°24'42.88" E
A-20	23°44'56.64" N	86°19'55.35" E	**D-5**	23°42'20.05" N	86°24'86.06" E
A-22	23°43'06.65" N	86°14'48.53" E	**D-7**	23°43'12.08" N	86°27'11.89" E
A-23	23°45'06.38" N	86°15'12.69" E	**D-8**	23°44'06.13" N	86°27'20.72" E
A-24	23°45'20.44" N	86°13'45.12" E	**D-23**	23°47'20.89" N	86°20'09.96" E
A-25	23°47'06.20" N	86°15'27.79" E	**D-25**	23°47'03.28" N	86°23'29.56" E
A-26	23°46'49.24" N	86°18'12.12" E	**D-30**	23°48'36.10" N	86°21'50.07" E
A-27	23°48'42.55" N	86°20'21.80" E	**D-33**	23°45'34.62" N	86°23'18.50" E
A-28A	23°47'34.74" N	86°18'04.18" E	**D-34**	23°45'36.50" N	86°23'02.45" E
A-29	23°47'08.02" N	86°16'02.72" E	**D-35**	23°40'46.54" N	86°25'46.33" E
A-32	23°44'15.56" N	86°20'43.80" E	**D-36**	23°40'19.26" N	86°25'18.98" E
A-33	23°44'32.58" N	86°16'58.28" E	**D-39**	23°43'28.50" N	86°26'0.10" E
A-34	23°42'58.63" N	86°15'19.31" E	**D-40A**	23°43'20.18" N	86°25'45.70" E
B-1	23°48'48.06" N	86°14'16.87" E	**D-41**	23°42'40.00" N	86°26'17.20" E
B-14	23°48'00.81" N	86°16'25.88" E	**D-43***	NA	NA
B-15	23°46'06.92" N	86°08'59.30" E	**D-47**	23°45'20.59" N	86°24'34.86" E
B-21A	23°45'10.50" N	86°09'36.38" E	**D-49**	23°44'08.96" N	86°26'32.71" E
B-23	23°44'13.05" N	86°11'46.56" E	**D-51**	23°44'20.86" N	86°27'11.37" E
B-24	23°44'26.80" N	86°13'09.38" E	**D-55**	23°43'58.37" N	86°24'07.45" E
B-25	23°44'44.98" N	86°13'57.80" E	**D-74**	23°41'33.66" N	86°25'06.10" E
B-32A	23°45'49.18" N	86°13'03.64" E	**D-77**	23°41'00.74" N	86°22'25.55" E
B-48	23°‘4'35.09" N	86°16'38.30" E	**D-80**	23°46'09.46" N	86°24'33.08" E
B-51	23°47'40.20" N	86°09'11.90" E	**DB-22**	23°43'38.81" N	86°45'09.00" E
B-53	23°45'55.25" N	86°09'35.44" E	**DB-23**	23°43'44.24" N	86°45'06.39" E
B-53A	DO	DO	**DB-24**	23°43'53.00" N	86°45'03.88" E
B-59	23°47'59.87" N	86°13'37.97" E	**DB-25**	23°44'10.75" N	86°44'35.84" E
B-60	23°48'7.87" N	86°15'37.12" E			
B-61A	23°45'59.85" N	86°11'40.80" E			
B-62A	23°45'44.15" N	86°11'27.80" E			

Annexure – VA

Details of Hydrograph Stations (Dug Wells)

Well No	Location	M.P. (agl) in m	Well Dia in m	Well Depth (m bmp)	R.L. (G.L) (m)	Formation	Owner	Utility
A-3	Sijua	0.53	3.00	5.20	203	Barakar	Govt.	Domestic
A-12	Jamua	0.80	1.90	3.30	202	Barakar	Govt.	Domestic
A-16	Ekra, Kalali More	0.45	3.10	6.50	205	Barakar	Govt.	Domestic
A-17	Kachi Balihari	0.56	1.60	5.30	182	Barakar	Govt.	Domestic
A-18	Bhagabandh	0.61	1.45	3.37	182	Barakar	Govt.	Domestic
A-19	Bhaura	0.54	3.15	11.65	162	Barakar	Govt.	Domestic
A-20	Gorbhudih	0.43	3.30	8.30	181	BM	Govt.	Domestic
A-22	Nagdah, Niche	0.00	1.40	9.50	171	Raniganj	Govt	Irrigation
A-23	Machhyara	0.43	1.85	12.40	203	Raniganj	Govt	Domestic
A-24	Pipra Tanr	0.22	1.80	19.55	208	Raniganj	Govt	Domestic
A-25	Sinidih	0.22	2.00	11.30	203	Barakar	Govt	Domestic
A-26	Pasitanr	0.32	1.80	9.65	198	Barakar	Govt	Domestic
A-27	Chandor	0.60	2.50	5.50	221	Barakar	Govt	Domestic
A-28A	Lakarka 6 no.	0.65	1.30	5.25	199	Barakar	BCCL	Domestic
A-29	Aambagan	0.10	2.60	9.15	186	Barakar	Govt	Domestic
A-32	Baludih	0.55	2.30	6.85	182	BM	Govt	Domestic
A-33	Mahuda	0.75	2.00	10.80	195	BM	BCCL	Domestic
A-34	Bhatdih	0.55	3.50	24.50	162	Raniganj	BCCL	Domestic
B-1	Muraidih	0.47	1.80	5.35	212	Talchir	Govt	Domestic
B-14	Mathadih	0.76	2.15	3.75	201	Barakar	Govt	Domestic
B-15	Bera Basti	0.55	1.60	2.50	221	Talchir	Dhanu Roy	Domestic
B-21A	Dugdha	0.55	2.10	10.35	220	Metamorphics	Govt	Domestic
B-23	Lohapati	0.26	3.60	10.85	204	Raniganj	Govt	Domestic
B-24	Telmuchu	0.67	4.35	10.83	207	Raniganj	Govt	Domestic
B-25	Mahuda More	0.10	2.45	8.45	205	Raniganj	Govt	Domestic
B-32A	Madhuband	0.80	4.30	8.60	205	Barakar	BCCL	Domestic
B-48	Mahuda	0.65	2.10	11.50	181	Raniganj	Mosque	Domestic
B-51	Taranga	0.00	2.50	5.75	215	Metamorphics	Bisun	Irrigation
B-53	Karmatanr	0.58	2.70	13.25	195	Barakar	Govt	Domestic
B-53A	Damoda OCP							
B-59	Khodovaly	0.60	2.40	9.30	202	Barakar	BCCL	Domestic
B-60	Bahiyardih	0.77	3.00	15.60	196	Barakar	BCCL	Domestic
B-61A	Kesargora	0.48	2.00	11.20	201	Barakar	BCCL	Domestic
B-62A	Sadariyadih	0.15	3.10	9.50	188	Barakar	Govt	Domestic

Annexure – VA

Details of Hydrograph Stations (Dug Wells)

Well No	Location	M.P. (agl) in m	Well Dia in m	Well Depth (m bmp)	R.L. (G.L) (m)	Formation	Owner	Utility
B-63	West Mudidih	0.60	1.70	3.35	196	Barakar	BCCL	Domestic
B-64	Keshalpur	0.65	1.10	3.40	195	Barakar	BCCL	Domestic
B-65A	Jhinjipahari	0.95	2.20	12.40	196	Barakar	Shiv Temple	Domestic
B-67	Simatanr	0.55	2.20	11.80	198	Raniganj	Govt	Domestic
D-3	Dhansar	0.60	1.70	8.70	217	Barakar	Govt	Domestic
D-4	Jharia	0.59	1.90	5.73	218	Barakar	Govt	Domestic
D-5	Jiyalgora	0.70	2.80	10.55	183	Barakar	Govt	Domestic
D-7	Golden Pahari	0.67	2.85	10.05	201	Barakar	BCCL	Domestic
D-8	Alokdiha	0.35	1.75	7.57	201	Metamorphics	BCCL	Domestic
D-23	Jogta (Sindra)	0.40	3.10	7.25	205	Barakar	BCCL	Domestic
D-25	Godhar More	0.60	2.75	5.60	219	Barakar	Govt	Domestic
D-30	Borkiboa	0.70	2.00	5.60	221	Talchir	H.Kumbhakar	Domestic
D-33	Kustore-4	0.55	1.85	3.45	196	Barakar	BCCL	Domestic
D-34	Kusunda-7	0.60	1.50	3.45	201	Barakar	BCCL	Domestic
D-35	Patherdih	0.40	2.00	11.20	160	Barakar	BCCL	Domestic
D-36	Sudamdih	0.90	2.00	6.20	141	Barakar	BCCL	Domestic
D-39	Tilabani	0.85	2.00	5.90	178	Barakar	BCCL	Domestic
D-40A	Khapra Dhaora	0.55	1.95	3.70	180	Barakar	Panchayat	Domestic
D-41	Joyrampur	0.50	1.80	4.00	180	Barakar	BCCL	Domestic
D-43	Alagdih	0.45	2.20	8.90	200	Metamorphics	Govt	Domestic
D-47	Parastanr	0.45	3.20	23.80	206	Barakar	BCCL	Domestic
D-49	Goluckdih	0.55	1.80	6.15	192	Barakar	BCCL	Domestic
D-51	Chankuiya	0.55	3.70	11.90	197	Barakar	BCCL	Domestic
D-55	Hariladih	0.48	2.80	11.80	184	Barakar	Govt	Domestic
D-74	Bhulan Barari	0.10	1.60	12.80	173	Barakar	Govt	Domestic
D-77	Rohoniatanr	0.40	3.15	6.70	156	Barakar	Govt	Domestic
D-80	Bastacolla	0.70	2.50	24.95	219	Barakar	Govt	Domestic
DB-22	Nichebasti	0.67	2.40	10.65	121	Barakar	Govt	Domestic
DB-23	Dahibari OC	0.70	2.30	8.00	-	Barakar	BCCL	Domestic
DB-24	Dahibari	0.60	3.60	13.70	125	Barakar	BCCL	Domestic
DB-25	Palasya	0.37	1.55	5.25	127	Barakar	Govt	Domestic

MP: Measuring Point **R.L.: Reduced Level** **W.L.: Water Level m: Meter**
Abn.: Abandoned **b.g.l.: Below Ground Level a.g.l.: Above Ground Level**
G.L.: Ground Level **bmp: Below Measuring Point BM: Barren Measure**

Annexure – VB

Historical Water Level data of Hydrograph Stations

Well No	Water level below ground level (bgl) in meters													
	May 14	Nov 14	May 15	Nov 15	May 16	Nov 16	May 17	Nov 17	May 18	Nov 18	May 19	Nov 19	May 20	Nov 20
A-3	4.67	2.37	3.70	3.42	4.87	0.47	0.67	0.77	1.27	0.47	3.47	0.47	1.57	0.47
A-12	2.45	1.4	3.00	2.68	2.50	0.70	2.55	0.85	2.80	1.0	2.10	0.45	2.60	0.50
A-16	5.5	2.9	5.55	4.17	5.85	3.15	3.65	2.20	4.30	3.65	5.45	1.95	7.15	1.75
A-17	2.19	1.91	3.79	2.64	2.44	2.69	2.44	2.24	3.34	2.84	2.94	2.24	2.14	1.69
A-18	1.76	1.19	2.84	1.29	1.14	0.89	1.29	0.99	1.24	0.99	2.29	0.69	1.09	0.34
A-19	3.00	2.75	3.05	2.75	7.81	4.11	6.37	2.45	5.55	2.45	4.85	3.43	6.05	3.25
A-20	3.97	2.55	4.59	2.93	7.49	3.50	4.27	1.77	4.57	2.57	4.57	1.82	8.47	3.87
A22A	1.50	2.0	3.20	1.96	3.25	1.75	4.27	1.77	3.35	1.30	2.60	2.00	2.90	1.98
A-23	8.76	6.82	11.3	9.37	11.87	8.13	6.40	1.50	11.15	7.17	11.97	3.77	8.92	5.62
A-24	16.28	14.98	17.2	14.5	16.62	12.43	11.87	6.97	14.58	6.88	15.88	2.48	'4.88	4.28
A-25	7.03	5.28	7.78	5.85	7.43	4.58	6.38	2.88	6.63	3.13	6.08	1.93	2.98	1.83
A-26	7.71	4.58	7.73	3.18	8.93	4.48	5.28	2.53	6.23	3.88	6.58	3.33	6.98	3.18
A-27	1.63	1.55	4.40	3.95	4.85	1.80	2.90	1.25	2.90	1.0	2.40	0.92	2.40	1.10
A28A	3.29	1.91	4.35	3.60	3.35	1.47	4.30	1.55	4.15	2.51	2.45	3.15	4.00	3.03
A-29	3.3	2.35	4.55	4.60	5.92	6.96	4.40	1.30	6.45	2.10	4.85	3.40	6.20	3.20
A-32	3.15	2.45	4.41	2.13	4.75	2.10	3.15	1.55	2.80	0.70	2.75	0.95	1.90	1.75
A-33	4.06	1.57	4.91	1.97	5.75	2.60	6.45	1.55	4.07	2.35	3.65	1.25	4.55	1.85
A-34	4.45	4.45	8.40	4.81	4.75	4.45	12.45	4.45	5.90	3.70	6.35	3.95	8.35	3.45
B-1	2.43	1.81	3.28	2.75	3.58	1.93	2.33	0.85	2.88	2.08	3.18	1.73	3.28	1.63
B-14	3.24	4.44	2.94	2.29	2.44	0.47	2.94	1.84	3.64	2.84	2.24	0.94	2.44	1.04
B-15	0.95	1.45	1.50	0.45	1.85	0.55	4.85	0.15	1.85	0.85	1.90	1.65	3.70	1.47
B21A	9.54	3.7	7.37	4.65	5.55	4.50	8.85	5.65	9.65	2.65	9.45	-	10.00	5.80
B-23	6.57	2.74	7.86	4.29	6.81	2.41	7.74	2.14	6.64	2.14	2.84	1.34	3.24	1.76
B-24	9.40	2.21	10.0	5.76	10.63	4.28	10.03	4.03	9.28	4.33	4.58	2.33	5.48	3.53
B-25	5.82	5.15	6.88	-	7.05	1.70	6.70	1.40	5.90	3.70	4.80	1.40	7.90	2.55
B32A	8.33	2.05	7.55	3.32	6.95	3.07	6.95	2.80	6.75	3.90	5.55	1.70	3.30	2.00
B-48	6.38	4.35	7.90	5.42	9.35	4.60	7.70	4.15	7.33	3.97	7.05	4.35	8.20	3.85
B-51	2.09	1.98	4.65	3.40	4.90	3.18	4.98	2.55	5.02	2.42	5.10	2.70	5.00	2.10
B-53	3.39	-	5.58	2.82	4.70	1.45	4.02	1.92	3.92	1.42	3.22	1.42	3.12	1.40
B-59	2.65	1.0	4.12	1.60	4.40	0.50	5.40	0.60	5.47	1.10	6.20	0.90	5.25	1.40
B-60	9.82	4.59	9.21	5.28	10.33	5.03	13.23	3.18	13.68	4.23	8.13	3.23	10.33	3.21
B61A	6.93	3.57	6.15	4.52	6.58	3.87	2.57	0.82	2.57	2.02	3.32	0.52	3.32	1.60
B62A	8.83	5.85	9.10	5.21	9.30	4.95	8.15	4.35	8.27	4.78	7.55	3.25	6.95	3.00

Annexure – VB

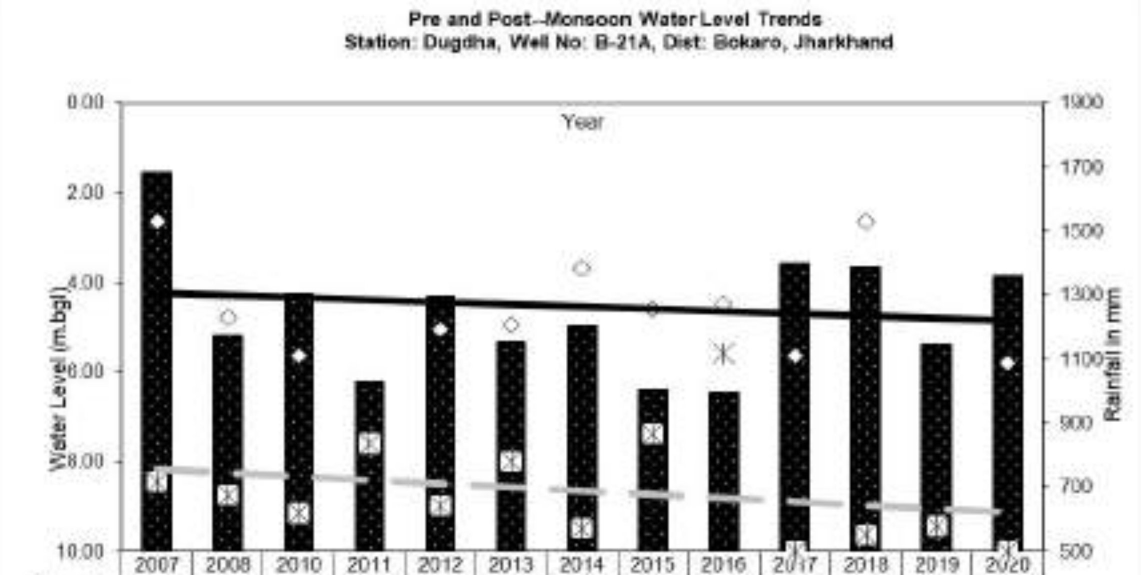
Historical Water Level data of Hydrograph Stations

Well No	Water level below ground level (bgl) in meters													
	May 14	Nov 14	May 15	Nov 15	May 16	Nov 16	May 17	Nov 17	May 18	Nov 18	May 19	Nov 19	May 20	Nov 20
B-64	0.7	1.15	1.38	0.95	2.35	0.55	1.25	0.85	2.15	1.85	0.95	0.45	1.85	0.50
B65A	10.45	2.4	7.82	5.87	7.15	2.68	9.05	1.25	10.03	2.40	11.05	0.95	9.25	2.30
B-67	9.80	3.72	9.23	5.53	9.53	4.30	10.00	2.15	9.55	4.0	8.57	4.35	7.55	3.95
D-3	2.54	2.11	4.25	2.25	2.35	1.90	2.15	2.30	3.43	2.45	1.75	1.30	5.40	1.38
D-4	1.23	0.91	2.41	1.27	1.21	1.36	1.21	1.46	1.91	1.56	2.81	1.71	3.41	1.41
D-5	9.0	7.8	9.37	8.33	9.40	6.40	7.90	5.20	7.80	5.30	8.25	4.85	8.60	7.70
D-7	5.28	5.53	8.25	5.61	7.53	4.03	7.33	2.88	7.53	2.83	8.23	3.28	7.33	5.13
D-8	7.73	-	6.24	4.38	8.00	3.43	5.15	1.85	5.65	1.85	4.80	2.85	5.83	2.75
D-23	6.38	2.4	6.55	3.48	5.70	1.63	2.80	2.98	4.40	3.40	4.70	1.40	5.60	3.35
D-25	4.42	2.9	4.48	2.45	2.40	1.90	2.40	1.20	2.60	2.40	*9.90	*5.38	10.50	5.62
D-30	4.17	3.3	4.55	3.15	4.45	3.20	4.40	1.25	4.58	1.10	4.60	0.75	4.50	1.35
D-33	1.72	0.35	2.25	1.10	2.50	1.95	0.75	0.75	2.85	0.95	2.35	1.65	3.65	1.45
D-34	2.80	0.30	2.55	1.45	2.30	0.30	0.80	0.55	2.80	0.45	4.75	2.40	3.30	2.80
D-35	6.94	6.15	9.80	7.90	9.52	6.45	8.80	3.60	8.40	4.45	8.00	3.80	8.20	5.40
D-36	1.82	0.75	1.66	1.13	0.78	0.95	1.30	0.70	1.20	0.60	1.20	0.55	2.10	1.00
D-39	5.03	2.25	5.00	2.61	2.18	2.65	6.17	4.75	4.95	4.35	*12.60	*5.95	9.40	6.05
D40A	2.35	2.45	3.07	2.45	1.40	0.85	1.45	1.35	2.10	1.40	1.85	1.45	1.95	1.43
D-41	3.20	1.35	2.65	2.32	1.30	1.52	1.40	1.20	1.59	1.32	2.30	1.25	3.30	1.45
D-43	6.0	4.75	6.61	5.05	8.20	3.35	7.50	3.60	7.15	3.45	7.35	2.70	6.60	2.55
D-47	8.0	2.37	9.60	3.60	3.18	2.95	3.15	2.85	5.33	2.55	4.55	4.35	9.45	5.45
D-49	2.51	1.65	3.55	2.35	2.45	1.72	2.70	2.05	3.45	2.45	1.75	1.50	3.25	1.65
D-51	9.60	9.05	10.48	9.15	11.15	6.45	10.45	5.43	10.93	7.10	9.95	5.75	8.45	5.70
D-55	1.95	2.07	6.15	1.57	2.52	3.62	6.42	2.37	8.42	1.57	8.42	5.47	9.42	8.60
D-74	5.0	4.0	10.05	7.20	7.73	5.00	9.25	3.85	8.80	4.80	5.80	3.57	4.30	3.93
D-77	6.23	6.0	6.44	5.60	4.60	2.90	6.50	4.90	6.30	5.20	6.40	3.20	6.40	3.50
D-80	13.3	3.15	10.97	3.35	6.55	4.15	8.65	3.70	9.35	4.20	5.00	3.05	4.30	4.90
RCF (part)	May 14	Nov 14	May 15	Nov 15	May 16	Nov 16	May 17	Nov 17	May 18	Nov 18	May 19	Nov 19	May 20	Nov 20
DB22	6.48	3.03	4.59	3.53	5.38	3.33	1.93	1.63	2.34	1.93	4.93	1.63	2.63	2.25
DB23	3.95	2.13	3.38	6.04	5.30	0.90	2.05	1.90	2.85	1.75	1.60	0.80	2.50	1.95
DB24	-	8.45	9.52	8.20	10.65	6.50	5.80	3.78	8.25	5.70	9.35	3.88	5.70	3.60
DB25	3.27	2.73	3.83	2.68	3.61	1.98	3.23	2.58	3.93	1.63	-	-	3.98	2.63

*New well

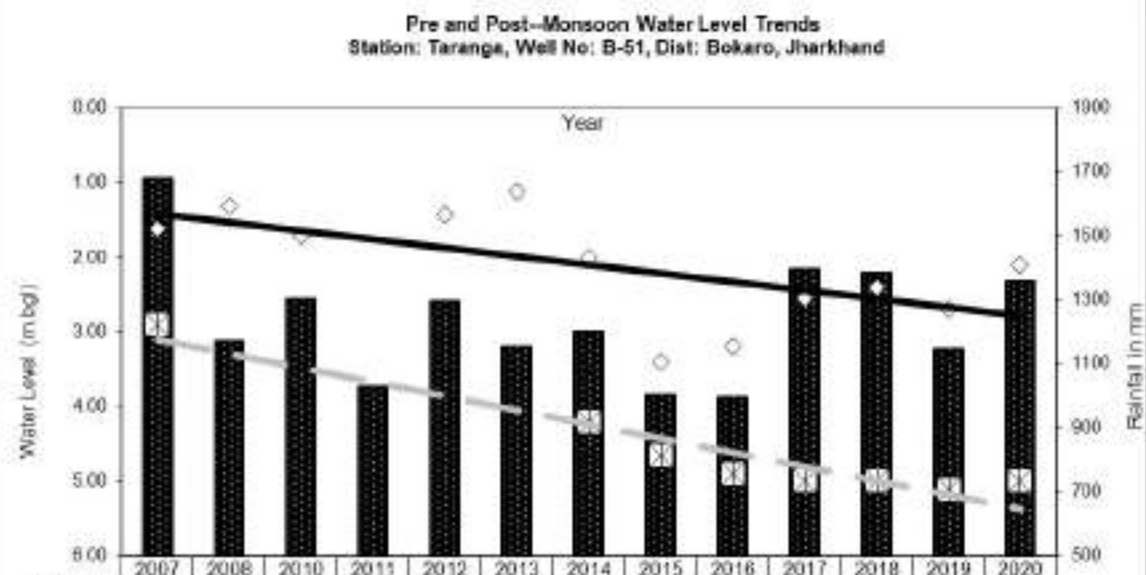
Annexure – VI

HYDROGRAPHS OF CLUSTER-I



	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	8.47	8.75	9.15	7.60	9	8.01	9.50	7.40	5.60	10.00	9.65	9.45	10.00
◇ Nov	2.65	4.79	5.65		5.05	4.95	3.70	4.60	4.50	5.65	2.65		5.80

Rainfall   x May   ◇ Nov



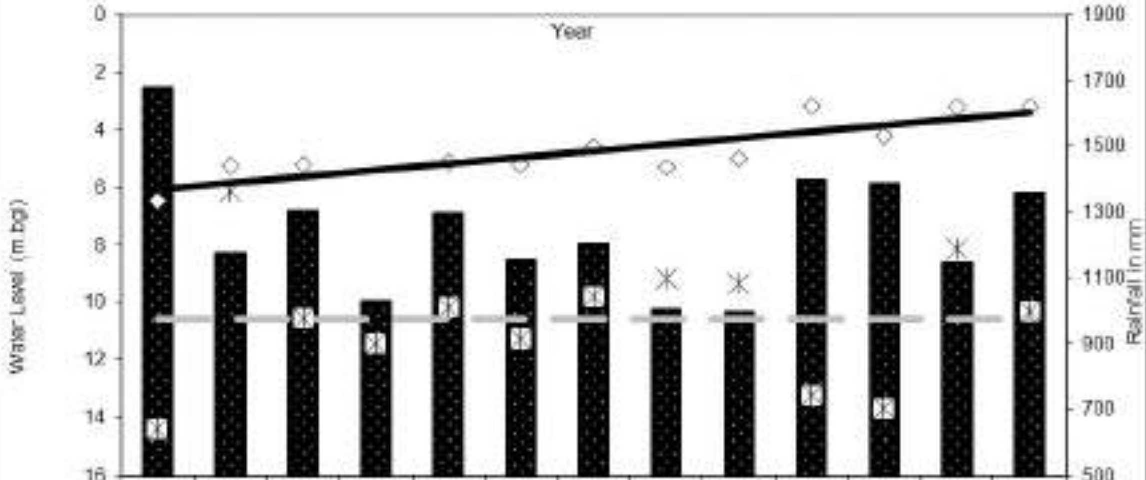
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	2.90						4.20	4.65	4.90	5.00	5.00	5.10	5.00
◇ Nov	1.62	1.32	1.72		1.42	1.12	2.00	3.40	3.20	2.55	2.40	2.70	2.10

Rainfall   x May

Annexure – VI

HYDROGRAPHS OF CLUSTER-II

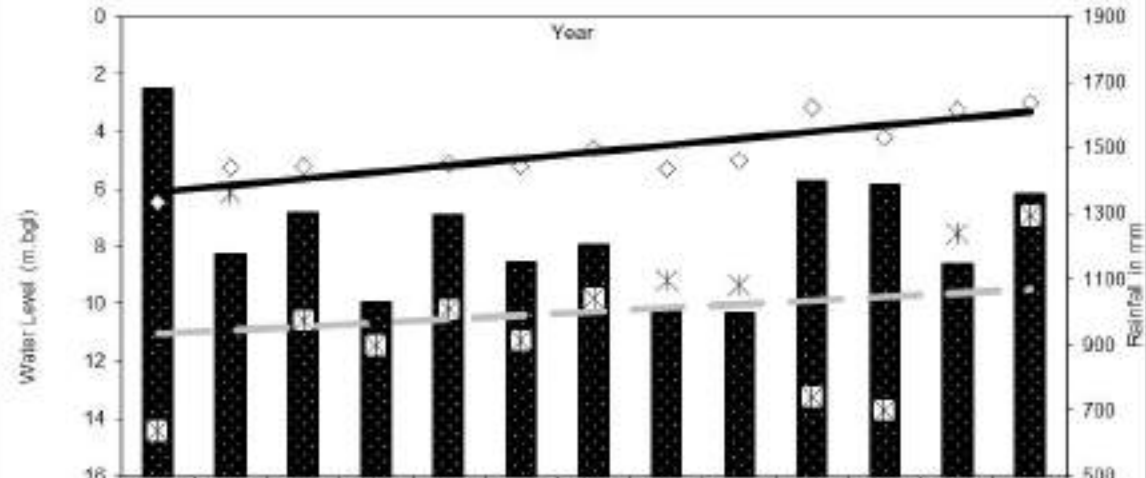
Pre and Post--Monsoon Water Level Trends
Station: Bahiyardih (Barora Area), Well No: B-60, Dist: Dhanbad, Jharkhand



	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1680	1172.82	1303	1027.07	1295.55	1152.15	1203.08	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May	14.41	6.13	10.56	11.44	10.18	11.29	9.82	9.21	9.36	13.23	13.68	8.13	10.33
◇ Nov	6.48	5.28	5.24		5.13	5.23	4.60	5.30	5.00	3.18	4.23	3.23	3.21

Rainfall ⋇ May

Pre and Post--Monsoon Water Level Trends
Station: Sadiyardih (Barora Area), Well No: B-62A, Dist: Dhanbad, Jharkhand

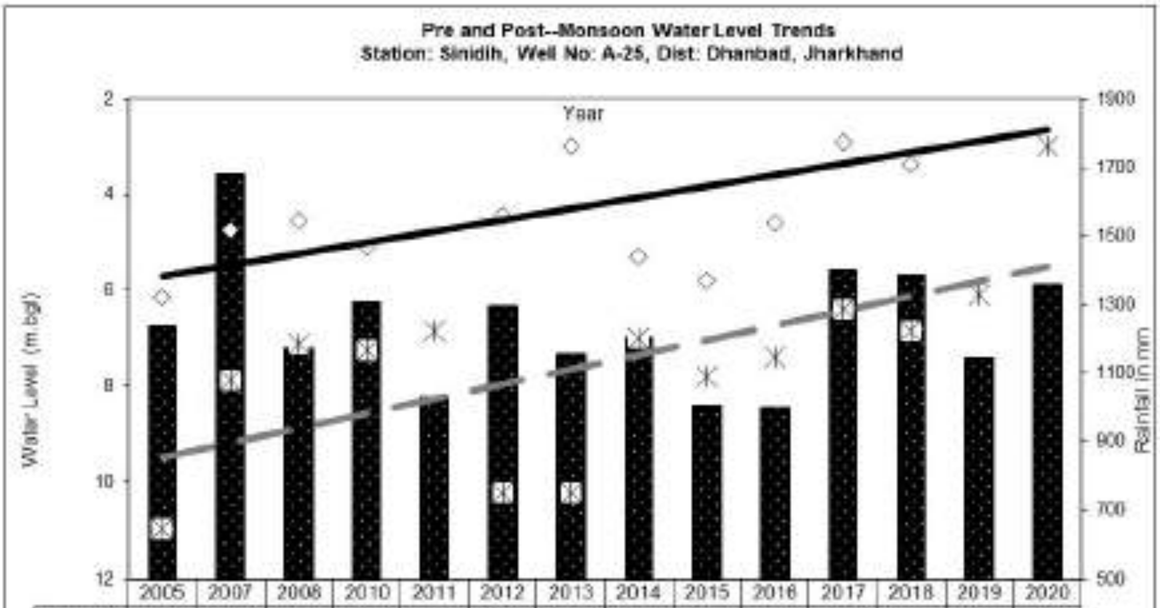


	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1680	1172.82	1303	1027.07	1295.55	1152.15	1203.08	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May	14.41	6.13	10.56	11.44	10.18	11.29	9.82	9.21	9.36	13.23	13.68	7.55	6.95
◇ Nov	6.48	5.28	5.24		5.13	5.23	4.60	5.30	5.00	3.18	4.23	3.25	3.00

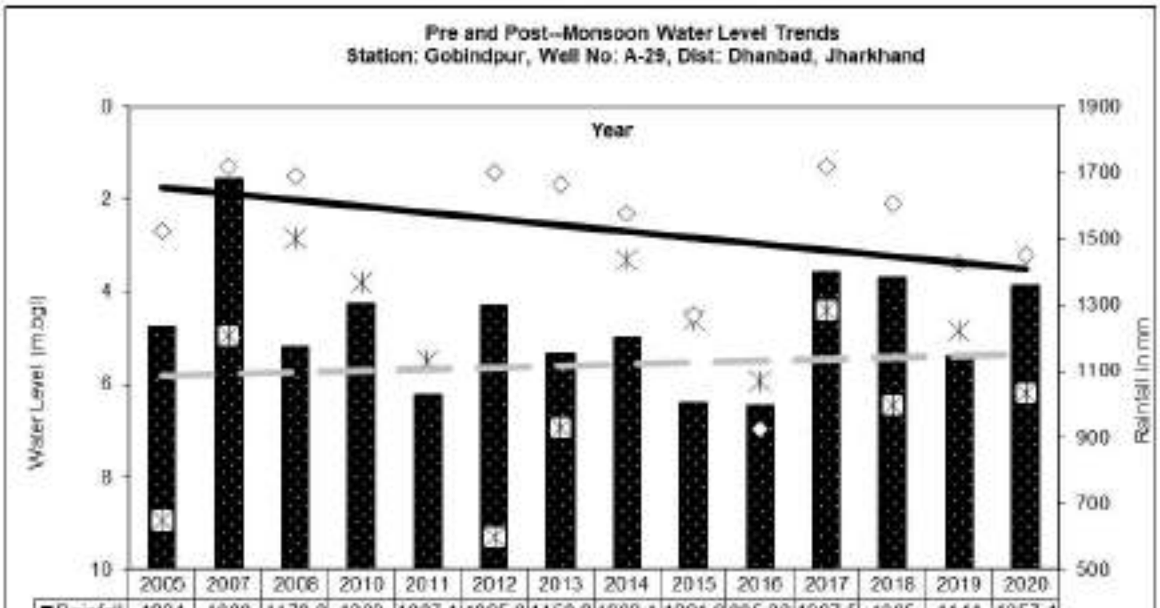
Rainfall ⋇ May

Annexure – VI

HYDROGRAPHS OF CLUSTER-III

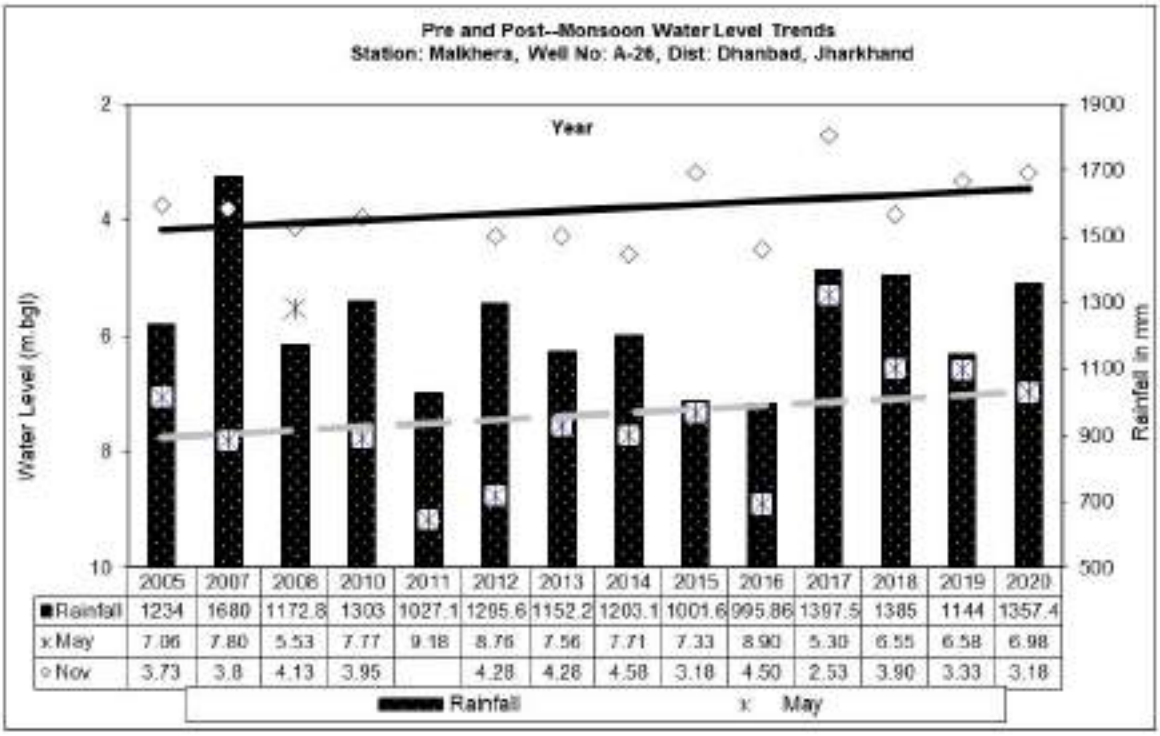


	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
May	10.98	7.86	7.12	7.23	6.83	10.23	10.23	7.00	7.80	7.40	6.40	6.85	6.08	2.98
Nov	6.13	4.73	4.53	5.1		4.43	2.98	5.30	5.80	4.60	2.90	3.35	1.93	1.83

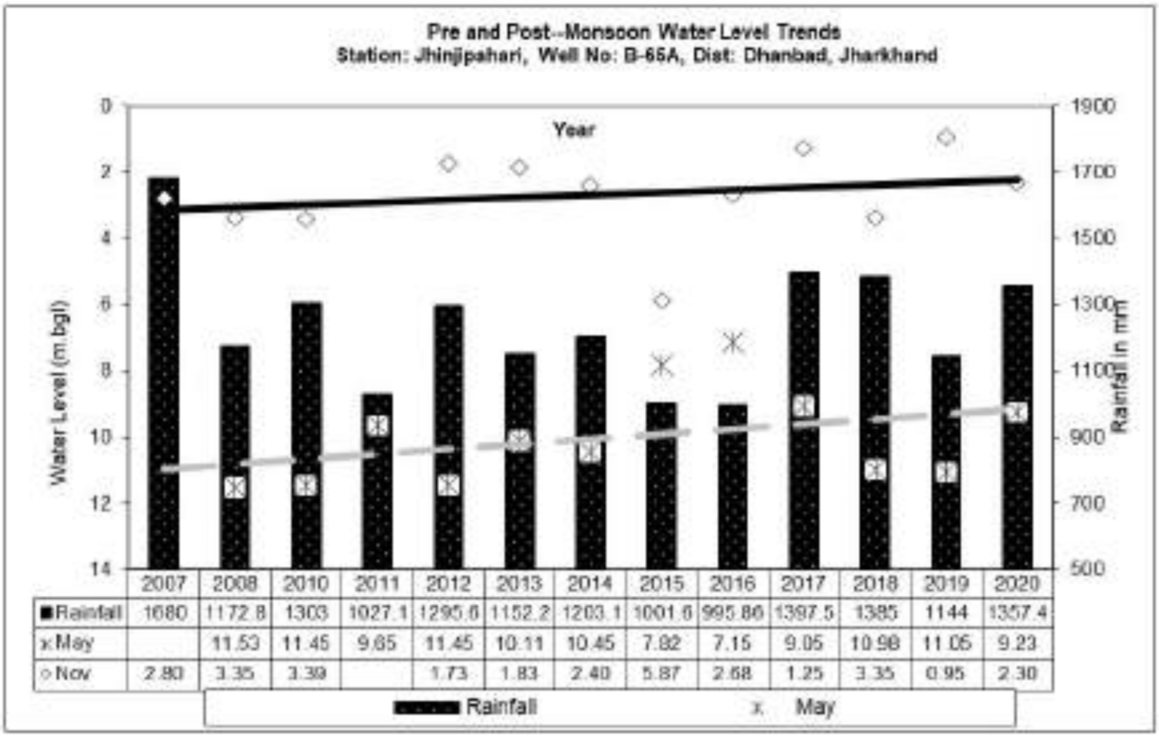


	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
May	8.95	4.95	2.85	3.8	5.5	9.30	6.95	3.30	4.60	5.92	4.40	6.45	4.85	6.20
Nov	2.70	1.3	1.50			1.42	1.67	2.30	4.50	6.98	1.30	2.10	3.40	3.20

HYDROGRAPHS OF CLUSTER-IV



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	7.06	7.80	5.53	7.77	9.18	8.76	7.56	7.71	7.33	8.90	5.30	6.55	6.58	6.98
◇ Nov	3.73	3.8	4.13	3.95		4.28	4.28	4.58	3.18	4.50	2.53	3.90	3.33	3.18

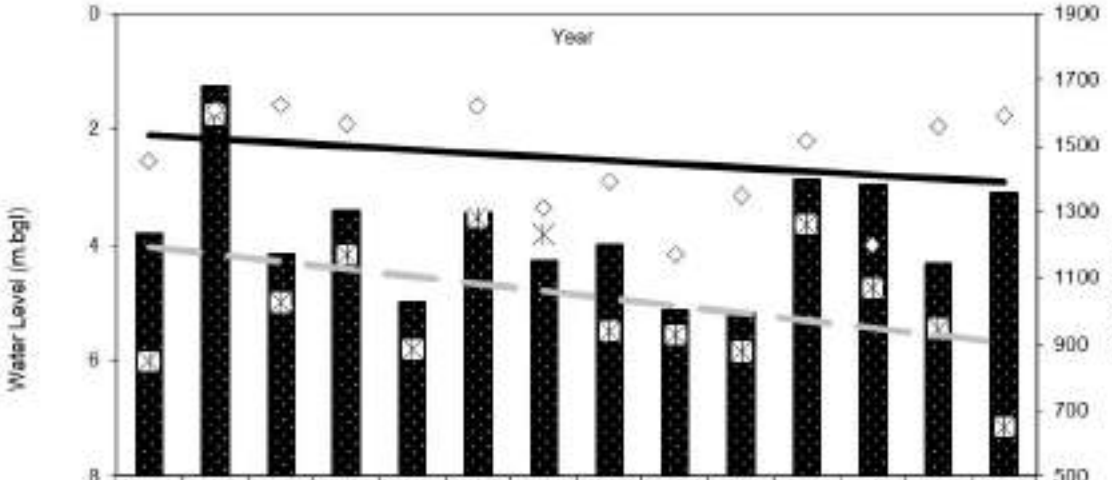


	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Rainfall	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May		11.53	11.45	9.65	11.45	10.11	10.45	7.82	7.15	9.05	10.98	11.05	9.23
◇ Nov	2.80	3.35	3.39		1.73	1.83	2.40	5.87	2.68	1.25	3.35	0.95	2.30

Annexure – VI

HYDROGRAPHS OF CLUSTER-V

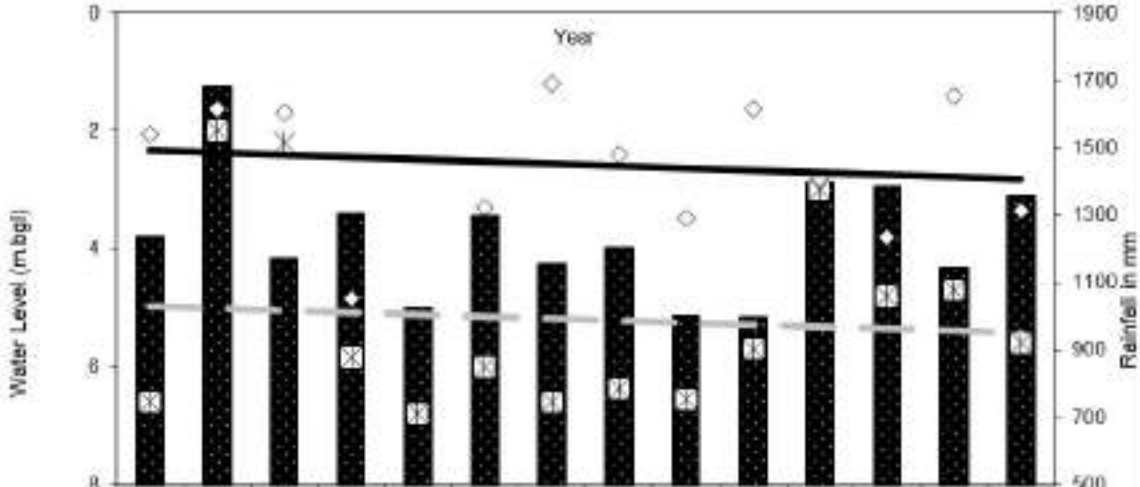
Pre and Post--Monsoon Water Level Trends
Station: Ekra, Well No: A-16, Dist: Dhanbad, Jharkhand



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	6	1.73	4.99	4.17	5.8	3.53	3.80	5.50	5.55	5.85	3.65	4.75	5.45	7.15
◦ Nov	2.54	1.65	1.58	1.9		1.60	3.35	2.90	4.17	3.15	2.20	4.00	1.95	1.75

Rainfall x May

Pre and Post--Monsoon Water Level Trends
Station: Jogta, Well No: D-23, Dist: Dhanbad, Jharkhand

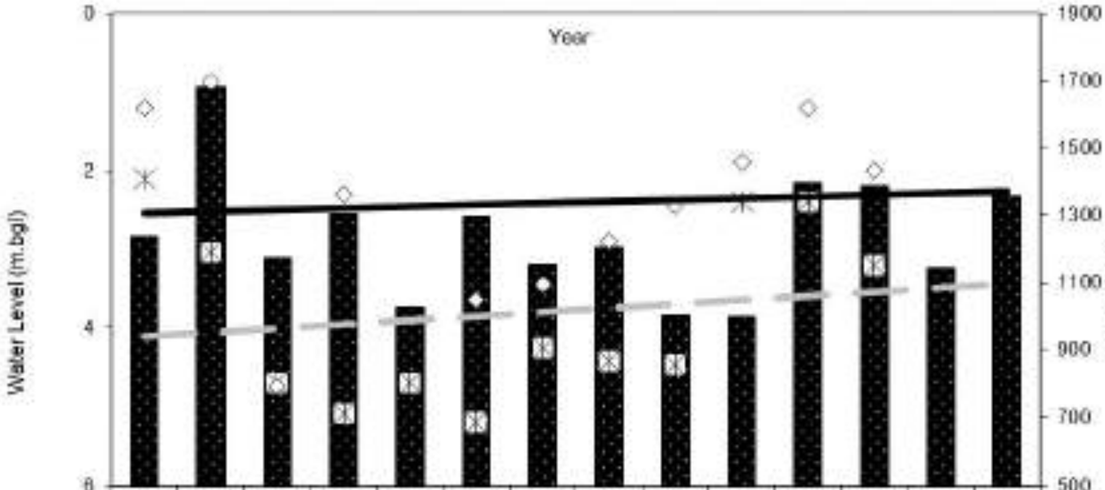


	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	6.6	2.00	2.20	5.85	6.8	6.00	6.60	6.38	6.55	5.70	3.00	4.80	4.70	5.60
◦ Nov	2.05	1.62	1.70	4.85		3.30	1.20	2.40	3.48	1.63	2.80	3.80	1.40	3.35

Rainfall x May

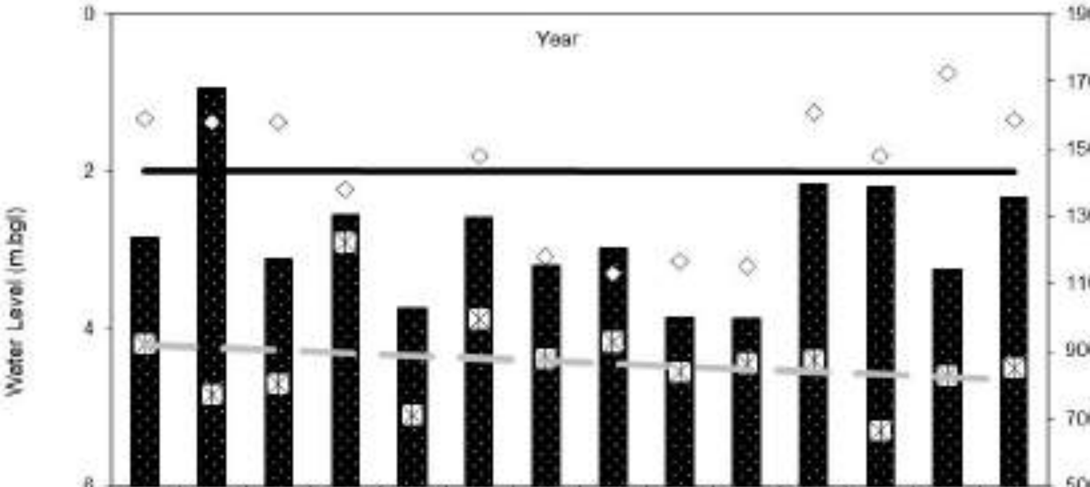
Annexure – VI

HYDROGRAPHS OF CLUSTER-VI



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	2.1	3.04	4.70	5.1	4.7	5.20	4.26	4.42	4.48	2.40	2.40	3.20		
◇ Nov	1.20	0.87	4.75	2.3		3.65	3.45	2.90	2.45	1.90	1.20	2.00		

Rainfall x May



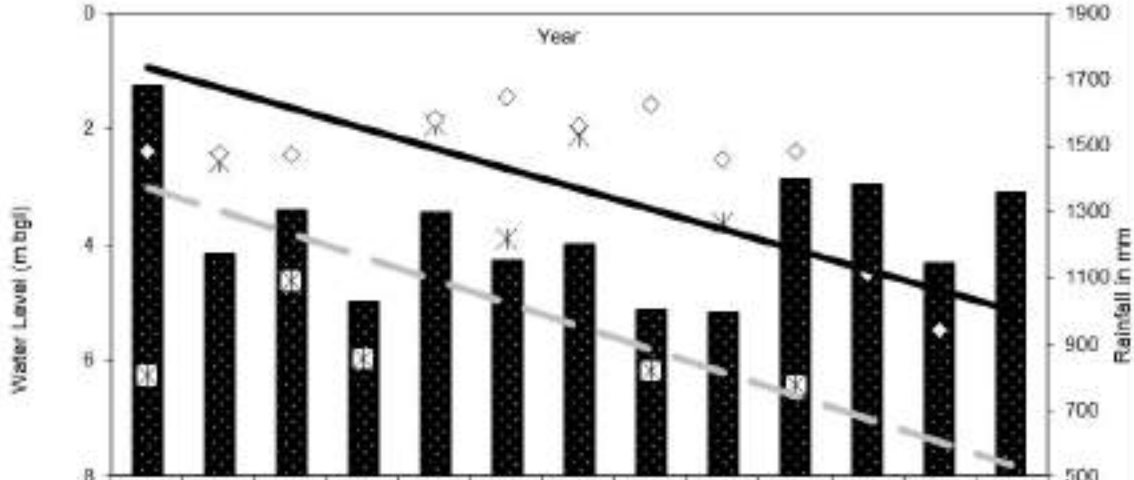
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	4.2	4.84	4.70	2.9	5.1	3.88	4.38	4.17	4.55	4.45	4.40	5.30	4.60	4.50
◇ Nov	1.33	1.37	1.37	2.23		1.80	3.08	3.30	3.15	3.20	1.25	1.80	0.75	1.35

Rainfall x May

Annexure – VI

HYDROGRAPHS OF CLUSTER-VII

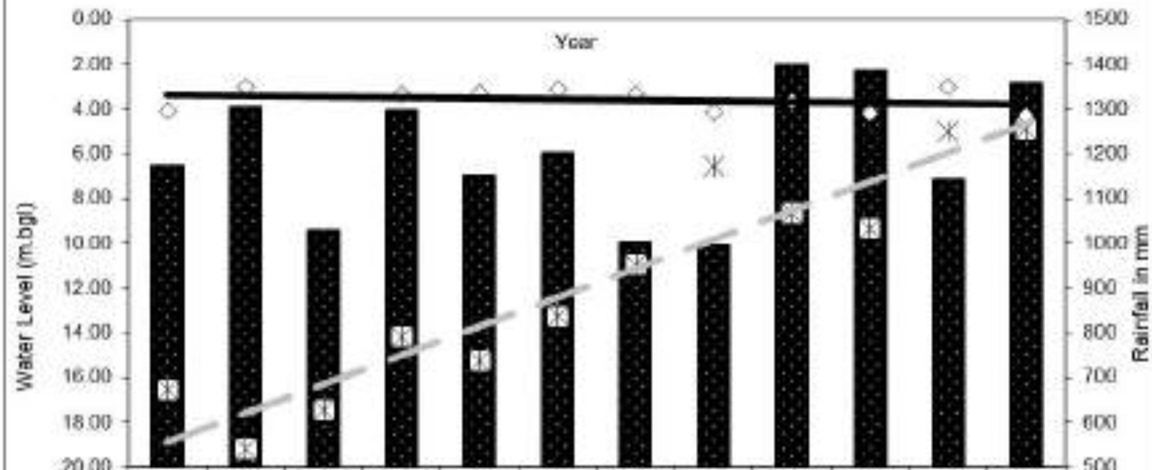
Pre and Post--Monsoon Water Level Trends
Station: Harliadih, Well No: D-55, Dist: Dhanbad, Jharkhand



	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1680	1172.82	1303	1027.07	1295.55	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May	6.25	2.57	4.62	5.97	1.93	3.90	2.10	6.17	3.62	6.42	8.90	8.42	9.42
◇ Nov	2.37	2.42	2.44		1.82	1.45	1.95	1.57	2.52	2.37	4.50	5.47	8.60

Rainfall x May

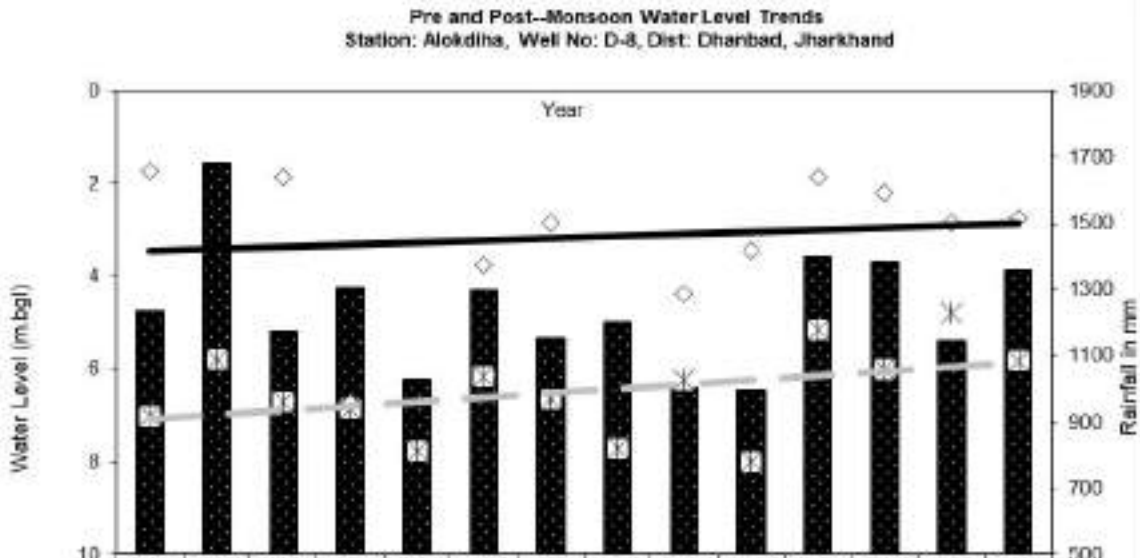
Pre and Post--Monsoon Water Level Trends
Station: Dhansar, Well No: D-80, Dist: Dhanbad, Jharkhand



	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1172.82	1303	1027.07	1295.55	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May	16.55	19.20	17.45	14.2	15.25	13.30	10.97	6.55	8.65	9.35	5.00	4.90
◇ Nov	4.1	3.05		3.35	3.32	3.15	3.35	4.15	3.70	4.20	3.05	4.30

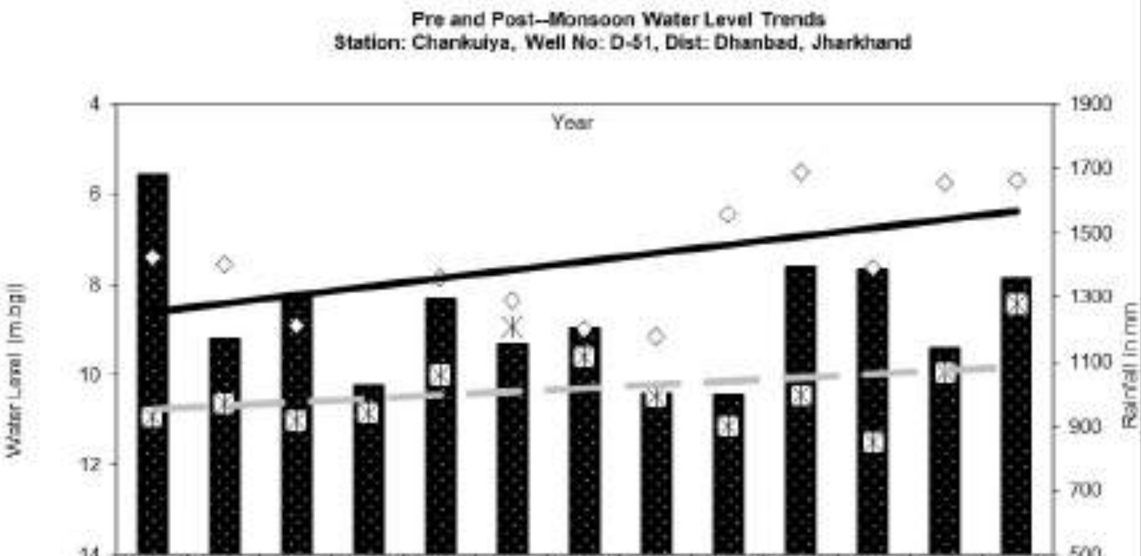
Rainfall x May

HYDROGRAPHS OF CLUSTER-VIII



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	7.02	5.80	6.70	6.85	7.76	6.15	6.65	7.73	6.24	8.00	5.15	6.00	4.80	5.83
○ Nov	1.73		1.87	6.73		3.75	2.85		4.38	3.43	1.85	2.20	2.85	2.75

