भारत कोकिंग कोल लिमिटेड
(एक मिनिरत्न कम्पनी)
(कोल इन्डिया लिमिटेड का एक अंग)
महाप्रबन्धक का कार्यालय
कुसुन्डा क्षेत्र, पो: कुसुन्डा, धनबाद्, झारखन्ड

Ref No. BCCL/KA-6/Env./2017/

Date : 21-11-2017

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

Sub : Six monthly compliance report on Environmental Clearance Conditions for the period from April '2017 to September '2017 in respect of Cluster-VI Group of mines, EC order no.: J-11015/183/2011-1A.II(M), dated 26-08-2013

Dear Sir,

Enclosed please find herewith six monthly compliance report on environmental clearance conditions for the period from **April '2017 to September '2017** in respect of **Cluster-VI** Group of mines, **EC order no.: J-11015/183/2011-1A.II(M), dated 26-08-2013** for your kind perusal.

With regards,

General Manager
Kusunda Area, BCCL

Encl.: as above with soft copy (CD)

Copy:

(1) Director, 1A Monitoring Cell,
Paryavaran Bhawan,
CGO Complex, New Delhi- 110003
(2) The Member Secretary,
Jharkhand State Pollution Control Board,
TA Division Building, HEC, Dhurwa, Ranchi-834004
(3) Dy.GM(Environment), BCCL, Koyla Bhawan, Dhanbad
(4) Office copy

COMPLIANCE OF EC CONDITIONS of CLUSTER-VI

EC order no.: J-11015/183/2011-1A.II(M), dated 26-08-2013

(April '17 to September '17)

Sl. no.	A. Specific Conditions by MOEF:	Compliance
i	The maximum production from the two opencast section in the cluster shall not exceed beyond that for which environmental clearance has been granted.	The approved peak production capacity for East Bassuriya OC and Gondudih Khas Kusunda OC under Kusunda Area are total 4.55 MTPA and for whole cluster consisting of East Bassuriya Colliery, Bassuriya Colliery, Gondudih Khas Kusunda Colliery and Godhur Colliery, 7.631 MTPA. **Total production of all mines of the cluster-VI in 2017-'18 (upto Sept.'17) is 1.013 MT which is well within the limit.**
ii	The two nallahs passing through the mines should be preserved and made functional to drain the water.	Complied. In every year, before monsoon the nallahs are made clear o f any obstacles to ensure proper draining of water.
iii	The coal transport to the siding will continue by road to the siding within 2 km with payloader loading into Rly. Wagons for a period of 5 years by which time the proposed silo in Rly. Siding not being affected in the Jharia Action Plan will be constructed for RLS loading into railway wagons.	Coal transport to siding is being done by road to siding with payloader loading into railway wagons.
iv	As subsidence is on higher side in Godhur colliery, special attention should be given for control and monitoring of subsidence.	For control and monitoring of threat of subsidence at fire affected area within Godhur lease hold special attention has been made by mine management. JRDA has completed survey the basties at fire affected area for evacuation & rehabilitation of the inhabitants under Jharia Master Plan and partially distributed Identity Cards (about 350 nos.), but evacuation of non-BCCL persons have not yet been done by JRDA. Colliery Management have allotted quarters at other safe place to employees residing at/near fire affected area for their early evacuation and accordingly shifting of employees is going on at the allotted quarters at newly constructed colonies at East Bassuriya and Jagjivan Nagar. Till about 62 no. families have been shifted. Besides, Safety Committee team is there at the Colliery for inspection/supervision of Godhur for early detection of any pot hole, fume and report to mine management for early action. Pot holes detected

23/11/12

v	**All old dumps will be filled back in mine voids. At the end of mining there should not be any OBD and should be only one void which shall not exceed 30 m deep.**	It shall be complied. Action is being taken as specified in EMP.
vi	**An increase in the CSR**	BCCL is taking up activities from the HQ level and through its administrative areas for the implementation of CSR activities. For this purpose A CSR cell is functioning which is headed by General Manger(CSR) under the direct control of Director(Personnel) of the company. A details of CSR activities at Kusunda Area is enclosed Annexure-A 3.
vii	**Dhanbad Action Plan, as CEPI, be implanted where ever is applicable.**	Dhanbad Action Plan has been prepared in consultation with Jharkhand State Pollution Control Board for entire BCCL and not clusterwise. It is being implemented comprehensively for all the mines of BCCL including mines of Kusunda Area. Some of the salient actions of this cluster are enclosed as Annexure-E.
viii	**Since the cluster is situated close to Dhanbad, thick green belt and residential areas should be done along the periphery of ML area. Avenue-plantation should be done along the roads which are used for coal transport and measures to arrest coal dust while transporting by covering the trucks and water sprinkling measures etc.**	It is being complied. Plantation at decoaled OB dump area is already being executed for development of green belts as per EC. Adequate water sprinkling is being done at coal transportation road regularly by mobile water sprinklers, and coal transportation is being done by covering trucks by tarpaulin as measures to control dust pollution. At degraded OB dumps at Gondudih eco-restoration work are in successful progress. In East Bassuriya New Colonies plantation have been done. Details of plantation done and programme of eco-restoration are enclosed as Annexure-B.
ix	**Whereas laudable efforts have been made in drawing skill development programmes along with Planning Commission of GoI , all out efforts should be made to ensure that they are suitably employed either with the PP or elsewhere.**	Training programmes for all employees are conducted regularly at mine Vocational Training Centre as per Mine VT Rule and also through NSDC (National Skill Development Corporation), and special training are being conducted at mine VT Centre, at HRD Deptt. of BCCL HQ and outside of Company for development of their skill. The required details are given in Annexure-F.
x	**The measure to identify in the Environmental Plan for Cluster- VI groups of mine and the conditions given in this environmental clearance letter shall be dovetailed to the implementation of the Jharia**	Master Plan activities are dovetailed with compliance of environmental clearance conditions. The master plan deals with fire control and

	Action Plan.	rehabilitation activities of fire affected areas in the leasehold of BCCL. By implementing complete digging out of fiery seams with water spraying in force as fire control measures air pollution and emission of Green House Gases (GHGs) from the fire affected areas are being prevented. Further rehabilitation of the families from the fire endangered area to the safe places is being taken-up with the help of State Govt. of Jharkhand. The Master plan is being implemented for BCCL as per the prioritization of fire and rehabilitation activities in approved Master Plan. The brief status of Rehabilitation and Fire control measures are enclosed **(Annexure-D)**
xi	**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. Measures to prevent ingress of air (Ventilation) in such areas, to prevent restart fresh/spread fires in other areas including in mines of cluster VI shall be undertaken. Expertise available internationally could also be utilized for control of fire in Jharia Coalfields and for their reclamation and to further minimize time for fire and subsidence control. Isothermal mapping using thermal imaging has been got done by NRSA. Measures would be taken to prevent ingress of air (ventilation) in such areas, which may re-start fresh fires**	NRSC had conducted survey of fires of Jharia coalfield by remote sensing methods using thermal infra-red data and land subsidence mapping of Jharia coalfield using Inter-ferometic SAR data. Total fire affected area in Jharia Coalfield has been reduced. Further, the next survey by NRSC shall start soon (2016-17). The work has been awarded and MoU is to be entered in this regard. For control and monitoring of threat of subsidence at fire affected area within Godhur lease hold special attention has been made by mine management. JRDA has nearly completed survey the basties at fire affected area for evacuation & rehabilitation of the inhabitants under Jharia Master Plan and partially distributed Identity Cards, but evacuation of non-BCCL persons have not yet been done by JRDA. Colliery Management have allotted quarters at other safe place to employees residing at/near fire affected area for their early evacuation and accordingly shifting of employees is going on at the allotted quarters at newly constructed colonies at East Bassuriya and Jagjivan Nagar. Besides, one special team headed by senior mine official has been made at Colliery for inspection/supervision of the lease hold area of Godhur for early detection of any pot hole, fume and report to mine management for early action.Under Jharia Master Plan, fire patch of V/VI/VII/VIII seam at Gareria Section of East

		Bassuriya, Kusunda Area about 1,70,000 m^3 have been filled by mitti/incombustible OB, rest void will be filled up by quarry OB of East Bassuriya OC.
xii	**Underground mining should be taken up after completion of reclamation of Opencast mine area.**	It shall be complied.
xiii	**The OB material should be crushed like sand and be used for stowing in underground mines.**	At present no underground mining work is going on in the mines of Kusunda Area.
xiv	**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-VI shall be drawn up and implemented. The schedule of backfilling should be clearly brought out and submit the same to MoEF.**	Calendar plan has been prepared and enclosed as annexure –A 1, 2. Mine closure plan as per the guidelines of Ministry of Coal has been prepared by Regional Institute –II , Central Mine planning and Design Institute (CMPDI), Dhanbad. The financial provisions required for the implementation of mine closure plan are being kept in accounts, and accordingly action are being taken.
xv	**The embankment constructed along the river boundary shall be of suitable dimensions and critical patches shall be strengthened by stone pitching on the river front side and stabilized with plantation so as to withstand the peak water flow and prevent mine inundation**	It is being followed. Embankments have been constructed and maintained as specified in EC **(Figure 1)**.
xvi	**No mining shall be undertaken where underground fires continue. Measure shall be taken to prevent/check such fire including in old OB dump areas where the fire could start due to presence of coal/shale with sufficient carbon content.**	It is being complied. Action is being taken to control, mine fires as specified in Jharia Master Plan and the mining is being done as per the guidelines and permissions of Directorate General of Mines Safety (DGMS).
xvii	**There shall be no internal OB dumps. There will be 8 external OB Dumps covering an area of 32.84 Ha. The height of the dumps shall be 16 m and the total quantity shall be of 5.247 Mm3. The final mine voids will have an area of 66.76 ha (Filled up with water). with depth of 25 m bgl. The entire mined out area shall be re-vegetated. Areas where opencast mining was carried out and completed shall be reclaimed immediately thereafter. It was observed that most of the OB are reclaimed total area 441.24 ha at the end of mining where reclaimed external OB dump 32.84**	It is being complied. Action is being taken as specified in EMP. Backfilling of OB is going on concurrent with mining and at the end of mining activity the area will be re-vegetated and reclaimed as per EMP. Plantation work have already been done with the help of DFO, Dhanbad. At degraded OB dump areas eco-restoration work is in successful progress. **(Annexure-B)**

	ha and internal OB Dump 120.34 ha. Green Belt over an area of 66.12 ha. Density of tree plantation 2500 trees/ ha of plants which of and abandoned. The proponent should dump all the OB material in abandoned mines.	
xviii	**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 60m 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.**	It is being followed. Embankments have been constructed as specified in EC
xix	**Active OB dumps near water bodies and rivers should be rehandled for backfilling abandoned mine voids. However, those which have been biologically reclaimed need not be disturbed.**	No OB is being dumped near any water bodies.
xx	**Thick green belt shall be developed along undisturbed areas, mine boundary and in mine reclamation.**	It is being complied. Yearly plantation is being done for development of green belts as per EC. For green belt development plantation / eco-restoration programme is enclosed in Annexure-B.
xxi	**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 VI shall be implemented.**	Dhanbad Action Plan has been prepared in consultation with Jharkhand Pollution Control Board for entire BCCL and not clusterwise. It is being implemented comprehensively for all the mines of BCCL. Some of the salient actions of this cluster are enclosed in Annexure-E.
xxii	**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 has been finalized in consultation with JSPCB and the Environmental monitoring of mines/units of BCCL as per the requirement of environmental Acts, Laws, Environmental Clearance conditions, etc . The work is now being carried out by CMPDI.
xxiii	**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.**	At present CMPDI is doing the work of monitoring of ambient environment. NEERI Nagpur has been contacted for carrying out the Source Apportionment Study for BCCL.

	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.	
xxiv	**The Plan for conveyor-cum—rail for Cluster-VI should be dovetailed with Jharia Action Plan. The Committee desired that road transportation of coal during Phase—I should be by mechanically covered trucks, which should be introduced at the earliest. Coal dispatch shall be diverted from the present rail sidings to Rapid Loading System (RLS) soon after the construction and commissioning of the RLS at Maheshpur is completed. The railway siding order issued and same would come in 3 years. The details of same should be provided to ministry. The mode of transportation of coal by truck till Railway Siding should be by mechanically covered trucks.**	CMPDIL, RI-II has been requested to conduct study and prepare the plan in this regard. By that time transportation is being done by covering vehicle with tarpaulin cover
xxv	**1387 no. of PAF's should be rehabilitated at cost of Rs 10,768.17 Lakhs as per the approved Jharia Action Plan.**	It is being complied.
xxvi	**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.**	No underground mining work is going on in this Area. For control and monitoring of threat of subsidence at fire affected area within Godhur lease hold special attention has been made by mine management. JRDA has completed survey the basties at fire affected area for evacuation & rehabilitation of the inhabitants under JhariaMaster Plan and partially distributed Identity Cards, but evacuation of non-BCCL persons have not yet been done by JRDA. Colliery Management have allotted quarters at other safe place to employees residing at/near fire affected area for their early evacuation and accordingly shifting of employees is going on at the allotted quarters at newly constructed colonies at East Bassuriya and Jagjivan Nagar. Besides, one special team headed by senior mine official has been made at Colliery for inspection/supervision of the lease hold area of Godhur for early detection of any pot hole, fume and report to mine management for

		early action.
xxvii	**Sufficient coal pillars shall be left un extracted around the air shaft (within the subsidence influence area) to protect from any damage from subsidence, if any.**	It shall be complied. Action is being taken as specified in EMP.
xxviii	**High root density tree species shall be selected and planted over areas likely to be affected by subsidence.**	It will be complied, if required
xxix	**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 complied, if required
xxx	**Solid barriers shall be left below the roads falling within the blocks to avoid any damage to the roads.**	It has been complied and maintained
xxxi	**No depillaring operation shall be carried out below the township/colony.**	It will be complied,
xxxii	**A detailed CSR Action Plan shall be prepared for Cluster VI croup of mines. As stated by the Proponent, it is formulating a detailed Corporate Social Responsibility (CSR) Action Plan through Tata Institute of Social Sciences (TISS), Mumbai which will consist of need-based base-lit e survey, CSR Action Plan, CSR Auditing and monitoring mechanism etc. Director (Per.), BCCL. along with a**	CSR activities have been taken up on priority basis. The details of activities is enclosed in Annexure-A.3 .

