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-41/2019/203 Date- 29/11/2019

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

Subject- Half yearly compliance report of Environmental Clearance Conditions for the period from 1st Apr., 2019 to 30th Sept. 2019 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

Dear Sir,

Please find enclosed herewith the half yearly compliance report of Environmental Clearance Conditions for the period from 1st Apr., 2019 to 30th Sept. 2019 in respect of cluster V group of mines i.e. Sijua Area of Bharat Coking Coal Limited, Dhanbad in soft copy.

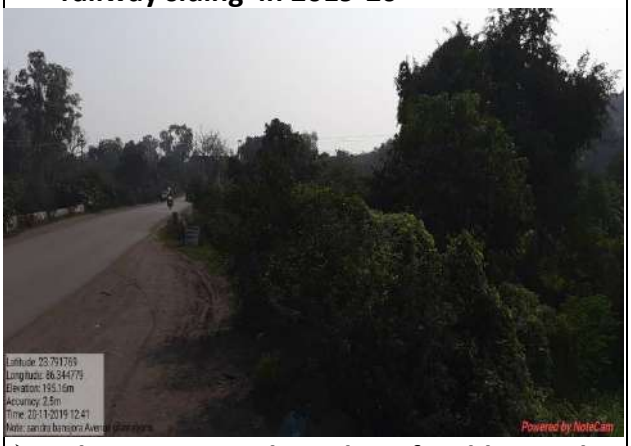
Hope you will find the same in order.

29/11/19

General Manager
Sijua Area

Cc:
1. Director, 1 A Monitoring Cell, Paryavaran Bhawan, CGO Complex, New Delhi-110003
2. Scientist & Incharge, Zonal Office, Central Pollution Control Board, 5th Floor 502, Hous & Conclave, 1582, Rajdanga Main Road, Kolkata-700107
3. Member Secretary, Jharkhand State Pollution Control Board, TA Division Building, H.E.C.,Dhurwa, Ranchi-834004
4. Dy. General Manager (Env.), Koyla Bhawan
5. Addl. General Manager, Sijua Area
6. All Project Officers- Nichitpur, Tetulmari, Kanakanee, Mudidih, Sendra Bansjora, Bansdeopur
7. Asst. Manager (Env.), Sijua Area
8. File

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 Cluster V has been within the granted EC limit over the years. **Annexure 1- Coal Production data of Cluster V from 2016-17 to 2019-20 (Up to 31.10.2019) 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. It has been included in the Transportation agreement with the transporting agency. Transportation of coal in Cluster V is mostly internal. Coal from Sendra Bansjora, Tetulmari, Nichitpur OCPs is transported to Bansjora railway siding which is located within the leasehold of Sendra Bansjora Colliery. Smaller amount of coal transportation to local and other consumers is done through road. 1320 nos of avenue plantation have been done alongside road on both sides for a distance of approx. 4 kms from Shakti Chowk to Mohlidih. At Tetulmari Colliery, avenue plantation is present along a distance of approx 500 m alongside the internal road leading up to the public road. Approx. 300 nos of trees are planted on both sides of the public road for a distance of approximately 2 kms from Naya more to Kerkend More on the boundary of Tetulmari, Sendra Bansjora, loyabad, Bansdeopur & Kankanee Collieries. To cover the remaining portion of mine boundaries, jore banks, railway siding, transportation roads & to increase the density of the existing avenue plantation along the both sides of public road, a proposal for gabion and riverbank plantation covering total length of 15.6 kms is in process. A double row plantation over a constructed platform of top-soil has been carried out in 2019-20 along Bansjora railway siding for a length of 300 m along which vehicles move for loading of coal into rakes.

		 ➢ **Tarpaulin covered coal transportation in Cluster V of Bharat Coking Coal Limited**  ➢ **Plantation carried out along Bansjora railway siding in 2019-20**  ➢ **Plantation on the sides of public roads along the mine boundaries of Sendra Bansjora & Kankanee in Cluster V.**

		 ➢ **Avenue plantation alongside the road from Shakti Chowk to Mohlidih in Cluster V.**  ➢ **Avenue plantation alongside the internal transportation road in Tetulmari**
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 fields ranging from ecological restoration/plantation to health & safety apart from the job related training are being imparted to the employees within the company. Capacity building in activities such as Computer Skills, Stitching Skills, Handloom, Handicraft, etc. is being provided to the nearby populace. **Annexure 2- Details of recent training programs conducted and pictures of 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 Implementation details of Environmental Action Plan have been maintained 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**
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 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 from 0.975 MTPA to 2.340 MTPA and that of Kankanee 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 as reservoir being utilized by the local community for aquaculture**
8	BCCL may consider setting up a separate management structure for implementing environment policy and socio-economic issues	A full-fledged Environment Department, headed by a HoD (Environment) along with a suitable qualified multidisciplinary team

	and the capacity building required in this regard.	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) have also been deputed at area level. A dedicated Executive of Community Development cadre is also deputed at area level. Inter-area inspection mechanism for monitoring of EC/FC Compliances has been introduced and an Environmental committee has been formed at area level which meets monthly. At Headquarters level, an Environmental Advisory Committee has been formed which meets on Bi-monthly basis. Capacity building at both corporate and operating level is being done through regular training programmes conducted within company and at the leading centres 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 monitoring stations in cluster V have been approved by 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 awarded to NEERI, Nagpur. Summer data has been collected. A progress report has been submitted. Final Report will be submitted after collection of winter data. **Annexure 10- Work progress 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	The work for "Source Apportionment Study" has been awarded to NEERI, Nagpur. Summer data has been collected. A progress report has been submitted. Report will be submitted after collection of winter data. Mineralogical Composition Study is being carried out as a part of Source

	taken.	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 third time series map. **Annexure 11– Last Time-series map of 2018**
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.
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 in Cluster V for monitoring of CO, CO2, Methane and its homologues. **Annexure 12- Report of IIT (ISM), Dhanbad for Tetulmari UG mine 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 Sendra Bansjora, Tetulmari, Nichitpur OCPs is transported to Bansjora railway siding which is located within the leasehold of Sendra Bansjora Colliery. Smaller 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 has been stalled due to problems of land acquisition. **Annexure 13- Copy of the work Order of Installation of Silo Loading**
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 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.
19	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.	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. To quench fire, water sprinkling is also being done. Water quenching, grassing and biological reclamation is done to control mine fires including in old OB dump areas.
20	The rejects of washeries in Cluster –V should be sent to FBC based plant.	There is no Coal washery in cluster V.
21	There shall be no external OB dumps. At the end of the mining there shall be no void and	Mining is being done in Cluster V as per approved Mining Plan & Mine Closure Plan.

<table>
<tr><td></td><td>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>Progressive mine closure plan is being implemented. There is no external OB dump. Life of different mines of Cluster V as per EC is as below:
<table><tr><th>S.No.</th><th>Name of the mine</th><th>Life of Mine as per EC (in yrs.)</th></tr><tr><td>1</td><td>Nichitpur</td><td>10</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>16</td></tr><tr><td>5</td><td>Kankanee</td><td>7</td></tr><tr><td>6</td><td>Bnasdeopur</td><td>>30</td></tr><tr><td>7</td><td>Loyabad</td><td>-</td></tr></table>
End stage of the mine is yet to be reached. Final mine closure plan will be prepared and implemented five years before the end of the mining.

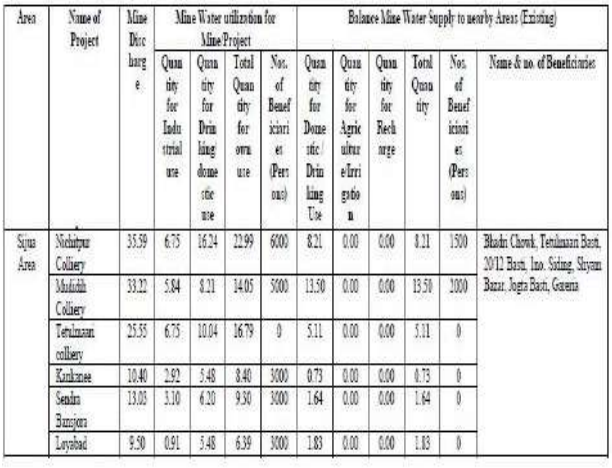
Annexure 14- Mine-wise data regarding progressive backfilling and reclamation for Cluster V</td></tr>
<tr><td>22</td><td>There shall be no water body left at the end of mining.</td><td>It is a post-closure requirement. End stage of the mines is yet to be reached. Final mine closure plan will be prepared and implemented five years before the end of the mines.</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 two collieries, Sendra Bansjora and Kankanee, have been prepared and approved by BCCL Board. For the rest of the mines, mining plans are under draft by CMPDIL and will be soon prepared and approved. However, Feasibility reports of all the mines have been prepared.
Progressive Mine closure plans as per the guidelines of Ministry of Coal have been prepared by Central Mine Planning and Design Institute (CMPDI) for six collieries and it is being implemented.
For the currently non-producing Bansdeopur colliery which is being planned for re-opening, progressive Mine Closure plan will be drafted soon.</td></tr>
<tr><td>24</td><td>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</td><td>It will be done at the time of final closure of mining activities.
Mines in the cluster V are at present active and concurrent backfilling and reclamation is being done.</td></tr>
</table>

	fenced. The abandoned pits and voids should be backfilled with OB and biologically 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 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/nalas 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 2019-20. 
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.	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. Thick green belt is also developed on the common mine boundaries of Sendra Bansjora, Kankanee & Mudidih Collieries. In 2019-20, 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 for a distance of approx. 4 kms from Shakti Chowk to Mohlidih. At Tetulmari Colliery, avenue plantation is present along a distance of approx 500 m alongside the internal road leading up to the public road. Approx. 300 nos of trees are planted on both sides of the public road for a distance of approximately 2 kms from Naya more to Kerkend More on the boundary of Tetulmari, Sendra Bansjora, loyabad, Bansdeopur & Kankanee Collieries. A double row plantation over a constructed platform of top-soil has been carried out in 2019-20 along Bansjora railway siding for a length of 300 m along which vehicles move for loading of coal into rakes. Plantation has also been carried out along the quarry edges and at mine viewpoints. To cover the remaining portion of mine boundaries, jore banks, railway siding, transportation roads & to increase the density of the existing avenue plantation

		along the both sides of public road, a proposal for gabion and riverbank plantation covering total length of 15.6 kms is in process. A “Sneh Smriti Upawan” dedicated to the memory of one’s ancestors and a herbal garden is being developed at Sendra Bansjora Office Complex. Plantation drives have also been conducted in colonies and in schools within and near 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	1320 nos of avenue plantation have been done alongside road on both sides for a

	carbon and other pollutant.	distance of approx. 4 kms from Shakti Chowk to Mohlidih. At Tetulmari Colliery, avenue plantation is present along a distance of approx 500 m alongside the internal road leading up to the public road. Approx. 300 nos of trees are planted on both sides of the public road for a distance of approximately 2 kms from Naya more to Kerkend More on the boundary of Tetulmari, Sendra Bansjora, loyabad, Bansdeopur & Kankanee Collieries. A double row plantation over a constructed platform of top-soil has been carried out in 2019-20 along Bansjora railway siding for a length of 300 m along which vehicles move for loading of coal into rakes. To cover the remaining portion of mine boundaries, jore banks, railway siding, transportation roads & to increase the density of the existing avenue plantation along the both sides of public road, a proposal for gabion and riverbank plantation covering total length of 15.6 kms is in process.  
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 herewith as **Annexure 6**.
30	The locations of monitoring stations in the Jharia Coalfields should be finalized in	The locations of monitoring stations in cluster V have been approved by Jharkhand

	consultation with the Jharkhand State Pollution Control Board. The Committee stated that smoke/dust emission vary from source to source (fuel wood, coal, fly ash from TPPs, silica from natural dust, etc) and a Source Apportionment Study should be got carried out for the entire Jharia Coalfields. Mineralogical composition study should be undertaken on the composition of the suspended particulate matter (PM10 and PM2.5) in Jharia Coalfields and also quantified. These studies would help ascertain source and extent of the air pollution, based on which appropriate mitigative measures could be taken.	State Pollution Control Board. The work for "Source Apportionment Study" has been awarded to NEERI, Nagpur. Summer data has been collected. A progress report has been submitted. Final Report will be submitted after collection of winter data. Mineralogical Composition Study is being 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 quenching, washing of vehicles, plantation, etc.) Water is also 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	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. Three tenders had been floated for construction of new peizometric wells which were unsuccessful. A fresh revised proposal

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 (Person)	Quantity for Domestic/ Drinking Use	Quantity for Agriculture/Irrigation	Quantity for Recharge	Total Quantity	Nos. of Beneficiaries (Person)	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	Bhadu Chowk, Tetulmaari Basti, 20/12 Basti, Ino. Siding, Shyam Bazar, Jogta Basti, Ganesa
	Mudidih Colliery	33.22	5.84	8.21	14.05	5000	13.50	0.00	0.00	13.50	2000	
	Tetulmaan 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	

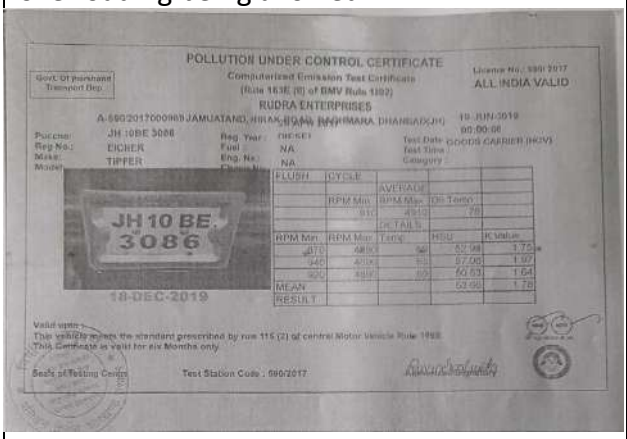
	water table indicates a declining trend.	is under preparation for re-tendering. **Annexure 15 – Ground Water Monitoring Report**
33	Mine discharge water shall be treated to meet prescribed standards before discharge into natural water courses/agriculture. The quality of the water discharged shall be 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 in compliance with the prescribed standards. The discharge 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. **Annexure 16- Analysis report of Mine water discharge by CMPDIL at the monitoring point Approved by JSPCB**
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. However regular monitoring of subsidence will be undertaken on 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 planted over areas likely to be affected by subsidence.	Plantation of high root density tree species is being taken up in Cluster V as certified by FRI, Dehradun. **Annexure 17- High root density tree plantation certificate 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. It has been included in the Transportation agreement with the transporting agency. Transportation of coal in Cluster V is mostly internal. Coal from Sendra Bansjora, Tetulmari, Nichitpur OCPs is transported to Bansjora railway siding which is located within the leasehold of Sendra Bansjora Colliery. Smaller amount of coal transportation to local and other consumers is done through road.
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 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 as of 31.10.2019 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. 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 are 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	CSR Action Plan of BCCL as a whole has been prepared. A CSR study has been done by Tata Institute of Social Sciences, Mumbai. CSR activities are also being undertaken as per EMP of cluster V. Two villages namely Nagri Kalan and Ganduwa Bastee have been identified for CSR works through an integrated scheme in 2020-21. The status of implementation of the issues raised in the public hearing of cluster V is attached as **Annexure 18.**

	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.	
45	Mine Closure Plan of Cluster –V is in draft stage, the same should be submitted to ministry.	Progressive Mine closure plans as per the guidelines of Ministry of Coal have been prepared by Central Mine Planning and Design Institute (CMPDI) for six of the seven collieries of cluster V and is being implemented. For the non-producing Bansdeopur colliery which is being planned for re-opening, Progressive Mine Closure plan will be drafted soon.
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 2017-18 for cluster V. Next monitoring will be done in 2020-21. **Annexure 19- 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 reintroduction 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 mines. The mines of Cluster V have not reached the end stage yet. 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 20- 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 a 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) have also been deputed at area level. A dedicated Executive of Community Development cadre is also

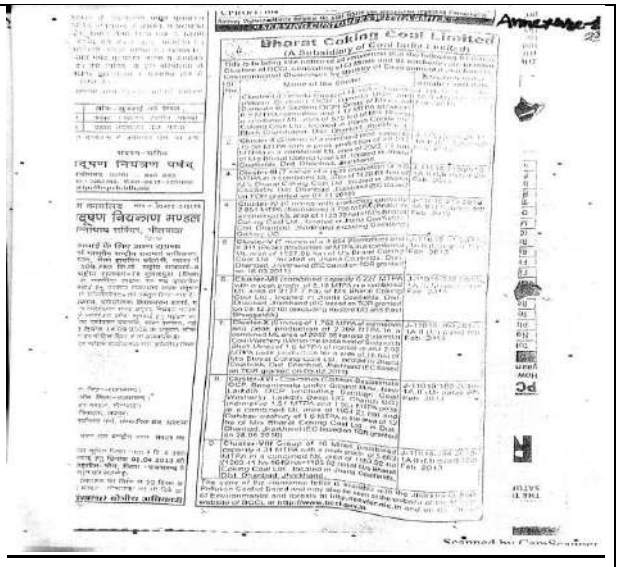
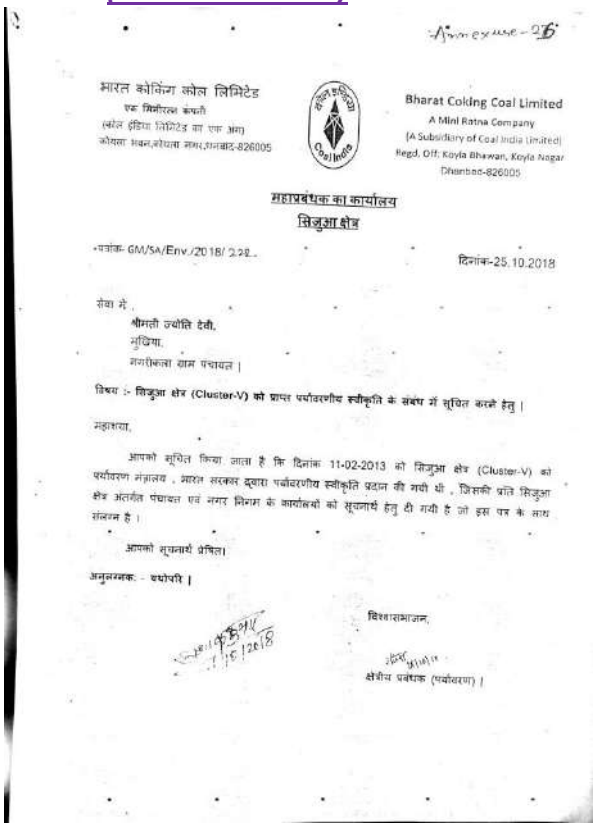
		deputed at area level. Inter-area inspection mechanism for monitoring of EC/FC Compliances has been introduced and an Environmental committee has been formed at area level which meets monthly. At Headquarters level, an Environmental Advisory Committee has been formed which meets on Bi-monthly basis. Capacity building at both corporate and operating level is being done through regular training programmes conducted within company and at the leading centres and institutes of the country. **Annexure 9- 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 mines. The mines of Cluster V have not reached the end stage yet. Presently, approved progressive mine closure plan is under implementation.
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 also uploaded on the website. **Annexure 21- 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 two collieries, Sendra Bansjora and Kankanee, have been prepared and approved by BCCL Board. For the rest of the mines, mining plans are under draft by CMPDIL and will be soon prepared and approved. However, Feasibility reports of all the mines have been prepared.
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 are conducted in six months. **Annexure 22- Environmental Monitoring Report of Cluster V for Aug. 2019**
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. Work order has been issued to IIT(ISM) Dhanbad for random verification of air samples in cluster V. The work is expected to be completed within one month. **Annexure 23:- Copy of the Work order for random analysis of air samples to 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 ground vibration and noise. Development of green belt around infrastructure, colonies and in vacant land have also been undertaken for arresting dust and 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	Oil & Grease Trap-cum-settling tanks have been Constructed at Nichitpur & Tetulmari workshops to treat workshop effluents. The discharge quality is monitored regularly at the stations approved by Jharkhand State

<table>
<tr><td></td><td>amended from time to time before discharge. Oil and grease trap shall be installed before discharge of workshop effluents.</td><td>Pollution Control Board. Mine water discharge parameters in Cluster V are in compliance with the prescribed standards.</td></tr>
<tr><td>7</td><td>Vehicular emissions shall be kept under control and regularly monitored. Vehicles used for transporting the mineral shall be covered with tarpaulins and optimally loaded.</td><td>PUC certificates of vehicles engaged in transportation are collected and inspected for its validity.
Road transportation is being done by covering vehicle with tarpaulin with no overloading being allowed.
 
POLLUTION UNDER CONTROL CERTIFICATE
ALL INDIA VALID
RUDRA ENTERPRISES
JH 10 BE 3086
18-DEC-2019
Sample PUC certificate collected</td></tr>
<tr><td>8</td><td>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.</td><td>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.</td></tr>
<tr><td>9</td><td>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.</td><td>Dust masks have been provided to the personnel working in dusty areas.
Regular training is provided to the workers on health & safety aspects at GVTC, Sendra.
<table><tr><th>S.N.</th><th>Unit name</th><th>No. of dust masks provided in 19-20</th></tr><tr><td>1</td><td>Tetulmari</td><td>40</td></tr><tr><td>2</td><td>Sendra Bansjora</td><td>130</td></tr><tr><td>3</td><td>Nichitpur</td><td>30</td></tr><tr><td>4</td><td>Kankanee</td><td>30</td></tr><tr><td>5</td><td>Mudidih</td><td>20</td></tr></table></td></tr>
<tr><td>10</td><td>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.</td><td>IME and PME is done for the workers to observe any contractions due to exposure to dust and to take corrective measures, if needed and records maintained thereof.
The outsourced manpower is also covered under it.

Annexure 24- Details of IME/PME done in 2019</td></tr>
</table>

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 a 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) have also been deputed at area level. A dedicated Executive of Community Development cadre is also deputed at area level. Inter-area inspection mechanism for monitoring of EC/FC Compliances has been introduced and an Environmental committee has been formed at area level which meets monthly. At Headquarters level, an Environmental Advisory Committee has been formed which meets on Bi-monthly basis. Capacity building at both corporate and operating level is being done through regular training programmes conducted within company and at the leading centres and institutes of the country. **Annexure 9- 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. **Annexure 25- 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.

		
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 at Company's website (http://www.bcclweb.in/?page_id=25895. The monitoring data of environmental quality parameters is displayed at the entrance of the area office, 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 Office s 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 East-Central Zonal Office of the MoEF&CC, respective Zonal Offices of 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 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 31 March in Form V is submitted to the Jharkhand State Pollution Control Board regularly on time.
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,	It is being Complied. The storage of material is below the threshold limit attracting the Public Liability Insurance Act, 1991.

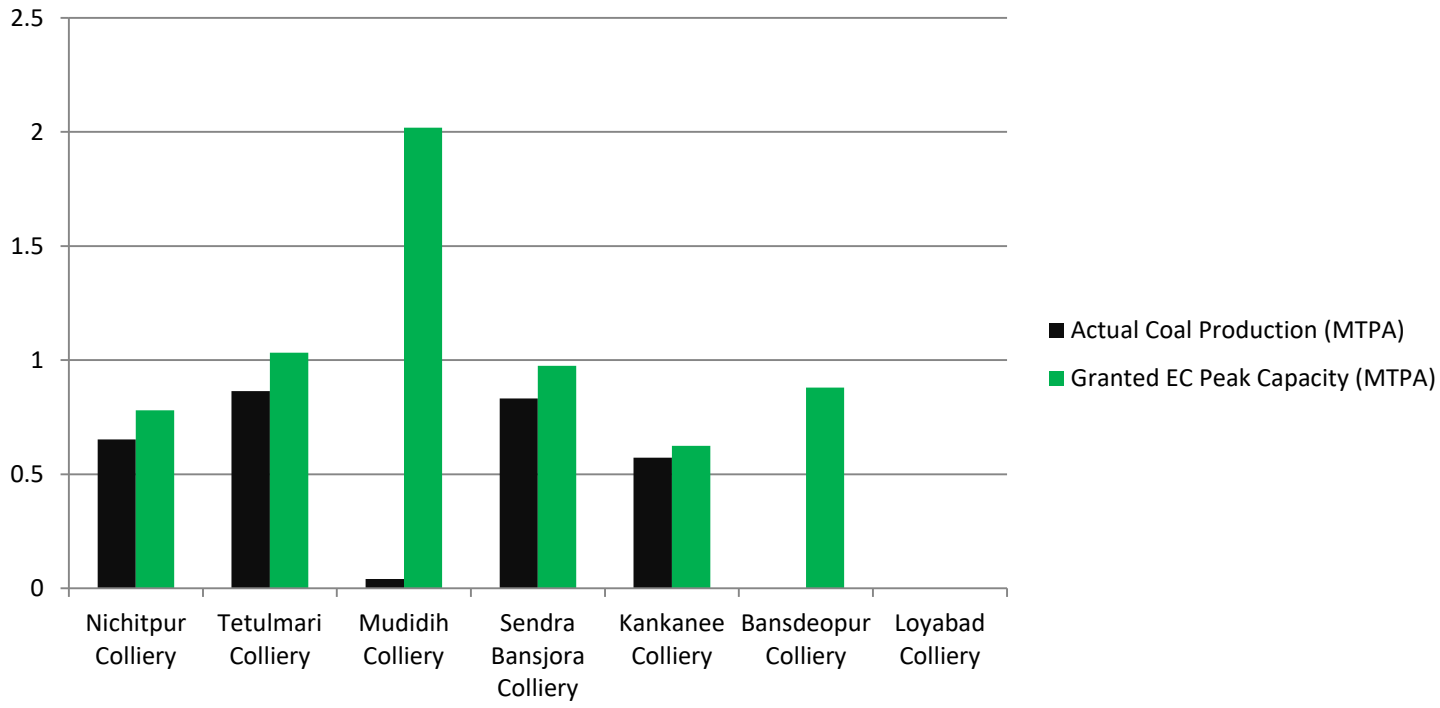
	the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and Rules. The proponent shall ensure to undertake and provide for the costs incurred for taking up remedial measures in case of soil contamination, contamination of groundwater and surface water, and occupational and other diseases due to the mining operations.	

ANNEXURE 1: COAL PRODUCTION DATA OF CLUSTER V VIS-A-VIS EC CAPACITY FOR LAST FOUR YEARS

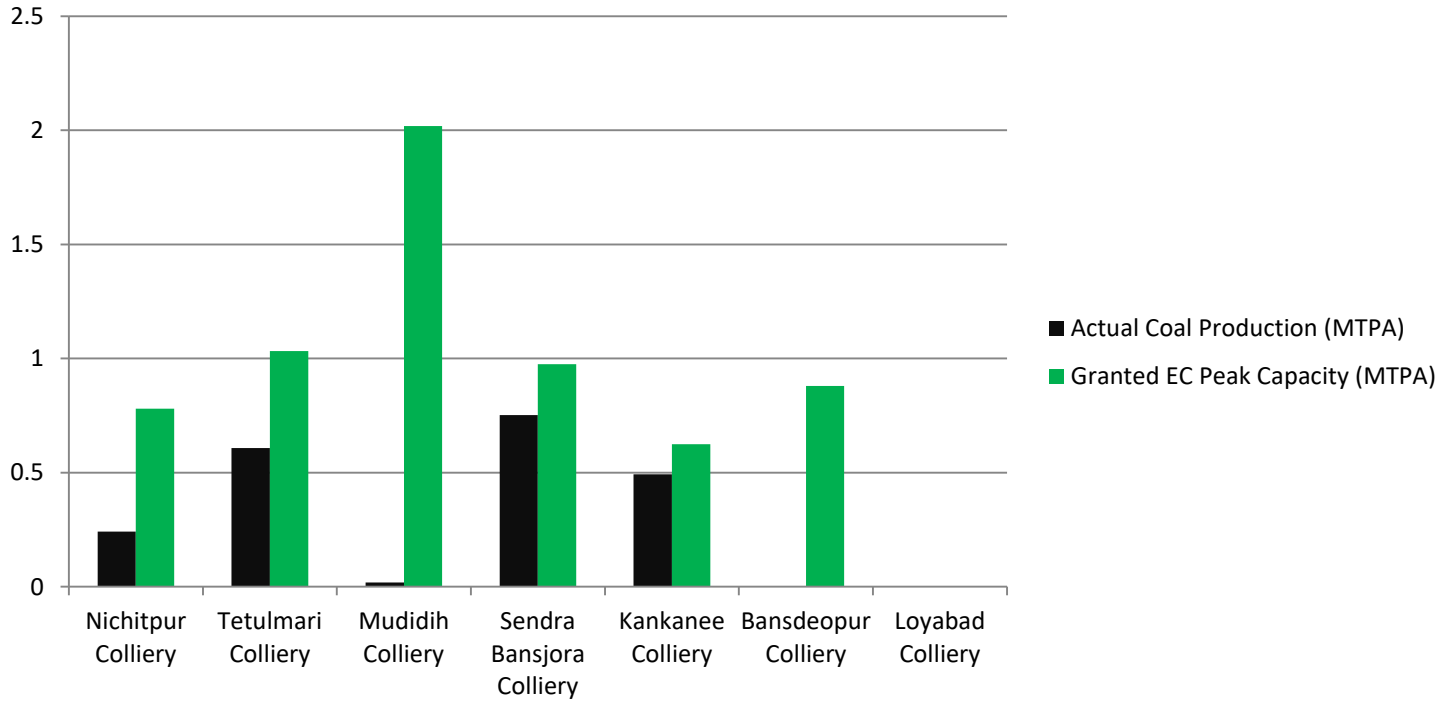
Unit Name		Coal Production in Year (In MTPA)			
	Granted Peak EC Capacity (In MTPA)	2016-17	2017-18	2018-19	2019-20 (till 31.10.2019)
Nichitpur Colliery	0.780	0.652	0.241	0.779	0.349
Tetulmari Colliery	1.033	0.864	0.607	0.727	0.344
Mudidih Colliery	2.019	0.041	0.018	0.028	0.009
Sendra Bansjora Colliery	2.340 (Enhanced from 0.975 in 2018-19)	0.832	0.752	1.515	0.667
Kankanee Colliery	1.190 (Enhanced from 0.624 in 2018-19)	0.572	0.493	0.283	0.237
Bansdeopur Colliery	0.879	0.000	0.000	0.000	0.000
Loyabad Colliery	0.000	0.000	0.000	0.000	0.000
Total	**6.311***	**2.961**	**2.111**	**3.332**	**1.606**

*Peak production capacities of different units to be achieved in different years

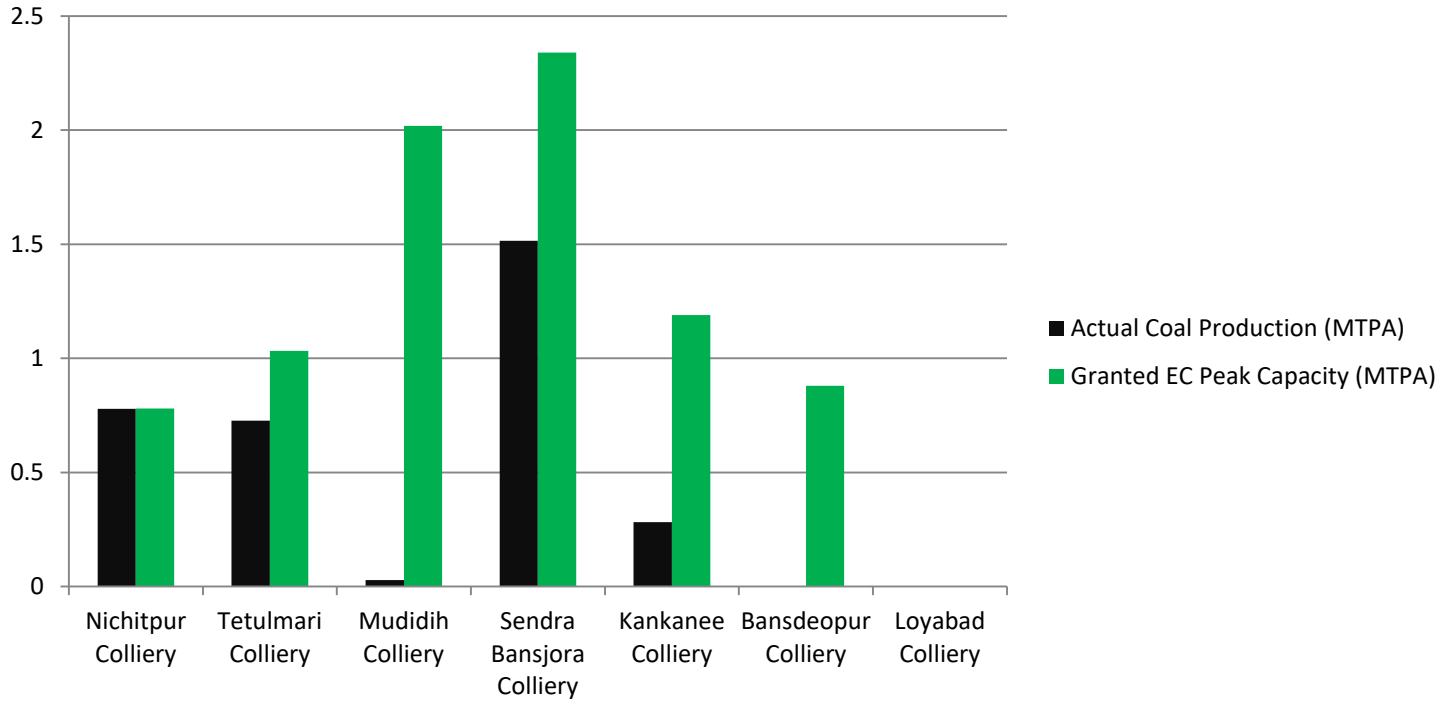
2016-17:



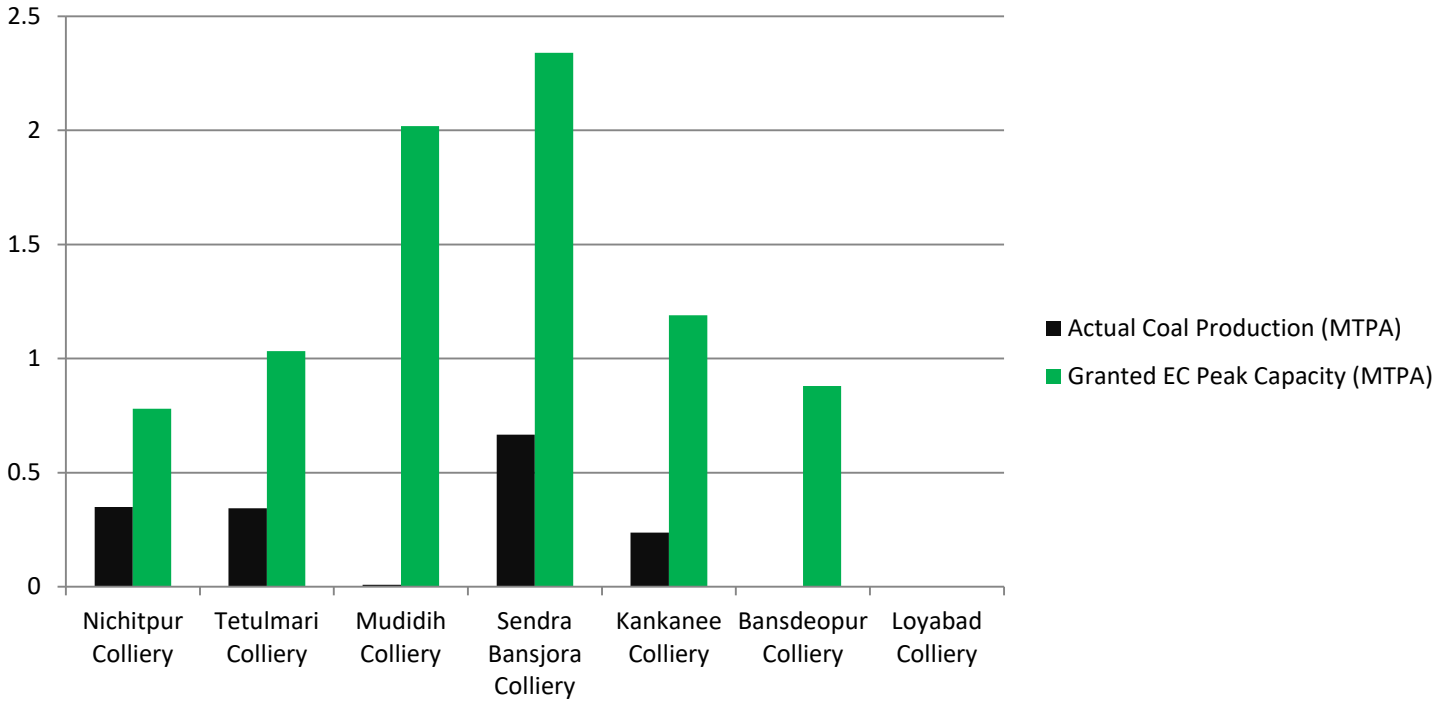
2017-18:



2018-19:



2019-20 (Up to 31.10.2019):

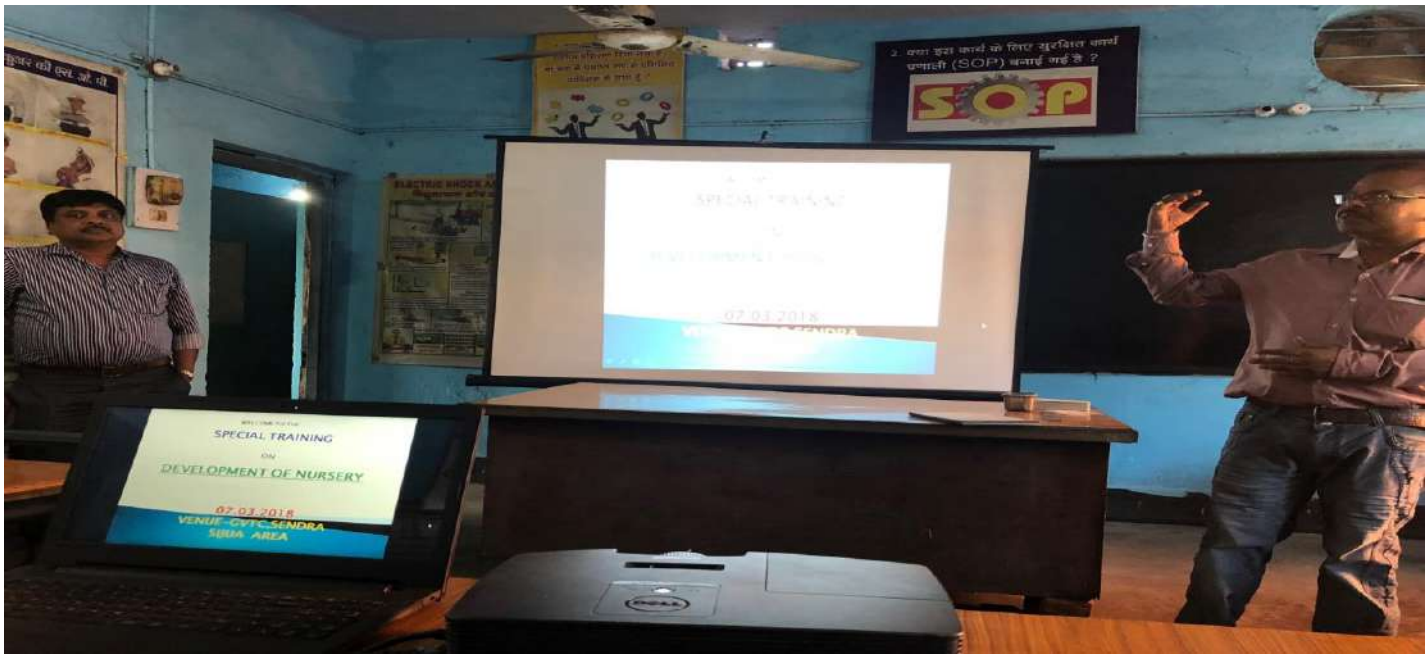


Annexure 2: Details of special training programs for employees & capacity building activities for local population

Date	Topic 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

Stitching Training

Handloom Training Centre at Nichitpur



Special Training on "Nursery Development" at GVTC, Sendra

Special Training on "Ecological Restoration for Integrated Environmental Management in Coal Mines"

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 2019-20

CATEGORIES OF TRANSPORTING VEHICLES IN CLUSTER V:

A. HEAVY VEHICLES:

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

B. LIGHT MOTOR VEHICLES:

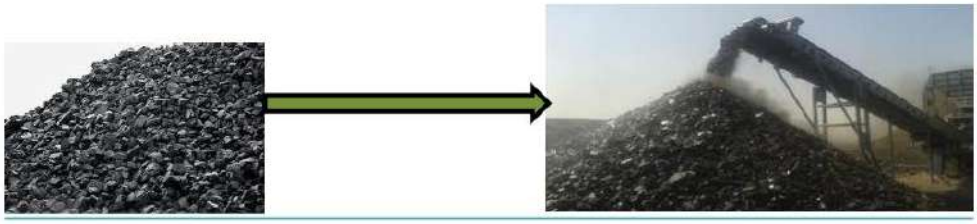
1. Official movement vehicles
2. Personal Vehicles

COAL TRANSPORTATION:

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

1. **Road Transport through weighbridges**
2. **Rail Transport through railway sidings**

Life cycle of Coal in Cluster V:



Coal mined out from mines at Coal Dumps

Coal Crushed at Coal Handling Plant at Sendra Bansjora

Transported to Consumers/Coal-washeries through road

Transported to Consumers through rail

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

PROGRESSIVE SECTOR WISE OFFTAKE REPORT 2018-19 (in Tonnes):

CONSUMERS	MUDIDIH	SENDRA BANSJORA				
	WIII	WIII	W IV		G 7	
	ROAD	ROAD	RAIL	ROAD	RAIL	ROAD
B. POWER HOUSES						
CTPS, CHANDRAPURA (FSA)	0	0	0	0	0	0
BTPS, BOKARO	0	0	0	0	0	0
MTPS, MEJIA (FSA)	0	0	330729	0	4654	0
MTPS, MEJIA (BRIDGE LINKAGE)	0	0	143135	0	85297	0
DTPS, DURGAPUR	0	0	2819	0	0	0
KTPS, KODERMA	0	0	144520	0	5848	0
DSTPS, DURGAPUR	0	0	28465	0	1327	0
RTPS, RAGHUNATHPUR (FSA)	0	0	1351	948	0	0
NTPC,FARAKKA	0	0	29260	0	4040	0
NTPC,UNCHAHAR	0	0	46669	0	15971	0
NTPC,DADRI	0	0	25173	0	0	0
NTPC, BARH	0	0	32548	0	0	0
HDJ, HARDUAGANJ	0	0	10177	0	0	0
PIC, PARICHA	0	0	7951	0	4043	0
ROPER/LEHRA MOHABBAT, PSEB	0	0	1379	0	0	0
PANIPATH/PMRG/RGTPP, HSEB	0	0	1584	0	2133	0
MJPJ, JHAJHAR	0	0	5082	0	0	0
MGLE, SAGARDIGHI	0	0	2759	0	0	0

BKTPP/BTPC BAKRESWAR	0	0	5487	0	0	0
KTPP, KOLAGHAT	0	0	8160	0	0	0
BTMT, BANDEL	0	0	2496	0	865	0
DPL, DURGAPUR	0	0	19112	0	1560	0
MPL, MAITHON (FSA)	0	0	0	121266	0	28586
MPL, MAITHON (S.F. E-AUC)	0	0	0	0	0	0
NABHA POWER	0	0	0	59855	0	0
BARA, PRAYAG RAJ	0	0	0	9999	0	0
CESE UNIT III, BUDGE BUDGE (FSA)	0	0	1362	0	0	0
CESC (S.F. E-AUC)	0	0	0	34212	0	0
ADHUNIK POWER (S.F. E-AUC)	0	0	0	43991	0	0
HALDIA POWER (S.F. E-AUC)	0	0	0	83883	0	0
JAYPEE NIGRIE (S.F. E-AUC)	0	0	0	15995	0	0
GVK POWER (S.F. E-AUC)	0	0	0	19366	0	0
DB POWER (S.F. E-AUC)	0	0	0	35991	0	0
WBPDCL, KOLAGHAT (S.F. E-AUC)	0	0	0	0	0	0
WBPDCL, STPS (S.F. E-AUC)	0	0	616	0	0	0
NTPC MOUDA (S.F. E-AUC)	0	0	0	0	0	0
JINDAL POWER, TAMNER (S.F. E-AUC)	0	0	0	11996	0	0
JAYPEE BINA (FSA)	0	0	0	43983	0	0
TOTAL POWER	**0**	**0**	**849482**	**481484**	**125737**	**28586**
C. FERTILIZER						
BTI, BHATINDA	0	0	8608	0	1560	0
NGL, NANGALDAM	0	0	5795	0	1639	0
PANIPATH/DIWANA	0	0	11147	0	0	0
TOTAL FERTILIZER	**0**	**0**	**25550**	**0**	**3198**	**0**
D. BRK & OTHRS.						
SPOT E-AUCTION	0	39951	0	0	0	0
EXCLUSIVE E-AUCTION	37551	0	0	0	0	0
FSA (LINKAGE E-AUC)-STEEL	0	0	0	0	0	0
PVT COKERY	0	15422	0	0	0	0
TOTAL BRK & OTHERS	**37551**	**55373**	**0**	**0**	**0**	**0**
E. OWN WASH.						
MOONIDIH	0	0	0	0	0	0
MAHUDA	11509	0	0	0	0	0
TOTAL WASHERY	**11509**	**0**	**0**	**0**	**0**	**0**
F. INT. CONSUMPTION						
BOILER	0	0	0	0	0	0
WORKSHOP	0	0	0	0	0	0

TOTAL INT CONS.	0	0	0	0	0	0
TOTAL OFFTAKE	49060	55373	875032	481484	128935	28586

CONSUMERS	TETULMARI					
	W IV		G 7		G 8	
	RAIL	ROAD	RAIL	ROAD	RAIL	ROAD
B. POWER HOUSES						
CTPS, CHANDRAPURA (FSA)	0	0	0	0	0	0
BTPS, BOKARO	0	0	0	0	0	0
MTPS, MEJIA (FSA)	93476	0	2116	0	3593	0
MTPS, MEJIA (BRIDGE LINKAGE)	95865	0	2223	0	0	0
DTPS, DURGAPUR	587	0	0	0	0	0
KTPS, KODERMA	53134	0	1362	0	3416	0
DSTPS, DURGAPUR	4994	0	0	0	1541	0
RTPS, RAGHUNATHPUR (FSA)	0	14839	0	0	0	0
NTPC,FARAKKA	7793	0	1450	0	0	0
NTPC,UNCHAHAR	18387	0	0	0	1529	0
NTPC,DADRI	4104	0	0	0	0	0
NTPC, BARH	2268	0	0	0	0	0
HDJ, HARDUAGANJ	1616	0	0	0	944	0
PIC, PARICHA	4790	0	0	0	0	0
ROPER/LEHRA MOHABBAT, PSEB	1480	0	0	0	0	0
PANIPATH/PMRG/RGTPP, HSEB	0	0	0	0	0	0
MJPJ, JHAJHAR	2107	0	0	0	0	0
MGLE, SAGARDIGHI	1403	0	0	0	0	0
BKTPP/BTPC BAKRESWAR	3920	0	233	0	0	0
KTPP, KOLAGHAT	1486	0	0	0	0	0
BTMT, BANDEL	1529	0	0	0	0	0
DPL, DURGAPUR	3609	0	0	0	0	0
MPL, MAITHON (FSA)	0	31472	0	15798	0	18678
MPL, MAITHON (S.F. E-AUC)	0	0	0	0	0	0
NABHA POWER	0	26181	0	0	0	0
BARA, PRAYAG RAJ	0	9951	0	14992	0	0
CESE UNIT III, BUDGE BUDGE (FSA)	1377	0	0	0	0	0
CESC (S.F. E-AUC)	0	40174	0	0	0	0
ADHUNIK POWER (S.F. E-AUC)	0	188392	0	0	0	0
HALDIA POWER (S.F. E-AUC)	0	0	0	0	0	0
JAYPEE NIGRIE (S.F. E-AUC)	0	11994	0	0	0	0
GVK POWER (S.F. E-AUC)	0	0	0	0	0	0
DB POWER (S.F. E-AUC)	0	24734	0	0	0	0

WBPDCL, KOLAGHAT (S.F. E-AUC)	0	0	0	0	0	0
WBPDCL, STPS (S.F. E-AUC)	0	0	0	0	0	0
NTPC MOUDA (S.F. E-AUC)	0	0	0	0	0	0
JINDAL POWER, TAMNER (S.F. E-AUC)	0	0	0	0	0	0
JAYPEE BINA (FSA)	0	15216	0	3240	0	0
TOTAL POWER	**303926**	**363075**	**7384**	**34029**	**11024**	**18678**
C. FERTILIZER						
BTI, BHATINDA	2146	0	0	0	0	0
NGL, NANGALDAM	6275	0	0	0	0	0
PANIPATH/DIWANA	4460	0	0	0	0	0
TOTAL FERTILIZER	**12880**	**0**	**0**	**0**	**0**	**0**
D. BRK & OTHRS.						
SPOT E-AUCTION	0	24945	0	0	0	0
EXCLUSIVE E-AUCTION	0	0	0	0	0	0
FSA (LINKAGE E-AUC)-STEEL	0	0	0	0	0	0
PVT COKERY	0	3917	0	0	0	0
TOTAL BRK & OTHERS	**0**	**28862**	**0**	**0**	**0**	**0**
E. OWN WASH.						
MOONIDIH	0	0	0	0	0	0
MAHUDA	0	0	0	0	0	0
TOTAL WASHERY	**0**	**0**	**0**	**0**	**0**	**0**
F. INT. CONSUMPTION						
BOILER	0	0	0	0	0	0
WORKSHOP	0	0	0	0	0	0
TOTAL INT CONS.	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL OFFTAKE	**316806**	**391937**	**7384**	**34029**	**11024**	**18678**

CONSUMERS	NICHITPUR			KANKANEE	
	W III	W IV		ST II	W II
	ROAD	RAIL	ROAD	ROAD	ROAD
B. POWER HOUSES					
CTPS, CHANDRAPURA (FSA)	0	0	14	0	0
BTPS, BOKARO	0	0	1090	0	0
MTPS, MEJIA (FSA)	0	101149	0	0	0
MTPS, MEJIA (BRIDGE LINKAGE)	0	112497	0	0	0
DTPS, DURGAPUR	0	366	0	0	0
KTPS, KODERMA	0	46450	0	0	0
DSTPS, DURGAPUR	0	9776	0	0	0
RTPS, RAGHUNATHPUR (FSA)	0	2218	143283	0	0

NTPC,FARAKKA	0	7346	0	0	0
NTPC,UNCHAHAR	0	29581	0	0	0
NTPC,DADRI	0	16915	0	0	0
NTPC, BARH	0	19943	0	0	0
HDJ, HARDUAGANJ	0	6258	0	0	0
PIC, PARICHA	0	7507	0	0	0
ROPER/LEHRA MOHABBAT, PSEB	0	0	0	0	0
PANIPATH/PMRG/RGTPP, HSEB	0	1264	0	0	0
MJPJ, JHAJHAR	0	3087	0	0	0
MGLE, SAGARDIGHI	0	330	0	0	0
BKTPP/BTPC BAKRESWAR	0	1752	0	0	0
KTPP, KOLAGHAT	0	3143	0	0	0
BTMT, BANDEL	0	1205	0	0	0
DPL, DURGAPUR	0	5910	0	0	0
MPL, MAITHON (FSA)	0	0	53012	0	0
MPL, MAITHON (S.F. E-AUC)	0	0	38983	0	0
NABHA POWER	0	0	28204	0	0
BARA, PRAYAG RAJ	0	0	0	0	0
CESE UNIT III, BUDGE BUDGE (FSA)	0	16734	0	0	0
CESC (S.F. E-AUC)	0	0	0	0	0
ADHUNIK POWER (S.F. E-AUC)	0	0	37347	0	0
HALDIA POWER (S.F. E-AUC)	0	0	0	0	0
JAYPEE NIGRIE (S.F. E-AUC)	0	0	91977	0	0
GVK POWER (S.F. E-AUC)	0	0	0	0	0
DB POWER (S.F. E-AUC)	0	0	7997	0	0
WBPDCL, KOLAGHAT (S.F. E-AUC)	0	592	0	0	0
WBPDCL, STPS (S.F. E-AUC)	0	616	0	0	0
NTPC MOUDA (S.F. E-AUC)	0	3710	0	0	0
JINDAL POWER, TAMNER (S.F. E-AUC)	0	0	0	0	0
JAYPEE BINA (FSA)	0	0	0	0	0
TOTAL POWER	**0**	**396131**	**409610**	**0**	**0**
C. FERTILIZER					
BTI, BHATINDA	0	3806	0	0	0
NGL, NANGALDAM	0	1522	0	0	0
PANIPATH/DIWANA	0	4362	0	0	0
TOTAL FERTILIZER	**0**	**9689**	**0**	**0**	**0**
D. BRK & OTHRS.					
SPOT E-AUCTION	31900	0	0	0	0
EXCLUSIVE E-AUCTION	0	0	0	5000	227266

FSA (LINKAGE E-AUC)-STEEL	0	0	0	0	55399
PVT COKERY	8954	0	0	0	0
TOTAL BRK & OTHERS	**40854**	**0**	**0**	**5000**	**282665**
E. OWN WASH.					
MOONIDIH	0	0	0	0	58429
MAHUDA	0	0	0	0	12375
TOTAL WASHERY	**0**	**0**	**0**	**0**	**70805**
F. INT. CONSUMPTION					
BOILER	0	0	0	0	0
WORKSHOP	0	0	0	0	0
TOTAL INT CONS.	**0**	**0**	**0**	**0**	**0**
TOTAL OFFTAKE	**40854**	**405820**	**409610**	**5000**	**353470**

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

Pollution Monitoring & Control measures adopted in Cluster V-

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.

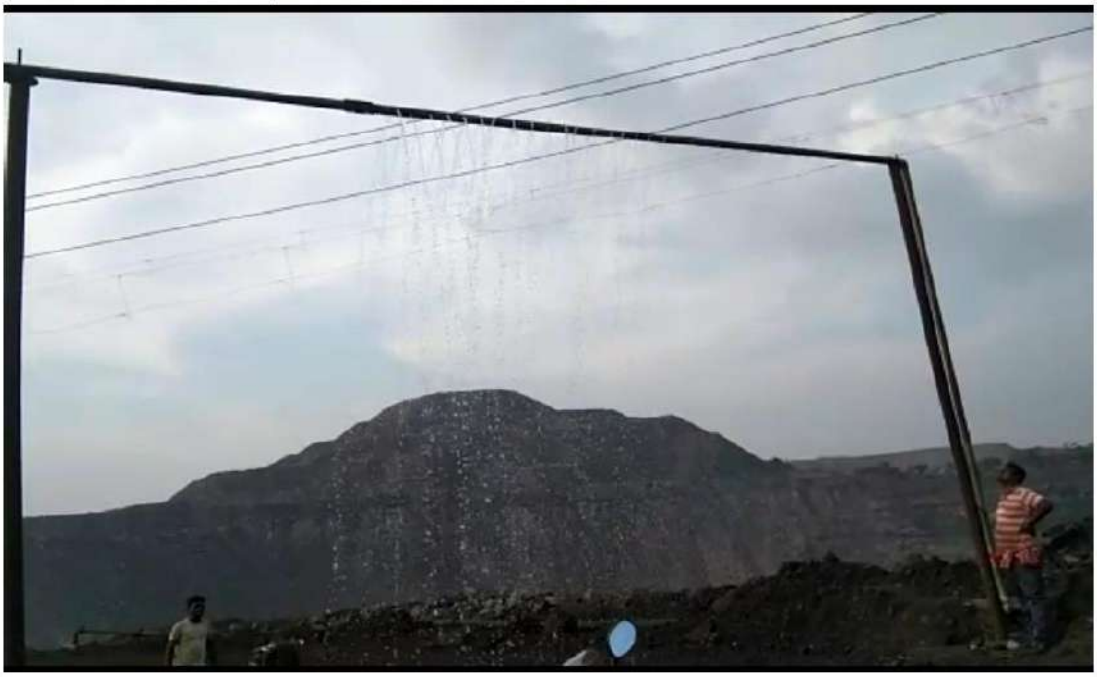
Details of Mobile Water Sprinklers in Cluster V:

Name of Unit	No. of Mobile Sprinklers/Water spraying tankers	Capacity
Tetulmari	2	1 unit of 12 KL & 1 unit of 28 KL
Nichitpur	3	3 units of 12 KL
Sendra Bansjora	4	1 unit of 15 KL & 3 units of 20 KL
Kankanee	2	1 unit of 12 KL & 1 unit of 20 KL

5. Avenue plantation along both sides of transportation road.

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

7. Provision of overhead water curtain at Sendra Bansjora to wet the coal loaded vehicles to reduce particulate matter emission.



8. Monitoring Study through Central Mine Planning & Design Institute to analyze the extent of reduction of pollution load by reducing coal transportation by road.
9. Regular checks to ensure vehicles engaged in transportation are having valid Pollution Under Control Certificates.

Future planned Pollution Monitoring & Control measures in Cluster V-

1. Construction of perforated jute cloth curtain enclosure along Bansjora railway siding to minimize the spread of particulate matter.
2. Construction of a wheel washing ditch-cum-settling tank at Sendra Bansjora to make the wheels of the vehicles dust-free before it gets on the public road.
3. Provision of fixed water sprinklers all along Bansjora railway siding for dust suppression.
4. Installation of real time PM_{10} analyzer at Bansjora railway siding for monitoring of particulate matter emission.
5. Source apportionment study to analyze the major sources of pollution.

Annexure 4 :

CORPORATE SOCIAL RESPONSIBILITY

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED, DHANBAD

2019-20

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 drinkingwater.
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: 2018-19

Healthcare: CSR (Healthcare) Activities for the year 2018-19

BHARAT COKING COAL LIMITED
CSR CAMP AT REGIONAL HOSPITAL LOYABAD UNDER SIJUA AREA
April-2019 to October-2019

Month	CSR Clinic (Benifciries)
April-2019	290
May-2019	197
June-2019	171
July-2019	240
Auguest-2019	245
September-2019	241
October-2019	160
Total Binificiries	1544

CMO/AMO I/C
RHL, Sijua Area-V

BHARAT COKING COAL LIMITED
CSR CAMP AT REGIONAL HOSPITAL LOYABAD / DISPENSARY OF SIJUA AREA
April-2019 to October-2019

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
			Total	192

CMO/AMO I/C
RHL, Sijua Area-V

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

भारत कोकिंग कोल लिमिटेड एक मिनीरत्न कम्पनी (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

पत्रांक सं : बीसीसीएल/कल्याण/नि.स.प.वि.स्वीकृति आदेश/2019/1487-23 (W/H) दिनांक- 11.11.2019

स्वीकृति आदेश

सेवा में,

महाप्रबंधक,

पश्चिमी झरिया क्षेत्र/ गोविन्दपुर क्षेत्र/ कतरास क्षेत्र/ सिजुआ क्षेत्र/ कुसुण्डा क्षेत्र/ पुटकी बलिहारी एवं कुस्तौर क्षेत्र/ बस्ताकोला क्षेत्र/ लोदना क्षेत्र/ पूर्वी झरिया क्षेत्र/ चाँच विक्टोरिया क्षेत्र/ बी.टी.ए मूनी क्षेत्र।

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

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 Qrtr. तिमाही की स्वीकृति सक्षम पदाधिकारी द्वारा दी गई है।

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

1. आज की तरीख में विद्यालय सुचारु 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 <u>E.B.C.Sl.No.-BCCL/REV/2700/19-20/Educational Grant/-1458, dated-21.08.2019</u> एवं <u>F.C.SL.No.-BCCL/REV/2700/19-20/Educational Grant/2107-dated-09.11.2019</u> के द्वारा निर्गत किया जाता है।

अनुलग्नक : यथोक्त।

नोट: <u>वित्तीय सहायता की राशि का भुगतान 15 दिनो के अंदर अवश्य ही करने की व्यवस्था करें और इस कार्यालय को अविलम्ब सूचित करें।</u>

भ व दी य

(आहुति स्वाई)

महाप्रबंधक(का0) कल्याण।

प्रतिलिपि:

1. अध्यक्ष-सह-प्रबंध निदेशक/ निदेशक मंडल/ मुख्य सतर्कता पदाधिकारी के वरीय कार्यपालक अधिकारी(सचिवीय)।
2. महाप्रबंधक (कल्याण), सीआईएल, कोलकाता को सूचनार्थ प्रेषित।
3. मुख्य प्रबंधक (वित्त) निधि, बीसीसीएल, कोयला भवन- निधि विमुक्ति संबंधित आवश्यक कार्यवाई हेतु।
4. महाप्रबंधक(वित्त)/ महाप्रबंधक(सी एण्ड बी), कोयला भवन को सूचनार्थ प्रेषित।
5. महाप्रबंधक(का0 एवं औ0स0), 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)

			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 4th Qrt of FY 2018-19
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	Pandey 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 Kanali 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

11.1.19

CONT.

	Contd. Page-2- Sl|ua						
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	0	0	0	45000
16	Janta Janardan Bal Vidya Mandir, Tetulmari	3	2	1	0	0	46500
17	Indira Gandhi Smarak Vidya Mandir, Tetulmari	3	3	0	0	0	45000
	Total	54	41	13	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(PAY)I/C/E.F.C/19-20/2700/Educational Grant/2107 dated 09.11.2019

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.6600/- PM/PT	Graduate with BT Rs.6500/- PM/PT	Graduate with B.Ed Rs.7000/- PM/PT	Amt.of 1st & 2nd Qrt of FY 2018-19
1	2	3	4	5	6	7	8
	Sijua Area						
1	AdarshHarijanShishu Pathshala Sendra-10	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 No5	1	1	0	0	0	30000
9	Laxmi Devi Vidya Mandir,Loyabad	4	2	2	0	0	126000
10	Panda Kanali 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

	Contd. Page-2- Sijua						
13	Shishu Shiksha Niketan Loyabad,	3	3	0	0	0	90000
14	Gandhi Smarak Primary School	4	4	0	0	0	120000
15	Saraswati Vidya Mandirw Tetulmari	3	3	0	0	0	90000
16	Janta Janardan Bal Vidya Mandir,Tetulmari	3	2	1	0	0	93000
17	Indira Gandhi Smarak Vidya Mandir,Tetulmari	3	3	0	0	0	90000
	Total	54	41	13	0	0	1659000

EBC Sl No. BCCL/REV/2700/18-19/Educational Grant/2383 dated 30.10.2018 and
FC SL. No. BCCL/REV/HOD(PAY)I/C/E.F.C/18-19/2700/Educational Grant/3460 dated 11.03.2018

BD 951 12/3/19
APM Sec
ac 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

Status of issues raised in the public hearing of Cluster V:

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 have been throughout cared after 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 plantation done is still continuing.
2	Public awareness should be generated to preserve the trees planted by BCCL.	Various initiatives have been taken such as awareness program mes 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 frequency should be increased including in the night time.	The frequency of water sprinkling by mobile sprinklers has been increased for more effective dust suppression.
4	The no. of water tankers should be increased.	Sufficient no. of water tankers have been provided in Cluster V.
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 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.	An area of 8 Ha has been ecologically restored near Chandour Bastee in Tetulmari Collliery. 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 survey work of the affected families is being done by 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. Road lights, community centres, water arrangements, high schools roads(from Subhash Chowk to Azad chowk), ambulance should be provided in Nichitpur.	Regular water spraying is done in Nichitpur. The roads in Nichitpur Township are also paved. Various provisions have been made in Nichitpur such as lighting, water supply and Handloom training centre. Road from Subhash Chowk to Azad chowk is bitumen topped and very well maintained. An ambulance is available in Nichitpur Colliery.
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 personnels are deputed in Regional Hospital, Loyabad in cluster V.

ACTION PLAN FOR FUTURE CSR ACTIVITIES

1. Integrated CSR activities in peripheral Nagri Kalan & Ganduwa villages have been planned for 2020-21 in addition to the existing annual CSR activities in operation in Sijua Area.
2. Plantation of fruit-bearing saplings in nearby villages.

Annexure 5 :

REHABILITATION & RESETTLEMENT BOOKLET

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED, DHANBAD

2019-20

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).

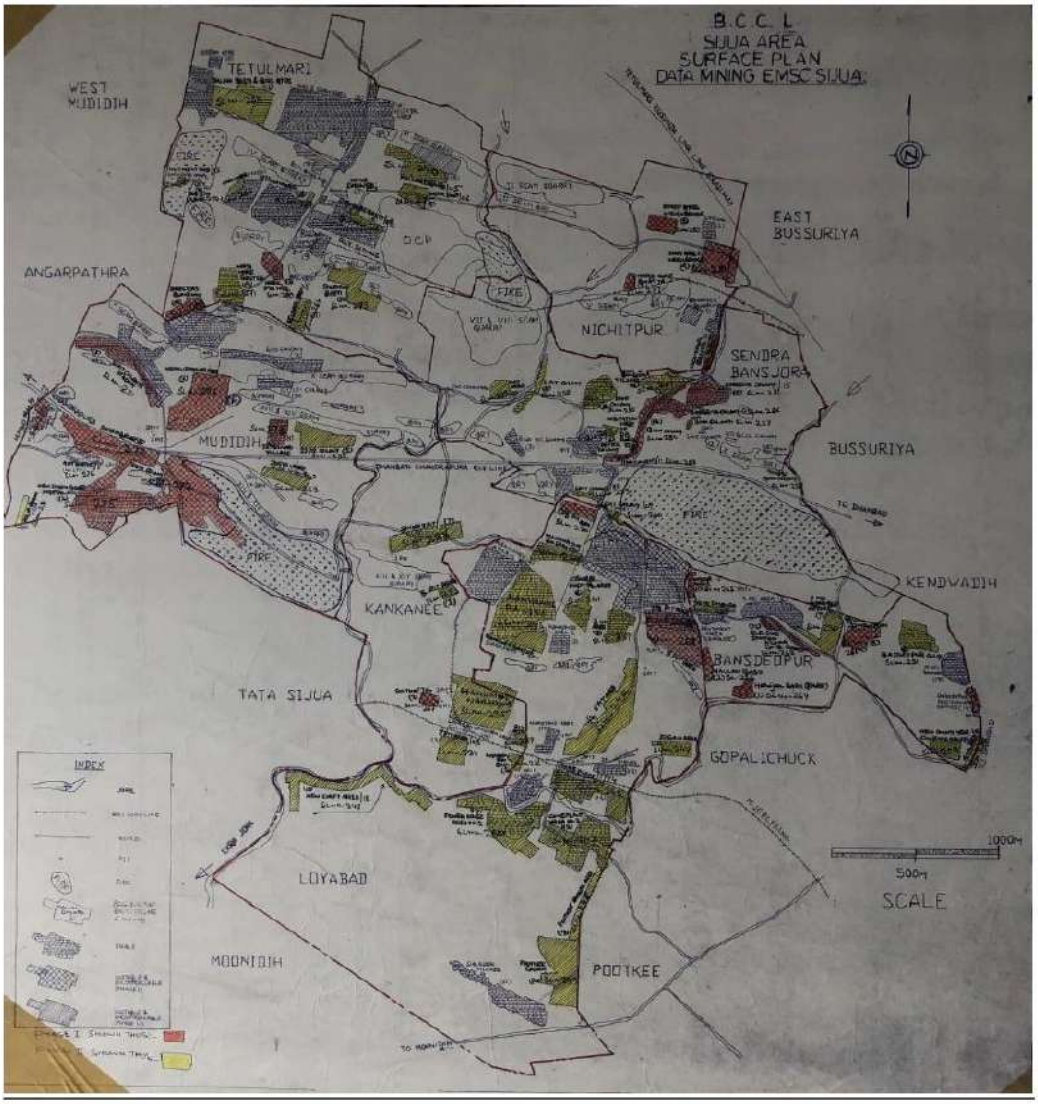
3. **CURRENT STATUS:**

- 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 as of 31.10.2019.

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:



Fire & Subsidence Site Survey Report of Sijua Area

S.No.	COLLIERY	SITE NAME	SITE NO	No. of Households Surveyed	No. of LTH	No. of Encroachers	Total No. of employees	Vacated
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/08	2/265	**19**	**19**	0	23	11
6		CHANDORE WEST	2/266	188	0	188		

		NO1/17						
7		CHANDORE WEST NO2/18	2/267	360+58	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	4	2
14		WORKSHOP/06	2/275	30	0	30		
15	**BANSDEOPUR**	8 NO. DHOWRA/08	1/261	238+34	0	272	23	10
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***	**NA**				
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	333+133	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	31	-
51		GARERIA COLONY/15	1/285	65	7	58	35	-
52		GARERIA COLONY1/14	1/286	**120**	**0**	120	58	-
53		HABITATION WEST OF DB ROAD/12	1/287	**59**	**0**	59	-	
54		19 NO. COLONY/19	2/256*				Demolished	
55		21 NO. COLONY/21	2/257*				4	-
56		6PIT COLONY/04	2/258*	NA			150	150
57		6 PIT COLONY/PAST/09	2/260	**20**	**0**	20	4	-
58		6 PIT COLONY/08	2/259	**7**	**0**	7	12	-
59		BANSJORA VILLAGE/16	2/261	**56**	**56**	0	-	-
60		OFFICE COLONY	2/263	34	0	34	54	54
61		10 No. COLONY	2/255	91	0	91	71	66
62		OCP OFFICE/02	2/262*	NA			7	7
63	**MUDIDIH**	10 PIT COLONY/07	1/271	200	0	200	18	3
64		JOGTA COLONY/13	1/272	289	0	289	25	6
65		LIPROSY AREA/09	1/273	15	0	15	3	1
66		NEW SHYAM BAJAR/12	1/275	351	0	351	39	12
67		NO. 04 PIT AREA/11	1/276*	NA			Demolished	
68		SHYAM BAZAR/08	1/277	362	0	362	7	4
69		TETULMARI VILL./04	1/278	**309**	**161**	148	0	0
70		22/12 COLONY/05	2/252	252	0	252	34	24
71		KAJRI BAGAN	2/254	14	0	14	0	0
72		JOGTA UPPER	2/253	204	0	204	21	8
73		6/10 COLONY	2/251	105	0	105	23	14
74		NEPAI DHOWRAH	1/274	193	0	193	60	1
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		9635	595	9040	706	373

Annexure 6 :

ENVIRONMENTAL ACTION PLAN & ITS IMPLEMENTATION

CLUSTER V

SIJUA AREA

BHARAT COKING COAL LIMITED, DHANBAD

2019-20

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 26.11.2019	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 located above coal bearing areas. • The roads over coal bearing areas are regularly graded and strengthened.	NA	NA
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*	• Wet drilling is being done in Tetulmari, Nichitpur and Sendra Bansjora, Kankanee OCPs of Sijua Area.	NA	

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 26.11.2019	Moved Proposal No. (If any)	Proposal status
		completion: E&M Deptt.			
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**)	• A proposal for installation of 34 nos of fixed water sprinklers at Bansjora Railway siding & CHP at Sendra Bansjora Colliery is in process.	• ***SB/SA/PO/ 2019/4125 dated 07.03.2019***	• Tender in final stage • Work order wiil be issued soon.
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.	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**)	• Indent for providing Mist sprinkling arrangement in the existing mobile water sprinklers is prepared.	NA	Indent forwarded to HQ for further approval.

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 26.11.2019	Moved Proposal No. (If any)	Proposal status
		C) *Capital Indent*: Area E&M Manager (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: MM deptt, HQ (**6 Months**)			
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 (3**2 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**)	• A proposal is in process for construction of wheel-washing ditch arrangement at Sendra Bansjora.	• ***718; dated 31.08.2019***	In process for fund allocation under capital budget.
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**)	• Enclosure of CHP is in progress at Sendra Bansjora. 2 CHPs have already been covered. The work for enclosing the remaining third CHP is in progress.	NA	• Tender floated.