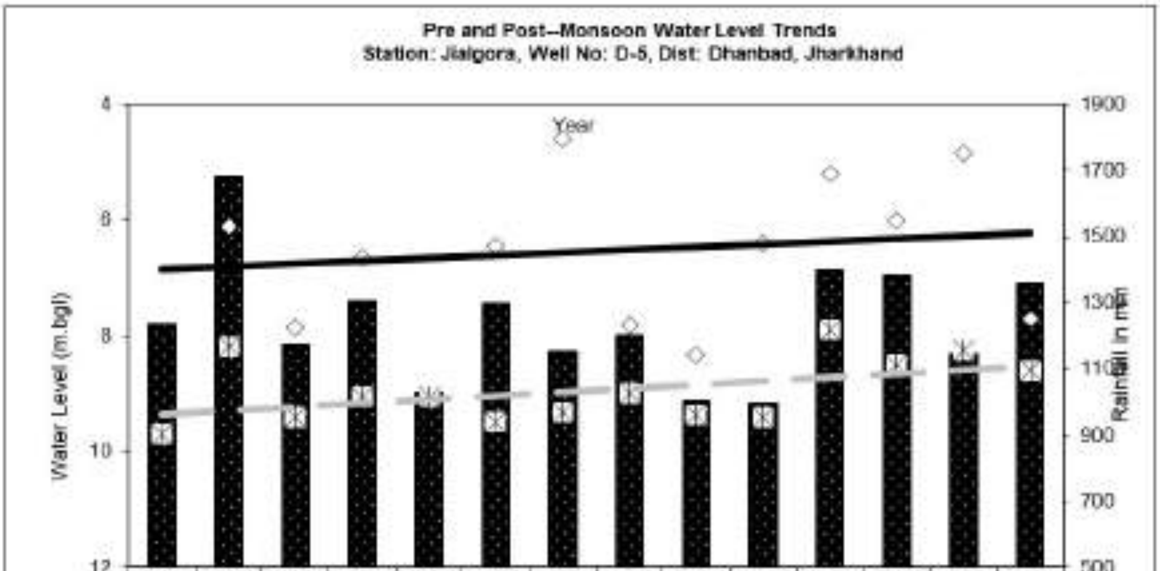
Rainfall x May



	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1680	1172.82	1303	1027.07	1295.55	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May	10.95	10.65	11.03	10.85	10	8.94	9.60	10.48	11.15	10.45	11.50	9.95	8.45
○ Nov	7.40	7.57	8.93		7.85	8.35	9.00	9.15	6.45	5.50	7.65	5.75	5.70

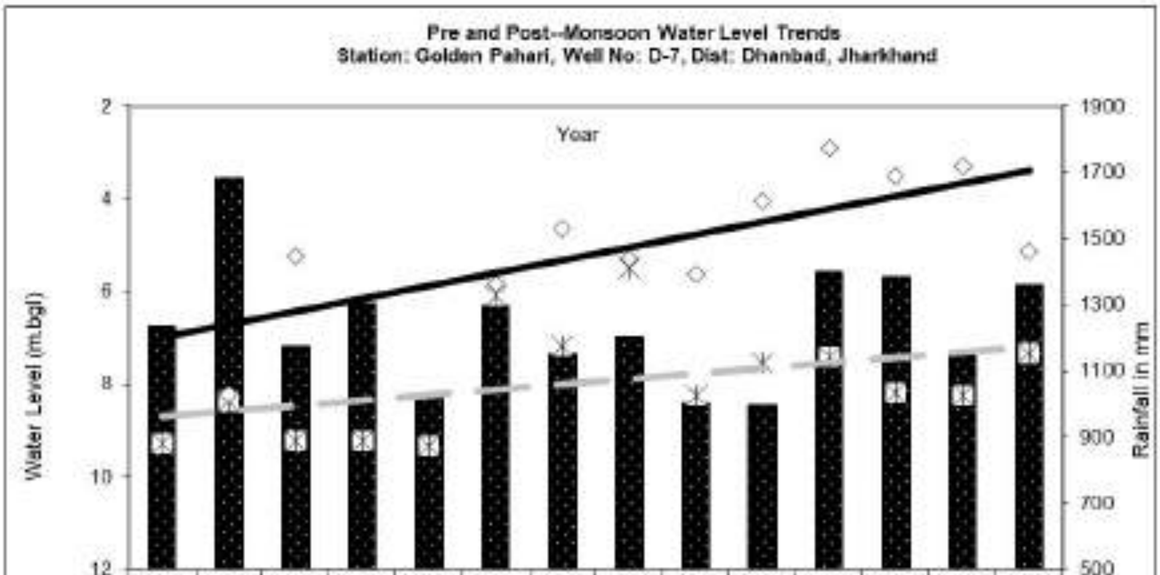
Rainfall x May

HYDROGRAPHS OF CLUSTER-IX



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1285.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	9.7	8.18	9.40	9.05	9.05	9.50	9.32	9.00	9.37	9.40	7.90	8.50	8.25	8.60
◇ Nov		6.1	7.85	6.65		6.45	4.59	7.80	8.33	6.40	5.20	6.00	4.85	7.70

Rainfall x May



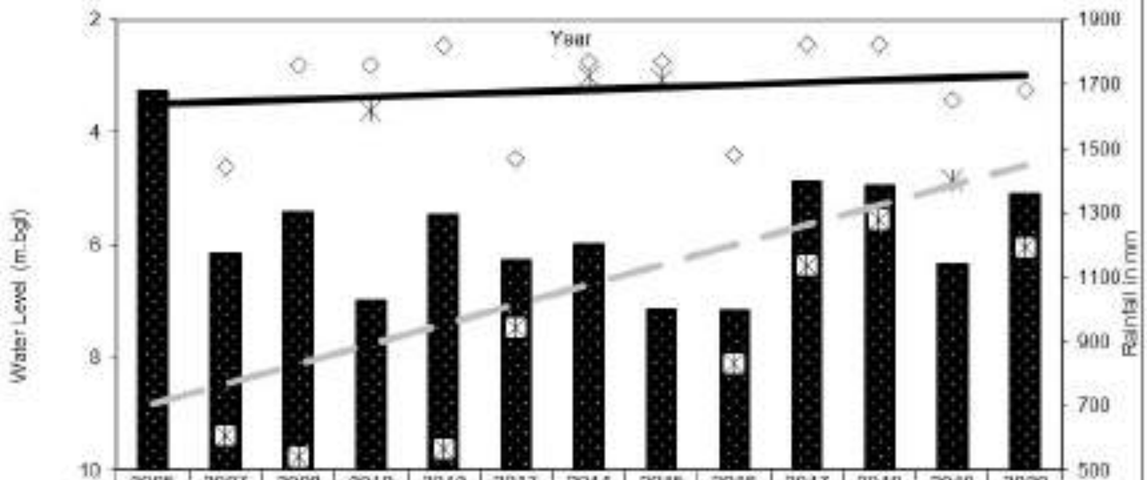
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	9.28	8.38	9.23	9.23	9.33	6.08	7.19	5.50	8.25	7.53	7.40	8.20	8.23	7.33
◇ Nov		8.21	5.23			5.83	4.63	5.28	5.81	4.03	2.90	3.50	3.28	5.13

Rainfall x May

Annexure – VI

HYDROGRAPHS OF CLUSTER-X

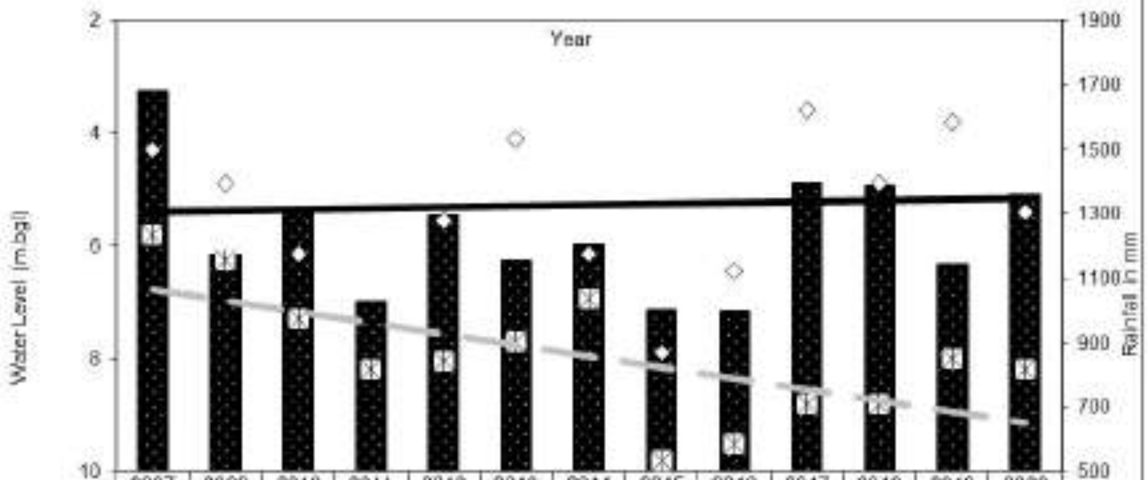
Pre and Post--Monsoon Water Level Trends
Station: Bhowra, Well No: A-19, Dist: Dhanbad, Jharkhand



	2005	2007	2008	2010	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1680	1172.82	1303	1027.07	1295.55	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
× May	10.31	9.39	9.76	3.61	9.61	7.46	3.00	3.05	8.10	6.37	5.55	4.85	6.05
◦ Nov		4.61	2.81	2.81	2.46	4.46	2.75	2.75	4.40	2.45	2.45	3.43	3.25

Rainfall × May

Pre and Post--Monsoon Water Level Trends
Station: Patherdih, Well No: D-35, Dist: Dhanbad, Jharkhand



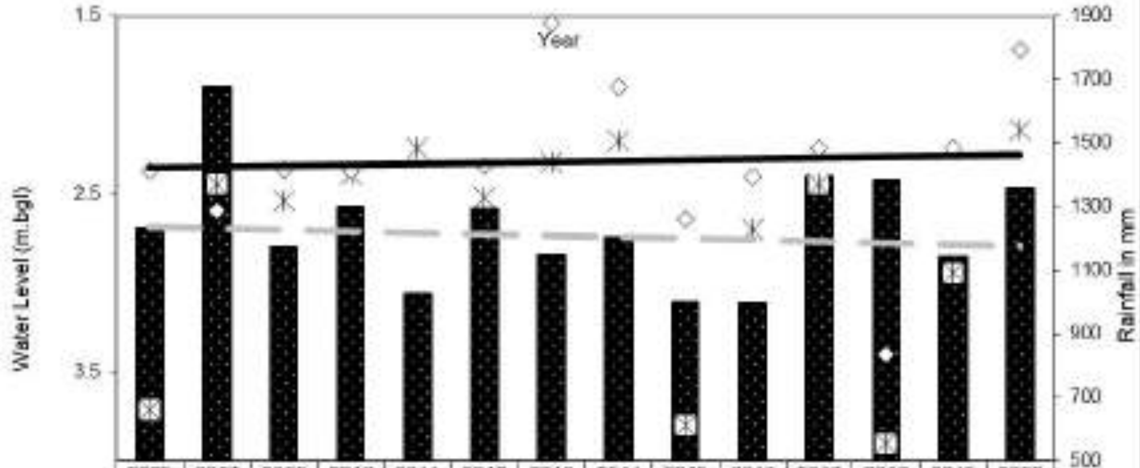
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1680	1172.82	1303	1027.07	1295.55	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
× May	5.8	6.25	7.30	8.2	8.05	7.70	6.94	9.80	9.52	8.80	8.80	8.00	8.20
◦ Nov	4.30	4.9	6.15		5.55	4.10	6.15	7.90	6.45	3.60	4.90	3.80	5.40

Rainfall × May

Annexure – VI

HYDROGRAPHS OF CLUSTER-XI

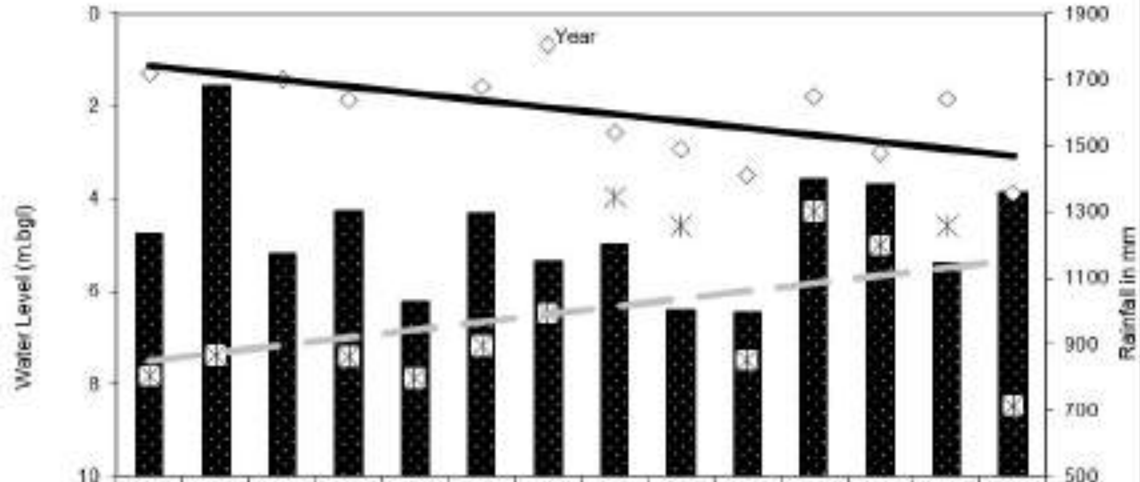
Pre and Post--Monsoon Water Level Trends
Station: Kachi Balihari, Well No: A-17, Dist: Dhanbad, Jharkhand



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	3.71	2.44	2.54	2.39	2.24	2.52	2.32	2.20	3.80	2.70	2.44	3.90	2.94	2.14
○ Nov	2.37	2.59	2.36	2.37		2.34	1.54	1.90	2.64	2.40	2.24	3.40	2.24	1.69

Rainfall x May

Pre and Post--Monsoon Water Level Trends
Station: Gorbudih, Well No: A-20, Dist: Dhanbad, Jharkhand



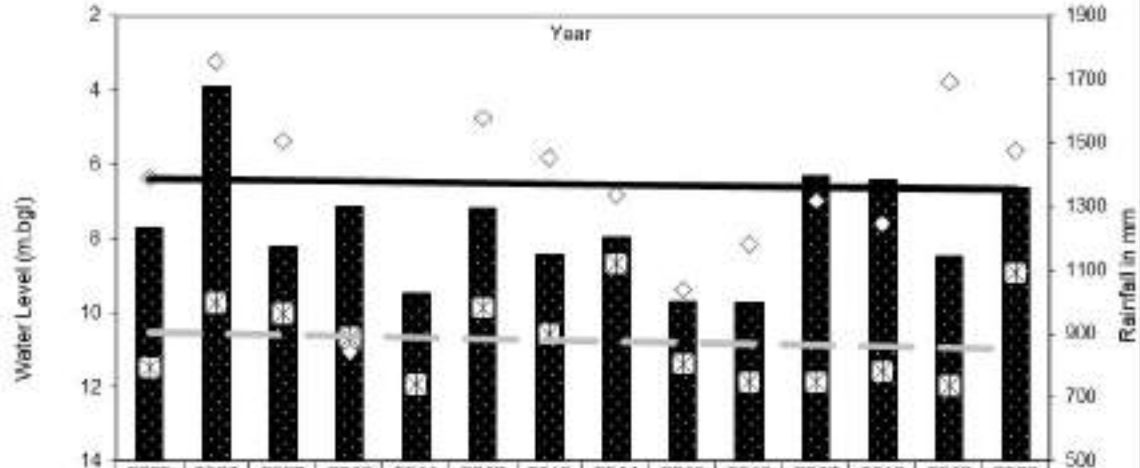
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	7.82	7.37		7.42	7.87	7.17	6.47	3.97	4.59	7.49	4.27	5.00	4.57	8.47
○ Nov	1.29		1.43	1.87		1.57	0.67	2.55	2.93	3.50	1.77	3.00	1.82	3.87

Rainfall x May

Annexure – VI

HYDROGRAPHS OF CLUSTER-XIII

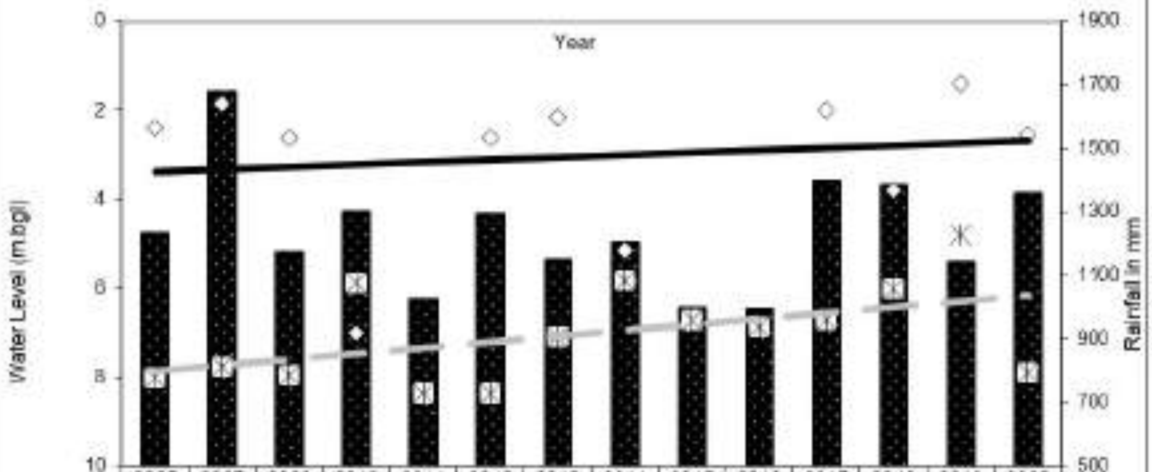
Pre and Post--Monsoon Water Level Trends
Station: Machyyara, Well No: A-23, Dist: Dhanbad, Jharkhand



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	11.49	9.72	10.01	10.67	11.92	9.87	10.57	8.67	11.37	11.87	11.87	11.58	11.97	8.92
◦ Nov	6.37	3.24	5.37	11.07		4.75	5.82	6.82	9.37	8.13	6.97	7.60	3.77	5.62

Rainfall x May

Pre and Post--Monsoon Water Level Trends
Station: Mahuda, Well No: B-25, Dist: Dhanbad, Jharkhand



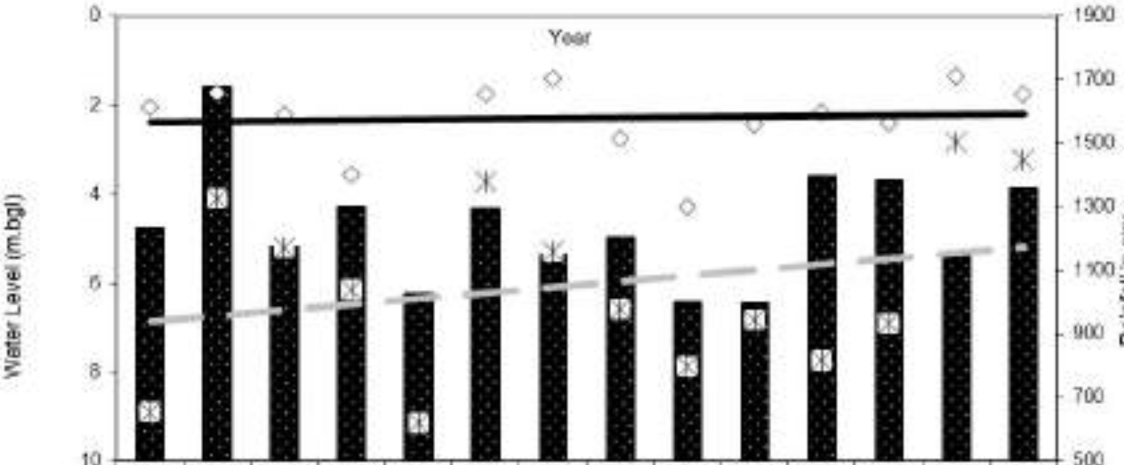
	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	8	7.75	7.95	5.88	8.35	8.35	7.08	5.82	6.70	6.88	6.70	6.00	4.80	7.90
◦ Nov	2.40	1.85	2.60	7		2.60	2.15	5.15			2.00	3.80	1.40	2.55

Rainfall x May

Annexure – VI

HYDROGRAPHS OF CLUSTER-XIV

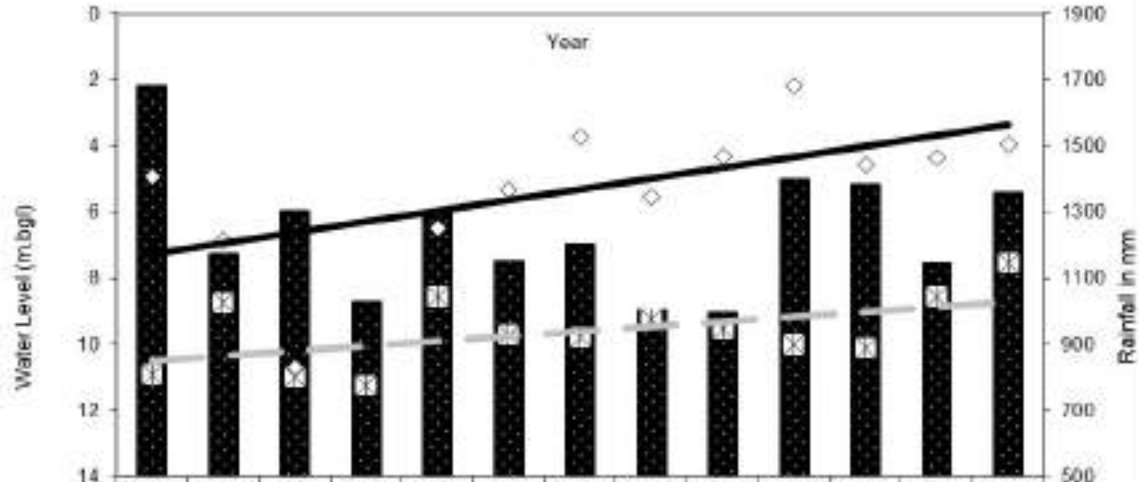
Pre and Post--Monsoon Water Level Trends
Station: Lohapatti, Well No: B-23, Dist: Dhanbad, Jharkhand



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	8.89	4.09	5.19	6.14	9.14	3.71	5.27	6.57	7.86	6.81	7.74	6.9	2.84	3.24
○ Nov	2.04	1.72	2.22	3.56		1.74	1.39	2.74	4.29	2.41	2.14	2.4	1.34	1.76

Rainfall x May

Pre and Post--Monsoon Water Level Trends
Station: Simatanr, Well No: B-67, Dist: Dhanbad, Jharkhand



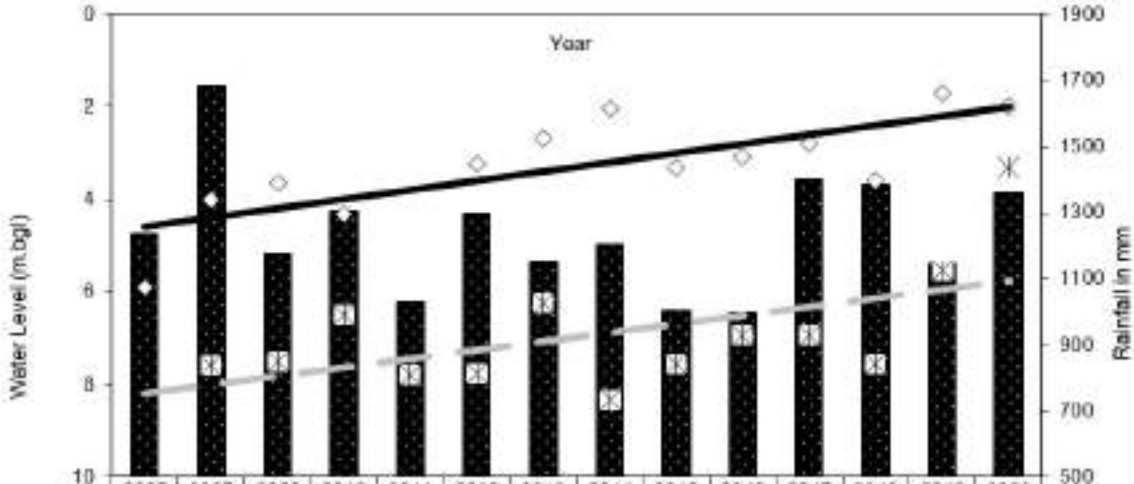
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May	10.9	8.75	11.00	11.25	8.55	9.73	9.80	9.23	9.53	10.00	10.10	8.57	7.55
○ Nov	4.93	6.85	10.69		6.50	5.31	3.72	5.53	4.30	2.15	4.55	4.35	3.95

Rainfall x May

Annexure – VI

HYDROGRAPHS OF CLUSTER-XV

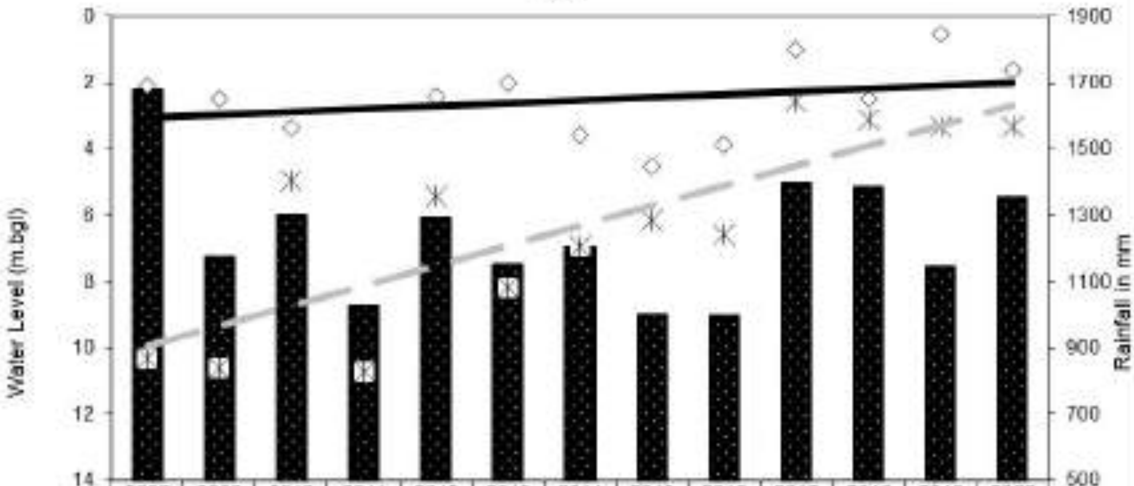
Pre and Post--Monsoon Water Level Trends
Station: Madhuband, Well No: B-32A, Dist: Dhanbad, Jharkhand



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1234	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4
x May		7.60	7.50	6.5	7.8	7.76	6.25	8.33	7.55	6.95	6.95	7.55	5.55	3.30
○ Nov	5.90	4	3.86	4.32		3.22	2.68	2.05	3.32	3.07	2.80	3.6	1.70	2.00

Rainfall x May

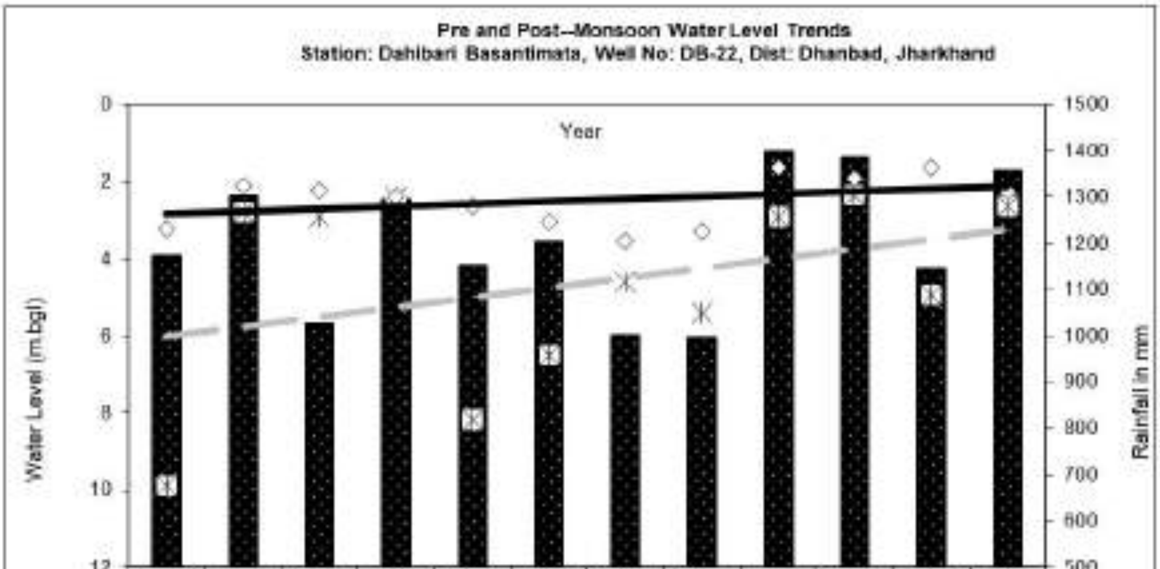
Pre and Post--Monsoon Water Level Trends
Station: Kesragora (Block-II Area), Well No: B-61A, Dist: Dhanbad, Jharkhand
Year



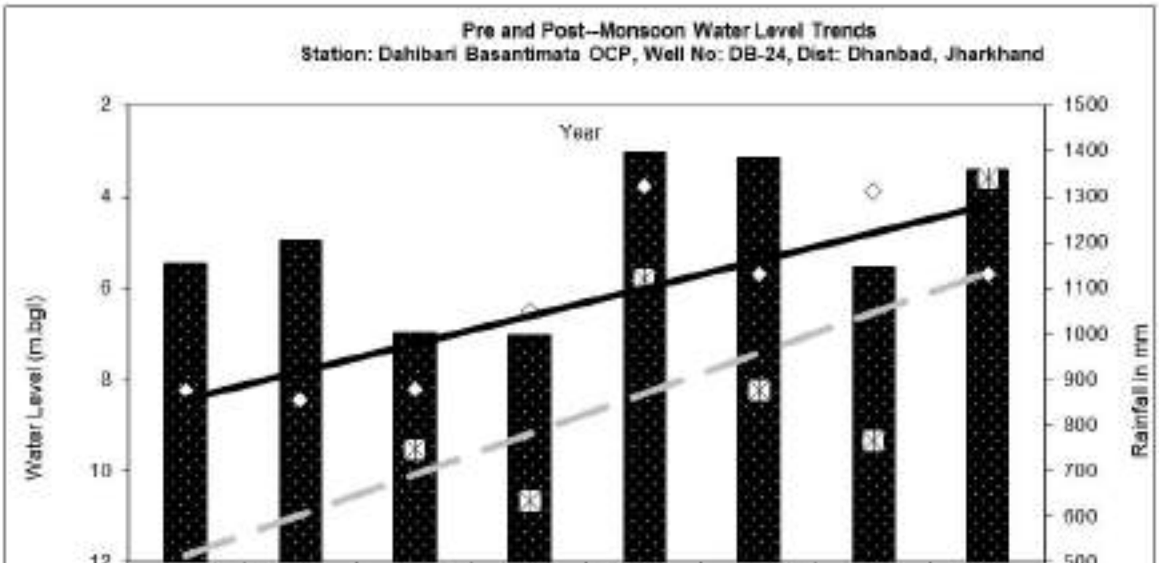
	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1680	1172.82	1303	1027.07	1295.55	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May	10.32	10.62	4.96	10.72	5.42	8.17	6.93	6.15	6.58	2.57	3.10	3.32	3.32
○ Nov	2.10	2.49	3.36		2.40	2.02	3.57	4.52	3.87	1.00	2.50	0.52	1.60

Rainfall x May

HYDROGRAPHS OF CLUSTER-XVI

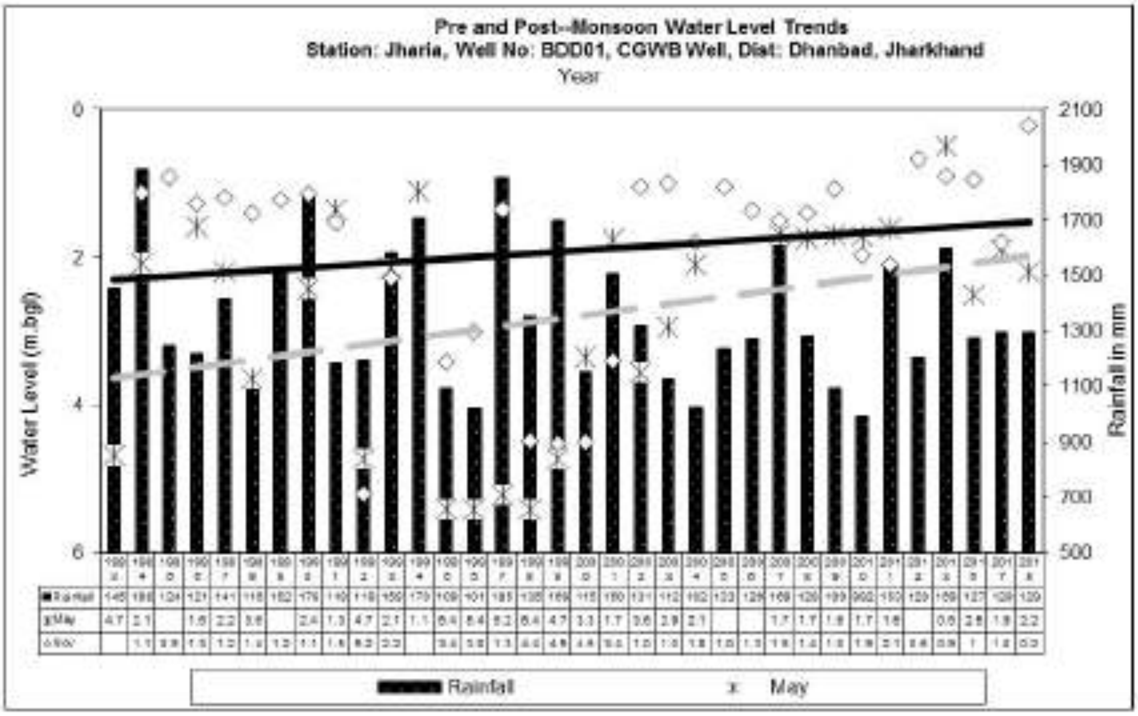


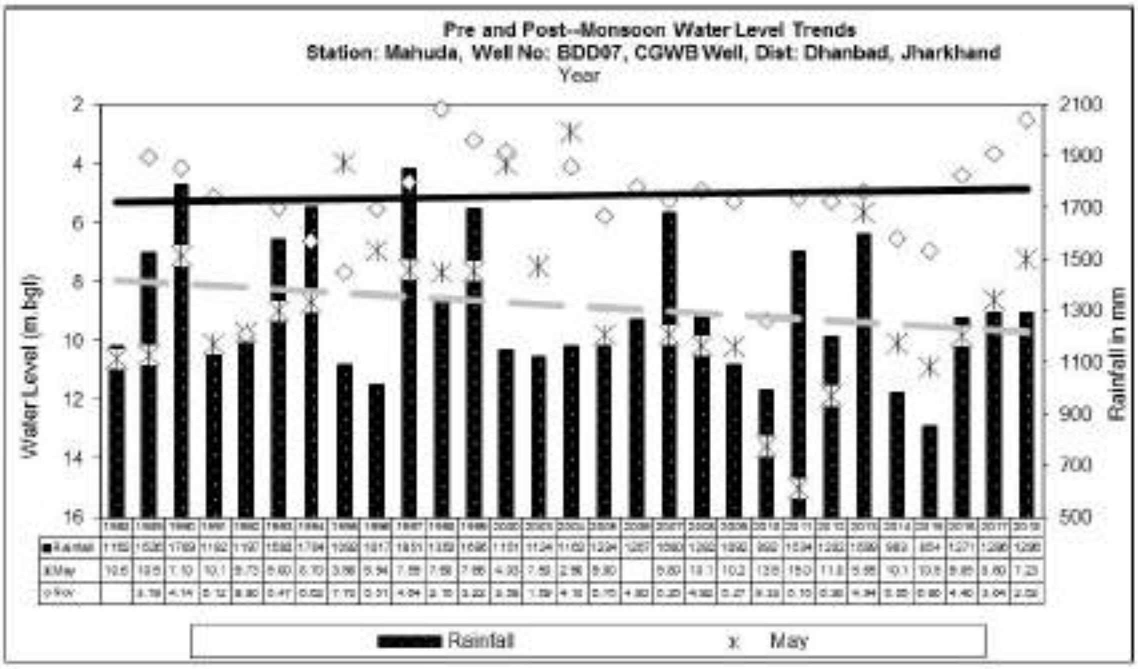
	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1172.82	1303	1027.07	1295.55	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May	9.89	2.79	2.90	2.43	8.18	6.48	4.60	5.40	2.93	2.34	4.93	2.63
◇ Nov	3.23	2.11	2.23	2.38	2.64	3.03	3.53	3.30	1.63	1.93	1.63	2.25



	2013	2014	2015	2016	2017	2018	2019	2020
■ Rainfall	1152.15	1203.06	1001.59	995.86	1397.5	1384.95	1144.01	1357.43
x May			9.52	10.65	5.80	8.25	9.35	3.60
◇ Nov	8.25	8.45	8.20	6.50	3.78	5.70	3.88	5.70

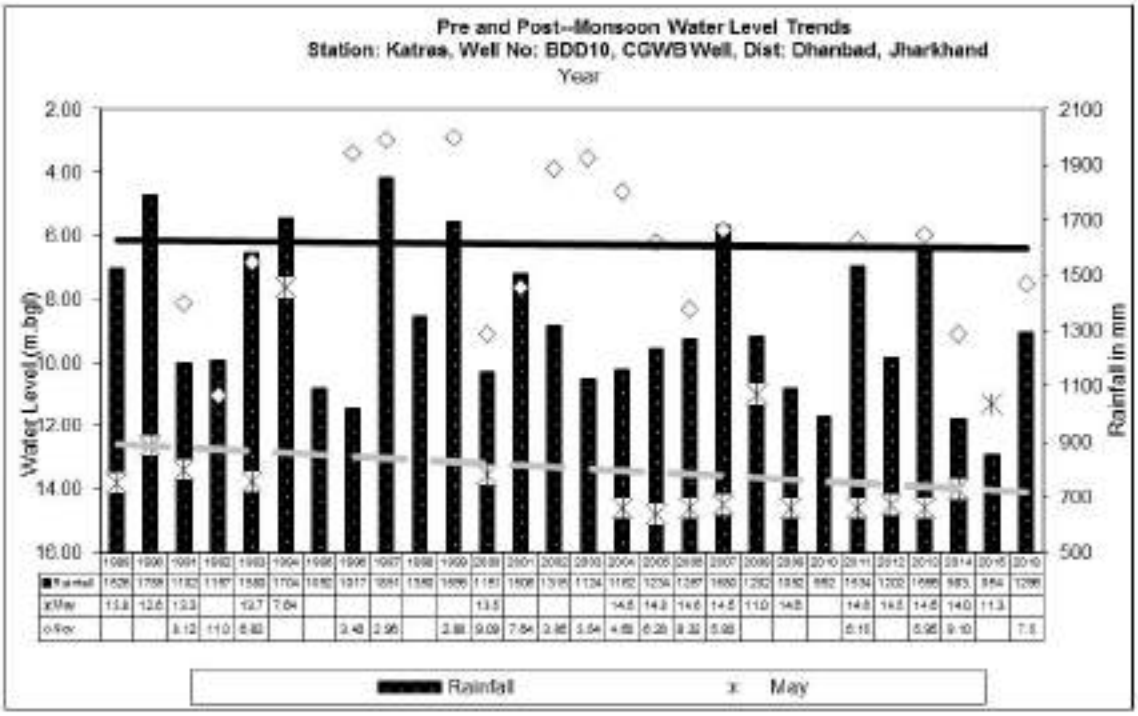
HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS

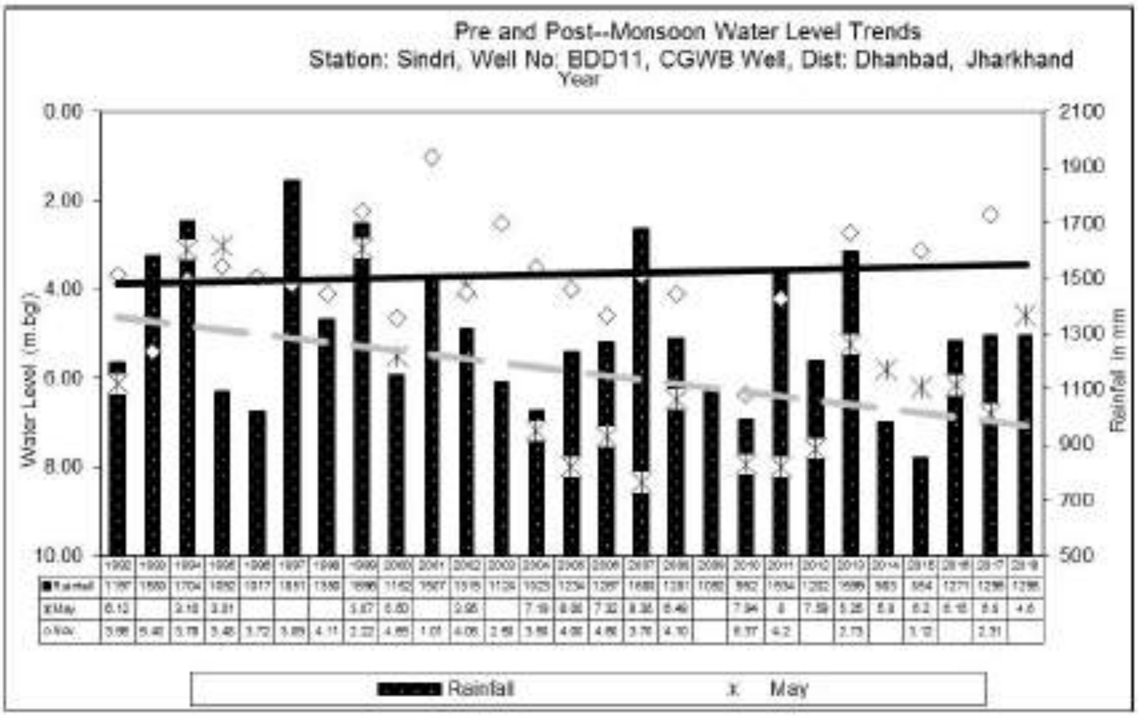




Annexure – VII

HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS





Annexure – VIII

GROUNDWATER SAMPLE LOCATION DETAILS

Sampling month: June month of the assessment year of 2020-21

Sl No	Name of Cluster	Ground Water Sample	Dug well (CMPDI)	Location	Sampling Date
					June'2020
1	CLUSTER-I	GW-1	B-15	BERA VILLAGE	01.06.2020
2	CLUSTER-II	GW-2	B-59	KHODOVALY VILLAGE	01.06.2020
3	CLUSTER-III	GW-3	A-29	GOVINDPUR,AMBAGAN VILLAGE	01.06.2020
4	CLUSTER-IV	GW-4	B-63	KESHALPUR, BATIGHAR	01.06.2020
5	CLUSTER-V	GW-5	D-30	BORKIBOA VILLAGE	01.06.2020
6	CLUSTER-VI	GW-6	D-25	GODHUR MORE	01.06.2020
7	CLUSTER-VII	GW-7	D-80	DHANSAR MINE RESCUE STN.	02.06.2020
8	CLUSTER-VIII	GW-8	D-49	NEAR GHANOODIH OC	02.06.2020
9	CLUSTER-IX	GW-9	D-5	JEALGORA, NEAR P.O.	02.06.2020
10	CLUSTER-X	GW-10	D-35	PATHERDIH RLY. COLONY	02.06.2020
11	CLUSTER-XI	GW-11	A-32	MONNIDIH BAZAR	01.06.2020
12	CLUSTER-XIII	GW-13	A-23	MACHHAYARA	01.06.2020
13	CLUSTER-XIV	GW-14	B-23	LOHAPATTI VILLAGE	01.06.2020
14	CLUSTER-XV	GW-15	B-32A	MADHUBAND VILLAGE	01.06.2020
15	CLUSTER-XVI	GW-16	DB-22	DAHIBARI,NICHE BASTI	02.06.2020

WATER QUALITY
(GROUND WATER- ALL PARAMETERS)

Year: 2020-21

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		GW-1 01.06.2020	**GW-2 01.06.2020**	**GW-3 01.06.2020**			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.2	0.5	APHA, 23rd Edition ,Carmine
2	Colour,in Hazen Units	1	2	1	1	5	APHA, 23rd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	40	48	54	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	18	22	28	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.62	0.78	0.54	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	<0.04	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500-Cl⁻B (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	<0.2	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	IS:3025(Part 47):1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	6.72	5.48	10.18	0.5	45	APHA, 23rd Edition, P4-127, 4500 - NO_3^-B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	8.21	8.10	8.12	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.002	APHA, 22nd Edition,4-Amino Antipyrine
15	Selenium, mg/l, Max	<0.007	<0.007	<0.007	0.007	0.01	IS :3025 part 56:2003,R-2019/APHA 23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	42	54	38	10	200	APHA –23rd Edition, P4-199, 4500 SO_4^{2-} E
17	Taste	Acceptable	Acceptable	Acceptable	Qualitative	Acceptable	APHA,23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($CaCO_3$),, mg/l, Max	112	138	140	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Total Arsenic (as As), mg/l,Max	<0.006	<0.006	<0.006	0.006	0.01	IS-3025, part 37:1988,R-2019/APHA23rd Edition AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025 Part 52:2003, R.2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	204	244	214	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness ($CaCO_3$), mg/l, Max	182	206	198	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	2	2	2	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	<0.1	<0.1	<0.1	0.1	5	IS 3025 Part 49 : 1994,R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	<0.01	<0.01	0.01	0.02	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

WATER QUALITY

(GROUND WATER- ALL PARAMETERS)

Year: 2020-21

Sl. No	Parameter	Sampling Stations			Detection Limit	IS 10500 Drinking Water Standards	Standard / Test Method
		GW-4 01.06.2020	GW-5 01.06.2020	GW-6 01.06.2020			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.2	0.5	APHA, 23[rd] Edition,Carmine
2	Colour,in Hazen Units	3	1	1	1	5	APHA, 23[rd] Edition Pt-Co. Method
3	Calcium (as Ca), mg/l, Max	36	156	64	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	20	98	36	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA 23[rd] Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.52	0.72	0.74	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	<0.04	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500-Cl B. (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	<0.2	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019, AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	IS 3025 (Part 47) 1994 (Reaffirmed 2019) APHA, 23[rd] Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	APHA, 23[rd] Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	12.84	33.08	15.28	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3^- B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	7.96	8.04	7.81	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.002	APHA, 23[rd] Edition,4-Amino Antipyrine
15	Selenium, mg/l, Max	<0.007	<0.007	<0.007	0.007	0.01	IS -3025,part 56 2003,R-2019/APHA 23[rd] Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	48	127	64	2	200	APHA –23rd Edition: P-4-199, 4500 SO_4^{2-} E
17	Taste	Acceptable	Acceptable	Acceptable	Qualitative	Acceptable	APHA 23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($CaCO_3$),, mg/l, Max	144	96	112	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Total Arsenic (as As), mg/l,Max	<0.006	<0.006	<0.006	0.006	0.01	IS-3025, part 37:1988 R-2019/APHA23rd Edition AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025 Part 52:2003, R 2019,AAS-Flame APHA, 23[rd] Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	208	764	236	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness ($CaCO_3$), mg/l, Max	182	680	204	4	200	IS 3025, Part 21: 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	2	3	1	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	<0.1	<0.1	<0.1	0.1	5	IS 3025 Part 49 : 1994,R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	<0.01	<0.01	0.01	0.02	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA 23[rd] Edition, AAS-GTA

WATER QUALITY

(GROUND WATER- ALL PARAMETERS)

Year: 2020-21

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		GW-7 02.06.2020	GW-8 02.06.2020	GW-9 02.06.2020			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.2	0.5	APHA, 23rd Edition Carmine
2	Colour,in Hazen Units	1	1	1	1	5	APHA, 23rd Edition Pt -Co Method
3	Calcium (as Ca), mg/l, Max	64	52	144	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	36	24	68	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA,23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.46	0.76	0.58	0.2	1.0	APHA, 23RD Edition, Page 4-90 m , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	<0.04	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500-Cl B. (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	<0.2	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	IS 3025(Part 47):1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	16.28	8.92	28.42	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3^- B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	7.88	8.12	8.15	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.002	APHA, 22nd Edition,4-Amino Antipyrine
15	Selenium, mg/l, Max	<0.007	<0.007	<0.007	0.007	0.01	IS -3025 part 56 2003,R.2019/APHA 23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	62	38	174	2	200	APHA –23rd Edition P-4-199, 4500 SO_4^{2-} E
17	Taste	Acceptable	Acceptable	Acceptable	Qualitative	Acceptable	APHA,23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity (C_aCO_3), mg/l, Max	76	132	96	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Total Arsenic (as As), mg/l,Max	<0.006	<0.006	<0.006	0.006	0.01	IS-3025, part 37:1988,R-2019/APHA23rd Edition AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025 Part 52:2003, R 2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	244	196	744	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness (C_aCO_3), mg/l, Max	172	148	636	4	200	IS 3025, Part 21: 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	1	1	2	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	<0.1	<0.1	<0.1	0.1	5	IS 3025 Part 49 : 1994,R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	<0.01	<0.01	0.01	0.02	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

WATER QUALITY

(GROUND WATER- ALL PARAMETERS)

Year: 2020-21

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		GW-10 02.06.2020	GW-11 01.06.2020	GW-13 01.06.2020			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.2	0.5	APHA, 23rd Edition Carmine
2	Colour,in Hazen Units	3	3	2	1	5	APHA, 23rd Edition Pt-Co Method
3	Calcium (as Ca), mg/l, Max	52	32	164	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	46	26	104	2	250	IS-3025/32:1988, R 2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.82	0.56	0.76	0.2	1.0	APHA, 23RD Edition, Page 4-90 m, 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	<0.04	<0.04	0.04	0.2	APHA 23rd Edition, , 4500-Cl B. (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	<0.2	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019, AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	IS 3025(Part 47) 1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	18.42	12.48	7.88	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3^- B, UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	8.21	7.96	8.03	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.002	APHA, 23rd Edition 4-Amino Antipyrine
15	Selenium, mg/l, Max	<0.007	<0.007	<0.007	0.007	0.01	IS -3025,part 56 2003,R-2019/APHA 23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	88	44	178	2	200	APHA –23rd Edition, P-4-199, 4500 SO_4^{2-} E
17	Taste	Acceptable	Acceptable	Acceptable	Qualitative	Acceptable	APHA 23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity (c_aco_3)., mg/l, Max	98	152	88	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Total Arsenic (as As), mg/l,Max	<0.006	<0.006	<0.006	0.006	0.01	IS-3025, part 37:1988,R-2019/APHA23rd Edition AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025 Part 52:2003, R:2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	248	178	756	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness (c_aco_3), mg/l, Max	192	164	680	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	2	1	2	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	<0.1	<0.1	<0.1	0.1	5	IS 3025 Part 49 : 1994,R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	<0.01	<0.01	0.01	0.02	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

WATER QUALITY
(GROUND WATER- ALL PARAMETERS)

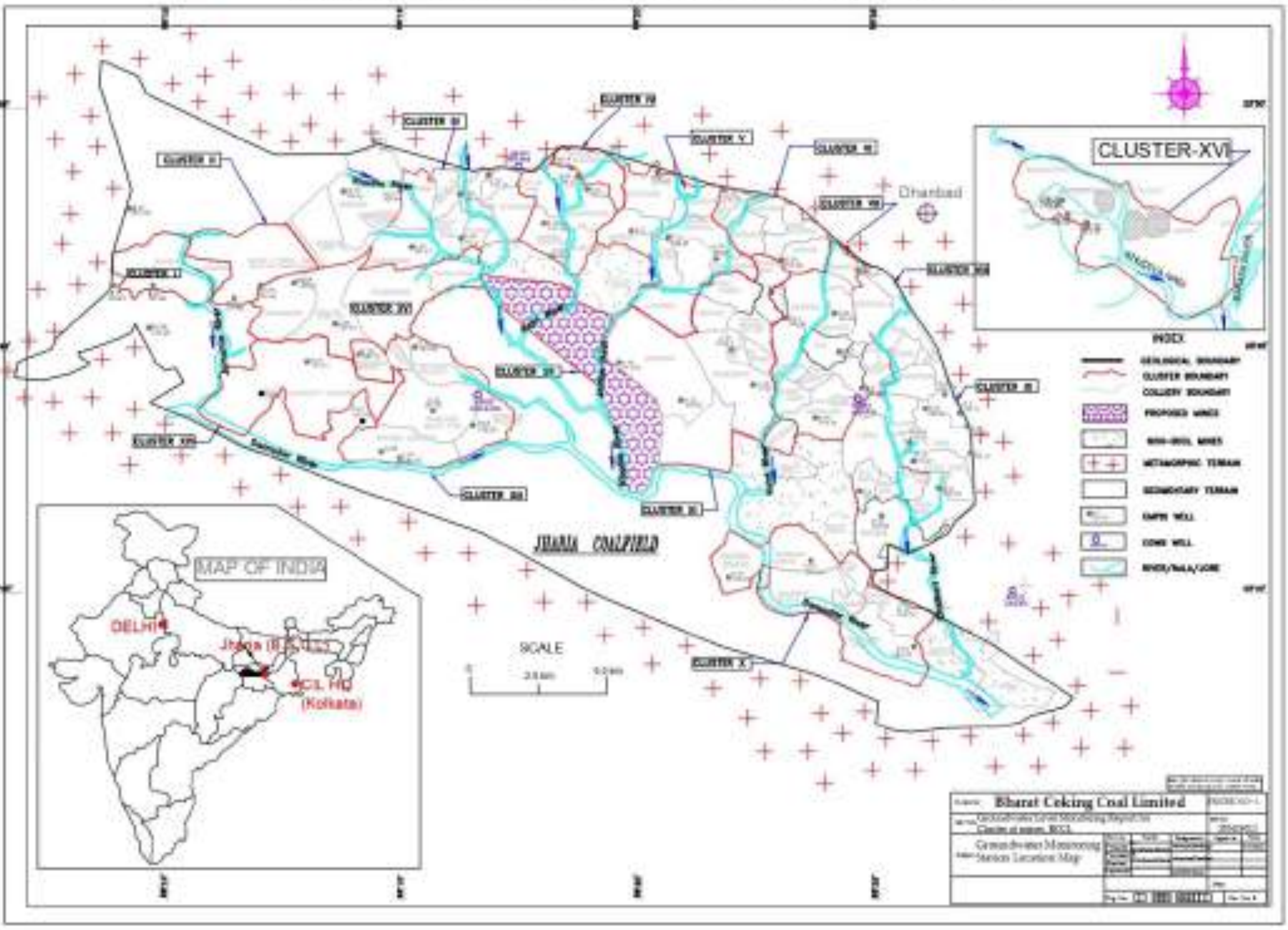
Year: 2020-21

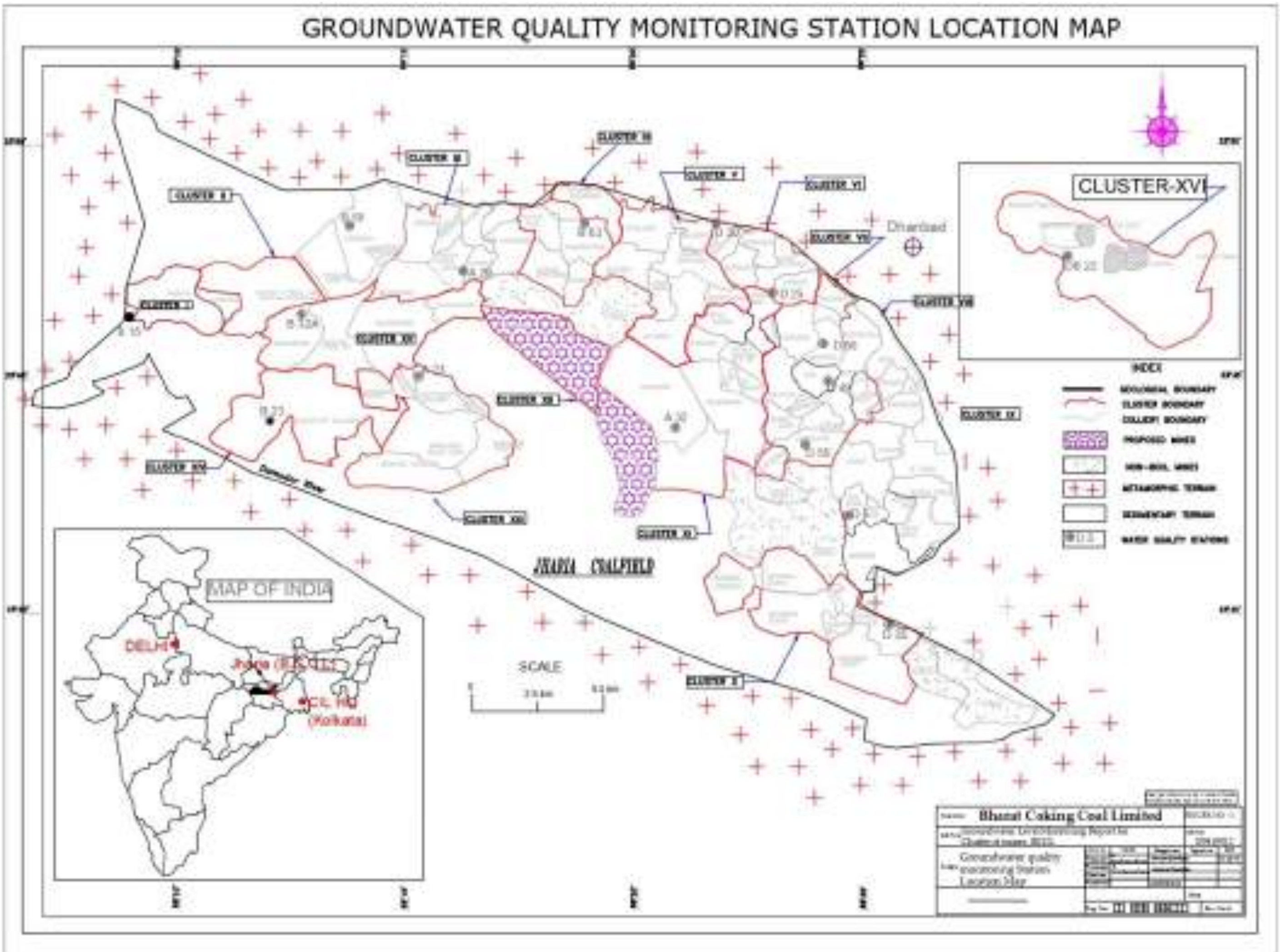
Sl. No.	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		GW 14 01.06.2020	GW15 01.06.2020	GW16 02.06.2020			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.2	0.5	APHA, 23rd Edition, Carmine
2	Colour,in Hazen Units	1	1	3	1	5	APHA, 23rd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	44	180	122	1.6	75	IS 3025, Part 40, 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	56	104	66	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.52	0.44	0.66	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	<0.04	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500-Cl B (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	<0.2	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	IS:3025(Part 47) 1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	11.48	7.58	14.76	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3^- B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	8.08	7.83	7.89	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.002	APHA, 22nd Edition,4-Amino Antipyrine
15	Selenium, mg/l, Max	<0.007	<0.007	<0.007	0.007	0.01	IS -3025 part 56 2003,R-2019/APHA 23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	40	152	128	2	200	APHA –23rd Edition, P-4-199, 4500 SO_4^{2-} E
17	Taste	Acceptable	Acceptable	Acceptable	Qualitative	Acceptable	APHA,23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($_{CaCO_3}$),, mg/l, Max	110	98	116	4	200	IS 3025, Part 23 : 1986 R 2019 Titration Method
19	Total Arsenic (as As), mg/l,Max	<0.006	<0.006	<0.006	0.006	0.01	IS-3025, part 37:1988,R-2019/APHA23rd Edition AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025 Part 52:2003, R.2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	204	756	512	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness ($_{CaCO_3}$), mg/l, Max	194	666	472	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	1	1	1	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	<0.1	<0.1	<0.1	0.1	5	IS 3025 Part 49 : 1994,R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	<0.01	<0.01	0.01	0.02	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