	team visited TISS/ National CSR Hub, Mumbai on 18th Jun, 2012 for finalizing the MoU with TISS and National CSR Hub for conducting base-line survey, empanelment of NGOs and formulating the project specific CSR action plan for BCCL. The Action Plan for Corporate Social Responsibility will include 5% of the retained earnings of the previous year subject o minimum of Rs. 5 per tonne of coal production of the previous year will be provided for Corporate Social Responsibility (CSR), an amount of Rs. 381.55 lakhs/year has been year marked for the CSR activities.	
xxxiii	**The area within Cluster VI ML existing as waste land and not being acquired shall be put for productive use under CSR and developed with fruit bearing and other useful species for the local communities. A 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 expenditures there on 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. The gap/space available between the entire mine area should he suitably planted with native species. Plantation should also be made in vacant area and along the road side so as to reduce dust pollution.**	CSR activities have been taken up on priority basis.. The details of activities are enclosed . Plantation at degraded area and office/colonies premises has been done for development of green belts as per EC. Eco-restoration work are in successful progress at degraded at OB dump areas. Details of plantation to be done and programme of eco-restoration are enclosed in Annexure- B.
xxxiv	**The mine water should be treated properly before supply to the villager**.	Mine water is treated by water filter plant before supply to villagers. For which in Kusunda Area, three Pressure Filters, two Slow Sand Filter and two Rapid Gravity Filter Plant are there and at East Bassuriya New Colony, installation of two nos. Pressure Filters is under process. At Alkusa installation of Pressure Filters are under proposal.
xxxv	**Details of transportation, CSR, R&R. and implementation of environmental action plan for each of the clusters-VI should be brought out in a**	being complied.

	booklet form within a year and regularly updated.	
xxxvi	**Central recreation park with herbal garden should be developed for use of all inhabitants.**	It shall be complied.
xxxvii	**Mine discharge water shall be treated to meet standards prescribed standards before discharge into natural water courses/agriculture. The quality of the water discharged shall be monitored at the outlet points and proper records maintained thereof and uploaded regularly on the company website.**	Being complied. The work of monitoring of ambient air and water is being carried out by CMPDI.
xxxviii	**No groundwater shall be used for the mining activities. Additional water required, if any shall be met from mine water or by recycling/reuse of the water from the existing activities and from rainwater harvesting measures. The project authorities shall meet water requirement of nearby village(s) in case the village wells go dry to dewatering of mine.**	No ground water is being utilized for the purpose of industrial use. Mine water has been channelized through pipelines and through delivery for its use for the community purposes after filtration. Drinking water is being purchased from the Mineral Area Development Authority (MADA). Further for the utilization of mine water following actions has been taken by the company 1. **Installation of Pressure filters:** Mine water is treated by water filter plant before supply to villagers. For which in Kusunda Area, three Pressure Filters, two Slow Sand Filter and two Rapid Gravity Filter Plant are there and at East Bassuriya New Colony, installation of two nos. Pressure Filters is under process. At Alkusa installation of Pressure Filters are under proposal. 2. **Rain water Harvesting:** to catch run-off water in colonies Rain water Harvesting is being done. BCCL has already developed rain water harvesting at Koylanagar Township In Kusunda Area, proposal for rain water harvesting at colonies is under process from Civil Deptt.
xxxix.	**The void shall be converted into a water reservoir of a maximum depth of 15-20 m and shall be gently sloped and the upper benches of the reservoir shall be stabilized with plantation and the periphery of the reservoir fenced. The abandoned pits and voids should be backfilled with OB and reclaimed with plantation and or may he used for pisciculture.**	It shall be complied.
xl	**Regular monitoring of groundwater level and quality of the study area shall be carried out by**	Regular monitoring of Ground water is being carried out by CMPDIL. The proposal for establishment of

	establishing a network of existing wells and construction of new peizorneters. The monitoring for quantity shall be done four times a year in pre-monsoon(May), monsoon(August), post-monsoon(Novemer) and winter(January) seasons and for quality including Arsenic and Fluoride during the month of May. Data thus collected shall be submitted to the Ministry of Environment & Forest and to the Central Pollution Control Board/SPCB quarterly within one month of monitoring. Rainwater harvesting measures shall be undertaken in case monitoring of water table indicates a declining trend.	Piezometer has been prepared. The preparation of estimation for drilling of new wells is under process.
xli	**ETP shall also be provided for workshop, and CHP, if any. Effluents shall be treated to confirm to prescribe standards in case discharge into the natural water course.**	It shall be complied.
xlii	**For monitoring land use pattern and for post mining land use, a time series of land use maps, based on satellite imagery (on a scale of 1:5000) of the core zone and buffer zone, from the start of the project until end of mine life shall be prepared once in 3 years(for any one particular season which is consistent in the time series), and the report submitted to MOEF and its Regional office at Bhubaneswar.**	Presently a time series map of vegetation cover in the Jharia Coal Field is being carried out through CMPDI Ranchi using satellite imagery for every 3 years. CMPDI has started to prepare "Time series of land use maps based on satellite imagery of the core zone and buffer zone.
xliii	**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 eco system 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, the mining plan and post-mining plan, closure plan should be prepared and submitted to the Ministry;**	CMPDI has prepared Mine Closure Plan for progressive mine closure activities which are being implemented at mines. Final Mine Closure Plan will be prepared in time.
xliv	**A separate management structure for implementing environment policy and socio-economic issues and the capacity building required in this regard.**	A full-fledged Environment Department, headed by a HoD (Environment) along with a suitable qualified multidisciplinary team of executives has been established in Headquarters. They are also trained in

		ecological restoration, sustainable development, rainwater harvesting methods etc. At the Area level, one Executive in each area has also been nominated as Nodal Officer (Environment) under General Manager of Area and at Project level, concerned Safety Officer under Project Officer is looking after the environment related jobs and also entrusted with the responsibility of compliance and observance of the environmental Acts/ Laws including environment protection measures .The activities are monitored on regular basis at Area and at Head quarters levels. HoD (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company. The team is multidisciplinary and very much motivated under the guidance of company's CMD and Director (Technical) . Further capacity building at both corporate and operating level is being done.
Xlv	**Corporate Environment Responsibility.**	
(a.)	**The Company shall have a well laid down Environment Policy approved by the Board of Directors.**	A well defined Corporate Environment Policy has already been laid down and approved by the Board of Directors. This is also posted on BCCL website.
(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**.	Complied.
(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.**	A hierarchical system of the company to deal with environmental issues from corporate level to mine level already exists.
(d.)	**To have proper checks and balances, the company shall have a well laid down system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the company and/or shareholders or stakeholders at large.**	Being complied.
B.	**<u>General Conditions</u>**	

i	**No change in mining technology and scope of working shall be made without 'prior approval of the Ministry of Environment and Forests.**	Being followed.
ii	**No change in the calendar plan of production for quantum of mineral coal shall be made.**	Being followed. Production of clusters are well within the production capacity as per EC.
iii	**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.**	Air quality monitoring stations and monitoring of ambient environment has been established after consultation with State Pollution Control Board. CMPDIL is presently doing the monitoring work .Results of monitoring is enclosed as Annexure-C.
iv	**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.**	It is being complied.
v	**Adequate measures shall be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in blasting and drilling operations, operation of HEMM, etc shall be provided with ear plugs/muffs.**	Being complied
vi	**Industrial wastewater (workshop and waste water 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 December1993 or as amended from time to time before discharge. Oil and grease trap shall be installed before discharge of workshop effluents.**	It is being followed .Mine water is being reutilized for industrial purposes (sprinkling, cooling/ fire control etc.)

vii	**Vehicular emissions shall be kept under control and regularly monitored. Vehicles used for transporting the mineral shall be covered with tarpaulins and optimally loaded.**	It is being complied. As part of DAP condition, actions are being taken for its implementation.
viii	**Monitoring of environmental quality parameters shall be carried out through establishment of adequate number and type of pollution monitoring and analysis equipment in consultation with the State Pollution Control Board and data got analyzed through a laboratory recognized under EPA Rules, 1986.**	Air quality monitoring stations and monitoring of ambient environment has been established after consultation with State Pollution Control Board. The monitoring work is being carried out by CMPDIL.
ix	**Personnel working in dusty areas shall wear protective respiratory devices and they shall also be provided with adequate training and information on safety and health aspects.**	Being Complied. A separate full fledged Human Resource Development Deptt. is conducting regular training programme on these issues. Apart from this Vocational Training Centers are existing in the Area which provides periodical training on the safety and occupational health issue to each of the workers working in the mines.
x	**Occupational health surveillance programme of the workers shall be undertaken periodically to observe any contractions due to exposure to dust and to take corrective measures, if needed an records maintained thereof. The quality of environment due to outsourcing and he health and safety issues of the outsourced manpower should be addressed by the company white outsourcing.**	Initial Medical Examination (IME) and Periodical Medical Examination (PME) of all the personnel of the Area is carried out at Bhuli PME Centre, Bhuli, Dhanbad as per the Statutes and guidelines of Director General of Mines Safety (DGMS). Data enclosed as Annexure-F
xi	**A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the Head of the company.**	A full-fledged Environment Department, headed by HoD (Environment) along with a suitable qualified multidisciplinary team of executives has been established in Headquarters. They are also trained in ecological restoration, sustainable development, rainwater harvesting methods etc. At the Area level, one Executive in each area has also been nominated as Nodal Officer (Environment) under General Manager of Area and at Project level, concerned Safety Officer under Project Officer is looking after the environment related jobs and also entrusted with the responsibility of compliance and observance of the environmental Acts/ Laws including environment protection measures .The activities are monitored on regular basis at Area and at Head quarters levels.

		HoD(Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company.
xii	**The funds earmarked for environmental protection measures shall be kept in separate account and shall not be diverted for other purpose. Year-wise expenditure shall be reported to this Ministry and its Regional Office at Bhubaneswar**	Being complied
xiii	**The Project authorities shall advertise at least in two local newspapers widely circulated around the project, one of which shall be in the vernacular language of the locality concerned within seven days of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution control Board and may also be seen at the website of the ministry of Environment & Forests at www.envfor.nic.in.**	It has been complied.
xiv	**A copy of the environmental clearance letter shall be marked to concern Panchayat /Zila Parishad, Municipal Corporation or Urban local body and local NGO, if any, from whom any suggestion/representation has been received while processing the proposal. A copy of the clearance letter shall also be displayed on company's website.**	Complied.
xv	**A copy of the environmental clearance letter shall also be displayed on the website of the concerned State Pollution Control Board.** **The EC letter shall also be displayed at the Regional Office, District Industry Sector and Collector's Office/Tehsildar's Office for 30 days.**	Complied.
xvi	**The clearance letter shall be uploaded on the company's website. The compliance status of the stipulated environmental clearance conditions shall also be uploaded by the project, authorities on their website and updated at least once every six months so as to bring the same in public domain. The monitoring data of environmental quality parameter (air, water, noise, and soil) and**	Complied.

	critical pollutant such as PM10, PM2.5, SO2 and NO„ (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.	
xvii	**The project proponent shall submit six monthly compliance reports on status of compliance the stipulated environmental clearance conditions (both in hard copy and in e-mail) to view respective Regional Office of the Ministry, respective Zonal Office s of CPCB and the SPCB.**	Being complied in time.
xvii i	**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.**	Shall be **c**omplied.
xix	**The Environmental statement for each financial year ending 31 March in Form —V is mandated to be submitted by the project proponent for the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules,1986,as amended subsequently, shall also be uploaded on the company's website along with the status of compliance of EC conditions and shall be sent to the respective Regional Offices of the MoEF by E-mail.**	Being **c**omplied.
6.	**The proponent shall abide by all the commitments and recommendations made in the EIA/EMP report so also during their presentation to the EAC.**	Agreed
7.	**The proponent is required to obtain all necessary clearances/approvals that may be required before the start of the project.**	Agreed
8.	**The Ministry or any other competent authority may stipulate any further condition for environmental protection.**	Agreed
9.	**Failure to comply with any of the conditions mentioned above may result in the withdrawal of this clearance and attract the provisions of the Environment (Protection) Act,1986.**	Agreed

10.	**The above conditions will be enforced inter-alia, under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981.The Environment (Protection) Act, 1986 and the Public Liability insurance Act, 199 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 minting operations.**	It is being complied
11.	**The Environmental Clearance is subject to the outcome of the Writ Petition filed b. M/S Bharat Coking Coal Limited (BCCL) in response to the closure orders issued by the Jharkhand State Pollution Control Board which is pending in the Jharkhand High Court.**	Agreed

----

Annexure-A

1. **Coal Production of the Cluster will be well within the limit for which environmental clearance has been granted.**

2. **OB BACKFILLING PROGRAMME**

At Godhur OC- After progressive extraction of coal upto V/VI/VII/VIII combined seam back filling of OB is going on.

At Gondudih KKC- progressive back filling of OB is going on after progressive extraction of total coal of all seams.

At East Bassuriya Colliery- Back filling will be done in continuous succession of total coal extraction.