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 26.11.2019	Moved Proposal No. (If any)	Proposal status
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 3 dormant OB dumps (26 Ha) in Mudidih & Loyabad has been 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**)	• A proposal has been moved for enclosing the railway siding at Bansjora with jute cloth. • Double row plantation has been done along the railway siding.	NA	• Fund has been approved & allocated. • File is in process for Budget Concurrence. 
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	• As discussed with Environment Dept., HQ, the work of Bioswale is a pilot project and it has been already planned in two other areas. It needs not to be taken up in Sijua Area.	NA	NA

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 26.11.2019	Moved Proposal No. (If any)	Proposal status
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 & Kankanee. A fixed water sprinkler has also been installed for the same.	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 Redressal**	***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 26.11.2019	Moved Proposal No. (If any)	Proposal status
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 locations for installation of Online PM_{10} analyzers have been identified. Capital indent has been moved for Tetulmari, Nichitpur & Sendra Bansjora.	NA	• Forwarded to Environment Dept., HQ for preparation of composite indent for all the areas.
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 started and is being done by NEERI, Nagpur. • Summer data has been collected. • Winter Data will be collected soon and thereafter report will be submitted.	NA	NA

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 26.11.2019	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 is going on.	NA	• Inter- Area Inspection are 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 26.11.2019	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. • A proposal is in process for providing inlet channel and heightening of washing ramp to make the O&G trap fully functional at Tetulmari workshop.	NA	• Estimate prepared & administrative approval has been accorded. 
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**)	• For the time being, construction of retaining wall is not feasible at Bansjora, & Nichitpur OB dumps. • The construction of OB dump at Kankanee as proposed by AM (Survey), Sijua Area was also found not to serve the required purpose.	NA	

SL No.	Type of Action	Activities and Executing Responsibilities	Action Taken as on 26.11.2019	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	• A proposal for plantation along mine boundaries, jores, and railway sidings covering total length of 15.6 km is in process. • Plantation work over OB dumps covering an area of 32 Ha in Loyabad and Bansdeopur is being done in association with DFO, Dhanbad. • Plantation is also being done in the existing Eco-restoration sites for gap filling. • "Sneh Smriti Upvan" is being developed at Sendra Bansjora. • Approx. 81,500 saplings have been planted within the leasehold of Sijua Area in 2019-20 till date. • Seed-balls of native species (approx. 45 kg) have also broadcasted.	• 1040 dated 27.06.2019	 
24		***Mechanical Sweeper*** Proposal: CSR Deptt. Handed over to Dhanbad Municipal Corporation	• To be done by the CSR Dept., HQ, Koyla Bhawan.	NA	NA

Annexure 7 :

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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.

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

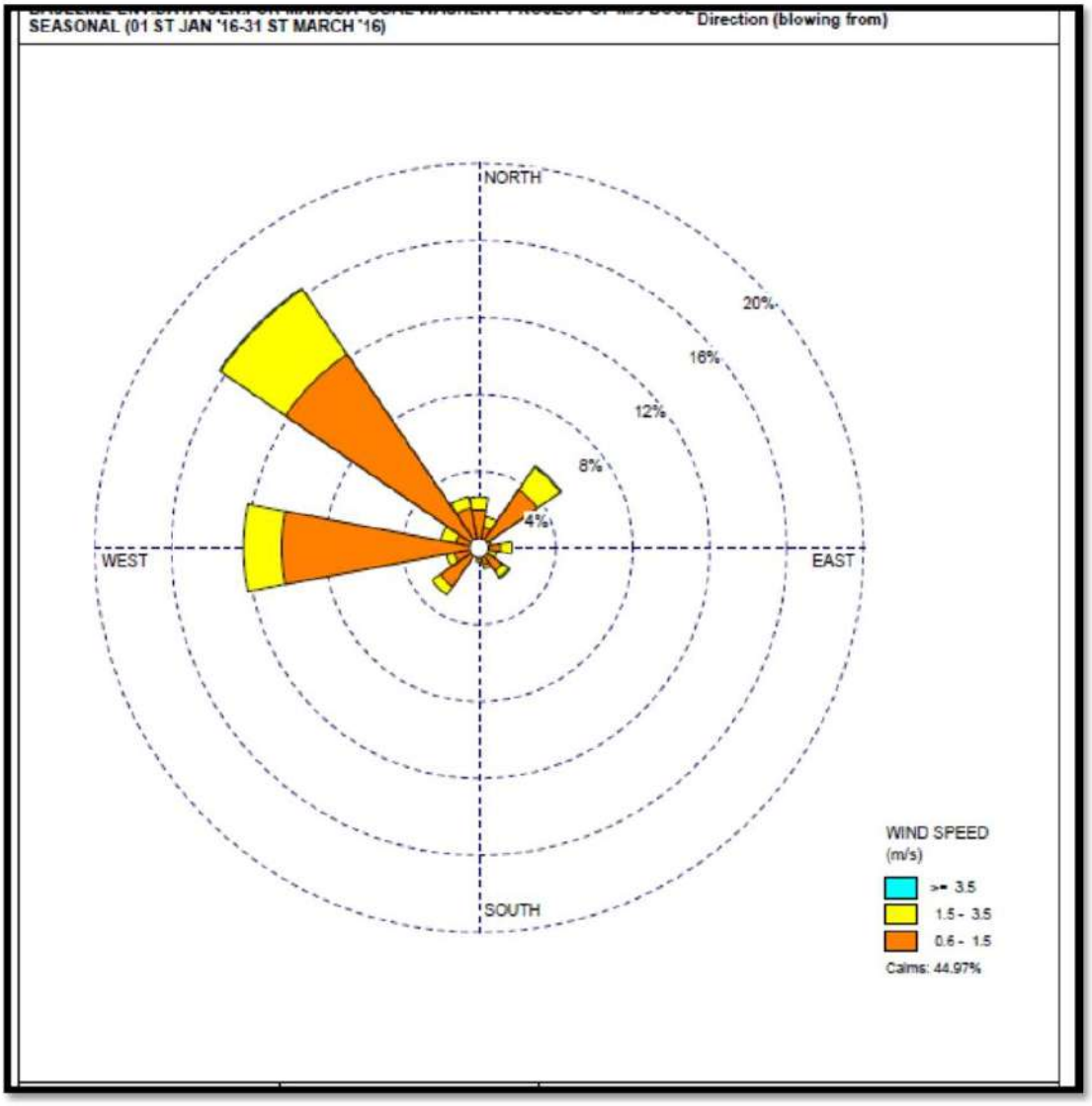


Figure No.-1.1 Wind Rose diagram for the period 1St Jan to 31St March 2016

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
Kank	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

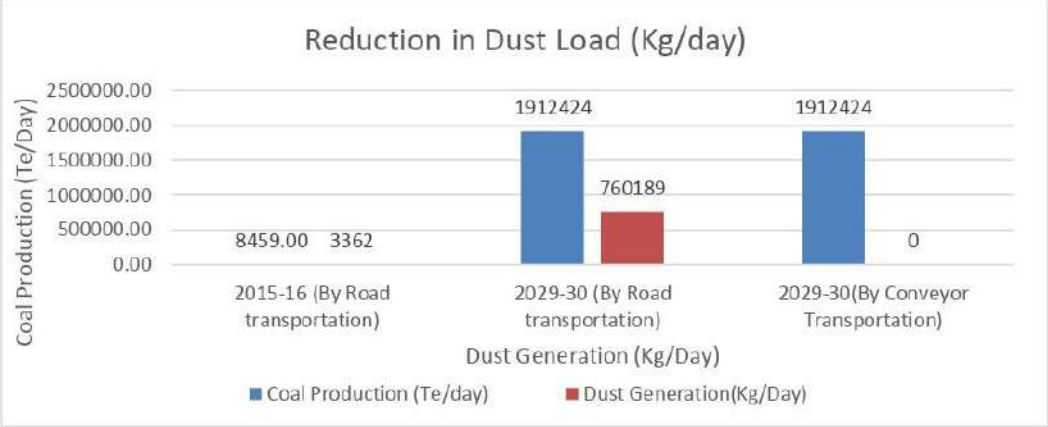
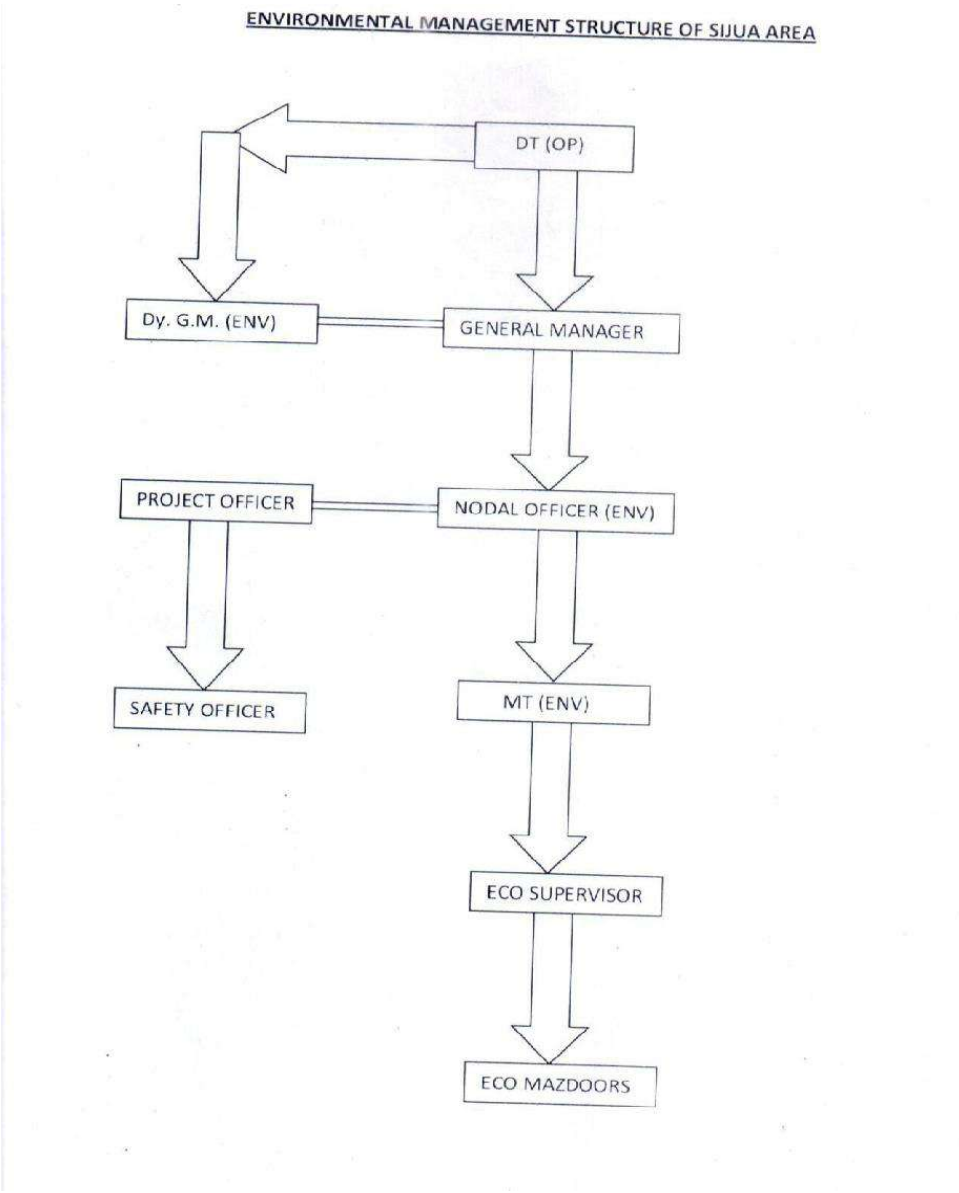


Figure 2.1: Presentation of reduction in dust generation due to replacement of Road transportation by Conveyor system.

Annexure 8:



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

S. No.	Name	Designation	Educational Qualification
1	Rajesh Ranjan	Asst. Manager (Env.)	B.Tech (Environmental Engineering)
2	Anant Vijay Kumar	M.T. (Env.)	M.Tech (Environmental Engineering)
3	Paramjeet Ranjan	Asst. Manager (Community Development)	Masters(Rural Development)
4	B.N. Prasad	Sr. Manager (Mining)	Diploma (Mining)
5	S.K. Manna	Manager(Mining)	Diploma (Mining)
6	Ramu Prasad	Deputy Manager(Mining)	B.Tech (Mining)
7	Abhishek Kumar	Deputy Manager(Mining)	B.Tech (Mining)
8	Ajay Sharma	Asst. Manager(Mining)	Diploma (Mining & Mine Survey)

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.....

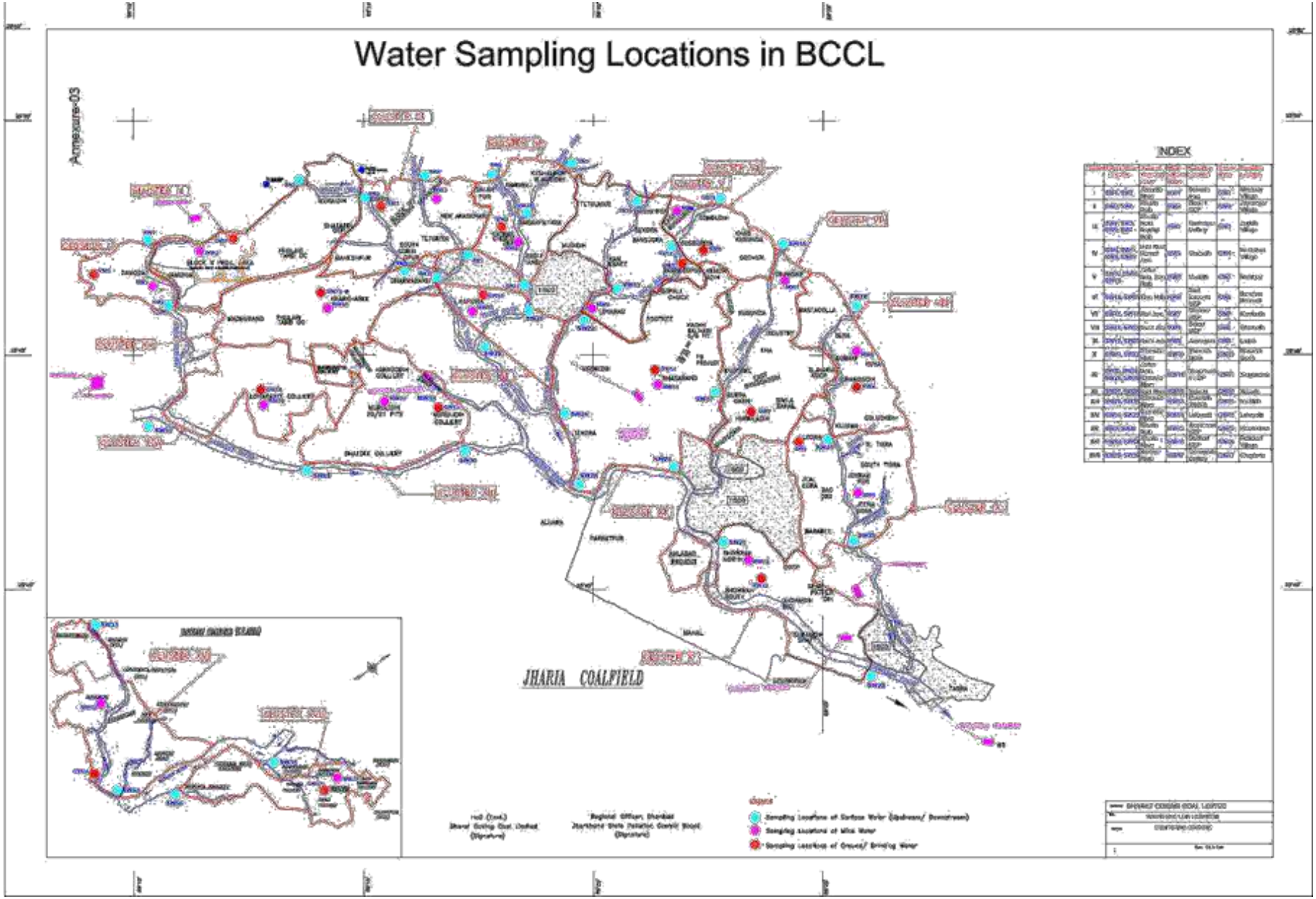
Copy to: The Member Secretary, Jharkhand State Pollution Control Board for information & enclose a copy of the map for necessary action.

Encl-A/a.

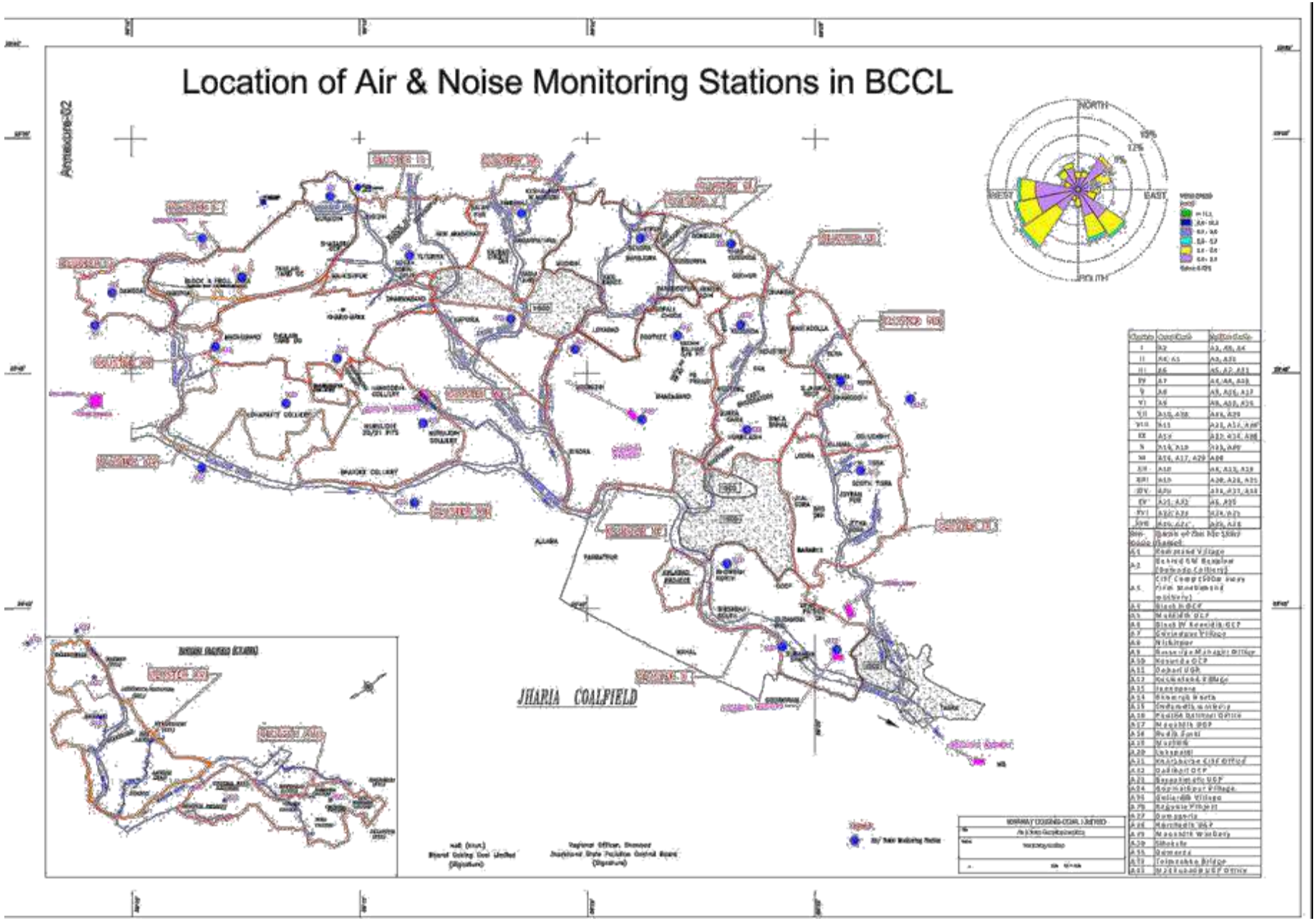
(Dinesh Pd. Singh)
Regional Officer.

Printed by Sandip

Water Sampling Locations in BCCL



Location of Air & Noise Monitoring Stations in BCCL



Annexure 10- Work progress report of NEERI, Nagpur for source apportionment Study

Progress Report

1st Phase Air Monitoring report for

"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

2019

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1. Introduction

1.1 Project Background

Bharat Coking Coal Limited, a subsidiary of Coal India Limited, has been operating the majority of the coal mines in the Jharia coal field regions since its inception in 1972. Jharia coal mines are special for its low ash content and high calorific value coals. 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 causes lot of fugitive gaseous and PM emissions. Hence, Jharia region has been under scrutiny by various public authorities and 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 dusts, fugitive emissions, fuel oils, household LPGs, etc. The percentage contribution of these factors in the ambient depends exclusively on the economic activities of that particular region. 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 MoEF 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 Jharia coalfields region in order to quantify the various sources PM emissions and suggest an effective environmental management plan.

1.2 Project objectives

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

The detailed objectives are as following:

i. Ambient Air Monitoring

- ✓ Monitoring of ambient air quality at selected receptor locations for pollutants including PM10, PM 2.5(limited), SO2, NOx, PAHs to establish the status of the air quality in Jharia Coalfields along with area up to 10 K.M from the periphery/boundary of BCCL mines. Also, review of the available air quality monitoring data from Central Pollution Control Board (CPCB) /Jharkhand State Pollution Control Board (JSPCB).

- ✓ To calibrate dispersion modelling predictions using measured air quality parameters.

- ✓ To draw supportive data through specific site related monitoring regarding impact causing sources such as kerbside monitoring.
- ✓ To establish the impact of meteorological conditions on a few select indicator pollutants in different micro meteorological conditions of the Jharia Coalfields.

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

- ✓ To identify the pollution load grid wise for point, line and area source
- ✓ To establish possibilities of receptor level concentrations of air pollutants by matching dispersion modelling and air quality-monitoring data.

iii. Source apportionment related

- ✓ To identify and apportion the pollution load at receptor level to various sources in the Jharia Coalfields along with area up to 10 Km from the periphery / boundary of BCCL mines.
- ✓ To carry out the source apportionment using molecular markers for a limited number of samples through a time resolved sample collection at various period of the day and day-of-the-week.

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

2. Field visit

In connection with the above objectives, the NEERI's team and BCCL's team visited BCCL's Jharia coal filed for 3 days from 23 September to 27 September 2018. The team covered the entire Jharia coalfield, which spans roughly 30km in length and 22 km wide in three days with the following purpose.

To identified the location for air monitoring station in entire Jharia Coal Field region.

2.1 Jharia coalfield maps:

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 and details of the visit along with mine cluster names are given in Table 2.1.

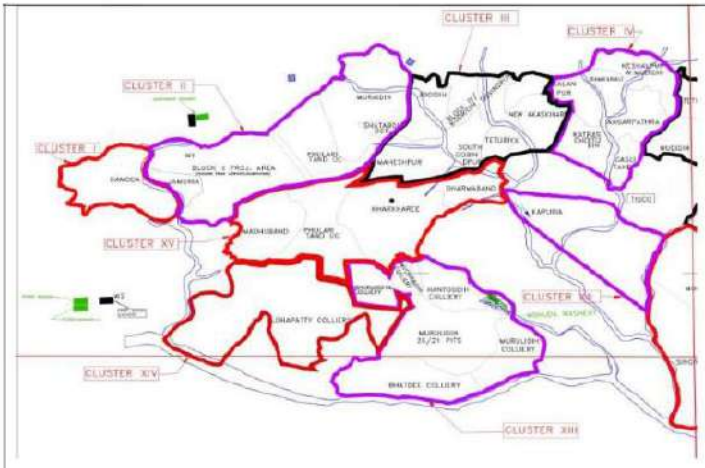
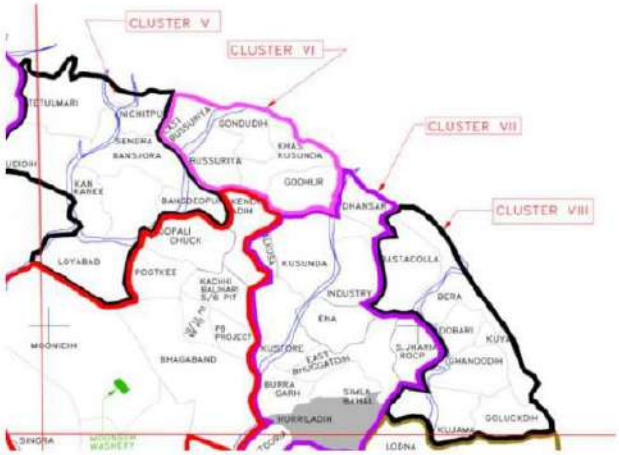
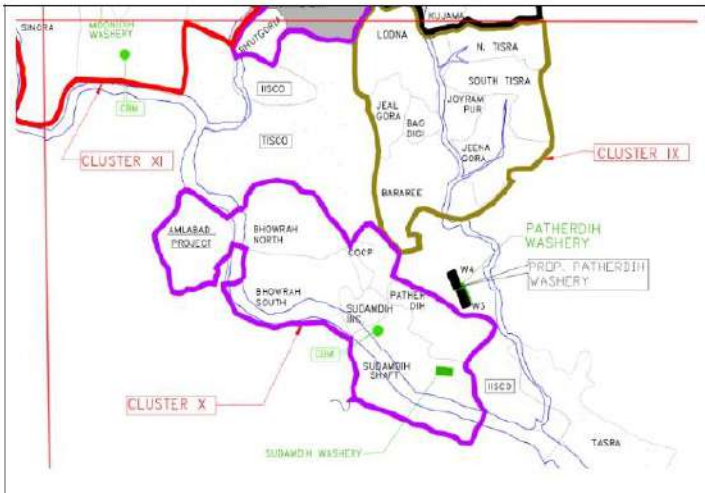
	**Part 1:** Cluster VI, VII, VIII, and X
	**Part 2:** I, II,III, IV, V, XI, XII, XIII, and XV
	**Part 3:** Cluster IX

Table 2.1 Jharia coalfields Site visit on cluster-base

Based on the objectives and outcomes envisaged, the various mine areas were visited to identify sources of emissions such dumpsite emissions, fugitive emissions, blasting emissions. Furthermore, the already existing PM monitoring sites of BCCL were also visited to explore of possibility of installing NEERI's PM monitoring stations.

2.2 Site Identification:

The Entire Jharia Coal Field (JCF) is divided into 16 clusters. Both opencast 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, which have 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.

Based on the preliminary field visit by CSIR-NEERI Scientists along with BCCL staffs, the following locations are 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 IV or Cluster V – Banssuriya or Katras
4. Cluster IX (Lodhna)
5. Cluster XI (Moonidih)
6. Cluster X (Patherdih): nearby sources: Coal Mine, Steel Industry
7. Cluster VIII (Bastacola)

Buffer Zone

8. Bank More
9. Harina
10. Bhuli
11. Sindri
12. Parbatpur Electrosteel/ Bhaga

13. Background site (Upwind & away from sources) and also secondary Data from DVC, CCL mines Sail Bokaro and Jharkhand pollution Control Board will be obtained.

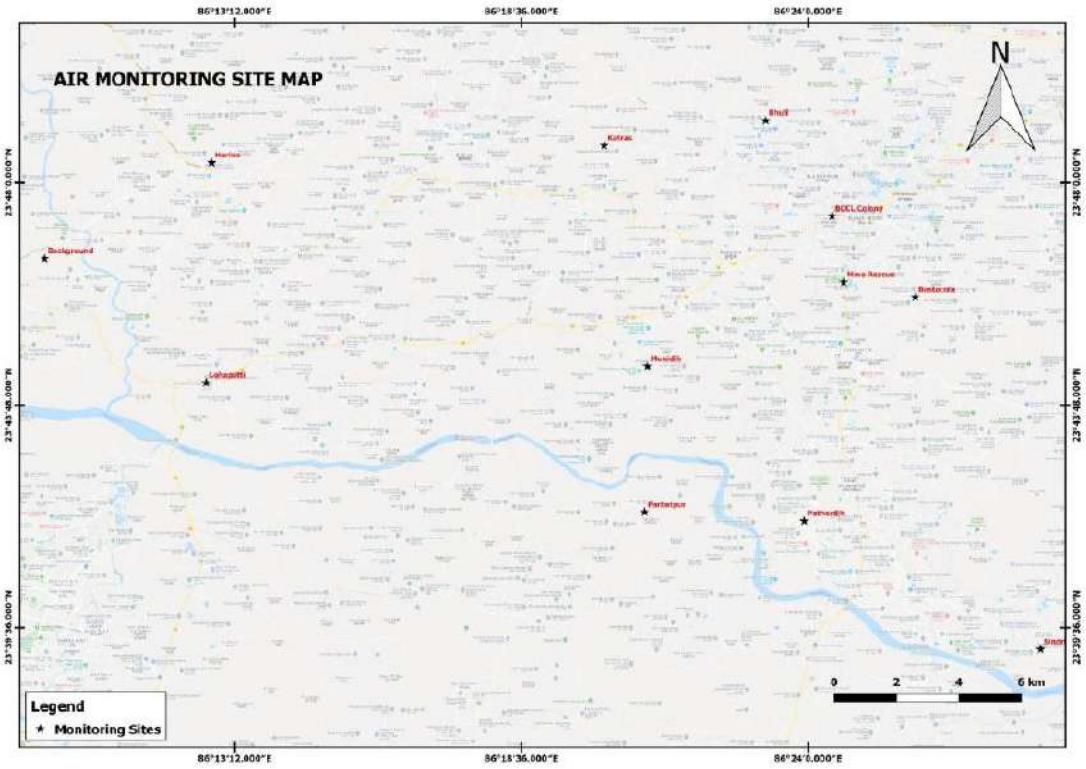


Figure2.1 Identified air monitoring station in Jharia Coalfield

3. Sampler Selection and Procurement

Standard equipment were catered for the parameter required towards ambient air particulate characterization and gaseous sampling in the initial phase of the project.

Table 3.1 Samplers Procured for Monitoring

Sampler	**Brief Description of operating conditions**
Fine Dust Sampler	Sampling Inlets- $PM_{2.5}$, PM_{10} and TSP Flow rate-16.7LPM
FRM Sampler	Versatile inlet configurations for $PM_{2.5}$, PM_{10}, or TSP sampling FRM quality 24-hour sampling at 16.7 LPM
Gaseous Sampler	Sampling Rate-0.5-1.0 LPM Operation time-8 hours

4. Monitoring parameters

Parameters of monitoring were decided based on the objectives of air pollution and source apportionment study. The source apportionment analysis required air monitoring for particulate matter ($PM_{2.5}$ and PM_{10}) and its chemical speciation to develop signature profiles of pollution sources that can be used in chemical mass balance models. The analysis data could also be used to interpret the overall loading of different chemicals contributed varied sources. Monitoring included air quality attributes such as Particulate matter, Sulphur Dioxide (SO_2) and Oxides of Nitrogen as NO_2, to understand not only the regulatory compliance but also their inter-correlations with other species such as Heavy metals, EC, OC etc. Since the objective of source apportionment study is to determine the contributions from various sources such as industries, vehicular and other area sources additional parameters were also monitored such as Polycyclic Aromatic Hydrocarbons (PAHs). List of all parameters, sampling flow rate and analytical methods are provided in Table 4.1

Table 4.1 Ambient Air Quality Sampling/Analysis Methodology for Target Pollutants

Particulars	Parameters			
	PM_{10}	$PM_{2.5}$	NO_2	SO_2
Sampling Instrument	Fine Dust Sampler & FRM Sampler	Fine Dust Sampler & FRM Sampler	APM sampler	APM sampler
Sampling Principle	Cyclonic Flow Technique	Cyclonic Flow Technique/ WINS Impactor	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	10 days continuous, Teflon and quartz on alternate days	10 days continuous, Teflon and quartz on alternate days	10 days continuous	10 days continuous

Analytical Instrument	Electronic Micro Balance	Electronic Micro Balance	Spectrophoto-meter	Spectrophoto-meter
Analytical Method	Gravimetric	Gravimetric	Colorimetric Improved West & Gaeke Method	Colorimetric Improved West & Gaeke Method
Minimum reportable value	5 $\mu g/m^3$	5 $\mu g/m^3$	9 $\mu g/m^3$	4 $\mu g/m^3$

4.1 Monitoring Frequency

All pollutants exhibit diurnal and seasonal variations, which have been taken into account while determining the frequency of the sampling. In order to assess the impact of the diurnal variations in source contributions for a given meteorology of the day, 24 hourly monitoring plan was envisaged (8 hourly sampling for gaseous pollutants and 24 hourly sampling for particulate matter). The field study was planned for a period of 10 days at each monitoring site for the season to represent variation in air quality. The sampling frequency details are presented in Table 4.1.

Table 4.1.1 Frequency of Air pollutants sampling in Jharia Coalfield

Parameter	Number of Days	Change of Filter/ absorbing media	Reporting
PM_{10}	10	24 hourly, Teflon: 05 days Quartz: 05 days	24 hourly
$PM_{2.5}$	10	24 hourly Teflon: 05 days Quartz: 05 days	24 hourly
NO_2	10	8 hourly	8 hourly
SO_2	10	8 hourly	8 hourly

The glimpses of air monitoring of some locations are shown in Figure 4.1.

Figure 4.1 Glimpses of air monitoring of some locations

4.2 Filter handling and Weighing:

Teflon-membrane and quartz-fibre filter are most commonly used for chemical analysis. Each filter was individually examined prior to labelling for discoloration, pinholes, creases, separation of ring, chaff or flashing, loose material, or other defects.

Gravimetry measured the net mass on a filter by weighing the filter before and after sampling with balance in temperature and relative humidity controlled environment. To minimize particle volatilization and aerosol liquid water bias, $PM_{2.5}$ Filters were equilibrated for 24 hours at a constant (within ±5%) relative humidity between 30% and 40% at a constant (within ±2°C) temperature between 20°C and 23°C. PM_{10} filters were equilibrated at 20% to 45% relative humidity (±5%) and 15°C to 30°C temperature (±3°C).

Methods of Chemical characterization:

Sulphur dioxide (SO_2)	: Modified West and Gaeke method
Nitrogen dioxide (NO_2)	: Sodium Arsenite method
Suspended Particulate Matter (SPM)	: High Volume method (Gravimetric method)
Respirable suspended Particulate Matter (RSPM)	: Gravimetrically with GFA/EPM 2000 filter paper using respirable dust sampler (Cyclonic Flow Technique)

5. Ambient Air Quality Monitoring

Core Zone

Site 1: Cluster XIV (Lohapatty)

The samplers were installed on the roof of area office of Lohapatty (Latitude 23.737066 and Longitude 86.210894). It was located near residential colony. Coal mine was 1 km away from the sampling site. Coal has been transported through railway line which is 1.5 km away on a daily basis and also through trucks. NH-32 construction was going on 500 m away from the site. The major fuel used for cooking is coal in the study area.

Site 2: Cluster VII Mine rescue Station

Monitoring station was positioned in Mine rescue station, Dhansar on the roof of office building (Latitude 23.768746 and Longitude 86.411141). Mine rescue station is next to

the state highway 12 where continuous movement of heavy vehicles takes place. Mining activities were also observed nearby the location.

Site 3: Cluster V Katras

In Katras, samplers were installed at Expert hostel (Latitude 23.811692 and Longitude 86.335910). There was a settlement residential area nearby. Mining activities was in progress within 500m area. Railway track was nearly at 150m distance from the site. Coal was used for cooking. Many other activities were observed during sampling in the nearby area which may contribute. 'Mela' and continuous 'Hawan' were going on within 100m area. Also road construction was in progress near 7km.

Site 4: Cluster IX (Lodhana)

Samplers were installed at office in Lodhna (Latitude 23.721713 and Longitude 86.410260). Near Lodhna, colliery was 2 km away from the site. Nearest Railway track was 1.5 km away. Coal was mostly used for cooling.