Abbreviations

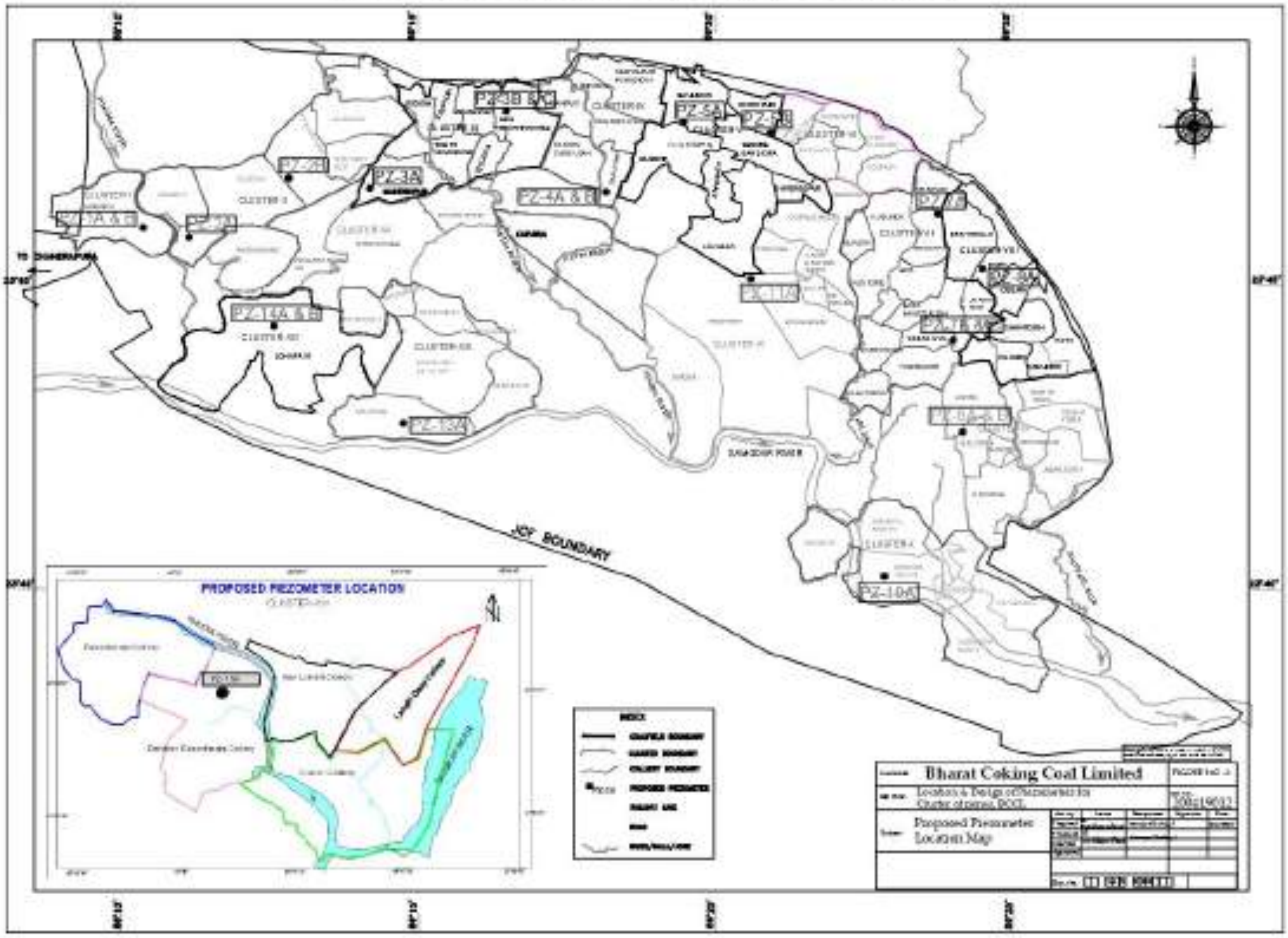
AMSL: Above mean sea level
Avg.: Average
APT: Aquifer Pumping Test
BCCL: Bharat Coking Coal Ltd.
bgl: Below Ground Level
Buffer zone: periphery of the 10 km radius from the project boundary
Core zone: Project / mine / colliery boundary (leasehold area)
CMPDI: Central Mine Plan & Design Institute
DVC: Damodar Valley Corporation
DTW: Depth to water level
GW: Groundwater
IMD: Indian Meteorological Division
JCF: Jharia Coalfield
RCF: Raniganj Coalfield
MADA: Mineral Area Development Authority
MCM: Million Cubic Meter
MGD: Million Gallon per day
NTU: Nephlometric Turbidity unit
OC / UG: Opencast / Underground
OCP / UGP: Opencast Project / Underground Project
RL: Reduced Level
RWH: Rainwater Harvesting
FF: Fire Fighting

GROUNDWATER MONITORING STATION LOCATION MAP

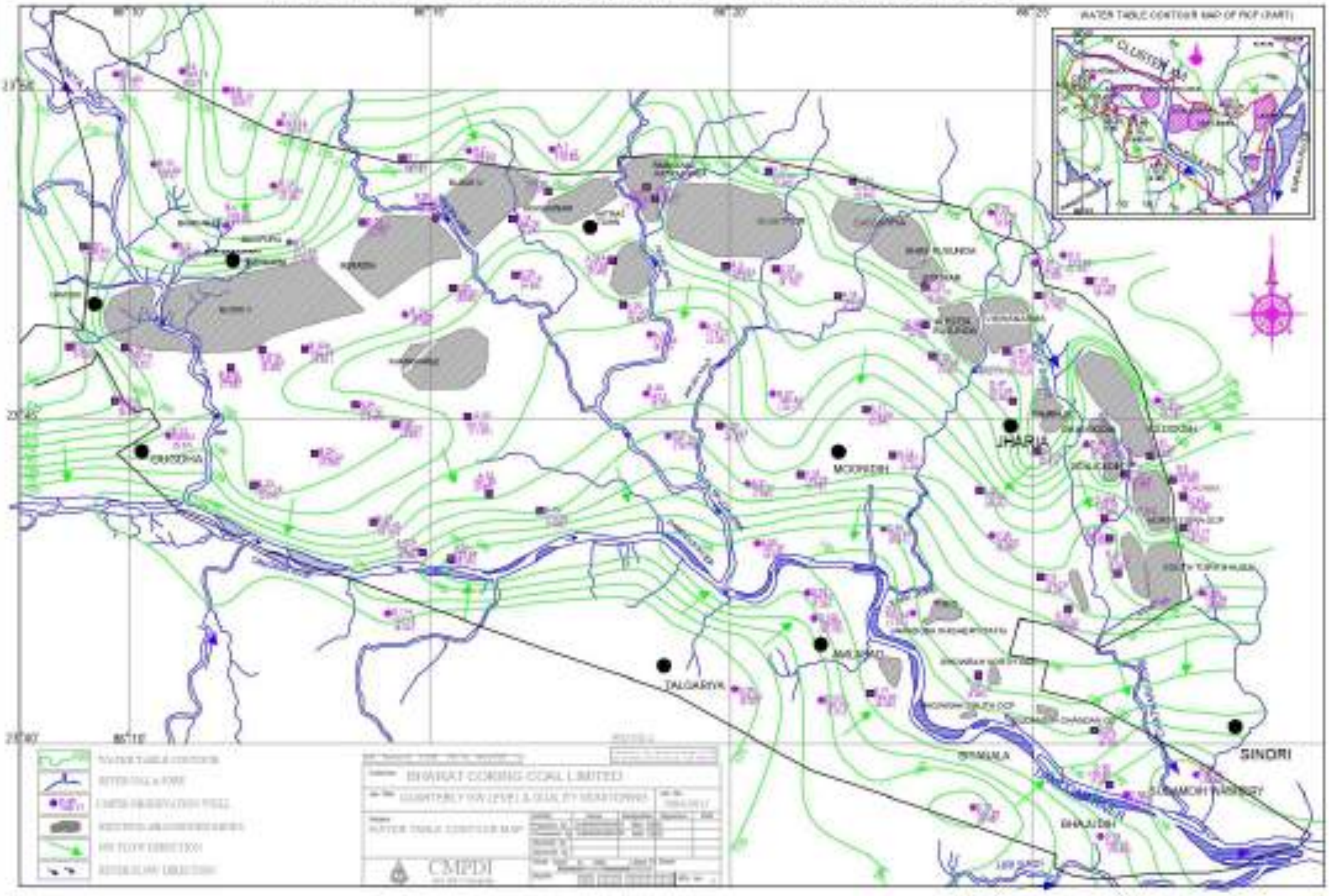


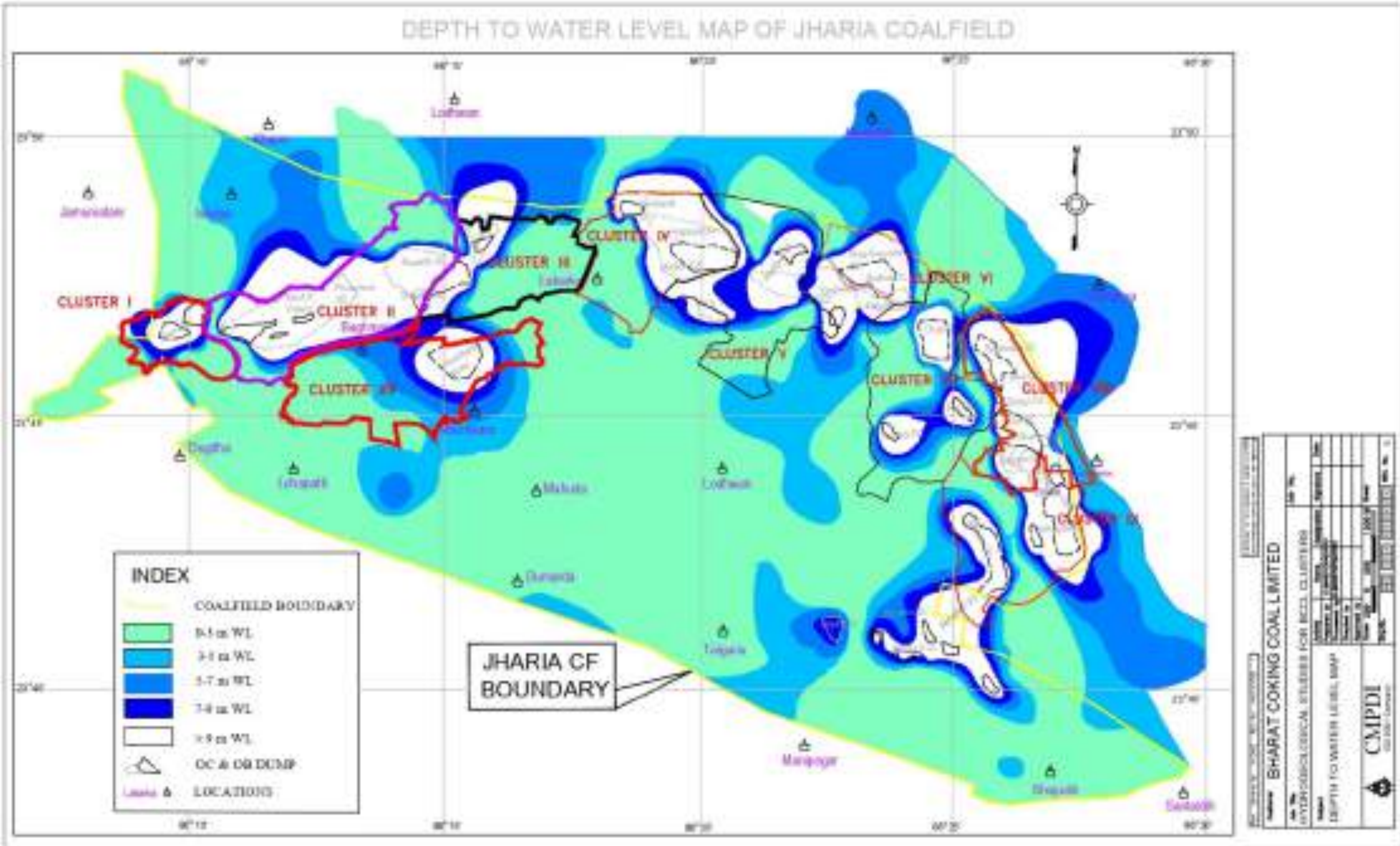

GROUNDWATER QUALITY MONITORING STATION LOCATION MAP
CLUSTER-XVI
Dhanbad
INDEX
JHARIA COALFIELD
SCALE
MAP OF INDIA
DELHI
(Kolkata)
Bharat Coking Coal Limited

PROPOSED PIEZOMETER LOCATION MAP, JCF & RCF (part)



WATER TABLE CONTOUR MAP OF PRE-MONSOON 2020




DEPTH TO WATER LEVEL MAP OF JHARIA COALFIELD
CLUSTER I
CLUSTER II
CLUSTER III
CLUSTER IV
CLUSTER V
CLUSTER VI
CLUSTER XV
JHARIA CF
BOUNDARY
INDEX
COALFIELD BOUNDARY
0-3 m WL
3-5 m WL
5-7 m WL
7-9 m WL
>9 m WL
OC & OB DUMP
LOCATIONS
BHARAT COKING COAL LIMITED
HYDROGEOLOGICAL STUDIES FOR BCCL CLUSTERS
DEPTH TO WATER LEVEL MAP
CMPDI

Annexure 17:

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of Mudidih (MW5)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jarian Nala and Ekra Nala.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analysed 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 parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -V**		Month: **AUG 2021**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	**MW5** First Fortnight 09.08.2021	**MW5** Second Fortnight 23.08.2021	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	48	34	*100 (Max)*
2	pH	7.85	8	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	12	16	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By JSA/SA/SSA

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

Approved By HOD(In-charge) Environment RI-2, CMPDI, Dhanbad

WATER QUALITY REPORT
OF
BHARAT COKING COAL LIMITED,
CLUSTER – V

(FOR THE Q.E. MARCH, 2020)

E. C. no. J-11015/01/2010-IA.II (M) dated30.05.2018.

CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CLUSTER - V

(FOR THE Q.E. MARCH, 2020)

CONTENTS

WATER QUALITY REPORT OF BHARAT COKING COAL LIMITED CLUSTER – V

(FOR THE Q.E. MARCH, 2020)

E. C. no. J-11015/01/2010-IA.II (M) dated30.05.2018.

CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

EXECUTIVE SUMMARY

1.0 Introduction

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

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by $23^{0}37'$ N to $23^{0}52'$ N latitudes and $86^{0}09'$ E to $86^{0}30'$ E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEFCC while granting environmental clearance of project, consent letter issued by the respective SPCB's, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Water sampling stations

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

3.0 Methodology of sampling and analysis

3.1 Water quality

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

4.0 Results and interpretations

4.2 Water quality

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

CHAPTER - I

INTRODUCTION

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

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

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

1.1 The Cluster-V is in the Northern part of the Jharia coalfield. It includes a group of 7 Mines (viz. Nichitpur, OCP, Mudidih colliery (Mixed), Tetulmari colliery (Mixed), SendraBansjora colliery (Mixed), Kankanee colliery (Mixed), Bansdeopur colliery (Mixed) and Loyabad UG colliery. The Cluster – V is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – V are operating since pre nationalization period (prior to 1972-73). It is connected by both Railway and Road. The drainage of the area is governed by Jarian Nala and Ekra Nala.

1.2 The Cluster-V is designed to produce 4.854 MTPA (normative) and 6.311 MTPA (peak) capacity of coal. The average grade of coal W – III & W- IV.

The Project has Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEF&CC) for a rated capacity 4.854 MTPA (normative) and 6.311 MTPA (peak) capacity of coal production vide letter no. J-11015/01/2010-IA.II (M) dated 30th JUNE, 2018

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

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CHAPTER – II

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. - I**)

i) Drinking water quality at **Mine Discharge of Nichitpur**

ii) Drinking water quality at **Mine Discharge of Loyabad UG.**

iii) Drinking water quality at **Mine Discharge of Mudidih**

iv) Drinking water quality at **Mine Discharge of Tetulmari**

v) Drinking water quality at **Mine Discharge of Kankanee**

vi) Drinking water quality at **Mine Discharge of Sendra Bansjora OC.**

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis and for 27 parameters on half yearly basis. The drinking and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at 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 parmeters are within the permissible limits.

WATER QUALITY

(MINE EFFLUENT- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2019-20.**

Name of the Cluster : **Cluster -V** PERIOD: **Q. E. MARCH- 2020.**

Type of Sample:	Mine Discharge Water Sample	Name of Mine	NICHITPUR
Testing Protocol:	As per DW Standards (IS- 10500)	Date of Sampling:	25.03.20

Sl. No	Parameter	Test Result	Detection Limit	Permissible Limit	Method of Testing
1	Boron (as B), mg/l, Max	<0.2	0.2	0.5	APHA, 23rd Edition Carmine
2	Colour in Hazen Units	2	1	5	APHA, 23rd Edition, Pt -Co. Method
3	Calcium (as Ca), mg/l, Max	64	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	38	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.75	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 -F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500-Cl-B (Iodometric Method I)
8	Iron (as Fe), mg/l, Max	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	0.005	0.01	IS 3025(Part 47):1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	14.37	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3 – B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	8.29	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	0.001	0.002	APHA, 22nd Edition,4-Amino Antipyrine
15	Mercury (as Hg), mg/l, Max	<0.0005	0.0005	0.001	APHA,23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	120	2	200	APHA -23rd Edition, P-4-189, 4500-SO_4^{2-} E
17	Taste	Acceptable	Qualitative	Acceptable	APHA,23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($CaCO_3$), mg/l, Max	178	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Cadmium (as Cd), mg/l, Max	<0.0006	0.0006	0.003	APHA,23rd Edition, AAS-GTA Method
20	Total Chromium (as Cr), mg/l, Max	<0.04	0.04	0.05	IS-3025 Part 52:2003, R:2019 AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	494	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness ($CaCO_3$), mg/l, Max	252	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	3	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	<0.1	0.1	5	IS 3025 Part 49 : 1994 R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	0.01	0.02	IS 3025 Part 54 : 2003 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

All values are expressed in mg/lit unless specified.

Analysed By

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY

(MINE EFFLUENT- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2019-20.**

Name of the Cluster : **Cluster -V** PERIOD: **Q. E. MARCH- 2020.**

Type of Sample: Mine Discharge Water Sample | Name of Mine: LOYABAD UG

Testing Protocol: As per DW Standards (IS- 10500) | Date of Sampling: 09.03.20

Sl. No	Parameter	Test Result	Detection Limit	Permissible Limit	Method of Testing
1	Boron (as B), mg/l, Max	<0.2	0.2	0.5	APHA, 21st Edition ,Carmine
2	Colour,in Hazen Units	3	1	5	APHA, 23rd Edition Pt-Co Method
3	Calcium (as Ca), mg/l, Max	80	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	112	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.67	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 -F- D [SPADNS Method]
7	Free Residual Chlorine, mg/l, Min	<0.04	0.04	0.2	APHA, 23rd Edition , 4500-Cl- B (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	0.005	0.01	IS 3025(Part 47):1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	25.9	0.5	45	APHA, 23rd Edition, P-4-127, 4500-NO3 – B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition , 2150-C
13	pH value	7.84	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	0.001	0.002	APHA, 22nd Edition,4-Amino Antipyrine
15	Mercury (as Hg), mg/l, Max	<0.0005	0.0005	0.001	APHA,23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	119	2	200	APHA -23rd Edition, P-4-199, 4500 SO 42- E
17	Taste	Acceptable	Qualitative	Acceptable	APHA,23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($CaCO_3$), mg/l, Max	104	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Cadmium (as Cd), mg/l, Max	<0.0005	0.0005	0.003	APHA,23rd Edition, AAS-GTA Method
20	Total Chromium (as Cr), mg/l, Max	<0.04	0.04	0.05	IS-3025 Part 52 2003, R:2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	714	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness ($CaCO_3$), mg/l, Max	416	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	3	1	5	IS 3025 Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	<0.1	0.1	5	IS 3025 Part 49 : 1994 R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	0.01	0.02	IS 3025 Part 54 : 2003 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

All values are expressed in mg/lit unless specified.

Analysed By
JRA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY

(MINE EFFLUENT- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2019-20.**
Name of the Cluster : **Cluster -V** PERIOD: **Q. E. MARCH- 2020.**

Type of Sample: Mine Discharge Water Sample Name of Mine **Mudidih**
Testing Protocol: As per DW Standards (IS- 10500) Date of Sampling: 17.03.20

Sl. No	Parameter	Test Result	Detection Limit	Permissible Limit	Method of Testing
1	Boron (as B), mg/l, Max	<0.2	0.2	0.5	APHA, 23rd Edition, Carmine
2	Colour in Hazen Units	1	1	5	APHA, 23rd Edition, Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	100	1.6	75	IS 3025, Part 40, 1991, R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	128	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.87	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500-Cl B (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	0.005	0.01	IS 3025 (Part 47) 1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	20.26	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3^- B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	7.95	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	0.001	0.002	APHA, 22nd Edition, 4-Amino Antipyrine
15	Mercury (as Hg), mg/l, Max	<0.0005	0.0005	0.001	APHA, 23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	86	2	200	APHA – 23rd Edition, P-4-189, 4500 SO_4^{2-} E
17	Taste	Acceptable	Qualitative	Acceptable	APHA 23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($CaCO_3$), mg/l, Max	102	4	200	IS 3025, Part 23, 1986 R 2019 Titration Method
19	Cadmium (as Cd), mg/l, Max	<0.0005	0.0005	0.003	APHA, 23rd Edition, AAS-GTA Method
20	Total Chromium (as Cr), mg/l, Max	<0.04	0.04	0.05	IS-3025 Part 52:2003, R 2019, AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	732	25	500	IS 3025, Part 16, 1984 R 2017 Gravimetric method
22	Total Hardness ($CaCO_3$), mg/l, Max	508	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	3	1	5	IS 3025 , Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	0.1	0.1	5	IS 3025 Part 49 : 1994 R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	0.01	0.02	IS 3025 Part 54 : 2003 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY

(MINE EFFLUENT- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2019-20.**

Name of the Cluster : **Cluster -V** PERIOD: **Q. E. MARCH- 2020.**

Type of Sample:	Mine Discharge Water Sample	Name of Mine	Tetulmari
Testing Protocol:	As per DW Standards (IS- 10500)	Date of Sampling:	11.03.20

Sl. No	Parameter	Test Result	Detection Limit	Permissible Limit	Method of Testing
1	Boron (as B), mg/l, Max	<0.2	0.2	0.5	APHA, 23rd Edition, Carmine
2	Colour in Hazen Units	4	1	5	APHA, 23rd Edition Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	98	1.6	75	IS 3025, Part 40, 1991, R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	164	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.68	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	0.04	0.2	APHA, 23rd Edition , 4500-Cl B (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	0.005	0.01	IS 3025 (Part 47) 1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.04	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	24.59	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3^- B : UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition , 2150-C
13	pH value	7.45	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	0.001	0.002	APHA, 22nd Edition,4-Amino Antipyrine
15	Mercury (as Hg), mg/l, Max	<0.0005	0.0005	0.001	APHA,23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	169	2	200	APHA –23rd Edition, P-4-189, 4500 SO_4^{2-} E
17	Taste	Acceptable	Qualitative	Acceptable	APHA 23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($CaCO_3$), mg/l, Max	106	4	200	IS 3025, Part 23, 1986 R 2019 Titration Method
19	Cadmium (as Cd), mg/l, Max	<0.0005	0.0005	0.003	APHA,23rd Edition, AAS-GTA Method
20	Total Chromium (as Cr), mg/l, Max	<0.04	0.04	0.05	IS-3025 Part 52:2003, R 2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	606	25	500	IS 3025, Part 16, 1984 R 2017 Gravimetric method
22	Total Hardness ($CaCO_3$), mg/l, Max	314	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	1	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	0.15	0.1	5	IS 3025 Part 49 : 1994 R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	0.01	0.02	IS 3025 Part 54 : 2003 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY
(MINE EFFLUENT- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2019-20.**
Name of the Cluster : **Cluster -V** PERIOD: **Q. E. MARCH- 2020.**

Type of Sample:	Mine Discharge Water Sample	Name of Mine	**Kankanee**
Testing Protocol:	As per DW Standards (IS- 10500)	Date of Sampling:	09.03.20

Sl. No	Parameter	Test Result	Detection Limit	Permissible Limit	Method of Testing
1	Boron (as B), mg/l, Max	<0.2	0.2	0.5	APHA, 23rd Edition, Carmine
2	Colour, in Hazen Units	4	1	5	APHA, 23rd Edition, Pt.-Co Method
3	Calcium (as Ca), mg/l, Max	82	1.6	75	IS 3025, Part 40: 1991, R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	142	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.62	0.2	1.0	APHA, 23RD Edition, Page 4-90 to, 4500-F-D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	0.04	0.2	APHA, 23rd Edition, 4500-Cl B (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019, AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	0.005	0.01	IS 3025 (Part 47) 1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	19.73	0.5	45	APHA, 23rd Edition, P-4-127, 4500-NO_3^- B., UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, 2150-C
13	pH value	7.74	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	0.001	0.002	APHA, 22nd Edition, 4-Amino Antipyrine
15	Mercury (as Hg), mg/l, Max	<0.0005	0.0005	0.001	APHA, 23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l Max	74	2	200	APHA – 23rd Edition, P-4-199, 4500 SO_4^{2-} E
17	Taste	Acceptable	Qualitative	Acceptable	APHA, 23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($CaCO_3$), mg/l, Max	92	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Cadmium (as Cd), mg/l, Max	<0.0005	0.0005	0.003	APHA, 23rd Edition, AAS-GTA Method
20	Total Chromium (as Cr), mg/l, Max	<0.04	0.04	0.05	IS-3025 Part 52:2003, R 2019, AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	632	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness ($CaCO_3$), mg/l, Max	388	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	2	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	0.1	0.1	5	IS 3025 Part 49 : 1994 R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	0.01	0.02	IS 3025 Part 54 : 2003 R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

All values are expressed in mg/lit unless specified.

Analysed By	Checked By Lab In Charge RI-2, CMPDI, Dhanbad	Approved By HOD(In-charge) Environment RI-2, CMPDI, Dhanbad

WATER QUALITY

(MINE EFFLUENT- 25 PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2019-20.**

Name of the Cluster : **Cluster -V** PERIOD: **Q. E.MARCH- 2020.**

Type of Sample: Mine Discharge Water Sample Name of Mine **Sendra Bansjora**

Testing Protocol: As per DW Standards (IS- 10500) Date of Sampling: 09.03.20

Sl. No	Parameter	Test Result	Detection Limit	Permissible Limit	Method of Testing
1	Boron (as B), mg/l, Max	<0.2	0.2	0.5	APHA, 23rd Edition, Carmine
2	Colour in Hazen Units	1	1	5	APHA, 23rd Edition, Pt-Co Method
3	Calcium (as Ca), mg/l, Max	124	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	122	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA,23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.60	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500 Cl B (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	0.005	0.01	IS 3025 (Part 47) 1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	9.36	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3 - B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition , 2150-C
13	pH value	7.91	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	0.001	0.002	APHA, 22nd Edition, 4-Amino Antipyrine
15	Mercury (as Hg), mg/l, Max	<0.0005	0.0005	0.001	APHA,23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	108	2	200	APHA –23rd Edition, P-4-190, 4500 SO_4^{2-} E
17	Taste	Acceptable	Qualitative	Acceptable	APHA,23rd Edition, 2160-C Flavour Rating Assessment
18	Total Alkalinity ($caco_3$), mg/l, Max	144	4	200	IS 3025, Part 23 : 1986 R 2019 Titration Method
19	Cadmium (as Cd), mg/l, Max	<0.0005	0.0005	0.003	APHA,23rd Edition, AAS-GTA Method
20	Total Chromium (as Cr), mg/l, Max	<0.04	0.04	0.05	IS-3025 Part 52:2003, R.2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	807	25	500	IS 3025, Part 16 : 1984 R 2017 Gravimetric method
22	Total Hardness ($caco_3$), mg/l, Max	518	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	1	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	0.1	0.1	5	IS 3025 Part 49 : 1994 R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	0.01	0.02	IS 3025 Pat 54 : 2003 R : 2019 AAS-Flame APHA 23rd Edition, AAS-GTA

All values are expressed in mg/lit unless specified.

Analysed By
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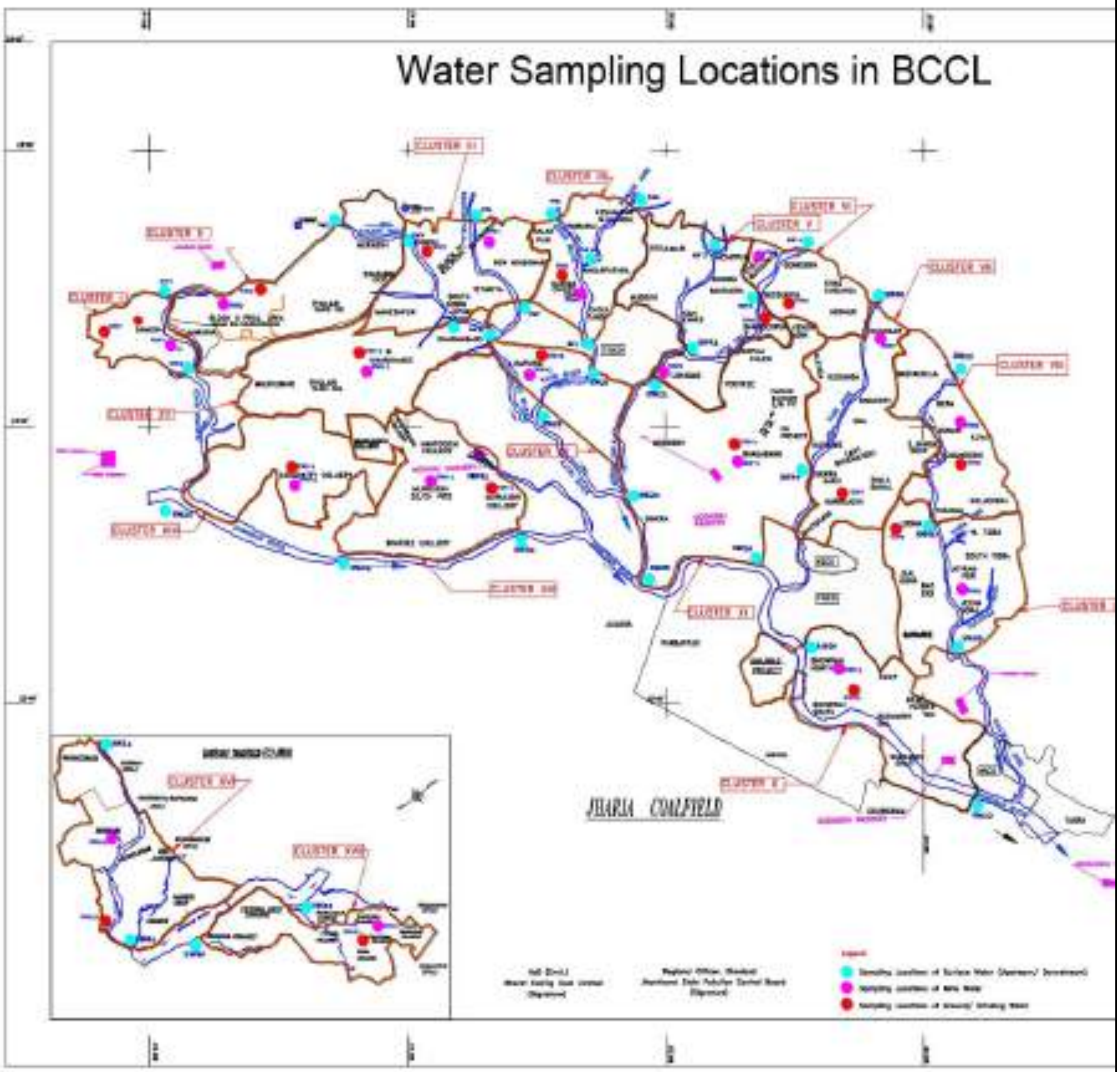
RI-2, CMPDI, Dhanbad

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad


Water Sampling Locations in BCCL
JHARIA COALFIELD

ANNEXURE 18:

Certificate of high root density plant for controlling subsidence

This is to certify that BCCL has been doing plantation/ecological restoration under the guidelines of Forest Research Institute. The various species selected for the restoration are having a tap root system with branches which serve the purpose. These species have high root density and are already being planted at all the ecorestoration/plantation sites of BCCL. The various species having tap root system are given below

S.No.	Species	Common name
1.	*Acacia nilotica*	Kikkar
2.	*Albizia odoratissima*	Kala siris
3.	*Bauhinia variegata*	Kachnar
4.	*Cassia fistula*	Amaltas
5.	*Ficus benghalensis*	Baniyan /bargad
6.	*Ficus racemosa*	Gular
7.	*Ficus religiosa*	Pipal
8.	*Gmelina arborea*	Ghamar
9.	*Lagerstroemea parviflora*	Jarul
10.	*Lannea coromandelica*	Zhingan
11.	*Madhuca latifolia*	Mahua
12.	*Mangifera indica*	Aam
13.	*Morus alba*	Shahtoot
14.	*Phyllanthus emblica*	Aonla
15.	*Pithecellobium dulce*	Jangal jalebi
16.	*Pongamia pinnata*	Karanj
17.	*Tamarindus indica*	Imli
18.	*Trema orientalis*	Tree
19.	*Terminalia arjuna*	Arjun
20.	*Terminalia bellerica*	Bahera
21.	*Dalbergia sissoo*	Shisham
22.	*Syzizium cumini*	Jamun
23.	*Azadirachta indica*	Neem
24.	*Holoptelea integrifolia*	Indian elm
25.	*Butea monosperma*	Palash /dhak

ANNEXURE 19:

S. No.	Issues Raised	Status
1	Trees are planted but not cared for and saved	Both the gabion plantation and block plantation done in Cluster V area cared for and has been well preserved as can be verified through the pictures and inspection report of gabion plantation by the forest Officials. The preservation and maintenance of all the plantations done is continuous.  
2	Public awareness should be generated to preserve the trees planted by BCCL.	Various initiatives have been taken such as awareness programmes in nearby schools on the occasions such as Environment Day & Swachhta Pakhwada to generate awareness. Moreover trees have also been planted by Cluster V in nearby schools, grounds and other areas. 
3	Water Sprinkling	The frequency of water sprinkling by mobile sprinklers has been

	frequency should be increased including in the night time.	increased for more effective dust suppression. Records are being maintained in the water sprinkling register. **(ANNEXURE- 20)** 
4	The no. of water tankers should be increased.	Sufficient no. of water tankers have been provided in Cluster V. Details are included in the transportation booklet attached.
5	Arrangements should be made for Drinking water.	Cluster V supplies water for domestic usage in the nearby villages. A MoU has been signed between BCCL and Jharkhand Govt. for mine water utilization by converting Mine water to Drinking water.
6	BCCL spends too much money on CSR activities. There should be improvement in it.	CSR activities are carried out as per the CSR policy of BCCL. 
7	Arrangements should be made for control of dust emissions during drilling operations.	Drill machines are fitted with wetting system and/or dust extractor system to control the emission of dust during the drilling operation.
8	No work has	Two eco-restoration parks have been constructed near Chandour

	been done for environmental protection near Chandour Bastee in Tetulmari. The residents of Chandour Bastee should be rehabilitated as it is close to Tetulmari mine.	Bastee in Tetulmari Collliery covering total area of 10.3 Ha. Water sprinkling is done on the roads and other dust prone areas to suppress dust. The rehabilitation work is under process as per Jharia Master Plan. Currently verification of the surveyed affected families is being done by the Jharia Rehabilitation and Development Authority.  
9	Proper water spraying should be done in Nichitpur Township. Controlled blasting operation which is carried out in Nichitpur should be continued. The quarried out area should be backfilled with OB and trees planted thereon.	Regular water spraying is done in Nichitpur. The roads in Nichitpur Township are also paved. Controlled blasting is being done. Backfilling and reclamation is being done in the quarried out areas in Nichitpur. An OB dump area of 2.8 Ha has been biologically reclaimed in Nichitpur. Road lights, water supply arrangements, Yoga centre have been provided in Nichitpur. Road from Subhash Chowk to Azad chowk is bitumen topped and well maintained. An ambulance is available in Nichitpur.

	Road lights, community centres, water arrangements, high schools roads(from Subhash Chowk to Azad chowk), ambulance should be provided in Nichitpur.	
10	Electricty, water and healthcare facilities should be provided.	Electricity, water and healthcare facilities are provided in Cluster V. Healthcare and wellness camps are also organized in nearby villages from time to time. 
11	Sporting activities should be promoted.	Games and sports are duly funded and promoted in cluster V. There is a well maintained football stadium in Sijua in Cluster V.

		
12	Dust pollution from blasting activities should be controlled.	Controlled blasting and water spraying is done to control dust pollution.
13	Covered transportation should be done.	Tarpaulin covered transportation is being ensured to control dust pollution. 
14	Closed UG mines should be reopened.	Operation of mines is guided by company policy, economic feasibility, safety and operational convenience,etc.
15	Water should be ensured in Chandour Pond.	Water is sufficiently available in Chandour pond. 
16	Loyabad	Loyabad weighbridge has been closed.

	weighbridge should be shifted.	
17	There should be no shortage of Doctors and paramedic staffs	Doctors, paramedic staffs and other healthcare personnels are deputed in Regional Hospital, Loyabad in cluster V.

ANNEXURE 20: SAMPLE COPIES OF WATER SPRINKLER MOVEMENT RECORD REGISTERS

MIST SPRINKLER LOG BOOK

OF

NICHITPUR OCP.

SIJUA AREA.

APRIL - 21

Date	SHIFT	Hours of operation	Location	Remarks.
01.4.21	A	2 hr. (2 Trip)	Haul Road, Transparency road	
	B	2 hr. (2 Trip)	Coal dump	
	C	1 hr. (1 Trip)		
2.4.21	A	2 hrs (2 Trip)	Transparency road, Haul road & Coal dump	
	B	2 hrs (2 Trip)	.. ..	
	C	2 hrs (2 Trip)	.. ..	
3.4.21	A	2 hrs (2 Trip)	.. ..	
	B	2 hrs 2 Trip)	.. ..	
	C	2 hrs (2 Trip)	.. ..	
4.4.21	A	2 hrs (2 Trip)	.. ..	
	B	2 hrs (2 Trip)	.. ..	
	C	1 hrs (01 Trip)	.. ..	
5.4.21	A	2 hrs (2 Trip)	.. ..	
	B	2 hrs (2 Trip)	.. ..	
	C	1 hrs (01 Trip)	.. ..	

Date	Shift	Hours of operation	Location	Remarks
6.4.21	A	2 hrs (2 Trip)	Transporting south Haul Road	
	B	2 hrs (2 Trip)	Coal Dump	
	C	1 hrs (01 Trip)	" "	
7.4.21	A	2 hrs (2 Trip)	" "	
	B	1 hrs (1 Trip)	" "	
	C	1 hrs (1 Trip	" "	
8.4.21	A	3 hrs (3 Trip)	Transporting Ram Haul Road	
	B	2 hrs (3 Trip)	Coal Dump	
	C	2 hrs (2 Trip)	" "	
9.4.21	A	2 hrs (2 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
10.4.21	A	2 hrs 2 Trip	" "	
	B	2 hrs (2 Trip)	" "	
	C	2 (2 Trip)	" "	

Date	Shift	Hours of operation	Location		Remarks
11.4.21	A	3 hrs (3 Trip)	Transporting Road Haul Road		
	B	2 hrs (2 Trip)	Coal pump		
	C	2 hrs (2 Trip)	"	"	
12.4.21	A	2 hrs (2 Trip)	"	"	
	B	2 hrs (2 Trip)	"	"	
	C	1 hrs (1 Trip)	"	"	
13.4.21	A	2 hrs (2 Trip)	"	"	
	B	2 hrs (2 Trip)	"	"	
	C	2 hrs (2 Trip)	"	"	
14.4.21	A	2 hrs (2 Trip)	"	"	
	B	2 hrs (2 Trip)	"	"	
	C	2 hrs (2 Trip)	"	"	
15.4.21	A	3 hrs (3 Trips)	"	"	
	B	2 hrs (2 Trips)	"	"	
	C	2 hrs (2 Trips)	"	"	
16.4.21	A	3 hrs (2 Trips)	"	"	
	B	2 hrs (1 Trips)	"	"	
	C	1 hrs (1 Trips)	"	"	

Date	Shift	Hours of operation	location	Remark
			Transporting Route	
17.4.21	A	3hrs (2 Trip)	Haul Road	
			Coal Dump	
	B	3hrs 2 Trip	" "	
	C	1 hrs (1 Trip)	" "	
18.4.21	A	2hrs (2 Trip)	" "	
	B	2 (2 Trips)	" "	
	C	2. 2 Trips)	" "	
19.4.21	A	3hrs (3 Trips)	" "	
	B	3 hrs (3 Trips)	" "	
	C	1hrs (1 Trip)	" "	
20.4.21	A	3hs (3 Trips)	Face Sparing	
			Haul Road	
	B	3hr (3 Trips)	" "	
	C	2hrs (2 Trips)	" "	
21.4.21	A	3 hrs (3 Trip)	" "	
	B	4 hrs (4 Trip)	" "	
	C	2 hrs (1 Trip	" "	
22.4.21	A	4 hrs (4 Trip)	" "	
	B	3 hrs (3 Trip)	" "	

Date	Shift	Hours of operation	Location	Remark.
	C	1hrs (1 Trip)	Noc P Coal pump.	
23.4.21	A	5hr 5 Trip	" "	
	B	3hr (3 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
24.4.21	A	4 hrs 4 Trip	" "	
	B	4 hrs (4 Trip)	" "	
	C	NO.	—	
25.4.21	A	4 hrs (4 Trip)	Transporting Haul Road Face stowing	
	B	5hrs 5 Trip	" "	
	C	1 (1 Trip)	" "	
26.4.21	A	2 hrs (2 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	2 hrs (2 Trip)	" "	
27.4.21	A	4 hrs (4 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	2 hrs (2 Trip)	" "	
28.4.21	A	4 hrs (4 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	2 hrs (2 Trip)	" "	

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Date	Shift	Hours of operation	Location	Remark
	C	1hrs (1 Trip)	Noep Coal plumb.	
23.4.21	A	5hr 5 Trip	" "	
	B	3hr (3 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
24.4.21	A	4 hrs 4 Trip	" "	
	B	4 hrs (4 Trip)	" "	
	C	NO.	—	
25.4.21	A	4 hrs (4 Trip)	Transporting Howl Road Face sharing	
	B	3 hrs 3 Trip	" "	
	C	1 (1 Trip)	" "	
26.4.21	A	2 hrs (2 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	2 hrs (2 Trip)	" "	
27.4.21	A	4 hrs (4 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	2 hrs (2 Trip)	" "	
28.4.21	A	4 hrs (4 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	2 hrs (2 Trip)	" "	

Date	Shift	Hours of operation	Location	Remarks
			Transporting Route	
29.4.21	A	3hrs (3 Trip)	Haul Road Coal Dump	
	B	2hrs (2 Trip)	" "	
	C	2hrs (2 Trip)	" "	
30.4.21	A	4hrs (4 Trip)	" "	
	B	2hrs (2 Trip)	" "	
	C	2hrs (2 Trip)	" "	

Safety officer
Nichitpur Colliery.

Manager
Nichitpur Colliery

MAY- 2021

Date	Shift	Hours of operation	Location	Remarks
1.5.21	A	4 hrs (4 Trip)	Transporting Route Haul Road Coal Dumb	
	B	4 hrs (4 Trip)	" "	
	C	2 hrs (2 Trip)	" "	
2.5.21	A	4 hrs (4 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
3.5.21	A	Not require	—	Rain fall Total 16 mm
	B	" "	—	
	C	" "	—	
4.5.21	A	" "	—	
	B	" "	—	
	C	" "	—	
5.5.21	A	Not require	—	Rain fall Total 8 mm
	B	" "	—	
	C	" "	—	
6.5.21	A	" "	—	
	B	" "	—	
	C	" "	—	

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MAY /2021

Date	Shift	Hours of operation	Location	Remarks
7.5.21	A	4 hrs (4 Trip)	Trans porting Route Haul Road coal Dumb	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
8.5.21	A	Not required	—	Rain Fall Total: [illegible]
	B	" "	—	
	C	" "	—	
9.5.21	A	Not required	—	Rain Fall Total: 7.2 [illegible]
	B	" "	—	
	C	" "	—	
10.5.21	A	2 hrs (2 Trip)	Trans porting Route coal dump.	
	B	1 hrs (1 Trip)	face Loading haul road.	
	C	No.		
11.5.21	A	4 hrs (4 Trip)	" "	
	B	3 hrs (3 Trip)	" "	
	C	No.		
12.5.21	A	Not required	—	Rain [illegible] Total: 1.8 [illegible]
	B	" "	—	

MAY/2021

Date	Shift	Hours of operation	Location	Remarks
	C	NO –	Transporting Road	
13.5.21	A	2 hrs (2 Trip)	[illegible] Haul Road Coal Dumb	
	B	1 hrs (1 Trip)	" "	
	C	NO.	—	
14.5.21	A	2 hrs (2 Trip)	" "	
	B	3 hrs (3 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
15.5.21	A	3 hrs (3 Trip)	Face Sparing	
	B	1 hrs (1 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
16.5.21	A	2 hrs (2 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
17.5.21	A	Not required	—	Rain fall Total 9.6 mm
	B	" "	—	
	C	" "	—	

MAY/2021

Date	Shift	Hours of operation	location	remarks
18.5.21	A	Not required	Transporting road haul road —	Rain fall Total. 20 mm
	B	"	—	
	C	"	—	
19.5.21	A	2 hrs (2 Trip)	Transporting, haul road and coal dump	
	B	1 hrs (1 Trip)	" "	
	C	Nil	—	
20.5.21	A	2 hrs (2 Trip)	" "	
	B	1 hrs (1 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
21.5.21	A	NIL	—	Rain Fall Total 24.5 mm
	B	"	—	
	C	"	—	
22.5.21	A	NIL	—	
	B	"	—	
	C	"	—	
23.5.21	A	2 hrs (2 Trip)	Transporting road, haul road and coal dump	

MAY /2021

Date	Shift	Hous of operation	Location	Remarks
	B	2 hrs (2 Trip)	Transporting Route	
			Houl Road	
	C	2 hrs (2 Trip	Coal Dumb	
24/5/21	A	Not required	—	Rain Fall Total 8 M.M
	B	"	—	
	C	"	—	
25.5.21	A	Not required	—	Rain Fall Total: 4 M.M
	B	"	—	
	C	"	—	
26.5.21	A	Not required	—	Rain fall Total: 36 M.M
	B	"	—	
	C	"	—	
27.5.21	A	Not required	—	Rain Fall Total: 4 M.M
	B	"	—	
	C	"		
28.5.21	A	NIL	—	
	B	"	—	
	C	"	—	

MAY /2021

Date	Shift	Hours of operation	Location	Remarks
			Transporting, haulroad	
29.5.21	A	1 hour (1 trip)	and coal depo.	
	B	1 hour (1 trip)	"	
	C	Nil	—	
30.5.21	A	Not requiring	—	Rain Fall
				Total 18 M.M
	B	" "	—	
	C	" "	—	

Safety officer
Nichitpur colliery

Manager
Nichitpur colliery

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June/2021

Date	Shift	Hours of operation	Location	Remark
			Trans porting Route	
01.06.21	A	2 hrs (2 Trip)	Houl Road	
			Coal Dumb	
	B	1 hrs (1 Trip)	,, ,,	
	C	NO	—	
02.06.21	A	1 hrs. (1 trips)	" "	
	B	1 hrs. (1 trips)	" "	
	C	NO	—	
03.06.21	A	2 hrs (2 Trip)	,, ,,	
	B	2 hrs (2 Trip)	,, ,,	
	C	1 hrs (1 Trip	,, ,,	
04.06.21	A	3 hrs (3 Trip)	Trans porting Route Houl Road	
	B	3 hrs (3 Trip)	Coal Dumb	
	C	1 hrs (1 Trip)	,, ,,	
05.06.21	A	2 hrs (2 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip	" "	
06.06.21	A	3 hrs (3 Trip)	" "	

June /2021

Date	Shift	Hours of operation.	Location	Remarks
			Trans porting Route	
	B	2 hrs (2 Trip)	Haul Road	
			Coal Dumb	
	C	2 hrs (2 Trip)	,, ,,	
07.06.21	A	2 hrs (2 Trip)	,, ,,	
	B	2 hrs (2 Trip)	,, ,,	
	C	1 hrs (1 Trip)	,, ,,	
08.06.21	A	NIL	— —	Rain Fall
				Total: 44.4 M.M
	B	NIL	— —	
	C	NIL	— —	
09.06.21	A	NIL	—	
	B	,,	—	
	C	,,	—	
10.06.21	A	NIL	—	Rain Fall
				Total: 78 M.M
	B	NIL	—	
	C	NIL	—	
11.06.21	A	NIL	—	Rain Fall
				Total: 24 M.M
	B	NIL	—	

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June /2021

Date	Shift	Hours of operation	Location	Remark.
	C	NIL	—	
12.06.21	A	NO	—	
	B	NO	—	
	C	NO	—	
13.06.21	A	Not required	—	
	B	"	—	
	C	"	—	
14.06.21	A	1 hour (1 trips)	Transporting, haul road & coal depo	
	B	1 hour (1 trips)	"	
	C	NO	—	
15.06.21	A	NIL	—	Rain Fall Total: 20 M.M
	B	"	—	
	C	"	—	
16.06.21	A	NIL	—	Rain Fall Total 24 M.M
	B	"	—	
	C	"	—	

June /2021

Date	Shift	Hours of operation	Location	Remarks
17.06.21	A	Not required due to rain	—	Rain fall Total = 32.8 mm
	B	〃 〃	—	
	C	〃 〃	—	
18.06.21	A	〃 〃	—	Rain fall Total = 32.8 mm
	B	〃 〃	—	
	C	〃 〃	—	
19.06.21	A	〃 〃	—	Rain fall Total: 34.4 mm
	B	〃 〃	—	
	C	〃 〃	—	
20.06.21	A	Not required due to rain	—	Rain fall Total: 32.[illegible]
	B	〃 〃	—	
	C	〃 〃	—	
21.06.21	A	Not required due to rain	—	Rain fall Total: 13.[illegible]
	B	〃 〃	—	
	C	〃 〃	—	
22.06.21	A	Not required	—	

June /2021

Date	Shift	Hours of operation	Location	Remarks
	B	Not required	—	
	C	"	—	
22.06.21	A	Not required due to rain	—	Rain Fall Total - 7.2 M.M
	B	"	—	
	C	"	—	
23.06.21	A	Not required	—	
	B	"	—	
	C	"	—	
24.06.21	A	Not required	—	Rain Fall Total 4. M.M
	B	"	—	
	C	"	—	
25.06.21	A	1 hr (1 trip)	Transporting and hauling road	
	B	1 hr (1 trip)	Coal depo "	
	C	Nil -	—	
26.06.21	A	1 hrs (1 trip)	Transporting & hauling road and coal dump	
	B	1 hr (1 trip)		

June /2021

Date	Shift.	Hours of operation	Location	Remarks.
	C	1 hrs (1 trip)	Transporting & hauling road	
27.06.21	A	2 hrs (2 trips)	" "	
	B	1 hrs (1 trip)	" "	
	C	1 hrs (1 trip)	" "	
28.06.21	A	2 hrs. (2 trip)	" "	
	B	1 hrs (1 trip)	" "	
	C	1 hrs (1 trip)	" "	
29.06.21	A	1 hrs. (1 trip)	coal dump, haul road and transporting road.	
	B	2 hrs (2 trips)	" "	
	C	1 hrs (1 trip)	" "	
30.06.21	A	1 hrs. (1 trip)	" "	
	B	1 hrs (1 trip)	" "	
	C	1 hrs. (1 trip)	" "	

Safety officer
Nichitpur colliery.