Annexure-B

- **Plantation- At Gondudih- Khas Kusunda Colliery Plantation has already been done by DFO, Dhanbad at about 10.5 Ha area of OB dump, and at present more than 26250 trees are there. 500 no. bamboo-gabion plantation have already been done. At about 2.0 Ha Ecological restoration site total about 6402 no. plants and plenty of grass-seeds have been planted successfully with encouraging results, and natural eco-system is being established there with increasing flora & fauna (Fig.2). At 2nd. eco-restoration site (about 1.79 Ha OB dump- area) about 2400 plants along with seeds of grass and shrubs have spread over since 2015-'16 successfully. And at 3rd. site, (about 3.0 Ha OB dump area) about 5322 plants and plenty of grass seeds have been planted and spreaded over during this monsoon successfully.**

PLANTATION/ECOLOGICAL-RESTORATION PROGRAMME

Plantation/Ecological Restoration Programme (Cluster-VI & part of Cluster-VII mines of Kusunda Area) :

YEAR	CLUSTER VI & CLUSTER VII(Part under Kusunda Area)	No.of saplings/plants
2016-17	3.00 Ha(approx.)	5322 nos. were planted with plenty of grass seeds and plants in 2016-17
2017-18	3.00 Ha(approx.)	2495 saplings have already been planted till Sept'17 against an yearly target of 7500
2018-19	5.00 Ha(approx.)	12500
2019-20	6.00 Ha(approx.)	15000
2020-21	6.00 Ha(approx.)	15000

Action taken : (1) regular and sufficient water spraying by mobile tankers and through pipe lines is done at roads(haul roads, transportation roads, etc.), at all strategic dust generating points such as loading, un-loading,transfer points etc.

(2) covered coal transportation by trucks is already implemented

(3) plantation/eco-restoration at non-coal bearing/decoaled OB dump site is being done.

(4) making transportation road pucca and its regular maintenance

(5) use of dust extractors at drill m/c.

etc.

Note: Pollution inventory of different sources within the area apart from the coal mining is required to be carried out for actual assessment of pollution load by mining and other sources.

Annexure-C

ENVIRONMENTAL MONITORING REPORT OF CLUSTER – VI

(FOR THE Q.E. JUNE, 2017)

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

(FOR THE Q.E. JUNE, 2017)

E. C. no. J-11015/183/2011-IA.II (M) dated 26.08.2013.

October, 2017

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CLUSTER - VI

(FOR THE Q.E. June, 2017)

CONTENTS

ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED CLUSTER – VI

(FOR THE Q.E. JUNE, 2017)

E. C. no. J-11015/183/2011-IA.II (M) dated 26.08.2013.

October, 2017

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the 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 MoEFCC 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, drinking water supply, well/ Hand pump water and also surface water samples.

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 noise levels were recorded in mining area, washery and in residential area.

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.

3.2 Water quality

Water samples were collected as per standard practice. The effluent samples were collected and analyzed for four parameters on fortnightly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI (HQ), Ranchi.

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.

4.2 Water quality

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

4.3 Noise Level

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

CHAPTER - I

INTRODUCTION

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

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.

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

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

1.1 The Cluster-VI is situated in the Northern part of the Jharia coalfield. It includes a group of 4 Mines (viz. East Basseriya Colliery , Gondudih Khas Kusunda colliery and Godhur Colliery. The Cluster – VI is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – VI 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 Sendra and Ekra nalas.

1.2 The Cluster-VI is designed to produce 5.87 MTPA (normative) and 7.631 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 5.87 MTPA (normative) and 7.631 MTPA (peak) capacity of coal production vide letter no. J-11015/183/2011-IA.II (M) dated 26th August, 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, NO_x monitoring. Location of the stations has been decided based on the meteorological data, topographical features and

environmentally and ecologically sensitive targets 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 & SPCB and other statutory authorities.

CHAPTER-II

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

II.

i) Basseriya Managers Office (A9): Industrial Area

The location of the sampling station is 23^0 47'17" N & 86^0 22'12" E. The sampler was placed at 1.5 m above the ground level of Safety Office. The station was selected to represent the impact of mining activities of the area, poor roads condition, heavy public traffic, burning of coal by the surrounding habitants.

III. BUFFER ZONE Monitoring Location

i) Nichitpur (A8) : Industrial Area

The location of the sampling station is 23^0 48'20" N & 86^0 21'30" E. The sampler was placed at 1.5 m above the ground level at Safety office of Nichitpur colliery.

ii) Kusunda OCP (A10) : Industrial Area

The location of the sampling station is 23^0 46. 822' N & 86^0 24. 241' E. The sampler was placed at 1.5 m above the ground level of Safety Office. The station was selected to represent the impact of mining activities of Kusunda area, poor roads condition, heavy public traffic, burning of coal by the surrounding habitants.

Iii) Pootki Balihari Office (A16): **Industrial Area**

The location of the sampling station is 23º45'18'' N & 86º21'46''E The sampler was placed at 1.5 m above the ground level of Colliery Office.

2.2 Methodology of sampling and analysis

Parameters chosen for assessment of ambient air quality were Particulate Matter (PM_{10}), Particulate Matter ($PM_{2.5}$), Sulphur Di-oxide (SO_2) and Nitrogen Oxides (NO_X). Respirable Dust Samplers (RDS) & fine particulates for $PM_{2.5}$ sampler were used for sampling of PM_{10} & $PM_{2.5}$ respectively at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analyzed in Environmental Laboratory of CMPDI.

2.3 Results & Interpretations

The results of Ambient Air Quality are presented in tabular form along with Bar chart for each monitoring station. The interpretations of different parameters are given below:

2.3.1 **Ambient air quality**

Particulate Matter PM_{10}

In **core zone** under **Industrial area** varies 96 to 191 µg/m^3
In **buffer zone** in **Industrial area** varies from 59 to 278 µg/m^3

Particulate Matter $PM_{2.5}$

In **core zone** under **Industrial area** varies 37 to 51 µg/m^3
In **buffer zone** in **Industrial area** varies from 29 to 79 µg/m^3

Sulphur Dioxide:

In **core zone** under **Industrial area** varies 10 to 16 µg/m^3
In **buffer zone** in **Industrial area** varies from 10 to 18 µg/m^3

Oxides of Nitrogen:

In **core zone** under **Industrial area** 28 to 35 µg/m^3
In **buffer zone** in **Industrial area** varies from 21 to 37 µg/m^3

AMBIENT AIR QUALITY DATA

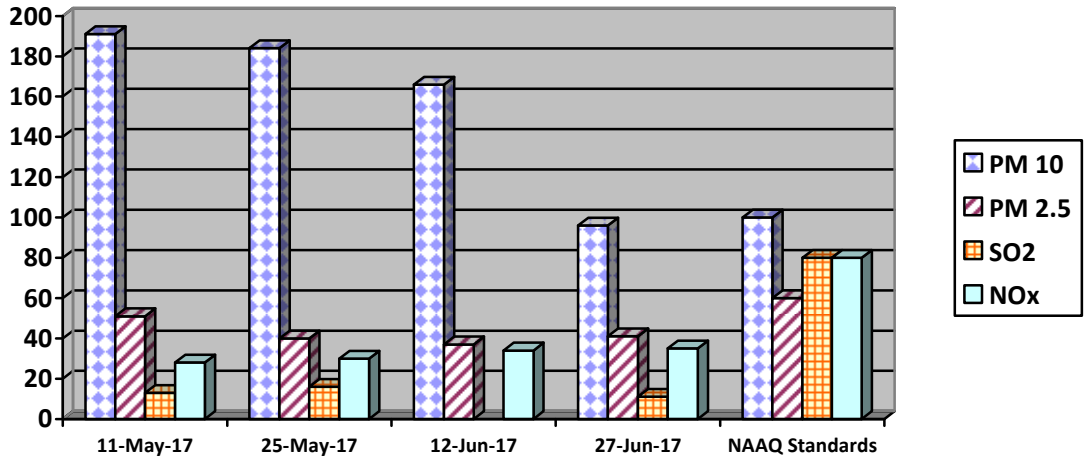
Name of the Company: **Bharat Coking Coal limited** Year : **2017-18.**
Name of the Cluster : **Cluster – VI** Q.E.:**JUNE 2017**

Station Code/Name: (a) A9 Basseriya Managers Office **Category: Industrial**

ZONE: Core

(a). Station Code/Name: A9 – Basseriya Managers Office **Category: Industrial.** [1]

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	11- May - 17	191	51	13	28
2	25- May - 17	184	40	16	30
3	12- June - 17	166	37	<10	34
4	27- June - 17	96	41	11	35
NAAQ Standards		100	60	80	80



Note:

- *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

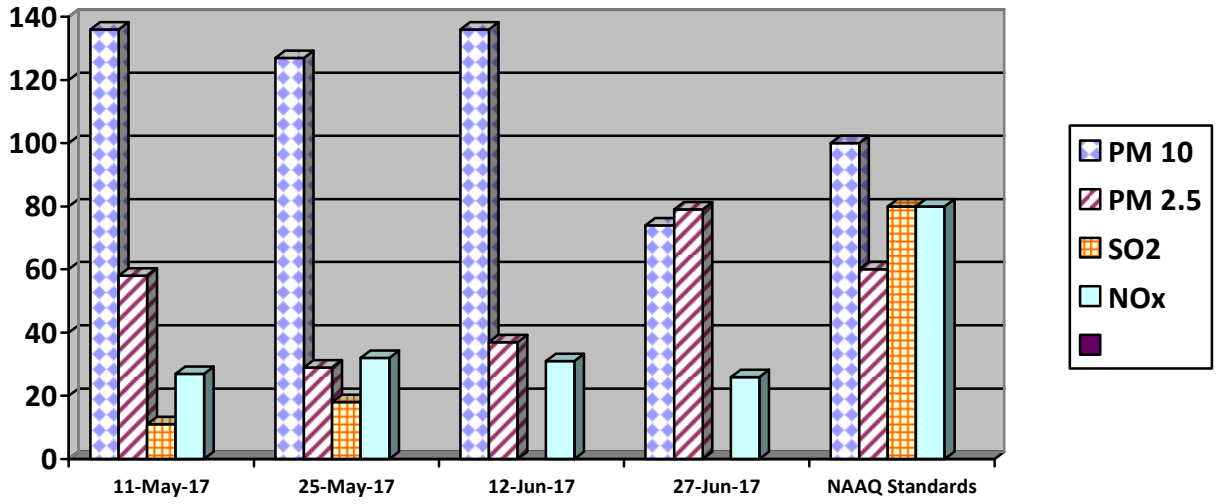
AMBIENT AIR QUALITY DATA

Name of the Company: **Bharat Coking Coal limited** Year: **2017-18.**
Name of the Cluster : **Cluster – VI** Q.E.: **JUNE 2017**

Station Code/Name: **(a) A8 – Nichitpur** **Category:**
(b) A10 – Kusunda OCP **Industrial.**
(C A16 Pootki Balihari Office
ZONE: BUFFER

(a). Station Code/Name: A8 – Nichitpur, Category: Industrial. [2]

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	11- May - 17	136	58	11	27
2	25- May - 17	127	29	18	32
3	12- June - 17	136	37	<10	31
4	27- June - 17	74	79	<10	26
	NAAQ Standards	100	60	80	80



Note:

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

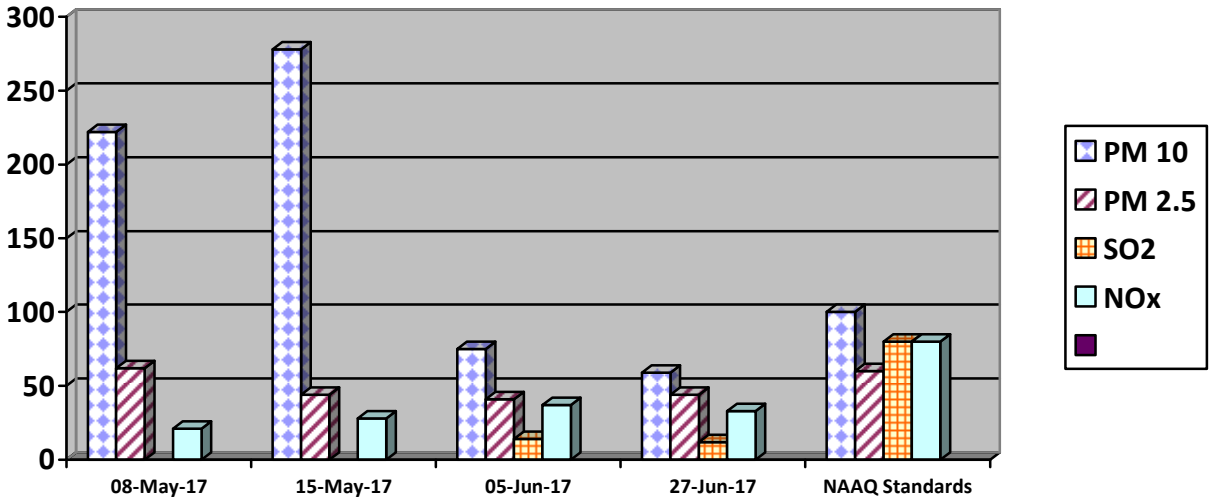
Analysed By
JSA/SA/SSA

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

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

(b). Station Code/Name: A10 – Kusunda OCP Category: Industrial. [3]

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	08- May - 17	222	62	<10	21
2	15- May - 17	278	44	<10	28
3	05- June - 17	75	41	14	37
4	27- June - 17	59	44	12	33
	NAAQ Standards	100	60	80	80



Trace Metal analysis report of Ambient Air Quality

Parameters	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Mercury (Hg)	Nickel (Ni)	Led (Pb)
Concentration(µg/m^3)	<0.005	<0.001	<0.01	<0.001	<0.1	<0.005

Note:

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

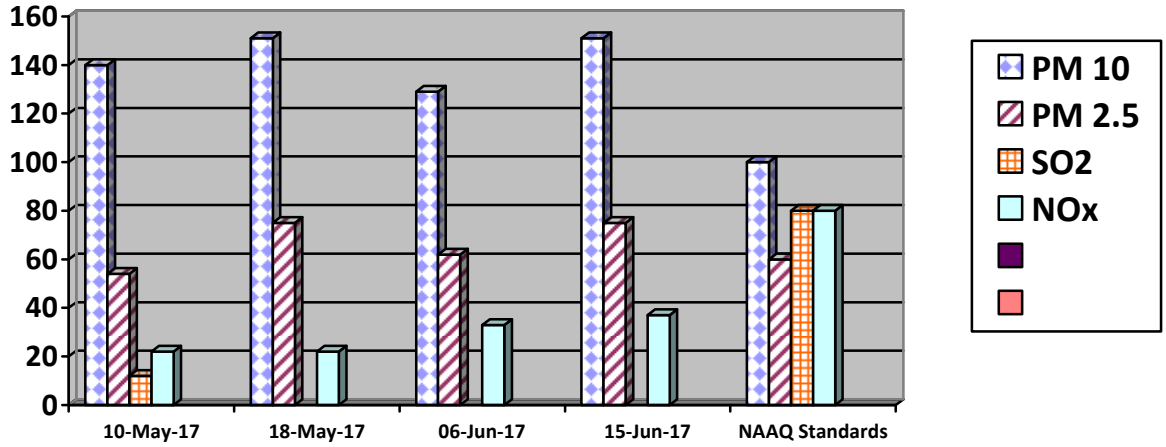
Analysed By
JSA/SA/SSA

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

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

(c). Station Code/Name: A16 – Pootki Balihari Office, Category: Industrial.[4]

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	10- May - 17	140	54	12	22
2	18- May - 17	151	75	<10	22
3	06- June - 17	129	62	<10	33
4	15- June - 17	151	75	<10	37
	NAAQ Standards	100	60	80	80



Trace Metal analysis report of Ambient Air Quality

Parameters	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Mercury (Hg)	Nickel (Ni)	Led (Pb)
Concentration(µg/m^3)	<0.005	<0.001	<0.01	<0.001	<0.1	<0.005

Note:

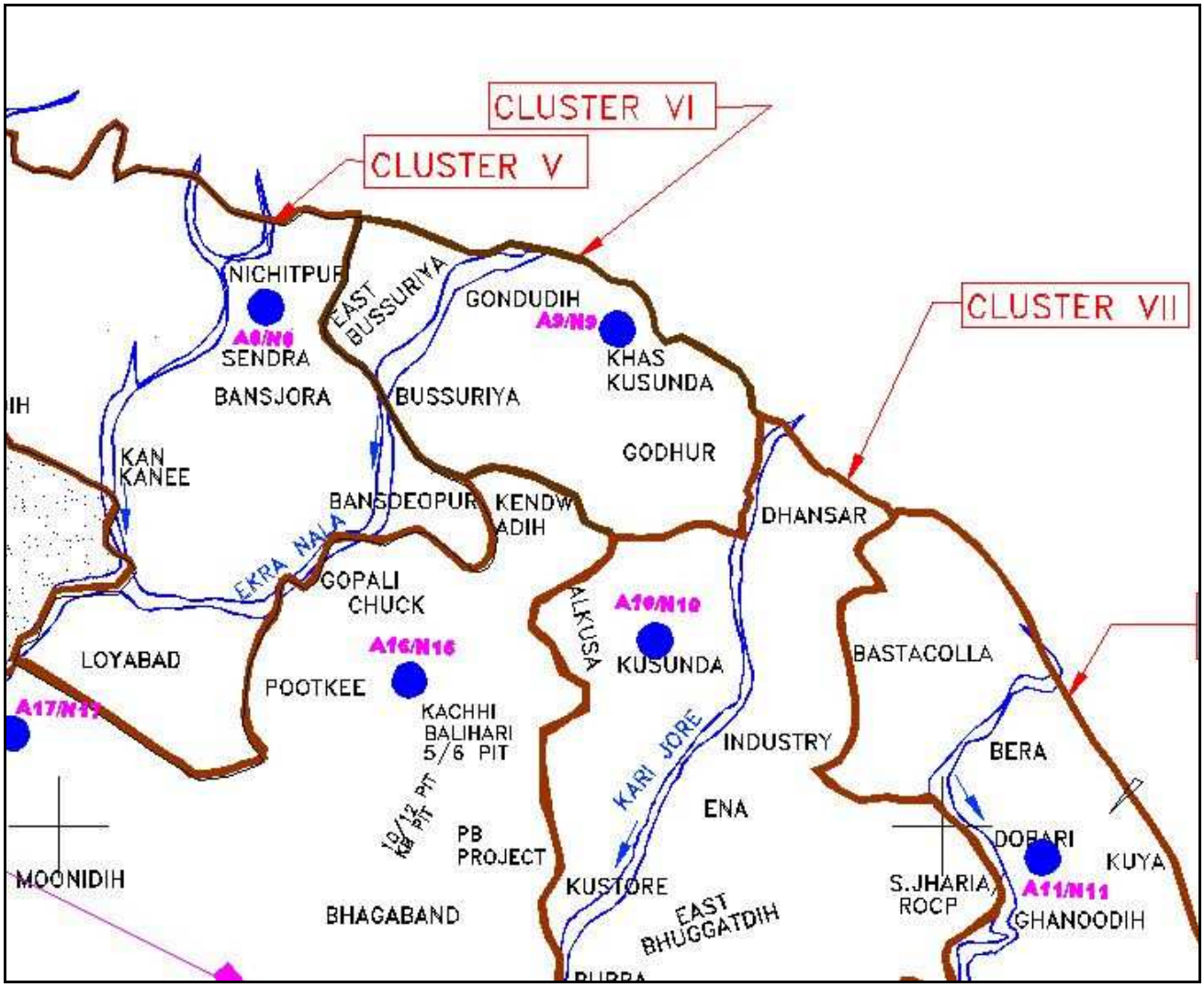
- *All values are expressed in microgram per cubic meter.*
- *24 hours duration.*

Analysed By
JSA/SA/SSA

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

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

Fig I: Ambient Air Monitoring Stations in Cluster- VI in Core & Buffer Zones



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

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

Note:

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

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

NATIONAL AMBIENT AIR QUALITY STANDARDS

New Delhi the 18th November 2009

In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No. 14 of 1981), and in supersession of the notification No(s).S.O.384(E), dated 11th April 1994 and S.O.935(E), dated 14th 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.

CHAPTER – III

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. - II**)

i) **Mine Discharge of East Basseriya (MW6)**
A sampling point is fixed to assess the effluent quality of Mine discharge. This location is selected to monitor effluent discharge in to Ekra Nala.

ii) Ground Water Quality at **Bansjora Borewell (GW6)**

iii) Surface Water Quality at **U/S of Ekra Nala (SW14)**

iv) Surface Water Quality at **D/S of Ekra Nala (SW15)**

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. Effluent samples were also analysed for 27 parameters on half-yearly basis. The Ground and Surface water samples were collected and analyzed for 25 & 17 parameters respectively on quarterly basis. Thereafter the samples were preserved and analysed at the Environmental Laboratory at CMPDI (HQ), Ranchi.

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*)*

Name of the Company: **Bharat Coking Coal Limited**
Year : **2017-18.**
Name of the Cluster: **Cluster - VI**
Month: **MAY, 2017.**
Name of the Stations & Code : **1. MW6- Mine Discharge of East Basseriya**

First Fortnight

Sl. No.	Parameters	MW6 (Mine Discharge) 11.05.2017	As per MOEF General Standards for schedule VI
1	Total Suspended Solids	24	*100 (Max)*
2	pH	8.54	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	28	*250 (Max)*

Second Fortnight

Sl. No.	Parameters	MW6 (Mine Discharge) 25.05.2017	As per MOEF General Standards for schedule VI
1	Total Suspended Solids	48	*100 (Max)*
2	pH	8.51	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	36	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

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

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

WATER QUALITY DATA

(Effluent Water*)*

Name of the Company: **Bharat Coking Coal Limited**
Year : **2017-18.**

Name of the Cluster : **Cluster - VI**
Month: **JUNE, 2017.**

Name of the Stations & Code : **1. MW6- Mine Discharge of East Basseriya**

First Fortnight

Sl. No.	Parameters	MW6 (Mine Discharge) 13.06.2017	As per MOEF General Standards for schedule VI
1	Total Suspended Solids	32	*100 (Max)*
2	pH	8.32	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	32	*250 (Max)*

Second Fortnight

Sl. No.	Parameters	MW6 (Mine Discharge) 28.06.2016	As per MOEF General Standards for schedule VI
1	Total Suspended Solids	32	*100 (Max)*
2	pH	7.17	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	28	*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

WATER QUALITY

(MINE EFFLUENT- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2017-18.**

Name of the Cluster : **Cluster -VI** PERIOD: **Q. E. JUNE- 2017.**

Area : **East Bassuria UGP** **Project: East Bassuria UGP** **Cluster VI**

Stations: 1. Mine Water Discharge East Bassuria UGP MW-6 **Date of Sampling:** 28/06/2017

Sl.No.	Parameter	Sampling Stations			Detection Limit	MOEF -SCH-VI STANDARDS Class 'A'	BIS Standard & Method
		MW-6	2	3			
1	Ammonical Nitrogen, mg/l, Max	<0.02			0.02	50.0	IS 3025/34:1988, R : 2009, Nessler's
2	Arsenic (as As), mg/l, *Max*	<0.002			0.002	0.2	IS 3025/37:1988 R : 2003, AAS-VGA
3	B.O.D (3 days 27°C), mg/l, Max	<2.00			2.00	30.0	IS 3025 /44:1993,R:2003 3 day incubation at 27°C
4	COD, mg/l, Max	28			4.00	250.0	APHA, 22nd Edition, Closed Reflux, Titrimetric
5	Colour	colourless			Qualitative	Qualitative	Physical/Qualitative
6	Copper (as Cu), mg/l, *Max*	<0.03			0.03	3.0	IS 3025/42: 1992 R : 2009, AAS-Flame
7	Dissolved Phosphate, mg/l, Max	<0.30			0.30	5.0	APHA, 22nd Edition Molybdovanadate
8	Fluoride (as F) mg/l, *Max*	0.37			0.02	2.0	APHA, 22nd Edition, SPADNS
9	Free Ammonia, mg/l, Max	<0.01			0.01	5.0	IS:3025/34:1988, Nesseler's
10	Hexavalent Chromium, mg/l, Max	<0.01			0.01	0.1	APHA, 22nd Edition, Diphenylcarbohydrazide
11	Iron (as Fe), mg/l, *Max*	0.56			0.06	3.0	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
12	Lead (as Pb), mg/l, *Max*	<0.005			0.005	0.1	APHA, 22nd Edition, AAS-GTA
13	Manganese(as Mn), mg/l, Max	<0.02			0.02	2.0	IS-3025/59:2006, AAS-Flame
14	Nickel (as Ni), mg/l, *Max*	<0.10			0.10	3.0	IS-3025/54:2003, AAS-Flame
15	Nitrate Nitrogen, mg/l, *Max*	1.7			0.50	10.0	APHA, 22nd Edition, UV-Spectrphotometric
16	Oil & Grease, mg/l, Max	<2.00			2.00	10.0	IS 3025/39:1991, R : 2003, Partition Gravimetric
17	Odour	Agreeable			Agreeable	Qualitative	Is-3015/5:1983/R:2012/Qualitative
18	pH value	7.17			2.5	5.5 to 9.0	IS-3025/11:1983, R-1996, Electrometric
19	Phenolic compounds (as C_6H_5OH),mg/l, *Max*	<0.002			0.002	1.0	APHA, 22nd Edition 4-Amino Antipyrine
20	Selenium (as Se), mg/l, *Max*	<0.002			0.002	0.05	APHA, 22nd Edition, AAS-GTA
21	Sulphide (as SO_3), mg/l, Max	<0.005			0.005	2.0	APHA, 22nd Edition Methylene Blue
22	Temperature (°C)	32.0			Shall not exceed 5° C above the receiving temp.		IS-3025/09:1984, Thermometeric
23	Total Chromium (as Cr), mg/l, *Max*	<0.06			0.04	2.0	IS-3025/52:2003, AAS-Flame
24	Total Kjeldahl Nitrogen, mg/l, Max	<1.0			1.00	100.0	IS:3025/34:1988, Nesseler's
25	Total Residual Chlorine, mg/l, Max	<0.02			0.02	1.0	APHA, 22nd Edition, DPD
26	Total Suspended Solids, mg/l, Max	32			10.00	100.0	IS 3025/17:1984, R :1996, Gravimetric
27	Zinc (as Zn), mg/l, *Max*	<0.01			0.01	5.0	IS 3025 /49 : 1994, R : 2009, AAS-Flame

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

WATER QUALITY

(SURFACE WATER- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2017-18.**

Name of the Cluster : **Cluster - VI** Period: **Q. E. JUNE, 2017.**

Area : **Kusunda** **Project: East Basseriya UGP** **Cluster VI**

Stations:

1. Upstream in Ekra Nala SW-14
2. Downstream in Ekra Nala SW-15

Date of Sampling:
30/05/2017
29/05/2017

Sl. No	Parameter	Sampling Stations				Detection Limit	IS:2296 – 1982 (Inland surface water) Class C	BIS Standard & Method
		SW-14	Sw-15	3	4			
1	Arsenic (as As), mg/l, Max	<0.002	<0.002			0.002	0.2	IS 3025/37:1988 R : 2003, AAS-VGA
2	BOD (3 days 27°C), mg/l, Max	2.6	2.8			2.00	300	IS 3025 /44: 1993, R : 2003 3 day incubation at 27°C
3	Colour (Hazen Unit)	colourless	colourless			Qualitative	300	Physical/Qualitative
4	Chlorides (as Cl), mg/l, Max	26	31			2.00	600	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03			0.03	1.5	IS 3025 /42 : 1992 R : 2009, AAS-Flame
6	Disolved Oxygen, min.	4.9	4.2			0.10	4	IS 3025/381989, R : 2003, Winkler Azide
7	Fluoride (as F) mg/l, Max	0.41	0.56			0.02	1.5	APHA, 22nd Edition SPADNS
8	Hexavalent Chromium, mg/l, Max	<0.01	<0.01			0.01	0.05	APHA, 22nd Edition, 1,5 - Diphenylcarbohydrazide
9	Iron (as Fe), mg/l, Max	<0.06	<0.06			0.06	50	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
10	Lead (as Pb), mg/l, Max	0.124	<0.005			0.005	0.1	APHA, 22nd Edition AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	18.74	24.39			0.50	50	APHA, 22nd Edition, UV-Spectrphotometric
12	pH value	7.30	7.72			2.5	6.5-8.5	IS-3025/11:1983, R-1996, Electrometric
13	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.002	<0.002			0.002	0.0005	APHA, 22nd Edition 4-Amino Antipyrine
14	Selenium (as Se), mg/l, Max	<0.002	<0.002			0.002	0.05	APHA, 22nd Edition AAS-GTA
15	Sulphate (as SO_4) mg/l, Max	32	36			2.00	400	APHA, 22nd Edition Turbidity
16	Total Dissolved Solids, mg/l, Max	312	544			25.00	1500	IS 3025 /16:1984 R : 2006, Gravimetric
17	Zinc (as Zn), mg/l, Max	0.068	0.270			0.01	5.0	IS 3025 /49 : 1994, R : 2009, AAS-Flame

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

WATER QUALITY

(DRINKING WATER- ALL PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2017-18.**

Name of the Cluster : **Cluster - VI** Period: **Q. E. June, 2017.**

Area : **Kusunda** **Project: East Basseriya UGP** **Cluster VI**

Stations: **Date of Sampling:**

1. Ground Water from Bansjora borewell GW-6 29/05/2017

Sl.No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		GW-6	2	3			
1	Boron (as B), mg/l, Max	<0.20			0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2			1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	30			1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	102			2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03			0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.12			0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.06			0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	0.1			0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	0.124			0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	1.570			0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	33.91			0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable			Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.36			2.5	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	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002			0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Taste	Acceptable			Qualitative	Acceptable	APHA, 22nd Edition. Taste
17	Sulphate (as SO_4) mg/l, Max	160			2.00	200	APHA, 22nd Edition. Turbidity
18	Total Alkalinity (c_aco_3),, mg/l, Max	188			4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<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	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	1117			25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	296			4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2			1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.023			0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame
25	Nickel(as Ni), mg/l Max	0.043			0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

CHAPTER - IV
NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites and their rationale

i) **Basseriya Managers Office (N9)**

To assess the noise level in mine site, the noise levels were recorded in the mine area where all mining activities are in progress.

ii) **Nichitpur (N8)**

To assess the noise generated in the mines activity. Noise levels were recorded in the mines area

iii) **Kusunda OCP (N10)**

To assess the noise level in the industrial area,

iv) **Pootki Balihari Office (N16)**

To assess the noise level in the industrial area, noise levels were recorded during day time in the Mines area.

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 Company: **Bharat Coking Coal Limited** Year : **2017-18.**

Name of the Cluster : **Cluster -VI** Month: **May, 2017.**

Name of the Stations & Code :

1. **Basseriya Manager's Office (N9)**
2. **Nichitpur (N8)**
3. **Kusunda OCP (N10)**
4. **Pootki Balihari Office (N16)[1]**

a. First Fortnight

Sl. No.	Station Name/Code	Category of area	Date	Noise level dB(A)LEQ	**Permissible Limit of Noise level in dB(A)*
1	**Basseriya Manager's Office (N9)**	**Industrial area**	11.05.2017	57.2	*75*
2	**Nichitpur (N8)**	**Industrial area**	11.05.2017	54.4	*75*
3	**Kusunda OCP (N10)**	**Industrial area**	08.05.2017	64.1	*75*
4	**Pootki Balihari office (N16)**	**Industrial area**	10.05.2017	57.3	*75*

b. Second Fortnight

Sl. No.	Station Name/Code	Category of area	Date	Noise level dB(A)LEQ	**Permissible Limit of Noise level in dB(A)*
1	**Basseriya Manager's Office (N9)**	**Industrial area**	25.05.2017	59.6	*75*
2	**Nichitpur (N8)**	**Industrial area**	25.05.2017	61.3	*75*
3	**Kusunda OCP (N10)**	**Industrial area**	15.05.2017	60.6	*75*
4	**Pootki Balihari office (N16)**	**Industrial area**	18.05.2017	54.2	*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.**

NOISE LEVEL DATA

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

Year : **2017-18.**

Name of the Cluster : **Cluster -VI**

Month: **June, 2017.**

Name of the Stations & Code :

1. **Basseriya Manager's Office (N9)**
2. **Nichitpur (N8)**
3. **Kusunda OCP (N10)**
4. **Pootki Balihari Office (N16)[2]**

a. First Fortnight data

Sl. No.	Station Name/Code	Category of area	Date	Noise level dB(A)LEQ	**Permissible Limit of Noise level in dB(A)*
1	**Basseriya Manager's Office (N9)**	**Industrial area**	12.06.2017	63.7	*75*
2	**Nichitpur (N8)**	**Industrial area**	12.06.2017	59.2	*75*
3	**Kusunda OCP (N10)**	**Industrial area**	05.06.2017	61.6	*75*
4	**Pootki Balihari office (N16)**	**Industrial area**	06.06.2017	61.4	*75*

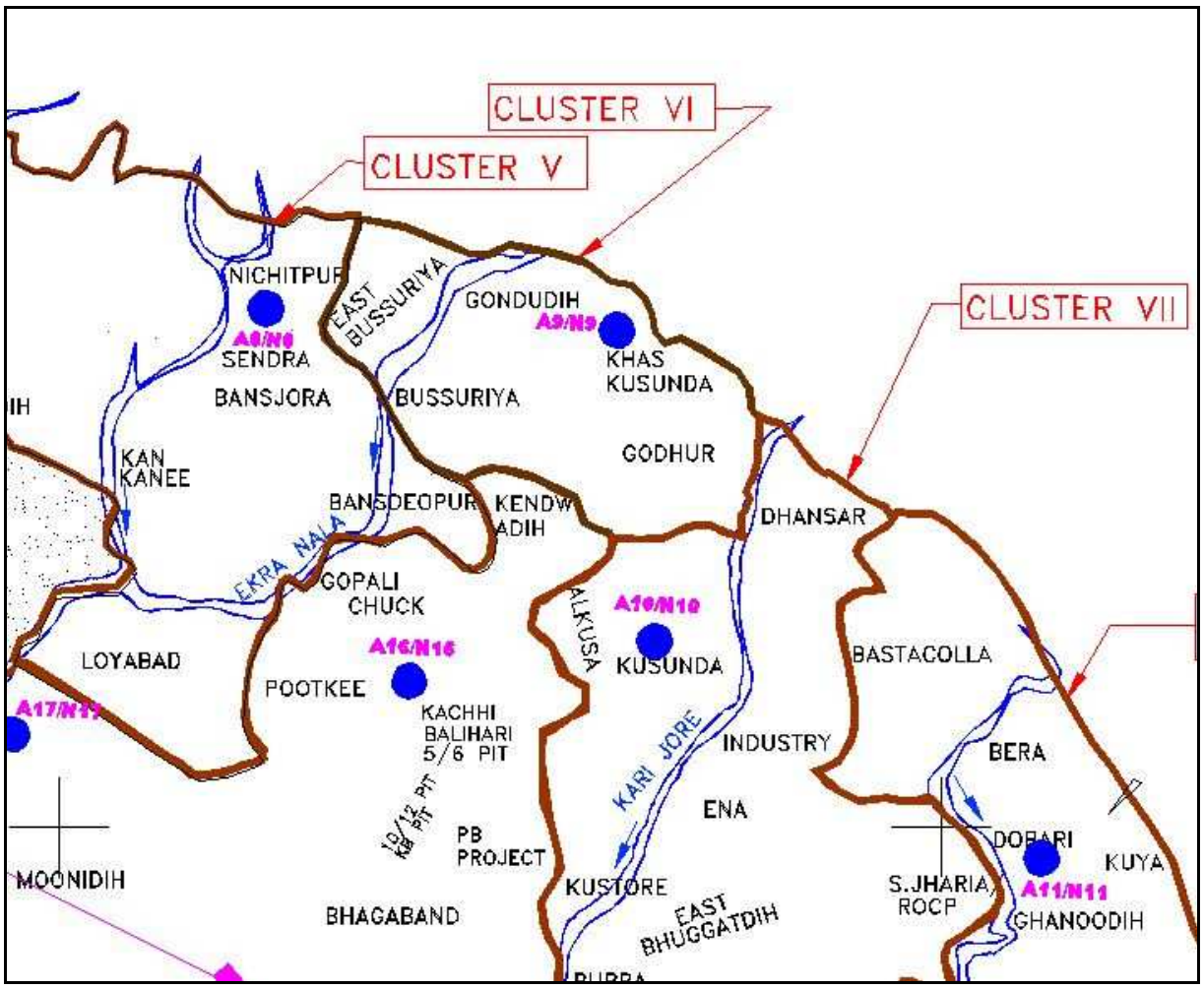
b. Second Fortnight data

Sl. No.	Station Name/Code	Category of area	Date	Noise level dB(A)LEQ	**Permissible Limit of Noise level in dB(A)*
1	**Basseriya Manager's Office (N9)**	**Industrial area**	27.06.2017	64.8	*75*
2	**Nichitpur (N8)**	**Industrial area**	27.06.2017	63.4	*75*
3	**Kusunda OCP (N10)**	**Industrial area**	27.06.2017	63.8	*75*
4	**Pootki Balihari office (N16)**	**Industrial area**	15.06.2017	64.5	*75*

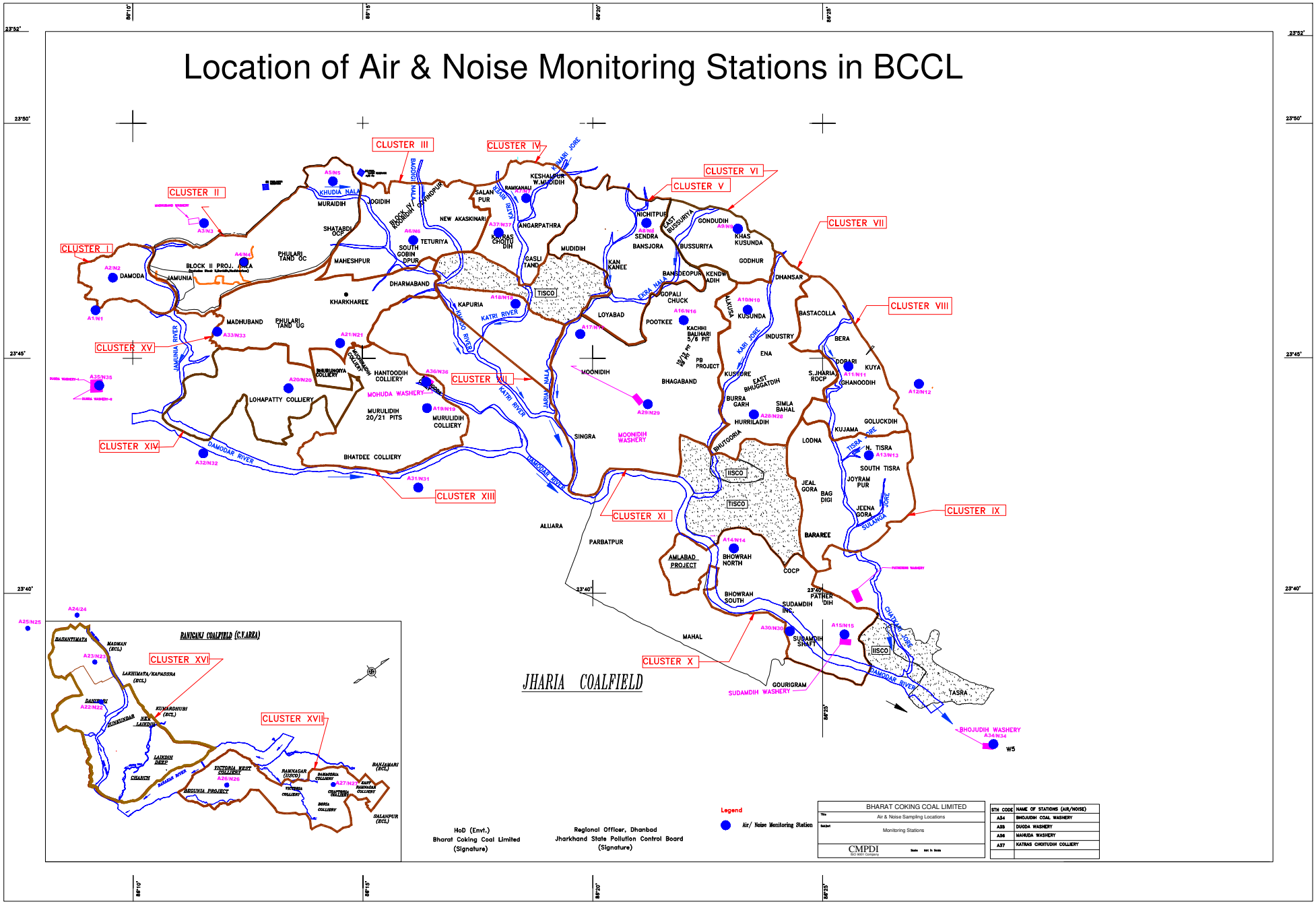
****Permissible limits of Noise Level as per MOEF Gazette Notification No. GSR 742(E) dt. 25.09.2000 Standards for Coal Mines and Noise Pollution (Regulation and Control) Rules, 2000.***