Site 5: Cluster XI (Moonidih)

Moonidih mine is one of the underground mine of BCCL. Sampler was stationed in Area office of Moonidih mine (Latitude 23.742228 and Longitude 86.349494). Since monitoring location was 250-300m from the mine, movement of heavy vehicles was continuous. There is washery also at distance of 500m where trucks and conveyor were used for transportation of coal. So the mining activities nearby contributes to particulate matter emission.

Site 6: Cluster X (Patherdih)

Samplers were stationed in guest house of BCCL in Patherdih area (Latitude 23.693577 and Longitude 86.398728). It is situated beside highway where continuous movement of heavy vehicles observed. TATA steel coal mine is situated 1km away from the location where continuous mining activities takes place. Transportation of coal through railway wagons in same area also contributes to particulate matter emission.

Site 7: Cluster VIII (Bastacola)

The samplers were positioned in area office of Bastacola mine (Latitude 23.763966 and Longitude 86.433635). Here also, coal was used as a cooking media. Railway track was

at Jodaphata which was 3-4 km away from the site. Residential area was nearly 0.5-1km. Mine was situated 3km from the site but no Mining activity was observed during monitoring.

Buffer zone

Site 8: Bank More (BCCL Colony)

Sampling station was installed in BCCL colony, Jawahar Nagar on the roof of a resident (Latitude 23.789463 and Longitude 86.407448). No mining activities were observed but the colony was beside the NH 18 highway so it may contribute to particulate matter emission.

Site 9: Harina

At Harina, the site chosen for air sampling was BCCL colony (Latitude 23.806308 and Longitude 86.212641). Since it was BCCL residential area, fuel used for cooking purpose was LPG. Settlement residential area was observed nearby where coal was used as a media for cooking. Colliery and Railway track were 3km and 2 km away from the site respectively. Highway was 1km away from the site and Coal washery at distance of 4.5km.

Site 10: Bhuli

The samplers were installed on the roof of Saraswati Vidya Mandir, Bhuli (Latitude 23.819554 and Longitude 86.386647). The location was in residential area. Mining activity was going at a distance of 8-10km. A closed Brick factory was located in the nearby area. Fuel used for cooking was mostly coal. Railway track used for coal transportation was 4km from the site. Construction of highway was also going on within 1.5km area during the monitoring.

Site 11: Sindri

Air samplers were installed at BIT Sindri college campus (Latitude 23.653214 and Longitude 86.473022). Transportation of coal was done by railway wagons at distance of 2km from monitoring site. LPG was mostly used for cooking rather than coal. A construction activity was going on nearby. The site was near the highway at a distance of <100m.

Site 12: Parbatpur

The sampling station was installed on roof of a house (Latitude 23.696296 and Longitude 86.348609). Mining activity was no longer going nearby. Coal was primarily used for cooking.

Site 13: Background

The air monitoring samplers were installed on roof of resident's house which was near to the highway at a distance of less than 1 km (Latitude 23.776180 Longitude 86.160177). Construction activities were going on nearby the location. Heavy rainfall also occurred during monitoring period. Mine activities were also observed in radius of 2-3km. Settlement resident's uses coal for cooking purposes.

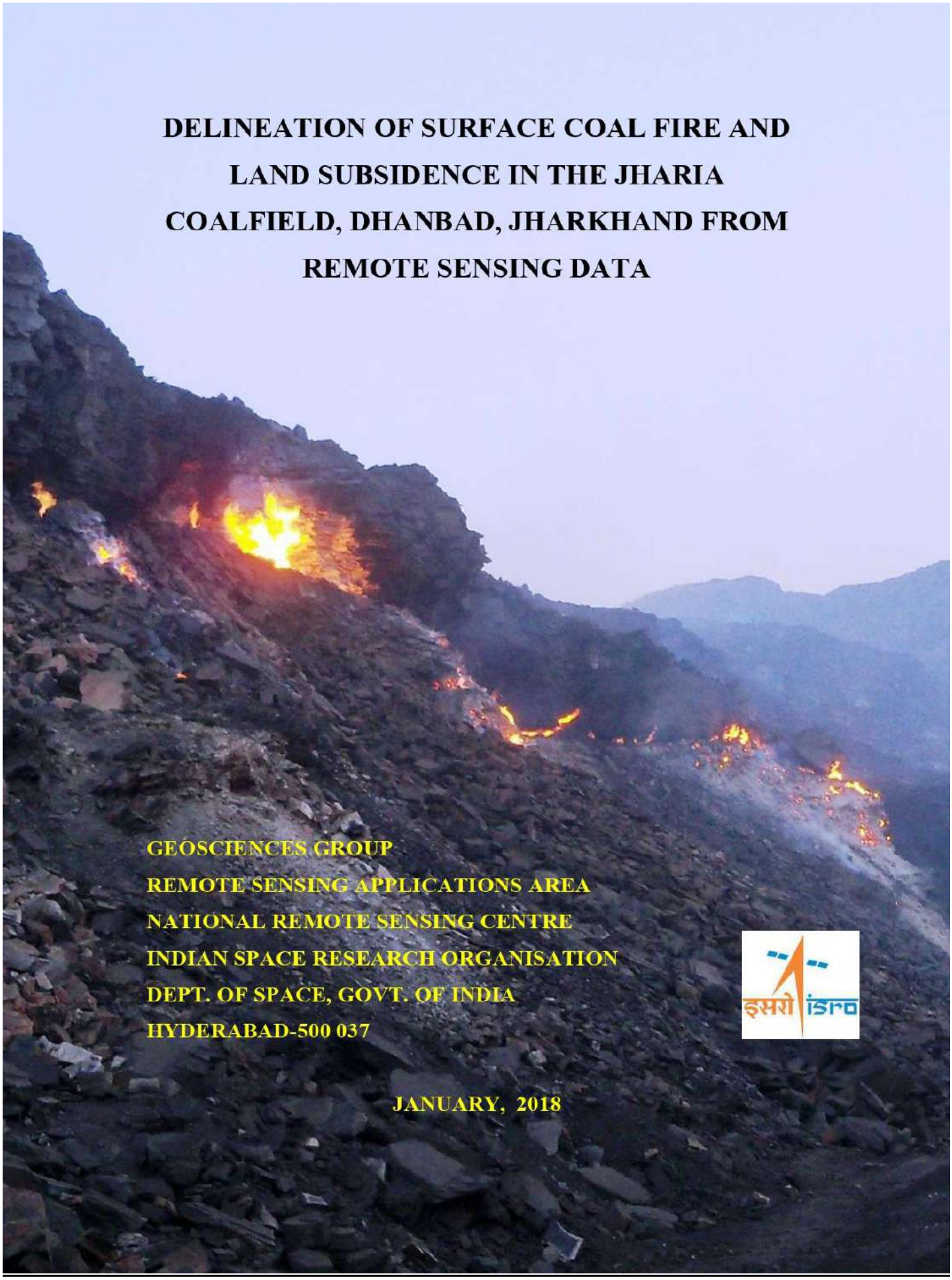
Sample collection Transportation and Preservation

Ambient $PM_{2.5}$ and PM_{10} samples were collected using suitable sampler at a desired flow rate. Filters were wrapped carefully with aluminium foil and stored in re-sealable plastic bags. At sampling site, the filter that collected the particle sample on the previous day was taken out of the filter holder and immediately wrapped with aluminium foil and sealed. The sample filers were transported back to the laboratory in an isolated cooler container with ice and then frozen at -10°C until analysis.

Table 5. 1 Physical and Chemical components for characterization of Particulate matter

Components	**Filter Matrix**	**Analytical Methods**
PM10/ PM2.5	Teflon/Quartz filter paper	Gravimetric
Elements (Na, Mg, Al, Si, P, S, Cl, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Se, Br, Rb, Sr, Y, Zr, Mo, Pd, Ag, Cr, Cd, In, Sn, Sb, Ba, La, Hg, Ti, and Pb)	Teflon/Quartz filter paper	ICP-OES
Ions ($NO2^-$, $NO3^-$, SO_4^{-2}, K+, NH^{4+}, Na^+)	Teflon/Quartz filter paper	Ion chromatography with conductivity detector
Carbon Analysis (OC, EC)	Quartz filter paper	TOR/TOT method
PAHs	Teflon/Quartz filter paper	Extraction followed by GC-MS analysis with and without derivatization

Annexure 11: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NRSC/RSAA/GSG/BCCL/Project Report/JAN2018

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

GEOSCIENCES GROUP

REMOTE SENSING APPLICATIONS AREA

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DEPT. OF SPACE, GOVT. OF INDIA

HYDERABAD-500 037

JANUARY, 2018

PROJECT TEAM

1. **Dr. K VINOD KUMAR**, Group Head, Geosciences Group
   Project formulation and coordination
2. **Dr. Tapas R. Martha**, Scientist 'SF'
   Field survey and report preparation
3. **Shri Priyom Roy,** Scientist 'SD'
   Image processing, interpretation, field survey, maps and report preparation

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.

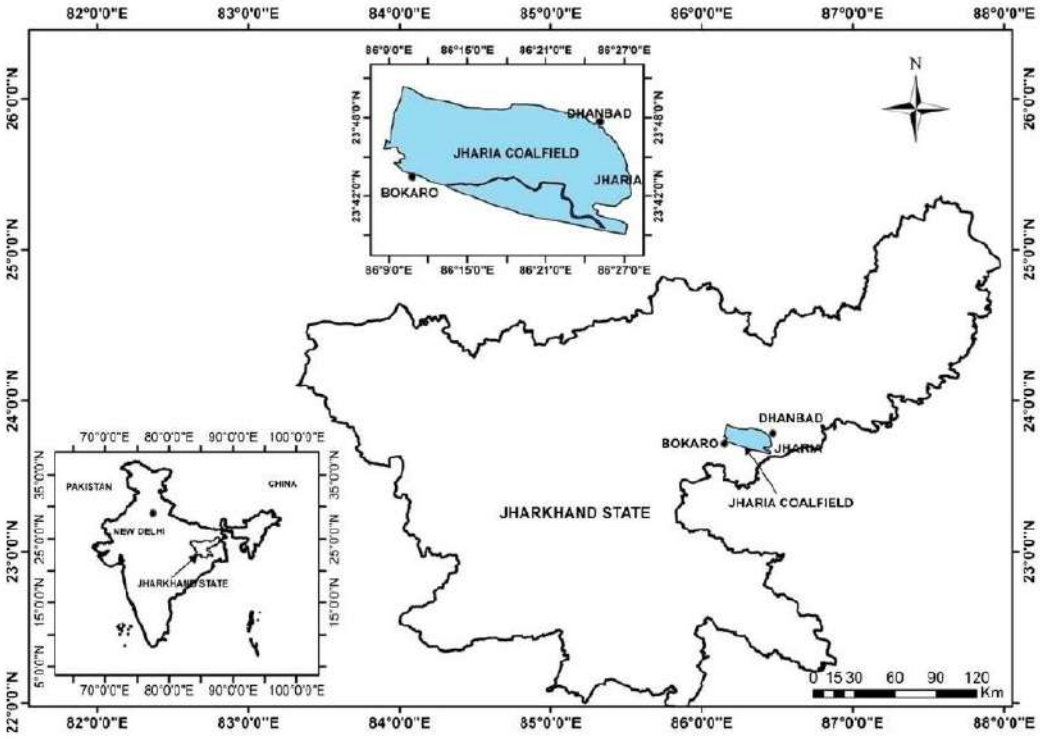

Figure 1: Study area map of Jharia Coalfied, Jharkhand

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° C in the month of December – January and maximum temperature is >50° 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.

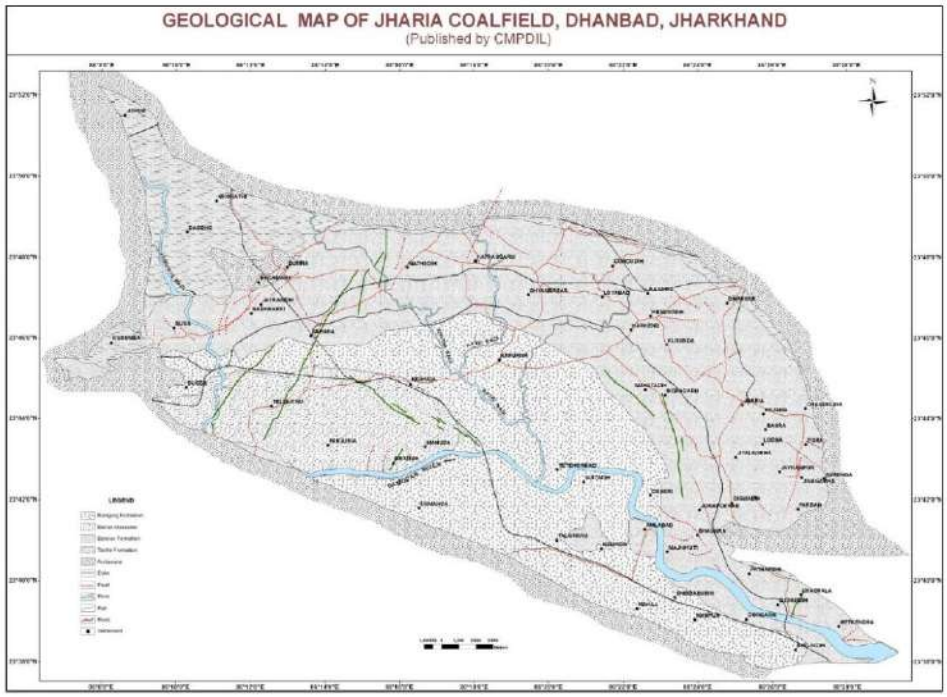

Figure 2 : Geological map of Jharia coal field, Dhanbad, Jharkhand (published by CMPIDL)

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.

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

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).

$$T_R = K_2 / \ln ((K_1 / L_\lambda) + 1) \ldots\ldots\ldots (2)$$

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).

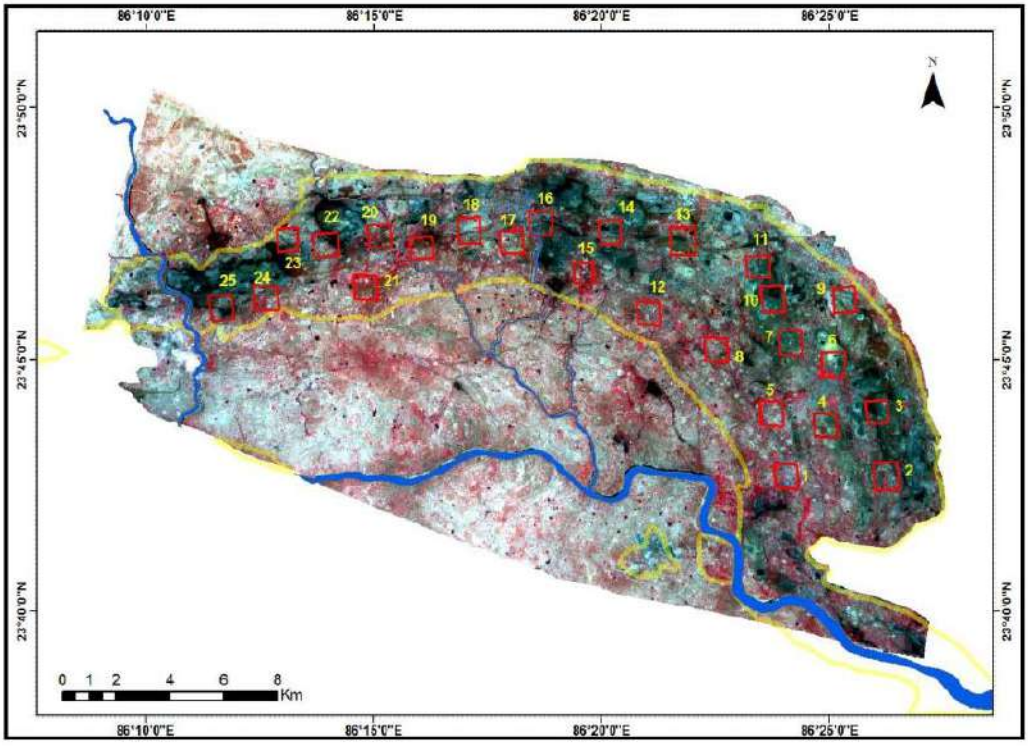

Figure 3. False colour composite image of Jharia Coalfield, with subset blocks (in red boxes) to obtain temperature values (from radiant temperature image) within the Barakar formation across the Jharia coalfield.

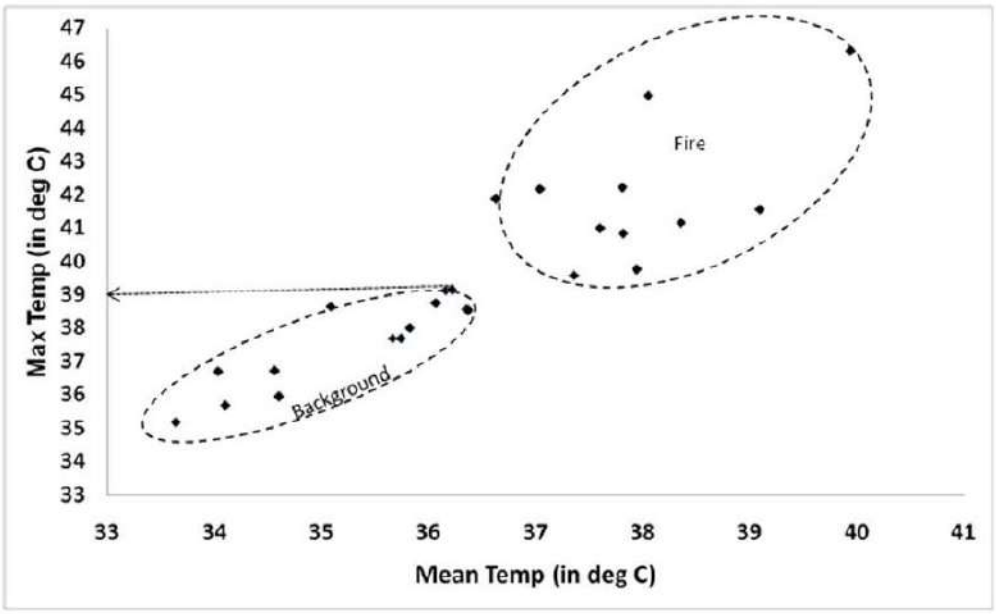

Figure 4. Maximum temperature plotted against mean temperature for various locations; cluster separation observed around 39 °C (marked with arrow)

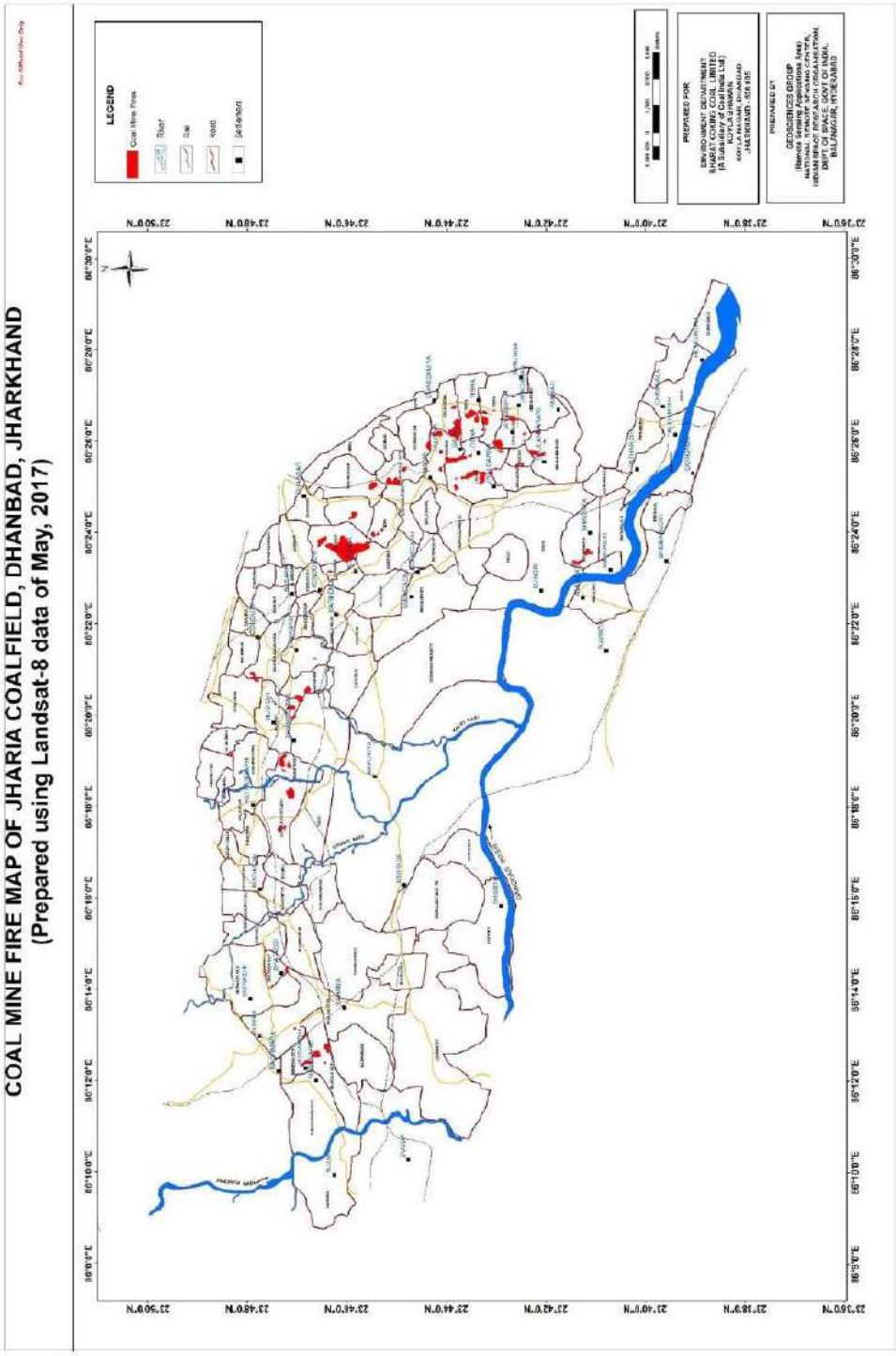

Figure 5: Coal mine fire map (May, 2017) of Jharia coal field, Dhanbad. The fire areas shown in this map have been verified in the field as per field points in figure 13.

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).

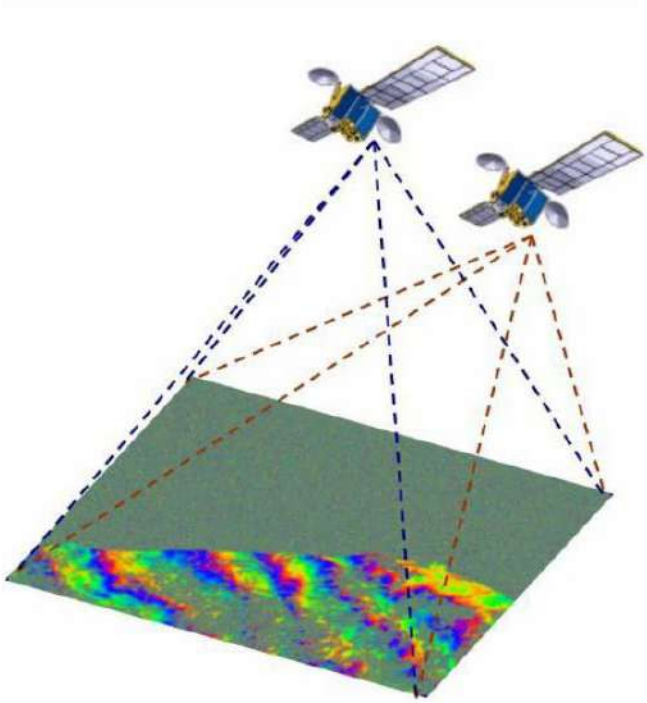

Figure 6. DInSAR acquisition scheme.

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, $\Phi Topo$ denotes the topographic component, ΦMov denotes the terrain deformation/ displacement component, ΦAtm is the noise component and $\Phi Noise$ is the thermal noise.

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

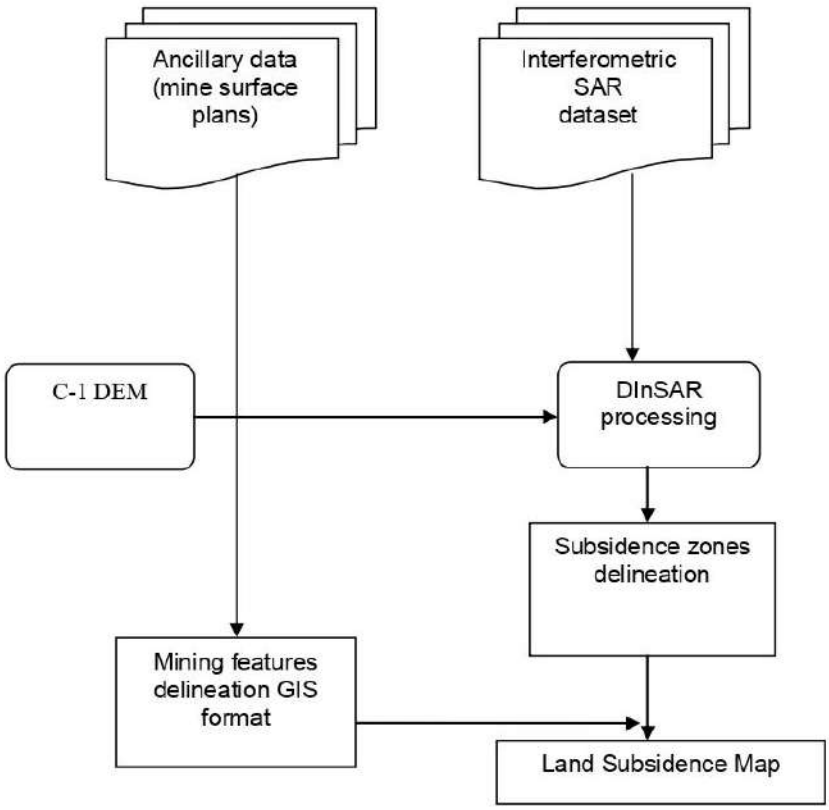

Figure 7. Work flow diagram for generating land subsidence map using DInSAR technique.

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.

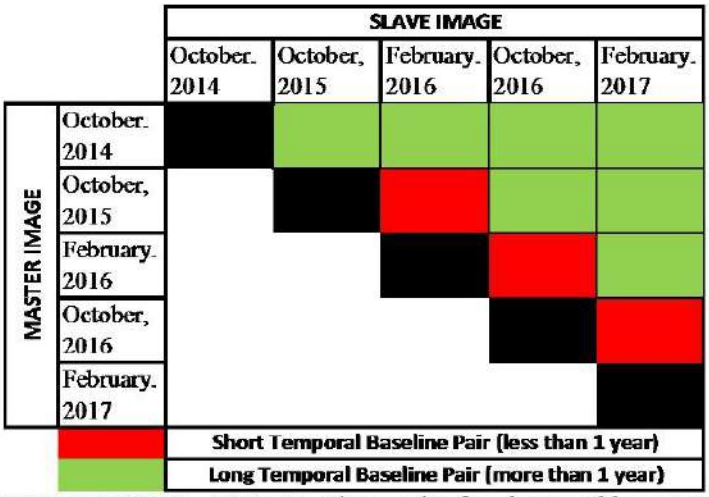

Figure 8. ALOS-PALSAR - 2 Master-Slave pairs for short and long temporal base line processing

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).

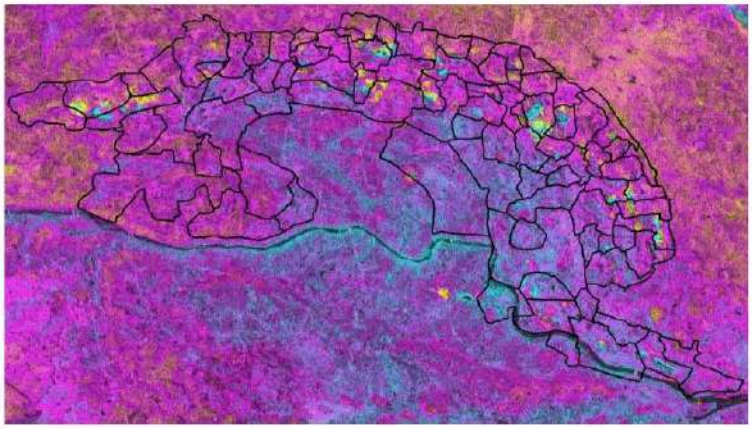

Figure 9. Fringe patterns generated from short baseline processing (e.g. Master: Oct, 16, Slave: Feb, 17).

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).

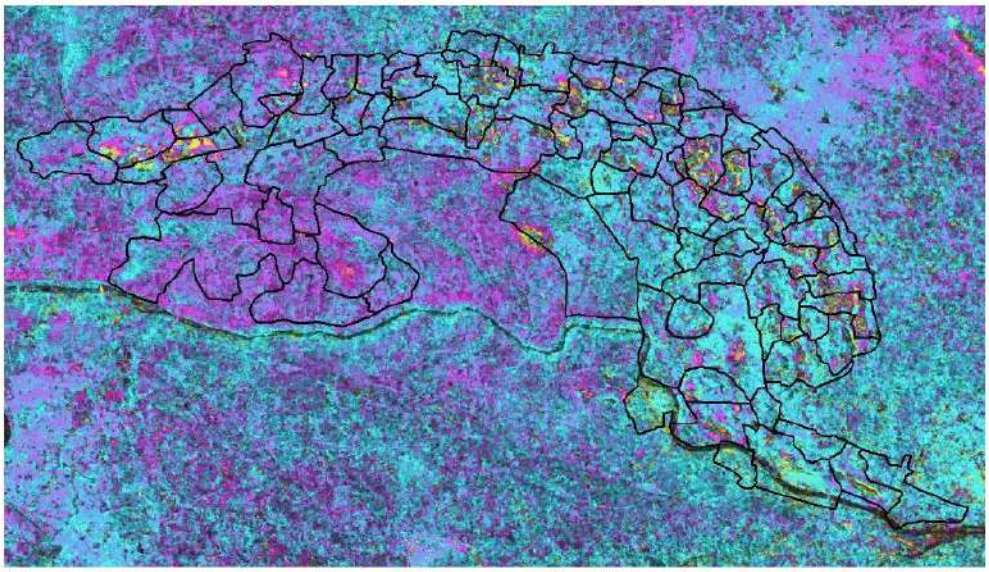

Figure 10. Fringe patterns generated from long baseline processing (e.g. Master: Oct, 15, Slave: Feb, 17).

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).

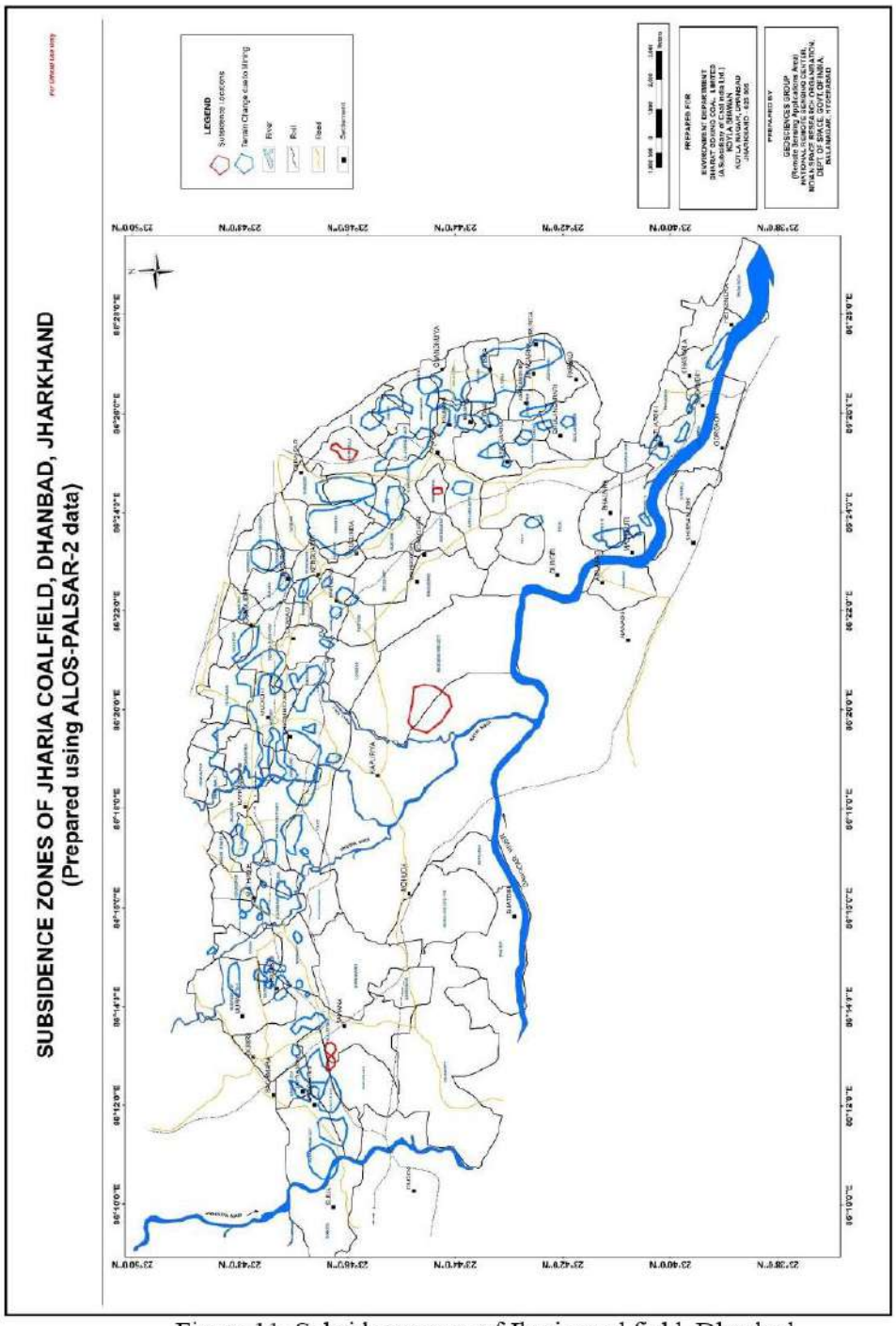

Figure 11: Subsidence map of Jharia coal field, Dhanbad.