Manager
Nichitpur colli-

July /2021

Date	Shift	Hours of operation	Location	Remark
01.07.21	A	2 hrs (2 Trip)	Transporting Route Haul Road Coal Dumb	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
02.07.21	A	Not required	—	Rain Fall Total: 36.8 MM
	B	" "	—	
	C	" "	—	
03.07.21	A	Not required	—	
	B	" "	—	
	C	" "	—	
04.07.21	A	2 hrs (2 Trip)	Transporting road, Haul road & Coal depo	
	B	1 hr. (1 trip)	" "	
	C	1 hr (1 trip	" "	
05.07.21	A	Not required	—	Rain Fall Total: 40 MM
	B	" "	—	
	C	" "	—	
06.07.21	A	Not required	—	

JULY /2021

Date	Shift	Hours of operation	Location	Remarks
	B	Not required due to stair.	—	
	C	"	—	
07.07.21	A	Not required	—	
	B	"	—	
	C	"	—	
08.07.21	A	Not required	—	Rain Fall Total 8.4
	B	" "	—	
	C	" "	—	
09.07.21	A	2 hrs (2 Trip)	Trans parking Route Haul Road coal Dumb	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
10.07.21	A	1 hrs. (1 trips)	" — "	
	B	1 hrs (1 trips)	" — "	
	C	No		
11.07.21	A	Not required	—	Rain Fall Total 48
	B	" "	—	

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July /2021

Date	Shift	Hours of operation	Location	Remarks
	C	Not required	—	
12-07-21	A	1 hrs. (1 trip)	Transporting, haul road & coal depo	
	B	1 hrs (1 trip)	" "	
	C	1 hrs (1 trip)	" "	
13-07-21	A	1 hrs (1 trip)	" "	
	B	2 hrs (2 trips)	" "	
	C	1 hrs (1 trip)	" "	
14-07-21	A	1 hrs. (1 trip)	" "	
	B	1 hrs (1 trip)	" "	
	C	1 hrs (1 trip)	" "	
15-07-21	A	2 hrs (2 Trip)	Transporting Route Haul Road & Coal Dumb	
	B	1 hrs (1 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
16-07-21	A	2 hrs (2 Trip)	" "	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	

July /2021

Date	Shift	Hours of operation	Location	Remarks
17.07.21	A	Not required	—	Rain fall Total: 9.8 mm
	B	" "	—	
	C	" "	—	
18.07.21	A	Not required	—	Rain fall Total: 88 mm
	B	" "	—	
	C	" "	—	
19.07.21	A	Not required	—	Rain fall Total: 28 mm
	B	" "	—	
	C	" "	—	
20.07.21	A	Not required	—	
	B	" "	—	
	C	" "	—	
21.07.21	A	Not required	—	
	B	" "	—	
	C	" "	—	
22.07.21	A	2 hrs (2 Trip)	Haul road, transport road and coal dump :	

July /2021

Date	Shift	Hours of operation	Location	Remarks
	B	1 hrs (1 Trip)	Trans porting Route Haul Road	
	C	1 hrs (1 Trip)	Coal Dumb " "	
23-07-21	A	Not required.	—	Rain Fall Total 12.M.M
	B	"	—	
	C	"	—	
24-07-21	A	1 hrs (1 Trip)	" "	
	B	1 hrs (1 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
25-07-21	A	1 hrs (1 trip)	Transporting rock Coal dump and haul road	
	B	1 hrs (1 trips)	"	
	C	1 hrs (1 trip)	"	
26-07-21	A	2 hrs (2 trips)	"	
	B	1 hrs (1 trip)	"	
	C	1 hrs (1 trips)	"	
27-07-21	A	2 hrs (2 trips)	"	
	B	1 hrs (1 trip)	"	

July /2021

Date	Shift.	Hours of operation	Location	Remark
	C	1 hr (1 trip)	Transporting & Hauling road and coal depo	
28.07.21	A	Not required due to rain	—	Rain Fall Total 08 m.m.
	B	" "	—	
	C	" "	—	
29.07.21	A	" "	—	Rain Fall Total: 43.2 m.m.
	B	" "	—	
	C	" "	—	
30.07.21	A	Not required due to heavy rain	—	Rain Fall Total: 164. m.m.
	B	" "	—	
	C	" "	—	
31.07.21	A	Not required	—	
	B	" "	—	
	C	" "	—	

Safety Officer

Manager Nichitpur Colly

August /2021

Date	Shift	Hours of operation	Location	Remarks
01.08.21	A	2 hrs (2 trip)	Transporting, haul road & coal dump	
	B	1 hrs (1 trip)	" "	
	C	1 hrs (1 trip)	" "	
02-08-21	A	2 hrs (2 Trip)	Transporting Route Haul Road & coal dump.	
	B	1 hrs (1 trip)	" "	
	C	1 hrs (1 trip)	" "	
03-08-21	A	NO	—	Rain Fall
	B	NO	—	Total: 4 mm
	C	NO	—	
04-08-21	A	NO	—	Rain Fall
	B	NO	—	Total 23.2 mm
	C	NO	—	
05-08-21	A	NO	—	
	B	NO	—	
	C	NO	—	
06-08-21	A	NO	—	

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August /2021

Date	Shift	Hours of operation	Location	Remarks
	B	Not required	—	
	C	Not required	–	
07.08.21	A	No	—	Rain Fall Total 31 m.m
	B	No	—	
	C	No	—	
08.08.21	A	No	—	Rain Fall [illegible] Total 28.4 m.m
	B	No	—	
	C	No	–	
09.08.21	A	Not required	—	
	B	Not required	—	
	C	"	—	
10.08.21	A	"	–	
	B	"	—	
	C	"	—	
11.08.21	A	"	—	
	B	"	—	

AUGUST/2021

Date	Shift	Hours of operation	Location	Remark.
	C	NO	—	
12.08.21	A	1 hrs (1 trips)	—	
	B	1 hrs (1 trips)	—	
	C	NO-	—	
13-08-21	A	1 hrs (1 Trip)	Trans parting Route Houl Road Coal Dumb	
	B	1 hrs (1 Trip)	" "	
	C	NO-	—	
14-08-21	A	2 hrs (2 Trip)	" "	
	B	1 hrs (1 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
15-08-21	A	2 hrs (2 Trip)	Trans parting Route Houl Road Coal Dumb	
	B	1 hrs (1 Trip)	" "	
	C	NO-	—	
16-08-21	A	1 hrs (1 Trip)	" "	
	B	1 hrs (1 Trip)	" "	
	C	1 hrs (1 trips)	" "	

August / 2021

Date	Shift	Hours of operation	Location	Remark
17-08-21	A	1 hrs (1 trip)	Transporting, Loading and coal depo	
	B	1 hrs (1 trip)	"	
	C	No	—	
18-08-21	A	Not required due to rain	—	Rain fall total 19.2 [illegible]
	B	" "	—	
	C	" "	—	
19-08-21	A	Not required	—	
	B	"	—	
	C	"	—	
20-08-21	A	2 hrs (2 Trip)	Towards parking Route Haul Road coal Dump	
	B	2 hrs (2 Trip)	" "	
	C	1 hrs (1 Trip)	" "	
21-08-21	A	2 hrs (2 Trip)	" "	
	B	1 hrs. (1 trip)	"	
	C	NO	—	
22-08-21	A	Not required	—	Rain Fal total 5.8 [illegible]

August/2021

Date	Shift	Hours of operation	Location	Remarks
	B	Not required	—	
	C	"	—	
23-08-21	A	Not required	—	
	B	"	—	
	C	"	—	
24-08-21	A	Not required	—	Rain Fall Total 11.2 mm
	B	" "	—	
	C	" "	—	
25-08-21	A	Not required	—	
	B	"	—	
	C	"	—	
26-08-21	A	"	—	
	B	"	—	
	C	"	—	
27-08-21	A	Not required	—	Rain Fall Total 14.14
	B	Not required	—	

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August/2021

Date	Shift	Hours of operation	Location	Remarks
	C	Not required	—	
28.08.21	A	1 hour (1 trips)	Transporting & Haul road and Coal depo	
	B	1 hour (1 trip)	"	
	C	N.R.	—	
29.08.21	A	Not required due to rain.	—	Rain Fall Total: 84 ML
	B	"	—	
	C	"	—	
30.08.21	A	Not required due to rain	—	
	B	"	—	
	C	"	—	
31.08.21	A	Not required due to rain.	—	Rain Fall Total: 12 ML
	B	" "		
	C	" "		

Safety Officer. NPC

Manager. NPC.

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SEPTEMBER/2021

Date	Shift	Hours of operation	Location	Remarks
01.09.21	A	Not required due to rain	—	
	B	"	—	
	C	"	—	
02.09.21	A	Not required due to rain	—	Rain Fall Total 30 M.M
	B	"		
	C	"		
03.09.21	A	Not required due to rain	—	Rain Fall Total: 4 M.M
	B	"	—	
	C	"	—	
04.09.21	A	"	—	Rain Fall Total 4 M.M
	B	"	—	
	C	"	—	
05.09.21	A	Not required.	—	
	B	"	—	
	C	"	—	
06.09.21	A	1 hrs (1 Trip)	Transporting Route Haul Road Coal Dump	

SEPTEMBER/2021

Date	Shift	Hours of operation	location	Remarks
	B	2 hrs (2 Trip)	Transporting haul road and coal dump.	
	C	NO	—	
07.09.21	A	NO	—	Rain Fall Total 13 mm
	B	NO	—	
	C	NO	—	
08.09.21	A	NO	—	
	B	NO	—	
	C	NO	—	
09.09.21	A	1 hrs (1 Trip)	Trans porting Route Haul Road coal Dumb	
	B	1 hrs (1 trips)	"	
	C	Not required	"	
10.09.21	A	1 hrs (1 Trip)	" "	
	B	1 hrs (1 Trip)	" "	
	C	NO	—	
11.09.21	A	NO	—	Rain Fall Total 4 mm
	B	NO	—	

SEPTEMBER/2021

Date	Shift	Means of operation	Location	Remarks
	C	NO	—	
12.09.21	A	NO	—	Rain fall Total 11.4 mm
	B	NO	—	
	C	NO	—	
13.09.21	A	NO	—	Rain Fall Total 22.4 mm
	B	NO	—	
	C	NO	—	
14.09.21	A	NO	—	Rain Fall Total 27.2 mm
	B	NO	—	
	C	NO	—	
15.09.21	A	Not required	—	
	B	"	—	
	C	"	—	
16.09.21	A	"	—	
	B	"	—	
	C	"	—	

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SEPTEMBER /2021

Date	Shift	Hours of operation	Location	Remarks
17.07.21	A	1 hour (1 Trip)	Trans porting Route Haul Road Coal Dumb	
	B	Nil		
	C	Nil	—	
18.09.21	A	Not required	—	Rain Fall Total 18.4 Hr
	B	Not "	—	
	C	Not "	—	
19.09.21	A	Not required	—	
	B	"	—	
	C	"	—	
20.09.21	A	Not requird.	—	Rain Fall Total 10.4 Hr
	B	"	—	
	C	"	—	
21.09.21	A	"	—	Rain Fall Total 19.2 Hr
	B	"	—	
	C	"	—	
22.9.21	A	"	—	Rain Fall Total [illegible]

SEPTEMBER/2021

Date	shift	Hours of operation	location	Remarks
	B	Not required	—	
	C	"	—	
23.09.21	A	Not required	—	
	B	"	—	
	C	"	—	
24.09.21	A	Not required	—	
	B	1 hrs (1 Trip)	Tram posting Route Haul Road coal Dump	
	C	No —	—	
25.09.21	A	1 hrs. (2 trips)	" "	
	B	2 hrs (2 Trip)	" "	
	C	No —	—	
26.09.21	A	1 hrs (1 Trip)	" "	
	B	1 hrs (1 Trip)	" "	
	C	Not required	—	
27.09.21	A	~~Not required~~ NIL	—	Rain Fall Total: 58 M.M
	B	~~Not required~~ NIL	—	

SEPTEMBER/2021

Date	Shift	Hours of operation	Location	Remark
28.09.21	A	Not required	—	Rain fall
	B	" "	—	Total: 13.[illegible]
	C	" "	—	
29.09.21	A	Not required	—	Rain Fall
				Total: 152.[illegible]
	B	" "	—	
	C	" "	—	
30.09.21	A	Not required	—	Rain Fall
				Total: 129.[illegible]
	B	"	—	
	C	"	—	

Safety officer
Nichitpur Colliery.

Manager
Nichitpur Colliery

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WATER TANKER / SPRINKLING
LOGBOOK
SENDRA BANSJORA COLLIERY

DATE : 01.01.2021 / FRI

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS	Sign.
A	HT-07	Deepak Das	02	–	Deepak Das
	HT-77	Baijnath Kr. Ram	03	–	Baijnath Ram
B	HT-09	Arjun Verma	02	–	[illegible]
	HT-77	Suresh Mahato	02	–	[illegible]
C	HT-09	Santosh Mahato	01	–	[illegible]
	HT-77	Gunjan Singh	02	–	Gunjan Singh

H.S. Diesel – HT-07 – NIL HT-77 – NIL

DATE : 02.01.2021 / SAT

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS	Sign.
A	HT-07	Deepak Das	01	–	Deepak Das
	HT-77	Baijnath Ram	03	–	Baijnath Ram
B	HT-09	Arjun Verma	01	–	[illegible]
	HT-77	Sanjay Kumar	02	–	Sanjay
C	HT-09	Santosh Mahato	01	–	[illegible]
	HT-77	Gunjan Singh	02	–	Gunjan Singh

H.S. Diesel – HT-07 – NIL HT-77 – 65

DATE : 03.01.2021 / SUN

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS	Sign.
A	HT-07	Deepak Das	02	–	Deepak Das
	HT-77	Baijnath Kr. Ram	02	–	Baijnath Ram
B	HT-09	Arjun Verma	01	–	[illegible]
	HT-77	Suresh Mahato	02	–	[illegible]
C	HT-09	Santosh Mahato	01	–	[illegible]
	HT-77	Gunjan Singh	02	–	Gunjan Singh

H.S. Diesel – HT-07 – NIL HT-77 – 50

DATE : 04.01.2021 / MON

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS	Sign.
A	HT-09	Arjun Verma	01		[illegible]
	HT-77	Suresh Mahato	03		[illegible]
B	HT-09	Santosh Mahato	02		[illegible]
	HT-77	Pankaj Bhardwaj	05		[illegible]
C	HT-07	Deepak Das	01		Deepak Das
	HT-77	Baijnath Kr. Ram	01		Baijnath Ram

H.S. Diesel – HT-09 – NIL HT-77 – NIL

DATE : 05.01.2021 / TUE

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign.	
A	HT-09	Arjun Verma	02	[illegible]	
	HT-77	Suresh Mahato	02	[illegible]	
B	HT-09	Santosh Mahato	02	[illegible]	
	HT-77	Gunjan Singh	02	Gunjan Singh	
C	HT-07	Deepak Das	01	Deepak Das	
	HT-77	Baijnath Kr. Ram	01	Baijnath Ram	

H.S. Diesel – HT-09 – 102 HT-77 – 217

DATE : 06.01.2021 / WED

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign.	
A	HT-09	Sanjay Kumar	01	[illegible]	
	HT-77	Suresh Mahato	02	[illegible]	
B	HT-09	Santosh Mahato	02	[illegible]	
	HT-77	Gunjan Singh	02	Gunjan Singh	
C	HT-09	Rahul Kumar	01	[illegible]	
	HT-77	Sitaram Mahato	01	S.R. Mahato	

H.S. Diesel – HT-09 – NIL HT-77 – 60

DATE : 07.01.2021 / THU

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign.	
A	HT-09	Md. Afij Ansari	02	[illegible]	
	HT-77	Suresh Mahato	02	[illegible]	
B	HT-09	Pankaj Bhardwaj	01	[illegible]	
	HT-77	Gunjan Singh	02	Gunjan Singh	
C	HT-07	Deepak Das	01	Deepak Das	
	HT-77	Baijnath Kr. Ram	01	Baijnath Ram	

H.S. Diesel – HT-09 – NIL HT-77 – NIL

DATE : 08.01.2021 / FRI

SHIFT	TRUCK NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign.	
A	HT-09	Arjun Verma	02	[illegible]	
	HT-77	Suresh Mahato	02	[illegible]	
B	HT-09	Santosh Mahato	02	[illegible]	
	HT-77	Gunjan Singh	01	Gunjan Singh	
C	HT-09	Deepak Das	01	Deepak Das	
	HT-77	Baijnath Kr. Ram	02	Baijnath Ram	

H.S. Diesel – HT-09 = 61 HT-77 = NIL

Date: 09-01-2024 / SAT

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	Arjun Verma	02	[illegible]
	HT-77	Chandrika Paul	02	
B	HT-07	Santosh Mahato	01	[illegible]
	HT-77	Gunjan Singh	02	[illegible]
C	HT-07	Deepak Das	01	Deepak Das
	HT-77	Baijnath Kr. Ram	01	Baijnath Ram

H.S. Diesel → HT-07 = NIL HT-77 = NIL

Date: 11.01.2024 / SUN

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	Arjun Verma	02	[illegible]
	HT-77	Suman Mahato	01	Taken for Motor [illegible]
B	HT-07	Santosh Mahato	02	[illegible]
	HT-77	Gunjan Singh	02	[illegible]
C	HT-07	Deepak Das	01	Deepak Das
	HT-77	Baijnath Kr. Ram	02	Baijnath Ram

H.S. Diesel → HT-07 - NIL HT-77 - 200

Date: 11.01.2024 / MON

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	—	—	Flushed & clutch problem [illegible]
	HT-77	Santosh Mahato	02	
B	HT-07	—	—	— Do —
	HT-77	Baijnath Kr. Ram	02	Baijnath Ram
C	HT-07	—	—	— Do —
	HT-77	Suresh Mahato	02	[illegible]

H.S. Diesel → HT-07 - NIL HT-77 - NIL

Date: 12.01.2024 / TUE

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	—	—	Flushed & clutch problem [illegible]
	HT-77	Santosh Mahato	01	
B	HT-07	—	—	— Do —
	HT-77	Baijnath Kr. Ram	02	Baijnath Ram
C	HT-07	—	—	— Do —
	HT-77	Suresh Mahato	02	[illegible]

H.S. Diesel → HT-07 - NIL HT-77 - 50

Date: 13-01-2024 / WED

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	—	—	Flusher & clutch problem [illegible]
	HT-77	Santosh Mahato	02	
B	HT-07	—	—	— Do —
	HT-77	Subodh Kumar Mahato	02	S.K. Mahato
C	HT-07	Sanjay Ravidas	02	[illegible]
	HT-77	Suresh Mahato	02	[illegible]

H.S. Diesel → HT-07 - NIL HT-77 - 50

Date: 14.01.2024 / THU

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	Pankaj Bhardwaj	02	[illegible]
	HT-77	Gunjan Singh	03	[illegible]
B	HT-07	Deepak Das	01	Deepak Das
	HT-77	Baijnath Kr. Ram	03	Baijnath Ram
C	HT-07	Arjun Verma	01	[illegible]
	HT-77	Suresh Mahato	02	[illegible]

H.S. Diesel → HT-07 - 50 HT-77 - 100

Date: 15.01-2024 / FRI

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	Santosh Mahato	03	[illegible]
	HT-77	—	—	AC problem
B	HT-07	Deepak Das	02	Deepak Das
	HT-77	Baijnath Kr. Ram	03	Baijnath Ram
C	HT-07	Arjun Verma	01	[illegible]
	HT-77	[illegible] Mahato	02	[illegible]

H.S. Diesel → HT-07 - 50 HT-77 - 50

Date: 16.01.2024 / SAT

SHIFT	MACE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS & Sign
A	HT-07	Santosh Mahato	03	[illegible]
	HT-77	Gunjan Singh	02	[illegible]
B	HT-07	Deepak Das	01	Deepak Das
	[illegible]	Baijnath Kr. Ram	03	Baijnath Ram
C	HT-07	Arjun Verma	01	[illegible]
	HT-77	Sanjay Kumar	02	Sanjay

H.S. Diesel → HT-07 - NIL HT-77 - 50

DATE 17.01.2021 / SUN

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-07	Tausted Mahato	—	Pump ED	[illegible]
	HT-71	Gunjan Singh	—	Pump ED	Gunjan
B	HT-07	Deepak Ram	02	Deepak Ram	
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram	
C	HT-07	Arjun Kumar	01	[illegible]	
	HT-73	Suresh Mahato	02	[illegible]	

H.S. Diesel — HT-09 - NIL HT-77 - 50

Date 18.01.2021 / MON

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-09	Deepak Ram	02	Deepak Ram	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
B	HT-09	Arjun Kumar	01	[illegible]	
	HT-73	Suresh Mahato	02	[illegible]	
C	HT-09	Santosh Mahato	01	[illegible]	
	HT-73	Pankaj Choudhary	02	[illegible]	

H.S. Diesel — HT-07 - 50 HT-73 → 52

Date 19.01.2021 / TUE

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-09	Deepak Ram	01	Deepak Ram	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
B	HT-09	Arjun Kumar	02	[illegible]	
	HT-73	Suresh Mahato	02	[illegible]	
C	HT-09	Santosh Mahato	01	[illegible]	
	HT-73	Gunjan Singh	02	Gunjan Singh	

H.S. Diesel — HT-09 - NIL HT-73 → NIL

Date 20.01.2021 / WED

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-09	Kamal Kumar	01	Kamal Singh	
	HT-73	Sebla Ram Mahato	03	S.R. Mahato	
B	HT-09	Sanjay Kumar	03	Sanjay	
	HT-73	Suresh Mahato	02	[illegible]	
C	HT-09	Santosh Mahato	02	Santosh	
	HT-73	Gunjan Singh	02	Gunjan Singh	

H.S. Diesel — HT-09 — NIL HT-73 - 50

Date 21.01.2021 / THU

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-07	Deepak Ram	02	Deepak Ram	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
B	HT-07	Arjun Kumar	02	[illegible]	
	HT-73	Suresh Mahato	02	[illegible]	
C	HT-07	Pankaj Choudhary	01	[illegible]	
	HT-77	Gunjan Singh	02	Gunjan Singh	

H.S. Diesel → HT-09 = 50 HT-73 = 50

Date 22.01.2021 / FRI

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-07	Deepak Ram	02	Deepak Ram	
	HT-77	Baijnath Kr. Ram	02	Baijnath Ram	
B	HT-07	Arjun Kumar	01	[illegible]	
	HT-73	Suresh Mahato	02	[illegible]	
C	HT-07	Santosh Mahato	02	[illegible]	
	HT-73	Gunjan Singh	02	Gunjan Singh	

H.S. Diesel → HT-07 = NIL HT-73 - 50

Date 23.01.2021 / SAT

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-09	Deepak Ram	01	Deepak Ram	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
B	HT-09	Arjun Kumar	02	[illegible]	
	HT-73	Chandrika Devi	02		
C	HT-09	Santosh Mahato	01	Santosh	
	HT-73	Gunjan Singh	01	Gunjan Singh	

H.S. Diesel → HT-07 = NIL HT-73 = 50

Date 24.01.2021 / SUN

SHIFT	MCH NO	OPERATOR NAME	No. OF TRIPS	REMARKS & Sign	
A	HT-09	Deepak Ram	02	Deepak Ram	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
B	HT-09	Arjun Kumar	02	[illegible]	
	HT-73	Suresh Mahato	02	[illegible]	
C	HT-09	Santosh Mahato	02	Santosh	
	HT-77	Gunjan Singh	02	Gunjan Singh	

H.S. Diesel → HT-09 - 50 HT-73 = 50

Date: 25.01.2024 / MON

SHIFT	DOOR NO	OPERATOR NAME	NO. of TRIPS	REMARKS & Sign
A	HT - 07	Arjun Kumar	02	[illegible]
	HT - 73	Suresh mahato	02	सुरेश महतो
B	HT - 09	Santosh mahato	02	[illegible]
	HT - 73	Pankaj Chaudhary	01	[illegible]
C	HT - 09	Deepak Das	01	[illegible]
	HT - 73	Baijnath kr. Ram	03	Baijnath Ram

H.S.Diesel - HT-09 - NIL, HT-73 - NIL

26th Jan 2024 - Republic Day.

Date: 27.01.2024 / WED

SHIFT	DOOR NO	OPERATOR NAME	NO. of TRIPS	REMARKS & Sign
A	HT - 09	Sanjay kumar	01	सुरेश महतो
	HT - 73	Suresh mahato	02	
B	HT - 09	Santosh mahato	02	[illegible]
	HT - 73	Gunjan Singh	01	[illegible]
C	HT - 09	Rahul kumar	01	[illegible]
	HT - 73	Sobha Ram mahato	02	[illegible]

H.S.Diesel — HT-09 — NIL HT-73 — 52

Date: 28.01.2024 / THU

SHIFT	DOOR NO	OPERATOR NAME	NO. of TRIPS	REMARKS & Sign
A	HT - 09	-	-	Head Hauk jam (?)
	HT - 73	Suresh mahato	02	सुरेश महतो
B	HT - 09	Pankaj Chaudhary	02	[illegible]
	HT - 73	Gunjan Singh	01	[illegible]
C	HT - 09	Deepak Das	01	Deepak Das
	HT - 73	Baijnath kr. Ram	02	Baijnath Ram

H.S.Diesel → HT-09 - NIL HT-73 — 50

Date: 29.01.2024 / FRI

SHIFT	DOOR NO	OPERATOR NAME	NO. of TRIPS	REMARKS & Sign
A	HT - 09	Arjun kumar	01	[illegible]
	HT - 73	Suresh mahato	02	सुरेश महतो
B	HT - 09	Santosh mahato	01	[illegible]
	HT - 73	Gunjan Singh	01	[illegible]
C	HT - 09	Deepak Das	01	Deepak Das
	HT - 73	Baijnath kr. Ram	02	Baijnath Ram

H.S.Diesel — HT-09 — NIL HT-73 — 50

Date: 30.01.2024 / SAT

SHIFT	DOOR NO.	OPERATOR NAME	No. of TRIPS	REMARKS & Sign
A	HT - 09	Arjun kumar	02	[illegible]
	HT - 73	Chandrika Ravi	07	
B	HT - 09	-	-	-
	HT - 73	-	-	-
C	HT - 09	-	-	-
	HT - 73	-	-	-

30.01.24 → 06.02.24 → Project close H.S.Diesel HT-09 - NIL, HT-73 - 50

Date: 06.02.2024 / SAT

SHIFT	DOOR NO.	OPERATOR NAME	No. of TRIPS	REMARKS & Sign
A	HT - 09	-	-	-
	HT - 73	-	-	-
B	HT - 09	Deepak Das	02	Deepak Das
	HT - 73	Baijnath kr. Ram	02	Baijnath Ram
C	HT - 09	Arjun kumar	01	[illegible]
	HT - 73	Chandrika Ravi	03	

H.S.Diesel → HT-09 - NIL HT-73 - NIL

Date: 07.02.2024 / SUN

SHIFT	DOOR NO.	OPERATOR NAME	No. of TRIPS	REMARKS & Sign
A	HT - 09	Santosh mahato	02	[illegible]
	HT - 73	Gunjan Singh	02	[illegible]
B	HT - 09	Deepak Das	01	Deepak Das
	HT - 73	Baijnath kr. Ram	02	Baijnath Ram
C	HT - 09	Arjun kumar	01	[illegible]
	HT - 73	Suresh mahato	01	सुरेश महतो

H.S.Diesel → HT-09 = NIL HT-73 - 150

Date: 08.02.2024 / MON

SHIFT	DOOR NO.	OPERATOR NAME	No. of TRIPS	REMARKS & Sign
A	HT - 09	Deepak Das	03	Deepak Das
	HT - 73	Baijnath kr. Ram	01	Baijnath Ram
B	HT - 09	Arjun kumar	01	[illegible]
	HT - 73	Suresh mahato	03	सुरेश महतो
C	HT - 09	Santosh mahato	02	[illegible]
	HT - 73	Md. Afif Ansari	02	[illegible]

H.S.Diesel → HT-09 → NIL HT-73 - NIL

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Date 09.02.2024 / TUE

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	Deepak Das	03	Deepak Das
	HT-72	Rajnath Kr. Ram	03	Rajnath Ram
B	HT-09	Arjun Mahto	02	[illegible]
	HT-72	Suresh Mahato	01	[illegible]
C	HT-09	Santosh Mahato	03	Santosh
	HT-72	Gunjan Singh	03	Gunjan Singh

H.S. Diesel → HT-09 - NIL   HT-72 - 50

Date 10.02.2024 / WED

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	—	—	[illegible]
	HT-72	Sitaram Mahato	03	[illegible]
B	HT-09	—	—	[illegible]
	HT-72	Suresh Mahato	03	[illegible]
C	HT-09	Santosh Mahato	02	Santosh
	HT-72	Gunjan Singh	01	Gunjan Singh

H.S. Diesel → HT-09 - 50   HT-72 - 66

Date 11.02.2024 / THU

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	Deepak Das	02	Deepak Das
	HT-72	Sitaram Mahato	03	
B	HT-09	Arjun Verma	01	[illegible]
	HT-72	Suresh Mahato	02	[illegible]
C	HT-09	Md. Aftab Alam	02	[illegible]
	HT-72	Gunjan Singh	02	Gunjan Singh

H.S. Diesel → HT-09 - NIL   HT-72 - 50

Date 12.02.2024 / FRI

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	Deepak Das	02	Deepak Das
	HT-72	Rajnath Kr. Ram	02	Rajnath Ram
B	HT-09	Arjun Verma	02	[illegible]
	HT-72	Suresh Mahato	01	[illegible]
C	HT-09	Santosh Mahato	01	Santosh
	HT-72	Gunjan Singh	02	Gunjan Singh

H.S. Diesel → HT-09 - NIL   HT-72 - 50

Date 13.02.2024 / SAT

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	Deepak Das	01	Deepak Das
	HT-72	Rajnath Kr. Ram	03	Rajnath Ram
B	HT-09	Arjun Verma	02	[illegible]
	HT-72	Sanjay Kumar	03	[illegible]
C	HT-09	Santosh Mahato	03	Santosh
	HT-72	Gunjan Singh	02	Gunjan Singh

H.S. Diesel → HT-09 - NIL   HT-72 - 50

Date 14.02.2024 / SUN

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	Deepak Das	03	Deepak Das
	HT-72	Rajnath Kr. Ram	03	Rajnath Ram
B	HT-09	Arjun Verma	02	[illegible]
	HT-72	Suresh Mahato	01	[illegible]
C	HT-09	Santosh Mahato	02	Santosh
	HT-72	Gunjan Singh	02	Gunjan Singh

H.S. Diesel → HT-09 - NIL   HT-72 - 50

Date 15.02.2024 / MON

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	Arjun Verma	02	[illegible]
	HT-72	Suresh Mahato	03	[illegible]
B	HT-09	Santosh Mahato	03	Santosh
	HT-72	Pankaj Bhardwaj	02	[illegible]
C	HT-09	Deepak Das	01	Deepak Das
	HT-72	Rajnath Kr. Ram	02	Rajnath Ram

H.S. Diesel → HT-09 - 50   HT-72 - 100

Date 16.02.2024 / TUE

SHIFT	DOZE NO	OPERATOR NAME	NO. OF TRIPS	REMARKS Sign
A	HT-09	Arjun Verma	03	[illegible]
	HT-72	Suresh Mahato	03	[illegible]
B	HT-09	Santosh Mahato	02	Santosh
	HT-72	Pankaj Bhardwaj	02	[illegible]
C	HT-09	Deepak Das	01	Deepak Das
	HT-72	Rajnath Kr. Ram	02	Rajnath Ram

H.S. Diesel → HT-09 - NIL   HT-72 - 50

Date 17.02.2021 / WED

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Arjun Verma	02	अर्जुन राम
	HT-73	Suresh Mahato	02	सुरेश महतो
B	HT-07	Santosh Mahato	03	[signature]
	HT-73	Gunjan Singh	03	Gunjan Singh
C	HT-07	Rahul Kumar	02	[signature]
	HT-73	Sobha Ram Mahato	01	S. Mahato

H.S. Diesel → HT-07 - 50 HT-73 - 100

Date 18.02.2021 / THUS

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Arjun Verma	01	अर्जुन राम
	HT-73	Suresh Mahato	02	सुरेश महतो
B	HT-07	Pankaj Bhardwaj	02	[signature]
	HT-73	Gunjan Singh	01	Gunjan Singh
C	HT-07	Deepak Das	02	दीपक दास
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram

H.S. Diesel → HT-07 — NIL HT-073 - 50

Date 19.02.2021 / FRI

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Arjun Verma	02	अर्जुन राम
	HT-73	Suresh Mahato	03	सुरेश महतो
B	HT-07	Santosh Mahato	03	[signature]
	HT-73	Gunjan Singh	02	Gunjan Singh
C	HT-07	Deepak Das	02	दीपक दास
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram

H.S. Diesel — HT-07 - 50 HT-73 - 50

Date 20.02.2021 / SAT

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Arjun Verma	02	अर्जुन राम
	HT-73	Sanjay Kumar	02	Sanjay
B	HT-07	Santosh Mahato	02	[signature]
	HT-73	Gunjan Singh	03	Gunjan Singh
C	HT-07	Deepak Das	01	दीपक दास
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram

H.S. Diesel → HT-07 - NIL HT-73 - 50

Date 21.02.2021 / SUN

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Arjun Verma	02	अर्जुन राम
	HT-73	Suresh Mahato	02	सुरेश महतो
B	HT-07	Santosh Mahato	02	[signature]
	HT-73	Gunjan Singh	03	Gunjan Singh
C	HT-07	Deepak Das	01	दीपक दास
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram

H.S. Diesel → HT-07 - NIL HT-73 - 150

Date 22.02.2021 / MON

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	–	–	[illegible]
	HT-73	Pankaj Bhardwaj	03	[illegible]
B	HT-07	–	–	— Do —
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram
C	HT-07	Arjun ~~[illegible]~~ Verma	02	अर्जुन राम
	HT-73	Suresh Mahato	02	सुरेश महतो

H.S. Diesel → HT-07 - NIL HT-73 - 50

Date 23.02.2021 / TUE

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Santosh Mahato	03	[signature]
	HT-73	Gunjan Singh	01	Gunjan Singh
B	HT-07	Deepak Das	02	दीपक दास
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram
C	HT-07	Arjun Verma	02	अर्जुन राम
	HT-73	Suresh Mahato	02	सुरेश महतो

H.S. Diesel → HT-07 - NIL HT-73 - 57

Date 24.02.2021 / WED

SHIFT	DESK No.	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Santosh Mahato	03	[signature]
	HT-73	Gunjan Singh	02	Gunjan Singh
B	HT-07	Rahul Kumar	01	[signature]
	HT-73	Sobha Ram Mahato	01	S. Mahato
C	HT-07	Chandrika Ravi	02	
	HT-73	Suresh Mahato	01	सुरेश महतो

H.S. Diesel → HT-07 - 55 HT-73 - 150

Date 25.02.2024 / THU

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Pankaj Bhardwaj	02	[illegible]
	HT-73	Gunjan Singh	03	Gunjan Singh
B	HT-07	Deepak Das	01	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram
C	HT-07	Arjun Verma	01	अर्जुन वर्मा
	HT-73	Suresh Mahato	02	सुरेश महतो

H.S. Diesel → HT-09 - 07 HT-73 - 50

Date 26.02.2024 / FRI

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	—	—	Airline leakage
	HT-73	Gunjan Singh	03	Gunjan Singh
B	HT-07	—	—	— Do —
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram
C	HT-09	Arjun Verma	01	अर्जुन वर्मा
	HT-73	Suresh ~~[illegible]~~ Mahato	02	सुरेश महतो

H.S. Diesel — HT-09 - 40 HT-73 - 60

Date 27.02.2024 / SAT

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Santosh Mahato	—	Pump B.D. [illegible]
	HT-73	Gunjan Singh	02	Gunjan Singh
B	HT-09	Deepak Das	01	Deepak Das
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram
C	HT-07	Arjun Verma	02	संजय वर्मा
	HT-73	Sanjay Kumar	01	Sanjay

H.S. Diesel → HT-07 - 50 HT-73 - 50

Date 28.02.2024 / SUN

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	02	Gunjan Singh
B	HT-07	Rahul Kumar	02	Rahul Sing
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram
C	HT-09	Arjun Verma	01	अर्जुन वर्मा
	HT-73	Suresh Mahato	01	सुरेश महतो

HS-Diesel → HT-09 - NIL HT-73 - 50

Date 01.03.2024 / MON

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-09	Rahul Kumar	02	Rahul Sing
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram
B	HT-07	Arjun ~~[illegible]~~ Verma	01	अर्जुन वर्मा
	HT-73	Suresh Mahato	01	सुरेश महतो
C	HT-09	Santosh Mahato	02	Santosh
	HT-73	Pankaj Bhardwaj	02	पंकज भारद्वाज

H.S. Diesel → HT-09 - 50 HT-73 - 50

Date 02.03.2024 / TUE

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Deepak Das	02	Deepak Das
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram
B	HT-09	Arjun Verma	01	अर्जुन वर्मा
	HT-73	Suresh Mahato	02	सुरेश महतो
C	HT-09	Santosh Mahato	01	Santosh
	HT-73	Gunjan Singh	03	Gunjan Singh

H.S. Diesel → HT-09 - 55 HT-73 - 50

Date 03.03.2024 / WED

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-09	Rahul Kumar	02	Rahul
	HT-73	Sobha Ram Mahato	02	S.R. Mahato
B	HT-09	Sanjay Kumar	01	Sanjay
	HT-73	Suresh Mahato	02	सुरेश महतो
C	HT-09	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	02	Gunjan Singh

H.S. Diesel → HT-09 - NIL HT-73 - 72

Date 04.03.2024 / THU

SHIFT	POLE NO	OPERATOR NAME	No. of TRIP	REMARKS & Sign
A	HT-07	Deepak Das	02	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram
B	HT-09	Arjun Verma	02	अर्जुन वर्मा
	HT-73	Suresh Mahato	01	सुरेश महतो
C	HT-07	~~Santosh~~ Md. Aliij Ansari	01	[illegible]
	HT-73	Gunjan Singh	02	Gunjan Singh

H.S. Diesel → HT-09 - 50 HT-73 - 70

Date: 05.07.2021 / FRI

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Deepak Das	03	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram
B	HT-09	Arjun Verma	01	अर्जुन वर्मा
	HT-73	Suresh Mahato	07	सुरेश महतो
C	HT-09	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	09	Gunjan Singh

H.S. Diesel — HT-09 – 72 HT-73 – NIL

Date: 06.07.2021 / SAT

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Deepak Das	02	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram
B	HT-09	Arjun Verma	01	अर्जुन वर्मा
	HT-73	Chandrika Rao	02	
C	HT-09	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	01	Gunjan Singh

H.S. Diesel — HT-09 – 57 HT-73 – 70

Date: 07.07.2021 / SUN

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Deepak Das	02	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram
B	HT-09	Arjun Verma	01	अर्जुन वर्मा
	HT-73	Suresh Mahato	03	सुरेश महतो
C	HT-09	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	02	Gunjan Singh

H.S. Diesel — HT-09 – 50 HT-73 – 51

Date: 08.07.2021 / MON

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Arjun Verma	02	अर्जुन वर्मा
	HT-73	Suresh Mahato	03	सुरेश महतो
B	HT-09	Santosh Mahato	01	Santosh
	HT-73	Pankaj Bhardwaj	02	पंकज भारद्वाज
C	HT-09	Deepak Das	01	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram

H.S. Diesel — HT-09 – 50 HT-73 – 50

Date: 09.07.2021 / TUE

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Arjun Verma	02	अर्जुन वर्मा
	HT-73	Suresh Mahato	03	सुरेश महतो
B	HT-09	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	02	Gunjan Singh
C	HT-09	Deepak Das	01	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram

H.S. Diesel — HT-09 – 50 HT-73 – 70

Date: 10.07.2021 / WED

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Sanjay Kumar	03	Sanjay
	HT-73	Suresh Mahato	03	सुरेश महतो
B	HT-09	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	02	Gunjan Singh
C	HT-09	Rahul Kumar	02	Rahul
	HT-73	Sobha Ram Mahato	02	S.R. Mahato

H.S. Diesel — HT-09 – 50 HT-73 – 70

Date: 11.07.2021 / THU

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Arjun Verma	08	[illegible]
	HT-73	Suresh Mahato	03	सुरेश महतो
B	HT-09	Md. Afij Ansari	01	[illegible]
	HT-73	Gunjan Singh	02	Gunjan Singh
C	HT-09	Deepak Das	01	Deepak Das
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram

H.S. Diesel — HT-09 – 55 HT-73 – 60

Date: 12.07.2021 / FRI

SHIFT	DOZER NO.	OPERATOR NAME	NO. OF TRIPS	REMARKS/ Sign
A	HT-09	Arjun Verma	02	अर्जुन वर्मा
	HT-73	Suresh Mahato	02	सुरेश महतो
B	HT-09	Santosh Mahato	02	Santosh
	HT-73	Gunjan Singh	01	Gunjan Singh
C	HT-09	Deepak Das	01	Deepak Das
	HT-73	Baijnath Kr. Ram	03	Baijnath Ram

H.S. Diesel — HT-09 – NIL HT-73 – 50

Date 13.01.2024 / SAT

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	Arjun Verma	02	अर्जुन वर्मा	
	HT-73	Chandrika Ravi	02		
B	HT-07	Santosh Mahato	01	Santosh	
	HT-73	Gunjan Singh	02	Gunjan	
C	HT-07	Deepak Das	01	Deepak Das	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	

H.S. Diesel → HT-07 – 50 HT-73 – 37

Date 14.01.2024 / SUN

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	Arjun Verma	01	अर्जुन वर्मा	
	HT-73	Suresh Mahato	02	सुरेश महतो	
B	HT-07	Santosh Mahato	02	Santosh	
	HT-73	Gunjan Singh	01	Gunjan	
C	HT-07	Deepak Das	02	Deepak Das	
	HT-73	Baijnath Kr. Ram	01	Baijnath Ram	

H.S. Diesel → HT-07 – NIL HT-73 – 40

Date 15.01.2024 / MON

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	Santosh Mahato	02	Santosh	
	HT-73	Pankaj Bhardwaj	01	Pankaj Bhardwaj	
B	HT-07	Deepak Das	03	Deepak Das	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
C	HT-07	Arjun Verma	02	अर्जुन वर्मा	
	HT-73	Suresh Mahato	01	सुरेश महतो	

H.S. Diesel → HT-07 – 100 HT-73 – 70

Date 16.01.2024 / TUE

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	Santosh Mahato	02	Santosh	
	HT-73	Gunjan Singh	03	Gunjan	
B	HT-07	—	—	—	
	HT-73	—	—	—	
C	HT-07	—	—	—	
	HT-73	—	—	—	

H.S. Diesel → HT-07 – NIL HT-73 – NIL

* Date 16th Jan 24 (2nd shift) → 19th Jan 24 (1st shift)
Project Close

Date 19.01.2024 / FRI

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	—	—	—	
	HT-73	—	—	—	
B	HT-07	Deepak Das	02	Deepak Das	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
C	HT-07	Arjun Verma	01	अर्जुन वर्मा	
	HT-73	Suresh Mahato	02	सुरेश महतो	

H.S. Diesel → HT-07 – 50 HT-73 – 150

Date 20.01.2024 / SAT

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	Santosh Mahato	02	Santosh	
	HT-73	Gunjan Singh	02	Gunjan	
B	HT-07	Deepak Das	02	Deepak Das	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
C	HT-07	Arjun Verma	02	अर्जुन वर्मा	
	HT-73	Sanjay Kumar	01	Sanjay	

H.S. Diesel → HT-07 – 50 HT-73 – 50

Date 21.01.2024 / SUN

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	Santosh Mahato	01	Santosh	
	HT-73	Gunjan Singh	03	Gunjan	
B	HT-07	Deepak Das	01	Deepak Das	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
C	HT-07	Arjun Verma	02	अर्जुन वर्मा	
	HT-73	Suresh Mahato	02	सुरेश महतो	

H.S. Diesel → HT-07 – NIL HT-73 – 70

Date 22.01.2024 / MON

SHIFT	DOZER NO	OPERATOR NAME	NO OF TRIPS	REMARKS	Sign
A	HT-07	Deepak Das	01	Deepak Das	
	HT-73	Baijnath Kr. Ram	02	Baijnath Ram	
B	HT-07	Arjun ~~Verma~~ Verma	02	अर्जुन वर्मा	
	HT-73	Suresh Mahato	02	सुरेश महतो	
C	HT-07	Santosh Mahato	01	Santosh	
	HT-73	Pankaj Bhardwaj	02	पंकज भारद्वाज	

H.S. Diesel → HT-07 – NIL HT-73 – 50

Date: 23.03.2024 / TUE

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	Deepak Das	06	Deepak Das	
	HT-73	Bajrang Kr. Ram	03	Bajrang Ram	
B	HT-09	Arjun Kumar	02	सुरेश महतो	
	HT-73	Suresh Mahato	01	सुरेश महतो	
C	HT-09	Santosh Mahato	01	Santosh	
	HT-73	Gunjan Singh	02	Gunjan	

H.S. Diesel → HT-09 - 60 HT-73 - 70

Date: 24.03.2024 / WED

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	Babu Kumar	00	- BD -	Babu
	HT-73	Sitala Ram Mahato	07	S. Mahato	
B	HT-09	—	00	- BD -	
	HT-73	Suresh Mahato	05	सुरेश महतो	
C	HT-09	—	00	- BD -	
	HT-73	Gunjan Singh	07	Gunjan Singh	

H.S. Diesel → HT-09 - NIL HT-73 - 70

Date: 25.03.2024 / THU

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	—	00	- BD -	
	HT-73	Deepak Das	07	Deepak Das	
B	HT-09	—	00	- BD -	
	HT-73	Suresh Mahato	04	सुरेश महतो	
C	HT-09	—	00	- BD -	
	HT-73	Gunjan Singh	04	Gunjan	

H.S. Diesel → HT-09 - NIL HT-73 - 70

Date: 26.03.2024 / FRI

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	—	00	- BD -	
	HT-73	Deepak Das	04	Deepak Das	
B	HT-09	—	00	- BD -	
	HT-73	Suresh Mahato	07	सुरेश महतो	
C	HT-09	—	00	- BD -	
	HT-73	Gunjan Singh	04	Gunjan	

H.S. Diesel → HT-09 - NIL HT-73 - 70

Date: 27.03.2024 / SAT

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	—	00	- BD -	
	HT-73	Bajrang Kr. Ram	04	Bajrang Ram	
B	HT-09	—	00	- BD -	
	HT-73	Suresh Mahato	07	सुरेश महतो	
C	HT-09	—	00	- BD -	
	HT-73	Gunjan Singh	07		

H.S. Diesel → HT-09 - NIL HT-73 - 70

Date: 28.03.2024 / SUN

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	—	00	- BD -	
	HT-73	Bajrang Kr. Ram	04	Bajrang Ram	
B	HT-09	—	00	- BD -	
	HT-73	Suresh Mahato	07	सुरेश महतो	
C	HT-09	—	00	- BD -	
	HT-73	Santosh Mahato	07	Santosh	

H.S. Diesel → HT-09 - NIL HT-73 - 60

Date: 30/03/2024 / TUE

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	—	00	- BD -	
	HT-73	Suresh Mahato	03	सुरेश महतो	
B	HT-09	—	00	- BD -	
	HT-73	Santosh Mahato	04	Santosh	
C	HT-09	—	00	- BD -	
	HT-073	Deepak Das	03	Deepak Das	

H.S. Diesel → HT-09 - NIL HT-73 - 50

Date: 31.03.2024 / WED

SHIFT	DOZER NO	OPERATOR NAME	No. of TRIP	REMARKS	Sign
A	HT-09	—	00	- BD -	
	HT-73	Suresh Mahato	04	सुरेश महतो	
B	HT-09	—	00	- BD -	
	HT-73	Gunjan Singh	03	Gunjan	
C	HT-09	—	00	- BD -	
	HT-73	Deepak Das	03	Deepak Das	

H.S. Diesel → HT-09 - NIL HT-73 - NIL

WATER-TANKER
MOVEMENT REGISTER
TOCP

Tetulmari - Colliery, Sijua Area

Record of Water Tanker / Water Sprinkler Movements

MONTH OCTOBER 2020

Date	Shift	Water Tanker No.	Location	Distance Covered	Hours of Work	Signature	Remark
01/10/2020	1st	WS 437	Work shop to coal dump and Transport road	1.5	2.0		
	2nd	WS-437	Work shop to coal dump & coal dump to OB face	2.0	2.0		
	3rd	WS-437	Work shop to coal dump & coal dump to OB face	2.5	1.0		
02/10/2020	1st	WS 437	Work shop coal dump & coal dump weight bridge to Transport road	1.0	3.0		
	2nd	WS 437	Work shop to coal dump coal dump to OB face	2.5	2.0		
	3rd	WS 437	Work shop to coal dump & Transport road	1.5	1.0		
03/10/2020	1st	WS 437	Work shop to coal dump & haul road	2.0	2.0		
	2nd	WS-437	Work shop to coal dump & work shop to OB dump	2.0	2.0		
	3rd	WS-437	Work shop to coal dump & Transport road	1.5	2.0		
04/10/2020	1st	WS 437	[illegible] to coal dump & coal dump weight bridge transport road	2.8	3.0		
	2nd	WS-437	Work shop to coal dump & OB [illegible] haul road	1.5	1.0		
	3rd	WS-437	Work shop to coal dump & haul road	2.0	2.0		
05/10/2020	1st	WS 437	Work shop to coal dump & coal dump to OB dump	1.5	1.0		
	2nd	WS 437	Work shop to coal dump & Transport road	2.0	2.0		
	3rd	WS-437	Work shop to coal dump & haul road	1.5	1.0		
06/10/2020	1st	WS 437	Work shop to coal dump & coal dump to OB dump	2.0	3.0		
	2nd	WS-437	Work shop to coal dump & haul road & face	2.0	2.0		
	3rd	WS-437	Work shop coal dump & face	1.5	1.0		
07/10/2020	1st	WS 437	Work shop to coal dump & OB [illegible]	2.0	2.0		
	2nd	WS-437	Work shop to haul road	1.5	1.0		
	3rd	WS-437	Work shop to haul road & OB face	2.0	2.0		

MONTH OCTOBER 2020

Date	Shift	Water Tanker No	Location	Distance Covered	Hours of Work	Signature	Remark
08/10/2020	1st	WS 437	Workshop to coal dump & weight bridge [illegible] dump to pit road	2.5	3.0	[illegible]	
	2nd	WS 437	Workshop to coal dump & [illegible] pit road	3.0	2.0		
	3rd	WS 437	Workshop to coal dump & haul road	1.5	2.0		
09/10/2020	1st	WS 437	Workshop to coal dump & coal [illegible] to coal dump	3.0	3.0	[illegible]	
	2nd	WS 437	Workshop to coal dump & coal [illegible] to weight bridge	2.5	3.0		
	3rd	WS 437	Workshop to coal dump & haul [illegible] face	2.5	2.0		
10/10/2020	1st	WS 437	Workshop to coal dump & transport road	2.0	2.0	[illegible]	
	2nd	WS 437	Workshop to coal dump & haul [illegible] face	2.0	2.0		
	3rd	WS 437	Workshop to coal dump & haul [illegible]	1.5	1.0		
11/10/2020	1st	WS 437	Workshop to coal dump & transport road	1.5 km	2.0	[illegible]	
	2nd	WS 437	Workshop to coal dump & haul road	1.0 km	1.0		
	3rd	WS 437	Workshop to coal dump & coal dump to weight bridge	2.5	3.0		
12/10/2020	1st	WS 437	Workshop to coal dump & coal dump to coal face	2.5	3.0	[illegible]	
	2nd	WS 437	Workshop to coal dump & coal [illegible] transport road	1.5	2.0		
	3rd	WS 437	Workshop to coal dump & haul road	1.0	1.0		
13/10/2020	1st	WS 437	Workshop to coal dump & coal [illegible] to transport road	1.5	2.0	[illegible]	
	2nd	WS 437	Workshop to coal dump & coal [illegible] to weight bridge	2.0	2.0		
	3rd	WS 437	Workshop to coal dump & haul road	1.0	1.0		
14/10/2020	1st	WS 437	Workshop to coal dump & haul road	1.0	1.0	[illegible]	
	2nd	WS 437	Workshop to coal dump & coal dump to weight bridge	2.8	2.0		
	3rd	WS 437	Workshop to coal dump & coal [illegible] to transport road	2.0	2.0		

VK

Record of Water [illegible]
MONTH OCTOBER 2020

Sprinklers Movement

Date	Shift	Water Tanker No.	Location	Distance Covered	Hours of Work	Signature	Remark
15/10/2020	1st	WS-437	workshop to coal dump & haul road OB face	1.5	2.0	[illegible]	
	2nd	WS-437	workshop to coal dump & OB face	1.0	1.0		
	3rd	WS-437	workshop to coal dump & coal dump & weigh bridge	2.5	3.0		
16/10/2020	1st	WS-437	workshop to coal dump & coal dump & weigh bridge	2.5	3.0	[illegible]	
	2nd	WS-437	workshop to coal dump & transport road	3.0	2.0		
	3rd	WS-437	workshop to coal dump & haul road	1.0	1.0		
17/10/2020	1st	WS-437	workshop to coal dump & OB face	2.0	2.0	[illegible]	
	2nd	WS-437	workshop to coal dump & haul road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & OB face	1.0	1.0		
18/10/2020	1st	WS-437	workshop to coal dump & weight bridge	2.8	2.0	[illegible]	
	2nd	WS-437	workshop to coal dump & haul road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & transport road	2.0	3.0		
19/10/2020	1st	WS-437	workshop to coal dump & haul road	1.0	1.0	[illegible]	
	2nd	WS-437	workshop to coal dump & OB face	1.5	1.0		
	3rd	WS-437	workshop to coal dump & transport road	1.0	1.0		
20/10/2020	1st	WS-437	workshop to coal dump & coal dump & weigh bridge	2.5	3.0	[illegible]	
	2nd	WS-437	workshop to coal dump & haul road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & transport road	1.5	2.0		
21/10/2020	1st	WS-437	workshop to coal dump & OB face	1.5	2.0	[illegible]	
	2nd	WS-437	workshop to coal dump & transport road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & haul road	1.0	1.0		

Record of Work
MONTH OCTOBER 2020

Sprinklers Movement

Date	Shift	Water Tanker No.	Location	Distance Covered	Hours of Work	Signature	Remark
2?/10/2020	1st	WS-437	workshop to coal dump & transport [illegible]	2.0	2.0		
	2nd	WS-437	workshop to coal dump & haul road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & OB [illegible]	1.0	1.0		
23/10/2020	1st	WS-437	workshop to coal dump & coal dump to weigh bridge	2.5	3.0		
	2nd	WS-437	workshop to coal dump & haul road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & transport road	1.5	2.0		
24/10/2020	1st	WS-437	workshop to coal dump & transport road	2.0	2.0		
	2nd	WS-437	workshop to coal dump & OB [illegible]	1.5	2.0		
	3rd	WS-437	workshop to coal dump & haul road & OB dump	1.5	2.0		
25/10/2020	1st	WS-437	workshop to coal dump & haul road	1.0	1.0		
	2nd	WS-437	workshop to coal dump & OB [illegible]	2.0	2.0		
	3rd	WS-437	workshop to coal dump & haul road	1.0	1.0		
26/10/2020	1st	WS-437	workshop to coal dump & coal dump to weigh bridge	2.5	3.0		
	2nd	WS-437	workshop to coal dump & haul road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & haul road	1.0	1.0		
27/10/2020	1st	WS-437	workshop to coal dump & OB face	1.5	2.0		
	2nd	WS-437	workshop to coal dump & haul road	1.0	1.0		
	3rd	WS-437	workshop to coal dump & OB dump	1.0	1.0		
28/10/2020	1st	WS-437	workshop to coal dump & coal dump to weigh bridge	3.0	3.0		
	2nd	WS-437	workshop to coal dump & OB face haul road	2.5	2.0		
	3rd	WS-437	workshop to coal dump & haul road	1.0	1.0		

Record of work
MONTH OCTOBER 2020

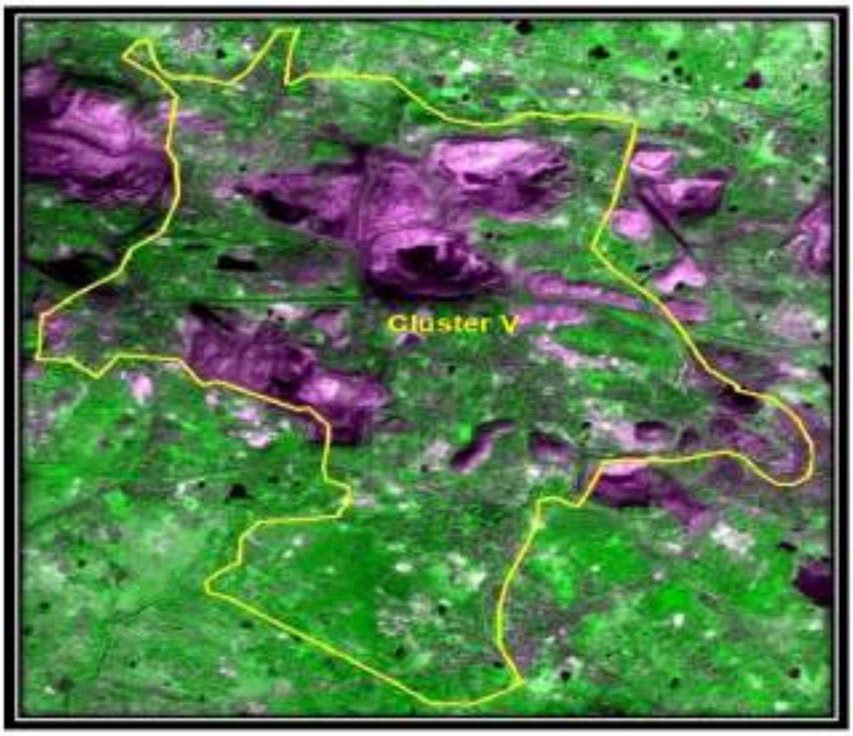
Sprinklers Movement

Date	Shift	Water Tanker No.	Location		Distance Covered	Hours of Work	Signature	Remark
29/10/2020	1st	WS-437	workshop to coal dump & coal dump	bridge	2.0	2.0		
	2nd	WS-437	workshop to coal dump & to crusher	road	1.5	2.0		
	3rd	WS-437	workshop to coal dump & haul	road	1.0	1.0		
30/10/2020	1st	WS-437	workshop to coal dump & to crusher	road	2.0	2.0		
	2nd	WS-437	workshop to coal dump & haul road		1.0	1.0		
	3rd	WS-437	workshop to coal dump & OB face		1.0	1.0		
31/10/2020	1st	WS-437	workshop to coal dump & OB dump		1.5	2.0		
	2nd	WS-437	workshop to coal dump & OB face		1.5	2.0		
	3rd	WS-437	workshop to coal dump & haul	road	1.0	1.0		
						15		

Total hours of operation = 169 hrs
Total fuel consumption = 169x20 = 3,380 litres

Annexure 21:

Land Reclamation/ Restoration Monitoring of five Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data of the Year 2020



Submitted to

Bharat Coking Coal Limited

cmpdi

A Mini Ratna Company

Land Reclamation/ Restoration Monitoring of five Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data of the Year 2020

March-2021

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

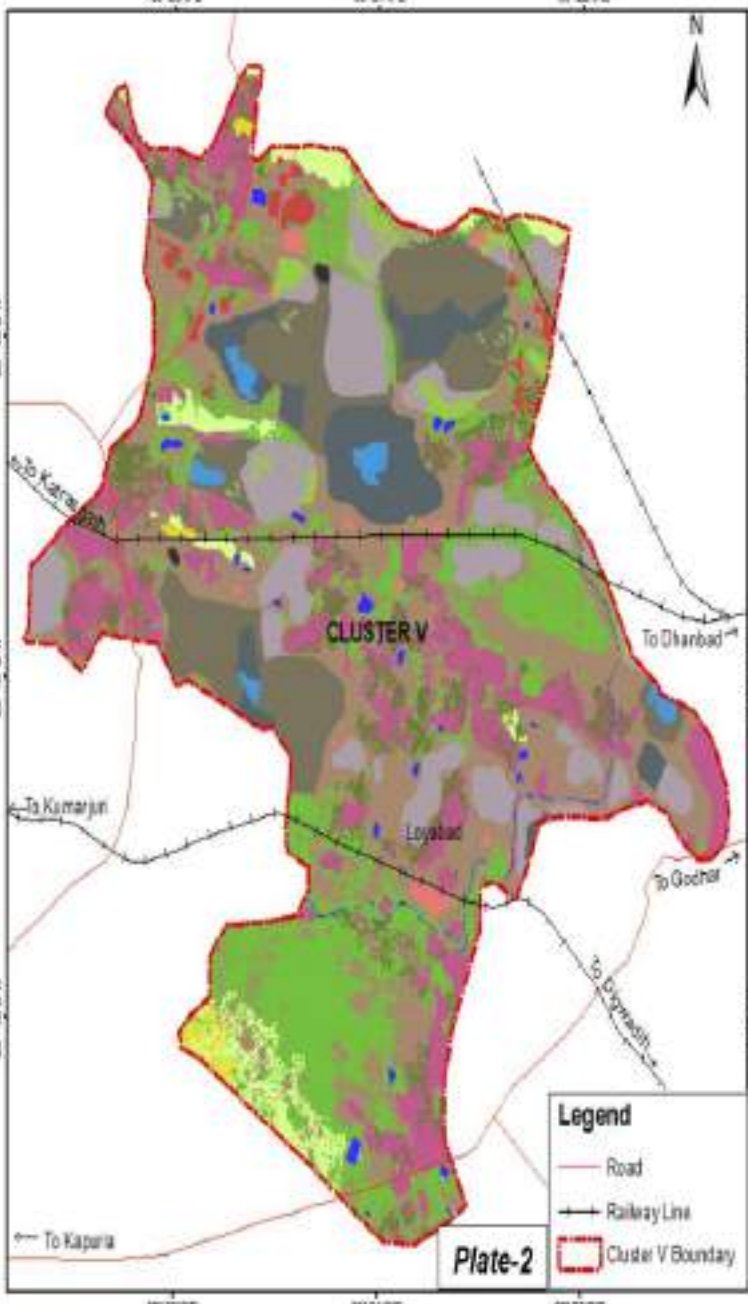


Plate-2

Area Statistics - Cluster V (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)		320.90	18.61
Plantation Area	Social Forestry		105.29	6.11
	Plantation on OB		23.85	1.38
	Plantation on Backfill		7.19	0.42
	Total Plantation Area (C)		136.33	7.91
	Total Vegetation (A+B+C)		457.23	26.51
Agriculture Land	Crop land		8.41	0.49
	Fallow Land		58.64	3.40
	Total Agriculture Land		67.05	3.89
Waste Land	Waste Land		472.92	27.42
	Sand Body		0.00	0.00
	Total Waste Land		472.92	27.42
Mining Area	Advance Quarry area		0.00	0.00
	Coal Quarry		87.72	5.09
	Barren OB Dump		174.62	10.13
	Back Fill		187.59	10.88
	Coal Dump		1.70	0.10
	Water Filled Qry		15.80	0.92
	Total Mining Area		467.43	27.10
Settlements	Urban Settlements		220.71	12.80
	Rural Settlements		13.97	0.81
	Industrial Settlements		11.55	0.67
	Total Settlement Area		246.23	14.28
Water Body	River/ Ponds		13.66	0.79
	Total Area		1724.52	100.00

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of BCCL Clusters				Int No
Subject: Land Reclamation Monitoring Status of Cluster-V Group of Mines based on Satellite Data (RS-2 L-IV) of the year 2020	Activity	Name	Designation	Signature	
	Prepared	A. Panda	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-V			Rev No.0

ANNEXURE 22:

Road Map for Ecorestoration of BCCL Mine Areas of Dhanbad, Jharkhand

Forest Ecology & Environment Division
Forest Research Institute
Indian Council of Forestry Research & Education
(Ministry of Environment & Forests, Govt. of India)
P.O. New Forest, Dehradun- 248006

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Executive Summary

Landscape of Jharkhand is fragmented because of the large tracts of mined lands .This has resulted in ecological imbalances due to disturbance in air, water, loss of topsoil as well as flora and fauna. Mining of minerals, roads and rails construction, Dams and irrigation schemes, construction of mineral based factories and industries, stone quarrying and unrestricted grazing by free range cattle etc. have exerted pressures on the bio-diversity of the state.