*** Day Time: 6.00 AM to 10.00 PM.**

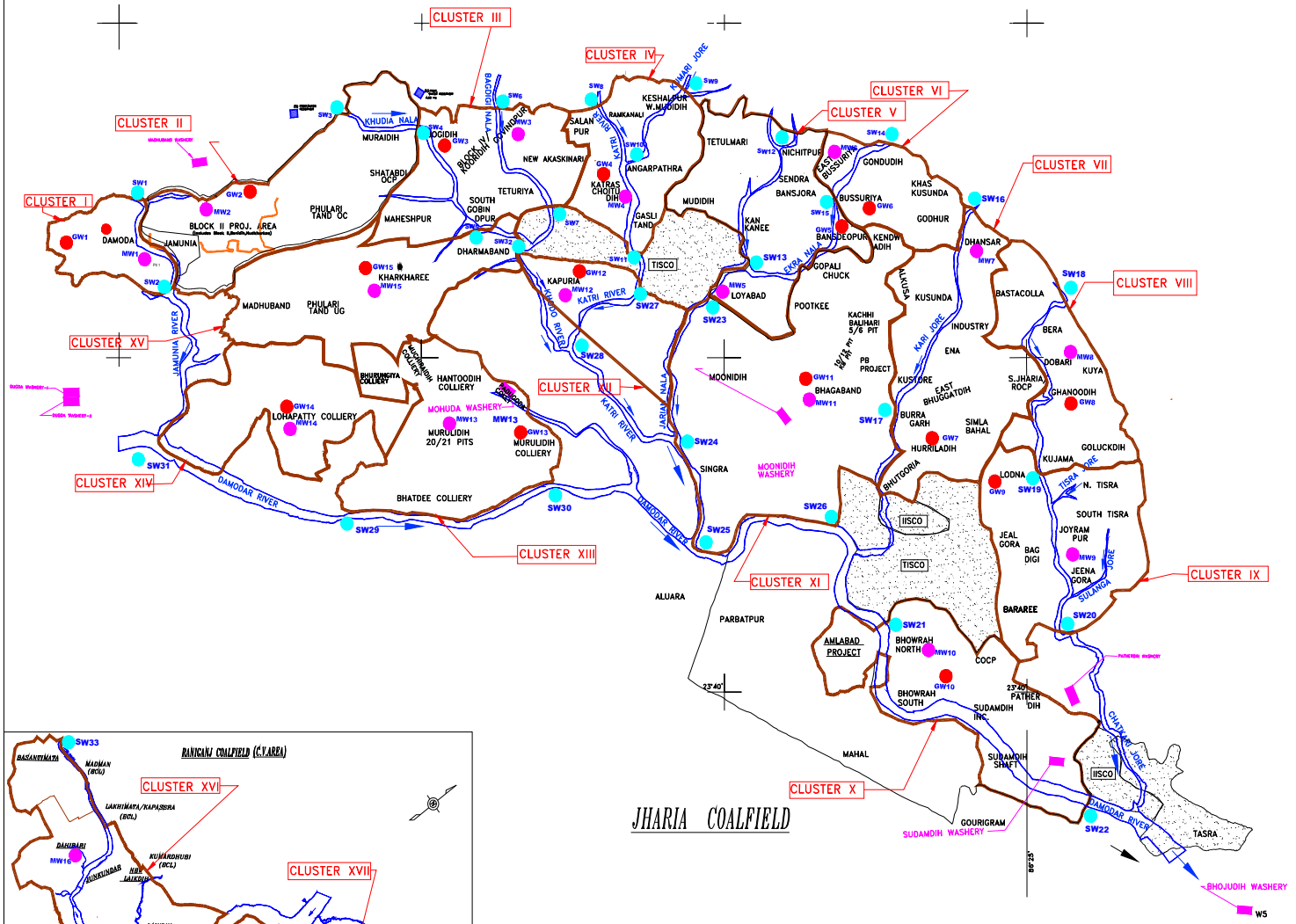
Fig: Noise Level Monitoring Location of Cluster VI



Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL



INDEX

Cluster	Suface Water (U/S, D/S)	Name of River/ Nala / Jore	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Jamunia River	MW1	Damoda Area	GW1	Ghutway Village
II	SW3, SW4	Khudia Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudia Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogidih Village
IV	SW8, SW11, SW9, SW10	Katri River, Kumari Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kari Jore	MW7	Dhansar UGP	GW7	Hurriladih
VIII	SW18, SW19	Kashi Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kashi Jore	MW9	Jeenagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagaband h UGP	GW11	Bhagabandh
XII	SW27, SW28	Katri River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Murulidih (20/21)	GW13	Murulidih
XIV	SW31, SW29	Damodar River	MW14	Lohapatti	GW14	Lohapatti
XV	SW5, SW32	Khudia Nala	MW15	Kharkharee UGP	GW15	Kharkharee
XVI	SW33, SW34	Khudia River	MW16	Dahibari OCP	GW16	Patlabari Village
XVII	SW35, SW36	Barakar River	MW17	Damagoria Colliery	GW17	Chaptoria

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

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

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

Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS
	CMPDI (ISO 9001 Company)
Scale	Not to Scale

ANNEXURE--- D

STATUS OF JHARIA MASTER PLAN DOVETAILED WITH ENVIRONMENT CLEARANCE CONDITIONS

Rehabilitation and Fire control measures

Socio-economic Survey :

Survey of fire affected families (non-BCCL) at Kusunda Area has been nearly completed by JRDA and distribution of ID Card has been partially done by JRDA.

Accommodation provided in Satellite Township:

- Till about 946 quarters at newly constructed colonies at East Bassuriya and at Jagjivan Nagar have been allotted to the employees residing at coal bearing/fire affected areas in different collieries under Kusunda Area and out of which 493 employees have been shifted. More quarters are under construction for phasewise shifting of employees.
- In temporary rehabilitation site at decoaled zone of East Bassuriya about 28 PAF/encroachers have been shifted.
- Non-BCCL families will be shifted by JRDA.

Status of fire dealing :

Under Master Plan, many Fire schemes have been formulated / prepared /implemented for dealing fires sites spread in collieries of BCCL. Further for expediting the fire dealing process, excavation methods has been resorted to by deploying Hired HEMM at various mines of BCCL. Total digging out of fiery coal has been adopted for dealing of fire.
In fire patch of V/VI/VII/VIII seam of Gareria Secn. at East Bassuriya, about 1,70,000 cu.m. mitti and non-combustible material has been filled, rest will be filled by quarry OB .

At Kusunda Colliery total firey coal are being dug out as a measure of fire dealing with the deployment of hired HEMM, and at Ena OC, after restart, total firey coal will be dug out . The underground workings of Alkusa Colliery has been sealed due to fire threats after taking measures to control UG fire as per CMR'57 DGMS guidelines. The coal reserve of Alkusa Colliery will be extracted from Kusunda OC side. For control and monitoring of threat of subsidence at fire affected area within Godhur lease hold special attention has been made by mine management.

ANNEXURE-E

COMPLIANCE OF DHANBAD ACTION PLAN

(1) Covering of loaded transport vehicles

It has been complied. The clause of covering of loaded coal transport vehicle has also been incorporated in the transport agreement/ contract.

(2) Coal transport roads shall be made pucca

In 2015-16 about 80 m pucca road near Kusunda Office has been constructed.
In 2016-17:

- **Repair & maintenance of PCC Rd. from NH-32 to Kali Mandir for coal transportation at Godhur Colliery- - 200 mtr. Lenth completed**
- **Repair & maintenance of road by locking pre-cast cement concrete block from NH-32 to Sub-station at Godhur Colliery - - 60 mtr. Length – proposal in progress**
- **Repair & maintenance of 15 nos. road NH-32 to Godhur Weigh Bridge - - 120 mtr. Length – proposal in progress.**

(3) All drillings to be done with dust containment and suppression systems. Sprinklers will be installed including at all coal stock & sidings

DUST EXTRACTOR: Regarding drilling it has already been complied in all OC mines. Drill machines are having OEM fitted DUST EXTRACTION system.

Complied. Water sprinkling at all coal stock and sidings is being done by mobile water tankers and through pipe lines. Proposal for installation of fixed sprinklers at siding is under process.

(4) MOBILE SPRINLKLERS

Sl. no.	Mine	Haul road length in Km	No. of mobile sprinklers	Total Capacity(KL)	Trips per day
1	Kusunda OC + Godhur mixed	6.5-7.0	6	3-20 KL each,3-12KL each	35 trips/day
2	Dhansar/Industry	7.0-8.0	4	2-12KL each, 1-20KL, 1 - 28KL	40 trips/day
3	Gondudih KKC	5.0-6.0	3	60	15 trips each/day,
4	Ena	mine has not been re-started till date.	1	9	Presently used for water

					supply at colonies.
5.	East Bassuriya	2.5-3.0	1	20KL	9 trips each/day

(5) The direction of surface run-off of the premises of collieries shall be diverted to created water bodies.

Creation of water bodies in coal bearing area will pose safety threats to nearby mine and it will be violation of mines act. This will also create grave danger of inundation of the adjacent mines since the mines are 100 years old and interconnected with each other. So this action cannot be complied**.**
However to catch run-off water in colonies proposal for Rain water Harvesting in colonies is under process

(6) Dealing of mine fires

A Master plan for Dealing with fires and subsidence and rehabilitation in the Leasehold of BCCL has been approved by Govt. of India vide letter no- 22020/1/2005-CRC dated 12 08 09. In fire patch of V/VI/VII/VIII seam of Gareria Secn. At East Bassuriya about 1, 70,000 cu.m. mitti and non-combustible material has been filled, rest will be filled by quarry OB .
In Kusunda OC, fiery coal patches are being dug out for the purpose of dealing with fire and combustible materials are extracted out to save the coal from burning and to stop further spread of the fire. Once the total fiery coal is dug-out/excavated there will be no more chance of re-starting of fresh/ spreading of fire into other areas.
At Alkusa mine, measures have been taken as per CMR'57 and DGMS Guidelines to control ug fire and entrances have been filled/sealed to stop ingress of air into fire affected area.

(7) The waste water shall be passed through oil separator-cum-filtration system

-- It shall be complied

(8) The removed OBs shall be utilized for low land filling or for making roads.

Complied. Removed OB is used for low land filling and for making roads as and when required**.**

(9) Tree plantation on the dumps

Complied. At Gondudih- Khas Kusunda Colliery Plantation has already been done by DFO, Dhanbad at about 10.5 Ha area of OB dump, and at present more than 26250 trees are there. 500 no. bamboo-gabion plantation have already been done. At about 2.0 Ha Ecological restoration site total about 6402 no. plants and plenty of grass-seeds have been planted successfully with encouraging results, and natural eco-system is being established there with increasing flora & fauna. At 2nd. eco-restoration site (about 1.79 Ha OB dump- area) about 2400 plants along with seeds of grass and shrubs have spread over since 2015-'16 successfully. And at 3rd. site, (about 3.0 Ha OB dump area) about 5322 plants and plenty of grass seeds have been planted and spreaded over during this monsoon successfully.

(10) All hazardous wastes shall be disposed off

Complied.

1. All units have applied for authorization as per Hazardous Wastes (Management, Handling and Trans boundary Movement) Rules.
2. Burnt/used oil is disposed off as per rule.
3. Disposal of Hazardous waste, burnt Oil / batteries is being done through E-auctioning to authorized recycler/ re-processor having valid authorization from CPCB/ SPCB. Return are also being filed.

(11) Monitoring and Reporting six monthly

Monitoring work has been done by CMPDI, Dhanbad as per work order issued by BCCL HQ.

(12) Introduction of GIS/ GPS

CMPDI, HQ has been given the job of satellite surveillance of the Jharia coal field through NRSA Hyderabad and the information is being uploaded in the website.

ANNEXURE-F

KUSUNDA AREA

Status of Periodical Medical Examination & Training

Mines under Cluster-VI	Total PME done for the period April'17 to Sept.'17	Vocational Training done for the period April'17 to Sept.'17
Bassuriya, East Bassuriya, Godhur and Gondudih Khas Kusunda	375	425

Figure 1 *Stone Pitching/embankment at Kari Jore near Godhur Colliery.*

Fig. 2 : Eco-restoration at OB Dump at Gondudih Khas Kusunda Colliery

CSR, R&R AND TRANSPORTATION PLAN OF CLUSTER-VI

As per the condition [Specific condition : A(xxxv)] of Environment Clearance of Cluster VI group of Mines of BCCL granted by Ministry of Environment & Forest, Govt. of India vide order no.: J-11015/183/2011-1A.II(M), dated 26th. August, 2013.

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 it's peripheral communities in particular.
BCCL is taking up activities from the HQ level and through its administrative areas for the implementation of CSR activities. For this purpose A CSR cell is functioning which is headed by General Manger(CSR) under the direct control of Director(Personnel) of the company.

The CSR activities presently being done by BCCL

- To meet the acute shortage of drinking water in peripheral villages' drinking Water is provided through deep borewells, tubewells, pumps/motors, in the peripheral villages of BCCL. Water supply through pipeline, through water tanker is provided also to the villages. Mine water is supplied after proper filtration in Filter Plants.
- **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 are done to promote quality education in the nearby villages. BCCL is Extending financial aid for educational facilities to 83 nos. Private Committee Managed schools. Measures are taken to promote women literacy and carrier development.
- **Health Care**: BCCL Conducts medical/health camps for dwellers of peripheral villages for rendering free medical consultancy. CSR Clinics, wellness clinics, artificial limbs centers are organized for the benefit of the needy section of the society.. Mobile medical vans are deployed as special arrangement for medical services. AIDS awareness camps are organized as special drive to develop awareness and to render free consultancy. In Kusunda Area many medical /health camps in peripheral villages and in collieries and various awareness programmes have already been conducted, and is being conducted regularly by Area Medical Team.
- **Occupational health**: awareness programme are organized.
- **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, etc.
- **Mashla Chakki centres :** Mashla Chakki centres has been established with machines to promote self employment.
- **Sports & Cultural**: Various activities are organized to propagate sports and cultures. Sports/games items and instruments are also provided with play ground.
- **Village adoption**: Lahbera – A SC/ST village nearby Dhansar Mine has been adopted for its all round development and a number of development activities have been carried out including school, health care and Ambulance facility, Mashla Chakki Centre, Community Centre, Play ground, etc.
- **IN KUSUNDA AREA :**

A lot of CSR activities have been done in the peripheral villages in the field of medical and civil and welfare.