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.*

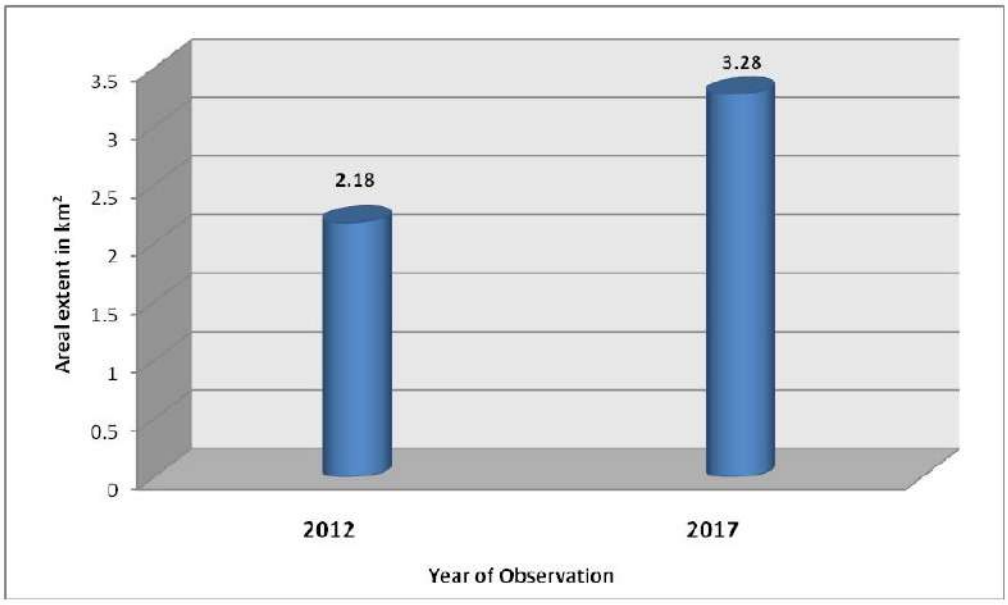

Figure 12: Total fire area statistics

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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11. Coal mine fire delineation and surface features mapping using satellite data in Jharia coal field, Dhanbad, Jharkhand. Geosciences Group. *Official report, NRSC, 2014*

Annexure –I

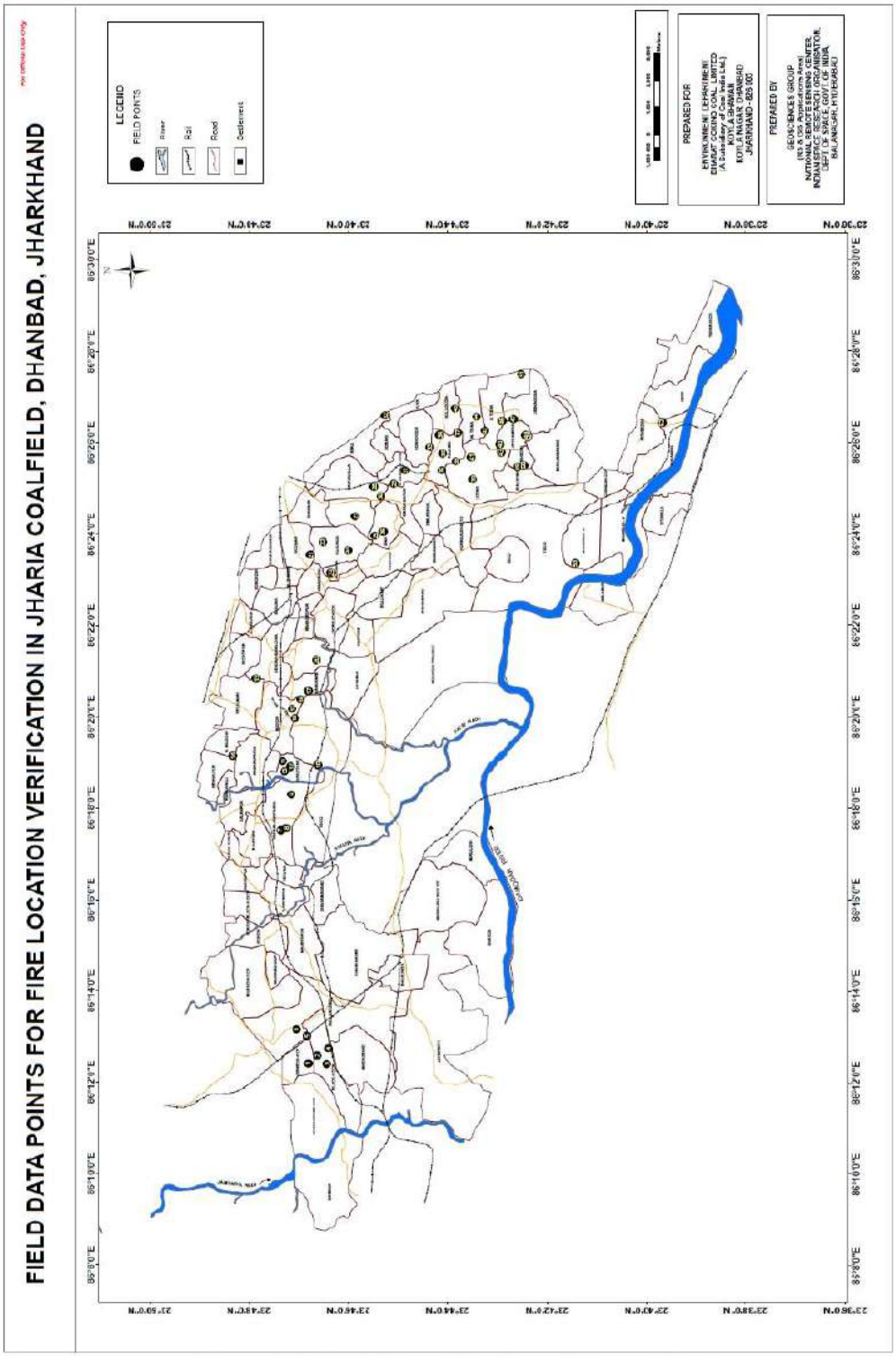


Figure 13. Field data points for coal fire verification

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	ADIC
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

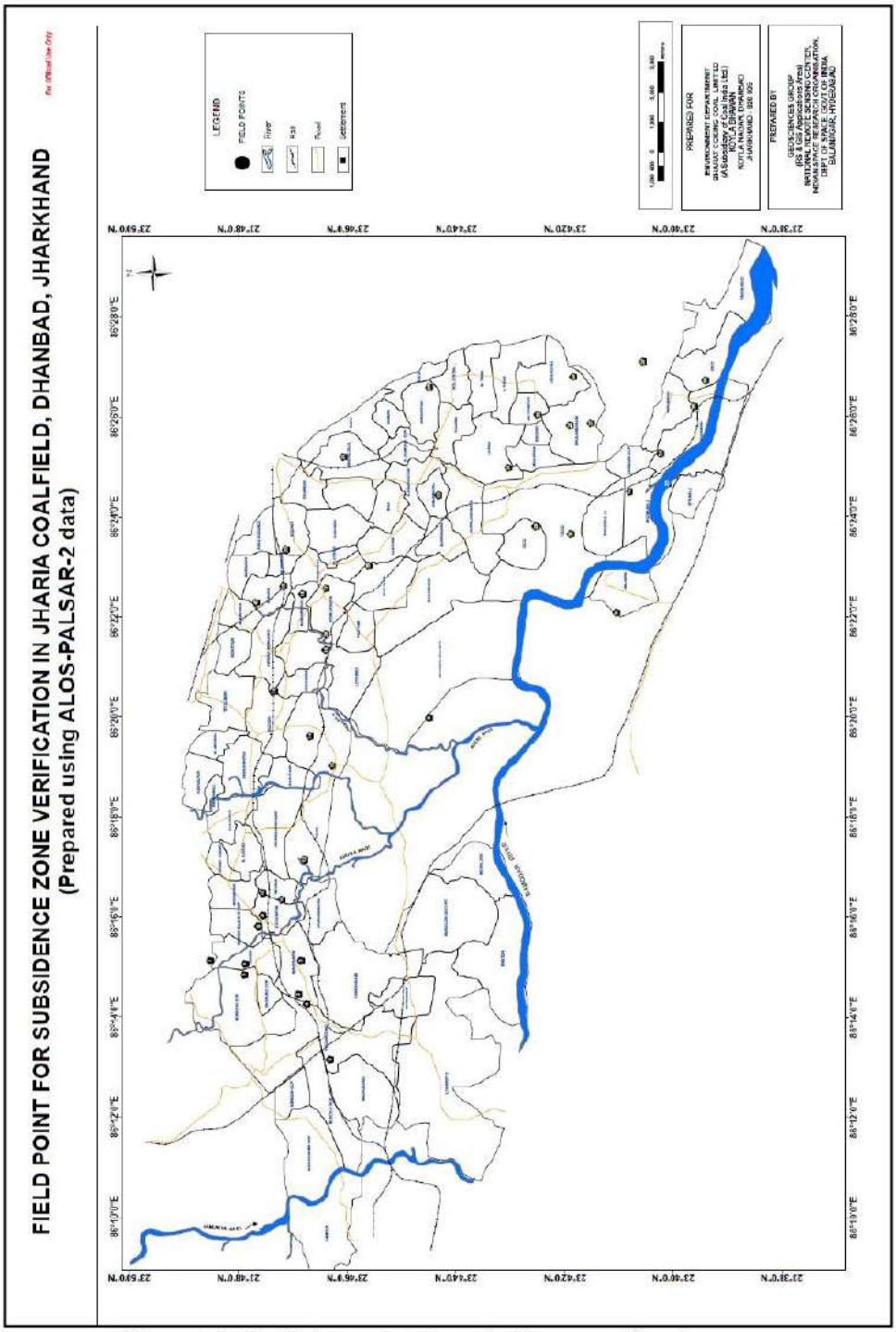


Figure 14. Field data points for subsidence verification

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)

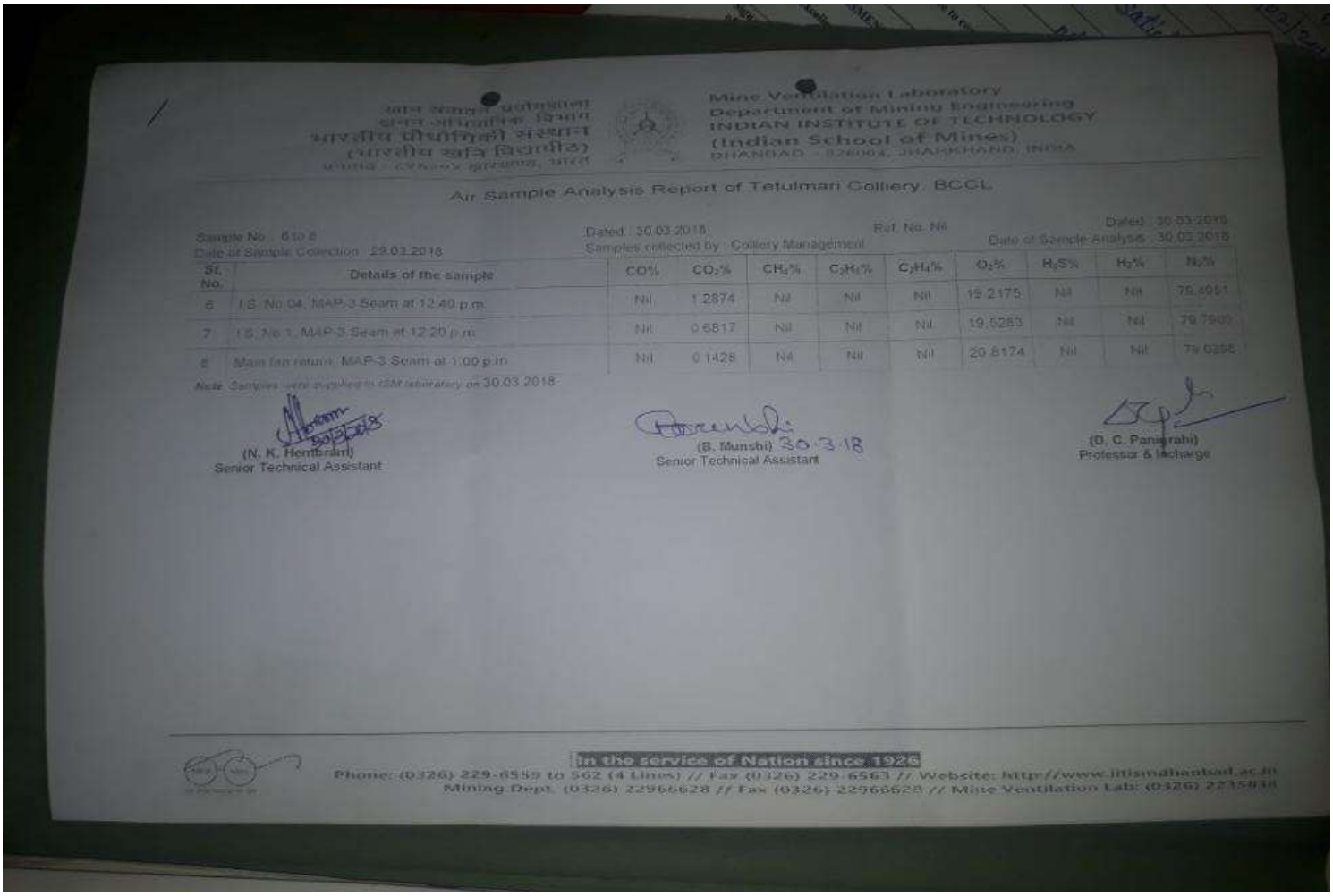
Figure 17: Coalfries in active seams in Kusunda (point 23 in figure 13 and table 4)

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:



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, BCCL

Sample No. : 6 to 8
Date of Sample Collection : 29.03.2018

Dated : 30.03.2018
Samples collected by : Colliery Management

Ref. No. Nil

Dated : 30.03.2018
Date of Sample Analysis : 30.03.2018

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%
6	I.S. No. 04, MAP-3 Seam at 12.40 p.m.	Nil	1.2874	Nil	Nil	Nil	19.2175	Nil	Nil	79.4951
7	I.S. No 1, MAP-3 Seam at 12.20 p.m.	Nil	0.6817	Nil	Nil	Nil	19.5283	Nil	Nil	79.7900
8	Main fan return, MAP-3 Seam at 1.00 p.m.	Nil	0.1428	Nil	Nil	Nil	20.8174	Nil	Nil	79.0398

Note : Samples were supplied to ISM laboratory on 30.03.2018

(N. K. Hembram)
Senior Technical Assistant

(B. Munshi) 30.3.18
Senior Technical Assistant

(D. C. Panigrahi)
Professor & Incharge

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Mining Dept. (0326) 22966628 // Fax (0326) 22966628 // Mine Ventilation Lab: (0326) 2745818

खान संवातन प्रयोगशाला
खनन अभियांत्रिकी 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

Sample No. : 13 to 15 Dated : 17.05.2018 Ref. No. Nil 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

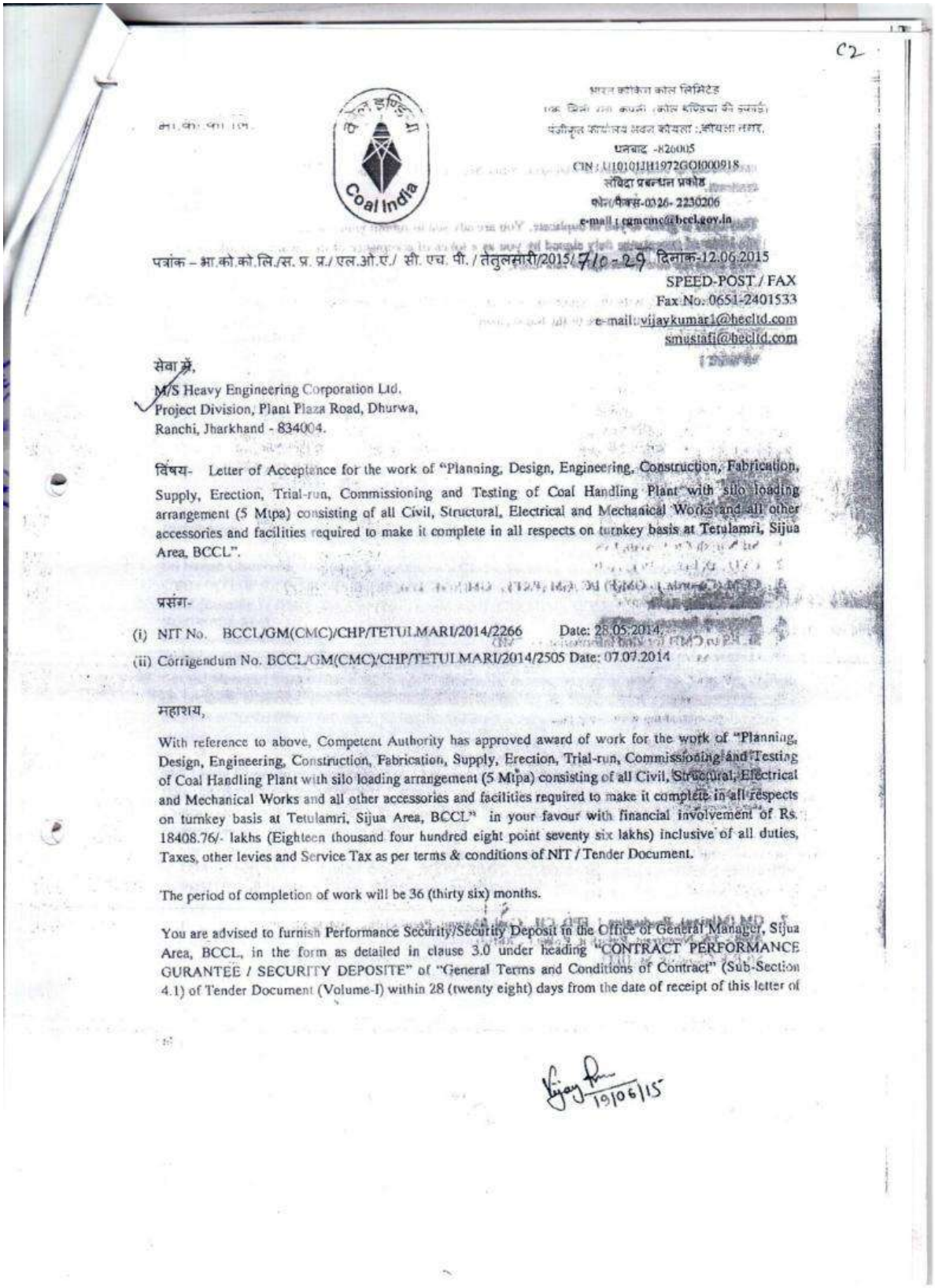
17/5/2018
(N. K. Hembram)
Senior Technical Assistant

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

(D. C. Panigrahi)
Professor & Incharge

Phone: (0326) 229-6559 to 562 (4 Lines) // Fax (0326) 229-6563 // Website: http://www.iitismdhanbad.ac.in
Mining Dept. (0326) 22966628 // Fax (0326) 22966628 // Mine Ventilation Lab: (0326) 2235838

Annexure 13:



C2

भारत कोकिंग कोल लिमिटेड
(एक मिनी रत्न कम्पनी, कोल इण्डिया की सूचीबद्ध)
पंजीकृत कार्यालय सदन कोयला भवन, कोयला नगर,
धनबाद -826005
CIN : U10101JH1972GOI000918
संविदा प्रबन्धन प्रकोष्ठ
फोन/फैक्स-0326- 2230206
e-mail : cgmcmc@bccl.gov.in

पत्रांक – भा.को.को.लि./स. प्र. प्र./ एल.ओ.ए./ सी. एच. पी. / तेतुलमारी/2015/ 710 - 29 दिनांक-12.06.2015

SPEED-POST / FAX
Fax No. 0651-2401533
e-mail: vijaykumar1@heclltd.com
smustafi@heclltd.com

सेवा में,
M/S Heavy Engineering Corporation Ltd.
Project Division, Plant Plaza Road, Dhurwa,
Ranchi, Jharkhand - 834004.

विषय- Letter of Acceptance 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 and Mechanical Works and all other accessories and facilities required to make it complete in all respects on turnkey basis at Tetulamri, Sijua Area, BCCL".

प्रसंग-

(i) NIT No. BCCL/GM(CMC)/CHP/TETULMARI/2014/2266 Date: 28.05.2014.

(ii) Corrigendum No. BCCL/GM(CMC)/CHP/TETULMARI/2014/2505 Date: 07.07.2014

महाशय,

With reference to above, Competent Authority has approved award of work 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 and Mechanical Works and all other accessories and facilities required to make it complete in all respects on turnkey basis at Tetulamri, Sijua Area, BCCL" in your favour with financial involvement of Rs. 18408.76/- lakhs (Eighteen thousand four hundred eight point seventy six lakhs) inclusive of all duties, Taxes, other levies and Service Tax as per terms & conditions of NIT / Tender Document.

The period of completion of work will be 36 (thirty six) months.

You are advised to furnish Performance Security/Security Deposit in the Office of General Manager, Sijua Area, BCCL, in the form as detailed in clause 3.0 under heading "CONTRACT PERFORMANCE GURANTEE / SECURITY DEPOSITE" of "General Terms and Conditions of Contract" (Sub-Section 4.1) of Tender Document (Volume-I) within 28 (twenty eight) days from the date of receipt of this letter of

Vijay Kr 19/06/15

acceptance to enable General Manager, Sijua Area, BCCL, to issue formal work order to you and sign the contract.

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

Failure to comply with the requirement as above shall constitute sufficient ground for cancellation of the award of work and forfeiture of the bid security.

धन्यवाद।

भवदीय

Sd/-

GM (CMC)
Bharat Coking Coal Limited

Distribution:

1. Sri Naresh Chaturvedi, IAS (Retd.), Address :- CL-14, Sector-II, Salt Lake, Kolkata- 700091.
2. CVO / D(T) OP /D(T) P&P /D(F) /D(P), BCCL.
3. CGM (Co-ordn.) / GM(F) I/C /GM (P&P) / GM(MM) /GM(E&M)I/C/ GM (Civil)/ GM (System), BCCL/ RD,CMPDI, RI-II.
4. Company Secretary, BCCL.
5. Sr. ES to CMD for kind information of CMD.
6. General Manager, Sijua Area, BCCL: Copy of Resolution item no. 315.3.U of BCCL Board, all documents, i.e. complete original tender files, Bid documents submitted by the bidders, TCR , Approved estimate etc are to be collected from CMC deptt. for issuance of work order and execution of agreement after signing of Integrity Pact along with compliance of other formalities from your end.

   M/S Heavy Engineering Corporation Ltd., have submitted EMD in form of B.G No. 0962014BG0000157 Date: 08.08.2014 for Rs 50,00,000/- (Fifty lakhs) issued by State Bank of India, SME Branch, Mecon Campus, Doranda, Ranchi- 834002. **Please note that the validity of the BG submitted by the Agency as Earnest Money will expire on 06.09.2015.** It is requested to kindly intimate the undersigned immediately in case Performance Security/Security Deposit is not submitted by the contractor within 28 days of receipt of LOA as per clause 3.0 under heading "CONTRACT PERFORMANCE GURANTEE / SECURITY DEPOSITE" of "General Terms and Conditions of Contract" (Sub-section 4.1) of Tender Document (Volume-I).

7. GM (Mining), Production / FPD, CIL, Coal Bhawan, Premise No. – 04 MAR, Plot No. – AF-III, Action Area – 1A, Newtown, Rajarhat, Kokata - 700156.
8. Sri R K Choubey, Sr. DEO, CMC Deptt. – For uploading this LOA in BCCL Website.

GM (CMC)
Bharat Coking Coal Limited

15/06/15

Annexure 14:

DATA REGARDING MINE CLOSURE ACTIVITIES

1	Name of Mine	KANKANEE COLLIERY
2	Name of Company/Subsidiary	BCCL
3	Type of Mine - OC	OCP
4	Project Area as per MCP (Ha)	152.19
5	Life of Mine	8yrs.
6	Balance life of Mine	8yrs
7	Total Broken Area (Ha)	82.66 Hect.
8	Total Decoaled Area (Ha)	NIL
9	Active Mining Area (Ha) (Sl.7- Sl.8)	82.66, Hect.
10	Backfilled Area (out of decoaled area) (Ha)	NIL
11	% Back filled (i.e. Sl. 10/ Sl. 8)	0.0%
12	Reclamation of backfilled area	NIL
13	Reclamation of other areas	NIL

Accompanied by	Inspected by
Signature with Date:- 22/05/15	Signature with Date:- 22/5/15
Name:- M. Ahmed	Name:- J.K. Jaiswal
Designation:- Surveyor	Designation:- Agent

DATA REGARDING MINE CLOSER ACTIVITIES FOR THE YEAR 2018-19 , AS ON 31.03.2019		
1	Name of Mine	Sendra Bansjora Colliery
2	Name of Company / Subsidiary	Bharat Coking Coal Limited
3	Type of Mine - OC	Open Cast Mine
4	Project Area as per MCP(Ha)	150 Ha
5	Life of Mine	23 years
6	Blance life of Mine	16 years
7	Total Broken Area (Ha)	26.7
8	Total Decoaled Area (Ha)	7.06
9	Active Mining Area (Ha)(Sl.7-Sl.8)	19.64
10	Backfilled Area (out of decoaled area)(Ha)	NIL
11	% Back filled (i.e. Sl.10/Sl.8)	0
12	Reclamation of backfilled area	NIL
13	Reclamation of other areas	NIL

Accompanied by	Inspected by
Signature with date :- 21.05.19	Signature with date :- 21.05.19
Name :- S.K. Mitra	Name :- K. Sarkar
Designation Sr. Surveyor	Designation Sr. Mgr (Min)

DATA REGARDING MINE CLOSURE ACTIVITIES

1	Name of Mine	Nichitpur Colliery
2	Name of Company / Subsidary	BHARAT COKING COAL LIMITED
3	Type of Mine - OC	OC
4	Project Area as per MCP (Ha)	122.73 Hac.
5	Life of Mine	10 Yrs.
6	Balance life of Mine	06 Yrs.
7	Total Broken Area (Ha)	94.04 Hac.
8	Total Decoaled Area (Ha)	46.93 Hac.
9	Active Mining Area (Ha) (Sl.7-Sl.8)	47.11
10	Backfilled Area (out of decoaled area) (Ha)	28.00 Hac.
11	% Back filled (i.e.Sl. 10/ Sl.8)	59.43
12	Reclamation of backfilled area	2.80 Hac.
13	Reclamation of other area	NIL

Accompanied	Inspected by
Signature with Date :- Mahato 25/05/19	Signature with Date :- 25/5/19
Name :- Gopal ch. Mahato.	Name :- H. K. Sinha
Designation Sr. Surveyor	Designation Project officer

DATA REGARDING MINE CLOSURE ACTIVITIES

1	Name of Mine	**TETULMARI COLLIERY, SIJUA AREA**
2	Name of Company/Subsidiary	**B.C.C.L.,**
3	Type of Mine-OC	**OCP**
4	Project Area as per MCP (Ha)	273.00 (MIXED).
5	Life of Mine	**10 YEARS**
6	Balance life of Mine	**06 YEARS**
7	Total Broken Area (Ha)	**62.62 Hect.**
8	Total Decoaled Area (Ha)	**39.97 Hect.**
9	Active Mining Area (Ha) (Sl7-Sl8)	**22.65 Hect.**
10	Backfilled Area (Out of Decoaled area) (Ha)	**28.78 Hect.**
11	% Back filled (i.e. Sl. 10/Sl.8)	72.00%
12	Reclamation of backfilled area	NIL
13	Reclamation of other area	NIL

Accompanied By
Signature with Date:- 23/5/19
Desgnation:- Dy. Manager (Survey)
Tetulmari Colliery

Inspected by
Signature with Date:- 23/5/19
Desgnation:- Project Officer
Tetulmari Colliery

DATA REGARDING MINE CLOSURE ACTIVITIES

1	Name of Mine	MUDIDIH
2	Name of Company/Subsidiary	BHARAT COKING COAL LTD.
3	Type of Mine - OC	OCP
4	Project Area as per MCP (Ha)	356.23 (MIXED)
5	Life of Mine	13 Yrs.
6	Balance life of Mine	NA (OCP not in operation at present)
7	Total Broken Area (Ha)	81.60 (approx)
8	Total Decoaled Area (Ha)	46.60
9	Active Mining Area (Ha) (Sl.7- Sl.8)	NA (OCP not in operation at present)
10	Backfilled Area (out of decoaled area) (Ha)	46.60
11	% Back filled (i.e. Sl. 10/ Sl. 8)	100%.
12	Reclamation of backfilled area	NIL
13	Reclamation of other areas	NIL

Accompanied by	Inspected by
Signature with Date:- 24/5/19	Signature with Date:- 24/5/19
Name:- SANJEEV KR. SINGH	Name:- JAYANT KR. JAISWAL
Designation:- SR. SURVEYOR	Designation:- PROJECT OFFICER

Annexure 15:

GROUNDWATER LEVEL & QUALITY REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year – 2018-19)

[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 – 2019

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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*	*Jharkhand State – 1264.0 mm (2016)* *Dhanbad District - 1271.60 mm (2016)* *Normal Rainfall – 1296.30 mm* *(Source: Rainfall Statistics of India-2016, IMD, Ministry of Earth Sciences)*
5	*Geological Formations*	*Gondwana Formation* *(Talchir Formation, Barakar Formation, Barren Measure & Raniganj Formation)*
6	*Aquifer System*	*Top Unconfined/Phreatic Aquifer – average thickness 25 m* *Semi-confined to confined Aquifer – average thickness 50–200 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 254 no 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 is 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 – 1.20 to 14.58 m (Avg. 5.55 m bgl) in '2018* *Post-monsoon – 0.40 to 07.17 m (Avg. 2.83 m bgl) in '2018* *RCF area (part):* *Pre-monsoon – 2.34 to 8.70 m (Avg. 4.35 m bgl) in '2018* *Post-monsoon – 1.75 to 5.70 m (Avg. 2.75 m bgl) in '2018*
10	*Groundwater Quality*	*Potable (Annexure- IV)*
11	*Proposed Piezometers*	*New piezometers (23 nos.) have been proposed to monitor impact of coal mining on groundwater regime within the coalfield area (JCF & part of RCF) for maximum depth upto 290 m to monitor deeper aquifers.*
12	*Stage of Groundwater Development (CGWB)*	*Dhanbad District – 77%* *(GWRE-2013)*

1.0 INTRODUCTION

1.1 CLIMATE, TEMPERATURE & 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^{o} C and falls between 10^{o} C to 5^{o} C in winter. The maximum rainfall occurs during the period between June and September.

The annual rainfall in the Dhanbad District is 1271.60 mm (Rainfall Statistics of India-2016, IMD (Ministry of Earth Sciences), has been considered. The non-monsoon rainfall in the District is 93.60 mm (Winter-19.5 mm, Pre-monsoon-48.8 mm and Post-monsoon-25.3 mm) and the monsoon rainfall is 1178.10 mm of total annual rainfall. Monsoon Rainfall is around 92.65% of total annual rainfall in 2016 in Dhanbad District. Rainfall is the primary source of groundwater recharge. The normal rainfall of Jharkhand is 1296.30 mm (2015) as documented in MOSPI, Govt. of India.

1.2 GEOMORPHOLOGY

Northern part of the JCF area is 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 are developed over sedimentary rocks or Gondwana formation consisting of Sandstone, Shale, coal, etc. Dissected pediplains are 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.

1.3 DRAINAGE

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 south easterly 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 (**Figure No-1**). 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 are 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 to the various coalfield area from Maithon dam, Damodar River, Jamunia River, Topchachi Lake, etc.

2.0 GROUNDWATER SYSTEM

2.1 GEOLOGY OF THE AREA

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

Chanch-Victoria Area which is located in the western part of Raniganj Coalfield. The Raniganj coalfield represents the eastern most coal basin in the Damodar Valley Region and located in Burdwan District, 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.

2.2 HYDROGEOLOGY OF THE STUDY AREA

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 are constituted of fine to coarse grained 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 AQUIFER DISPOSITION

The aquifer system for shallow and deeper aquifer has been 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 is 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 varies from few meters to 50 m. This un-confined aquifer is more potential than deep seated 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.

2.4 AQUIFER PARAMETERS

PHREATIC/UN-CONFINED AQUIFER – *The wells are 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 – *Below the un-confined aquifer, the sandstone partings in-between impervious layers of shale and coal seams is 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 been 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.*

Aquifer Type	***Hydraulic Conductivity (m/day)***	***Transmissivity (m^2 /day)***	***Remarks***
Unconfined	*0.50*	*10.68 – 41.48*	*Site: Damuda (BJ Section) and Block-III area*
Semi-confined	*0.0006 – 1.44 (1)* *0.0027 – 0.05 (2)*	*-*	*Site: (1): Sitanala Block* *(2): Kumari Block*

3.0 GROUNDWATER LEVEL MONITORING

To collect the representative groundwater levels in the study area, CMPDI has established a monitoring network of total 254 monitoring stations out of which 64 located within core zone and rest comes within Buffer zone. 60 dug wells within JCF and 04 dug wells within RCF (part) area (Details of the Hydrograph stations & water level are given in ***Annexure-I, IIA*** *&* ***IIB****) spread over the entire BCCL leasehold area,* ***Figure No-1****. Water level monitoring in 254 hydrograph stations has been done in pre-monsoon as well as in post monsoon whereas in 64 stations monitoring done in quarterly (March, May, August and November month of 2018) 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 be 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*

*Construction of piezometers within Jharia Coalfield and part of Raniganj Coalfield to monitor groundwater level of deeper aquifers is already in progress.

3.1 HISTORICAL GROUNDWATER LEVEL

Historical GWL of JCF and part of RCF are given from 2005 to 2018 of CMPDI monitoring stations (total 66 stations within Coalfield area). Pre-monsoon and Post-monsoon GWL with Fluctuation has been mentioned below in the table.

Table No – 1: 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*
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*

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 is summarized in the Table No-2.

Table No – 2: Depth to water table

Formation	**Area**		**DTW (bgl, m) [Year-2018]**		**Average GWL (m)**	
			Pre-monsoon (Apr/May)	**Post-monsoon (Nov/Dec)**	**Pre-monsoon**	**Post-monsoon**
Sedimentary (Gondwana)	*Non-mining*		*1.85-9.65*	*0.85-3.70*	*5.47*	*2.49*
	Mining	*OC*	*1.59-10.93*	*0.45-7.10*	*5.00*	*2.57*
		UG	*1.20-14.58*	*0.60-7.17*	*6.52*	*3.28*
Metamorphics	*Peripheral part of the Coalfield*		*0.75-13.68*	*0.45-8.00*	*7.12*	*3.90*

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 is given in Table No-3. There is no significant change in hydraulic gradient has been observed. Relatively steep gradient near active opencast mining areas w.r.t., Non-Mining, Underground mines and Metamorphics areas is observed.

Table No – 3: Average hydraulic gradient

Sl. No	**Formation**	**Area**		**Average hydraulic gradient**
1	*Sedimentary (Gondwana)*	*Non-Mining*		*1.5 X 10^{-3} to 2.0 X 10^{-3}*
2		*Mining*	*OC*	*5.0X 10^{-2} to 4.0 X 10^{-3}*
3			*UG*	*2.0 X 10^{-2} to 3.0 X 10^{-3}*
4	*Metamorphics*	*Peripheral part of the Coalfield*		*1.0 X 10^{-3} to 2.0 X 10^{-3}*

3.3 QUARTERLY GROUNDWATER LEVEL, CLUATER OF MINES (BCCL)

3.3 A Monitoring of Ground Water Levels of Cluster-I

Cluster-I (Damuda Group of Mines) consisting of Damoda (BJ and Gutway section) UG, Damoda (Albion section) OCP, proposed Damoda (B.J.section) OCP and Closed Gutway OCP of Barora Area of BCCL. It is located in the extreme western part of JCF in Bokaro district of Jharkhand.

The present leasehold area of Cluster-I is 575 Ha. The Damoda block area is 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.

*4 hydrograph 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 been done in the months of February, April and August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	B-15	Bera Basti	1.56	1.85	0.75	0.85
2	B-21A	Dugdha	6.73	9.65	3.45	2.65
3	B-51	Taranga	3.00	5.02	2.25	2.42
4	B-53	Karmatanr	2.52	3.92	1.62	1.42
Average WL (bgl)			3.45	5.11	2.02	1.84

Ground Water Level (in bgl) varies from 1.56 to 6.73 m during February, 1.85 to 9.65 m during April, 0.75 to 3.45 m during August and 0.85 to 2.65 m during November within the Core Zone of Cluster-I area.

3.3 B Monitoring of Ground Water Levels of Cluster-II

Cluster-II consists of seven mines namely; Block-II mixed mine (OCP & UGP), Jamunia OCP, Shatabdi OCP, Muraidih mixed mine (OCP & UGP) and Phularitand OCP is under administrative control of Block-II Area and Barora Area of BCCL. It is located in the extreme western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-II is 2025.71 Ha. The Damoda block area is 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.

*5 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	B-1	Muraidih	1.68	2.88	1.48	2.08
2	B-59	Khodovaly	1.38	5.47	0.90	1.10
3	B-60	Bahiyardih	8.21	13.68	3.13	4.23
4	B-61A	Kesargora	1.27	2.57	2.62	2.02
5	B-62A	Sadiyardih	5.87	8.27	4.00	4.78
Average WL (bgl)			3.68	6.57	2.43	2.84

Ground Water Level (in bgl) varies from 1.27 to 8.21 m during February, 2.57 to 13.68 m during April, 0.90 to 4.00 m during August and 1.10 to 4.78 m during November within the Core Zone of Cluster-II area.

3.3 C Monitoring of Ground Water Levels of Cluster-III

Cluster-III consists of nine mines namely, Jogidih UG, Maheshpur UG, South Govindpur UG, Teturiya UG, Govindpur UG, New Akashkinaree mixed mine (OC & UG) and Kooridih/Block-IV mixed mine (OC & UG) under the administrative control of Govindpur Area of BCCL. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-III is 1420.0 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.