Restoration of these derelict landscapes based on ecological principles is the only answer for the speedy recovery of not only ecological systems but also for improve the socioeconomic potential of these areas. Besides carbon footprint of mining and other related activities will be reduced effectively within a short span of time.

Keeping these facts in view the road map for ecological restoration of mines of Bharat Coking Coal Limited in Dhanbad district has been prepared after a rapid appraisal of the extent of disturbance to biotic and abiotic components of the ecosystem. The major objectives for preparation of this road map is to improve productive capability of degraded lands and enhancing the conservation values of landscapes through :

1. Development and conservation of soil and *in-situ* moisture through ecological restoration interventions ;
2. Restoration/Regeneration of degraded lands including forests and adjoining areas on an ecological basis;
3. Intensification of the availability of fuel wood, fodder, grasses and other forest usufructs from the restored areas;
4. Securing people's participation in planning and restoration efforts in the surrounding villages to ensure sustainability).

Besides, restoration of derelict minespoils, developing a nursery for medicinal plants, Soil and moisture conservation practices, development of an eco park in the already quarried area and awareness and capacity building initiatives have also been considered.

The total project has to be implemented in two phases over a period of ten years. In the first Phase (2011-16) a field model will be developed by scientists of FRI, Dehradun which may be replicated in other areas. During phase II 2016-2021 Replication/expansion of proposed restoration models in the 226 hectares area spread over in 13 mines of BCCL. The critical role played by the various institutions in the context of execution of plan is well recognized. The various major stakeholders in the BCCL area have to jointly chalk out a strategic execution plan .The major stake holders in the region are BCCL and Local Communities.

It is expected that execution of the ecological restoration will in the long term contribute to mitigation of adverse impacts on the microclimate in the district as well as state and country at large.

Chapter 1 - Introduction

Jharkhand is a newly carved out state from the erstwhile state of Bihar, in November 2000. It is located on Chota Nagpur Plateau surrounded by Bihar to the north, Orissa to the south, West Bengal to the east, and Uttar Pradesh and Chhattisgarh to the west and lies between latitude 22° 00 and 24° 37 N and longitude 83° 15 and 87° 01E. It has an area of 79,714 km² that constitutes 2.42 % of the geographical area of India. Three major rivers flowing in the state are - the Sone, the Koel, and the Damodar. It is well known for its mineral wealth and forestry products. In particular, the four districts -Bokaro, Dhanbad, Ranchi and Jamshedpur are known for their rich mineral reserves.

It is worth mentioning that these minerals are the foundation of all the major industries in Jharkhand that is one of the biggest industrial belts in India. The Mines and Geology Department of the Government of Jharkhand monitors the mining in Jharkhand and checks the depletion of the mineral resources, as well as it works towards enhancing the prospects of mining at Jharkhand (Figure 1).

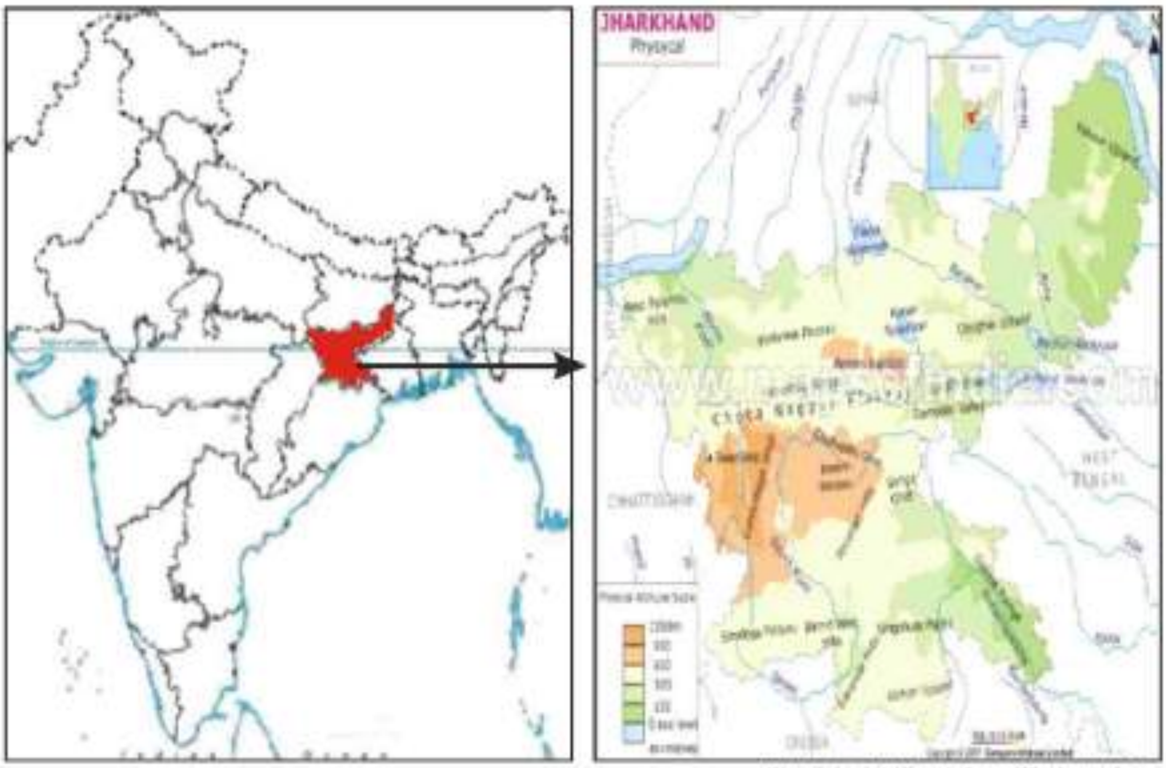

Figure 1. Map of Jharkhand indicating the Jharia mine

The Chhotanagpur plateau is rich in forest resources. The recorded forest area of the State is 23,605 km² which is 29.61% of the geographical area of the state. Reserved forests constitute 18.58%, protected forests 81.28%, and unclassed forests 0.14% of the total forest area. The forest cover in the state, based on interpretation of satellite data of Oct-Dec 2006, is 22,894 km², which is 28.72% of the state's geographic area. In terms of forest canopy density classes, the state has 2,590 km² very dense forest, 9,899 km² moderately dense forest and 10,405 km² open forest. Comparison of the current forest cover (satellite data Oct-Dec 2006) with the previous assessment (satellite data of Nov-Dec 2004) has shown a gain of 172 km² of forest cover.

Table 1. District-wise Forest Cover of Jharkhand

District	Geog. Area (km sq.)	Forest Cover (km sq.) Very Dense	Moderately Dense	Open	Total	Percent	Change*
Bokaro	1,929	64	244	252	560	29.03	-1
Chatra	3,732	251	863	668	1782	47.75	21
Deoghar	2,479	0	84	85	169	6.82	6
Dhanbad	2,996	0	50	155	205	6.84	0
Dumka	6,212	0	314	323	637	10.25	2
Garhwa	4,092	124	406	835	1365	33.36	0
Giridih	4,963	97	419	338	854	17.21	21
Godda	2,110	15	268	116	399	18.91	0
Gumla	9,077	324	919	1414	2657	29.27	35
Hazaribagh	5,998	272	622	1159	2053	34.23	42
Kodarma	1,435	69	320	211	600	41.81	5
Lohardaga	1,491	174	219	110	503	33.74	11
Pakaur	1,571	3	172	108	283	18.01	-1
Palamu	8,657	529	1809	1189	3527	40.74	31
Paschimi Singhbhum	9,907	453	1558	1824	3835	38.71	0
Purbi Singhbhum	3,533	53	612	346	1011	28.62	9
Ranchi	7,698	141	684	1079	1904	24.73	5
Shibganj	1,834	21	336	193	550	29.99	-14
Total	**79,714**	**2,590**	**9,899**	**10,405**	**22,894**	**28.72**	**172**

Source : Forest Survey of India, Dehradun. State of Forest Report 2009. Dehradun, FSI, 2005. 06
*change compare to 2005 Assessment (revised)

District wise forest cover of different canopy density classes and scrub along with the changes compared to 2005 assessment is given in the Table 1.

The state of Jharkhand is a part of biodiversity rich regions of India because of its diverse physiographic and climatic conditions. As per Champion & Seth classification, the state has six forest types that belong to two forest type groups viz., Tropical Moist Deciduous and Tropical Dry Deciduous Forests (Figure 2a). The Forests of the state form catchments of the three main rivers Koel, Damodar and Subernekha. The species found represent a wide range of taxa for both plants and animals. This can be attributed to variety of terrain and land forms (including water bodies). Various ethnic groups such as Munda, Ho, Oraon, Santhal, Paharia, Chero, Birjea, Asura and other have influenced their eco-systems in varying practices of agriculture and pasture.

The landscape of the state has a mix of wild, semi-wild and cultivated habitats. The bio-diversity of the state is under some threat due to a variety of adverse factors. These are mining, roads and rails construction, Dams and irrigation schemes, construction of mineral based factories and industries, stone quarrying and unrestricted grazing by free range cattle etc. Sal, Bamboo, Mango, Jackfruit, Kendu, Katha, Gamhar, Jamun, Harhe, Mahua, Shisham, Sagwan, Baheda, etc. are the important trees species in the area.

Figure 2a. Forest map of India

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Figure 2b. Distribution of major Coalfields

Mines and Minerals

Jharkhand State Mineral Development is an endeavor of the Government of Jharkhand to consolidate the prospects of mining in Jharkhand. As the territory of Jharkhand is replete with mineral resources, therefore, Jharkhand State Mineral Development has adopted policies in order to utilize the mineral resources to its fullest extent.

Jharkhand mines and minerals seem to be synonymous with the territory of Jharkhand. Jharkhand possesses a large reserve of mineral wealth within the territory: coal, iron ore, copper ore, bauxite, mica, graphite, kyanite, sillimanite, limestone, etc. form an integral part of mining industry in Jharkhand (Table 2).

It is noteworthy that Jharkhand is known to possess about 2000 million tonnes of hematite, which occurs in the Chiria region in the Singhbhum district of Jharkhand. In fact, Chiria has the potential to produce about 10 million tonnes of hematite per annum. Besides, coal is found in abundance in the Jharia, Rajmahal, Bokaro and Chatra districts of Jharkhand; it is said that Jharkhand possesses about 93% of medium coking coal, 30% of blendable coal and almost 100% of prime cooking coal. Moreover, there are about 22 limestone mines in Jharkhand, which are spread across Palamu, Hazaribagh, Ranchi and Sighbhum districts in Jharkhand (Table 2, Figure 2b).

Table 2 Major Mines and Minerals of Jharkhand

District	Important minerals	Other Minerals
Deoghar, Dhanbad	Coal	Fire Clay,Silver
Garwa	Coal	Dolomite
Bokaro	Coal	-
Godda	Coal	-
Hazaribagh	Coal	Fire-Clay, Feldspar, Mica, Lime stone, Stone-chips
Dumka	Coal	-
Sahibganj	-	Silica Sand, Kaolin, Stone chips
Giridih	Coal	Mica
Latehar, Lohardaga	Bauxite	-
Gumla	Bauxite	-
Palamau	Iron Ore	Fire Clay, Graphite, Dolomite, Feldspar, Limestone, Manganese
Ranchi	-	Lime stone, Kaolin
Jamtara, Kodarma	-	Mica, Stone-chips
East Singhbhum	Uranium, Copper	Quartzite, Kaolin, Gold, Silver, Fire Clay, Steatite
West Singhbhum	Iron Ore	Dolomite, Limestone, Manganese, Kyanite
Sarikela Kharswan, Simdega	-	Stone chips
Pakur	-	Stone-chips

Thus, it can be concluded that mines and minerals are an inevitable part of the economy, not only of Jharkhand but also of India.

India is the third leading coal producer in the world after China and the United States. India has huge coal reserves, with at least 80 billion tons of proven recoverable reserves of anthracite and bituminous coals, and at least another 2 billion tons of recoverable reserves of lignite and sub-bituminous coal. India's coal reserves account for 8% of the world's total.

As such, India is able to satisfy most of its country's coal demand through domestic production; the exception is its shortage of coking coal. Domestic production is concentrated in the Bihar, West Bengal, and Madhya Pradesh regions. A summary of India's coal reserves is shown in Figure 2b & Table 3.

Table 3. India's Coal Reserves as of January 2000 (millions of tons)

Coal Type	Proven	Indicated	Inferred	Total
Coking	16,364	12,735	1,328	**30,427**
prime coking	4,614	699	n/a	**5,313**
medium coking	11,267	11,133	1,106	**23,506**
blendable/semi-coking	482	904	222	**1,608**
Non-Coking	66,032	76,765	38,369	181,167
Total	**82,396**	**89,501**	**39,697**	**211,594**

Source: India Ministry of Coal

India depends on coal for more than half of its total energy needs. Nearly three quarters of the country's electricity and 63% of commercial energy comes from coal. Projected consumption is expected to climb to 444 million short tons by 2001 and 492 million short tons by 2010. Despite India's wealth in coal reserves, only about 3% is coking coal.

The coal mines of Coal India Limited (CIL) remove about 500 million cubic meter (Mcum) of overburden (OB) to produce 260 mt of coal in 2003-04 at an average stripping ratio of 1.92 cu m of OB against per tonne of coal production. As demand for coal increases to meet the country's energy requirement, the coal companies are digging deeper and deeper and even opting for lower grades of coal. The country is even planning for production from 300 m depths at stripping ratio of 1:15 for D and F grade quality of coal. If these mines were operational, it would mean that even if 1 million tonnes of coal were extracted, it would generate 15 million tonnes of waste material. This is huge quantity and in a country like India where land is at premium, it would be very difficult to find enough land to store this waste.

Chapter 2. Bharat Coking Coal Limited (BCCL)

BCCL is a subsidiary of Coal India Limited with its headquarters in Dhanbad. It was incorporated in January, 1972 to operate coking coal mines (214 Nos) operating in the Jharia & Raniganj Coalfields, taken over by the Govt. of India on 16th Oct,1971. Currently, the Company operates 78 coal mines which include 41 underground, 16 opencast & 21 mixed mines. The Company also runs 7 coking coal washeries, 3 non-coking coal washeries, one Captive Power Plant (2x10 MW), and 5 bye-product coke plants. The mines are grouped into 13 areas for administrative convenience.

BCCL is the major producer of prime coking coal (raw and washed). Medium coking coal is also produced in its mines in Mohuda and Barakar areas. In addition to production of hard coke, BCCL operates a number of sand gathering plants, a network of aerial ropeways for transport of sand and nine coal washeries, namely, Dugda, Mohuda, Bhojudih, Patherdih, Lodna, Sudamdih, Barora, Moonidih and Madhubhan.

Present study has been undertaken under an MoU between BCCL and Forest Research Institute, Dehradun for:

- Conducting a Rapid Ecological Appraisal of the mine sites of Bharat Coking Coal Limited, for the purpose of developing the Road Map/Action Plan for ecological restoration /plantation.
- Prepare the Road Map/ Action Plan for plantation work (in pursuing the cause of forest trees) in BCCL mine areas, based on scientific study. The road map would include soil working methods, soil and moisture conservation measures, choice of ecologically and socioeconomically viable plant species, methods of preparation of seed mix, methods of seeding and planting for ecological restoration of degraded mine areas.
- Documenting and producing a Technical Report/ Road Map/ Action Plan for plantation work in BCCL mine areas by FRI and submission thereof to Bharat Coking Coal Limited.
- NGO's / agencies who can successfully implement the Road map for work would be suggested in the Road map by FRI.

Jharia Coalfield

Jharia Coalfield (JCF) is located in the north eastern part of the State of Jharkhand, approximately 260 km west of Kolkata. It is linked to Kolkata and Delhi through NH-2, which is the part of Golden Quadrilateral highway network of India. The coalfield contains proven coal reserves of approximately one billion tonnes in a crescent-shaped basin of approximately 400 km2. BCCL operates within an area of approximately 258 Sq km. The Jharia coalfield covers an area of about 393 sq km it is bounded by Latitude 23°49'0.63"N and 23°38'36.50"N and Longitude 86°08'49.91"E and 86°25'54.92E (Figure 3). The major part of coalfield (about 400 sq km) lies in Dhanbad district of Jharkhand. Coalfield is connected by major highways road with Ranchi (117 km), Asansol (60 km), Jamshedpur (108 km) and Dhanbad (8 km). The nearest major railway station is Dhanbad, located on Delhi-Howrah Grand Chord line of East Central Railway which passes parallel to northern boundary of the coalfield.

Figure 3. Satellite map of Jharia Coal Field

Jharia Coalfield in Jharkhand, India, is known for being the exclusive storehouse of prime coking coal in the country. The coalfield is also known for hosting the maximum number of known coal fires among all coalfields in India. This coalfield is located in the district of Dhanbad in Jharkhand (formerly South Bihar). This is the largest coal producer in India with 23 big underground and nine open cast mines. The mining activities in these coalfields started in 1894. The history of Jharia coalfield fire can be traced back to 1916 when the first fire was detected. At present, more than 67 mine fires are reported from this region. There are about 20 fires spots covering an area of 17.35 sq.km.

Since the beginning of coal mining in the country, Jharia coalfield was a highly alluring area mainly because it has one of the highest concentration of thick coal seams in the world, ranging from 50cm. to 30m in thickness, and at relatively short depths. This coalfield contains the only remaining reserves of prime coking coal in India. 22% of the total coal produced in JCF is fed to steel industry. It meets almost 50% of the total prime coking coal requirement of the steel sector of the country and also supplies substantial quantity of coal to the pig iron sector. It meets the bulk of the coal requirement of the power stations in the northern region. 55% of coal is being dispatched to power and fertilizer sectors. Another 23% of coal is being marketed to non-core sector consisting of different types of industrial units like cement industry, refractories, rolling mills, dyeing & chemical, glass & potteries, paper, smokeless fuel & briquettes, mini cement plants, cokery units, brick kilns, bangles etc. (www.bccl.nic.in). Further, the district of Dhanbad is dependent on BCCL for its revenue. More than 85% of the working population of the district depends on coal mining or related operations.

Land Use/Cover in Jharia Coalfield

Land is one of the most precious natural resource on which all human activities are based. Changes in land use and land cover are therefore being increasingly recognized as critical factors influencing global change. While land cover and land use are often assumed to be identical, they are rather quite different. Land cover may be defined as the biophysical earth surface, while land use is often shaped by human, socioeconomic and political influences on the land. Therefore, knowledge of different type of lands as well as their spatial distribution is vital for its geospatial planning and management for optimal use of the land resources. For mining industry, the need for information on land use/ vegetation cover pattern is important particularly due to the environmental impact of mining on the landscape (Table 4).

The present framework of land use/cover classification(CMPDI) has been primarily based on the 'Manual of Nationwide Land Use/ Land Cover Mapping Using Satellite Imagery' developed by National Remote Sensing Agency, Hyderabad, which has further been modified by CMPDI for coal mining areas. Land use/vegetation cover map was prepared on the basis of image interpretation carried out based on the satellite data for the year 2008.

Data of land use/cover classes identified in the Jharia coalfield region, shows that vegetation cover of the coalfield area has predominantly of five classes.

- **Dense Forest :** Forest having crown density of above 40% comes in this class and is estimated to be 0.29 sq km, i.e., 0.07% of the coalfield area. Dense forest over the area has decreased, basically due to deforestation by local inhabitants

- **Open Forest :** Forest having crown density between 10% to 40% comes under this class. Open forest cover over Jharia coalfield is 8.53 sq km, i.e., 2.17 % of the coalfield area.

- **Scrubs :** Scrubs are vegetation with crown density less than 10% and cover 133.46 sq km, i.e., 33.97% of the coalfield area. They are scattered all over the area mixed with wastelands.

Plantation

Social Forestry : Plantation on wastelands, along the roadsides and colonies as green belt come under this category and cover 17.71 sq km, which is 4.51% of the coalfield area.

Plantation on Over Burden(OB) Dumps / Backfilled area The plantation on the OB dumps and backfilled areas are estimated to be 10.53 sq km, i.e., 2.68% of the coalfield area.

- **Mining Area**
  - Coal quarry
  - Advance quarry site, and
  - Barren OB dump. To make the study more relevant and to give thrust on land reclamation, in the current study some more classes have been added as follows:
  - Barren back filled area
  - Coal dumps
  - Water filled quarry

- **Agricultural Land**

Land primarily used for farming and production of food, fiber and other commercial and horticultural crops falls under this category. It includes both irrigated, unirrigated and fallow land (land used for cultivation, but temporarily allowed to rest).

Total area under agricultural land is 39.58 sq km in year 2008, which is 10.08 % of the coalfield area.

Table 4. Land Use / Vegetation Cover Classes Identified in Jharia Coalfield

Sl.No.	Level I	Level II	Area (km^2)	Percentage
1.	Vegetation Cover	Dense Forest	0.29	0.07
		Open Forest	8.53	2.17
		Total Forest	**8.82**	**2.24**
		Scrub	133.46	33.97
		Plantation under Social Forestry	17.71	4.51
		Plantation on OB Dumps	10.53	2.68
		Total Planted Area	28.24	7.19
2.	Mining Area	Coal Quarry	7.19	1.83
		Coal Dump	1.56	0.40
		Water Filled Quarry	0.43	0.11
		Barren OB Dump	6.42	1.64
		Barren Backfilled Area	9.35	2.38
		Total Mining Area	**24.96**	**6.35**
3.	Agricultural Land	Crop Land	4.69	1.19
		Fallow Land	34.90	8.88
		Total Agricultural Land	**39.58**	**10.08**
4.	Wasteland	Waste upland with/without scrubs	110.13	28.03
		Fly Ash Pond/slurry/tailing pond	0.26	0.07
		Sand Body	1.55	0.39
		Total Wastelands	**111.94**	**28.49**
5.	Settlements	Urban	27.80	7.08
		Rural	2.59	0.66
		Industrial	3.44	0.80
		Total Settlements	33.82	8.61
6.	Water Bodies	River/Streams /Reservoir	12.02	3.06
		Total	**392.85**	**100.00**

- **Wasteland :** Wasteland is degraded and under -utilized class of land which has deteriorated mainly because of either natural factors or due to lack of appropriate water and soil management.

  There are three types of wastelands predominant within the coalfield area, viz., wasteland,ash pond,slurry/tailing pond and sand bodies.

- **Settlements :** All the man-made structures (residential/official buildings etc.) are included under this category. Built-up land has been further divided in to rural, urban and industrial classes.

- **Water bodies :** Represent the area impounded by water includes natural lakes, rivers/streams and man made canal, reservoirs, tanks etc. The water bodies in the study area have found to be covering 12.02 sq km, which is 3.06% of the coalfield area.

Coal Reserves

The total coal reserves of the Jharia coalfield (BCCL area) are estimated to be 17,077 million tonnes. Further, 2,340 million tonne of coal lies within the jurisdiction of IISCO & TISCO. Details of the coal resources of Jharia coalfield are given in Table 5.

Table 5. Summary of Coal Resources in Jharia Coalfield in BCCL Leasehold Area

Type of Coal	Depth-wise resources in million tonne		
	0-600 meters	**600-1200 meters**	**Total**
Prime Coking	3,399 (3,019)	1,261 (512)	4,660 (3,531)
Medium Coking			
Low Volatile	3,172 (2,836)	2,097 (242)	5,269 (3,105)
High Volatile	295 (178)	Nil	295 (178)
Non Coking	5,002 (3,983)	1,851 (496)	6,853 (4,479)
Total	**11,868 (10,043)**	**5,209 (1,250)**	**17,077 (11,293)**

Source: http://www.bccl.nic.in.html
Note: Numbers in parenthesis are proved reserves

Physiography of the area

Jharia coalfield is characterized by gently undulating to a rolling topography with an overall slope towards east-southeast. The coalfield is roughly sickle shaped on plan and occurs as a basin with its axis trending broadly east-west and plunging towards the west (Figure 4).

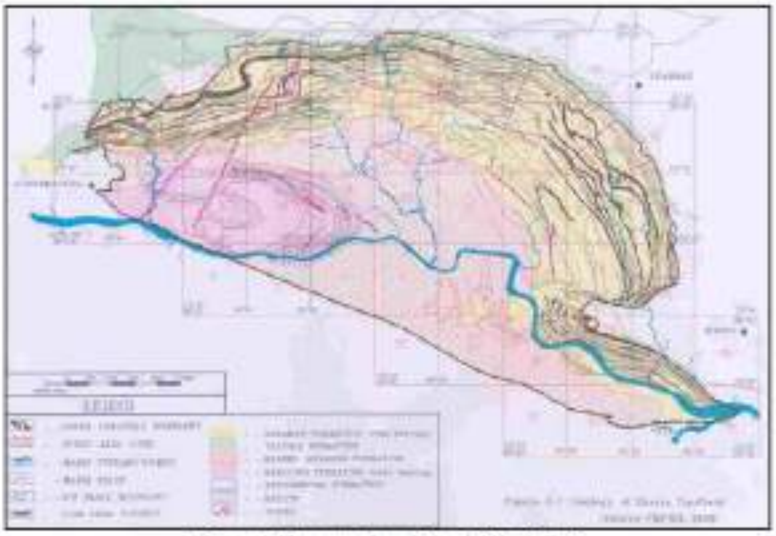

Figure 4. Topography of Jharia Coal Field

The southern flank is truncated by a major Boundary Fault. The general dip of the formation is 10 to 15 degrees. Flatter dips have also been noted at places. The entire southern part of Jharia coalfield in the vicinity of the Boundary Fault, however shows generally steep dipping beds with amounts increasing even up to 70 degrees. The strike of the formation is generally WSW to ENE in the western part and WNW to ESE in the southern part of the coalfield. This gradually swings to EW in the centre of the coalfield and then to NS further east. In the south-eastern part the strike is generally WNW-ESE. Besides the boundary part the coalfield is traversed by a number of other major and minor faults.

The Barakar formation contains 18 standard coal horizons (numbered I to XVIII). Of the Barakar formations, the coal seams XIII and above are generally thin and of relatively superior quality. Seams XII to IX/X are of medium to superior quality and attain sizable thickness at places. The V,VI,VII,IV, III & II are generally thick seams of inferior quality. The bottom most seam I is of superior medium coking quality in the eastern part of the coalfield.The drainage pattern in the Jharia coalfield is dendritic in nature. This may be due to more or less homogeneous lithology and structural controls. Damodar river is the main control of drainage system along the Jharia coalfield. It is a fourth order stream to which a number of third to first order streams, viz.Jamunia, Khudia, Katri, Ekra, Tisra, Chatkari etc. join. Damodar river flows along the southern periphery of the coalfield and is guided by the Great Boundary Fault. The main flow direction is from west to east.

Coal Mine Spoils of BCCL

Mining activity in JCF started as early as 1890. The trend of coal production, since the inception of mining activities to till date, is shown in Table 6.

Table 6. Coal production (in Mt) in JCF (BCCL)

Year	Production	Year	Production	Year	Production	Year	Production
1894	0.0015	1976	20.09	1988	25.11	2000	27.90
1896	1.00	1977	20.68	1989	26.30	2001	25.97
1901	2.00	1978	20.21	1990	26.62	2002	25.25
1906	6.00	1979	19.72	1991	26.70	2003	24.15
1918	11.00	1980	20.08	1992	27.01	2004	22.68
1920	12.00	1981	21.42	1993	28.06	2005	22.34
1947	11.79	1982	23.02	1994	29.04	2006	22.30
1950	12.69	1983	24.00	1995	28.75	2007	
1971	18.60	1984	21.63	1996	27.81	2008	
1973	18.05	1985	21.84	1997	27.14	2009	
1974	16.34	1986	21.08	1998	30.92	2010	
1975	17.74	1987	24.02	1999	27.17		

Source: www.bccl.nic.in

Earlier, mining in JCF was confined to the outcrop region with small leaseholds. It was carried by both underground (UG) and opencast (OC) methods. Shallow quarries were dug manually, and coal was carried manually by baskets to be dispatched. UG mining was more prevalent in the JCF. Coal seams were accessed by inclines and shafts, which were of shallow depth. Board and Pillar system was adopted. Coal was extracted by manual means using hand picks. Coal cutting machines and explosives were introduced later on.

Open cast mines are being worked mainly by Shovel-Dumper combination to remove coal and overburden. Draglines are also being used. Other Heavy Earth Moving Machinery (HEMM) includes drills, dozers, road graders, etc. (www.bccl.nic.in). The present mining setup of the JCF is shown in Figure 5.

Disturbance to natural ecosystem and existing land uses is an integral part of mining, and during the process of mineral excavation disturbance to the structure, and functioning of the ecosystems is inevitable. One of the reasons for the severity of impacts is that ore body in most of the cases lies deep inside the earth's crust and to reach the ore reserve topsoil as well as an appreciable thickness of overburden is required to be removed.

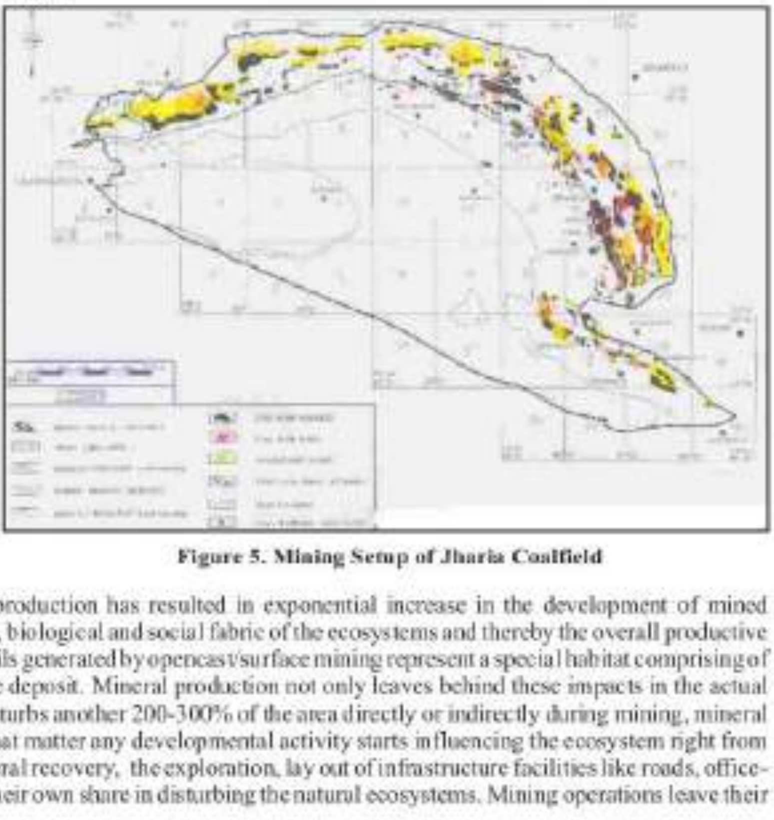

Figure 5. Mining Setup of Jharia Coalfield

Exponential growth in mineral production has resulted in exponential increase in the development of mined wastelands where alteration in the physical, biological and social fabric of the ecosystems and thereby the overall productive potential of the area has declined. Mine spoils generated by opencast/surface mining represent a special habitat comprising of unconsolidated materials overlying the ore deposit. Mineral production not only leaves behind these impacts in the actual area worked for mining but besides this disturbs another 200-300% of the area directly or indirectly during mining, mineral transport and processing . Mining or for that matter any developmental activity starts influencing the ecosystem right from the inception of the project. In case of mineral recovery, the exploration, lay out of infrastructure facilities like roads, office-cum-residential complexes etc. have also their own share in disturbing the natural ecosystems. Mining operations leave their impacts in the form of:

- landscape alteration
- removal of top soil and subsequent physical and biological erosion of resultant strata

- qualitative and quantitative changes of rivers, lakes and stream water
- air and noise pollution
- floral and faunal population
- altered socioeconomic status of people

Conventional reclamation and rehabilitation efforts often make use of exotic species. These practices include afforestation or plantation programmes; that include large-scale introduction of fast growing exotic species such as *Leucaena leucocephala;* Australian Acacia (*Acacia auriculiformis*), *Gliricidia sepium,* Silver oak *(grevillea robusta), Eucalyptus* species etc. but these species do not help in reconstructing the disturbed ecosystem. The use of non-native or exotics maybe justifiable in some areas but areas that have fragile ecosystems and biologically rich need to be treated differently as they are unique areas that support wide variety of native flora and fauna and provide ecological services.

Compensatory Afforestation Programmes

Afforestation is the act of planting trees on a large area. It could be to compensate the change of forestland use to non-forest land use, which is not compatible with the interest of long-term conservation.

Compensatory afforestation programmes though prescribed under various rules, does not really compensates the losses incurred due to landuse conversion in this case forest to opencast mines. The problems of introducing exotic plants are:

- Alter community composition and structure by influencing energy or nutrients proportion to their biomass.
- As exotics become established, reduces the share of available resources to the native or local species.
- Results in loss or decrease in diversity
- Loss of food species to other small mammals and makes habitat unfit for utilization.
- Reduces species richness diversity and density of bird species.

Chapter 3. Restoration Strategies

Various terminologies are in common use by mined land greening practitioners. Many times the word ***restoration*** is used to denote degree of greening of denuded site or at times used as synonymous with other words like ***rehabilitation***, ***reclamation***, etc. In application of vegetative applications these three words are commonly used and also used as a substitute for each other. It is the treatment of land creating conditions for bringing the land back to some beneficial use. Reclamation does not necessarily mean restoring the land to its original conditions.

Restoration is defined as the act of restoring to the former state or position or to restore is to bring back to the original state or to a healthy vigorous state. There is both the implication of returning to an original state and to state that is perfect and healthy.

Rehabilitation is defined as the action of restoring a thing to a previous condition or status. This appears similar to restoration, but there is little or no implication to perfection. In common usage, something rehabilitated is not expected to be in the original or healthy state as if it has been restored.

Reclamation is a term used by many practitioners, which can be defined as making land fit for beneficial use. But reclaim is used to indicate bringing back to a proper state. There is no implication of returning to an original state but rather to useful one.

Road Map for Restoration of Derelict Mined Landscapes

Disturbance to natural ecosystem and existing land uses is an integral part of mining, and during the process of mineral excavation disturbance to the structure, and functioning of the ecosystems is inevitable. One of the reasons for the severity of impacts is that ore body in most of the cases lies deep inside the earth's crust and to reach the ore reserve topsoil as well as an appreciable thickness of overburden is required to be removed.

Ecorestoration of mined areas is the most appropriate ecologically and socioeconomically compatible measure. Since ecological restoration of natural ecosystems attempts to recover as much historical authenticity as can be reasonably accommodated, the use of native species is highly desirable as native species assure rejuvenation of the ecosystem components and lead towards restoration of the ecosystem of the land to its pristine glory. Since, these species have evolved through natural selection and adapted to specialized edaphic environment, using these species in restoration of derelict lands may help in speeding of succession process and the system may become stable, and match with undisturbed natural forests within short span of time.

Indian Bureau of Mines (2000) has also recommended ecorestoration of dumps as a part of natural succession process and that it should be started with sowing of seeds of legumes, grasses, herbs and shrubs in the inter-spacing of tree plantation. The normal practice is to choose drought resistant, fast growing trees, that can grow in acidic, nutrient deficient, elevated metal contaminated soils. The effort should be aimed at finding out restoration success of nutrient poor acidic overburden dumps with liming, improvement of organic carbon, N and P status. The species selected for establishment also depend on the future land use of the area, soil conditions and climate. If the objective is to restore the native vegetation and fauna, then the species are pre-determined. Therefore, ecorestoration is the process of short-circuiting the process of natural recovery of degraded ecosystems through ecological interventions to :

- restore the derelict landscape,
- ameliorate the substrate,
- conserve the biodiversity,
- restore the ecological processes and
- provide the fuel, fodder and other NWFP,s to the local people.

Goals and Objectives : The basic goals and objectives of restoration are :

1. To restore highly degraded but localized sites
2. To improve productive capability of degraded lands based on their land capability
3. To enhance conservation values of landscapes

To achieve these goals, formulation of an effective restoration programme is necessary after assessment of-

- The major causes of degradation
- biological potential of the site based on assessment of the extent of disturbance to biotic components
- Degree of alteration in the physical and chemical composition of strata
- Quantitative and qualitative changes in the hydrological potential of the site

- Assess the limiting factors for establishment, growth, and diversity of recovering vegetation
- Quantification of socioeconomic impacts

Major causes of degradation

The pre-mining conditions in JCF were greener with very less sign of land degradation. The state and central governments have hardly attempted to prepare a land-use map of the whole JCF. Survey of India prepared the earliest land-use map of JCF. This map depicted the generalised land-use of JCF. As per this map mining area occupied about 5%, built-up land about 9%, forest land about 5% and agriculture land the rest, i.e., 81%.

The pre-mining conditions in and around the Jharia coalfield were much greener with very less sign of land degradation. The increase in coal production (Table 7) has reflected in the changes in land-use pattern in the area since the beginning of mining. The land-use of an particular area during a particular period depicts the environmental conditions that prevailed during premining times. Table 7 depicts the changes in the major Land-uses of the Jharia coalfield since 1925 to 1993. After the nationalisation of coal mines, the government emphasized on more coal production to meet the growing demands of the power and steel industries. In order to meet this growing demand of coal, opencast mining methods came into forefront. Further thrust was given to opencast mining in the area in 1986-87 by inducting large-scale mechanisation methods. Opencast mining methods engulf large tracts of surface land for quarrying, overburden dumping and for other infrastructure setup, large areas of agricultural land, forest land, natural vegetation land and villages were acquired by the mining companies operating in JCF. These changes in land-use/land-cover are evident from the data given in Table 7.

Table 7. Major Land-Use Patterns in JCF Between 1925 and 1993

Sl.	Land-Use	Area in Sq km.			
No.		1925	1974	1987	1993
1.	Villages, settlements	38.70 (8.6)	72.0 (16.0)	145.35 (32.3)	148.95 (33.10)
2.	Mining area	21.15 (4.7)	78.3 (17.4)	56.25 (12.5)	87.39 (19.42)
3.	Water bodies	32.85 (7.3)	30.15 (6.7)	13.95 (3.1)	13.05 (2.90)
4.	Forest	22.05 (4.9)	3.15 (0.7)	3.15 (0.7)	11.03 (2.45)
5.	Agriculture & natural vegetation	294.30 (65.4)	255.6 (56.8)	222.3 (49.4)	175.58 (39.02)
6.	Fallow land & pastures	40.95 (9.1)	10.8 (2.4)	9.0 (2.0)	14.0 (3.11)
	Total	**450.0 (100)**	**450.0 (100)**	**450.0 (100)**	**450.0 (100)**

Note: Numbers in parenthesis are in percentage

Source: www.bccl.nic.in

From the data presented in Table 7, it becomes evident that in 1925 the JCF was basically a forest-cum-agriculture land and mining activities have triggered changes in other land-use/ land-covers of the area as under:.

- Human settlement area *increased*,
- Agricultural land, forest cover, fallow land, pastures and other natural vegetation *decreased*,
- Area under water bodies i.e., ponds and streams has *reduced* and
- Mining area *increased*.

Major industrial developments in the Dhanbad district took place from early 1970s. The coal mines were nationalized in 1971-73, the Bokaro steel plant came into operation in 1970 and there was a rapid growth of coal based industries in and around the JCF.

Biological potential of the site based on assessment of the extent of disturbance to biotic components

Luxurious deciduous forest was present in and around the JCF during the beginning of this century (Hains,1925). Over the period of time this forest cover got depleted by human interference by way of mining and urbanisation. The forest cover has decreased from 22 Sq km. in 1925 to 3 Sq km. in 1998. Presently the so-called forestland in the coalfield is severely degraded, dry deciduous type. Presently most of the native vegetation is replaced by exotic species. These exotic weeds reflect their tolerance to pollution and their capacity to adapt to the present climatic conditions. *Leonotis nepitifolia* which is an invasive species and a well-known marker of ecological degradation occurs abundantly in the JCF. This species is associated with species like *Boerhavia diffusa, Cleome viscosa, Parthenium hysterophorus, Eragrostis plumosa, Cassia tora, Tridax procumbens, Lantana camara* etc. This vegetation spectrum clearly indicates that the exotic weeds have competed and replaced the endemic species like *Dichanthium annulatum, Cynodon dactylon, Heteropogon contortus* etc. The change in the vegetation pattern from native to exotic is a direct effect of land disturbance.

Much of the JCF is occupied by cultivated land. The cultivation is occasional and rainfed, and is dominantly paddy (*Oryza sativa*), most of it remains fallow. It is observed that, despite good soil and favorable climatic conditions, large tracts of agricultural land lie abandoned, the cropping pattern is not upto the required potential and the crop yield is very poor (the crop yield is only 10-25 quintals/ha). The conversion of large areas of agricultural land into degraded fallow or shrubby land is due to the shift in occupation by the local people from agriculture to other occupations and lack of irrigation facilities. In the post mining scenario vegetation cover has been totally removed from the mining areas. Most of the large areas are used as overburden dumping sites.

Further, biological potential of the site depends on the presence of propagules in the derelict land or in the vicinity. A reconnaissance survey of the area showed 61 species of common occurrence in the BCCL mining belt. This includes 19 tree species, 16 shrubs and 26 herbaceous species of plants (Table 8, Figure 6).

Table 8. Plants of Common Occurrence in BCCL Mining Areas

S.No.	Botanical Name	Common name	Family	Uses
Trees				
1.	*Ailanthus excelsa*	Mahanim	Simaroubaceae	Medicinal, Timber
2.	*Albizzia lebbeck*	Siras	Mimosaceae	Fodder, Medicinal, Timber
3.	*Alstonia scholaris*	Pala	Apocynaceae	Medicinal, Timber
4.	*Azadirachta indica*	Neem	Meliaceae	Medicinal, Timber
5.	*Bombax ceiba*	Semal	Bombacaceae	Fodder, Medicinal
6.	*Butea monosperma*	Palas	Fabaceae	Medicinal, Timber
7.	*Cassia fistula*	Amaltas	Caesalpiniaceae	Medicinal, Timber
8.	*Cassia siamea*	Pili fooli	Caesalpiniaceae	Ornamental
9.	*Dalbergia sissoo*	Shisham	Fabaceae	Timber, Fodder
10.	*Ehretia laevis*	Chamror	Boraginaceae	Medicinal
11.	*Ficus glomerata*	Gular	Moraceae	Fruit Edible, Fodder
12.	*Ficus hispida*	Kath gular	Moraceae	Fodder
13.	*Ficus religiosa*	Pipal	Moraceae	Fodder
14.	*Holarrhena antidysenterica*	Kutaj	Apocynaceae	Medicinal
15.	*Leucaena leucocephala*	Subabul	Mimosaceae	Fodder
16.	*Madhuca indica*	Mahua	Sapotaceae	Medicinal, Timber
17.	*Melia composita*	Bakain	Meliaceae	Timber
18.	*Tamarindus indica*	Imli	Mimosaceae	Fruit edible, Timber
19.	*Terminalia arjuna*	Arjun	Combretaceae	Medicinal
Shrub Species				
20.	*Adhatoda zeylanica*	Vasaka	Acanthaceae	Medicinal
21.	*Calotropis procera*	Aak	Asclepiadaceae	Medicinal
22.	*Cassia tora*	Senna	Caesalpiniaceae	Medicinal
23.	*Clerodendrum viscosum*	Bhant	Verbenaceae	Medicinal
24.	*Datura stramonium*	Datura	Solanaceae	Medicinal
25.	*Eupatorium adenophorum*	Nali	Asteraceae	Medicinal
26.	*Hyptis suaveolens*	Ganga tulsi	Lamiaceae	Medicinal
27.	*Ipomoea fistulosa*	Beha aak	Convolvulaceae	Soil binder
28.	*Lantana camara*	Putus	Verbenaceae	Soil binder
29.	*Pogostemon benghalense*	Phangla	Lamiaceae	Soil binder
30.	*Ricinus communis*	Arandi	Euphorbiaceae	Medicinal, Soil binder
31.	*Streblus asper*	malli	Moraceae	Soil binder
32.	*Vitex negundo*	Nirgundi	Verbenaceae	Good soil binder, Medicinal
33.	*Woodfordia fruiticosa*	Dehu	Lathyraceae	Good soil binder, Medicinal
34.	*Zizyphus nummularia*	Beri	Rhamnaceae	Fruit Edible
35.	Solanum torvum	Jangali bengan	Solanaceae	Medicinal
Herbaceous species(herbs and grasses)				
36.	*Alysicarpus monilifer*	Leel	Fabaceae	Soil binder
37.	*Boerhavia diffusa*	Punarva	Nyctaginaceae	Good soil binder, Medicinal

38.	*Cenchrus ciliaris*	Anjan grass	Poaceae	Soil binder
39.	*Cleome viscosa*	Jakhia	Capparidaceae	Seeds edible
40.	*Croton bonplandianus*	Jamal ghota	Euphorbiaceae	Waste land indicator
41.	*Cynodon dactylon*	Dub grass	Poaceae	Soil binder
42.	*Dicanthium annulatum*	Marvel grass	Poaceae	Soil binder
43.	*Eichhornia crassipes*	Jal sokha	Pontederiaceae	Aquatic Vegetable
44.	*Eragrostis atrovirens*	Bhant grass	Poaceae	Waste Land indicator
45.	*Eragrostis plumosa*	koli grass	Poaceae	Waste Land indicator
46.	*Eupatorium adenophorum*	Banmara	Asteraceae	Waste land indicator
47.	*Heteropogon contortus*	Pili grass	Poaceae	Fodder grass
48.	*Hygrophylla spinosa*	Gokulakanta	Acanthaceae	Aquatic plant, Medicinal
49.	*Indigofera trita*	Indigo	Fabaceae	Soil binder
50.	*Marsilea quadrifolia*	Sujni Saag	Marsiliaceae	Aquatic, Edible
51.	*Mucuna pruriens*	Konch phali	Fabaceae	Soil binder, Medicinal
52.	*Ocimum canum*	Ram Tulsi	Lamiaceae	Medicinal
53.	*Peristrophe paniculata*	Atrilal	Acanthaceae	waste land indicator, Medicinal
54.	*Phyla nodiflora*	Kocha saag	Verbenaceae	Well moister indicator
55.	*Polygonum hydropiper*	Gotki	Polygonaceae	Well moister indicator
56.	*Saccharum spontaneum*	Kans	Poaceae	Sand indicator
57.	*Sida acuta*	jharu grass	Malvaceae	Shoot used for sweeping
58.	*Sida cordifolia*	Bala	Malvaceae	Medicinal
59.	*Solanum surattence*	Nili kateli	Solanaceae	Clay indicator
60.	*Teprosia purpurea*	Lal puli	Fabaceae	Soil binder
61.	*Tragea involucrata*	Bichati	Euphorbiaceae	Poisnous

Herbaceous species (including herbs and grasses) have major contribution (42%) followed by shrubs (28%). However, trees are sparsely distributed over the area.

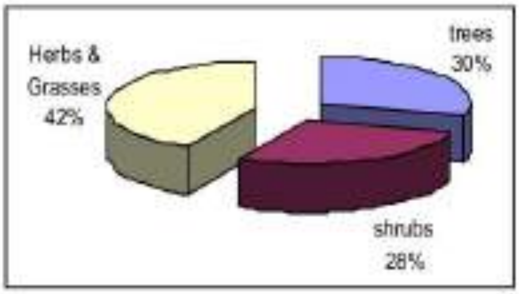

Figure 6. Floristic attributes in percentage of common occurrence in BCCL mining areas

Degree of Alteration in the Physical and Chemical Composition of Strata

The physiographic/ land features with their associated soil reveal that soils occur upto a good depth (+60cm). Table 9,10 and 11. Soil survey tests performed in 1995 revealed that soils occur upto a good depth (+60cm) in unmined areas. The texture is good with high percentage of clay (20-35%) that means the water holding capacity is good. Soil electrical conductivity is low (0.02-0.4 mmohs/cm) which means there is no problem of soil salinity. pH of soils is acceptable (5.3-7.5 and the organic carbon content is low (0.1%). The soils are mature, annual rainfall in JCF is 1600 mm with favorable distribution, the topography of JCF is nearly level to gently sloping making erosion moderate and terrain conditions amenable for any type of land shaping & management. All these characteristics rate the soils of JCF to be good and make them capable for agriculture, forestry and grazing. Distribution of physiography-wise land-capability classes in and around JCF are given in Table 9,10 and 11.

However, lands with land-capability classes I, IV, and V do not occur within the coalfield. The JCF is dominated by lands with the following :

1. CC-II - spread over 107 sqkm approx.
2. LCC-III - spread over 100 sqkm approx.
3. LCC-IV - spread over 10 sqkm approx.
4. LCC-VI - spread over 6 sqkm approx.
5. LCC-VII - spread over 73 sqkm approx.

Soils/Mine spoils

The dominant soils in the coalfield are coarse loamy type. They are very shallow to shallow, dark reddish brown to dark brown soils developed over sandstones. Top soil occurrence is very shallow ranging from 10-25cm thick. Due to severe land disturbance, the soils near the open cast mines are unsorted, coarse textured, and have low soil moisture retention and low organic matter content. The physiographic/land features with their associated soil types in JCF are shown in Table 9,10 and 11.

Table 9. Physiography-Wise Soil Description in JCF

Sl.No.	Physiography	Associated Soil type	Description
1.	Hills/Hillocks	Rocky; and coarse, loamy, mixed.	Occur to the North and East of JCF on the hills. Consist of granites, granite-gneisses. Soil cover is very negligible. Covers 190 sqkm (5%) of the total survey area.
2.	Foot slopes	Fine, loamy, mixed,skeletal.	Occur on the erosional phases and exhibit ill developed profiles. Slopes are gentle to strong and are afforested. Soil cover is 40-45 cm and covers 125 sqkm (3%) of the total survey area.
3.	Shallow weathered pediplain	Fine to coarse, loamy, mixed.	Are gently undulating convex lands. Soil cover is 50 cm and covers 1500 sqkm (34%) of the total survey area. Soils are productive.
4.	Moderately weathered pediplain	Fine to coarse, loamy, mixed.	Are mid-uplands bordering the valley flats. Soil cover is about 40 cm and covers 1500 sqkm (36%) of the total survey area. Soils are hydromorphic and productive.
5.	Valley flats	Fine , loamy, mixed.	Comprises the bottom lands of valleys where deep to very deep soils are encountered. Soil cover is upto 105 cm and covers 480 sqkm (11%) of the total survey area. Soils are hydromorphic and productive.
6.	Stony wastes (non-mining)	Fine, loamy, skeletal, mixed.	Comprise mostly granite rocks. Soils are skeletal and ravelly. Covers 53 sqkm (1%) of the total survey area.
7.	Coal mines & OB dumps	Disturbed & unclassified soils	Soil, sequence is in-consistent and horizons are disturbed. Covers 131 sqkm (3%) of the total survey area.
8.	Severely eroded, gullied area	Fine to coarse, loamy, mixed.	Occur near streams and are barren. But for the erosive nature, soils are deep and can support vegetation. Covers 20 sqkm (0.5%) of the total survey area.
9.	Disturbed land (subsided)	Fine to coarse, loamy, mixed; sometimes mixed up & unclassified	Are irregular depressions. Soil sequence is disturbed. Covers 10 sqkm (0.3%) of the total survey area.
10.	River bank area	Course, loamy, mixed.	Occur as small sandy patches on the banks of some river systems, in the loops. Covers 7 sqkm (0.2%) of the total survey area.
11.	Industrial and miscellaneous areas	Not known/ not surveyed	Include industries, water bodies, roads, settlements etc. Covers 232 sqkm (6%) of the total survey area.

Table 10.Physiography-Wise Land-Capability in and Around JCF

Sl. No.	Physiography	Land-capability class with description
1.	Hills/Hillocks	VIIes : Hilly, stony, soil patches are severely eroded and shallow. Non-arable land; suitable for grazing and forestry
2.	Foot slopes	IVes : Slopes are 10-15% with moderately deep soils, but are severely eroded. Fairly good land for limited cultivation
3.	Shallow weathered pediplain	IIIes : Moderately good cultivable land with limitations of erosion and soil depth/heavy texture/acidity
4.	Moderately weathered pediplain	IIesw : Good cultivable land with limitations of erosion; soil depth/heavy texture/acidity and wetness
5.	Valley flats	IIw : Good cultivable land with limitation due to wetness (subject to over flow)
6.	Stony wastes (non-mining)	VIes : Not arable, suitable for grazing; with limitations of erosion and soil depth/heavy texture/acidity
7.	Coal mines & OB dumps	VIIs : Not arable; suitable for grazing, or forestry with limitations of soil depth/ heavy texture/acidity
8.	Severely eroded, gullied area	IVse : Reduced soil depth and severe erosion; fairly good land, suitable for limited cultivation
9.	Disturbed land(subsided)	IVs : Fairly good land suitable for occasional or limited cultivation with limitations of soil depth/texture/acidity
10.	River bank area	IVsw : Land is subjected to frequent flooding. Soils are sandy and fairly good for limited cultivation

Source : www.bccl.nic.in

Table 11 Physiography-Wise Associated Soil Types and Land-Capability in JCF

Physiography	Associated Soil type	Land-capability class with description
Shallow weathered pediplain	Fine to coarse, loamy, mixed.	IIIes : Moderately good cultivable land with limitations of erosion and soil depth/heavy texture/acidity
Moderately weathered pediplain	Fine to coarse, loamy, mixed.	IIesw : Good cultivable land with limitations of erosion; soil depth/heavy texture/ acidity and wetness
Valley flats	Fine, loamy, mixed.	IIw : Good cultivable land with limitation due to wetness
Stony wastes (non-mining)	Fine, loamy, skeletal, mixed.	VIes : Not arable, suitable for grazing; with limitations of erosion and soil depth/heavy texture/acidity
Coal mines and OB dumps	Disturbed and unclassified soils	VIIs : Not arable; suitable for grazing, or forestry with limitations of soil depth/ heavy texture/acidity
Severely eroded, gullied area	Fine to coarse, loamy, mixed.	IVse : Reduced soil depth and severe erosion; fairly good land, suitable for limited cultivation
Disturbed land (subsided)	Fine to coarse, loamy, mixed; sometimes mixed up and unclassified	IVs : Fairly good land suitable for occasional or limited cultivation with limitations of soil depth/texture/acidity
River bank area	Coarse, loamy, mixed.	IVsw: Land is subjected to frequent flooding. Soils are sandy and fairly good for limited cultivation

Source : www.bccl.nic.in

Note: (1) II, III, IV, V, VI and VII denote the Land Capability Classes (LCC).

(2) s, se, es, w, sw and esw denote the Land Capability Sub-classes indicating the nature of limitations such as soil depth, texture (s), topographical problems such as slope length, grade reflecting the proneness to erosion (e) and problems due to excess water, flooding, very high water table etc. (w).

Soil quality

A limited soil quality data is available for JCF. However, distribution of some available soil quality characteristics of JCF is given in Tables12. Soil analyses results available for the study area revealed that soils occur upto a good depth (+60cm). The texture is good with high percentage of clay (20-35%) which means the water holding capacity is good. Soil electrical conductivity is low (0.02-0.4 mmohs/cm) which means there is no problem of soil salinity. pH of soils is acceptable (5.3-7.5 and the organic carbon content is low (0.1%). All types of soils in the JCF have low electrical conductivity values, indicating that salinity is not a problem in native soils. Organic matter levels are very low (0.1%) in all the soils of the JCF. All these characteristics rate the soils of JCF to be good and make them capable for agriculture, forestry and grazing Maiti, 2005).