Health Campaigning at surrounding villages by MMV (Mobile Medical Van) :

Year	No. of MMV camps	Beneficiaries
2013-'14	298	11,171 patients
2014-'15	306	11,884 patients
2015-'16	380	11,013 patients

Village Health Camps-	No. of camps	Beneficiaries
2017-'18 (upto Sept.'17)	109	2556

Special Health Camps in

2015-'16	5	354 patients
2016-'17	2	62 children
2017-'18(upto Sept'17)	1	46 patients

CSR Clinic :

2015-'16	5842 patients
2016-'17	1387 patients
2017-18 (upto Sept'17)	1069 patients

Welness Clinic

2015-'16	6244 patients
2016-'17	3922 patients
2017-18	2194 patients

In 2013-'14 & 2014-'15 and 2015-16 following civil work have been completed under CSR Activity

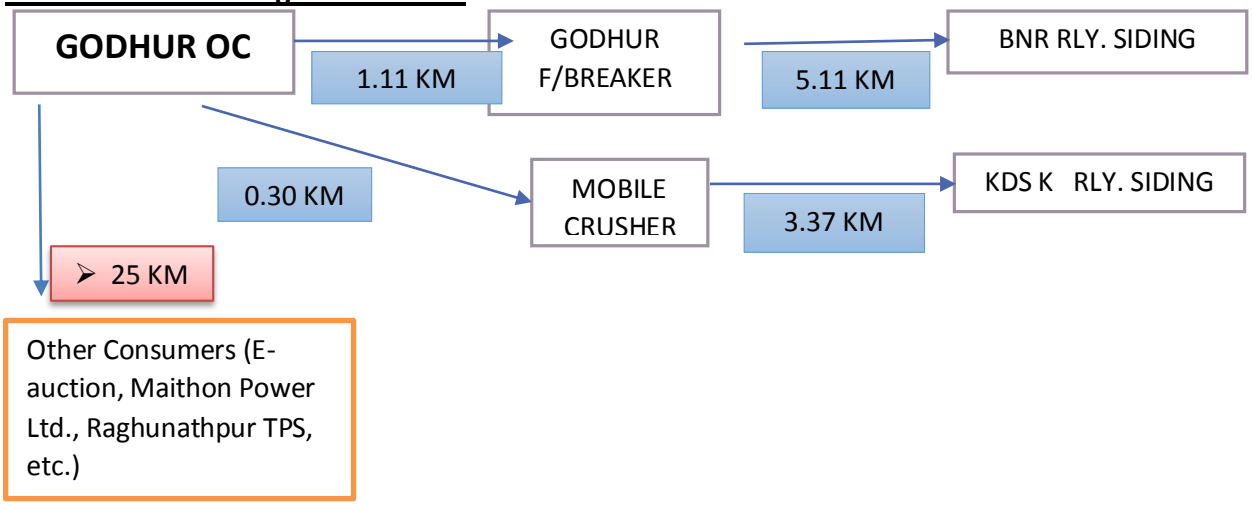
- **Construction of compound wall for Lahbera School at Dhansar -- work completed**
- **Deeping of Pond at Lahbera Basti at Dhansar -- work completed**
- **Constr. of pcc road from Dom tola to Kali Mandir at Barki Bowa Village -- work completed**
- **Constr. of pcc road from near house of Vikash Rajak to main road at Satitand Village -- work completed**
- **Constr. of pcc road from Parduman Singh Chowk to near house of Sri Kishore Pandey at Ranguni Panchayat -- work completed**
- **Constr. of Yatri shed at Dutta Tola near Hanuman Mandir of Ranguni Panchayat -- work completed**
- **Constr. of boundary wall , Chabutra and a shed near Gram Dewata at Dhansar -- work completed**
- **Construction of PCC road in Lahbera Basti at Dhansar -- work completed**
- **Construction of 318 toilets in 179 schools in Chaibasa has been undertaken by Kusunda Area under the Pradhan Mantri Swatchh Vidyalaya Yojana . Construction of toilets in 25 boys' school, 15 girls' schools and 139 Co-education School have been undertaken. -- Out of 318, 236 toilets have been completed.**

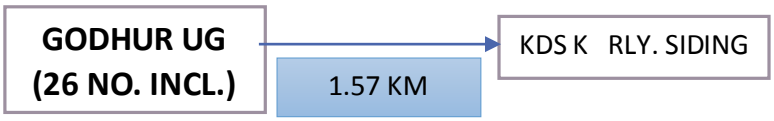
COAL TRANSPORTATION

Coal Despatch

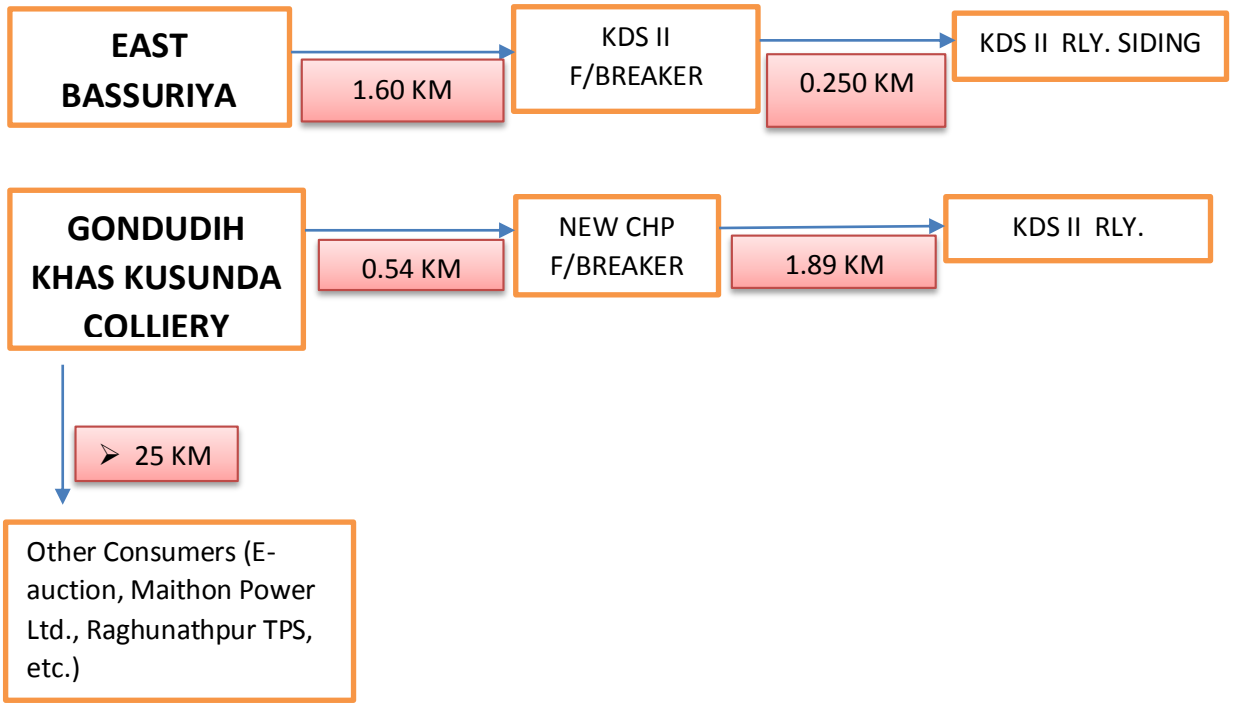
The coal produced from the working faces of the mine are transported and dumped in the coal stock yard and thereafter it is transported to different plants contractually under road sale, or transported to the railway sidings for despatch to different organisations (steel/power/fertilizer plants etc).
In Kusunda Area of BCCL, two railway sidings are there namely KDS-K and KDS II. BNR railway siding under Bastacola Area is also being used for coal despatch by railway wagon.

Av. Distance of Sidings from Mines





[At present Godhur UG is discontinued]



Average distance of different Power/Steel/fertilizer plants etc from Kusunda

Name of organisation	**Avg distance in km**
Chandrapura Thermal Power station	43
Harduaganj Thermal Power station	1071
Parichha Thermal Power station	948
Mejia Thermal Power station	105
Koderma Thermal Power station	123
DSTP	98
Pradhan Mantri Rajiv Gandhi	1409
NFL(Nangal dam)	1478
Budge Budge	1478
NFL	1287
NFL (BTI)	1497

MINE WISE TOTAL COAL DESPATCH

YEAR	DESPATCH	MINES UNDER CLUSTER-VI			
		Godhur	East Bassuriya	Bassuriya	Gondudih KKC
2013-14	Rail	34524	75734.76	75939.96	920230.73
	Road	58476	17922.95	13310.21	158851.97
	Total	93000	93657.71	89250.17	1079082.7
2014-15	Rail	32047	158749	4995	174200
	Road	23005	0.00	0.00	6032
	Total	55052	158749	4995	180232
2015-16	Rail	423345.14	14742	0.00	524138.1
	Road	11057.68	0.00	0.00	20790.52
	Total	434402.82	14742	0.00	544928.62
2016-17	Rail	721026.54	231008.26	0.00	928136.09
	Road	181471.18	12110.15	0.00	181635.77
	Total	902497.72	243118.41	0.00	1109771.86

DELINEATION OF SURFACE COAL FIRE IN THE JHARIA COALFIELD, DHANBAD, JHARKHAND USING REMOTE SENSING DATA

GEOSCIENCES GROUP

RS & GIS APPLICATIONS AREA

NATIONAL REMOTE SENSING CENTRE

INDIAN SPACE RESEARCH ORGANISATION

DEPT. OF SPACE, GOVT. OF INDIA

HYDERABAD-500 037

MARCH, 2014

DELINEATION OF SURFACE COAL FIRE IN THE JHARIA COALFIELD, DHANBAD, JHARKHAND USING 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

RS & GIS APPLICATIONS AREA

NATIONAL REMOTE SENSING CENTRE

INDIAN SPACE RESEARCH ORGANISATION

DEPT. OF SPACE, GOVT. OF INDIA

HYDERABAD-500 037

MARCH, 2014

DOCUMENT CONTROL SHEET					
1.	**Security Classification**	Official only			
2.	**Distribution**	BCCL and NRSC/ISRO/DOS			
3.	**Report / Document Version**	**(a) Issue no.** 01	**(b) Revision & Date** 00		
4.	**Report / Document Type**	Report on Coal fire study.			
5.	**Document Control Number**	NRSC-RSAA-GSG-ARR-2014-TR-608			
6.	**Title**	DELINEATION OF SURFACE COAL FIRE IN THE JHARIA COALFIELD, DHANBAD, JHARKHAND USING REMOTE SENSING DATA			
7.	**Particulars of collation**	**Pages** 47	**Figures** 18	**Tables** 6	**References** 10
8.	**Author(s)**	Shri Priyom Roy S/E 'SC'			
9.	**Affiliation of authors**	Geosciences Group, RSA, National Remote Sensing Centre			
10.	**Scrutiny Mechanism**	**Compiled by** Shri Priyom Roy S/E 'SC'	**Reviewed by** Dr. K. Vinod Kumar, S/E 'SG', Group Head, Geosciences Group	**Approved by** Dr. P. G. Diwakar, Dy. Director (RS&GIS-AA)	
11.	**Originating unit**	Geosciences Group, RSA.			
12.	**Sponsor(s) / Name and Address**	Bharat Coking Coal Limited (BCCL) (A Subsidiary of Coal India Ltd.) Environment Department, Koyla Bhawan Koyla Nagar, Dhanbad – 826 005, Jharkhand			
13.	**Date of Initiation**	September, 2013.			
14.	**Date of Publication**	22nd April, 2014			
15.	**Abstract (with Keywords)**	This report describes about the coal mine fire areas mapped using thermal channel of satellite sensor such as ASTER (90m resolution) in Jharia coal field. Relative radiant temperature image derived from raw thermal data of 2012 is thresholded by two different methodologies to delineate the fire zones in Jharia coal field for the year 2012.			

EXECUTIVE SUMMARY

Coal fire is a serious problem in Jharia coal field, where high grade coal is gradually combusted due to these fires. The combined act of surface and sub-surface fires 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. Remote sensing data have immense potential in earth sciences and other disciplines mainly because of its synopticity and repetivity. In the present study, delineation of coal fire, which is the major environmental problem in coal mining areas, is addressed. Thermal bands in ASTER (90m resolution) have been used to demarcate the coal mine fire areas from non fire areas. For this study, ASTER data of May, 2012 have been used. The band 13 (10.25-10.95 μm) of ASTER data is used to derive the relative radiant temperature. The study reflects that, compared to 2006, the eastern flanks (Lodna, Tisra areas) and the western flank (Nadkhurkee, Shatabdih area) show diminished fire presence. New fire areas are observed in the northern flank in the areas around Katras and Gaslitand. Among all the colliery areas, Kusunda area is most affected by coal mine fire. The coal mine fire and non fire areas are further verified on the ground and fire temperature on the ground was measured using the handheld infrared thermometer. The final coal mine fire map of Jharia coal field is prepared by using iterative as well as statistical thresholding techniques with the information collected from ground.

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 this coal fire hazard. 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 (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 absorption 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 threshold temperature, ranging between 80^0 to 120^0C, a steady reaction starts, which produces carbon dioxide. Temperature keeps on increasing once CO_2 is started to form and at 2300^0C exothermic reaction become rapid. It is known that high ranking coals (high carbon content) are more fire prone, though the reason behind this is not clear. 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 supplying slowly oxygen / air through their conduits.