*5 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-12	Jamua	1.20	2.80	0.40	1.0
2	A-25	Sinidih	4.88	6.63	2.88	3.13
3	A-29	Dharmaband	3.25	6.45	2.86	2.10
4	B-14	Mathadih	1.69	3.64	1.22	2.84
5	B-60	Sonardih	8.21	13.68	3.13	4.23
Average WL (bgl)			3.85	6.64	2.12	2.64

Ground Water Level (in bgl) varies from 1.20 to 8.21 m during February, 2.73 to 13.68 m during April, 0.40 to 3.13 m during August and 1.0 to 4.23 m during November within the Core Zone of Cluster-III area.

3.3 D Monitoring of Ground Water Levels of Cluster-IV

Cluster-IV consists of six mines namely, Salanpur UG, Katras-Choitudih UG, Amalgamated Keshalpur & West Mudidih OC, Amalgamated Keshalpur & West Mudidih UG, Amalgamated Angarpathra & Ramkanali UG and closed Gaslitand UG of Katras Area of BCCL. It is located in the north-central part of Jharia Coalfield in Dhanbad district of Jharkhand.

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.

*4 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-26	Malkhera	4.75	6.23	3.58	3.88
2	A28A	Lakarka	2.22	4.15	2.00	2.51
3	B-64	Keshalpur	1.42	2.15	0.55	1.85
4	B-65A	Jhinjipahari	4.18	10.03	2.10	2.40
Average WL (bgl)			3.14	5.64	2.16	2.66

Ground Water Level (in bgl) varies from 1.42 to 4.75 m during February, 2.15 to 10.03 m during April, 0.55 to 3.58 m during August and 1.85 to 3.88 m during November within the Core Zone of Cluster-IV area.

3.3 E Monitoring of Ground Water Levels of Cluster-V

Cluster-V consists of twelve mines namely; Tetulmari OC & UG mine, Mudidih OC & UG mine, Nichitpur OC, Sendra Bansjora OC & UG, Bansdeopur OCP (proposed) & UG, Kankanee OC & UG and closed Loyabad UG under the administrative control of Sijua Area of BCCL. This Cluster of mines is located in northern part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-V is 1957.08 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.

*4 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-3	Sijua	0.77	1.27	0.37	0.47
2	A-16	Ekra	2.60	4.30	2.05	3.65
3	A-27	Tetulmari	1.90	2.90	1.49	1.00
4	D-23	Jogta	2.70	4.40	2.60	3.40
Average WL (bgl)			1.99	3.22	1.63	2.13

Ground Water Level (in bgl) varies from 0.77 to 2.70 m during February, 1.27 to 4.40 m during April, 0.37 to 2.60 m during August and 0.47 to 3.65 m during November within the Core Zone of Cluster-V area.

3.3 F Monitoring of Ground Water Levels of Cluster-VI

Cluster–VI consists of four coal mines; East Bassuriya OC, Bassuriya UG, Gondudih Khas-Kusunda OC, Godhur Mixed Mines (OC and UG) are under the administrative control of Kusunda Area of BCCL. This Cluster of mines is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-VI is 876.55 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.

*2 hydrograph stations (**D-25 and D-30**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	D-25	Godhur	0.50	2.60	0.60	2.40
2	D-30	Borkiboa	2.60	4.58	1.00	1.10
Average WL (bgl)			**1.55**	**3.59**	**0.80**	**1.75**

3.3 G Monitoring of Ground Water Levels of Cluster-VII

Cluster-VII consists of fourteen mines namely; Dhansar mixed mine, Kusunda OCP, Viswakarma OCP, Industry UG (closed), Alkusa UG, Ena OCP, S.Jharia/Rajapur OCP, Burragarh UG, Simlabahal UG, Hurriladih UG, Bhutgoria UG, Kustore UG (closed) and E.Bhuggatdih UG (closed) under the administrative control of Kusunda Area and Kustore Area of BCCL. This Cluster of mines is located in east central part of Jharia Coalfield in Dhanbad district of Jharkhand.

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.

*7 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	D-3	Dhansar	1.65	3.43	1.50	2.45
2	D-4	Jharia	1.21	1.91	0.91	1.56
3	D-33	Kustore	0.55	2.85	0.55	0.95
4	D-34	Kusunda	0.60	2.80	0.45	0.70
5	D-47	Parastanr	3.55	5.33	2.55	3.65

6	*D-55*	*Hariladih*	*4.42*	*8.42*	*1.57*	*4.02*
7	*D-80*	*Bastacolla*	*4.35*	*9.35*	*3.28*	*4.20*
Average WL (bgl)			*2.33*	*4.87*	*1.54*	*2.50*

Ground Water Level (in bgl) varies from 0.55 to 4.42 m during February, 1.91 to 9.35 m during April, 0.45 to 3.28 m during August and 0.70 to 4.20 m during November within the Core Zone of Cluster-VII area.

3.3 H Monitoring of Ground Water Levels of Cluster-VIII

Cluster-VIII consists of ten mines namely; Bastacolla mixed mines (OC & UG), Bera mixed mines (OC & UG), Dobari UG, Kuya mixed (OC & UG), proposed Goluckdih (NC) OC, Ghanoodih OC and Kujama OC under the administrative control of Bastacolla Area of BCCL. This Cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-VIII is 1200.41 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.

*4 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	*Well No.*	*Location*	*Water level (bgl in meters)*			
			Feb'18	*Apr'18*	*Aug'18*	*Nov'18*
1	*D-8*	*Alokdiha*	*3.20*	*5.65*	*1.65*	*1.85*
2	*D-43*	*Alagdih*	*3.05*	*7.15*	*2.90*	*3.45*
3	*D-49*	*Galucdih*	*1.98*	*3.45*	*1.45*	*2.45*
4	*D-51*	*Chankuiya*	*8.26*	*10.93*	*4.80*	*7.10*
Average WL (bgl)			*4.12*	*6.80*	*2.70*	*3.71*

Ground Water Level (in bgl) varies from 1.98 to 8.26 m during February, 3.45 to 10.93 m during April, 1.45 to 4.80 m during August and 1.85 to 7.10 m during November within the Core Zone of Cluster-VIII area.

3.3 I Monitoring of Ground Water Levels of Cluster-IX

Cluster-IX consists of eight mines namely; North Tisra/South Tisra Expansion OCP, Lodna UG, Bagdigi UG, Bararee UG and Joyrampur UG and Jealgora UG (closed) are under the administrative control of Lodna Area of BCCL. This Cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-IX is 1942.12 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.

*6 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	D-5	Jiyalgora	5.80	7.80	4.39	5.30
2	D-7	Golden Pahari	5.15	7.53	2.23	2.83
3	D-39	Tilaboni	3.18	4.95	2.50	4.35
4	D-40A	Khapa Dhawra	1.70	2.10	1.10	1.40
5	D-41	Joyrampur	1.30	1.59	1.08	1.32
6	D-74	Bhulan Bararee	5.80	8.60	3.40	4.80
Average WL (bgl)			3.82	5.43	2.45	3.33

Ground Water Level (in bgl) varies from 1.30 to 5.80 m during February, 1.59 to 8.60 m during April, 1.08 to 4.39 m during August and 1.32 to 5.30 m during November within the Core Zone of Cluster-IX area.

3.3 J Monitoring of Ground Water Levels of Cluster-X

Cluster-X consists of ten coal mines and one coal Washery namely; Bhowrah North mixed mines (UG & OC), Bhowrah South mixed mines (UG, 3 Pit OCP, Chandan OCP), Patherdih Mixed mines (UG, Chandan OCP), Sudamdih incline UG mine, Sudamdih Shaft UG mine, Amlabad UG (Closed) and Sudamdih Coal Washery under the administrative control of Eastern Jharia Area of BCCL. This cluster of mines is located in the eastern part of Jharia Coalfield in Dhanbad district of Jharkhand.

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.

*4 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-19	Bhowrah	2.95	5.55	1.85	2.45
2	D-35	Patherdih	6.58	8.40	3.58	4.45
3	D-36	Sudamdih	1.00	1.20	0.45	0.60
4	D-77	Amlabad	3.63	6.30	4.00	5.20
Average WL (bgl)			3.54	5.36	2.47	3.18

Ground Water Level (in bgl) varies from 1.00 to 6.58 m during February, 1.20 to 8.40 m during April, 0.45 to 4.0 m during August and 0.60 to 5.20 m during November within the Core Zone of Cluster-X area.

3.3 K Monitoring of Ground Water Levels of Cluster-XI

Cluster–XI consists of eight coal mines and one coal Washery namely; 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 Pootkee Balihari Area and Moonidih UG & Moonidih Washery are under the administrative control of Western Jharia Area of BCCL. This Cluster of mines is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand.

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.

*5 hydrograph stations (**A-17, A-18, A-20, A-32 and D-34**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water below (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-17	Kachi Balihari	2.07	3.34	1.64	2.84
2	A-18	Baghaband	0.89	1.24	1.34	0.99
3	A-20	Gorbudih	3.59	4.57	1.92	2.57
4	A-32	Baludih	0.60	2.80	0.45	0.70
Average GW (bgl)			2.26	3.20	1.64	2.16

Ground Water Level (in bgl) varies from 0.60 to 3.59 m during February, 1.24 to 4.57 m during April, 0.45 to 1.92 m during August and 0.70 to 2.84 m during November within the Core Zone of Cluster-XI area.

3.3 L Monitoring of Ground Water Levels of Cluster-XIII

Cluster-XIII consists of one operating mine i.e. Murulidih 20/21 pits UG mine and six abandoned mines (Bhurungiya Colliery, Muchraidih colliery, Hantoodih colliery, Padugora colliery, Murulidih colliery, Bhatdee colliery) of Western Jharia Area of BCCL. It is located in the south-western part of Jharia Coalfield in Dhanbad district of Jharkhand.

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.

*6 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-22A	Nagdah Basti	1.70	3.35	1.10	1.30
2	A-23	Machhayara	8.92	11.15	6.46	7.17
3	A-33	Mahuda Washery	2.24	4.07	1.26	2.35
4	A-34	Mahuda Mosque	5.32	9.45	4.75	5.35
5	B-25	Mahuda More	3.68	5.90	2.90	3.70
6	B-48	Mahuda	3.55	7.33	2.95	3.97
Average GW (bgl)			4.24	6.88	3.24	3.97

Ground Water Level (in bgl) varies from 1.70 to 8.92 m during February, 3.35 to 11.15 m during April, 1.10 to 6.46 m during August and 2.35 to 7.17 m during November within the Core Zone of Cluster-XIII area.

3.3 M Monitoring of Ground Water Levels of Cluster-XIV

Cluster-XIV consists of two mines namely; Lohapatty UG and Lohapatty Opencast Patch (proposed). These are under the administrative control of Western Jharia of BCCL. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-XIV is 1577.22 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.

*3 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	B-23	Lohapatti	3.04	6.64	1.74	2.14
2	B-24	Telmuchu	6.43	9.28	3.31	4.33
3	B-67	Simatanr	6.50	9.55	3.60	4.00
Average GW (bgl)			5.32	8.49	2.88	3.49

Ground Water Level (in bgl) varies from 3.04 to 6.50 m during February, 6.64 to 9.55 m during April, 1.74 to 3.60 m during August and 2.14 to 4.00 m during November within the Core Zone of Cluster-XIV area.

3.3 N Monitoring of Ground Water Levels of Cluster-XV

Cluster–XV consists of four coal mines; Kharkharee UG 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 BCCL. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand.

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.

*3 hydrograph 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 been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	A-24	Pipratanr	11.68	14.58	5.78	6.88
2	B-32A	Madhuband	3.23	6.75	2.80	3.90
3	B-61A	Kesargora	1.27	2.57	2.0	2.02
Average GW (bgl)			5.39	7.97	3.63	4.27

Ground Water Level (bgl) varies from 1.27 to 11.68 m during February, 2.57 to 14.58 m during April, 2.0 to 5.78 m during August and 2.02 to 6.88 m during November within the Core Zone of Cluster-XV area.

3.3 O Monitoring of Ground Water Levels of Cluster-XVI

Cluster-XVI consists of five mines namely, Dahibari-Basantimata OC, Basantimata UG, New Laikidih OC, Laikdih Deep UG and Chunch UG under the administrative control of Chanch-Victoria Area of BCCL. This cluster of mines is located in the western part of Raniganj Coalfield in Dhanbad district of Jharkhand.

The present leasehold area of Cluster-XVI is 1964.21 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.

*4 hydrograph stations (**DB-22, DB-23, DB-24 and DB-25**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2018 and the Ground water level data is enclosed in the table below:*

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'18	Apr'18	Aug'18	Nov'18
1	DB-22	Dahibari, Niche Basti	1.98	2.34	1.35	1.93
2	DB-23	Dahibari OC	2.00	2.85	1.20	1.75
3	DB-24	Dahibari	8.70	8.25	4.43	5.70
4	DB-25	Palasya	3.23	3.93	1.41	1.63
Average GW Level			3.98	4.34	2.10	2.75

Ground Water Level (in bgl) varies from 1.98 to 8.70 m during February, 2.34 to 8.25 m during April, 1.20 to 4.43 m during August and 1.63 to 5.70 m during November within the Core Zone of Cluster-XVI area.

4.0 GROUNDWATER LEVEL SCENARIO

During the month of February'2018 the depth to water level (in bgl) within 15 nos Cluster of mines varies from 0.50 m to 11.68 m with an average varies from of 1.55 m to 5.39 m. During the month of April'2018 the depth to water level varies from 1.20 m to 14.58 m with an average varies from 3.12 m to 8.50 m. During the month of August'2018 the depth to water level varies from 0.80 m to 6.47 m with an average varies from 0.80 m to 3.73 m. During the month of November'2018 the depth to water level varies from 0.40 m to 7.17 m with an average varies from 1.75 m to 4.26 m. The summarized water level data of all clusters are given in ***Table No – 4****.*

Depth to water level (in bgl) values described that water level goes down to maximum 14.58 m during pre-monsoon'2018 and maximum upto 8.50 m during post-monsoon'2018. Un-confined aquifer is 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–III****.*

*Monitoring groundwater (quantity & quality) to assess the present condition and resource has been done regularly in the coalfield areas. Well hydrographs (****Annexure–III and VI****) are prepared and studied to identify potentially adverse trends so that appropriate action can be taken to protect groundwater resource. According to the hydrograph trend analysis of CGWB monitoring wells and CMPDI observation wells, there are decline trends in both Pre and Post-monsoon GW level trends (max. upto 0.50 cm/year in Patherdih/D-35) 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 (****Figure No–2****) with collection points details (dug wells) are given in* ***Annexure–IV*** *and Quality is given in* ***Annexure–V****.*

Table No–4: Groundwater level data Cluster-wise

Sl. No.	***Cluster of BCCL***	***No. of Monitoring Wells***	***Water level fluctuation Below ground level (Feb, Apr, Aug & Nov'18)***	***Formation***
1	*I*	*4 nos.*	*0.75 to 9.65 m*	*Barakar*
2	*II*	*5 nos.*	*0.90 to 13.68 m*	*Barakar*
3	*III*	*5 nos.*	*0.40 to 6.63 m*	*Barakar*
4	*IV*	*4 nos.*	*0.55 to 10.03 m*	*Barakar*
5	*V*	*4 nos.*	*0.37 to 4.40 m*	*Barakar*
6	*VI*	*2 nos.*	*0.50 to 4.58 m*	*Barakar*
7	*VII*	*7 nos.*	*0.45 to 9.35 m*	*Barakar*
8	*VIII*	*4 nos.*	*1.45 to 10.93 m*	*Barakar*
9	*IX*	*6 nos.*	*1.08 to 8.60 m*	*Barakar*
10	*X*	*4 nos.*	*0.45 to 8.40 m*	*Barakar*
11	*XI*	*5 nos.*	*1.0 to 3.65 m*	*Barakar & Barren Measure*
12	*XIII*	*6 nos.*	*1.10 to 11.15 m*	*Raniganj*
13	*XIV*	*3 nos.*	*1.74 to 9.55 m*	*Raniganj*
14	*XV*	*3 nos.*	*1.27 to 14.58 m*	*Barakar & Barren Measure*
15	*XVI*	*4 nos.*	*1.20 to 8.70 m*	*Barakar*

5.0 GROUNDWATER QUALITY

The ground water sample of the study area (15 nos. of Cluster of mines, BCCL) have been collected from dug wells and analysed. Fifteen ground water samples (GW-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 & 16) were analysed quarterly (March, May, August and November'2018) at CMPDI, RI-II, Dhanbad. The water sampling details are given in ***Annexure–IV*** *and Water sample locations are shown in* ***Figure No-2****. The water quality data are enclosed in* ***Annexure–VA, VB, VC and VD****.*

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

During the month of March, May, August and December'2018:

The pH of the groundwater samples varies between 7.45 to 7.92 in March'18, 7.19 to 8.11 in May'18, 7.71 to 8.23 in August'18 and 7.14 to 8.24 in December'18. The pH is within the ISI limit of drinking water standard.

During the month of March, May, August and December'2018:

The mineral constituents dissolved in water constitute the dissolved solids. The total dissolve solids varies from 188 to 485 mg/l in March'18, from 286 to 566 in May'18, from 320 to 1060 in August'18 and from 132 to 830 in December'2018. The TDS values are above the IS 10500 standards of drinking water.

During the month of March, May, August and December'2018:

During the month of March'18 the alkalinity of the water samples varies from 64 to 132 mg/l and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 30 to 46 mg/l and are within the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 68 to 196 mg/l and the value of total hardness in water samples are within the permissible limit (200 mg/l). The sulphate ranges between 08 to 96 mg/l 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 are found to be below the upper ISI limits for drinking water.

During the month of May'18 the alkalinity of the water samples varies from 70 to 188 mg/l and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 29 to 58 mg/l and are within the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 132 to 326 mg/l and the value of total hardness in water samples are **above** *the permissible limit (200 mg/l). The sulphate ranges between 65 to 180 mg/l 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 are found to be below the upper ISI limits for drinking water.*

During the month of August'18 the alkalinity of the water samples varies from 45 to 152 mg/l and are within the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 30 to 194 mg/l and are above the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 130 to 740 mg/l and the value of total hardness in water samples are above the permissible limit (200 mg/l). The sulphate ranges between 34 to 228 mg/l and the value of sulphate in water sample are **slightly above** *the permissible limit (200 mg/l). The Iron (***slightly above the limit***), Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.*

During the month of December'18 the alkalinity of the water samples varies from 112 to 212 mg/l and are **slightly above** *the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 12 to 28 mg/l and are within the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 286 to 602 mg/l and the value of total hardness in water samples are* **above** *the permissible limit (200 mg/l). The sulphate ranges between 48 to 84 mg/l and the value of sulphate in water sample are within the permissible limit (200 mg/l). The Iron, Manganese (***slightly above the limit***), Copper, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.*

6.0 STAGE OF GROUNDWATER DEVELOPMENT

The groundwater is 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 77%. 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%). The Gondwana sandstones in general, are 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 done by Central Ground Water Board (CGWB), Patna in 2013, the Block wise data of Dhanbad District is given below:

Table No–5: Block-wise Stage of Groundwater development

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

- ***Dynamic Groundwater Resource Assessment (as on 31st March, 2013), CGWB***

Table No–6: Cluster-wise Groundwater development scenario

Cluster/ Area	Adminis-trative Blocks/Stage Of GW Develo-Pment (SOD)	Total Water demand (Lakh cum/year)				Avg. GW level (bgl in m) 2018		GW level declining trend 2005-2018		Quantity Recharge/ future use (Lakh Cum/ Year)
		Mine Discharge (GW + Rainwater)	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)	9.56	NIL	7.42	2.14	5.11	1.84	YES	YES	NIL
Cluster-II	Baghmara (SOD: Critical)	170.17	Jamunia river	22.55	23.83	6.57	2.84	YES	NO	123.75
Cluster-III		58.18	NIL	2.58	12.65	6.64	2.64	NO	YES	42.95
Cluster-IV		68.84	MADA (Damodar river)	18.47	12.31	5.64	2.66	NO	NO	38.06
Cluster-V		127.29	MADA	77.92	31.02	3.22	2.13	YES	YES	18.35
Cluster-VI	Dhanbad (SOD: Over-exploited)	3.86	MADA (Damodar river)	3.69	0.0	3.60	1.75	YES	YES	NIL (loss due to FF)
Cluster-VII		93.33	MADA	27.70	6.87	4.87	2.50	YES	NO	58.76
Cluster-VIII	Jharia (SOD: Over-exploited)	29.27	MADA	24.04	1.18	6.80	3.71	NO	NO	4.05
Cluster-IX		310.34	MADA	160.28	45.05	5.43	3.33	NO	NO	105.01
Cluster-X		59.38	Damodar river	11.47	0.0	5.36	3.18	YES	NO	47.91

Cluster-XI	*Dhanbad (SOD: Over-exploited)*	*249.67*	*MADA & DVC*	*19.86*	*43.92*	*3.20*	*2.16*	*YES*	*YES*	*185.89*
Cluster-XIII	*Baghmara (SOD: Critical)*	*64.61*	*Damodar river*	*10.09*	*9.86*	*6.88*	*3.97*	*YES*	*YES*	*44.66*
Cluster-XIV		*NA*	*NA*	*NA*	*NA*	*8.49*	*3.49*	*NO*	*NO*	*NA*
Cluster-XV		*5.11*	*Jamunia river*	*0.0*	*5.11*	*7.97*	*4.27*	*NO*	*YES*	*0.0*
Cluster-XVI	*Nirsa (SOD:Safe)*	*29.78*	*DVC (Barakar river)*	*14.60*	*6.57*	*4.34*	*2.75*	*NO*	*NO*	*8.61*

7.0 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 been 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.*

- *Roof-top rainwater harvesting (RWH) will be taken 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 be 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 Rain water harvesting and artificial recharge will be given priority. This aspect is usually covered during the Environmental Week celebrated every year (5 to 12 June).*

- *Monitoring of water quality of mine water discharge, local River/nala and domestic water source (dug well/hand pump wells) will be continued under routine monitoring (February, May, August & November).*

Annexure – I

Location of Hydrograph Stations (Dug Wells)

Well No	***Latitude***	***Longitude***	***Well No***	***Latitude***	***Longitude***
A-3	*23^{0}47'53.35" N*	*86^{0}19'55.14" E*	***B-63***	*Abandoned due to OCP*	
A-12	*23^{0}48'20.31" N*	*86^{0}16'51.64" E*	***B-64***	*23^{0}48'43.14" N*	*86^{0}18'44.25" E*
A-16	*23^{0}46'57.00" N*	*86^{0}21'38.57" E*	***B-65A***	*23^{0}48'53.65" N*	*86^{0}18'11.82" E*
A-17	*23^{0}45'09.44" N*	*86^{0}22'16.35" E*	***B-67***	*23^{0}43'30.70" N*	*86^{0}14'01.45" E*
A-18	*23^{0}44'37.65" N*	*86^{0}22'58.90" E*	***D-3***	*23^{0}46'46.31" N*	*86^{0}24'49.30" E*
A-19	*23^{0}41'12.86" N*	*86^{0}23'55.27" E*	***D-4***	*23^{0}44'29.37" N*	*86^{0}24'42.88" E*
A-20	*23^{0}44'56.64" N*	*86^{0}19'55.35" E*	***D-5***	*23^{0}42'20.05" N*	*86^{0}24'86.06" E*
A-22	*23^{0}43'06.65" N*	*86^{0}14'48.53" E*	***D-7***	*23^{0}43'12.08" N*	*86^{0}27'11.89" E*
A-23	*23^{0}45'06.38" N*	*86^{0}15'12.69" E*	***D-8***	*23^{0}44'06.13" N*	*86^{0}27'20.72" E*
A-24	*23^{0}45'20.44" N*	*86^{0}13'45.12" E*	***D-23***	*23^{0}47'20.89" N*	*86^{0}20'09.96" E*
A-25	*23^{0}47'06.20" N*	*86^{0}15'27.79" E*	***D-25***	*23^{0}47'03.28" N*	*86^{0}23'29.56" E*
A-26	*23^{0}46'49.24" N*	*86^{0}18'12.12" E*	***D-30***	*23^{0}48'36.10" N*	*86^{0}21'50.07" E*
A-27	*23^{0}48'42.55" N*	*86^{0}20'21.80" E*	***D-33***	*23^{0}45'34.62" N*	*86^{0}23'18.50" E*
A-28A	*23^{0}47'34.74" N*	*86^{0}18'04.18" E*	***D-34***	*23^{0}45'36.50" N*	*86^{0}23'02.45" E*
A-29	*23^{0}47'08.02" N*	*86^{0}16'02.72" E*	***D-35***	*23^{0}40'46.54" N*	*86^{0}25'46.33" E*
A-32	*23^{0}44'15.56" N*	*86^{0}20'43.80" E*	***D-36***	*23^{0}40'19.26" N*	*86^{0}25'18.98" E*
A-33	*23^{0}44'32.58" N*	*86^{0}16'58.28" E*	***D-39***	*23^{0}43'28.50" N*	*86^{0}26'0.10" E*
A-34	*23^{0}42'58.63" N*	*86^{0}15'19.31" E*	***D-40A***	*23^{0}43'20.18" N*	*86^{0}25'45.70" E*
B-1	*23^{0}48'48.06" N*	*86^{0}14'16.87" E*	***D-41***	*23^{0}42'40.00" N*	*86^{0}26'17.20" E*
B-14	*23^{0}48'00.81" N*	*86^{0}16'25.88" E*	***D-43****	*NA*	*NA*
B-15	*23^{0}46'06.92" N*	*86^{0}08'59.30" E*	***D-47***	*23^{0}45'20.59" N*	*86^{0}24'34.86" E*
B-21A	*23^{0}45'10.50" N*	*86^{0}09'36.38" E*	***D-49***	*23^{0}44'08.96" N*	*86^{0}26'32.71" E*
B-23	*23^{0}44'13.05" N*	*86^{0}11'46.56" E*	***D-51***	*23^{0}44'20.86" N*	*86^{0}27'11.37" E*
B-24	*23^{0}44'26.80" N*	*86^{0}13'09.38" E*	***D-55***	*23^{0}43'58.37" N*	*86^{0}24'07.45" E*
B-25	*23^{0}44'44.98" N*	*86^{0}13'57.80" E*	***D-74***	*23^{0}41'33.66" N*	*86^{0}25'06.10" E*
B-32A	*23^{0}45'49.18" N*	*86^{0}13'03.64" E*	***D-77***	*23^{0}41'00.74" N*	*86^{0}22'25.55" E*

B-48	*23^{03}4'35.09" N*	*86^{0}16'38.30" E*	***D-80***	*23^{0}46'09.46" N*	*86^{0}24'33.08" E*
B-51	*23^{0}47'40.20" N*	*86^{0}09'11.90" E*	***DB-22***	*23^{0}43'38.81" N*	*86^{0}45'09.00" E*
B-53	*23^{0}45'55.25" N*	*86^{0}09'35.44" E*	***DB-23***	*23^{0}43'44.24" N*	*86^{0}45'06.39" E*
B-53A	*-*	*-*	***DB-24***	*23^{0}43'53.00" N*	*86^{0}45'03.88" E*
B-59	*23^{0}47'59.87" N*	*86^{0}13'37.97" E*	***DB-25***	*23^{0}44'10.75" N*	*86^{0}44'35.84" E*
B-60	*23^{0}48'7.87" N*	*86^{0}15'37.12" E*			
B-61A	*23^{0}45'59.85" N*	*86^{0}11'40.80" E*			
B-62A	*23^{0}45'44.15" N*	*86^{0}11'27.80" E*			

Annexure – IIA

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 tola*	*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 (Malkera)*	*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 (Gobindpur)*	*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	*Karmatanr-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 – IIA

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 – IIB

Historical Water Level data of Hydrograph Stations

Well No	Water level below ground level (bgl) in meters														
	May, 11	May, 12	Nov, 12	May, 13	Nov, 13	May, 14	Nov, 14	May, 15	Nov, 15	May, 16	Nov, 16	May, 17	Nov, 17	May, 18	Nov, 18
A-3	*4.77*	*4.25*	*1.87*	*4.47*	*4.45*	*4.67*	*2.37*	*3.70*	*3.42*	*4.87*	*0.47*	*0.67*	*0.77*	*1.27*	*0.47*
A-12	*2.80*	*2.80*	*1.30*	*3.00*	*1.17*	*2.45*	*1.4*	*3.00*	*2.68*	*2.50*	*0.70*	*2.55*	*0.85*	*2.80*	*1.0*
A-16	*5.80*	*3.53*	*1.60*	*3.80*	*3.35*	*5.5*	*2.9*	*5.55*	*4.17*	*5.85*	*3.15*	*3.65*	*2.20*	*4.30*	*3.65*
A-17	*2.24*	*2.52*	*2.34*	*2.32*	*1.54*	*2.19*	*1.91*	*3.79*	*2.64*	*2.44*	*2.69*	*2.44*	*2.24*	*3.34*	*2.84*
A-18	*2.49*	*2.59*	*0.90*	*2.87*	*0.91*	*1.76*	*1.19*	*2.84*	*1.29*	*1.14*	*0.89*	*1.29*	*0.99*	*1.24*	*0.99*
A19		*9.61*	*2.46*	*7.46*	*4.46*	*3.00*	*2.75*	*3.05*	*2.75*	*7.81*	*4.11*	*6.37*	*2.45*	*5.55*	*2.45*
A-20	*7.87*	*7.17*	*1.57*	*6.47*	*0.67*	*3.97*	*2.55*	*4.59*	*2.93*	*7.49*	*3.50*	*4.27*	*1.77*	*4.57*	*2.57*
A22A		*1.90*	*1.05*	*1.79*	*1.00*	*1.50*	*2.0*	*3.20*	*1.96*	*3.25*	*1.75*	*4.27*	*1.77*	*3.35*	*1.30*
A-23	*11.92*	*9.87*	*4.75*	*10.57*	*5.82*	*8.76*	*6.82*	*11.3*	*9.37*	*11.87*	*8.13*	*6.40*	*1.50*	*11.15*	*7.17*
A-24	*18.28*	*18.68*	*5.23*	*16.01*	*3.25*	*16.28*	*14.98*	*17.2*	*14.5*	*16.62*	*12.43*	*11.87*	*6.97*	*14.58*	*6.88*
A-25	*6.83*	*10.23*	*4.43*	*10.23*	*2.98*	*7.03*	*5.28*	*7.78*	*5.85*	*7.43*	*4.58*	*6.38*	*2.88*	*6.63*	*3.13*
A-26	*9.18*	*8.76*	*4.28*	*7.56*	*4.28*	*7.71*	*4.58*	*7.73*	*3.18*	*8.93*	*4.48*	*5.28*	*2.53*	*6.23*	*3.88*
A-27	*3.00*	*2.13*	*1.10*	*1.62*	*1.25*	*1.63*	*1.55*	*4.40*	*3.95*	*4.85*	*1.80*	*2.90*	*1.25*	*2.90*	*1.0*
A28A	*3.90*	*2.90*	*2.45*	*3.35*	*2.45*	*3.29*	*1.91*	*4.35*	*3.60*	*3.35*	*1.47*	*4.30*	*1.55*	*4.15*	*2.51*
A-29	*5.50*	*9.30*	*1.42*	*6.95*	*1.67*	*3.3*	*2.35*	*4.55*	*4.60*	*5.92*	*6.96*	*4.40*	*1.30*	*6.45*	*2.10*
A-32	*2.30*	*2.19*	*1.10*	*2.45*	*1.95*	*3.15*	*2.45*	*4.41*	*2.13*	*4.75*	*2.10*	*3.15*	*1.55*	*2.80*	*0.70*
A-33	*3.07*	*5.25*	*1.25*	*4.13*	*1.80*	*4.08*	*1.57*	*4.91*	*1.97*	*5.75*	*2.60*	*6.45*	*1.55*	*4.07*	*2.35*
A-34	*2.90*	*6.95*	*2.90*	*6.21*	*2.50*	*4.45*	*4.45*	*8.40*	*4.81*	*4.75*	*4.45*	*12.45*	*4.45*	*5.90*	*3.70*
B-1	*1.78*	*2.08*	*1.73*	*1.53*	*1.83*	*2.43*	*1.81*	*3.28*	*2.75*	*3.58*	*1.93*	*2.33*	*0.85*	*2.88*	*2.08*
B-14	*2.49*	*1.34*	*1.42*	*1.74*	*1.45*	*3.24*	*4.44*	*2.94*	*2.29*	*2.44*	*0.47*	*2.94*	*1.84*	*3.64*	*2.84*
B-15	*1.37*	*1.27*	*0.45*	*1.20*	*0.55*	*0.95*	*1.45*	*1.50*	*0.45*	*1.85*	*0.55*	*4.85*	*0.15*	*1.85*	*0.85*
B21A	*7.60*	*9.00*	*5.05*	*8.01*	*4.95*	*9.54*	*3.7*	*7.37*	*4.65*	*5.55*	*4.50*	*8.85*	*5.65*	*9.65*	*2.65*
B-23	*9.14*	*3.71*	*1.74*	*5.27*	*1.39*	*6.57*	*2.74*	*7.86*	*4.29*	*6.81*	*2.41*	*7.74*	*2.14*	*6.64*	*2.14*
B-24	*10.33*	*-*	*3.09*	*8.88*	*2.83*	*9.40*	*2.21*	*10.0*	*5.78*	*10.63*	*4.28*	*10.03*	*4.03*	*9.28*	*4.33*
B-25	*8.35*	*8.35*	*2.60*	*7.08*	*2.15*	*5.82*	*5.15*	*6.88*	*-*	*7.05*	*1.70*	*6.70*	*1.40*	*5.90*	*3.70*
B32A	*7.80*	*7.75*	*3.22*	*6.25*	*2.68*	*8.33*	*2.05*	*7.55*	*3.32*	*6.95*	*3.07*	*6.95*	*2.80*	*6.75*	*3.90*
B-48	*5.75*	*5.43*	*3.85*	*4.69*	*3.20*	*6.38*	*4.35*	*7.90*	*5.42*	*9.35*	*4.60*	*7.70*	*4.15*	*7.33*	*3.97*
B-51	*3.95*	*3.60*	*2.05*	*3.35*	*2.49*	*2.09*	*1.98*	*4.65*	*3.40*	*4.90*	*3.18*	*4.98*	*2.55*	*5.02*	*2.42*

B-53	*1.67*	*6.97*	*1.42*	*4.15*	*1.12*	*3.39*	*-*	*5.58*	*2.82*	*4.70*	*1.45*	*4.02*	*1.92*	*3.92*	*1.42*
B-59	*8.25*	*6.90*	*0.60*	*7.56*	*0.30*	*2.65*	*1.0*	*4.12*	*1.60*	*4.40*	*0.50*	*5.40*	*0.60*	*5.47*	*1.10*
B-60	*11.44*	*10.18*	*5.13*	*11.29*	*5.23*	*9.82*	*4.59*	*9.21*	*5.28*	*10.33*	*5.03*	*13.23*	*3.18*	*13.68*	*4.23*
B61A	*10.72*	*5.42*	*2.40*	*8.17*	*2.02*	*6.93*	*3.57*	*6.15*	*4.52*	*6.58*	*3.87*	*2.57*	*0.82*	*2.57*	*2.02*
B62A	*8.85*	*7.85*	*4.90*	*7.73*	*4.63*	*8.83*	*5.85*	*9.10*	*5.21*	*9.30*	*4.95*	*8.15*	*4.35*	*8.27*	*4.78*