Table 12. Soil Characteristics in the 'Disturbed Mining Zone' of JCF

Location	Sijua	Kusunda	Kustore	Bhowrah	Lodna	Barora	Block 2	Katras	Bastacola
Clay %	16.2-47.1	10.0-17.0	30.1-56.8	29.3-35.4	39.8-45.0	28.2-33.6			
Silt %	7.8-23.2	6.8-9.2	7.2-17.5	9.2-27.1	16.5-31.5	12.5-15.0			
Sand%	12.2-29.9	14.8-17.4	10.5-21.2	16.3-22.3	28.2-36.3	15.4-37.2			
Gravel %	1.8-63.8	59.5-65.2	15.2-41.5	15.2-45.2	0.5-2.2	19.6-38.5			
Water Holding Capacity (WHC %)	34.3-37.2	25.4-36.3	35.2-45.2	32.8-37.6	40.5-43.1	35.4-47.2			18-26
pH	4.5-7.5	4.8-6.5	4.4-6.9	6.5-7.0	4.6-6.5	5.2-7.5	6.5-6.7	7.3-8.0	5.9-7.6
EC (m.mohs/cm)	0.2-0.5	0.2-0.3	0.16-0.6	0.1-0.4	0.2-0.3	0.2		0.3-0.9	0.1-0.82
OC (%)	0.5-0.75	0.7-0.9	0.1-1.4	0.5-0.75	0.25-0.85	0.7-0.9	0.5-0.75		0.51-1.1
Total Nitrogen (%)	0.15-0.41	0.7-0.84	0.18-0.37	0.12-0.19	0.24-0.29	0.35-0.53			

Available Phosphate (P_2O_5 in %)	0.003	0.001-0.002	0.003	0.001-0.004	0.002	0.002-0.003			
Available Potassium K_2O in %)	0.005-0.10	0.005	0.006-0.021	0.006-0.008	0.005	0.006-0.012			
Bulk Density (gms/cm^3)	1.53	1.61-1.70	1.71-1.88	1.51-1.64	1.05-1.54	1.78		1.37-1.56	

Source: Maiti, 2005

1. Naydhora Bulanbari

Soil of Naydhora Bulanbari was acidic in reaction. Soils contain high organic carbon (4.96 %) as well as organic matter (8.55 %). Soils were having moderate concentration of Available nitrogen (61 ppm), Exchangeable potassium (30 ppm) and Available phosphorus (9 ppm). Soils separate indicates higher amount of sand followed by silt and clay particles. Soil samples indicate that soil fraction (< 2 mm particle) were only 65.97 % and gravels and others were 34.03 %, in whole sample.

2. Bastacola Colliery

Soil of Bastacola Colliery was slightly acidic in reaction. Organic carbon and organic matter were low *i.e.* 0.48 and 0.83 % respectively. Nutrients indicate low fertility level of soil as available nitrogen was 45 ppm, exchangeable potassium was 40 ppm and available phosphorus was only 5 ppm. Soils separate indicates higher amount of sand followed by silt and clay particles. Soil samples indicate that soil fraction (< 2 mm particle) was only 63.41 % and gravels and others were 36.59 %, in whole sample.

3. Muraidih-1

Soil of Muraidih-1 was nearly neutral in reaction. Organic carbon and organic matter was in good amount *i.e.* 2.10 and 3.62 % respectively. Soil was well enriched by available nitrogen (84 ppm) and available phosphorus (11 ppm) but exchangeable potassium concentration was little less (30 ppm). Soils separate indicates higher amount of sand followed by silt and clay particles. Soil samples indicate that soil fraction (< 2 mm particle) was only 68.70 % and gravels and others were 31.30 %, in whole sample.

4. Muraidih-2

Soil of Muraidih-2 natural recovered area was slightly acidic in reaction. Soil organic carbon was 1.00 % and soil organic matter was 1.72 %. Soil was well enriched by phosphorus (12 ppm) while available nitrogen was 45 ppm and exchangeable potassium was 30 ppm which indicate low values of these two essential nutrients. Soils separate indicates very higher amount of sand followed by silt and clay particles. Soil samples indicate that soil fraction (< 2 mm particle) was only 84.14 % and gravels and others were 15.86 %, in whole sample.

5. Chaturmari Workshop (Area proposed for restoration)

Soil of Chaturmari Workshop (Area proposed for restoration) was nearly neutral in reaction. Soil organic carbon was moderate *i.e.* 1.30 % and soil organic matter was 2.24 %. Soil was well enriched by nitrogen (117 ppm) and exchangeable potassium (80 ppm) while available phosphorus was very low (2 ppm). Soils separate indicates higher amount of sand followed by silt and clay particles. Soil samples indicate that soil fraction (< 2 mm particle) was only 51.42 % and gravels and others were 48.58 %, in whole sample.

6. From Fly ash dressing area

This sample was acidic in reaction. Organic carbon concentration was moderate *i.e.* 1.75 % and organic matter was 3.02 %. Available nitrogen was 73 ppm, available phosphorus was 18 ppm while available phosphorus was 20 ppm which indicate higher concentration. Soils separate indicates higher amount of sand followed by silt and clay particles. Soil samples indicate that soil fraction (< 2 mm particle) was 94.45 % and gravels and others were only 5.55 %, in whole sample.

Chapter 4. Recommended Ecorestoration Interventions

Since ecological restoration is dependent on intensive revegetation interventions with appropriate blend of species of trees, shrubs, herbs and grasses after the initial bioengineering interventions .The important criteria of the restoration strategy to be successful are:

i. Protection of the area from biotic interference -the concept of 'social fencing' is recommended for protection of the area from biotic interference, which involves seeking the agreeable support of the local stakeholders(villagers/tribals) by motivating them, rather than the barbed wire fencing that is conventionally adopted.

ii. Construction of a network of flexible and semi-permanent soil and water Conservation (SWC) structures to stabilize the eroding slopes, check erosion , improve moisture regime and conserve fertile soil/fine scree for providing congenial micro environment for plant establishment and growth.

iii. Raising vegetation cover of primary successional nature that paves way for plant communities of higher successional level thus providing ecological stability to derelict sites.

Protection/Fencing

Live fencing is an economic way of fencing large areas because once established living fences become permanent. They are cheap to establish and maintain as compared to barbed wire and other dead fences, which need constant maintenance. Besides, a living fence around the mining area that is prone to biotic disturbance has multiple benefits. Besides protection from cattle, a living fence also provides a buffer, and with a appropriate choice of plants like *Agave sislana* or , *Jatropha curcas* ,*Jatropha gossypifolia* etc.protection as well as greening of sites can evens be achieved. It does however take two to three years to develop. The species suitable for live fence should be thorny, inedible and non-browsable for cattle and goats, hardy and relatively maintenance-free ,adaptable to the local conditions, fast-growing.

Land Preparation and Bioengineering measures

Many degraded sites need some type of land preparation before revegetation. The degree and type of land preparation depends on several factors: site and soil conditions, vegetative cover to be raised, and cost to be incurred. Each mining area has unique characteristics and problems. Its treatment and management therefore require careful consideration of various site specific factors like topography (shape, configuration and slope of the land), nature and depth of soil cover, type of rocks and their pattern of formation and layout, water absorbing capacity of land, rainfall intensity, land use etc. However, as a general rule sustainable mine spoil restoration/amelioration bioengineering measures to conserve soil and moisture are taken in the following manner for different types of minespoils Table 13.

Land preparation can be done either manually or by machine. However,manual methods are less constrained by the rainy season, they require few skills, and the investment cost is relatively low. They also provide temporary employment to laborers and cause minimal damage to strata.

. Sometimes, artificial barriers of brushwood or other materials are required to be used in contour patterns for slope stabilization or for gully plugging (figure 7).

Table 13 Mine Spoil Restoration

S.No.	Nature of Mine spoil	Bioengineering measures
1.	Unstable mine spoil slopes mainly overburden dumps (OB)	Contour trenching Continuous /staggered
2.	Backfilled areas that have undulating terrain but not sloppy	Spread of soil balls inoculated with seeds of native species
3.	Hard rocky benches left after removal of coal	Geojute/coco fibre matting
4.	Drainage channels	Vegetative gully plugging

Based on the topographical, vegetation and soil surveys, an integrated approach consisting of a combination of bioengineering and vegetative interventions are to be implemented. The critically eroded areas that require immediate intervention for stabilization in the BCCL areas are identified as :

- Unstable mine spoil slopes mainly overburden dumps (OB)
- Backfilled areas that have undulating terrain but not sloppy

- Hard rocky benches left after removal of coal
- Drainage channels.
- Site for development of Ecopark

Erosion Control

Control of erosion is important both during mining, post mining and in the restoration programme. A major objective of restoration is to establish a sustainable vegetation cover to stabilise the site and prevent or control erosion. But prior to development of plant cover, mine spoil /soil working is required to manage erosion from disturbed areas. Since rainfall is not very high in these areas, severity of erosion due to rain is moderately low. Contour trenching continuous/ staggered, spread of biodegradable cocofibre mats , are some of the important treatment measures which not only reduce the erosive forces but also conserve the moisture and help in supporting sustainable vegetation cover. Bioengineering measures viz.,vegetative gully plugging and brushfills are first to be implemented to provide stability to the slopes and check the excessive runoff and debris flow.

Contour Trenching

This consists of excavating shallow/ intermittent trenches across the land slope The trenches retain the runoff and help in establishment of the vegetation . Trenches are useful where the land surface is fairly porous and rainwater collected in trenches can quickly percolate into the ground. The spacing of trenches and their size i.e. length, width and depth should be adequate to intercept about 50% of the peak rainfall in semi-arid regions i.e. with annual rainfall of about 400-550 mm.

- Steep slopes ($<60^0$) are stabilized by digging contour trenches (0.3 m x 0.45 m) at a vertical interval of about 2.0 m and planted with suitable plant species

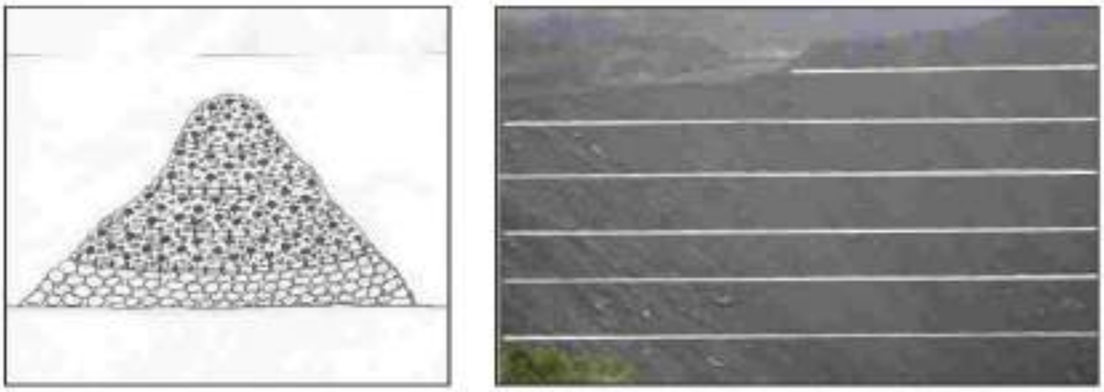

Plate 1a. Continuous contour trenches

- Short and staggered trenches are recommended for stabilization of slopes ($<30^0$) or flatter slopes followed by vegetation (Plate 1a, 1b).
- The steep mined out slopes with hard rocks with either very low or no loose scree Geojute/ geotextile, cocofibre mats may be used to stabilize and check evapotranspiration losses. However cocofibre is the preffered option as it is biodegradable and supports ameliorating the mine spoils through conversion into organic matter after decomposition. On the other hand synthetic geojute adversely affects the fast growing colonizing species after two-three years. Moreover, it is not ecofriendly also (Plate 2a, Plate 2b).

Plate 1b. Staggered contour trenches

Geotextiles are specially designed to provide erosion protection and stabilization of mined out slopes, overburden dumps, tailing dams and other degraded areas. They hold in place the loose dumps, gravel, soil etc and are most appropriate for dry exposed and sterile areas. These geo-textiles are available in rolls and are either made up of polyester fabric, jute, coir or wood fiber. Geotextiles of biological origin are always preferable due to the fact that:

Plate 2a. Steep mined out slope with hard rocks

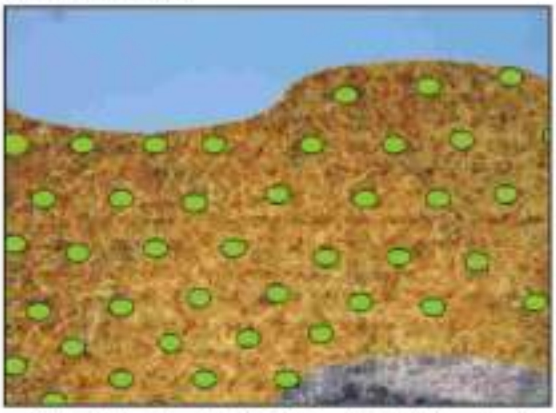

Plate 2b. Scattered soil balls inoculated with seeds of primary colonising species

i. These textiles have the mechanical strength to hold soil in place and prevent erosion. The netting also breaks up runoff from heavy rains by dissipating the energy of rain water.

ii. Biological materials being rich in organic matter, cellulose and lignin, helping promoting the growth of vegetation.

iii. Absorb solar radiation, which means there is no risk of excessive heating, synthetic geotextiles sometimes have this problem.

iv. Biological materials resemble natural soil in its capacity to absorb solar radiation, which means there is no risk of absorbs solar radiation, which means there is no risk of excessive heating, synthetic geotextiles sometimes have this problem.

v. Geotextiles of bio-origin are made up of natural organic products and thus organically biodegradable. They decompose slowly and allow ample time for vegetation to take over the job of holding the soil in place.

vi. Finally, when these materials disintegrate they leave only humus.

Geotextiles when come in contact of water and wetted they form a fine fabric that filters the silt from water passing through it. Therefore these have been identified as an efficient material for (i) erosion control, (ii) enforcement and (iii) filtration. Due to their weight and ability to absorb water they conforms closely to the contour of the soil surface.

These geotextile besides helping in soil stabilization works also as a material of mulch. Since they provide excellent microclimate for plant establishment and healthy growth, and finally becomes the part of the soil on biodegradation. The anchored and buried geotextile stimulates the effect of plant roots due to its protruding fibers.

Bench Terraces

CMPDI is a premier consultant in open pit and underground mine planning and design in coal, lignite and other minerals. These are series of continuous platforms developed during excavation of coal. As per norms height of the coal/overburden benches is proposed to be maximum 10 m, whereas, bench width of working and non-working benches is 25 m & 15 m respectively with a proposed cut width of 10 m. Slope of the bench varies from 45° to 70° based on the nature of material. Overburden is to be stacked tier by tier and height of each such tier is proposed to be 30 m.

Brush fills

Brush fill is a continuous filling on small gullies with brush, branches of trees, stems of bushy vegetation, etc. If brush is placed across the gully, it is called a "brush plug". The main purpose of brush fills is to obliterate the gully with the soil that brush holds. In non-humid regions, incipient and branch gullies, which do not exceed 0.6 by 0.6m (depth by width) in size, can easily be treated by brush fills, if the gradient of the gully channel is not greater than 10 percent. In humid regions, however, brushwood or loose stone check dams, are preferred to brush fills or brush plugs.

Continuously filling small gullies with brush is especially economical where brush is plentiful. When removing brush to reduce its competition with more valuable plants, or to enable the planting of species which more effectively control erosion, consider how it can most advantageously be used and not wasted.

Brush fill work starts at the head. First, line the gully bed with small tree and shrub branches to protect the soil; then place larger branches over them. A brush fill should rise above the gully banks so it can be weighted down with rocks or heavier limbs to shrink the brush. Use green limbs to permit the formation of the desired shape. The brush should be compacted to permit compost placement.

Gully Plugging

Gullies are a symptom of functional disorder of the land, improper land use and are the most visible result of severe soil erosion. They are small drainage channels which may affect the restoration efforts if not attended in time.

Since impact of water erosion is not a common feature in these areas gully plugging at the initiation stage itself on loose dump slopes using vegetative plantings of brushwood for creation of brushwood check dams or continuous Brush fill. Brushwood check dams made of shrub cuttings are placed across the gully (Figure 7) and packed with grass bundles and supplemented with seed sowing of colonizing shrub-grass mixture.

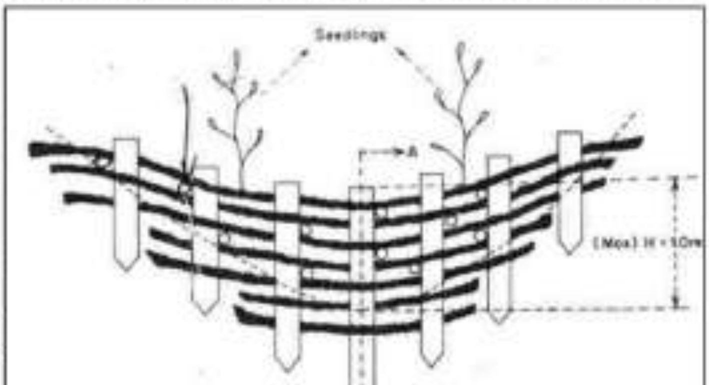

Figure 7. Gully plugging

The main objective of brushwood check dams is to hold fine material carried by flowing water in the gully. Small gully heads, no deeper than one meter, can also be stabilized by brushwood check dams. Following stepwise procedure is followed for making brushwood check dams:

- Young boles/cuttings (1.0 to 1.5 m and their top-end diameter 3 to 12 cm.) of fast growing trees are set in trenches (0.3 by 0.2 m in size) across the gully to a depth of about 1/3 to 1/2 of the boles/cuttings length, and about 0.3 to 0.4 m apart. Brushwood check dams should be preferably erected during the early rainy season. So that cutting gets a chance to sprout and seeds germinate.
- The flexible branches of trees/stems of shrubs/strips made of bamboo stems may be used as interlink material. These materials are woven between wooden posts driven into the ground
- The ends of interlink materials should enter at least 30 cm into the sides of the gully
- The space behind the brushwood check dams must be filled with soil/grass bundles -If sprouting species (Salix, Poplar, *Tithonia diversifolia*, etc.) are selected as posts and interlink materials,

Rain water harvesting

The drainage system of the district is the part of Damodar sub-basin. All the rivers that originate or flow through the district have an easterly or south easterly course. The Damodar is the most important river with an easterly course for about 125 km. streams as Jamunia, Katri, and Pusai are originating from northern hills of Parasnath and Tundi areas. These are flowing from N S to NNW SSE and meeting Damodar river. The Barakar river is the most important tributary of the Damodar and their confluence marks the eastern border of the district. It recieves from the west its only tributary, the Khudia, which takes its rise in the extreme west of the district between the parasnath and Tundi ranges.

In mining operation, huge quantity of water is generated and discharged on surface or in natural water bodies without any productive use. Jharia coalfield area has a large amount of coal deposit and every year a huge quantity of water is discharged from coal mines to the rivers to facilitate safe mining. By conservative estimate BCCL (Bharat Cooking Coal

Ltd.) coal mines of Jharia region discharges about 3,40,120 GPM (2.22 Mm^3/day) of wastewater. This has a visible detrimental effect on the water quality and aquatic lives of the region. Besides, a huge quantity of unused mine water is already available in all the abandoned opencast mines.

Rainwater harvesting is the accumulating and storing, of rainwater for reuse, before it reaches the aquifer. It has been used to provide drinking water, water for livestock, water for irrigation, as well as other typical uses given to water. Rainwater collected from the roofs of houses, tents and local institutions, can make an important contribution to the availability of drinking water. Water collected from the ground, sometimes from areas which are especially prepared for this purpose, is called Stormwater harvesting. In some cases, rainwater may be the only available, or economical, water source. Rainwater harvesting systems can be simple to construct from inexpensive local materials, and are potentially successful in most habitable locations. Roof rainwater can't be of good quality and may require treatment before consumption. As rainwater rushes from your roof it may carry pollutants in it such as the tiniest bit of mercury from coal burning buildings to bird or dog feces. Although some rooftop materials may produce rainwater that is harmful to human health, it can be useful in flushing toilets, washing clothes, watering the garden and washing cars; these uses alone halve the amount of water used by a typical home. Household rainfall catchment systems are appropriate in areas with an average rainfall greater than 200 mm (7.9 in) per year, and no other accessible water sources. Overflow from rainwater harvesting tank systems can be used to refill aquifers in a process called groundwater recharge, though this is a related process, it must not be confused with Rainwater harvesting.

There are a number of types of systems to harvest rainwater ranging from very simple to the complex industrial systems. The rate at which water can be collected from either system is dependent on the plan area of the system, its efficiency, and the intensity of rainfall (i.e. annual precipitation (mm per annum) x square meter of catchment area = litres per annum yield) - a 200 square meter roof catchment catching 1,000mm PA yields 200 kLPA.

Site specific detail planning is necessary for optimal harvesting of the rain water that can be used during dry season by local stakeholders.

Approaches for Different Types of Coal Mine Spoils

Strip mining, or surface mining of coal completely eliminates existing vegetation, destroys the genetic soil profile, displaces or destroys wildlife and habitat, degrades air quality, alters current land uses, and to some extent permanently changes the general topography of the area mined. The community of micro organisms and nutrient cycling processes are upset by movement, storage, and redistribution of soil.

Socioeconomic activities such as agriculture or hunting and gathering food or medicinal plants is affected. What becomes of the land surface after mining is determined by the manner in which mining is conducted.

Removal of soil and rock overburden covering the coal resource, if improperly done, causes burial and loss of top soil, exposes parent material, and creates vast stretches of infertile wastelands. Pit and spoil areas are devoid of food and cover for most species of wildlife. Without interventions, these areas must go through a weathering period, which may take a few years or many decades, before vegetation is established and they become suitable habitat. Natural biotic communities cannot be immediately restored. However,our interventions may assist nature through restoration of land.

However, for extraction of coal there is always a need to strip an initial area of mining and dump its OB. Whereas these OB dumps are a necessity for opencast mining but once formed they pose substantial threat to environment. Generally 20-30% of the total OB materials are to be excavated. According to MOEF stipulation the slope should not exceed 28°.

Why is Ecorestoration a preferred alternative to afforestation/reforestation?
Because of the fact that it is a process which is

- ***Short circuit to natural recovery***
- ***No input of external resources viz., soil (mined from other areas), fertilizer, irrigation required***
- ***Ecologically, economically & socially acceptable***

In India, those dumps are concurrently reclaimed once it is inactive (dead). Sometimes OB materials are dumped on abandoned quarry (if it is available).The success of any biological reclamation depends on: climatic conditions, nature of spoils, types of plant species, nature of dumps, proximity to seed banks (nearby vegetation) and types of amendments used.

While selecting species for raising plant communities, aspirations of local stakeholders need to be taken into account and therefore it is important to consider following set of criteria ;

- Plant species most appropriate for the development of sustainable ecological system that can set the disturbed nutrient cycling process, productivity & regulation of water regime
- Plant species that ensure rebuilding the damaged wild faunal habitat
- Plant species that ameliorate the substratum and rebuild the organic matter
- Plant species that can serve the requirements of local population

The climate of the area being sub-tropical sub-humid monsoonal type with an average 80% of the total annual precipitation received in a period of 100 days between June and September months. The vegetation development in the areas is mainly confined to this period. Therefore all seeding and planting operations have to be initiated in the month of July so that maximum moisture can be used by plants to sprout, germinate and survive. Seed mixes of the local species of forestry origin collected and procured are used for preparation of seed mixes for different types of mine spoils. Cuttings of *Ipomoea fistulosa* and *Vitex negundo* mixed with grass tufts of *Saccharum spontaneum* have to be planted in contour trenches on overburden dumps .This has to be supplemented with seeding of seed mix prepared for specific areas (Table 14, 15 and 16) for immediate arrest of soil erosion and amelioration of strata that is depleted in soil, organic matter and nutrients.

Planting/Sowing techniques

Cuttings of *Ipomoea fistulosa, Vitex negundo* (about 25 cm.long) and tufts of *Saccharum spontaneum* are planted in contour trenches (Table 14, 15 and 16) at an interval of 20-25 cm. during the onset of monsoon season

Broadcast Seeding : Seedmix (Table 14) is broad cast seeded over the whole area to be treated manually.

Hydroseeding/slurry spread

Hydraulic seeding is being successfully practiced to stabilize barren steep slopes and fragile unstable surface. The system requires large volumes of water, seed, fertilizer and mulch, which are applied on the surface in the form of a fine spray. Non-toxic dyes can be used by the operator to confirm the area covered. Sheldon and Bradshaw (1977) have suggested the use of hydraulic seeding device to provide a plug of vegetative material for transplanted trees on stoney ground. In case hydraulic seeder is not available ,the slurry can be prepared and spread manually.

Earthen balls

Small earthen balls prepared from local soil are inoculated with about 20 gms. seed mix (Table 16).These balls are scattered over the whole area to be treated. In these balls any of the locally available materials as detailed below may be added to provide immediate microenvironment for the seeds to germinate on an otherwise hostile site.

Composition of recommended soil ball of 8-10 cm. diameter is:

60% soil + 40% fibrous material easily available locally.

Wood-cellulose fiber

Natural virgin wood cellulose fibers produced from wood chips or recycled wood pulp. They are usually either wood or paper fiber. It is desirable where rapid mulching of an area is essential. Wood fiber and wood cellulose have equal value if applied at the same dry weight. They are free from chemical additives and foreign matter that inhibit growth.

Paper

Paper fiber can be made available from recycled wood pulp industries. Recycled office wastes and newspaper could also be used as paper mulch. Though these waste products are less effective but could be improved if fiber length is increased. The waste corrugated box can be recycled into a product nearly equal to virgin wood.

Agromulch

Forage crops, cereal straws, and grasses can be used as agromulch. The grasses provide a ground cover while it is growing and continues to protect the site after it has matured and died.

Sawdust

Saw dust is available from local sawmills or forest products industry. It can be obtained either from deciduous or coniferous vegetation. Chemically its pH ranges from 3.5 to 7.0 and C to N ratio 200:1 to 500:1. Saw dust is capable of absorbing water at 2 to 6 times its own weight. Decomposition of sawdust is more rapid than that of other wood residues because of the more finally divided materials and high cellulose contents.

Shavings

Shavings can be obtained from deciduous trees. Whole leaves, shredded and composted can be used as shavings mulch. The pH of composted leaves may around 6.5 and C to N ratio about 40:1. Leaves are important source of organic matter (leaf mold).

Garbage

The processed and composted garbage is available as solid garbage waste. Availability of this mulch can have from municipalities or commercial waste-recovery plants. The pH of garbage generally has in between 7.5 to 8.5 and C to N ratio in between 45:1 to 55.1 (unprocessed). Solid waste has beneficial effects on plant growth. Solid waste compost is most valuable as a soil conditioner. It promotes soil aggregation, which enhances the air water relationship of soil. Compost usually possesses a full complement of trace elements and also reduces acidity.\

Table 14. Seed mix for Overburden Dumps

S.No.	Botanical Name	Common name	Quantity gm/ha
Trees			
1.	*Azadirachta indica*	Neem	200
2.	*Bombax ceiba*	Semal	200
3.	*Butea monosperma*	Palas	150
4.	*Cassia fistula*	Amaltas	200
5.	*Dalbergia sissoo*	Shisham	200
6.	*Ficus glomerata*	Gular	50
7.	*Madhuca indica*	Mahua	250
8.	*Melia composita*	Bakain	200
Shrubs			
9.	*Adhatoda zeylanica*	Vasaka	200
10.	*Calotropis procera*	Aak	50
11.	*Clerodendrum viscosum*	Bhant	50
12.	*Datura stramonium*	Datura	50
13.	*Hyptis suaveolens*	Ganga tulsi	50
14.	*Ipomoea fistulosa*	Beha aak	20
15.	*Pogostemon benghalense*	Phangla	50
16.	*Ricinus communis*	Arandi	200
17	*Vitex nugundo*	Nirgundi	100
18.	*Zizyphus nummularia*	Beri	100
19.	Solanum torvum	Jangali bengan	50
Herbaceous Species (Rirbsand grasses)			
20.	*Alysicarpus monilifer*	Leel	100
21.	*Boerhavia diffusa*	Punarva	100
22.	*Cenchrus ciliaris*	Anjan grass	100
23.	*Cleome viscosa*	Jakhia	50
24.	*Cynodon dactylon*	Dub grass	100
25.	*Dicanthium annulatum*	Marvel grass	100
26.	*Eragrostis atrovirens*	Bhant grass	50
27.	*Eragrostis plumosa*	koli grass	50
28.	*Heteropogon contortus*	Pili grass	50
29.	*Indigofera trita*	Indigo	50
30.	*Mucuna pruriens*	Konch phali	250
31.	*Ocimum canum*	Ram Tulsi	50
32.	*Peristrophe paniculata*	Atrilal	50
33.	*Saccharum spontaneum*	Kans	100
34.	*Sida acuta*	jharu grass	50
35.	*Sida cordifolia*	Bala	50
36.	*Solanum surattense*	Nili kateli	50
37	*Tephrosia purpurea*	Lal puli	50

Table 15. Seed Mix for Mine Benches and Sites Covered with Cocofibre

S.No.	Botanical Name	Common name	Family	Uses
Trees				
1.	*Aegle marmelos*	Bel	Rutaceae	Fruit,medicinal
2.	*Ailanthus excelsa*	Mahanim	Simaroubaceae	Medicinal, Timber
3.	*Albizzia lebbeck*	Siras	Mimosaceae	Fodder and Medicinal, Timber
4.	*Azadirachta indica*	Neem	Meliaceae	Medicinal, Timber
5.	*Bombax ceiba*	Semal	Bombacaceae	Fodder, Medicinal
6.	*Bauhinia variegata*	Kachnar	Caesalpinaceae	Fodder,medicinal
7.	*Butea monosperma*	Palas	Fabaceae	Medicinal, Timber
8.	*Cassia fistula*	Amaltas	Caesalpiniaceae	Medicinal, Timber
9.	*Dalbergia sissoo*	Shisham	Fabaceae	Timber, Fodder
10.	*Ehretia laevis*	Chamror	Boraginaceae	Medicinal
11.	*Ficus glomerata*	Gular	Moraceae	Fruit Edible, Fodder
12.	*Ficus hispida*	Kath gular	Moraceae	Fodder
13.	*Ficus religiosa*	Pipal	Moraceae	Fodder
14.	*Holarrhena antidysenterica*	Kutaj	Apocynaceae	Medicinal
15.	*Madhuca indica*	Mahua	Sapotaceae	Medicinal, Timber
16.	*Mangifera indica,*	Aam	Anacardiaceae	Fruit
17.	*Melia composita*	Bakain	Meliaceae	Timber
18.	*Spondias pinnata*	Amra	Anacardiaceae	Medicinal
Shrubs				
19.	*Adhatoda zeylanica*	Vasaka	Acanthaceae	Medicinal
20.	*Calotropis procera*	Aak	Asclepiadaceae	Medicinal
21.	*Cassia tora*	Senna	Caesalpiniaceae	Medicinal
22.	*Clerodendrum viscosum*	Bhant	Verbenaceae	Medicinal
23.	*Datura stramonium*	Datura	Solanaceae	Medicinal
24.	*Hyptis suaveolens*	Ganga tulsi	Lamiaceae	Medicinal
25.	*Ipomoea fistulosa*	Beha aak	Convolvulaceae	Slope binder
26.	*Pogostemon benghalense*	Phangla	Lamiaceae	Soil binder
27.	*Ricinus communis*	Arandi	Euphorbiaceae	Medicinal, Soil binder
28.	*Vitex negundo*	Nirgundi	Verbenaceae	Good soil binder, Medicinal
29.	*Woodfordia fruiticosa*	Dehu	Lathyraceae	Good soil binder, Medicinal
30.	*Zizyphus nummularia*	Beri	Rhamnaceae	Fruit Edible
31.	Solanum torvum	Jangali bengan	Solanaceae	Medicinal
Herbaceous species(herbs and grasses)				
32.	*Alysicarpus monilifer*	Leel	Fabaceae	Soil binder
33.	*Boerhavia diffusa*	Punarva	Nyctaginaceae	Good soil binder, Medicinal
34.	*Cenchrus ciliaris*	Anjan grass	Poaceae	Soil binder
35.	*Cleome viscosa*	Jakhia	Capparidaceae	Seeds edible
36.	*Cynodon dactylon*	Dub grass	Poaceae	Soil binder
37.	*Dicanthium annulatum*	Marvel grass	Poaceae	Soil binder
38.	*Eragrostis atrovirens*	Bhant grass	Poaceae	Waste Land indicator
39.	*Eragrostis plumosa*	koli grass	Poaceae	Waste Land indicator
40.	*Heteropogon contortus*	Pili grass	Poaceae	Fodder grass
41.	*Indigofera trita*	Indigo	Fabaceae	Soil binder
42.	*Mucuna pruriens*	Konch phali	Fabaceae	Soil binder, Medicinal
43.	*Ocimum canum*	Ram Tulsi	Lamiaceae	Medicinal
44.	*Peristrophe paniculata*	Atrilal	Acanthaceae	waste land indicator, Medicinal
45.	*Phyla nodiflora*	Kocha saag	Verbenaceae	Well moister indicator
46.	*Polygonum hydropiper*	Gotki	Polygonaceae	Well moister indicator
47.	*Saccharum spontaneum*	Kans	Poaceae	Sand indicator
48.	*Sida acuta*	jharu grass	Malvaceae	Shoot used for sweeping
49.	*Sida cordifolia*	Bala	Malvaceae	Medicinal
50.	*Solanum surattense*	Nili kateli	Solanaceae	Clay indicator
51.	*Tephrosia purpurea*	Lal puli	Fabaceae	Soil binder

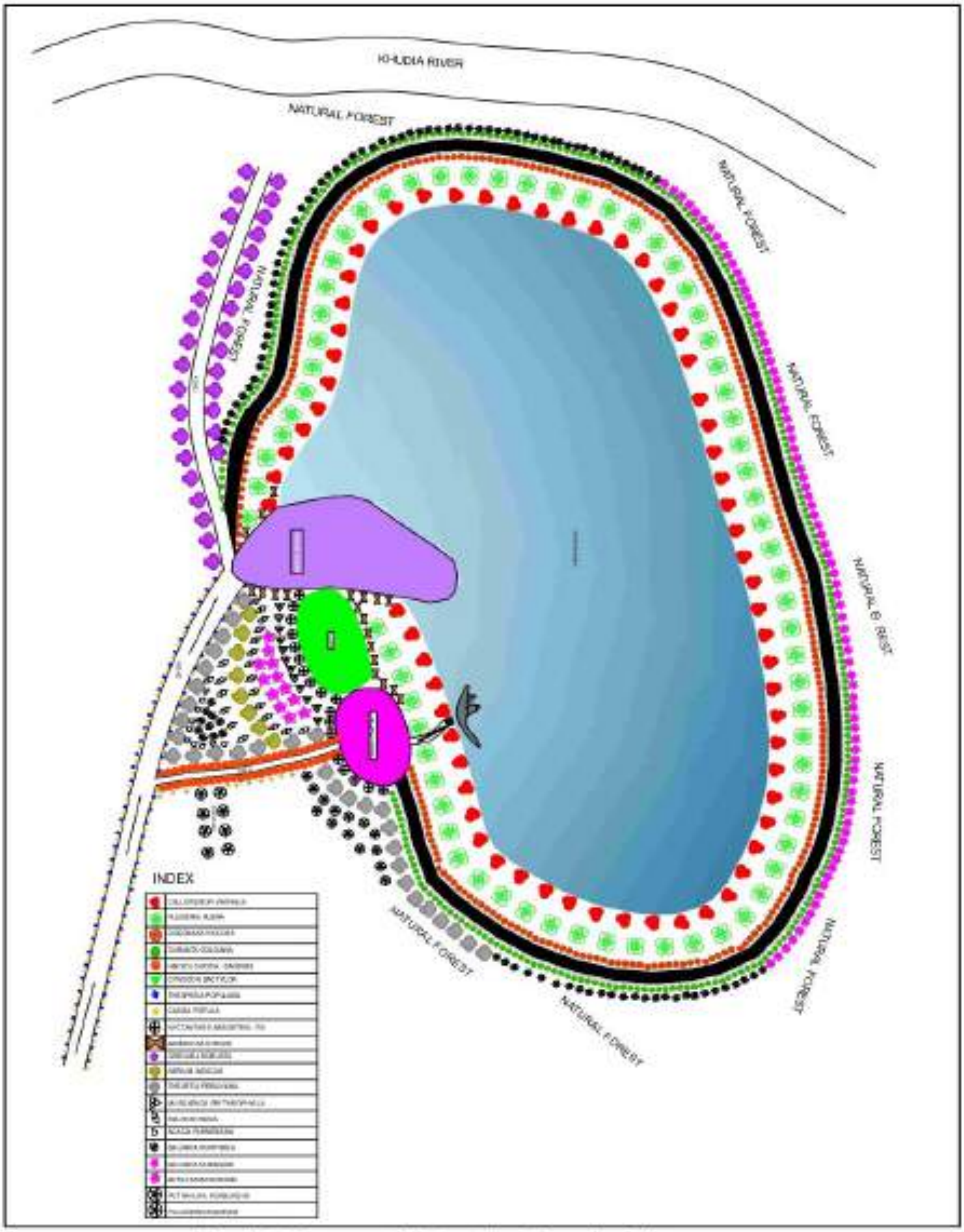

Figure 8. Species suggested for plantation in Recreation Park

Table 16. Seed Mix for Soil Balls

S.No.	Botanical Name	Common name	Family	Uses
Trees				
1.	*Ailanthus excelsa*	Mahanim	Simaroubaceae	Medicinal, Timber
2.	*Albizzia lebbeck*	Siras	Mimosaceae	Fodder and Medicinal, Timber
3.	*Azadirachta indica*	Neem	Meliaceae	Medicinal, Timber
4.	*Bombax ceiba*	Semal	Bombacaceae	Fodder, Medicinal
5.	*Butea monosperma*	Palas	Fabaceae	Medicinal, Timber
6.	*Cassia fistula*	Amaltas	Caesalpiniaceae	Medicinal, Timber
7.	*Dalbergia sissoo*	Shisham	Fabaceae	Timber, Fodder
8.	*Ficus glomerata*	Gular	Moraceae	Fruit Edible, Fodder
9.	*Ficus hispida*	Kath gular	Moraceae	Fodder
10.	*Ficus religiosa*	Pipal	Moraceae	Fodder
11.	*Madhuca indica*	Mahua	Sapotaceae	Medicinal, Timber
12.	*Melia composita*	Bakain	Meliaceae	Timber
13.	*Schleichera oleosa*	Kusum	Oleaceae	medicinal
Shrubs				
14.	*Calotropis procera*	Aak	Asclepiadaceae	Medicinal
15.	*Cassia tora*	Senna	Caesalpiniaceae	Medicinal
16.	*Datura stramonium*	Datura	Solanaceae	Medicinal
17.	*Dodonaea viscosa*	Vilayati mehndi	Sapindaceae	Soil binder
18.	*Hyptis suaveolens*	Ganga tulsi	Lamiaceae	Medicinal
19.	*Pogostemon benghalense*	Phangla	Lamiaceae	Soil binder
20.	*Ricinus communis*	Arandi	Euphorbiaceae	Medicinal, Soil binder
21.	*Zizyphus nummularia*	Beri	Rhamnaceae	Fruit Edible
Herbaceous species(herbs and grasses)				
22.	*Cenchrus ciliaris*	Anjan grass	Poaceae	Soil binder
23.	*Cleome viscosa*	Jakhia	Capparidaceae	Seeds edible
24.	*Cynodon dactylon*	Dub grass	Poaceae	Soil binder
25.	*Dicanthium annulatum*	Marvel grass	Poaceae	Soil binder
26.	*Eragrostis atrovirens*	Bhant grass	Poaceae	Waste Land indicator
27.	*Eragrostis plumosa*	koli grass	Poaceae	Waste Land indicator
28.	*Heteropogon contortus*	Pili grass	Poaceae	Fodder grass
29.	*Indigofera trita*	Indigo	Fabaceae	Soil binder
30.	*Mucuna pruriens*	Konch phali	Fabaceae	Soil binder, Medicinal
31.	*Ocimum canum*	Ram Tulsi	Lamiaceae	Medicinal
32.	*Peristrophe paniculata*	Atrilal	Acanthaceae	waste land indicator, Medicinal
33.	*Saccharum spontaneum*	Kans	Poaceae	Sand indicator
34.	*Sida acuta*	jharu grass	Malvaceae	Shoot used for sweeping
35.	*Sida cordifolia*	Bala	Malvaceae	Medicinal
36.	*Solanum surattense*	Nili kateli	Solanaceae	Clay indicator
37	*Tephrosia purpurea*	Lal puli	Fabaceae	Soil binder

Enrichment Planting on Voids left at the last part of the quarry

These large water bodies sometimes useful for the community- for storage of irrigation water, pisciculture, or used by day-today purpose. The banks must have gentle slope and afforested. For example, in ECL, some of the water bodies are presently being used by local community for irrigation, washing, bathing, even as source of livelihood by catching fishes. Of course, these water bodies not planned for commercial pisciculture, due to problems of catching fishes because of depth, or may be leasing problems or from theft, or community commonly shares these water body.

Hydro reclamation is also a bioremediation process. Bearing all problems in mind, the best economic end use of water bodies are pisciculture or water sports (boating).

For pisiculture following parameters are to monitored.

- Shape, slope, depth (around 30 m preferable), quality of water (whether suitable for pisiculture or not) and productivity. The shape, slope and depth are depends on geo-mining conditions, the quality of water depends on characteristics of strata, similarly food production for fishes depends on production of planktons (i.e. phytoplankton and zooplankton).
- Monitoring of water quality vis-à-vis enhance of suitability for pisciculture activity should be taken care and "database" must be created by monitoring similar type of water filled quarries. This database could be used during "mine closure" planning.

Shallow voids

At mines where the stripping ratio is low, OB materials may not be fill the void created due to the mining operation. In such case concurrent reclamation practices may be adopted. The backfilling sequence has to be planned in details and inspected by mine management frequently to ensure compliance. Once the voids are filled, these can be reclaimed.

Lakes and ponds are formed in the mined areas and a recreation spot may be created with boating facilities, along with a children park and food plaza. These large voids that are filled with water throughout the year may be developed into recreation parks (Plate 3, Figure 8 and Table17).

Plate 3. Proposed plan for development of Recreation Park

Table17. Species Suggested for Plantation in Recreation Park

Sl.No.	Species	Family	Vernacular Name
1.	*Acacia farnesiana*	Mimosaceae	Fragrant acacia
2.	*Bamboosa striata*	Poaceae	Strip Bamboo
3.	*Bauhinia purpurea*	Caesalpiniaceae	Kachnar (purple)
4.	*Bauhinia variegata*	Caesalpiniaceae	Kachnar (white)
5.	*Butea monosperma*	Fabaceae	Plash
6.	*Callistemon viminalis*	Myrtaceae	Bottle brush
7.	*Cassia fistula*	Caesalpiniaceae	Amaltash
8.	*Cynodon dactylon*	Poaceae	Doob Grass
9.	*Delonix regia*	Caesalpiniaceae	Gulmohar
10.	*Dodonaea viscosa*	Sapindaceae	Vilayati Menhadi
11.	*Duranta goldiana*	Verbenaceae	Duranta
12.	*Ficus benghalensis*	Moraceae	Bargad
13.	*Grevilea robusta*	Proteaceae	Bulbul
14.	*Hibiscus rosa - sinensis*	Malvaceae	Gudhal
15.	*Mussaenda erythrophylla*	Rubiaceae	Dhoby Bush
16.	*Nerium indicum*	Apocynaceae	Red Kaner
17.	*Nyctanthes arbortris - tis*	Oleaceae	Harsingar
18.	*Plumeria rubra*	Magnoliaceae	Temple tree
19.	*Putranjiva roxburghii*	Putranjivaceae	Putranjiva
20.	*Thespesia populnea*	Malvaceae	Bhendi Pipal
21.	*Thevetia peruviana*	Apocynaceae	Pili kaner

Enrichment Planting in the Fringe Forest Areas.

A large chunk of land on the fringe areas is degraded either due to the various operations in the mining areas or because of biotic interference by local villagers. These areas need to be planted to enrich the density and diversity of the forests.

Discussion with local people and looking into the site conditions,particularly soil and moisture,a number of species have been selected that will not only improve the forest density but will also provide locals with different fruit,fodder and other benefits(Table18).

Degraded Forests /village Areas

Table 18. Species for Degraded Forests /Village Areas

Species	Vernacular Name	Family	Requirement of Seeds gm./ha.
Trees			
Artocarpus heterophyllus Lam. Syn.	Kathal	Moraceae	250
Bauhinia retusa Roxb.	Semla	Caesalpiniaceae	100
Bauhinia variegata Linn.	Kachanr	Caesalpiniaceae	100
Cassia fistula Linn.	Sonari gach, Amaltas	Caesalpiniaceae	200
Madhuca indica J.F Gmel.	Mahua	Sapotaceae	200
Mangifera indica Linn.	Aam	Anacardiaceae	500
Pithecellobium dulce Benth.	Jungle-jalebi, Vilayati imli	Mimosaceae	100
Pongamia pinnata Linn.	Karanja	Fabaceae	100
Schleichera oleosa (Lour.) Oken. Syn.	Kusum	Sapindaceae	100
Spondias pinnata Linn.	Amra	Anacardiaceae	200
Shrubs			
Alangium salvifolium (Linn. F.) Wang. Syn	Ankul	Alangiaceae	500
Dodonaea viscosa (Linn.) Jacq.	Sinatha, Mehndi,	Sapindaceae	1000
Murraya koenigii Linn.	Mitha Sur	Rutaceae	500

Chapter 5. Development of Nursery

Medicinal plants play a vital role in the socio-economic and rural development of a derelict landscape. Medicinal plants of forestry origin are a traditional source of a large number of produce with medicinal interest and have sustained large masses of rural population. The steady depletion of forest resources and increasing deforestation has been responsible for fast depletion of medicinal species from their natural habitats. This has brought into focus the realisation that the active participation of the communities is necessary for the ex-situ conservation of medicinal plants as well as provide cash return to local stakeholders. It is also well known that village communities would have little incentive to participate unless they benefit directly.

Raising Medicinal Plants in a Temporary Nursery

Raising of plants in a nursery requires formulation of a production plan and preparation of detailed estimates of material and labour inputs. Considering the average age of plants to be 5 months at the time of outplanting a detailed cost estimate for raising 25,000 plants in a temporary nursery of 20 beds is given in Table 19.

Table 19 Production Plan of Temporary Nursery

Sl. No.	Technique	Proportion (%)	Number	Av. Age of plants(months)
1.	Direct sowing in polypots	60%	15000	5
2.	Pricking out from mother beds to polypots	40%	10000	5
3.	Total	100	25000	

Site for a new nursery should be selected so as to minimize the cost of transportation of plants to the plantation site. The quality and quantity of water availability must be ensured before finalizing the site. About 25000 liters of water is required daily for irrigating 1,00,000 plants during peak season. The terrain that best suits a nursery is gently sloping terrain followed by flat terrain. For a nursery of 1-3 lakh plants, raised primarily in polypots, an area of one hectare is suitable.

The nursery should be provided with a cattle-proof fence. Normally Barbed Wire fencing or Stone Wall fencing is suitable for most of the temporary nurseries while Masonry Wall topped with a barbed fence is ideal for permanent nurseries.

Model Cost Estimates for Plant Production

An estimate is a tool to watch ,to control and to monitor progress of expenditure while executing a work in proportion to the physical work done. Cost estimates for each item of work has to be prepared and used for the next step of nursery development/restoration work. Cost of work will depend mainly upon the wage rate since most of the operations are labor intensive. Normally in public funded programmes a Basic Schedule of Rates (BSR) for different items of work is worked out on the basis of average human effort and the minimum wages to be paid. Since the basic wage rate varies from place to place and at the same place from time to time, it is better to work out a BSR in terms of mandays which is standard irrespective of actual wage rates.

Computing Cost Estimates

Given the rates of work output per manday as per BSR, it is a simple to compute the cost estimate for the quantities of work items mentioned in the treatment plan. Spreadsheet programs running on microcomputers may also be used to automate this process.

The materials to be used in restoration work may be computed in quantitative terms and totaled up. It is desirable to compute the material and labour components separately, so that in the event of any changes in wage rates or in cost of materials in the market, it will be easy to revise the estimate.

Though it is impossible to draw a list showing costs of materials that would hold true across a wide range of times and places, yet Table attempts to present a tentative list of this kind to give some idea of the costs of materials. It is obvious that the cost of materials differs from place to place. It is equally obvious that labor is the basic economic entity behind every product. The cost of labor decides the market rate in general and hence there is a definite correlation between wage rates and market prices of commodities. Therefore, the cost of materials in the BSR has been expressed in terms of equivalent labour costs, that is, unskilled mandays (mdeq meaning manday equivalent).

This may sound strange at first, yet the cost of building stone is after all the cost of labor in quarrying it, plus cost of maybe dressing it or some such thing. Even though this is an approximate way of expressing material costs, it nevertheless has been tested over time and holds sufficiently accurate for the purpose of framing estimates.Every estimate should also include provision for unforeseen and contingency expenses approximately equal to five percent of the total cost. Therefore the estimates for separate years have been computed separately, and an abstract has been prepared showing year wise costs including the contingency expenses.

The detailed BSR showing mandays required for each activity and cost of materials in terms of mandays equivalent has been presented in Table 20.

Table 20. Year Wise Model Cost Estimate for 25,000 Plants in a Site Nursery

Sl. No.	Item Specification	Unit	Quantity	Required Mandays			Material (mdeq)
1	2	3	4	5	6	7	8
	Operations during Year 1						
1	Site clearance for establishment of nursery i/c clearing and uprooting growth of shrubs, refilling and leveling the pits so formed, and collecting and stacking branches etc in an area having more than 200 clumps/ shrubs/ha.	sqm	1000	20			
2	Erection of fence out of thorny shrubs thickness being 75 cm base 90 cm, height 1.3 m with the fence being overlain with soil on the toes to secure it in position where thorn is cut and brought from a mean distance of upto 500 mt.	m	150	23			
3	Levelling of slopping ground into terraces to prepare nursery beds original slope being 5° 20° and soil of hardness class S-4	sqm	300	45			
4	Excavation of nursery beds, disposal of excavated soil upto a lead of 50 m, beds of size 1 x 10 x 0.30 m, soil of hardness class S-4	no	20	40			
5	Procurement of standard quality polypots of size 12 x 30 cm	Kg	93				192
6	Excavation of clay in tank bed, removal of weed, pebbles etc for loading into vehicle	cum	11	11			
7	Loading and unloading of clay into animal drawn vehicle for transportation where clay has already been excavated a) Loading	Cum	11	3			
	b) Unloading	Cum	11	1			
8	Transportation of clay by animal drawn vehicle excluding loading and unloading, the mean distance of transportation being 5 km	cum	11			9	
9	Loading and unloading of sand into animal drawn vehicle for transportation where sand has already been excavated a) Loading	cum	17	4			
	b) unloading	cum	17	1			
10	Transportation of sand by animal drawn vehicle excluding loading and unloading, the mean distance of transportation being 5 km	cum	17			13	
11	Cost of FYM or compost free from insects, stones, weeds etc	cum	6				34
12	Loading and unloading of FYM or compost into bullock cart etc for transportation.						
	a) Loading	cum	6	1			
	b) Unloading		6	0			
13	Transportation cost of FYM or compost by animal drawn vehicle excluding loading and unloading, the mean distance being 10 km	cum	6			8	
14	Procurement of certified seeds of plus trees	kg	Prorata				10
15	Filling polypots with 1:2:3 soil mix, breaking of clay, pulverizing manure and cleaning of sand etc and mixing these in specified ratio and stacking filled polypots in beds, polypots of size 12 x 30 cm	no	25000	83			

16	Preparation of mother beds by spreading soil mix over ground with 10 cm thickness and sowing of seeds after mixing them with soil mix separately and irrigating the bed with rose cans	sqm	15	2			
17	Sowing of treated seeds in polypots and covering the seed with soil i/c treatment and breaking of pods/ seed coats where required	no	16000	13			
18	Pricking out seedlings and transplanting into polypots i/c watering	no	11500	19			
19	Irrigating plants in polypots from waterholes located at a distance of 15 m and depth 1 m (30 irrigations 175 sqm each)	sqm	5250	26			
20	Cost of pesticides		Prorata				8
21	Cost of tools required in nursery		Prorata				20
22	Energy/ diesel bill for pumping water		Prorata				30
23	Wages of security watchman	md	90	90			
24	Contingency expenditure (5%)		LS	18		2	12
	Total for Year 1			**400**	**0**	**31**	**306**
	Operation During Year 2						
25	Irrigation of plants in polypots or seed beds from waterholes located at a distance of 15 m and depth 1 m (90 irrigations 175 sqm each)	sqm	15750	79			
26	Removal of weeds, litter etc from top of polypots, motherbeds	sqm	175	11			
27	Shifting of polypots i/c pruning of roots	sqm	175	32			
28	Arranging shade over beds and fixing	sqm	175	21			
29	Cost of pesticides		Prorata				5
30	Energy/ diesel bill for pumping water		Prorata				75
31	Wages of security watchman	md	120	120			
32	Contingency expenditure (5%)		LS	12			4
	Total for Year 2			**275**			**84**
	Grand Total for Year 1 & 2			**675**	**0**	**31**	**390**

US unskilled; SS-semi skilled; SK-skilled; Material (mdeq)-Man Days Eq.Material

Beds are essential elements of a nursery and should be laid out carefully. Mother-beds should be leveled systematically by organizing them into blocks to let seeds germinate and grow to sufficient height.

The poly beds or sunken beds are used to hold polypots in position and are rectangular in shape. A standard bed should be 10m long and 1m wide. The depth of the bed can be kept 0.30 m or 0.40 m depending upon the height of the polypots to be contained. Sunken beds should be avoided in low lying areas prone to flooding during rains and in which case, raised beds should be made.

Table 21. Model Restoration Treatment Plan for Derelict Mined Lands

Sl. No.	Item/ Activity	Specifications of Item	Qty	Year of Exec.
1	2	3	4	5
4	Soil & Water Conservation	Digging of contour trench at spacing suitable for terrain	75000 m	Y1
		Construction of vegetative gully plugs in order to control gully erosion	15000 nos	Y1
	Works			
5	Sowing of seeds	Sowing of seeds of tree and shrub species in two parallel rows at 20 cm spacing on the bunds of contour-trench, along fence etc., by hand dibbling, just before rains	66000 row-m	Y1
		Sowing of seeds in notches made in cracks, pockets of soil etc. seen in rocky and steep areas.	20000 nos	Y1

6	Preparation of soil balls and spreading	Distribution of soil balls over the mine area	20000 nos	Y1
7	Spread of Cocofibre mat	Spread of Cocofibre mat and seed sowing	On 5 hectare area/depending on site requirment	Y1
8	Planting Live Fence	Planting of *Agave sislana* bulbils , *Vitex negundo, Ipomoea fistulosa* cuttings	30000 m	Y1

Artificial shades with brushwood thatches or commercial shade nets should be provided to save the young seedlings from heat and cold. Large central nurseries shades should also be erected for providing shade to workers engaged in filling polypots or transplanting seedlings.

Seed collection should be done from locally available trees after proper selection. Seeds can also be purchased from markets from certified seed suppliers. The potting mix to be filled in polypots should be in 1:1:1 ratio of manure, clay and sand. This potting mix should also be laid out on germination beds by spreading a uniform layer of about 10cm thick Plants sown in germination beds should be transplanted into polypots after it attains the requisite age. Weeding must be done from time to time. Shifting of polypots or pot-turning should be carried out to prevent roots from going into the earth, pest attack on the bed and for shock proofing. This pot turning should be accompanied with culling-cum-grading and root pruning.

A production plan must be drawn up to include the target, number of plants to be raised by each method, variety and the resources required in the production cost.The nurseries should plan to produce healthy plants covering timber, fuel, fodder, fruits, non-wood forest produce and even ornamental species having good demand in the locality.

Besides this the prevailing agro-climatic conditions in the area should also be taken into consideration while selecting the species.

Chapter 6. Potential Areas and Strategies for Restoration in India

Coal mining and subsequent consumption of fossil fuels and deforestation are the two major sources of rising carbon dioxide concentration and thus being an important cause of enhanced greenhouse effect with implications on Global Climate Change Forests act as a carbon sink for mitigating the green house effect and forest preservation is the best solution for carbon fixing and that extending the rotation period, Conversion to more natural forest and new afforestation of former agriculture land will all contribute to increased carbon storage. Carbon sequestration potential of tropical forests in particular has been discussed in detail with along with potential areas and strategies for restoration in India, so as to achieve maximum ecological benefits (Soni 2003).

The National Forestry Action Plan clearly outlines two important activities as priority areas to achieve 33% forest cover in the country. Firstly, the prevention of degradation of forests on one hand and secondly the rehabilitation of degraded forest areas on the other. In the Indian context ABD (1991) has looked into two broad categories of options:

- Conservation of forests
- Expansion of sinks.

However, protecting and conserving the most threatened ecosystems does not always provide the greatest carbon benefits. On the other hand, tradeoffs between carbon storage and maintenance of biodiversity can also occur in the creation of large areas of productive managed forest, especially monocultures of exotic species. Similarly, plantations of single tree species are likely to have more limited and particular types of fauna and flora than natural forest stands. There are, however, management options to address the tradeoffs between production and biodiversity such as adopting longer rotation times, altering felling unit sizes, altering edge lengths, prolonging rotation lengths, creating a multi-aged patchwork of stands, minimizing chemical inputs, reducing or eliminating measures to clear understorey vegetation, or using mixed species plantings, including native species.

Restoration and management strategies for degraded and secondary forests should aim to regain ecosystem integrity, that is, the maintenance of the potential to provide a certain set of goods and services for which the site is suited, implying the maintenance of biological diversity, ecological processes and structure, and sustainable cultural practices.

- **Forest restoration-** the aim of which is to assist the natural processes of forest recovery in a way that the species composition, stand structure, biodiversity, functions and processes of the restored forest will match, as closely as feasible, to those of the site-specific original forest.

- **Secondary forest management-** which aims to increase the capacity of secondary forests to generate important environmental and social services for a wide range of beneficiaries on a sustainable basis.

- **The rehabilitation of degraded forest lands-** that aims to re-establish site productivity and protective functions and many of the ecological services provided by a functional forest or woodland ecosystem. Some basic conditions for the restoration, rehabilitation and management of degraded and secondary forests can be enumerated as under:

- **The strong support and participation of local stakeholders** is needed in the planning, implementation and monitoring of activities. The rights and responsibilities of ownership, including customary claims and rights, must be clearly defined and mutually agreed.

- **Local forest users must obtain some short-term economic benefits** which must be in addition to any potential future benefits.

- **Sound understanding** of the complexities and dynamics of the forest ecosystem and of the interacting socio-economic and political systems.

- **Land capability** must be analysed and overall land-use relationships must be understood and legally defined.

Afforestation /Reforestation CDM Projects

A/R CDM project can be developed for carbon sequestration by the various implementing agencies of OAP such as Jharkhand Forest Department, W. Bengal Forest Department, DVC etc. in different areas depending upon the norms of UNFCCC. Benefits of the carbon credits can be taken by the implementing agencies (who have developed the CDM A/R project) depending upon the ownership of the land.

As a project developer, one needs to be clear about the implications of various definitions in the Indian context. For operationalizing the A/R CDM projects in India, the suitable land use categories must be identified prior to planning the project. The eligibility of the land for CDM primarily depends on the legal status of land prior to 1990 and also the present crown cover as the definition of forest.

The afforestation and reforestation activities are the only eligible activities under LULUCF in the CDM for the first commitment period (2008 to 2012) as per decision 17/CP.7 Para 7 (c). Project may be large or small scale, single or multiple species, pure forestry or farm forestry system such as:

1. Establishment of woodlot on communal land, reforestation of marginal areas with native species e.g. slopes, around and between existing forest fragment (through planting and natural regeneration).
2. New large scale industrial plantations.
3. Establishment of biomass plantations for energy production of fossil fuel.
4. Small scale plantation by landowners.
5. Introduction of trees in to existing agriculture systems (Agroforestry, if it fulfills the definition of forests).
6. Rehabilitation of degraded area through tree planting or assisted natural regeneration

These mentioned activities are eligible for A/R projects provided they meet land use / land cover eligibility criteria as per definition of A/R given in Marrakech Accords i.e. if tree cover is less than 10 to 30 % and not a forest area prior to 31.12.89. Afforestation /Reforestation CDM Projects are mainly:

- o promote sustainable development by encouraging investments by government and private firms in projects in developing countries that reduce or avoid emission.
- Developed countries will receive credits against their targets for emission avoided by these projects.

Clean Development Mechanism (CDM) is one such flexibility mechanism that allows projects between Annex 1 and non Annex 1 countries. The CDM aims to assist developing countries in achieving sustainable development by promoting environmental friendly investment in their economics from industrialized country governments and business. Some specified activities in the Land Use, Land Use Change and Forestry (LULUCF) sector namely afforestation, reforestation. These projects that sequester carbon in biomass are also commonly referred to as sink.

The CDM allows an Annex 1 party to implement a bilateral project that reduces green house gas emission or remove GHGs by carbon sequestration in the geographical territory of a non Annex 1 party. The resulting Certified Emission Reductions (CERs) can be used by the Annex 1 countries to help meet their own emission targets. The CDM is the only mechanism of the Kyoto Protocol which directly involves developing countries in GHG emission reduction projects.

The final rules for the CDM were agreed to at the 7th Conference of Parties to the UNFCCC in Marrakech in 2001. The Marrakech Accord (MA), as they became known, finalized the modalities and procedures for CDM projects (17/CP.7). These modalities and procedures are available on UNFCCC web site www.cdm.unfccc.int

The various issues related to the forestry sector are referred to as Land Use, Land Use Change and Forestry (LULUCF) in the Kyoto Protocol. LULUCF sector can provide relatively low cost opportunities to combat climate change by increasing the removal of GHG from the atmosphere through carbon sink e.g. by planting tress.

Forest is a sink of carbon. Immense potential of carbon mitigation through the carbon sequestration process, Land Use and Land Use Change (LULUCF) projects are globally introduced. On 11 December 1997 The Kyoto Protocol was adopted in Kyoto, Japan, and entered into force on 16 February 2005. The CDM was introduced to implement carbon reduction and sink projects under the Kyoto Protocol. As a result, Afforestation and Reforestation (A/R) CDM projects are coming to generate forestry carbon credits. In addition to projects in the industrial and energy sectors, A/R CDM sector offers a mix of carbon and sustainable development benefits.

Before developing A/R CDM projects guidelines laid down by UNFCCC must be followed. Criteria have been defined for particular activities that include:

Afforestation: Afforestation is the direct human induced conversion of land, that has not been forested for a period of at least 50 years, to forested land through planting, seeding and / or the human induced promotion of natural seed sources.

Reforestation: Reforestation is the direct human induced conversion of non-forested land to forested land through planting seeding and / or the human induced promotion of natural seed sources on the land that was forested but has been converted to non-forested land. For first commitment period (2008-2012), reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31st December 1989.

To qualify for CDM benefits, the CO_2 calculations may be done on following pattern depending on the number of trees being planted /ha under different plantation models:

a) Total wood produced in 2006-07 at 33.11% moisture	=9,20,392.0 MT
b) Total dry wood	=6,15,650.5 MT
c) Total biomass including BGB & LBB at 71%	=10,52,762.0 MT
d) Total carbon at 50%	=5,26,381.2 MT
e) Total carbon sequestered (c x 44/12)	=1926555.2 MT (1926 Kilo tones)

(BGB= below ground biomass i.e. root, LBB=leaf and bark biomass)

or else

one hectare containing 2222 no of trees produce 100 MT of green wood at 4 years
one hectare containing 2222 no of trees produce 25 MT of green wood at 1 year
Dry wood at (36% moisture) = 16 MT dry wood.
Total biomass (add 71% of wood as AGB and BGB)= 27.36 MT
Carbon (50% of dry wood) = 13.68 MT
CO_2 = 13.68 x 44/12 = 50.16 tonnes
(50.16 tonnes CO_2 (tonnes equivalent))

Chapter 7. Recommendations

Natural resource management is expected to play a key role in the development of Jharkhand in the years to come. The government stands committed, to bring about a new ethos of people-centered, growth-oriented governance in the state. Forest resources constitute a critical lifeline for poor forest dwellers by providing them sustenance and livelihood. Therefore to achieve maximum benefits for the poorest sections of the society living in the vicinity of the mining areas restoration of mined lands based on sound ecological principles is essential

While plant material that are both adapted to local climatic and soil conditions and appropriate for post mining land use plans are important, equally important are restoration of suitable planting sites and adherence to proper and sound planting and seeding methods. Plants have a major role to play in building productive soils. A few suitable species, even on compacted soils, are able to develop well knit root systems that improve soil porosity for better drainage and aeration. The massive additions of organic matter from leaf and branch litter improve soil tilth and nourish the impoverished soil physical ,chemical and biological characteristics of minespoils in turn assist amelioration of strata . The enriched minespoils of restored sites would favor secondary succession and conserve biodiversity of both plants and faunal species.

The goal of eco restoration is restoration of natural conditions premining that existed prior to mining,but this is an uphill task if not impossible. However, ecological interventions may go a long way in improving the micro environment most appropriate for plant establishment and growth of native floral communities.

Mine plan should be so made that the minimum proportion of OB is taken to external OB dump and as early as possible in-pit dumping should start in an opencast mine:

- Topsoil should be recovered and utilized in reclamation of dumps.
- Extensive tree plantation activity should be taken up on vacant land in the leasehold, for creation of green belt, avenue plantation and on external and internal OB dumps.
- External OB dumps should have gentle slope merging with the landscape and in any case the overall slope of dumps should not exceed 28o.
- Before biological reclamation of dumps, the area should be technically reclaimed by dozing.

The objective should be to bring the mined out land to productive land use as soon as the using is over in particular block of mine.

Capacity Building

Restoration ecology is multi-disciplinary, and the array of skills needed should be turned to the specific needs of the sector from those of the highly professional staff to sub-professionals and field workers. It also pre-supposes public education in restoration ecology. Capacity building is inadequate affecting the quality of performance in the sector. The appropriate expertise is necessary for efficient performance and therefore capacity building initiatives are a crucial aspect requiring urgent attention.

- Derelict lands be ecologically restored and managed for Bio-Diversity conservation.
- Due attention to include fuel and fodder and other useful species
- NWFP species to be developed and value addition may be promoted at the village level.

Chapter 8. Execution And Implementation

Execution of Road Map for Restoration

Mining of minerals, economic growth and environmental protection are inextricably associated and therefore sustainable restoration necessitates not only the restructuring and ecological stability of derelict minespoils but also the development of natural resources to meet the immediate needs of the local populace and the requirements of the future generations without in any way endangering the ecology and environment. The vital feature of sustainable restoration therefore lies in the paradigm of scientific novelty and economic determinism within the physical limits imposed by mined landscapes on economic activity. Origin of this concept is based on the fact that the environment does pose a limit for development and economic activity and a balance has to be struck between environmental constraints and developmental activity. The economics of development must expand within ecosystems that have limited regenerative capacities. This involves an integration of ecological capabilities, social expectations and minimising the differentials between resource demand/requirement and supply/availability.

Planning and implementation of road map for ecological restoration of BCCL mining areas has been oriented towards addressing both short-term and long-term implications and needs of ecological conservation.

A. Short Term Plan

- Development and conservation of soil and *in-situ* moisture through ecological restoration interventions ;
- Restoration/ Regeneration of degraded lands including forests and adjoining areas on an ecological basis;
- Intensification of the availability of fuel wood, fodder, grasses and other forest usufructs from the restored areas;
- Securing people's participation in planning and restoration efforts in the surrounding villages to ensure sustainability).

B. Long Term Plan

- Ecological restoration and environmental conservation;
- Protection and conservation of natural resources for local populace ;
- Checking land degradation, deforestation and loss of biodiversity;
- Improve microenvironment of the mined landscapes;
- Capacity building of all the stakeholders

Scope and Scale

The road map has three main components:

- Restoration of derelict minespoils
- Developing a nursery for medicinal plants
- Soil and moisture conservation practices
- Development of an eco park
- Awareness and capacity building initiatives

While implementing the plan sharing of activities has to be clearly defined as under:

- Activities like Nursery raising for medicinal plants be taken by local villagers in the fringe area of mining belt
- BCCL would be responsible for other project components viz., *in situ* soil and moisture conservation including contour trenching, vegetative gully treatment, management of ecopark, on site training of beneficiaries/ staff etc.

Financial outlay

A gross estimate shows that nearly 16-20 percent of the area in each mine is highly degraded and needs immediate attention. Approximately, 100 hectares has to undertaken in the first phase in three mines.

Table22. Financial Outlay of Mine Spoil Stabilization

S. No.	Mine spoil stabilization Measures	(Cost in Rs. /ha)*
1	Contour Trenching	8,000
2	Steep mined out slopes	15,000
3	**Geotextiles covered area (80 degree slope)	15,000
4	Gully plugging	10,000
5	Flat area (Waste land nearby village area)	8,000
6.	Average Cost/ha	11,200

*Includes Cost of labour, Cost of seed, Seed dispersal ,
**Excuding Cost of geotextiles Rupees 50,000/ha

Restoration/afforestation has to be taken in two phase starting from 2011 planting season. In the first phase 100 hectare area is recommended for greening ,during Phase II,126 hectare area may be worked with.Details of area that would be available for restoration in different mines under BCCL is detailed in Table 23.

Table 23 area Available for Restoration During Next Five Years.

Sl.No.	Area of BCCL	Area available for Restoration (in ha)	Remarks
1.	Barora Area	25 ha	–
2.	Bastacolla Area	38 ha	–
3.	Block-II Area	32 ha	–
4.	Chanch Victoria Area	8 ha	–
5.	Eastern Jharia Area	22 ha	–
6.	Govindpur Area	15 ha	
7.	Katras Area	22 ha	Fit for Bamboo plantation
8.	Kuslore Area	15 ha	–
9.	Kusunda Area	20 ha	–
10.	Lodna Area	15 ha	–
11.	Sijua Area	10 ha	–
12.	Western Jharia Area	2 ha	–
13.	Western Washery Zone	2 ha	
	Total	**226 ha**	–

Phase I	Average cost of ecorestoration/ afforestation /ha Total cost of ecorestoration /afforestation/100 ha	Rs. 11,200/- Rs.11.20 lakhs
Phase II	Total cost of ecorestoration /afforestation/126 ha	Rs.14,11,200
	Say	Rs.14.12 lakhs

Funding Mechanism

Substantial investment has to be provided by BCCL in terms of manpower and money for successful implementation of the project.

Execution Schedule

The total project needs to be implemented in two phases over a period of ten years.

Phase I 2011-16 Development of a model restoration plantation at one of the BCCL site by FRI, Dehradun on ten hectares of overburden dumps. Ninety hectares of the area to be restored by BCCL in their three mining sites based on this road map.

Phase II 2016-2021 Replication/expansion of proposed restoration models in the 126 hectares area spread over 13 mines of BCCL.

Sustainable restoration of mining areas of BCCL needs to be implemented for -

- Amelioration of minespoils for ecological and socio economical benefits
- Controlling erosion from minespoil areas and
- Developing the carbon credits under CDM

Institutional Mechanism for Implementation

The critical role played by the various institutions in the context of execution of plan is well recognized .The various major stakeholders in the BCCL area have to jointly chalk out a strategic execution plan .The major stake holders in the region are:

- BCCL and
- Local Communities

A Steering Committee has to be formed before implementation of plan to workout an effective mechanism of implementation. The constitution of steering committee is proposed as under:

Chairman Coal India Limited	Chairman
Chairman BCCL	Member
Director Technical BCCL	Secretary
General Managers of different mines under BCCL	Member
Presidents of Local NGOs *viz*.,R.K.Mission, and Local Mahila Mandals and Panchayats	Member
Director FRI	Member

Different Agencies Recognized for Executing the Restoration in the BCCL Mines

Agencies to take up Execution	Email and Contact No.
Ramesh Madav, (Ph. D.) Director and Chief Ecology & Restoration Terracon Ecotech Pvt Ltd 6th Floor, 'Swagat', Shraddhanand Road, Vile Parle (East), Mumbai Maharashtra - 400057, INDIA	Tel: +91.22.2618 3939 / 40 / 41 ramesh@terraconindia.com / ramesh@terraconindia.com>, http://www.terraconindia.com
Dr. D.K. Pandey (Ph.D) Louis Berger Group, INC (USA) Plot No. B-3, Sector 32, Gurgaon - 122001	0124-4578200 Ext. 221 dkpandey@louisberger.com/ dkpandey2001@rediffmail.com
Grass Roots Research and Creation India (P) Ltd.	Head Office: F-375, Sector-63, Noida -201 301, India Phone: + (91)-(120)-4044630, 4044660 Mobile: + (91)- 9818184005 Fax: + (91)-(120)-2406519 Regd. Office: 1102A, 11th Floor, Devika Tower, Nehru Place, New Delhi- 110019 Phone: 011-40740100 Fax: 011-26441761 info@grc-india.com eia@grc-india.com iso@grc-india.com accounts@grc-india.com grc.india@yahoo.com

Short and Long Term monitoring and evaluation

Using field-based indicators of forest condition to assess the state of the natural resources mainly vegetation, soil and socioeconomic criteria, monitoring has to be done. The objective is to assess as to how ecological restoration interventions have succeeded in restoring the derelict mined lands with special reference to changes in floristic , soil parameters and socio economics of the fringe villages. Forest Research Institute can undertake the short and long term evaluation and monitoring on annual basis.

Forest Research Institute has well developed infrastructure with multidisciplinary expertise in the fields of Ecosystem restoration including vegetation as well as soil amelioration and management, Silvicultre, Pathology and Entomology. The Institute will associate in the following areas:

1. Long term monitoring and evaluation of afforested areas under degraded forests, private lands and community lands with special reference to changes in ecological and soil parameters.
2. Maintenance of Forest health
3. Undertake restoration of mined lands based on ecosystem approach in Jharkhand to conserve biodiversity through use of native species of socioeconomic relevance and sequester carbon
4. Landscaping & Green Belt Development in industrial & urban areas
5. Afforestation on the reservoir embankments using species of economic importance viz., Fruits, medicinal plants etc. in and around the industrial belts
6. Capacity building through regular and customized courses for training of concerned staff and executives

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Loose over burden dump for development of ecorestoration model

Over burden dump with 70° slope

Plate 4. Loose over burden dumps

60° Over burden dump covered by natural vegetation

Loose over burden dump covered by natural vegetation

Plate 5. Over burden dumps with colonisation of native species

Waste land in fringe area

Flat area to be planted with local tree species

Plate 6. Near by village areas

Aegle marmelos

Alstonia scholaris

Argemone mexicana

Bauhinia purpurea

Butea monosperma

Calotropis gigantea

Calotropis procera

Cenchrus ciliaris

Plate. 7. Plant species of common occurrence in Jharia coal field sites

Cordia dichotoma

Croton bonplandianus

Dalbergia sissoo

Heteropogon contortus

Hollarrhena pubescens

Holoptelia integrifolia

Marsilea quadrifolia

Moringa oleifera

Plate 8. Plant species of common occurrence in Jharia coal field sites

Ocimum canum

Pongamia pinnata

Schleichera oleosa

Solanum surattense

Tragea involucrata

Vitex negundo

Vitis quadrangularis

Zizyphus nummularia

Plate. 9 Plant species of common occurrence at Jharia coal field sites

ANNEXURE 23:

BHARAT COKING COAL LIMITED
Corporate Environment Policy

ENVIRONMENTAL POLICY STATEMENT:

Bharat Coking Coal Limited (BCCL) is committed to promote sustainable development by protecting the environment through integrated project planning & design, prevention / mitigation of pollution, conservation of natural resources, restoration of ecology & biodiversity, recycling/ proper disposal of wastes, addressing climate change and inclusive growth. It also aims to bringing awareness amongst its stakeholders for continual improvement in environmental performances following best practices.

OBJECTIVES:

Bharat Coking Coal Limited shall endeavour to:
1. Plan & design projects with due consideration to environmental concerns for Sustainable Development.
2. Conduct mining and associated operation in an environmentally responsible manner to comply with applicable laws and other requirements related to environmental aspects.
3. Prevent pollution of surrounding habitation by continuous monitoring and adopting suitable measures for environment protection.
4. Implement Environment Management Plans in all our mines /projects/Clusters effectively to mitigate pollution, conservation of natural resources and restoration of ecology & biodiversity.
5. Ensure compliance of all applicable Environmental Clearance& Forestry Clearance conditions and other statutory conditions issued by regulatory agencies.
6. Recycling of wastes on the principle of REDUCE, REUSE and RECYCLE.
7. Put special thrusts on efficient energy utilization / renewable energy as a measure to reduce carbon foot-print.
8. Strive for continual improvement in our environmental performances by setting targets, measuring progress and taking corrective action.
9. Taking measures to render productive post mining land use.
10. Implementation of activities applicable to BCCL arising out of International Conventions.
11. Create environmental awareness among the employees and the local communities through pro-active communication and training

STRATEGIES FOR IMPLEMENTATION OF ENVIRONMENTAL POLICY:

BackGround:

Bharat Coking Coal Limited subscribes to the view of Sustainable Development. Unless theenvironment can sustain all the developmental activities, any pursuit of developmentin isolation can cause irreparable damage to the ecosystem and associatedenvironmental attributes. Keeping this view in mind, Bharat Coking Coal Limited attaches toppriority towards sustainable development and approved its 'Corporate EnvironmentalPolicy'. Based on CIL Environment Policy2012,incorporating theJharia Master Plan ,CEP of BCCL was approved by 285th BCCL board on 21.04.2012and is complimentary to theNational Environmental Policy, 2006.The Revised BCCL Policy, 2019 is the outcome of the experience gained since2012, keeping in view the modifications / amendments made time to time inenvironmental policies and additional stipulation notified by MoEF&CC (Ministry of Environment, Forest& Climate Change), and other organisations concerning mineclosure, reclamation of degraded land, environmental clearance etc. and also with theobjective of revisiting the corporate policy.The Policy has a vision of Green Mining and mission of 100% compliance of environmental statutes applicable to coal mining industry.This policy is prepared in line with that of CIL's policy with incorporation of prevailing local conditions.

STRATEGIES: Bharat Coking Coal Limited adopts the strategies appended below for effective implementation:

1. MINE/ PROJECT PLANNING & DESIGN FOR SUSTAINABLE DEVELOPMENT:

a) Coal being a non-renewal energy source, extraction shall be planned prudently tomeet national requirement in a planned way. The projects shall be designed on theprinciple of Sustainable Development with due consideration to environment, mine closure,safety and aspirations of the stakeholders at the planning& designstage itself with due regard to mine closure plan.

b) While preparing the Mining plan/project reports, the effort shall be to incorporatelatest mining technologies and equipment's with optimal capacity, which are moreenvironment friendly

c) All Mining Plan/ project reports will be provided with detailed provisions for ensuring environmental compliances

2. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) & ENVIRONMENT MANAGEMENT PLAN (EMP)

a. All mine planning and design shall be environmentally acceptable and operationshall be carried out in such a way as to facilitate the compliance of stipulated environmentalstandards.
b. EIA& EMP for all projects/Clusters shall be formulated as per the approved ToR (Termsof Reference) and pubic consultations for obtaining Environmental Clearance (EC) from MoEF&CC. Similarly, in the existing projects needing enhancementof production capacities with or without increase in land, change of technology,renewal of lease and change in land use etc. fresh EC is required to be sought asper norms. The projects shall be operated after obtaining Consent to Establish(CTE)/Consent to Operate (CTO) from State Pollution Control Boards (SPCB).
c. Detailed Mine Closure Plans shall be prepared for all existing and new mines as per the MoC (Ministry of Coal) guidelines.

3. COMPLIANCE OF THE STATUTORY REQUIREMENTS:

The implementation of EMP and fulfilment of all other statutory requirements like conditions of EC, FC and consents to establish & operate, including timely submission of returns to statutory bodies and various agencies, are to be ensured at all levels.

4. MEASURES TO MITIGATE POLLUTION:

a) Air Pollution:

i) Generation of dust is to be controlled at the source to the possible extent with necessary control measures during drilling, blasting, loading, unloading, CHPtransfer points etc

ii)Deployment of eco-friendly mining technologies.

iii) Dust generation is to be minimized along coal / waste transportation routes.

iv)Mechanized transportation of coal to be encouraged.

v) Green belt is to be created around the source of dust

b) Water pollution:

i) The mine water and other effluent shall be treated to ensure the discharge normsas per statute. The treated effluent shall be utilized to the extent possible with aview to achieve maximum water conservation.

ii) Oil & grease from the effluent shall be removed by Oil & Grease Traps forproper disposal.

c) Noise / ground vibration:

i) All measures to minimize noise pollution will be taken including maintenance of HEMM, equipment and provision of PPE where required.

ii) Suitable blasting techniques shall be followed to reduce ground vibration as well as noise pollution.

d)Land reclamation:

i) Progressive and concurrent reclamation of mined out areas will be carried out as per approved EIA/EMP and Mine Closure Plan (MCP).

ii) Slopes of external dumps are the important area to be suitably graded / terraced for effective reclamation and plantation.

iii) Preservation of top soil is required for future use. Old as well as existing nonactive dumps are to be technically and biologically reclaimed.

iv) Monitoring of reclamation work of all opencast mines will be done through Satellite Surveillance. The outcome shall be put in the websites.

e) Mine closure plans:

Mine Closure Plan (MCP) shall be prepared for each mineon which Mine closure guidelines are applicable. MCP are being delineated in two phases viz. progressive and final mine closure. Appropriate funds are set aside and deposited under a special Escrow fund every year as per MoC guidelines, to be utilized for proper and final mine closure.

For mines closed prior to issuance of MoC guidelines (i.e. 27th August, 2009) suitable action to be taken as per provisions of Mines Act 1952.

f) Mine fire& subsidence

BCCL shall endeavour to reduce occurrence of mine fire and subsidence due to mining activityfor safety and conservation purpose and, shall take steps for prevention and control of coal mine fire. Monthly report shall be submitted to top management of thesubsidiary and CIL and Quarterly to company board. Action Plan for mine fire control shall be implemented. Monitoring will be done through Satellite Surveillance/other suitable technology. Rehabilitation under Master Plan will be expedited to facilitate faster liquidation of fire. During the execution of the Master Plan since 2009, changes have occurred in the fire dealing methodology, the number of affected families and the infrastructure facilities to be provided to them. However, these modifications were executed in cognizance of HPCC committee for JMP.

BCCL is committed for implementation of the GOI approved Master Plan for Dealing with Fire, Subsidence and Rehabilitation in leasehold of BCCL (Jharia Master Plan) which is also required to be dovetailed with the implementation of EC conditions of various clusters of BCCL . Necessary steps shall be taken for implementation of Jharia master plan to deal with the problem of fire and subsidence in JCF along with R&R of affected people.

g) Monitoring:

I. All receptors in and around the mining projects/clusters all be monitored regularly to assess the efficacy of the pollution control / mitigation measures within stipulated standards.

II. Effect of mining on the hydrology of the area will be monitored through measurement of water level and quality of nearby wells and bore holes provided for this purpose. Conservation of water through rainwater harvesting shall be taken up.

III. Area and Unit environmental cells shall have regular interaction with the people in and around the coal mines and other allied units on matters related to environment to take necessary and timely corrective actions.

V. Environmental initiatives and monitoring through self and third party environment audit shall be conducted for generating useful data for taking corrective actions and mitigation measures as per guidelines.

h) Other measures:

I. Special emphasis shall be given to undertake R&D related to various facets of coal mine environmental management in collaboration with Central Mine Planning and Design Institute (CMPDI) and other competent institutions.

II. Besides ensuring statutory compliance, the BCCL desires to set high standards and continual improvement.

III. Mines & establishments shall be ISO 14001certified in phased manner.

IV. CSR and R&R policies of CIL are to be incorporated by BCCL for better planning and implementation of the socio-economic issues of coal mining areas.

V. The coal mining environmental issues are complex and require multidisciplinary approach to address the same. BCCL will endeavour to enter into MoUs with expert agencies of repute to assist in environment issues and also help in capacity building of BCCL executives.

VI. BCCL conduct periodical medical examination (PME) of its work force on routine basis in compliance of the requirement mining rules and regulation,
additional test will be done as and when require.

5. PRESERVATION OF BIO-DIVERSITY:

BCCL has made the ecological restoration a flagship programme for restoration of degraded mined areas and adopting 3- tier plantation consisting of native species grasses, bushes and trees under the technical expertise of Forest research institute, Dehradun, a renowned institute in the field of forests and ecology. Ecological restoration has been widely accepted as one of the most effective means to restore the ecology and biodiversity.

BCCL is committed towards the conservation and restoration of the natural biodiversity of the region on the degraded mined out areas and restore back to forest like areas. BCCL will strive to restore the habitats for the native fauna of the region by restoring the areas through ecological restoration.

BCCL is committed towards the wellbeing and betterment of the living standards for the local community through establishment of the eco-parks in the reclaimed mined areas in the coalfield and promoting the eco-mining tourism in the coalfield areas and exploring the new opportunities to the local communities. This will start from mine planning including technically and biologically reclamation of mined out areas in collaboration with State Forest Departments, Wild Life Divisions, NGOs, FRI Dehradun etc. working in the fields of biodiversity conservation.

6. COAL BENEFICIATION / COALWASHERIES:

a) For beneficiation of Runoff Mines (ROM) coal, washeries are being set up in a phased manner as per requirement and statutes.

b) Slurry Management System (SMS) in all washeries shall be organized to ensure collection of fines, gainful utilization of rejects viz. power generation in Fluidized Bed Combustion (FBC) plants, selling to brick manufacturers or adopting other environmental friendly disposal options as feasible.

c) The reject dumps and tailings shall be suitably handled to avoid any contamination.

d) The effluent from washeries including tailings pond shall be suitably treated and reused to minimize water consumption with zero discharge concept.

7. CONSERVATION AND CLEAN TECHNOLOGY:

a) R&D projects shall be taken up to promote clean coal technology and improve the existing technologies.

b) Energy saved is energy produced. Voluntary energy audit to be done for corrective action to reduce carbon footprint.

c) Clean Development Mechanisms will be explored for reducing emission of Green House Gases by exploration, identification, preparation of projects reports for extraction of methane from Coal Bed, Coal Mine, Abandoned Mine, Ventilation Air, UG Coal Gasification, generation and utilization of renewable energy etc.

8. AWARENESS PROGRAMME:

a) Publicity to generate awareness through exchange & communication of information, newsletters and periodicals on environment, seminars, workshops, celebration of

World Environment Day etc, at BCCL HQ, Areas & units to be undertaken. Regular training programs to be organized at various levels to inculcate awareness among employees.
b) Courses on environmental and forestry laws and Environmental Protection Measures and the Corporate Policy to be organized for project executives for improving knowledge.
c) BCCL will felicitate its workers for best practices in eco-restoration, land reclamation, conservation, compliance of statutes and innovative ways of sustaining environment.

9. WASTE MANAGEMENT:

BCCL will undertake appropriate action for safe handling, storage and disposal of solid waste and hazardous waste generated from its industrial set up and colonies as per relevant rules. The biomedical waste generated from hospitals and dispensaries will be collected and disposed in appropriate facilities created as per statutes. E-waste management and handling of various types of e-waste generatedin its operations will be done as per rule.

10. CORPORATE ENVIRONMENT RESPONSIBILITY:

Corporate Environment Responsibility (CER) is mandatory for issuing environmental clearance for all the Greenfield and Brownfield projects as per directives of MoEFCC with effect from 1st May, 2018 (O.M.No.22-65/2017- IAIII dt. 19.06.2018). Budgetary provisions should be kept for implementation of provisions of CER for all the projects which will be submitted to MoEFCC for grant of environmental clearance.

11. INCORPORATION OF VIEWS OF STAKEHOLDERS:

BCCL will critically examine and incorporate the viewpoints of various stakeholders like PAPs/PAFs, Parliamentary Committees, Standing Sub-Committees, NGOs etc.

12.IMPLEMENTATION OF POLICY:

i) Manpower: BCCL shall have environmental divisions at decision making & operational levels in its structure. The environment department shall be set up and strengthened at:
i)BCCL HQ
ii)Areas / Units / Collieries / Workshops /Washeries

ii) Roles and Responsibilities: The environmental department, set up at company HQs, Areas and Unit levels with appropriate manpower and resources, shall be responsible for implementation of policy, obtaining EC, FC, consent to establish & operate, statutes requirements and undertaking mitigation measures besides preparation of action plan every year and also to intimate the status of implementation to the management regularly.

iii) Annual Environment Budget (Revenue &Capital): The Annual Environment Budget (revenue & capital) shall be prepared based on the action plan including monitoring of various bench marks and the budget utilization. The year wise funds earmarked for environmental protection measures shall be kept in separate accounts with Environmental cost code.

REVIEW OF ENVIRONMENTAL POLICY:

In view of the present fast changing social, economic and environmental scenario, the CIL Policy shall be reviewed every 5 years to incorporate the changes in the legal, technical, environmental, economic and social inputs prevailing at that time.
Whenever, there is change in National Environmental Policy or other National / State relevant policies, Acts etc, the CILCorporate Environmental Policy would be reviewed and suitably revised. It will be followed by revision of this policy accordingly.

Place: Dhanbad **Chairman-cum-Managing Director**
Date:

ANNEXURE 24:

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

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

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Nichitpur (A8): Industrial Area

The location of the sampling station is 23^0 48'18.59" N 86^{0}21'30.93" E. The samplers were placed at a height of approx. 1.5m above ground level at Nichitpur.

II. BUFFER ZONE Monitoring Location

i) Basseriya Managers Office (A9) : Industrial area

The location of the sampling station is 23^0 48'11.53" N & 86^0 22'17.50" E. The samplers were placed at a height of approx. 1.5m above ground level at Safety Office.

ii) Pootki Ballihari Office (A16) : Industrial area

The location of the sampling station is 23°45.17.23' N 86°21.46.27'E. The samplers were placed at a height of approx. 1.5m above ground level at Project Office.

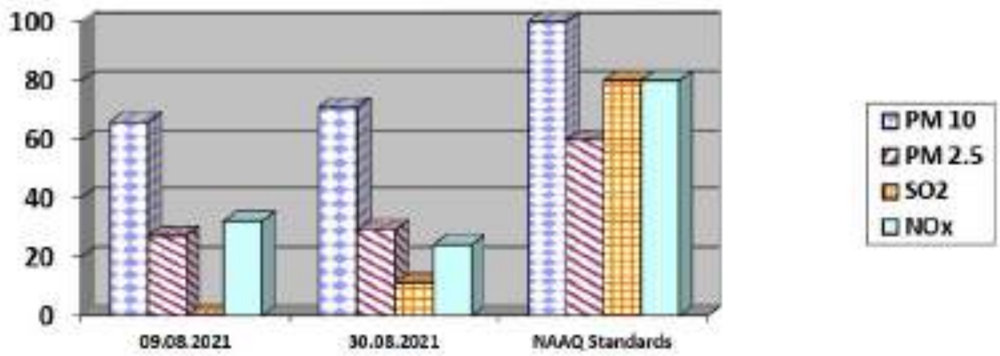
iii) Moonidih UGP(A17): Industrial Area

The location of the sampling station is 23^0 44'30.00" N & 86^0 20'56.00" E. The samplers were placed at a height of approx. 1.5m above ground level at project office.

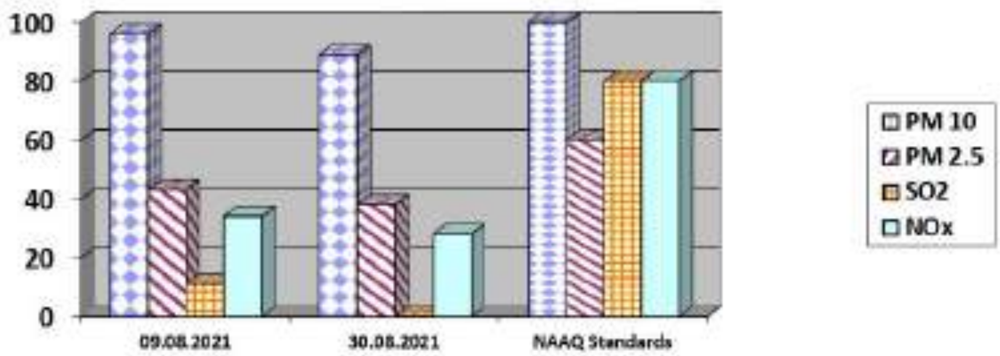
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited Month: **AUG 2021** Year: **2021-22.**

Station Name: A8, Nichitpur		**Zone: Core**		**Category: Industrial**	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_x**
1	09.08.2021	66	27	<10	32
2	30.08.2021	71	29	11	24
	NAAQ Standard	100	60	80	80



Station Name: A9, Basseriya Managers office		**Zone: Buffer**		**Category: Industrial**	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_x**
1	09.08.2021	96	43	11	34
2	30.08.2021	89	38	<10	28
	NAAQ Standard	100	60	80	80

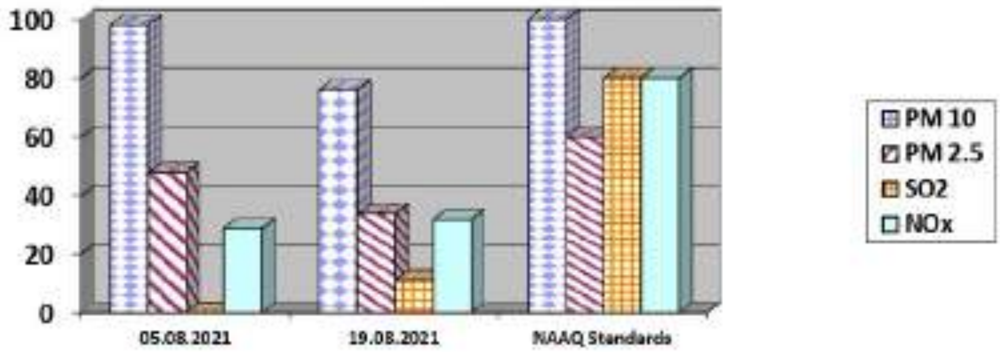


Analysed By
JSA/SA/SSA

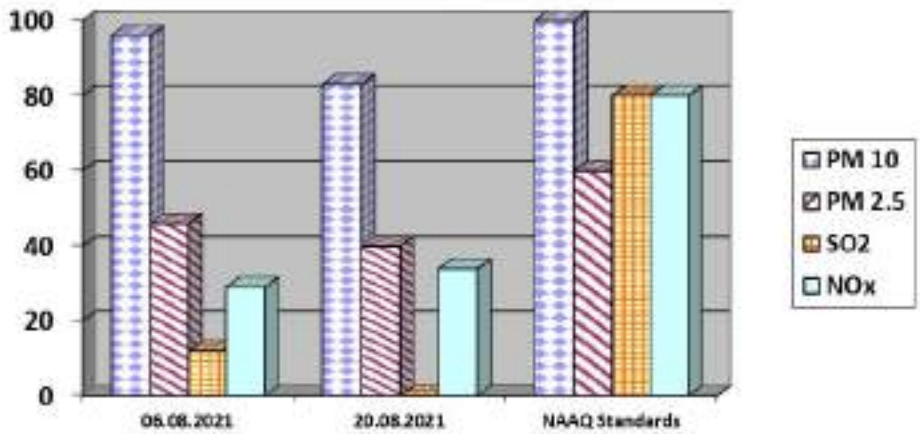
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

Station Name: A16 Pootki Balihari office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	05.08.2021	98	48	<10	29
2	19.08.2021	76	34	11	32
	NAAQ Standards	100	60	80	80



Station Name: A17 – Moonidih UGP		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	06.08.2021	96	46	12	29
2	20.08.2021	83	40	<10	34
	NAAQ Standards	100	60	80	80



- *All values are expressed in microgram per cubic meter.*
- *24 hours duration*

Analyzed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

AMBIENT AIR QUALITY DATA

Name of the Company: **Bharat Coking Coal Limited** Year : **2020-21**

Name of the Cluster : **Cluster -V** PERIOD: **Q. E. DEC- 2020.**

AREA: SIJUA

Heavy Metal Analysis report of Ambient Air Quality

SAMPLE	Cadmium(Cd) (µg/m3)	Mercury(Hg) (µg/m3)	Arsenic(As) (ng/m3)	Chromium(Cr) (µg/m3)	Nickel (Ni) (ng/m3)	Lead (Pb) (µg/m3)
Nichitpur (A8)	<0.001	0.015	<0.005	<0.01	<0.1	<0.005
Basseriya Managers Office (A9)	<0.001	<0.001	<0.005	<0.01	<0.1	<0.005
Pootki Ballihari Office (A16)	<0.001	<0.001	<0.005	<0.01	<0.1	0.01
Moonidih UGP(A17)	<0.001	<0.001	<0.005	<0.01	<0.1	0.03

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

ANNEXURE 25:

DEPARTMENT OF ENVIRONEMNAL SCIENCE & ENGINEERING
(CENTRE OF MINING ENVIRONMENT)
INDIAN INSTITUTE OF TECHNOLOGY (INDIAN SCHOOL OF MINES),
DHANBAD – 826004

ESE/2019-20/ BCCL/02 Date: 21.12.2019
Ref: GM/SA/SPA/F-ENV/2019/8/ Dated 05/11/2019

Air sampling in core and buffer zone of Sijua Area, BCCL

Date of Sampling: 02.12.2019 to 04.12.2019

S.N	Locations	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
Core Zone					
1	Nichitpur colliery Office	104	65	21	25
Buffer Zone					
2	Basseriya Managers Office	98	61	16	32
3	Pootki Balihari Project Office	102	65	22	28
4	Moonidih UG Project Office	91	60	15	29

Date of Sampling: 18.12.2019 to 20.12.2019

S.N	Locations	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
Core Zone					
1	Nichitpur colliery Office	101	61	18	22
Buffer Zone					
2	Basseriya Managers Offcie	95	67	21	28
3	Pootki Balihari Project Office	99	61	27	31
4	Moonidih UG Project Office	90	63	18	22

Standards

S.N	Locations	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)
1	**GSR-742 (E), dated 25.09.2000**				
	Existing Mines, 24 Hrs	300	-	120	120
	New Coal Mines, 24 Hrs	250	-	120	120
2	**NAAQS 2009**				
		100	60	80	80

Manish Jain
21/12/19

Dr Manish Kumar Jain
ASP/ESE

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ANNEXURE 26:

- **List of PPEs provided in Different collieries of Cluster V in Financial Year 2020-21:**

S.No.	List of Safety Equipment	Name of Colliery						
		Sendra Bansjora	Bansdeopur	Kankanee	Tetulmari	Nichitpur	Mudidih	Total
1	Safety Helmet	40	69	15	110	61	05	300
2	Safety Shoes	225	142	74	747	367	-	1555
3	Dust mask	525	100	25	550	142	350	1692
4	Safety Goggles	15 (Jan 20)	30	-	-		-	30
5	Fluorescent Jacket	200	71	10	274	254	-	809
6	Gum Boot	50	20	15	50	22	-	157

ANNEXURE 27:

BHARAT COKING COAL LIMITED																			
SIJUA AREA																			
2020																			
SL.no	NAME OF UNIT	MANPOWER (01/01/2020)	yearly target	MONTHLY PME TARGET	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	PROGRESSIVE 2020		PME DONE IN 2019
																	TARGET	ACHIEVEMENT	
1	TETULMARI COLLIERY	[illegible]	304	25	25	27	16	0	0	5	8	0	0	0	0	0	304	81	186
2	NICHITPUR COLLIERY	[illegible]	172	14	0	13	6	0	0	8	0	0	0	0	0	0	172	[illegible]	194
3	S/B COLLIERY	[illegible]	104	9	22	21	[illegible]	0	0	7	14	0	0	0	0	19	104	93	145
4	MUDIDIH COLLIERY	[illegible]	152	13	0	6	1	0	0	16	5	0	0	0	0	40	152	68	215
5	LOYABAD COLLIERY	[illegible]	41	3	3	3	5	0	0	2	2	0	0	0	0	6	41	21	48
6	BANSDEOPUR COLLIERY	61	17	2	0	2	0	0	0	6	6	0	0	0	0	0	17	14	31
7	KANKANEE COLLIERY	135	45	4	1	0	0	0	0	9	0	0	0	0	0	[illegible]	45	44	54
8	R.HOSPITAL LOYABAD/ SIJUA AREA	258	86	7	0	0	0	0	0	0	0	0	0	0	0	0	86	0	166
9																			
	TOTAL	[illegible]	921	77	51	69	46	0	0	53	35	0	0	0	0	91	921	345	1119

SL.no	NAME OF UNIT	MANPOWER (01/01/2021)	yearly target	MONTHLY PME TARGET	JAN	FEB	MAR
1	TETULMARI COLLIERY	1058	304	25	40	48	2
2	NICHITPUR COLLIERY	509	172	14	0	13	0
3	S/B COLLIERY	330	110	9	53	44	0
4	MUDIDIH COLLIERY	414	152	13	15	16	2
5	LOYABAD COLLIERY	93	41	3	0	6	0
6	BANSDEOPUR COLLIERY	110	17	2	16	19	0
7	KANKANEE COLLIERY	135	45	4	0	9	2
8	R.HOSPITAL LOYABAD/ SIJUA AREA	258	86	7	8	18	0
	TOTAL	2907	1026	77	132	173	6
	CONTRACTOR WORKER	IME					
	Departmental Worker	IME					

ANNEXURE 28:

ENVIRONMENTAL BUDGET AND EXPENDITURE FOR CLUSTER V

1. Details of fund earmarked for environmental management as per EMP of Cluster V:

Capital Cost of Environmental Protection Measures

(Amount in Lakhs)

S. No.	Item	Total Cost	Phasing						
			1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year & onwards
1	Pollution abatement cost including providing 03 additional water sprinklers at loading unloading points	250.00	50.00	20.00	50.00	20.00	50.00	-	60.00
2	Effluent Treatment Plant	40.00	-	10.00	10.00	10.00	10.00	-	-
3	Green Belt development	60.00	-	-	-	10.00	10.00	10.00	10.00
4	Pollution Monitoring & Control facilities	40.00	-	12.00	12.00	16.00	-	-	-
5	Afforestation	150.00	-	-	-	35.00	35.00	40.00	40.00
6	Biological Reclamation	60.00	-	-	-	-			
	Total	600.00	50.00	42.00	72.00	91.00	125.00	70.00	130.00

Revenue Budget for Mine Closure and Environmental Monitoring

Activities	Revenue Expenditure (Rs. In Lakhs)
Implementation of reclamation activities	50.00
Implementation of mine closure activities	200.00
Plantation including eco-restoration measures	210.00
Subsidence Management	10.00
Environmental Monitoring	12.00
Future CSR programme implementation	243.00
Rain water harvesting	25.00
Salary and wages	200.00
Cost of EMP preparation including baseline data generation	86.00
Total Cost	**1036.00**

2. Expenditure incurred on Environmental Management in Cluster V:

A. Capital Cost of Environmental Management

(Amount in Lakhs)

S.No.	Activity head as per EMP	Item	Unit Name	Year	Cost
1	Pollution abatement cost including providing 03 additional water sprinklers at loading unloading points	Procurement of one Mobile water Sprinkler	Tetulmari	2013-14	103.37
		Procurement of two mist type mobile sprinklers	Tetulmari, Nichitpur	2020-21	338.36
		Jute cloth enclosure of Bansjora railway siding	Sendra Bansjora	2019-20	3.25
2	Biological Reclamation	Ecological Restoration of OB dumps	Tetulmari	2013-14	11.01
			Tetulmari	2014-15	20.50
			Tetulmari	2015-16	73.63
			Tetulmari	2016-17	73.10
			Tetulmari	2017-18	83.82
			Tetulmari	2018-19	71.21
			Nichitpur	2016-17	42.23
			Nichitpur	2017-18	60.51
			Nichitpur	2018-19	73.28
			Nichitpur	2019-20	75.12
3	Green Belt development	Seed Ball Broadcasting	Tetulmari & Nichitpur	2018-19	0.25
			Tetulmari, Nichitpur, Loyabad & Mudidih	2019-20	19.14
			Loyabad & Mudidih	2020-21	20.00
4	Effluent Treatment Plant	Oil & Grease trap	Tetulmari & Nichitpur	2015-16,2018-19	6.00
5	Pollution Monitoring and Control Facilities	Installation of 34 nos. of fixed water sprinklers	Sendra Bansjora	2019-20	2.34
		Total			1077.12

B. Revenue Cost for Mine Closure and Environmental Monitoring

S. No.	Activity head as per EMP	Activities	Revenue Expenditure (Rs. In Lakhs)
1	Implementation of mine closure activities	Implementation of mine closure activities(subject to Third party audit of the claim as per approved Mine Closure Plan) (2013-14 to 2017-18)	429.08
2	Cost of EMP preparation including baseline data generation	Cost of EMP preparation including baseline data generation	86.00
3	Miscellaneous Environmental Expenditure	Miscellaneous Revenue Expenditure for Environmental Management (2013-14)	12.68
		Miscellaneous Revenue Expenditure for Environmental Management (2014-15)	1.52
		Miscellaneous Revenue Expenditure for Environmental Management (2015-16)	24.15
		Miscellaneous Revenue Expenditure for Environmental Management (2016-17)	5.17
		Miscellaneous Revenue Expenditure for Environmental Management (2017-18)	5.95
		Miscellaneous Revenue Expenditure for Environmental Management (2018-19)	11.83
		Miscellaneous Revenue Expenditure for Environmental Management (2019-20)	6.99
		Miscellaneous Revenue Expenditure for Environmental Management (2020-21)	0.63
4	Future CSR programme implementation	Educational Grant to schools (2016-17 to 2018-19)	99.54
5	Plantation including eco-restoration measures	Plantation of 1320 Bamboo Gabion saplings from Shakti Chowk to Mohlidih (2013-14 to 2016-17)	28.05
		Plantation of 18500 saplings along the banks of Ekra Jore and Bansjora & Jogta Railway Sidings (2020-21)	65.20

		560 Plantations along both sides of the road from Subhash Chowk to Naya More and from Sendra More to Kerkend More (2020-21)	6.29
		Plantation over 32 Ha OB dumps at Loyabad and Bansdeopur (2018-19,2019-20)	61.34
6	Environmental Monitoring	Regular Environmental Monitoring in Cluster V	57.16
		Mine water utilization study	1.50
		Random analysis of air samples through third party independent laboratory (IIT-ISM, Dhanbad)	2.36
		Total Cost	905.44

3. **Proposed Environmental Expenditure in Cluster V:**

S. No.	Activity head as per EMP	Item	Estimated Cost (in Lakhs)
1	Pollution abatement cost including providing 03 additional water sprinklers at loading unloading points (CAPITAL)	Construction of Wheel Washing Ditch-cum-settling tank arrangement at Sendra Bansjora	11.62
2	Pollution Monitoring & Control facilities (CAPITAL)	Random analysis of Air Samples through Independent Laboratory, Assessment of impact of harmful gases on human health and analysis of mine discharge water in Cluster V	11.80
		Installation of Real-time PM_{10} Analysers at five locations in Cluster V in 2021-22	105.75
		Construction of ETP at Regional Hospital, Loyabad	10.00
		Installation of Fixed Water Sprinklers at Nichitpur and Sendra Bansjora	15.00
		Installation of Fog Canons at Sendra Bnasjora	35.00
		Construction of toe-wall and garland drain-cum-settling pond around OB dumps	30.00
		Construction of garland drain-cum-settling pond around Coal dumps	20.00
		Renovation of Oil & Grease Trap-cum-settling tanks at Nichitpur and Tetulmari Workshops	10.00
		Repair of Hazardous waste storage area at Nichitpur and Tetulmari Workshops	2.00
3	Rain water harvesting (REVENUE)	Rain Water Harvesting at Regional Hospital Loyabad and Sendra Bansjora	10.00
4	Biological Reclamation (REVENUE)	Plantation over 32 Ha OB dumps at Loyabad and Bansdeopur (2020-21,2021-22)	22.14
		Plantation of 18500 saplings along the banks of Ekra Jore and Bansjora & Jogta Railway Sidings (2021-22 to 2026-27)	37.00
		560 Plantations along both sides of the road from	7.82

		Subhash Chowk to Naya More and from Sendra More to Kerkend More (2021-22 to 2023-24)	
		Construction of Netaji Sri Subhash Eco-park and Herbal Graden at Kankanee	30.00
		Total	**358.13**

Annexure 29: Last Environmental Statements submitted for the units of cluster V for FY 2020-21:

3404
26/10/21

18 59
26/X/21

भारत कोकिंग कोल लिमिटेड
(एक मिनीरत्न कंपनी)
परियोजना पदाधिकारी का कार्यालय
OFFICE OF THE PROJECT OFFICER
Reg. Off.: NICHITPUR COLLIERY OFFICE, SIJUA AREA, DHANBAD-828101
E-mail:- ponichitpur@bccl.gov.in

Ref. No. : NPC/PO/2021/1343

Dated: - 29/9/21

To,
The Member Secretary
Jharkhand State Pollution Control Board
Township Administration Building,
HEC Complex, Dhurwa
Ranchi-834004

Subject- Submission of Environmental Statement (Form V) for the year 2020-21 in respect of Nichitpur Colliery of Sijua Area (Cluster V), Bharat Coking Coal Limited Dhanbad

Dear Sir,

Please find attached herewith the duly filled Environmental Statement (Form V) for the year 2020-21 in respect of Nichitpur Colliery of Sijua Area (Cluster V) of Bharat Coking Coal Limited Dhanbad.

This is for your kind information.

Hope you will find the same in order.

Yours Faithfully

Project Officer
Nichitpur Colliery

Cc:

1. Regional Officer,JSPCB, H.I.G.-1, Sardar Patel Nagar, Hirapur, Dhanbad – 826001
2. HoD (Env.),Level II, KoylaBhawan, BCCL
3. General Manager, Sijua Area
4. AM (Env.), Sijua Area
5. File

AM (Env.)
26/10/21

ENVIRONMENTAL STATEMENT

IN

FORM-V

(Under Rule-14, Environmental protection Rules, 1986)

(2020 – 2021)

FOR

NICHITPUR COLLIERY

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED

ENVIRONMENTAL STATEMENT

FOR

NICHITPUR COLLIERY

FOR THE YEAR: 2020-2021

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LIST OF ANNEXURES

PLATES

CHAPTER – I

INTRODUCTION

1.1 GENESIS:

The Gazette Notification vide G.S.R No. 329 (E) dated 13th March, 1992 and subsequently renamed to 'Environmental Statement' vide Ministry of Environment & Forests (MOEF), Govt. of India gazette notification No. G.S.R No. 386 (E) Dtd.22nd April'93 reads as follows.

"Every person carrying on an industry, operation or process requiring consent under section 25 of the Water Act, 1974 or under section 21 of the Air Act, 1981 or both or authorization under the Hazardous Waste Rules, 1989 issued under the Environmental Protection Act, 1986 shall submit an Environmental Audit Report for the year ending 31st March in Form V to the concerned State Pollution Control Board on or before the 30th day of September every year."

In compliance with the above, the Environmental Statement for Nichitpur Colliery in Form V has been prepared.

1.2 PROJECT DESCRIPTION :

Nichitpur Opencast mine operating under Sijua Area of BCCL, comprises parts of pure Nichitpur and Khas Bnasjora Collieries and the mine is located about 10 kms west of Dhanbad and falls in North-central part of Jharia Coal field. The latitudinal and longitudinal extent of the mine is 23^0 47' 30" to 23^0 48' 30" North and 86^0 20' 40" to 86^0 22' 00" East respectively.
The limits of Nichitpur OCP on the surface are delineated as under-

North: In-crop of I seam
South: Sendra Bansjora Colliery.
East: East Basuriya Colliery.
West: Tetulmari Colliery.

Nichitpur colliery has a lease hold area of 150.00 Ha.

CHAPTER - II

[FORM – V]

Environmental Statement for the financial year ending 31st March 2021

PART – A

(i) Name and address of the owner/occupier of the industry operation or process-

Shri Sanjay Kumar Singh, Project Officer, Nichitpur Colliery, P.O. – Bansjora, Dist.-Dhanbad, PIN-828101

(ii) Industry category Primary ----(STC code) Secondary-----(SIC Code)

Primary (Coal Mining)

(iii) Production capacity.----

Peak EC Capacity- 1.794 MTPA

(EC order No. J-11015/01/2011-IA.II (M) dated 30 Sept., 2020)

(iv) Year of establishment-

Pre-nationalization (Pre-1973)

(v) Date of the last environmental statement submitted-

05/09/2020

PART – B

Water and Raw Material Consumption:

(1) Water consumption -

Process: NIL

Cooling/ Spraying – Approx. 666 KLD (For use in dust suppression, washing of vehicles, firefighting, etc.)

Domestic- Approx. 2593 KLD

(2) Raw Material Consumption

Name of raw materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial Year (2019-20)	During the Current financial Year (2020-21)
NA	**COAL**	**NA**	**NA**

*Industry may use codes if disclosing details of raw material would violate contractual obligations, otherwise all industries have to name the raw materials used.

PART – C

Pollution discharged to environment/unit of output (Parameter as specified in the consent Issued)

Pollutants	Quantity of pollutants discharged (mass/day)	Concentrations of pollutants in discharges (mass/volume)	Percentage of variation from prescribed standards with reasons
Water	Analysis report attached as annexure	Water Analysis Report for Cluster V attached in which Nichitpur Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.
Air	Analysis report attached as annexure	Air Analysis Report for Cluster V attached in which Nichitpur Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.

PART – D

Hazardous Wastes

(As specified under Hazardous Waste Management and Handling Rules, 1989)

Hazardous Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process	• 4.83 KL Burnt Oil	• 6.16 KL Burnt Oil
From Pollution Control Facilities	NIL	NIL

PART – E

Solid Wastes

Solid Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process (Over Burden)	2683842 Cub. M	8309468 Cub. M
From Pollution Control Facilities	NA	NA
Quantity recycled or re-utilized within the unit	- NA(Over Burden used in Backfilling)	NA(Over Burden used in Backfilling)

PART – F

Please specify the characterizations (in terms of concentration and quantum) of hazardous as well as solid wastes and indicate disposal practice adopted for both these categories of wastes.

1. Hazardous Waste (Burnt Oil)-
   Re-use.

2. Over Burden (Overlying rock)
   Utilized in backfilling of quarries.

PART – G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production

1. Protection of ambient environment-Reduction in particulate matter concentration in ambient air, maintenance of surface and ground water quality, control of noise pollution, restoration of ecology, etc.

2. No major impact on cost of production.

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution:

1. Plantation of 250 saplings along the Nichitpur colony.
2. Plantation along the roads.
3. Installation of PM_{10} Analyzer to monitor the concentration of PM_{10} in ambient air.

PART – I

Any other particulars for improving the quality of the environment:

1. Mobile water sprinkling in dust prone areas.
2. Plantation in mine area, townships and office complexes.
3. Distribution of saplings among locals.
4. Firefighting of fiery coal.

Project Officer
Nichitpur Colliery

3745
2/10/21

OFFICE OF THE PROJECT OFFICER
BANSDEOPUR COLLIERY
SIJUA AREA
BHARAT COKING COAL LIMITED

Ref. No.- TL/(A) 1246/2021

Date- 29-09-2021

To,

The Member Secretary
Jharkhand State Pollution Control Board
Township Administration Building,
HEC Complex, Dhurwa
Ranchi-834004

Subject- Submission of Environmental Statement (Form V) for the year 2020-21 in respect of Tetulmari Colliery of Sijua Area (Cluster V), Bharat Coking Coal Limited Dhanbad

Dear Sir,

Please find attached herewith the duly filled Environmental Statement (Form V) for the year 2020-21 in respect of Tetulmari Colliery of Sijua Area (Cluster V) of Bharat Coking Coal Limited Dhanbad.