Annexure – IIB

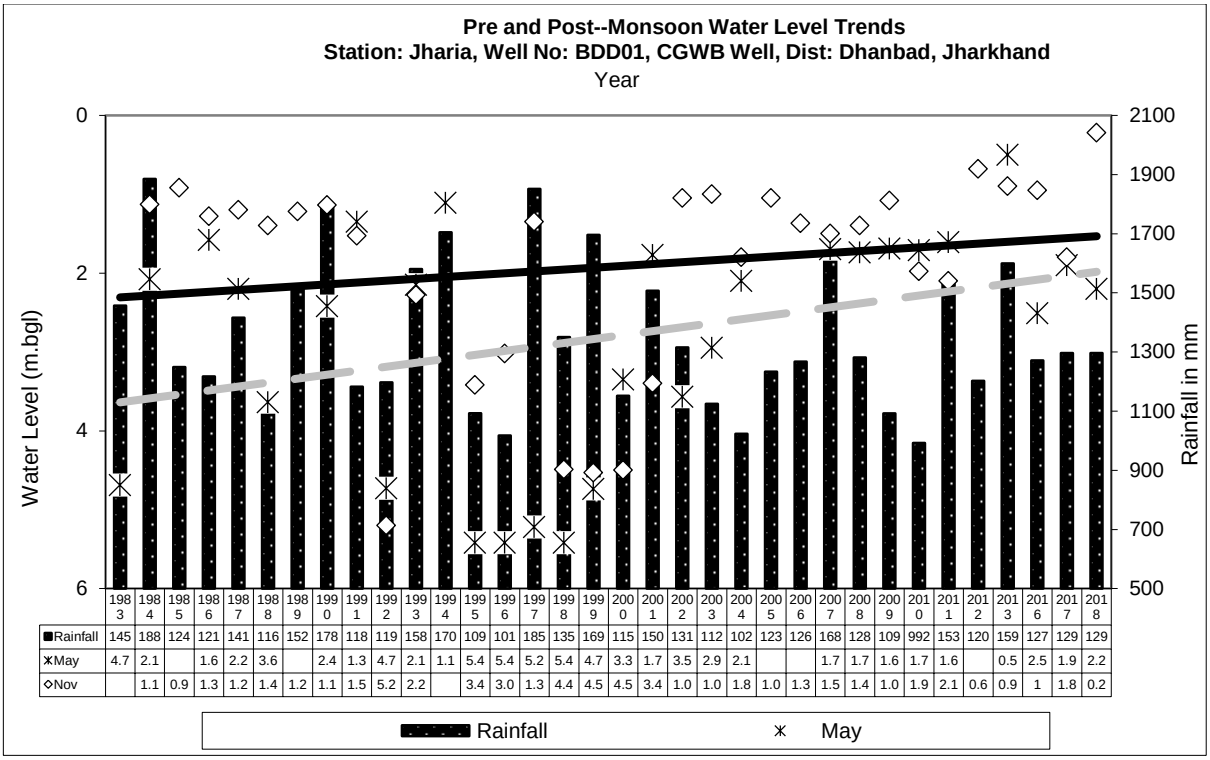
Historical Water Level data of Hydrograph Stations

Well No	Water level below ground level (bgl) in meters														
	May, 11	**May, 12**	**Nov, 12**	**May, 13**	**Nov, 13**	**May, 14**	**Nov, 14**	**May, 15**	**Nov, 15**	**May, 16**	**Nov, 16**	**May, 17**	**Nov, 17**	**May, 18**	**Nov, 18**
B-64	*0.85*	*1.05*	*1.00*	*1.35*	*0.85*	*0.7*	*1.15*	*1.38*	*0.95*	*2.35*	*0.55*	*1.25*	*0.85*	*2.15*	*1.85*
B65A	*9.65*	*11.45*	*1.73*	*10.11*	*1.82*	*10.45*	*2.4*	*7.82*	*5.87*	*7.15*	*2.68*	*9.05*	*1.25*	*10.03*	*2.40*
B-67	*11.25*	*8.55*	*6.50*	*9.73*	*5.31*	*9.80*	*3.72*	*9.23*	*5.53*	*9.53*	*4.30*	*10.00*	*2.15*	*9.55*	*4.0*
D-3	*2.55*	*2.93*	*1.80*	*3.45*	*1.68*	*2.54*	*2.11*	*4.25*	*2.25*	*2.35*	*1.90*	*2.15*	*2.30*	*3.43*	*2.45*
D-4	*1.51*	*1.94*	*0.91*	*2.41*	*0.98*	*1.23*	*0.91*	*2.41*	*1.27*	*1.21*	*1.36*	*1.21*	*1.46*	*1.91*	*1.56*
D-5	*9.05*	*9.50*	*6.45*	*9.32*	*4.59*	*9.0*	*7.8*	*9.37*	*8.33*	*9.40*	*6.40*	*7.90*	*5.20*	*7.80*	*5.30*
D-7	*9.33*	*6.08*	*5.83*	*7.19*	*4.63*	*5.28*	*5.53*	*8.25*	*5.61*	*7.53*	*4.03*	*7.33*	*2.88*	*7.53*	*2.83*
D-8	*7.75*	*6.15*	*3.75*	*6.65*	*2.85*	*7.73*	*-*	*6.24*	*4.38*	*8.00*	*3.43*	*5.15*	*1.85*	*5.65*	*1.85*
D-23	*6.80*	*6.00*	*3.30*	*6.60*	*1.20*	*6.38*	*2.4*	*6.55*	*3.48*	*5.70*	*1.63*	*2.80*	*2.98*	*4.40*	*3.40*
D-25	*4.70*	*5.20*	*3.65*	*4.26*	*3.45*	*4.42*	*2.9*	*4.48*	*2.45*	*2.40*	*1.90*	*2.40*	*1.20*	*2.60*	*2.40*
D-30	*5.10*	*3.88*	*1.80*	*4.38*	*3.08*	*4.17*	*3.3*	*4.55*	*3.15*	*4.45*	*3.20*	*4.40*	*1.25*	*4.58*	*1.10*
D-33	*0.95*	*2.85*	*0.35*	*1.80*	*0.45*	*1.72*	*0.35*	*2.25*	*1.10*	*2.50*	*1.95*	*0.75*	*0.75*	*2.85*	*0.95*
D-34	*2.85*	*2.35*	*2.50*	*2.50*	*2.13*	*2.80*	*0.30*	*2.55*	*1.45*	*2.30*	*0.30*	*0.80*	*0.55*	*2.80*	*0.45*
D-35	*8.20*	*8.05*	*5.55*	*7.70*	*4.10*	*6.94*	*6.15*	*9.80*	*7.90*	*9.52*	*6.45*	*8.80*	*3.60*	*8.40*	*4.45*
D-36	*1.95*	*1.55*	*0.15*	*1.28*	*0.80*	*1.82*	*0.75*	*1.66*	*1.13*	*0.78*	*0.95*	*1.30*	*0.70*	*1.20*	*0.60*
D-39	*5.05*	*5.05*	*3.65*	*3.98*	*2.50*	*5.03*	*2.25*	*5.00*	*2.61*	*2.18*	*2.65*	*6.17*	*4.75*	*4.95*	*4.35*
D40A	*1.95*	*2.45*	*1.70*		*2.25*	*2.35*	*2.45*	*3.07*	*2.45*	*1.40*	*0.85*	*1.45*	*1.35*	*2.10*	*1.40*
D-41	*1.55*	*1.50*	*1.50*	*1.72*	*1.35*	*3.20*	*1.35*	*2.65*	*2.32*	*1.30*	*1.52*	*1.40*	*1.20*	*1.59*	*1.32*
D-43	*7.65*	*7.05*	*4.00*	*6.23*	*4.05*	*6.0*	*4.75*	*6.61*	*5.05*	*8.20*	*3.35*	*7.50*	*3.60*	*7.15*	*3.45*
D-47	*4.35*	*1.95*	*2.12*	*2.60*	*2.97*	*8.0*	*2.37*	*9.60*	*3.60*	*3.18*	*2.95*	*3.15*	*2.85*	*5.33*	*2.55*
D-49	*1.55*	*1.60*	*1.65*	*1.30*	*1.45*	*2.51*	*1.65*	*3.55*	*2.35*	*2.45*	*1.72*	*2.70*	*2.05*	*3.45*	*2.45*
D-51	*10.85*	*10.00*	*7.85*	*8.94*	*8.35*	*9.60*	*9.05*	*10.48*	*9.15*	*11.15*	*6.45*	*10.45*	*5.43*	*10.93*	*7.10*
D-55	*5.97*	*1.93*	*1.82*	*3.90*	*1.45*	*1.95*	*2.07*	*6.15*	*1.57*	*2.52*	*3.62*	*6.42*	*2.37*	*8.42*	*1.57*
D-74	*4.05*	*4.95*	*3.60*	*4.55*	*3.41*	*5.0*	*4.0*	*10.05*	*7.20*	*7.73*	*5.00*	*9.25*	*3.85*	*8.60*	*4.80*
D-77	*6.30*	*6.50*	*4.75*	*4.79*	*5.10*	*6.23*	*6.0*	*6.44*	*5.60*	*4.60*	*2.90*	*6.50*	*4.90*	*6.30*	*5.20*
D-80	*17.45*	*14.20*	*3.35*	*15.25*	*3.32*	*13.3*	*3.15*	*10.97*	*3.35*	*6.55*	*4.15*	*8.65*	*3.70*	*9.35*	*4.20*
RCF (part)		**May, 12**	**Nov, 12**	**May, 13**	**Nov, 13**	**May, 14**	**Nov, 14**	**May, 15**	**Nov, 15**	**May, 16**	**Nov, 16**	**May, 17**	**Nov, 17**	**May, 18**	**Nov, 18**

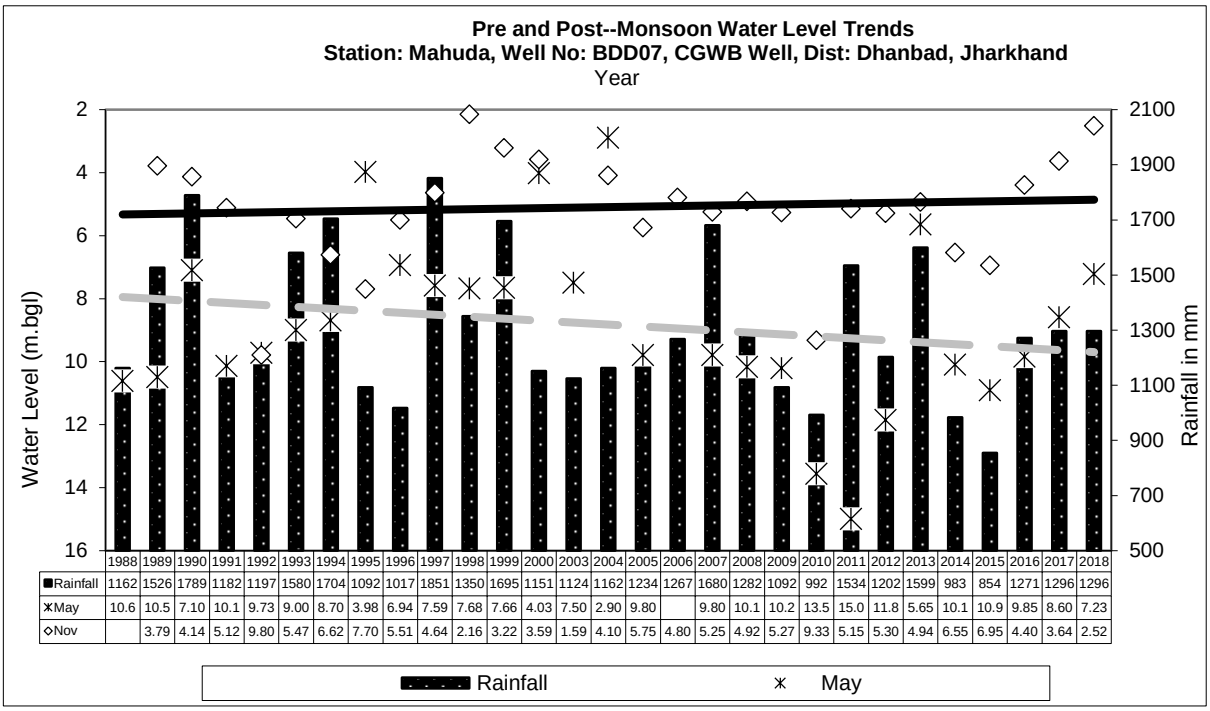
DB22		*2.43*	*2.38*	*8.18*	*2.64*	*6.48*	*3.03*	*4.59*	*3.53*	*5.38*	*3.33*	*1.93*	*1.63*	*2.34*	*1.93*
DB23		*2.90*	*2.33*	*5.05*	*3.10*	*3.95*	*2.13*	*3.38*	*6.04*	*5.30*	*0.90*	*2.05*	*1.90*	*2.85*	*1.75*
DB24		*-*	*-*	*-*	*8.25*	*-*	*8.45*	*9.52*	*8.20*	*10.65*	*6.50*	*5.80*	*3.78*	*8.25*	*5.70*
DB25		*3.96*	*1.18*	*1.33*	*2.53*	*3.27*	*2.73*	*3.83*	*2.68*	*3.61*	*1.98*	*3.23*	*2.58*	*3.93*	*1.63*

Annexure – III

HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS



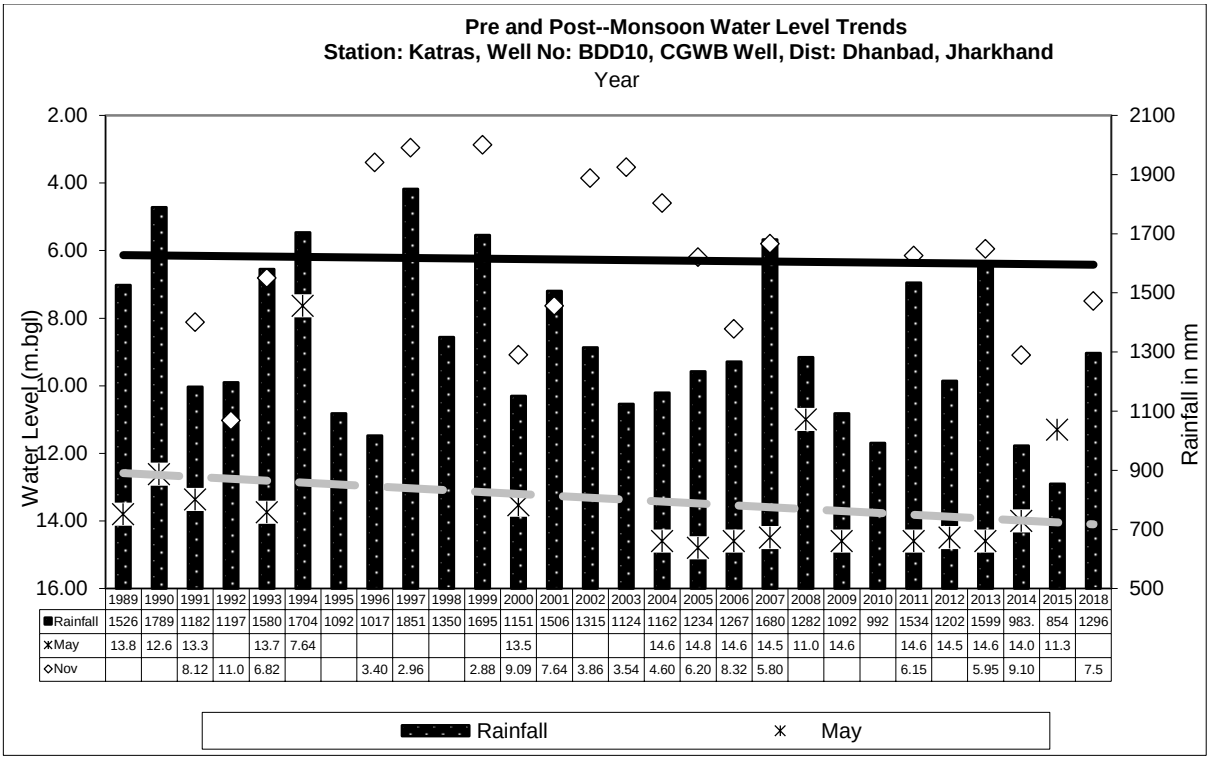
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	145	188	124	121	141	116	152	178	118	119	158	170	109	101	185	135	169	115	150	131	112	102	123	126	168	128	109	992	153	120	159	127	129	129		
May	4.7	2.1		1.6	2.2	3.6		2.4	1.3	4.7	2.1	1.1	5.4	5.4	5.2	5.4	4.7	3.3	1.7	3.5	2.9	2.1			1.7	1.7	1.6	1.7	1.6		0.5	2.5	1.9	2.2		
Nov		1.1	0.9	1.3	1.2	1.4	1.2	1.1	1.5	5.2	2.2		3.4	3.0	1.3	4.4	4.5	4.5	3.4	1.0	1.0	1.8	1.0	1.3	1.5	1.4	1.0	1.9	2.1	0.6	0.9	1	1.8	0.2		



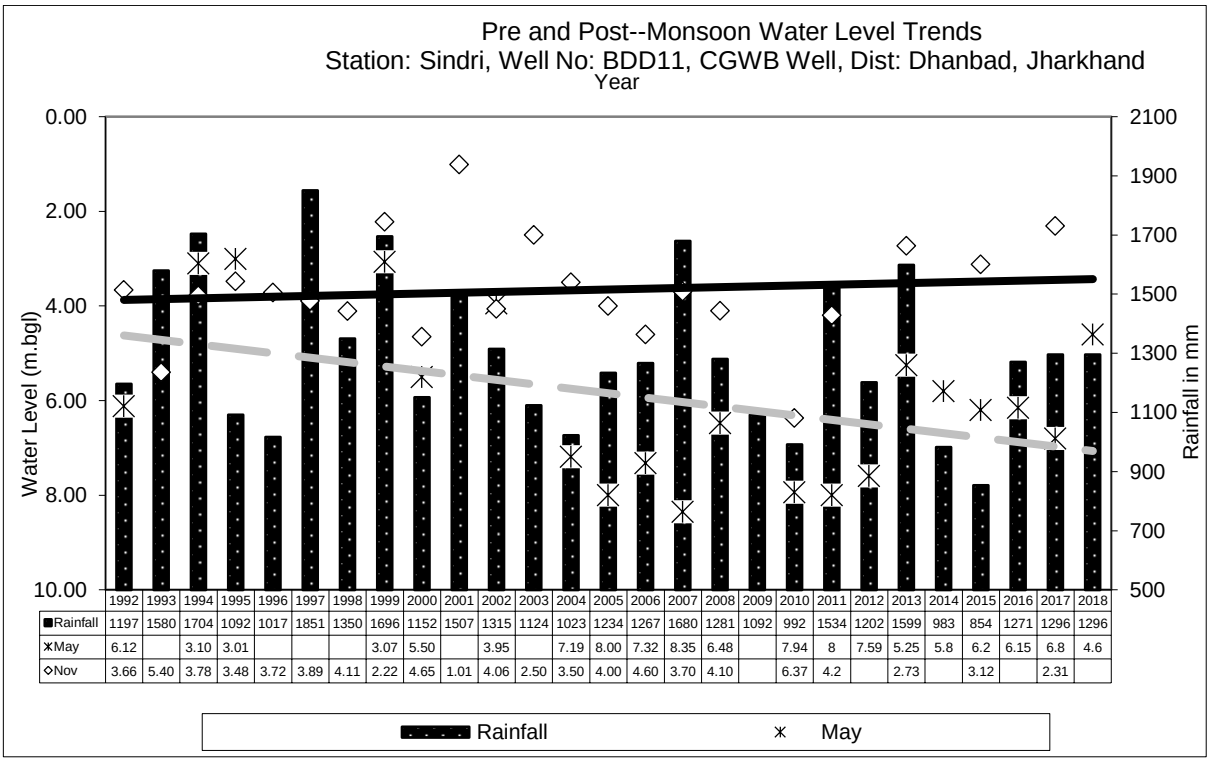
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1162	1526	1789	1182	1197	1580	1704	1092	1017	1851	1350	1695	1151	1124	1162	1234	1267	1680	1282	1092	992	1534	1202	1599	983	854	1271	1296	1296
May	10.6	10.5	7.10	10.1	9.73	9.00	8.70	3.98	6.94	7.59	7.68	7.66	4.03	7.50	2.90	9.80		9.80	10.1	10.2	13.5	15.0	11.8	5.65	10.1	10.9	9.85	8.60	7.23
Nov		3.79	4.14	5.12	9.80	5.47	6.62	7.70	5.51	4.64	2.16	3.22	3.59	1.59	4.10	5.75	4.80	5.25	4.92	5.27	9.33	5.15	5.30	4.94	6.55	6.95	4.40	3.64	2.52

Annexure – III

HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2018
Rainfall	1526	1789	1182	1197	1580	1704	1092	1017	1851	1350	1695	1151	1506	1315	1124	1162	1234	1267	1680	1282	1092	992	1534	1202	1599	983.	854	1296
May	13.8	12.6	13.3		13.7	7.64						13.5				14.6	14.8	14.6	14.5	11.0	14.6		14.6	14.5	14.6	14.0	11.3	
Nov			8.12	11.0	6.82			3.40	2.96		2.88	9.09	7.64	3.86	3.54	4.60	6.20	8.32	5.80				6.15		5.95	9.10		7.5



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1197	1580	1704	1092	1017	1851	1350	1696	1152	1507	1315	1124	1023	1234	1267	1680	1281	1092	992	1534	1202	1599	983	854	1271	1296	1296
May	6.12		3.10	3.01				3.07	5.50		3.95		7.19	8.00	7.32	8.35	6.48		7.94	8	7.59	5.25	5.8	6.2	6.15	6.8	4.6
Nov	3.66	5.40	3.78	3.48	3.72	3.89	4.11	2.22	4.65	1.01	4.06	2.50	3.50	4.00	4.60	3.70	4.10		6.37	4.2		2.73		3.12		2.31	

Annexure – IV

GROUNDWATER SAMPLE LOCATION DETAILS

Sampling month: *March, May, August & December month of assessment year'2018*

Sl No	***Name of Cluster***	***Ground Water Sample***	***Dug well (CMPDI)***	***Location***	***Sampling Date***			
					March'18	***May'18***	***Aug'18***	***Dec'18***
1	*CLUSTER-I*	*GW-1*	*B-15*	*BERA VILLAGE*	*08.03.18*	*30.05.18*	*16.08.18*	*10.12.18*
2	*CLUSTER-II*	*GW-2*	*B-59*	*KHODOVALY VILLAGE*	*08.03.18*	*30.05.18*	*16.08.18*	*10.12.18*
3	*CLUSTER-III*	*GW-3*	*A-29*	*GOVINDPUR,AMBAGAN VILLAGE*	*08.03.18*	*30.05.18*	*16.08.18*	*10.12.18*
4	*CLUSTER-IV*	*GW-4*	*B-63*	*KESHALPUR, BATIGHAR*	*08.03.18*	*30.05.18*	*16.08.18*	*10.12.18*
5	*CLUSTER-V*	*GW-5*	*D-30*	*BORKIBOA VILLAGE*	*08.03.18*	*30.05.18*	*16.08.18*	*10.12.18*
6	*CLUSTER-VI*	*GW-6*	*D-25*	*GODHUR MORE*	*08.03.18*	*30.05.18*	*16.08.18*	*11.12.18*
7	*CLUSTER-VII*	*GW-7*	*D-80*	*DHANSAR MINE RESCUE STN.*	*07.03.18*	*31.05.18*	*17.08.18*	*11.12.18*
8	*CLUSTER-VIII*	*GW-8*	*D-49*	*NEAR GHANOODIH OC*	*07.03.18*	*31.05.18*	*17.08.18*	*11.12.18*
9	*CLUSTER-IX*	*GW-9*	*D-5*	*JEALGORA, NEAR P.O.*	*07.03.18*	*31.05.18*	*17.08.18*	*11.12.18*
10	*CLUSTER-X*	*GW-10*	*D-35*	*PATHERDIH RLY. COLONY*	*07.03.18*	*31.05.18*	*17.08.18*	*11.12.18*
11	*CLUSTER-XI*	*GW-11*	*A-32*	*MONNIDIH BAZAR*	*08.03.18*	*30.05.18*	*18.08.18*	*10.12.18*
12	*CLUSTER-XIII*	*GW-13*	*A-23*	*MACHHAYARA*	*08.03.18*	*30.05.18*	*18.08.18*	*10.12.18*
13	*CLUSTER-XIV*	*GW-14*	*B-23*	*LOHAPATTI VILLAGE*	*08.03.18*	*30.05.18*	*18.08.18*	*10.12.18*
14	*CLUSTER-XV*	*GW-15*	*B-32A*	*MADHUBAND VILLAGE*	*08.03.18*	*30.05.18*	*18.08.18*	*10.12.18*
15	*CLUSTER-XVI*	*GW-16*	*D-22*	*DAHIBARI,NICHE BASTI*	*07.03.18*	*31.05.18*	*17.08.18*	*11.12.18*

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)

Month: March'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 08/03/2018

5. Cluster-V (GW-5), Borkiboa village, Date: 08/03/2018

6. Cluster-VI (GW-6), Godhur, Date: 08/03/2018

Sl. No	Parameter	*Sampling Stations*			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	*5*	*6*			
1	Boron (as B), mg/l, Max	*<0.20*	*<0.20*	*<0.20*	0.20	*0.5*	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	*03*	*03*	*1.0*	1	*5*	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	*32*	*46*	*34*	1.60	*75*	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	*24*	*38*	*48*	2.00	*250*	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	*<0.001*	*<0.001*	*<0.001*	0.03	*0.05*	*IS 3025/42 : 1992 R : 2009, AAS-Flame*
6	Fluoride (as F) mg/l, Max	*0.19*	*0.32*	*0.45*	0.02	*1.0*	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	*<0.02*	*<0.02*	*<0.02*	0.02	*0.2*	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	*0.14*	*0.06*	*0.12*	0.06	*0.3*	*IS 3025 /53 : 2003,* R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	*<0.005*	*<0.005*	*<0.005*	0.005	*0.01*	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	*<0.02*	*<0.02*	*<0.02*	0.02	*0.1*	*IS-3025/59:2006, AAS-Flame*
11	Nitrate (as NO_3), mg/l, Max	14.10	15.10	3.9	0.5	*45*	*APHA, 22nd Edition,* UV-Spectrphotometric
12	Odour	*Agreeable*	*Agreeable*	*Agreeable*	Qualitative	*Agreeable*	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	*7.81*	*7.69*	*7.54*	0.2	*6.5 to 8.5*	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	*<0.001*	*<0.001*	*<0.001*	0.001	*0.001*	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	*0.01*	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	64.0	78.0	82	2.00	*200*	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	*Acceptable*	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	104	94.0	88.0	4.00	*200*	IS-3025/23:1986, Titration

19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	*0.01*	*IS 3025/ 37:1988* R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	*0.05*	*IS-3025/52:2003, AAS-Flame*
21	Total Dissolved Solids, mg/l, Max	459	456	485	25.00	*500*	*IS 3025 /16:1984* R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	186	168	192	4.00	*200*	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	4.0	2.0	1.0	1.0	*1*	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	*5.0*	*IS 3025/ 49 : 1994,* R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	*5.0*	*IS 3025/ 49 : 1994,* *R : 2009, AAS-Flame*

*****_Sampling location details and sampling date has been given in **Annexure-IV**._

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)

Month: May'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 30/05/2018

5. Cluster-V (GW-5), Borkiboa village, Date: 30/05/2018

6. Cluster-VI (GW-6), Godhur, Date: 30/05/2018

Sl. No	Parameter	*Sampling Stations*			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	*5*	*6*			
1	Boron (as B), mg/l, Max	*<0.20*	*<0.20*	*<0.20*	0.20	*0.5*	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	*04*	*03*	*05*	1	*5*	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	*43.2*	*41.6*	*48*	1.60	*75*	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	*48*	*80*	*72*	2.00	*250*	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	*<0.001*	*0.001*	*<0.001*	0.03	*0.05*	*IS 3025/42 : 1992 R : 2009, AAS-Flame*
6	Fluoride (as F) mg/l, Max	*0.12*	*0.17*	*0.38*	0.02	*1.0*	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	*0.02*	*0.03*	*0.02*	0.02	*0.2*	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	*0.06*	*0.08*	*0.06*	0.06	*0.3*	*IS 3025 /53 : 2003,* R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	*<0.005*	*<0.005*	*<0.005*	0.005	*0.01*	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	*<0.02*	*<0.02*	*<0.02*	0.02	*0.1*	*IS-3025/59:2006, AAS-Flame*
11	Nitrate (as NO_3), mg/l, Max	13.6	12.80	4.7	0.5	*45*	*APHA, 22nd Edition,* UV-Spectrphotometric
12	Odour	*Agreeable*	*Agreeable*	*Agreeable*	Qualitative	*Agreeable*	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	*7.38*	*7.21*	*8.07*	0.2	*6.5 to 8.5*	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	*<0.001*	*<0.001*	*<0.001*	0.001	*0.001*	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	*0.01*	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	132	153	172	2.00	*200*	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	*Acceptable*	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	108	92	172	4.00	*200*	IS-3025/23:1986, Titration

19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	*0.01*	*IS 3025/ 37:1988* R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	*0.05*	*IS-3025/52:2003, AAS-Flame*
21	Total Dissolved Solids, mg/l, Max	470	454	490	25.00	*500*	*IS 3025 /16:1984* R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	188	180	196	4.00	*200*	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2.0	1.0	3.0	1.0	*1*	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	<0.01	<0.01	0.01	*5.0*	*IS 3025/ 49 : 1994,* R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	<0.005	<0.005	0.01	*5.0*	*IS 3025/ 49 : 1994,* *R : 2009, AAS-Flame*

*****_Sampling location details and sampling date has been given in **Annexure-IV**._

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)

Month: August'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 16/08/2018

5. Cluster-V (GW-5), Borkiboa village, Date: 16/08/2018

6. Cluster-VI (GW-6), Godhur, Date: 16/08/2018

Sl. No	Parameter	*Sampling Stations*			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	*5*	*6*			
1	Boron (as B), mg/l, Max	*<0.2*	*<0.2*	*<0.2*	0.20	*0.5*	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	*3*	*4*	*4*	1	*5*	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	*40*	*177.6*	*59.2*	1.60	*75*	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	*24*	*104*	*30*	2.00	*250*	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	*0.02*	*0.02*	*0.02*	0.03	*0.05*	*IS 3025/42 : 1992 R : 2009, AAS-Flame*
6	Fluoride (as F) mg/l, Max	*0.22*	*0.53*	*0.15*	0.02	*1.0*	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	*<0.02*	*<0.02*	*<0.02*	0.02	*0.2*	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	*<0.06*	*0.01*	*<0.06*	0.06	*0.3*	*IS 3025 /53 : 2003,* R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	*0.01*	*0.009*	*0.008*	0.005	*0.01*	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	*<0.02*	*<0.02*	*<0.02*	0.02	*0.1*	*IS-3025/59:2006, AAS-Flame*
11	Nitrate (as NO_3), mg/l, Max	0.40	*4.83*	*7.50*	0.5	*45*	*APHA, 22nd Edition,* UV-Spectrphotometric
12	Odour	*Agreeable*	*Agreeable*	*Agreeable*	Qualitative	*Agreeable*	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	*8.12*	*7.73*	*8.07*	0.2	*6.5 to 8.5*	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	*<0.001*	*<0.001*	*<0.001*	0.001	*0.001*	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	*<0.002*	*<0.002*	0.002	*0.01*	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	40	*228*	*85*	2.00	*200*	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	*Acceptable*	*Acceptable*	Qualitative	*Acceptable*	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	152	*95*	*105*	4.00	*200*	IS-3025/23:1986, Titration

19	Total Arsenic (as As), mg/l, Max	<0.002	*<0.002*	*<0.002*	0.002	*0.01*	*IS 3025/ 37:1988* R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	0.1	*0.1*	*0.2*	0.04	*0.05*	*IS-3025/52:2003, AAS-Flame*
21	Total Dissolved Solids, mg/l, Max	144	*830*	*204*	25.00	*500*	*IS 3025 /16:1984* R : 2006, Gravimetric
22	Total Hardness ($c_a co_3$), mg/l, Max	130	*740*	*192*	4.00	*200*	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	1	*<1*	*<1*	1.0	*1*	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	*<0.01*	*<0.01*	0.01	*5.0*	*IS 3025/ 49 : 1994,* R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	*<0.005*	*<0.005*	0.01	*5.0*	*IS 3025/ 49 : 1994,* *R : 2009, AAS-Flame*

*****_Sampling location details and sampling date has been given in_ ***Annexure-IV***.

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)

Month: December'2018

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 10/12/2018

5. Cluster-V (GW-5), Borkiboa village, Date: 10/12/2018

6. Cluster-VI (GW-6), Godhur, Date: 11/12/2018

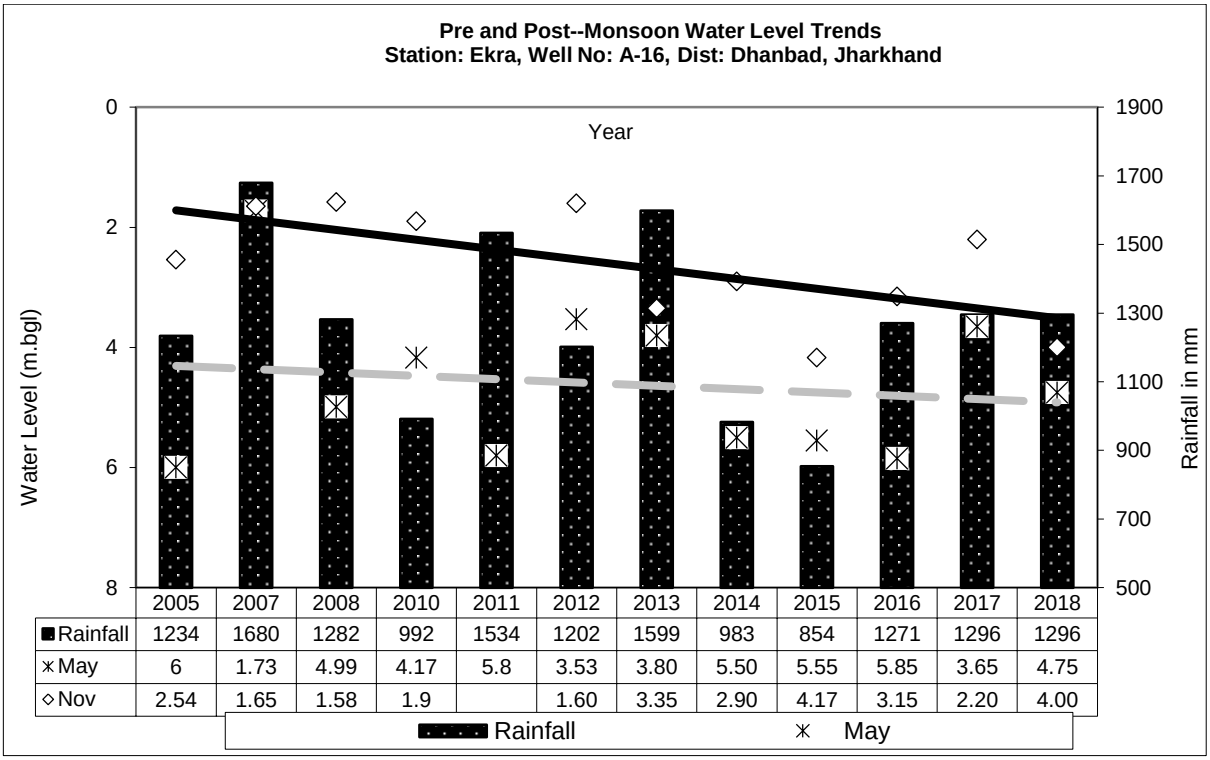
Sl. No	Parameter	*Sampling Stations*			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	*5*	*6*			
1	Boron (as B), mg/l, Max	*<0.2*	*<0.2*	*<0.2*	0.20	*0.5*	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	*4*	*2*	*3*	1	*5*	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	*20*	*16*	*28*	1.60	*75*	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	*26*	*24*	*34*	2.00	*250*	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	*<0.001*	*<0.001*	*<0.001*	0.03	*0.05*	*IS 3025/42 : 1992 R : 2009, AAS-Flame*
6	Fluoride (as F) mg/l, Max	*0.33*	*0.29*	*0.18*	0.02	*1.0*	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	*<0.02*	*<0.02*	*<0.02*	0.02	*0.2*	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	*0.5*	*<0.06*	*0.47*	0.06	*0.3*	*IS 3025 /53 : 2003,* R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	*<0.005*	*0.009*	*<0.005*	0.005	*0.01*	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	*0.08*	*<0.02*	*0.13*	0.02	*0.1*	*IS-3025/59:2006, AAS-Flame*
11	Nitrate (as NO_3), mg/l, Max	22.6	*10.4*	*16.7*	0.5	*45*	*APHA, 22nd Edition,* UV-Spectrphotometric
12	Odour	*Agreeable*	*Agreeable*	*Agreeable*	Qualitative	*Agreeable*	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	*8.08*	*8.12*	*7.96*	0.2	*6.5 to 8.5*	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	*<0.001*	*<0.001*	*<0.001*	0.001	*0.001*	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	*<0.002*	*<0.002*	0.002	*0.01*	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	68	*56*	*84*	2.00	*200*	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	*Acceptable*	*Acceptable*	Qualitat-ive	*Acceptable*	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_3),, mg/l, Max	165	*212*	*190*	4.00	*200*	IS-3025/23:1986, Titration