This is for your kind information.

Hope you will find the same in order.

Yours Faithfully

29/9/21
Project Officer
Tetulmari Colliery

Cc:

1. Regional Officer, JSPCB, H.I.G.-1, Sardar Patel Nagar, Hirapur, Dhanbad – 826001
2. HoD (Env.),Level II, Koyla Bhawan, BCCL
3. General Manager, Sijua Area
4. AM (Env.), Sijua Area
5. File

ENVIRONMENTAL STATEMENT

IN

FORM-V

(Under Rule-14, Environmental protection Rules, 1986)

(2020 – 2021)

FOR

TETULMARI COLLIERY

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED

ENVIRONMENTAL STATEMENT
FOR
TETULMARI COLLIERY

FOR THE YEAR: 2020-2021

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INTRODUCTION

1.1 GENESIS:

The Gazette Notification vide G.S.R No. 329 (E) dated 13th March, 1992 and subsequently renamed to 'Environmental Statement' vide Ministry of Environment & Forests (MOEF), Govt. of India gazette notification No. G.S.R No. 386 (E) Dtd.22nd April'93 reads as follows.

"Every person carrying on an industry, operation or process requiring consent under section 25 of the Water Act, 1974 or under section 21 of the Air Act, 1981 or both or authorization under the Hazardous Waste Rules, 1989 issued under the Environmental Protection Act, 1986 shall submit an Environmental Audit Report for the year ending 31st March in Form V to the concerned State Pollution Control Board on or before the 30th day of September every year."

In compliance with the above, the Environmental Statement for Tetulmari Colliery in Form V has been prepared.

1.2 PROJECT DESCRIPTION :

Tetulmari Colliery is taken over by BCCL from Private Mine owners after Nationalization through coal mines Nationalization Act, 1972-73. The mine is operating since prior to 1975. Currently, Tetulmari mine is operating under Sijua Area of BCCL. Tetulmari Colliery consists of both Underground and Opencast workings. The mine is located about 15 kms west of Dhanbad town and 1.5 km from Tetulmari Rly. Stn. and falls in North-Central part of Jharia Coal field.

Mines around the Tetulmari Colliery are delineated as under-

North: In-crop of I seam
South: Mudidih Colliery.
East: Nichitpur Colliery.
West: AKWMC Colliery
East & South: Sendra Bansjora Colliery.

CHAPTER - II

[FORM – V]

Environmental Statement for the financial year ending 31st March 2021

PART – A

(i) Name and address of the owner/occupier of the industry operation or process-

Md. Alamgir, Project Officer, Tetulamri Colliery, P.O. – Sijua, Dist.-Dhanbad, PIN-828121

(ii) Industry category Primary ----(STC code) Secondary-----(SIC Code)

Primary (Coal Mining)

(iii) Production capacity.----

Peak EC Capacity- 1.033 MTPA
(EC order No. J-11015/01/2011-IA.II (M) dated 30 Sept., 2020)

(iv) Year of establishment-

Pre-nationalization (Pre-1973)

(v) Date of the last environmental statement submitted-

04/09/2020

PART – B

Water and Raw Material Consumption:

(1) **Water consumption -**

Process: NIL

Cooling/ Spraying – Approx. 1850 KLD (For use in dust suppression, washing of vehicles, firefighting, etc.)

Domestic- Approx. 4150 KLD

(2) **Raw Material Consumption**

Name of raw materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial Year (2019-20)	During the Current financial Year (2020-21)
NA	COAL	NA	NA

*Industry may use codes if disclosing details of raw material would violate contractual obligations, otherwise all industries have to name the raw materials used.

PART – C

Pollution discharged to environment/unit of output (Parameter as specified in the consent Issued)

Pollutants	Quantity of pollutants discharged (mass/day)	Concentrations of pollutants in discharges (mass/volume)	Percentage of variation from prescribed standards with reasons
Water	Analysis report attached as annexure	Water Analysis Report for Cluster V attached in which Tetulmari Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.
Air	Analysis report attached as annexure	Air Analysis Report for Cluster V attached in which Tetulmari Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.

PART – D

Hazardous Wastes

(As specified under Hazardous Waste Management and Handling Rules, 1989)

Hazardous Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process	• 2.77 KL Burnt Oil	• 7.48 KL Burnt Oil
From Pollution Control Facilities	NIL	NIL

PART – E

Solid Wastes

Solid Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process (Over Burden)	1762126 Cub. M	7-22 924 Cub. M
From Pollution Control Facilities	NA	NA
Quantity recycled or re-utilized within the unit	NA(Over Burden used in Backfilling)	NA(Over Burden used in Backfilling)

PART – F

Please specify the characterizations (in terms of concentration and quantum) of hazardous as well as solid wastes and indicate disposal practice adopted for both these categories of wastes.

1. Hazardous Waste (Burnt Oil)-

   Re-use.

2. Over Burden (Overlying rock)

   Utilized in backfilling of quarries.

PART – G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production

1. Protection of ambient environment-Reduction in particulate matter concentration in ambient air, maintenance of surface and ground water quality, control of noise pollution, restoration of ecology, etc.
2. No major impact on cost of production.

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution:

1. Plantation of 1000 saplings at Tapovan Bio-Diversity Park and Green-Hill Eco-restoration Park as gap filling.
2. Plantation 560 Gabion Plantation along the roads.
3. Installation of PM_{10} Analyzer to monitor the concentration of PM_{10} in ambient air.

PART – I

Any other particulars for Improving the quality of the environment:

1. Mobile water sprinkling in dust prone areas.
2. Plantation in mine area, townships and office complexes.
3. Distribution of saplings among locals.
4. Firefighting of fiery coal.

29/9/21
Project Officer
Tetulmari Colliery

3741
7/10/21

OFFICE OF THE PROJECT OFFICER
KANKANEE COLLIERY
SIJUA AREA
BHARAT COKING COAL LIMITED

Ref. No.- KN/PO/2021/496 Date- 30/09/2021

To,

The Member Secretary
Jharkhand State Pollution Control Board
Township Administration Building,
HEC Complex, Dhurwa
Ranchi-834004

Subject- Submission of Environmental Statement (Form V) for the year 2020-21 in respect of Kankanee Colliery of Sijua Area (Cluster V), Bharat Coking Coal Limited Dhanbad

Dear Sir,

Please find attached herewith the duly filled Environmental Statement (Form V) for the year 2020-21 in respect of Kankanee Colliery of Sijua Area (Cluster V) of Bharat Coking Coal Limited Dhanbad.

This is for your kind information.

Hope you will find the same in order.

Yours faithfully

30.9.21

Project Officer
Kankanee Colliery

Cc:

1. Regional Officer, JSPCB, H.I.G.-1, Sardar Patel Nagar, Hirapur, Dhanbad – 826001
2. HoD (Env.),Level II, Koyla Bhawan, BCCL
3. General Manager, Sijua Area
4. AM (Env.), Sijua Area
5. File

3665
30/9/21

BHARAT COKING COAL LIMITED
(A MINI RATNA COMPANY)
OFFICE OF THE PROJECT OFFICER
MUDIDIH COLLIERY
SIJUA AREA
DHANBAD-828121

Ref. No.- MDC/PO/21/245

Date- 29.09.21

To,

The Member Secretary
Jharkhand State Pollution Control Board
Township Administration Building,
HEC Complex, Dhurwa
Ranchi-834004

Subject- Submission of Environmental Statement (Form V) for the year 2020-21 in respect of Mudidih Colliery ofSijua Area (Cluster V), Bharat Coking Coal Limited Dhanbad

Dear Sir,

Please find attached herewith the duly filled Environmental Statement (Form V) for the year 2020-21 in respect of Mudidih Colliery of Sijua Area (Cluster V) of Bharat Coking Coal Limited Dhanbad.

This is for your kind information.

Hope you will find the same in order.

Yours Faithfully

29/9/21

Project Officer
Mudidih Colliery

Cc:

1. Regional Officer,JSPCB, H.I.G.-1, Sardar Patel Nagar, Hirapur, Dhanbad – 826001
2. HoD (Env.),Level II, KoylaBhawan, BCCL
3. General Manager, Sijua Area
4. AM (Env.), Sijua Area
5. File

ENVIRONMENTAL STATEMENT

IN

FORM-V

(Under Rule-14, Environmental protection Rules, 1986)

(2020 – 2021)

FOR

MUDIDIH COLLIERY

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED

ENVIRONMENTAL STATEMENT
FOR
MUDIDIH COLLIERY

FOR THE YEAR: 2020-2021

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PLATES

CHAPTER – I

INTRODUCTION

1.1 GENESIS:

The Gazette Notification vide G.S.R No. 329 (E) dated 13th March, 1992 and subsequently renamed to 'Environmental Statement' vide Ministry of Environment & Forests (MOEF), Govt. of India gazette notification No. G.S.R No. 386 (E) Dtd.22nd April'93 reads as follows.

"Every person carrying on an industry, operation or process requiring consent under section 25 of the Water Act, 1974 or under section 21 of the Air Act, 1981 or both or authorization under the Hazardous Waste Rules, 1989 issued under the Environmental Protection Act, 1986 shall submit an Environmental Audit Report for the year ending 31st March in Form V to the concerned State Pollution Control Board on or before the 30th day of September every year."

In compliance with the above, the Environmental Statement for Mudidih Colliery in Form V has been prepared.

1.2 PROJECT DESCRIPTION :

Mudidih Colliery is located under the leasehold of Sijua Area (Cluster-V) of Bharat Coking Coal Limited. As per the EC granted to Cluster V, it is a mixed mine. There is no operation in open-cast at present but there is proposal of future opencast operation. It covers a leasehold area of 378.05 Ha. It is located on North Central part of the Jharia Coal-field. After Nationalization of Coal mines, Mudidih Colliery has been formulated by amalgamation of 3 small units. The open cast project by hiring HEMM was started in mid of 2009 and finished in 2014-15 but there is proposal of future opencast operation. The mine is producing coal from IV Bottom through underground operation

CHAPTER - II

[FORM – V]

Environmental Statement for the financial year ending 31st March 2021

PART – A

(i) Name and address of the owner/occupier of the industry operation or process-

Shri Sahadeb Maji, Project Officer, Mudidih Colliery, P.O. – Sijua, Dist.-Dhanbad, PIN-828121

(ii) Industry category Primary ----(STC code) Secondary-----(SIC Code)

Primary (Coal Mining)

(iii) Production capacity.----
Normattive – 1.553 MTPA
Peak EC Capacity- 2.019 MTPA
(EC order No. J-11015/01/2011-IA.II (M) dated 30 Sept., 2020)

(iv) Year of establishment-

Pre-nationalization (Pre-1973)

(v) Date of the last environmental statement submitted-

23/09/2020

PART – B

Water and Raw Material Consumption:

(1) Water consumption -

Process: NIL

Cooling/ Spraying – Approx. 5.84 LCUM/Year (For use in dust suppression, washing of vehicles, firefighting, etc.)

Domestic- Approx. 21.71 LCUM/Year

(2) Raw Material Consumption

Name of raw materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial Year (2019-20)	During the Current financial Year (2020-21)
NA	COAL	NA	NA

*Industry may use codes if disclosing details of raw material would violate contractual obligations, otherwise all industries have to name the raw materials used.

PART – C

Pollution discharged to environment/unit of output (Parameter as specified in the consent Issued)

Pollutants	Quantity of pollutants discharged (mass/day)	Concentrations of pollutants in discharges (mass/volume)	Percentage of variation from prescribed standards with reasons
Water	Analysis report attached as annexure	Water Analysis Report for Cluster V attached in which Mudidih Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.
Air	Analysis report attached as annexure	Air Analysis Report for Cluster V attached in which Mudidih Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.

PART – D

Hazardous Wastes

(As specified under Hazardous Waste Management and Handling Rules, 1989)

Hazardous Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process	• 2.32 KL Burnt Oil	NIL
From Pollution Control Facilities	NIL	NIL

PART – E
Solid Wastes

Solid Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process (Over Burden)	NA	NIL
From Pollution Control Facilities	NA	NA
Quantity recycled or re-utilized within the unit	NA(Over Burden used in Backfilling)	NA(Over Burden used in Backfilling)

PART – F

Please specify the characterizations (in terms of concentration and quantum) of hazardous as well as solid wastes and indicate disposal practice adopted for both these categories of wastes.

1. Hazardous Waste (Burnt Oil)-

   Re-use and auction to authorized recyclers.

PART – G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production

1. Protection of ambient environment-Reduction in particulate matter concentration in ambient air, maintenance of surface and ground water quality, control of noise pollution, restoration of ecology, etc.
2. No major impact on cost of production.

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution:

1. Greening of dormant OB dump through grasses, shrubs and bushes over total area of 20 Ha in Bhadrichak taken up in 2019-20.

PART – I

Any other particulars for improving the quality of the environment:

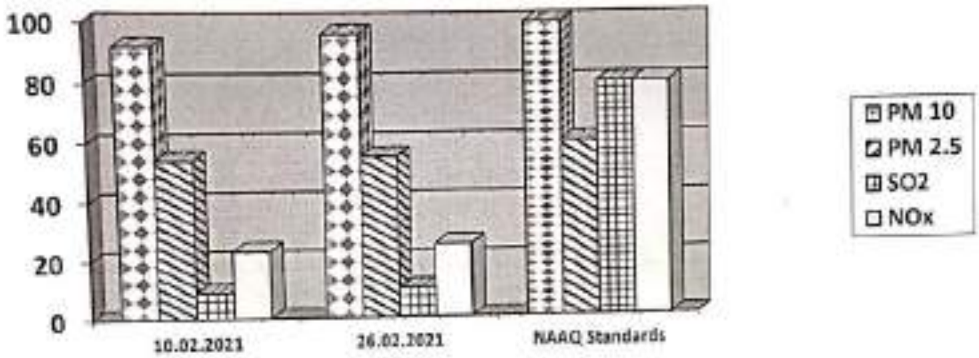
1. Mobile water sprinkling in dust prone areas.
2. Plantation in mine area, townships and office complexes.
3. Distribution of saplings among locals.
4. Firefighting of fiery coal.

Project Officer
Mudidih Colliery

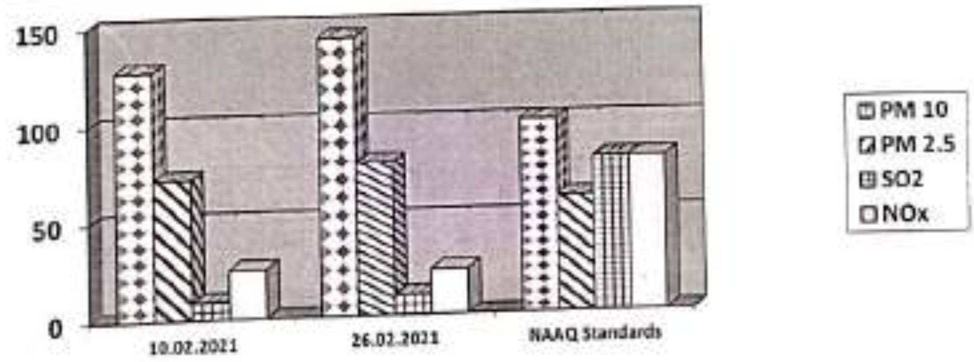
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited Month: **FEB 2021** Year: **2020-21.**

Station Name: A8, Nichitpur		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	10.02.2021	92	54	9	23
2	26.02.2021	96	55	10	25
	NAAQ Standard	100	60	80	80



Station Name: A9, Basseriya Managers office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	10.02.2021	128	72	9	25
2	26.02.2021	144	79	10	23
	NAAQ Standard	100	60	80	80

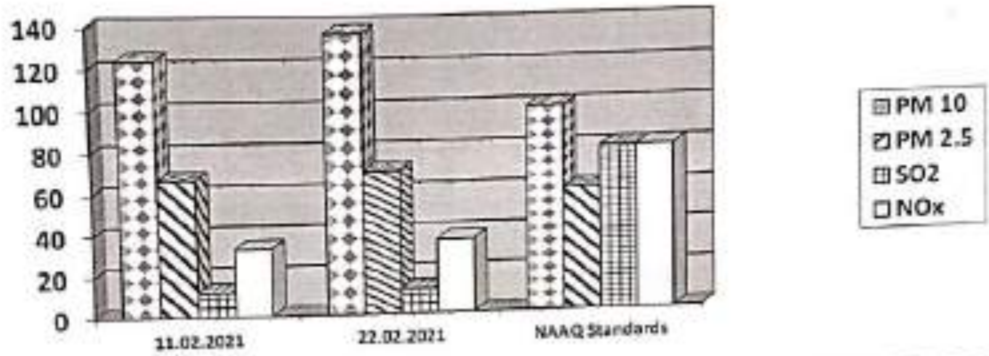


Analysed By
JSA/SA/SSA

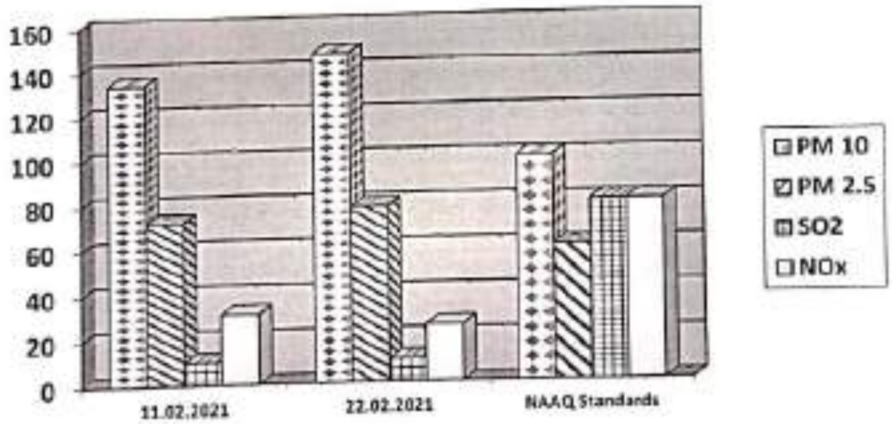
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

Station Name: A16 Pootki Balihari office		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	11.02.2021	124	67	12	33
2	22.02.2021	136	70	12	36
	NAAQ Standards	100	60	80	80



Station Name: A17 – Moonidih UGP		Zone: Buffer		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	11.02.2021	134	72	10	31
2	22.02.2021	147	78	10	25
	NAAQ Standards	100	60	80	80



- *All values are expressed in microgram per cubic meter.*
- *24 hours duration*

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II)**

i) Mine Discharge of Mudidih (MW5)

A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Jarian Nala and Ekra Nala.

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analysed 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 parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -V**		Month: **FEB. 2021**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	MW5 First Fortnight 09.02.2021	MW5 Second Fortnight 16.02.2021	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	36	32	*100 (Max)*
2	pH	8.06	7.91	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	16	16	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

NOISE LEVEL QUALITY MONITORING

4.1Location of sampling sites

i) **Nichitpur (N8)**
ii) **Basseriya Manager's office(N9)**
iii) **Pootki Balihari Office(N16)**
iv) **Moonidih UGP (N17)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of 'L_{EQ}' were taken using Integrated Data Logging Sound Level Meter (NL-52 OF RION CO. Ltd. Make) during day time. Noise levels were measured for about one hour time in day time. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

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

NOISE LEVEL DATA

Name of the Project: Cluster -V			Month: FEB. 2021		
Sl. No.	**Station Name/Code**	**Category of area**	**Date**	**Noise level dB(A)LEQ**	***Permissible Limit of Noise level in dB(A)***
1	Nichitpur(N8)	Industrial area	10.02.2021	57.3	75
2	Nichitpur	Industrial area	26.02.2021	56.9	75
3	Basseriya (N9) Managers Office	Industrial area	10.02.2021	62.2	75
4	Basseriya Managers Office	Industrial area	26.02.2021	63.4	75
5	Pootki Balihari Office(N16)	Industrial area	11.02.2021	58.2	75
6	Pootki Balihari Office	Industrial area	22.02.2021	58.6	75
7	Moonidih UGP(N17)	Industrial area	11.02.2021	56.5	75
8	Moonidih UGP	Industrial area	22.02.2021	57.7	75

**Permissible limits of Noise Level as per MOEF Gazette Notification No. GSR 742(E) dt. 25.09.2000 Standards for Coal Mines and Noise Pollution (Regulation and Control) Rules, 2000.*
* Day Time: 6.00 AM to 10.00 PM,

Analysed By

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

Approved By
HOD(In-charge) Environment
RI-2, CMPDI, Dhanbad

भारत कोकिंग कोल लिमिटेड

BHARAT COKING COAL LIMITED

(A MINI RATANA COMPANY)

Bansdeopur Colliery

Sijua Area

Ref. No.- BSP/PO/2021/821 Date- 18.9.21

To,

The Member Secretary
Jharkhand State Pollution Control Board
Township Administration Building,
HEC Complex, Dhurwa
Ranchi-834004

Subject- Submission of Environmental Statement (Form V) for the year 2020-21 in **respect of Bansdeopur Colliery of Sijua Area (Cluster V), Bharat Coking Coal Limited Dhanbad**

Dear Sir,

Please find attached herewith the duly filled Environmental Statement (Form V) for the year 2020-21 in respect of Bansdeopur Colliery of Sijua Area (Cluster V) of Bharat Coking Coal Limited Dhanbad.

This is for your kind information.

Hope you will find the same in order.

Yours Faithfully

Project Officer
Bansdeopur Colliery

Cc:

1. Regional Officer,JSPCB, H.I.G.-1, Sardar Patel Nagar, Hirapur, Dhanbad – 826001
2. HoD (Env.),Level I' KoylaBhawan, BCCL
3. General Manager, Sijua Area
4. AM (Env.), Sijua Area
5. File

Attachment → Attached Air & water quality report sent by ... through Whatsapp.

ENVIRONMENTAL STATEMENT

IN

FORM-V

(Under Rule-14, Environmental protection Rules, 1986)

(2020 – 2021)

FOR

BANSDEOPUR COLLIERY

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED

ENVIRONMENTAL STATEMENT

FOR

BANSDEOPUR COLLIERY

FOR THE YEAR: 2020-2021

CONTENT

LIST OF ANNEXURES

PLATES

CHAPTER – I

INTRODUCTION

1.1 **GENESIS:**

The Gazette Notification vide G.S.R No. 329 (E) dated 13th March, 1992 and subsequently renamed to 'Environmental Statement' vide Ministry of Environment & Forests (MOEF), Govt. of India gazette notification No. G.S.R No. 386 (E) Dtd.22nd April'93 reads as follows.

"Every person carrying on an industry, operation or process requiring consent under section 25 of the Water Act, 1974 or under section 21 of the Air Act, 1981 or both or authorization under the Hazardous Waste Rules, 1989 issued under the Environmental Protection Act, 1986 shall submit an Environmental Audit Report for the year ending 31st March in Form V to the concerned State Pollution Control Board on or before the 30th day of September every year."

In compliance with the above, the Environmental Statement for Bansdeopur Colliery in Form V has been prepared.

1.2 **PROJECT DESCRIPTION :**

Bansdeopur Colliery is located in the North Western part of Jharia Coal Field and falls in Dhanbad District of Jharkhand. It is about 10 km West of Dhanbad Railway station. The latitudinal and longitudinal extent of the mine is 23^0 46' 30" to 23^0 47' 15" North and 86^0 21'45" to 86^0 22'45" East respectively. The mine is bounded as-

North: Sendra Bansjora & Bassuriya
South: Gopalichuk Colliery.
East: Kenduadih Colliery.
West: Loyabad Colliery.

Bansdeopur colliery has a lease hold area of 104.72 Ha.

CHAPTER - II

[FORM – V]

Environmental Statement for the financial year ending 31st March 2021

PART – A

(i) Name and address of the owner/occupier of the industry operation or process-

Shri Bsihnu Kant Jha, Project Officer, Bansdeopur Colliery, P.O. – Bansjora, Dist.-Dhanbad, PIN-828101

(ii) Industry category Primary ----(STC code) Secondary-----(SIC Code)

Primary (Coal Mining)

(iii) Production capacity.----

Peak EC Capacity- 0.879 MTPA
(EC order No. J-11015/01/2011-IA.II (M) dated 30 Sept., 2020)

(iv) Year of establishment-

Pre-nationalization (Pre-1973)

(v) Date of the last environmental statement submitted-

03/09/2020

PART – B

Water and Raw Material Consumption:

(1) Water consumption -

Process: NIL

Cooling/ Spraying – Approx. 37 KLD (For use in dust suppression, washing of vehicles, firefighting, etc.)

Domestic- Approx. 256 KLD

(2) **Raw Material Consumption**

Name of raw materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial Year (2019-20)	During the Current financial Year (2020-21)
NA	**COAL**	**NA**	**NA**

*Industry may use codes if disclosing details of raw material would violate contractual obligations, otherwise all industries have to name the raw materials used.

PART – C

Pollution discharged to environment/unit of output (Parameter as specified in the consent issued)

Pollutants	Quantity of pollutants discharged (mass/day)	Concentrations of pollutants in discharges (mass/volume)	Percentage of variation from prescribed standards with reasons
Water	Analysis report attached as annexure	Water Analysis Report for Cluster V attached in which Bansdeopur Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.
Air	Analysis report attached as annexure	Air Analysis Report for Cluster V attached in which Bansdeopur Colliery is located.	The analysis results reveal that most of the parameters are below permissible limits.

PART – D

Hazardous Wastes

(As specified under Hazardous Waste Management and Handling Rules, 1989)

Hazardous Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process	• 0.63 KL Burnt Oil	• 2.1 KL Burnt Oil
From Pollution Control Facilities	NIL	NIL

PART – E

Solid Wastes

Solid Wastes	Total Quantity (Kg)	
	During the previous Financial Year (2019-20)	During the current Financial Year (2020-21)
From Process (Over Burden)	636508 Cub. M	__ Cub. M
From Pollution Control Facilities	NA	NA
Quantity recycled or re-utilized within the unit	NA(Over Burden used in Backfilling)	NA(Over Burden used in Backfilling)

PART – F

Please specify the characterizations (in terms of concentration and quantum) of hazardous as well as solid wastes and indicate disposal practice adopted for both these categories of wastes.

1. Hazardous Waste (Burnt Oil)-

   Re-use.

2. Over Burden (Overlying rock)

   Utilized in backfilling of quarries.

PART – G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production

1. Protection of ambient environment-Reduction in particulate matter concentration in ambient air, maintenance of surface and ground water quality, control of noise pollution, restoration of ecology, etc.
2. No major impact on cost of production.

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution:

1. Plantation of 18,000 saplings along the banks of Ekra Jore.
2. Plantation along the roads.
3. Installation of PM_{10} Analyzer to monitor the concentration of PM_{10} in ambient air.

PART – I

Any other particulars for improving the quality of the environment:

1. Mobile water sprinkling in dust prone areas.
2. Plantation in mine area, townships and office complexes.
3. Distribution of saplings among locals.
4. Firefighting of fiery coal.

18.9.21

Project Officer
Bansdeopur Colliery

ANNEXURE 30:

Name of Unit	No. of Mobile water and mist sprinklers	Capacity
Tetulmari	2	1 water sprinkler of 28 KL and 1 mist sprinkler of 28 KL
Nichitpur	2	1 water sprinkler of 12 KL and 1 mist sprinkler of 28 KL
Sendra Bansjora	3	2 units of 15 KL and 1 unit of 20 KL
Kankanee	2	1 unit of 12 KL and 1 unit of 20 KL
Bansdeopur	1	1 unit of 18 KL

ANNEXURE 31: MINE WATER UTILIZATION REPORT

REPORT
ON
VALIDATION OF COAL JAL APP DATA FOR DIFFERENT AREA/MINES OF BCCL

SUBMITTED BY

CENTRE OF MINING ENVIRONMENT
DEPARTMENT OF ENVIRONMENTAL SCIENCE AND ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY (ISM), DHANBAD
JHARKHAND-826004
OCT 2018

TABLE 5 MINE WATER UTILIZATION DATA FOR SIJUA AREA

Bharat Coking Coal Limited												
Mine Water Utilization Data for Mobile App (Quantity in Lakh m^3/year)												
Area	Name of Project	Mine Discharge	Mine Water utilization for Mine/Project				Balance Mine Water Supply to nearby Areas (Existing)					
			Quantity for Industrial use	Quantity for Drinking/domestic use	Total Quantity for own use	Nos. of Beneficiaries (Persons)	Quantity for Domestic / Drinking Use	Quantity for Agriculture/Irrigation	Quantity for Recharge	Total Quantity	Nos. of Beneficiaries (Persons)	Name & no. of Beneficiaries
Sijua Area	Nichitpur Colliery	35.59	6.75	16.24	22.99	6000	8.21	0.00	0.00	8.21	1500	Bhadri Chowk, Tetulmaari Basti, 20/12 Basti, Ino. Siding, Shyam Bazar, Jogta Basti, Gareria
	Mudidih Colliery	33.22	5.84	8.21	14.05	5000	13.50	0.00	0.00	13.50	2000	
	Tetulmaari colliery	25.55	6.75	10.04	16.79	0	5.11	0.00	0.00	5.11	0	
	Kankanee	10.40	2.92	5.48	8.40	3000	0.73	0.00	0.00	0.73	0	
	Sendra Bansjora	13.03	3.10	6.20	9.30	3000	1.64	0.00	0.00	1.64	0	
	Loyabad	9.50	0.91	5.48	6.39	3000	1.83	0.00	0.00	1.83	0	
Total		127.29	26.27	51.65	77.92	20000	31.02	0.00	0.00	31.02	3500	

Annexure 32

The status of implementation of 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" for Cluster V:

S. No.	Condition	Implementation Status
2 (a)	The project authority shall adopt best mining practice for the given mining conditions. In the mining area, adequate no. of check dams, retaining wall/ structures, garland drains and settling ponds should be provided to arrest the wash-off with rain water in catchment area.	Check dam has been constructed along Jores in cluster V. Toe wall and garland drain have been constructed along the OB dumps in Bansdeopur, Tetulmari and Loyabad. Construction of more toe-walls and garland drains with settling ponds has been proposed at Coal dumps and other OB dumps in Cluster V. Also, active and inactive OB dumps including their slopes are being greened through grassing and plantation of bamboo, shrubs & bushes to prevent erosion of loose materials.
2 (b)	The natural water bodies and/ or streams which are flowing in and around the village should not be disturbed. The water table should be nurtured so as not to go down below the pre-mining period. In case of any water scarcity in the area, the project authorities have to provide water to the villagers for their use. A provision for regular monitoring of water table in open dug well located in village should be incorporated to ascertain the impact of mining over ground water table.	Streams/Nalas, which are seasonal, flowing within/along the lease, are being protected to the extent feasible through check dams, stone-pitching, embankments, and regular cleaning/de-siltation to keep the natural flow in the monsoon. The water table level is monitored in Cluster V. The mines of cluster V are old mines located in Jharia Coalfields. No significant decline trend has been noticed in last 10 years. The ground water monitoring report is attached. Water is being supplied to nearby villages for domestic uses. (Mine water Utilization report is attached) Regular monitoring of ground water is being done in Cluster V through existing wells. To collect the representative groundwater level in the JCF area and its buffer zone, CMPDI has established a monitoring network of 210 hydrograph stations (Dug wells). 4 dug wells (Well Nos. A-3, A-16, A-27 & D-23) are located in and around Cluster V area.

2 (c)	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 levels 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.	The floodlights/ masks in the mines are oriented away from the villages. Noise level is monitored in Cluster V on fortnightly basis. **(Latest Noise level Monitoring Report is attached.)**
2 (d)	The project authority shall make necessary alternative arrangements, where required, in consultation with the state government to provide alternate areas for livestock grazing. In this context, project authority should implement the directions of the Hon'ble Supreme Court with regard in acquiring grazing land. The sparse trees on such grazing ground which provide mid-day shelter from the scorching sun should be scrupulously guarded against felling lest the cattle abandon the grazing ground or return home by noon.	Grassing is being undertaken in Cluster V on inactive and active OB dumps as well as other open spaces which provide grazing area for the livestock. Necessary alternative arrangements, if required in future, will be made in consultation with the state government to provide alternate areas for livestock grazing.
2(e)	Wherever blasting is undertaken as part of mining activity, the project authority shall carry out vibration studies well before such habitats or other buildings to evaluate the zone of influence and impact of blasting on the neighbourhood. Within 500 m of such sites vulnerable to blasting vibrations, avoidance of use of explosives and adoption of alternative means of mineral extraction such as ripper/dozer combination/ rock breakers/surface miners, etc. should be seriously considered and practised wherever practicable. A provision for monitoring of each blast should be made so that the impact of blasting on nearby habitation and dwelling units could be ascertained. The covenant of lease deed under Rule 31 of MCR 1960 provides that no mining operations shall be carried out within 50 m of public works such as public roads and buildings or inhabited sites	Vibration study is conducted for blasting activities to evaluate the impact of blasting on neighbourhood. The adoption of ripper is being considered in Cluster V. Controlled blasting is being practiced and monitored to avoid impact of blasting on nearby habitation.

	except with the prior permission from the competent authority.	
2 (f)	Main haulage road in the mine should be provided with permanent water sprinklers and other roads should be regularly wetted with water tankers fitted with sprinklers. Crusher and material transfer points should invariably be provided with Bag Filters and/or dry fogging system. Belt conveyors should be fully covered to avoid air borne dust.	Due to smaller nature of mines in Cluster V, the haul roads are rapidly shifting in nature. Haulage roads and other roads are regularly wetted with mobile water tankers fitted with sprinklers and mobile mist sprinklers. Sprinkling arrangements have been made at the crushers. The crusher units area covered to prevent air borne dust emission.
2 (g)	The project authority shall ensure that the productivity of agricultural crops is not affected due to mining operations. Crop Liability Insurance Policy has to be taken by the PP as a precaution to compensate for any crop loss. The impact zone shall be 5 km from the boundary of mine lease area for such insurance policy. In case, several mines are located in a cluster, the associations of owners of the cluster mines, formed inter-alia, to sub-serve such an objective, shall take responsibility for securing such crop liability policy.	The condition will be complied.
2 (h)	In case any village is located within the mining leasehold which is not likely to be affected due to mining activities during the life of mine, the EAC should consider the proposal of EC for reduced mining area, The mining lease may be executed for the area for which EC is accorded. The mining plan may also be accordingly revised and required stipulations under the MMDR Act, 1957 and MCR, 1960 met.	In case of such scenario, the proposal will be made to the EAC for grant of EC for the reduced mining area. The mining plan will also be accordingly revised in such case.
2 (i)	Transportation of the minerals by road passing through the village shall not be allowed. A bypass road should be constructed (say, leaving a gap of at least 200 m) for the purpose of transportation of the minerals so that the impact of sound, dust and accidents could be mitigated. The PP shall bear the cost towards the widening and strengthening of existing public road network in case the same is proposed to be used for the project. No road movement should be allowed on existing	Transportation of coal in Cluster V is mostly internal. Where ever, the existing road is being used, it is being strengthened.

	village road network without appropriately increasing the carrying capacity of such roads.	
2 (j)	Likewise, alteration for re-routing of footpaths, pagdandies, cart roads and village infrastructure/public utilities or roads (for purposes of land acquisition for mining) shall be avoided to the extent possible and in case such acquisition is inevitable, alternative arrangements shall be made first and then only the area acquired. In these types of cases, inspection reports by site visit by experts may be insisted upon which should be done through reputed institutes.	Will be complied in cases of any future land acquisition for mining.
2 (k)	As CSR activities by companies including the mining establishments has become mandatory up to 2% of their financial turnover, socio-economic development of the neighbourhood habitats could also be planned and executed by the PPs more systematically based on the " Need based door to door survey" by established social institutes/workers on the lines as required under ToR. R&R plan/compensation details for the PAP should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family wise, should be undertaken to assess their requirements and action programmes prepared and submitted accordingly integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village located in the mine lease area will be shifted or not. The issues relating to shifting of village including their R &R and socio-economic aspects should be discussed in the EIA report.	CSR Action Plan of BCCL has been prepared. An impact assessment study of CSR works and evaluation of Project "Swablamban"-Reeling & spinning training project under CSR have been done by National CSR Hub, Tata Institute of Social Sciences, Mumbai. Rehabilitation of affected families in fire & subsidence affected sites is being done as per the Govt. of India approved Jharia Master plan. 60 families have been rehabilitated at New Pandedih Bastee as per BCCL R&R policy. The issues relating to shifting of village including their R &R and socio-economic aspects has been discussed in the EIA report of Cluster V.

NOISE LEVEL QUALITY MONITORING

4.1Location of sampling sites

- i) **Nichitpur (N8)**
- ii) **Basseriya Manager's office(N9)**
- iii) **Pootki Balihari Office(N16)**
- iv) **Moonidih UGP (N17)**

4.2 Methodology of sampling and analysis

Noise level measurements in form of 'L_{EQ}' were taken using Integrated Data Logging Sound Level Meter (NL-52 OF RION CO. Ltd. Make) during day time. Noise levels were measured for about one hour time in day time. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

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

NOISE LEVEL DATA

Name of the Project: **Cluster -V**			Month: **AUG 2021**		
Sl. No.	**Station Name/Code**	**Category of area**	**Date**	**Noise level dB(A)LEQ**	***Permissible Limit of Noise level in dB(A)***
1	Nichitpur(N8)	Industrial area	10.08.2021	59.3	75
2	Nichitpur	Industrial area	31.08.2021	60.2	75
3	Basseriya (N9) Managers Office	Industrial area	10.08.2021	60.9	75
4	Basseriya Managers Office	Industrial area	31.08.2021	61.6	75
5	Pootki Balihari Office(N16)	Industrial area	06.08.2021	64.5	75
6	Pootki Balihari Office	Industrial area	19.08.2021	58.7	75
7	Moonidih UGP(N17)	Industrial area	06.08.2021	63.1	75
8	Moonidih UGP	Industrial area	19.08.2021	57.1	75

****Permissible limits of Noise Level as per MOEF Gazette Notification No. GSR 742(E) dt. 25.09.2000 Standards for Coal Mines and Noise Pollution (Regulation and Control) Rules, 2000.***

*** Day Time: 6.00 AM to 10.00 PM,**

Analysed By — Checked By, Lab In Charge, RI-2, CMPDI, Dhanbad — Approved By, HOD(In-charge) Environment, RI-2, CMPDI, Dhanbad

Annexure 33- Copies of Newspaper Advertisements

हिन्दुस्तान

Hindustan Media Ventures Ltd.
Mada Building,
Luby Circular Road
Dhanbad
Phone: 2221136
Fax: 2312619

GM (Envt.) Envt. Deptt. Koyla Bhawan B.C.C.L.
SL No. 417
Date 7/9/13

Receipt of Newspaper against the Tender/Court Notices/Corrigendum of BCCL published in Hindustan

Dear Sir,

Following are the details of your Tender/Court Notices/Corrigendum of BCCL published in Hindustan:

Advertisers Name: Head of Dept. (Environment) Koyla Bhawan.
Tender/Court Notices/Corrigendum No.: Environmental Clearance.
Date of Publication: 07.09.2013.

Signature: Receivers Name and Designation with Stamp

You are requested to please provide the receipt of the same to our representatives/couriers as Public Relations Department, BCCL has advised us to have the receivers Name and Designation with stamp.

Thanking you,

Sincerely Yours,

For Hindustan Media Ventures Ltd.,

Ad-Accounts Department
Hindustan Media Ventures Ltd
Luby Circular Road
Mada Campus, Dhanbad

आम बजट से जनता को राहत नहीं मिली है। बेरोजगार युवकों को रोजगार का अवसर नहीं मिलने से सभी को निराश किया [illegible] चुनाव में कांग्रेस [illegible]
[illegible], संयुक्त महामंत्री जनसं।

बजट कहीं से संतोषप्रद नहीं है। निराशाजनक बजट है। आम जनता पर बोझ बढ़ेगा। उद्योग [illegible] ध्यान नहीं दिया गया है। [illegible], केंद्रीय उपाध्यक्ष सीटू

आम बजट में बेरोजगारों के लिए कुछ नहीं किया गया। आम लोगों पर बोझ लादा गया
[illegible] पासवान, भाकपा

कांग्रेस ने जनता को निराश किया है। जनता इस बार आम बजट का जवाब बैलेट से देगी।
मुन्नीलाल राम, झाविमो

आम बजट जनविरोधी और महंगाई बढ़ाने वाला है। आंकड़ों के जाल में यूपीए ने फंसा कर जनता [illegible] है।
[illegible] अग्रवाल, भाजपा नेता

आम बजट से जनता को उतनी राहत नहीं मिलेगी जितना होने वाले चुनाव को रखकर जनता ने [illegible]
[illegible], निदेशक आइएसएम

बजट संतुलित है। लेकिन आम जनता को ध्यान में नहीं रखा गया है। जनता को निराशा हाथ लगी है।
अनूप साव, पार्षद

आम बजट का बोझ जनता के सिर पर पड़ा है। जनता को कोई राहत नहीं मिली है।
हरीश जोशी, अधिवक्ता

बजट से महंगाई बढ़ेगी। [illegible]
[illegible], व्यवसायी

[illegible]

भारत कोकिंग कोल लिमिटेड
(कोल इण्डिया लिमिटेड का एक अंग)

सभी संबंधित व्यक्तियों को यह सूचित किया जाता है कि निम्नलिखित 09 (नौ) भारत कोकिंग कोल लिमिटेड का समूह (Cluster) जिसमें 63 खानें एवं 02 वाशरीज सम्मिलित हैं, को पर्यावरण एवं वन मंत्रालय के द्वारा पर्यावरण स्वीकृति (Environmental Clearance) प्रदान किया जा चुका है।

क्र. सं.	समूह (Cluster) का नाम	स्वीकृति आदेश संख्या एवं तिथि
1.	समूह (Cluster) I : मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, [illegible], जिला- धनबाद, झारखंड [illegible] समूह की 8 खानें [illegible] (872 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 0.9 एम टी पी ए सामान्य एवं 1.17 एम टी पी ए (उच्च))	जे-11015/93/2009-आइ.ए. II (एम) दिनांक : 6 फरवरी 2013
2.	समूह (Cluster) II : मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 2025.71 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में (20.215 एम टी पी ए की उच्च उत्पादन के साथ 13.33 एम टी पी ए [illegible] की 8 खानें)	जे-11015/35/2011-आइ.ए. II (एम) दिनांक : 6 फरवरी 2013
3.	समूह (Cluster) III : मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 1420.41 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 3.6 एम टी पी ए की उच्च उत्पादन की 7 खानें (04.11.2010 को प्रदान की गई टी ओ आर पर आधारित है)	जे-11015/213/2010-आइ.ए. II (एम) दिनांक : 6 फरवरी 2013
4.	समूह (Cluster) IV : [illegible] को छोड़कर मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 1125.79 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 2.831 एम टी पी ए (सामान्य) 3.706 एम टी पी ए (उच्च) की उत्पादन क्षमता के साथ 6 खानें।	जे-11015/212/2010-आइ.ए. II (एम) दिनांक : 6 फरवरी 2013
5.	समूह (Cluster) V : मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 1457.60 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 4.854 (सामान्य) 6.311 (उच्च) एम टी पी ए के उत्पादन की 7 खानें (14.03.2011 को प्रदान की गई टी ओ आर पर आधारित है)	जे-11015/01/2011-आइ.ए. II (एम) दिनांक : 11 फरवरी 2013
6.	समूह (Cluster) VII : मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की 3127.7 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 8.16 एम टी पी ए की उच्च उत्पादन के साथ 9.327 एम टी पी ए की सम्मिलित क्षमता (09.12.2010 को प्रदान की गई टी ओ आर पर आधारित है) ([illegible] को छोड़कर)	जे-11015/238/2010-आइ.ए. II (एम) दिनांक : 6 फरवरी 2013
7.	समूह (Cluster) X : मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड की (2057.95 हेक्टेयर की एक सम्मिलित एम एल क्षेत्र में 1.763 एम टी पी ए की सामान्य एवं 2.289 एम टी पी ए की उच्च उत्पादन की 6 खानें) एवं 16 हेक्टेयर के एक क्षेत्र के लिए 1.6 एम टी पी ए सामान्य तथा 2.00 एम टी पी ए उच्च उत्पादन की [illegible] ([illegible]) (09.02.2011 को प्रदान की गई टी ओ आर पर आधारित है)	जे-11015/380/2010-आइ.ए. II (एम) दिनांक : 6 फरवरी 2013
8.	समूह (Cluster) XVI : मेसर्स भारत कोकिंग कोल लिमिटेड, जिला- धनबाद, झारखंड में कोयला खानें ([illegible]) (1964.21 हेक्टेयर के एक सम्मिलित एम एल क्षेत्र में 1.51 एम टी पी ए सामान्य तथा 1.963 एम टी पी ए उच्च) तथा 12 हेक्टेयर के क्षेत्र में 1.6 एम टी पी ए की [illegible] (28.03.2010 को प्रदान की गई टी ओ आर पर आधारित है)	जे-11015/185/2010-आइ.ए. II (एम) दिनांक : 6 फरवरी 2013
9.	समूह (Cluster) VIII : मेसर्स भारत कोकिंग कोल लिमिटेड, झरिया कोलफिल्ड्स में स्थित, जिला- धनबाद, झारखंड के 10 खानों का समूह (1183.92 हेक्टेयर के एक सम्मिलित एम एल क्षेत्र में 3.403 एम टी पी ए की तथा उत्पादन के साथ 4.21 एम टी पी ए की सम्मिलित क्षमता (12.0041 हेक्टेयर - [illegible] हेक्टेयर - 1183.92 हेक्टेयर)	जे-11015/298/2010-आइ.ए. II (एम) दिनांक : 15 फरवरी 2013

स्वीकृति पत्र की प्रतिलिपि झारखंड राज्य प्रदूषण नियंत्रण बोर्ड के पास उपलब्ध है तथा इसे पर्यावरण एवं वन मंत्रालय की वेबसाइट "http://envfor.nic.in" और भा. को. को. लि. के कार्यालय वेबसाइट "http://www.bccl.gov.in" पर भी देखा जा सकता है।

BD/-

[illegible]डस्ट्रीयल कॉरिडोर
[illegible] दोनों शहरों

विद्युत (सामान्य) विभाग [illegible]

निविदा सं. : इ.एल./41/पूर्वी/2012-2013, क्रम सं. : 1, कार्य का नाम एवं स्थान : [illegible]

निविदा सं. : इ.एल./42/पूर्वी/2012-2013, क्रम सं. : 1, कार्य का नाम एवं स्थान : [illegible]

निविदा सं. : इ.एल./43/पूर्वी/2012-2013, क्रम सं. : 1, कार्य का नाम एवं स्थान : [illegible]

[illegible] www.ecr.indianrailways.gov.in एवं www.tenders.go[illegible]

[illegible]

THE TIMES OF INDIA, RANCHI
SATURDAY, MARCH 2, 2013

Raw... कार्यालय ... परियोजना से ... प्रकाशित होने के ...

... हेतु लोक सुनवाई कार्यक्रम

	लोक–सुनवाई का स्थल
... बजे अपराह्न	प्रखंड कार्यालय, हरनौत, नालंदा
...0 बजे अपराह्न	प्रखंड कार्यालय, बाढ़, पटना

... है कि उपरोक्त कार्यक्रम में उपस्थित होने का कष्ट

सदस्य–सचिव

... राज्य प्रदूषण नियंत्रण पर्षद

...रॉन भवन, शास्त्रीनगर, पटना – 800 023
...0–0612–2281250 / 2282265, फैक्स–0612–2281050
वेबसाईट–http://bspcb.bih.nic

क्षेत्रीय कार्यालय फोन नं. 01482-241159

...न राज्य प्रदूषण नियन्त्रण मण्डल

...जाद नगर, पन्नाधाय सर्किल, भीलवाड़ा

दिनांक

...ति हेतु लोक सुनवाई के लिए आम सूचना

...ा जाता है कि मैसर्स भारतीय राष्ट्रीय राजमार्ग प्राधिकरण, ...काई, ए 11, चन्द्रकिरण, रीको हाउसिंग कॉलोनी, ब्यावर में ... संख्या 148-बी 109.750 कि.मी. राष्ट्रीय राजमार्ग–8 ...4.200 कि.मी., राष्ट्रीय राजमार्ग–79 गुलाबपुरा (जिला ...ई एवं सुदृढ़करण से संबंधित प्रार्थना पत्र मय दस्तावेज ... आवश्यक लोक सुनवाई हेतु प्रस्ताव राजस्थान राज्य प्रदूषण ...द में मण्डल के नाम से अभिलिखित) को प्रस्तुत किया गया है। ...ष्ट्रीय राजमार्ग प्राधिकरण, परियोजना क्रियान्वयन इकाई, ए ...िंग कॉलोनी, ब्यावर ने राजस्थान राज्य प्रदूषण नियंत्रण मण्डल ...विरणी स्वीकृति से पूर्व आवश्यक लोक सुनवाई हेतु मण्डल को ...ऽ परियोजना हेतु वन एवं पर्यावरण मंत्रालय, भारत सरकार, नई ...संख्या एस. ओ. 1533 दिनांक 14.09.2006 के अनुसार लोक ...ूचना जारी कर 30 दिवस का नोटिस दिया जाना आवश्यक है। ...ा EIA/EMP Report एवं संक्षिप्त कार्यकारी सार अभिलेख निम्न ...लब्ध है :–

...समन्द।
...राजसमन्द।
...मन्द।
...ीम, जिला–राजसमन्द।
...मिति, भीम, तहसील–भीम, जिला–राजसमन्द।
...जिस्ट्रेट, भीम, तहसील–भीम, जिला–राजसमन्द।
...ास्थान राज्य प्रदूषण नियंत्रण मण्डल, भीलवाड़ा।
...ास्थान सरकार, शासन सचिवालय, जयपुर।
...ण नियन्त्रण मण्डल, 4 संस्थागत मार्ग, संस्थानिक क्षेत्र, झालाना

...पर्यावरण एवं वन मंत्रालय, पंचम तल केन्द्रीय भवन, सेक्टर एच,

...ेस के माध्यम से एतद् द्वारा सूचित किया जाता है कि वे उक्त ...कृति से संबंधित लोक सुनवाई हेतु दिनांक 02.04.2013 को ...खण्ड मजिस्ट्रेट, भीम, तहसील–भीम, जिला –राजसमन्द में ...लिखित आक्षेप / सुझाव प्रस्तुत कर सकते हैं। ...ए / सुझाव इस सूचना के प्रकाशन की तिथि से 30 दिवस के ...धान राज्य प्रदूषण नियंत्रण मण्डल, भीलवाड़ा को भी दिये जा

(वी. एस. सांखला) क्षेत्रीय अधिकारी

Bharat Coking Coal Limited

(A Subsidiary of Coal India Limited)

This is to bring into notice of all concerned that the following 09 (Nine) Clusters of BCCL consisting of 63 Mines and 02 washeries are granted Environmental Clearances by Ministry of Environmental and forests.

Sl. No.	Name of the Cluster	Sanction order number and date
1.	**Cluster-I** (Damoda Group of 3 Mines - Damoda (Albion Section) OCP, Damoda UGP and Damuda BJ Section OCP) Group of Mines (of 0.9 MTPA normative and 1.17 MTPA (peak) in a combined ML area of 575 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Block Chandrapur, Dist. Dhanbad, Jharkhand.	J-11015/93/2009-1A.II (M) dated 6th Feb. 2013
2.	**Cluster-II** (5 mines of a combined prod. capacity 15.55 MTPA with a peak production of 20.215 MTPA) in a combined ML area of 2025.71 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Dist. Dhanbad, Jharkhand.	J-11015/35/2011-1A.II (M) dated 6th Feb. 2013
3.	**Cluster-III** (7 mines of a peak production of 3.6 MTPA in a combined ML area of 1420.61 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Dist. Dhanbad, Jharkhand (EC based on TOR granted on 04.11.2010).	J-11015/213/2010-1A.II (M) dated 6th Feb. 2013
4.	**Cluster-IV** (6 mines with production capacity 2.851 MTPA (Normative) 3.706 MTPA (Peak) in a combined ML area of 1123.79 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Dist. Dhanbad, Jharkhand excluding Gaslitand Colliery UG.	J-11015/212/2010-1A.II (M) dated 6th Feb. 2013
5.	**Cluster-V** (7 mines of a 4.854 (Normative) and 6.311 (Peak) production of MTPA in a combined ML area of 1957.08 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Dist. Dhanbad, Jharkhand (EC based on TOR granted on 16.03.2011).	J-11015/01/2011-1A.II (M) dated 11th Feb. 2013
6.	**Cluster-VII** (combined capacity 6.227 MTPA with a peak prodn. of 8.16 MTPA in a combined ML area of 2127.7 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Dist. Dhanbad, Jharkhand (EC based on TOR granted on 09.12.2010) (excluding Kusiore UG and East Bhuggatdih).	J-11015/238/2010-1A.II (M) dated 6th Feb. 2013
7.	**Cluster-X** (6 mines of 1.762 MTPA of normative and peak production of 2.289 MTPA in a combined ML area of 2057.95 ha) and Sudamdih Coal Washery (Within the lease hold of Sudamdih Shaft Mine) of 1.6 MTPA of normative and 2.08 MTPA peak production for a area of 18 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Dist. Dhanbad, Jharkhand (EC based on TOR granted on 09.02.2011).	J-11015/380/2010-1A.II (M) dated 6th Feb. 2013
8.	**Cluster-XVI** - Coalmines (Dahibari-Basantimata OCP, Basantimata under Ground Mine, New Laikdih OCP (including Dahibari Coal Washery), Laikdih Deep UG, Chanch UG) (normative 1.51 MTPA and 1.963 MTPA peak in a combined ML area of 1964.21 ha) and Dahibari washery of 1.6 MTPA in the area of 12 ha of M/s Bharat Coking Coal Ltd., in Dist. Dhanbad, Jharkhand (EC based on TOR granted on 28.05.2010).	J-11015/185/2010-1A.II (M) dated 6th Feb. 2013
9.	**Cluster-VIII** Group of 10 Mines (combined capacity 4.31 MTPA with a peak prodn. of 5.603 MTPA in a combined ML area of 1183.92 ha (1200.41 ha-16.49 ha=1183.92 ha) of M/s Bharat Coking Coal Ltd., located in Jharia Coalfields, Dist. Dhanbad, Jharkhand.	J-11015/298/2010-1A.II (M) dated 15th Feb. 2013

The copy of the clearance letter is available with the Jharkhand State Pollution Control Board and may also be seen at the website of the Ministry of Environmental and forests at http://envfor.nic.in and on the official website of BCCL at http://www.bccl.gov.in

PLATES

ECOLOGICAL RESTORATION OF OB DUMPS IN CLUSTER V

ORGANIZATION OF VAN MAHOTSAV IN CLUSTER V

ONGOING PLANTATION ON OB DUMP AT BANSDEOPUR

AREA PLANT NURSERY IN CLUSTER V

PROGRESSIVE BIOLOGICAL RECLAMATION AT TETULMARI COLLIERY

STONE-PITCHING ALONG SEASONAL JORE

PROGRESSIVE PHYSICAL RECLAMATION AT NICHITPUR COLLIERY

WATER SPRINKLING ON ROAD

PLANTATION AND SAPLING DISTRIBUTION ACTIVITIES IN LOCAL SCHOOL

FIXED SPRINKLER AT COAL HANDLING PLANT

ENVIRONMENTAL AWARENESS PROGRAMMES IN CLUSTER V

पर्यावरण संरक्षण कार्यशाला शुरू

सिजुआ. सिजुआ गेस्ट हाउस में बुधवार से पर्यावरण संरक्षण तथा संपोषण पर दो दिवसीय कार्यशाला शुरू हुई. आयोजन सिजुआ क्षेत्र ने किया है. कार्यशाला में एएफआरआइ देहरादून के आधा दर्जन वैज्ञानिक शामिल हो रहे हैं. उद्घाटन निदेशक कार्मिक आरएस महापात्रा ने किया. कहा कि धरती का संतुलन बनाये रखने के लिए हमें पर्यावरण का ख्याल रखना होगा. देहरादून के वैज्ञानिकों ने कहा कि धरती का संतुलन लगातार बदतर होता जा रहा है. प्रशिक्षण प्राप्त करने आये सिजुआ एरिया के अलावा कुसुंडा एरिया, पुटकी बलिहारी तथा डब्ल्यूजे एरिया के लगभग 105 प्रशिक्षु कर्मियों को पर्यावरण से संबंधित कई जानकारी दी. इससे पूर्व कर्मियों व प्रशिक्षुओं को स्वास्थ्य तथा सुरक्षा की शपथ श्री महापात्रा ने दिलायी. मौके पर पर्यावरण मुख्यालय के एजीएम इवीआर राजू, जीएम पी चंद्रा, एजीएम चंदन भट्टाचार्य, सुनील कुमार, जेके जैसवाल, धर्मवीर आलोक, राजेश रंजन कुमार, आनंद विजय, मीणा कुमारी, आरबी दोर्जी, एनके सरकार, देहरादून एएफआरआइ के प्रमुख एन बाला, डॉ एचबी वशिष्ठ, डॉ ताराचंद, एसके शर्मा, शैलेश पांडेय, एसके कंबोज, सचिन कुमार आदि मौजूद थे.

[ECO-PARK AT NICHITPUR COLLIERY]

FAUNA AT ECO-PARKS IN CLUSTER V

PLANTATION AT MUDIDIH COLLIERY

FIXED SPRINKLERS AT BANSJORA RAILWAY SIDING

PLANTATION AT TETULMARI COLLIERY

PLANTATION AT NICHITPUR OB DUMP

GRASSING ON OB DUMP

PLANTATION AT LOYABAD

PLANTATION ALONG THE BANKS OF EKRA JORE

GRASS SEEDBALL BROADCASTING ON OB DUMPS

ROADSIDE AVENUE PLANTATION IN CLUSTER V

PLANTATION ON NICHITPUR OB DUMP IN 2021-22