19	Total Arsenic (as As), mg/l, Max	<0.002	*<0.002*	*<0.002*	0.002	*0.01*	*IS 3025/ 37:1988* R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	*<0.04*	*<0.04*	0.04	*0.05*	*IS-3025/52:2003, AAS-Flame*
21	Total Dissolved Solids, mg/l, Max	832	*764*	*592*	25.00	*500*	*IS 3025 /16:1984* R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	532	*602*	*338*	4.00	*200*	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	5	*4*	*1*	1.0	*1*	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	*<0.01*	*<0.01*	0.01	*5.0*	*IS 3025/ 49 : 1994,* R : 2009, AAS-Flame
25	Nickel as Ni, mg/l max	<0.005	*<0.005*	*<0.005*	0.01	*5.0*	*IS 3025/ 49 : 1994,* *R : 2009, AAS-Flame*

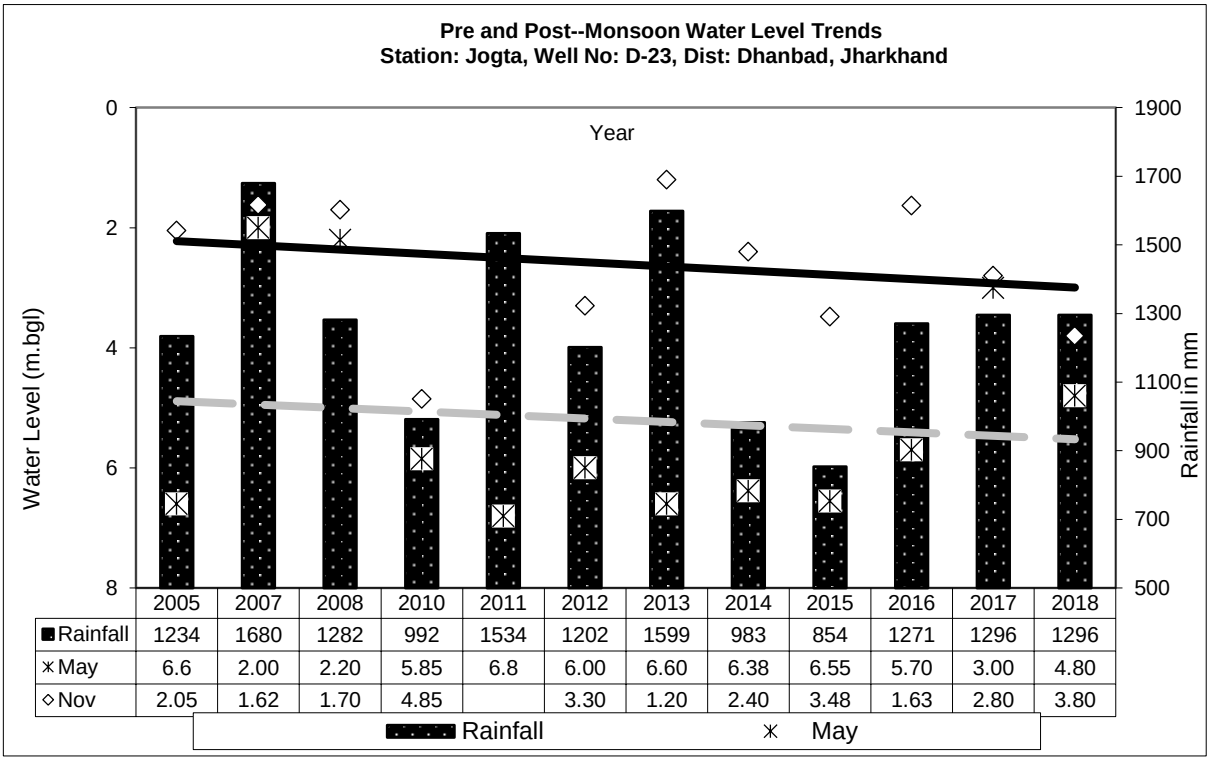
*****_Sampling location details and sampling date has been given in **Annexure-IV**._

Annexure – VI

HYDROGRAPHS OF CLUSTER-V



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
May	6	1.73	4.99	4.17	5.8	3.53	3.80	5.50	5.55	5.85	3.65	4.75
Nov	2.54	1.65	1.58	1.9		1.60	3.35	2.90	4.17	3.15	2.20	4.00



	2005	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rainfall	1234	1680	1282	992	1534	1202	1599	983	854	1271	1296	1296
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
Nov	2.05	1.62	1.70	4.85		3.30	1.20	2.40	3.48	1.63	2.80	3.80

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

Annexure 16:

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. 2019**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	**MW5** First Fortnight 16.08.2019	**MW5** Second Fortnight 17.08.2019	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	48	53	*100 (Max)*
2	pH	7.77	7.89	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	48	52	*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(Mining/Environment)
RI-2, CMPDI, Dhanbad

Annexure 17:

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 beeng planted at all the ecorestoration/plantation sites of BCCL. The various species having tap root system are given below

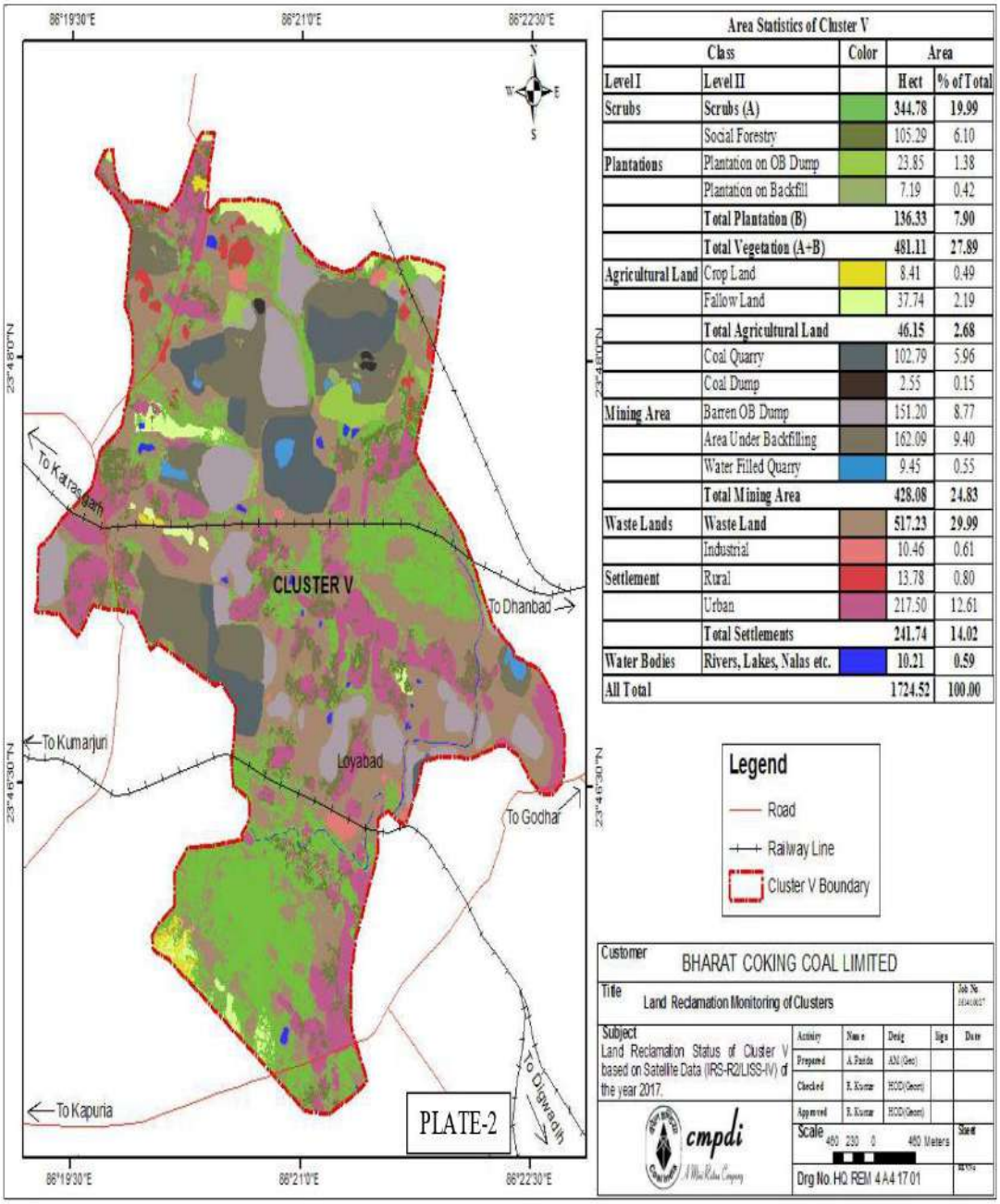
S.No.	Species	Common name
1.	*Acacia nilotica*	Kikkar
2.	*Albizia odoratissima*	Kala siris
3.	*Bauhinia variegata*	Kachnar
4.	*Cassia fistula*	Amaltas
5.	*Ficus benghalensis*	Baniyan /bargad
6.	*Ficus racemosa*	Gular
7.	*Ficus religiosa*	Pipal
8.	*Gmelina arborea*	Ghamar
9.	*Lagerstroemea parviflora*	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.	*Syzygium cumini*	Jamun
23.	*Azadirachta indica*	Neem
24.	*Holoptelea integrifolia*	Indian elm
25.	*Butea monosperma*	Palash /dhak

Annexure 18:

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 have been throughout cared after 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 plantation done is still continuing.
2	Public awareness should be generated to preserve the trees planted by BCCL.	Various initiatives have been taken such as awareness program mes 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 frequency should be increased including in the night time.	The frequency of water sprinkling by mobile sprinklers has been increased for more effective dust suppression.
4	The no. of water tankers should be increased.	Sufficient no. of water tankers have been provided in Cluster V.
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 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.	An area of 8 Ha has been ecologically restored near Chandour Bastee in Tetulmari Collliery. 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 survey work of the affected families is being done by 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. Road lights, community centres,	Regular water spraying is done in Nichitpur. The roads in Nichitpur Township are also paved. Various provisions have been made in Nichitpur such as lighting, water supply and Handloom training centre. Road from Subhash Chowk to Azad chowk is bitumen topped and very well maintained. An ambulance is available in Nichitpur Colliery.

	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 personnels are deputed in Regional Hospital, Loyabad in cluster V.

Annexure 19:



Area Statistics of Cluster V				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		344.78	19.99
	Social Forestry		105.29	6.10
Plantations	Plantation on OB Dump		23.85	1.38
	Plantation on Backfill		7.19	0.42
	Total Plantation (B)		**136.33**	**7.90**
	Total Vegetation (A+B)		**481.11**	**27.89**
Agricultural Land	Crop Land		8.41	0.49
	Fallow Land		37.74	2.19
	Total Agricultural Land		**46.15**	**2.68**
	Coal Quarry		102.79	5.96
	Coal Dump		2.55	0.15
Mining Area	Barren OB Dump		151.20	8.77
	Area Under Backfilling		162.09	9.40
	Water Filled Quarry		9.45	0.55
	Total Mining Area		**428.08**	**24.83**
Waste Lands	**Waste Land**		**517.23**	**29.99**
	Industrial		10.46	0.61
Settlement	Rural		13.78	0.80
	Urban		217.50	12.61
	Total Settlements		**241.74**	**14.02**
Water Bodies	**Rivers, Lakes, Nalas etc.**		**10.21**	**0.59**
All Total			1724.52	100.00

Legend

- Road
- Railway Line
- Cluster V Boundary

Customer	BHARAT COKING COAL LIMITED					
Title	Land Reclamation Monitoring of Clusters					Job No
Subject	Land Reclamation Status of Cluster V based on Satellite Data (IRS-R2/LISS-IV) of the year 2017.	Activity	Name	Desig	Sign	Date
		Prepared	A. Panda	ASI (Geo)		
		Checked	B. Kumar	HOD (Geom)		
		Approved	B. Kumar	HOD (Geom)		
	cmpdi	Scale	460 230 0 460 Meters			Sheet
		Drg No. HQ REM 4 A4 17 01				Rev No.

Annexure 20:

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

Annexure 21:

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 22:

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

(FOR THE MONTH AUGUST, 2019)

E. C. no. J-11015/01/2010-IA.II (M) dated11.02.2013.

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CONTENTS

EXECUTIVE SUMMARY

1.0 Introduction

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

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by $23^0$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 MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

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

2.2 Water sampling stations

The Water sampling stations were selected for mine sump water.

2.3 Noise level monitoring locations

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

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM_{10}), Fine Particulate Matter ($PM_{2.5}$), Sulphur Di-oxide (SO_2) and Nitrogen Oxides (NO_x). Respirable Dust Samplers (RDS) and Fine

Dust Sampler ($PM_{2.5}$ sampler) were used for sampling of PM_{10}, SO_2, & NO_x and Fine Dust Sampler ($PM_{2.5}$ sampler) were used for sampling of $PM_{2.5}$ at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analysed in Environmental Laboratory of CMPDI, RI-II, Dhanbad.

3.2 Water quality

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

3.3 Noise level monitoring

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

4.0 Results and interpretations

4.1 Air quality

It has been seen from the analysis results that the 24 hours average concentration parameters like PM_{10}, $PM_{2.5}$, SO_2 and NO_x are mostly within the permissible limits in all sampling locations as per MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000 Standards for Coal Mines and National Ambient Air Quality Standard -2009. Sometimes the concentration of PM_{10}& $PM_{2.5}$ exceeds the limits due to heavy public traffic, poor road condition, coke oven plants, burning of coal by surrounding habitants, brick making, municipal waste dumps and industries like Steel Plant, thermal Plants including their fly ash etc.

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

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

4.2 Water quality

The test results indicate that the major parameters compared with MoEF&CC Gazette Notification No. GSR 742(E) dt 25.09.2000

4.3 Noise Level

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

INTRODUCTION

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

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

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

1.1 The Cluster-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 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 11th February, 2013.

Ministry of Environment, Forest and Climate Change while granting environmental clearance has given one of the General conditions that " Four ambient air quality monitoring stations should be established in the core zone as well as in the buffer zone for PM_{10}, $PM_{2.5}$, SO_2, NOx monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets, other conditions regarding water / effluent and noise level monitoring in consultation with the State Pollution Control Board."

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

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

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

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) 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.

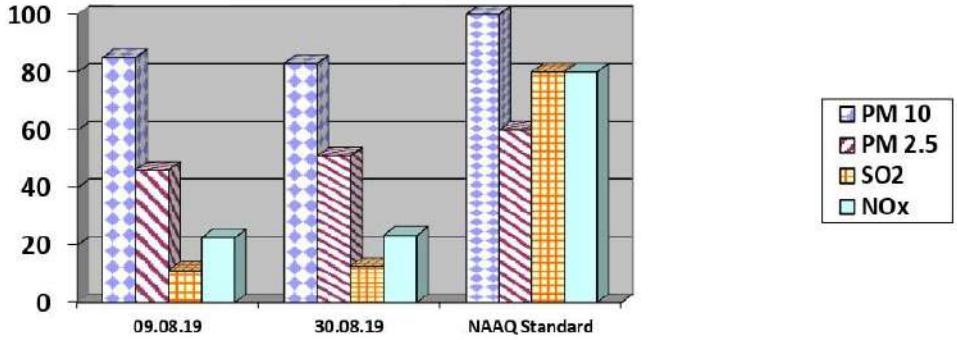
iii)Moonidih UGP(A17): Industrial Area

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.

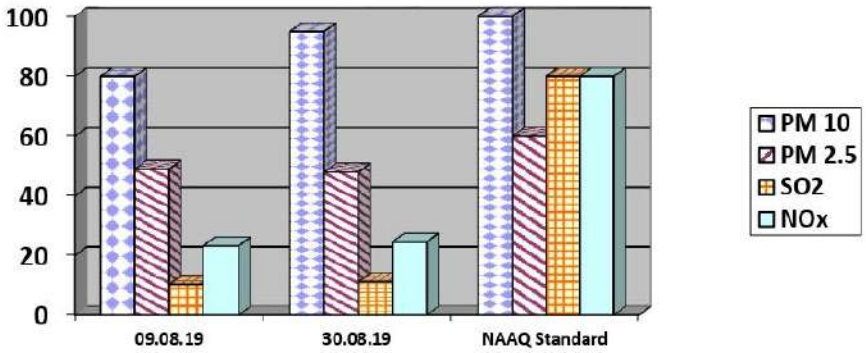
AMBIENT AIR QUALITY DATA

Cluster – V, Bharat Coking Coal limited Month: **AUG. 2019** Year: **2019-20.**

Station Name: A8, Nichitpur		Zone: Core		Category: Industrial	
Sl. No.	**Dates of sampling**	**PM 10**	**PM 2.5**	**SO_2**	**NO_x**
1	09.08.19	85	46	11.10	22.62
2	30.08.19	83	51	12.55	23.34
	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	09.08.19	80	49	10.33	23.22
2	30.08.19	95	48	11.21	24.49
	NAAQ Standard	100	60	80	80

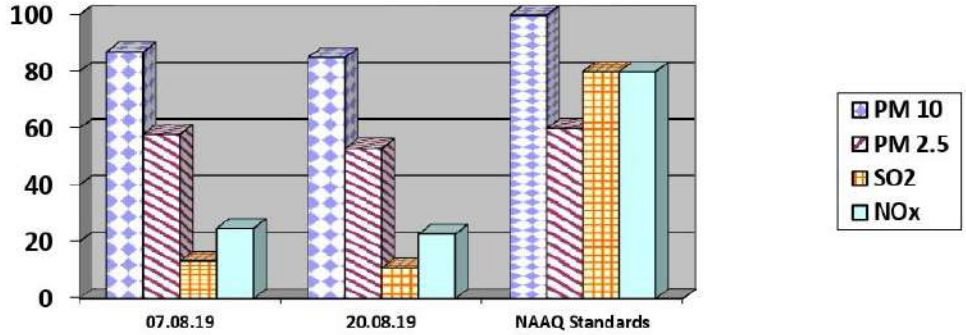


Analysed By
JSA/SA/SSA

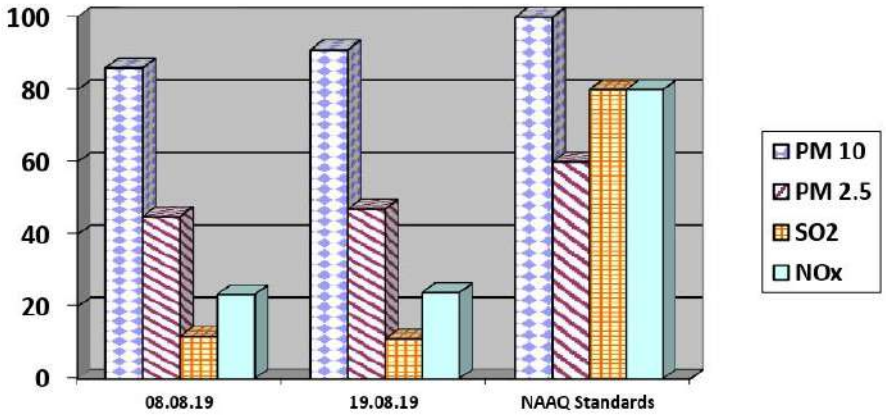
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

Approved By
HOD(Mining/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	07.08.19	87	58	13.25	24.78
2	20.08.19	85	53	10.84	22.79
	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	08.08.19	86	45	11.86	23.35
2	19.08.19	91	47	11.07	23.90
	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(Mining/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: **AUG. 2019**	Name of the Station: **Mine Discharge of Mudidih**	
Sl. No.	**Parameters**	**MW5** First Fortnight 16.08.2019	**MW5** Second Fortnight 17.08.2019	**As per MOEF General Standards for schedule VI**
1	Total Suspended Solids	48	53	*100 (Max)*
2	pH	7.77	7.89	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	48	52	*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(Mining/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 MoEFCC. 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. 2019**		
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**	09.08.19	60.2	*75*
2	**Nichitpur**	**Industrial area**	30.08.19	60.2	*75*
3	**Basseriya (N9) Managers Office**	**Industrial area**	09.08.19	63.5	*75*
4	**Basseriya Managers Office**	**Industrial area**	30.08.19	62.9	*75*
5	**Pootki Balihari Office(N16)**	**Industrial area**	07.08.19	70.1	*75*
6	**Pootki Balihari Office**	**Industrial area**	20.08.19	68.2	*75*
7	**Moonidih UGP(N17)**	**Industrial area**	08.08.19	65.6	*75*
8	**Moonidih UGP**	**Industrial area**	19.08.19	67.4	*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
JSA/SA/SSA

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

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

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

Category	Pollutant	Time weighted average	Concentration in Ambient Air	Method of Measurement
1	2	3	4	5
III Coal mines located in the coal fields of • Jharia • Raniganj • Bokaro	Suspended Particulate Matter (SPM)	Annual Average * 24 hours **	500 µg/m^3 700 µg/m^3	- High Volume Sampling (Average flow rate not less than 1.1
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m^3 300 µg/m^3	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO_2)	Annual Average * 24 hours **	80 µg/m^3 120 µg/m^3	1. Improvedwest and Gaeke method 2. Ultraviolet fluorescene
	Oxide of Nitrogen as NO_2	Annual Average * 24 hours **	80 µg/m^3 120 µg/m^3	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

* Annual Arithmetic mean for the measurements taken in a year, following the guidelines for frequency of sampling laid down in clause2.

** 24hourly/8hourlyvaluesshallbemet92%ofthetimeinayear.However,8% of the time it may exceed but not on two consecutivedays.

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

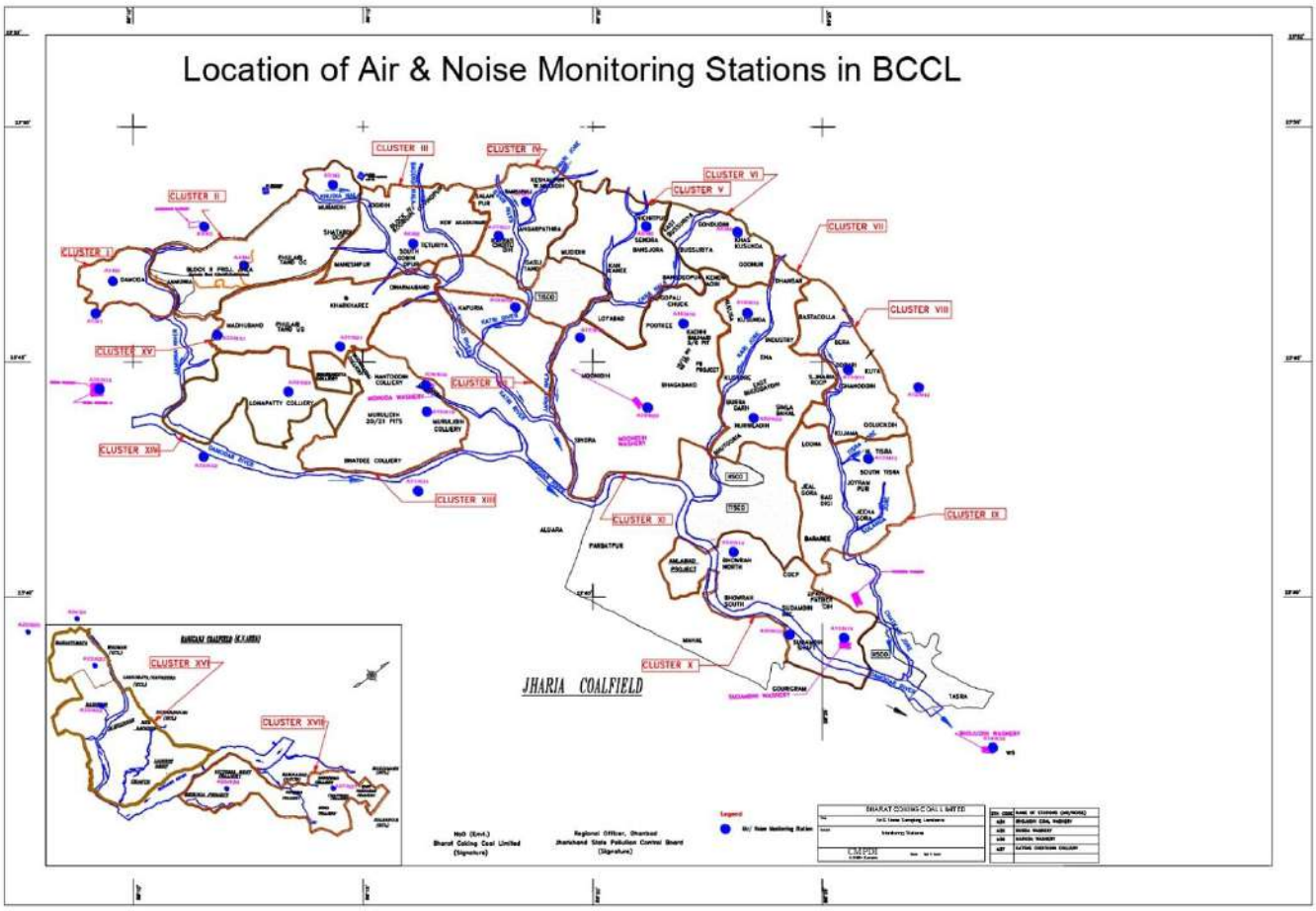
In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th October 1998, the Central Pollution Control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

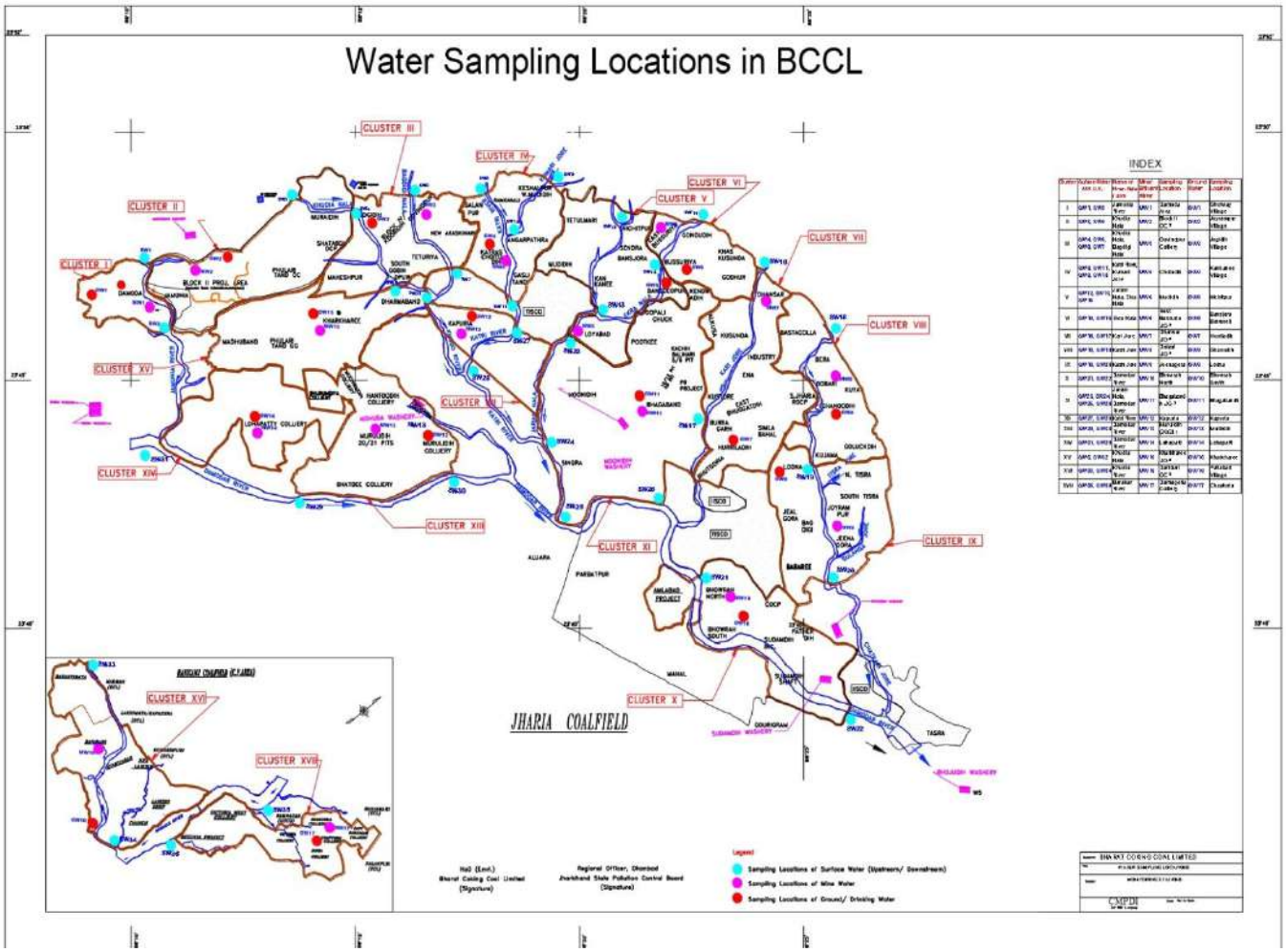
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO_2), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
Nitrogendioxide (NO_2), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob &Hochheiser modified ($NaOH$-$NaAsO_2$) Method -Gas Phase Chemiluminescence
Particulate Matter (Size less than 10µm) or PM_{10}, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
Particulate Matter (Size less than 2.5µm) or $PM_{2.5}$, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
Ozone (O_3) , µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical Method
Lead (Pb) , µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy
Ammonia (NH_3), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
Benzene (C_6H_6), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed byHPLC/GC analysis
Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

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

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

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigations.


Location of Air & Noise Monitoring Stations in BCCL
CLUSTER I
CLUSTER II
CLUSTER III
CLUSTER IV
CLUSTER V
CLUSTER VI
CLUSTER VII
CLUSTER VIII
CLUSTER IX
CLUSTER X
CLUSTER XI
CLUSTER XII
CLUSTER XIII
CLUSTER XIV
CLUSTER XV
CLUSTER XVI
CLUSTER XVII
JHARIA COALFIELD


Water Sampling Locations in BCCL
CLUSTER I
CLUSTER II
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Annexure 23:

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

OFFICE OF THE GENERAL MANAGER
SIJUA AREA

Ref.No.-GM/SA/SPA/F-ENV/2019/181 Date: 05/11/2019

To,
Sri Manish Kumar Jain
Associate Professor
Department of Environmental Science & Engineering,
IIT(ISM) Dhanbad-826004

Sub- Work Order for "Analysis of air samples at 4 locations (core and buffer stations) in Sijua Area of Bharat Coking Coal Limited"

Dear Sir,

With reference to our offer letter no. GM/SA/SPA/F-ENV/2019/49 dated 09.09.2019 and your subsequent letter no. ESE/2019-20/BCCL/02 dated 24.09.2019, the competent authority has approved the work of **"Analysis of air samples for the parameters viz. PM_{10}, $PM_{2.5}$, SO_2 & NO_2 at 4 locations (1 core and 3 buffer stations) in Sijua Area of Bharat Coking Coal Limited"** for a total value of **2,36,000.00 (Two lakhs thirty six thousand rupees only) including GST.** You are required to comply with the following terms and conditions for the above work:-

1. The period of completion of work including the submission of the analysis report will be 40 days from the date of acceptance of the work.
2. Transportation of the sampling machines will be carried out by you. Electricity will be provided at the monitoring stations.
3. 80 % of the total job value will be paid after the acceptance of the work by you. The remaining 20% of the total job value will be paid within 10 days of the acceptance of the analysis report for the above work. All payment will be made by Electronic Mode.
4. Paying authority will be Area Manager (Finance), Sijua Area.
5. Refreshment will be provided to the persons carrying out the above work.
6. BCCL shall have no liability in case of any accident towards your persons or damage/theft of the machines engaged in the above work.

Received
Manish Jain
5/11/19

Scanned by CamScanner

Annexure 24:

BHARAT COKING COAL LIMITED

SIJUA AREA

2019

SL.no	NAME OF UNIT	MANPOWER (01/01/2018)	yearly target	MONTHLY PME TARGET	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	PROGREGGIVE 2019		PME DONE IN 2018
																	TARGET	ACHEIVEMENT	
1	TETULMARI COLLIERY	1196	337	29	37	28	25	30	2	22	55	41	35				337	275	393
2	NICHITPUR COLLIERY	528	162	14	7	23	34	14	16	12	11	1	8				162	126	183
3	S/B COLLIERY	382	107	9	10	33	19	9	4	17	7	30	6				107	135	84
4	MUDIDIH COLLIERY	587	196	17	16	10	19	9	3	9	59	47	21				196	193	219
5	LOYABAD COLLIERY	142	45	4	9	10	3	6	1	2	0	6	3				45	40	56
6	BANSDEOPUR COLLIERY	65	22	2	2	2	2	2	11	2	2	2	2				22	27	23
7	KANKANEE COLLIERY	132	40	4	3	3	5	0	0	2	5	4	2				40	24	24
8	R.HOSPITAL LOYABAD	0	0	0	0	0	0	0	1	0	21	63	39				0	124	18
9	SIJUA AREA OFFICE	264	73	7	0	0	0	0	0	0							73	0	0
	TOTAL	3296	982	86	84	109	107	70	38	66	160	194	116	0	0	0	982	944	1000
	CONTRACTOR WORKER	IME													0	0			

Annexure 25:

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:

Capital Cost of Environmental Management

(Amount in Lakhs)

S.No.	*Item*	*Unit Name*	*Year*	*Cost*
1	Procurement of one Mobile water Sprinkler	Tetulmari	2013-14	103.37
2	Biological Reclamation	Tetulmari	2015-16	73.63
		Tetulmari	2016-17	73.10
		Tetulmari	2017-18	83.82
		Nichitpur	2017-18	60.51
3	Seed Ball Broadcasting	Tetulmari & Nichitpur	2018-19	0.25
		Tetulmari, Nichitpur, Loyabad & Mudidih	2019-20	0.51
4	Oil & Grease trap	Tetulmari & Nichitpur	-	6.00
	Total			**401.19**

Revenue Cost for Mine Closure and Environmental Monitoring

S.No.	Activities	Revenue Expenditure (Rs. In Lakhs)
1	Implementation of mine closure activities(subject to Third party audit of the claim as per approved Mine Closure Plan)	509.38
2	Cost of EMP preparation including baseline data generation	86.00
3	Miscellaneous Revenue Expenditure for Environmental Management (2013-14)	12.68
4	Miscellaneous Revenue Expenditure for Environmental Management (2014-15)	1.52
5	Miscellaneous Revenue Expenditure for Environmental Management (2015-16)	24.15
6	Miscellaneous Revenue Expenditure for Environmental Management (2016-17)	5.17
7	Miscellaneous Revenue Expenditure for Environmental Management (2017-18)	5.95
8	Miscellaneous Revenue Expenditure for Environmental Management (2018-19)	11.83
	Total Cost	**656.68**

3. Framework for Proposed Environmental Expenditure in Cluster V:

S.No.	*Item*	*Estimated Cost (in Lakhs)*
1	Biological reclamation of 32 Ha. Of OB dumps	83.50
2	Construction of Wheel Washing Ditch-cum-settling tank arrangement	11.62
3	Jute cloth enclosure of railway siding	3.25
4	Rain Water Harvesting	3.00
5	Random analysis of Air Samples through Independent Laboratory	2.36
6	Installation of Real-time PM_{10} Analysers at three locations	63.45
7	Installation of fixed water sprinkler at railway siding and CHP	2.34
8	Construction of Overhead sprinkling arrangement	0.33
	Total	***169.85***