Coal mining in Jharia Coal Field (JCF) started way back in 1895. History of fire in Jharia Coal Field dates back to 1916 when the first incidence of fire was reported from XIV seam of Bhowrah colliery. JCF was nationalised in 1972 and over

the decades, the fire has spread or been contained but never extinguished. The combinations of underground fires and subsidence have affected vast areas of JCF.

1.1 Background

In order to manage effectively the coal fire menace, it is essential to know the exact location and extent of the fire affected areas. Remote sensing technique in thermal band offers a cost-effective and time-saving technology for mapping various geoenvironmental / hazardous features like coal fires, forest fires, oil well fires, volcanic eruptions etc. These features are identified in thermal bands as high temperature anomalous areas. Hot bodies on the surface of the earth mostly emit radiation in this band. NRSC has carried out coal fire mapping projects in the past; conducting an airborne campaign in 1989 and using Landsat-5 TM data in 1995 (Bhattacharya *et. al.*, 1995), over Jharia coalfield, Jharkhand and using data for 2001 over Raniganj coalfield, West Bengal. Further another project was executed in 2006, in which coal fire of the Jharia Coalfield was mapped for 2003 and 2006, using ETM+ and ASTER data respectively. In view of the past experiences, based on the letter (Ref. no. BCCL/DT(OP)/F-13) from Director (Tech.) BCCL, Operations, BCCL addressed to Director, NRSC with consequent discussions on the 8th of January, 2013 (Minutes recorded in letter vide BCCL/DT(OP)/F-ENV/2012/148(A)) a project was formulated to take up Coal fire study of the Jharia Coal Field using space-borne remote sensing techniques to study the status of coal-fire as of the year 2012. The formal Memorandum of Understanding between BCCL and NRSC was signed on 15th of July, 2013.

1.2 Objectives

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

I. Mapping of Coal fire in the study area based on pixel integrated relative radiant temperature derived from ASTER data of 2012.

II. Comparison of the change in the coal fire distribution in the Jharia coalfield within the period of 2006 and 2012.

1.3 Study Area

Jharia Coalfield is located in the Dhanbad district of Jharkhand state (Figure 1) and it is named after the main mining area of Jharia. It is situated in the heart of Damodar River valley and is about 250 km NW of Kolkata. The coalfield is contained roughly within latitudes 23º 38' N and 23º 52'N and longitudes 86º 08'E and 86º 30'E.

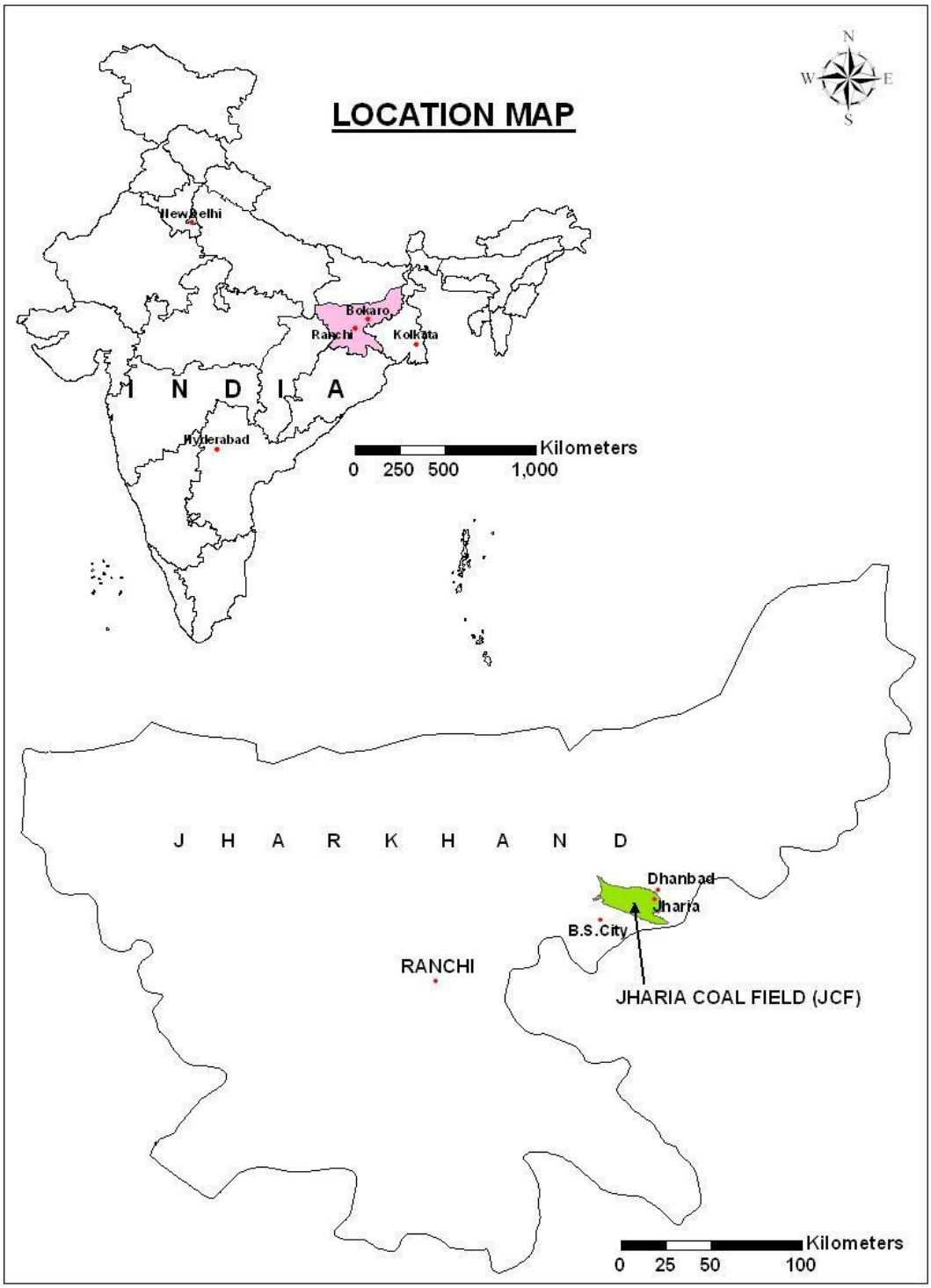
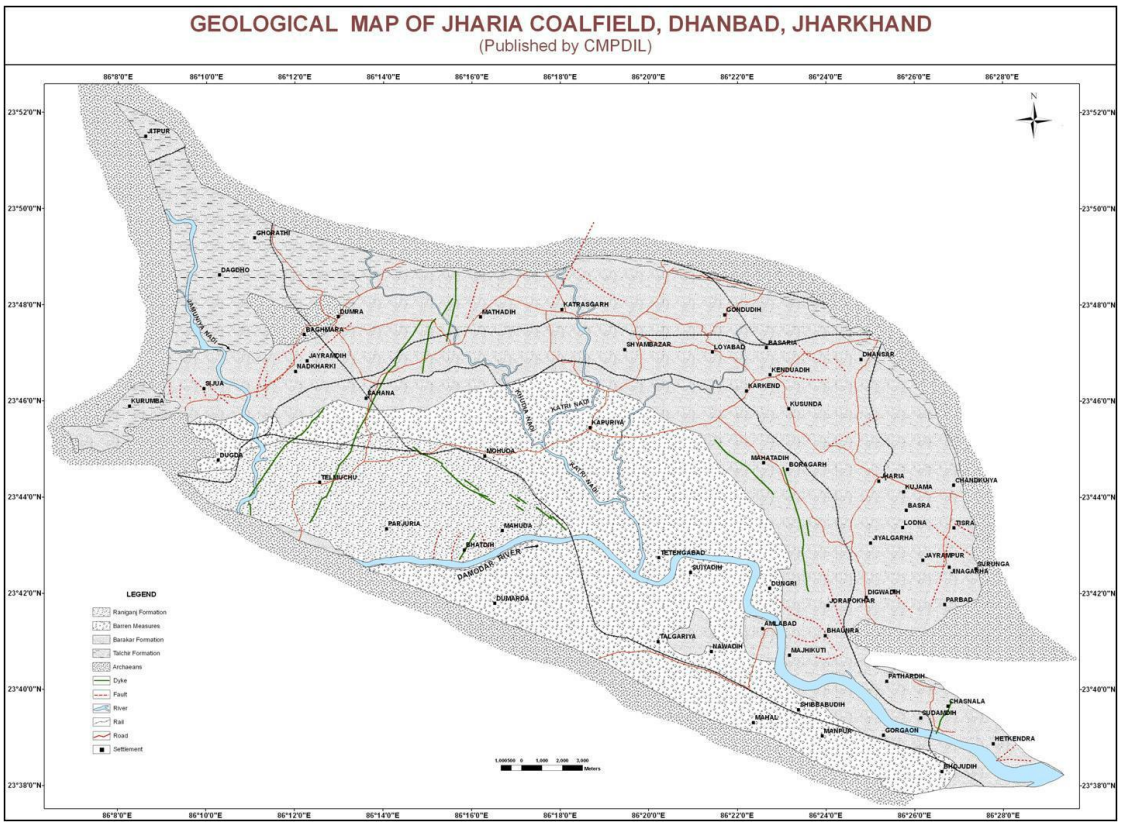


Figure1: Study area

The generalised stratigraphy of this area 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

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



REMOTE SENSING DATA ANALYSIS

4.1 Principles of thermal remote sensing

All matter at temperature above absolute zero (0º Kelvin) emits electromagnetic radiation continuously. The temperature of the earth materials and high temperature phenomenon can be estimated based on the thermal emission from these materials. Max Planck, using his quantum theory, developed a relation between spectral radiance, wavelength of the emitted radiation and temperature for the blackbody. The Planck's equation for black body is given in equation -1.

$$L_\lambda = \left[\frac{2\pi hc^2}{\lambda^5}\right] * \left[\frac{1}{e^{hc/\lambda\kappa T_{rad}} - 1}\right] \quad \text{…….. (1)}$$

Where

L_λ= Spectral radiance of selected thermal infrared band ($W/m^2/Sr$)

λ = Wavelength (m) in selected thermal infrared band

T_{rad} = Radiant Temperature (^0K)

h = Planck's constant (6.63×10^{-34} joule

sec) c = Speed of light (3.0×10^8 m/sec)

κ = Boltzmann constant (1.38×10^{-23} joules/k)

Equation (1) can be rearranged as follows

$$T_{rad} = \frac{C_2}{\lambda \ln(((\in C_1) / (\pi L_\lambda \lambda^5)) + 1)} \quad \text{…….. (2)}$$

Where

$C_1 = 2\pi hc^2 = 3.742 \times 10^{-16}\ Wm^2$

$C_2 = hc/k = 0.0144mK$

$\in$ = Emissivity

In equation - 2, wavelength may be considered as the mean wavelength of the spectral region under investigation. Once the corrected spectral radiance (L_λ) is

known for a pixel, it can be substituted to equation – 2 to compute radiant temperature value. The radiant temperature is defined as the equivalent temperature of a black body which would give the same amount of radiation, as obtained from a real body. The radiant temperature (T_R) depends on actual temperature of surface element i.e. kinetic temperature (T_K), emissivity (ε) and transmissivity of atmosphere (Gupta, 2003). Emissivity (ε) for a blackbody is 1 and for most materials it is less than 1 ranging generally between 0.7 and 0.96. So the kinetic temperature of natural materials is always higher than the radiant temperature.

In the present study, coal fires are mapped on the basis of their temperature from the back ground non fire zone. Coal fires are very high temperature surface elements with high thermal flux and are very close to black body in terms of their thermal behaviour. However emissivities of fire zones are dependent on several factors such as presence of moisture in coal and the total carbon concentration in coal etc. Coal fires with high thermal flux are very restricted in terms of surface extent. Therefore total thermal flux is 8100m^2 (in case of ASTER Data) represent the average thermal flux emanating from both coal fire zones and non coal fire area of given pixel. The emissivity and radiant temperature of a pixel containing fire depends on the entire contributing element within the pixel. If pixel averaged radiant temperature remains quite higher than the pixel containing no fire (background), then only coal fire zones can be delineated.

4.2 Methodology

4.2.1 Processing of ASTER Data

In the present study, Multispectral Advanced Thermal Emission and Reflection Radiometer (ASTER) data dated May, 2012 is acquired for coal fire mapping. ASTER provides five thermal channels in the thermal region within 8.125 -11.65 µm wavelength domain. Multi channel ASTER data is very useful to derive emissivity by using temperature emissivity algorithm and thereby allows seeing the thermal anomaly within the range of entire thermal domain of ASTER. However, Band 13 (10.25-10.95 µm) is considered here to delineate the coal mine fire zones as transmission of thermal wave is highest in this channel and upwelling (generated by

the additive radiance of atmosphere) appear lowest in this particular thermal channel (Figures 3 and 4).

Thermally emitted radiance from any surface depends on two major factors.

(1) Surface temperature, which is the expression of state of heat energy budget on the surface and also indicate the equilibrium thermodynamic state of incident and emitted thermal energy fluxes.

(2) The surface emissivity, which determines the efficiency of surface for transmitting the radiant energy (Schmugge, 2002).

Therefore band 13 data appear as the best available combination to derive the coal fire map.

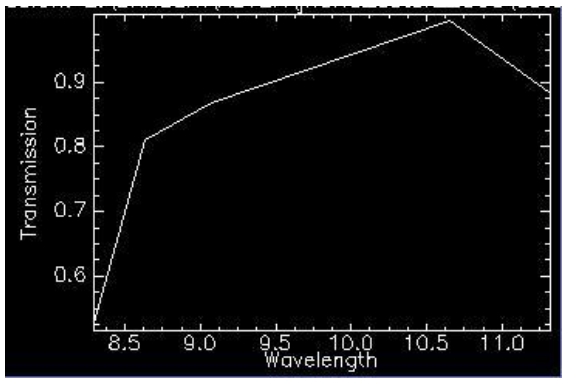


Figure 3: Transmission profile in ASTER thermal channel

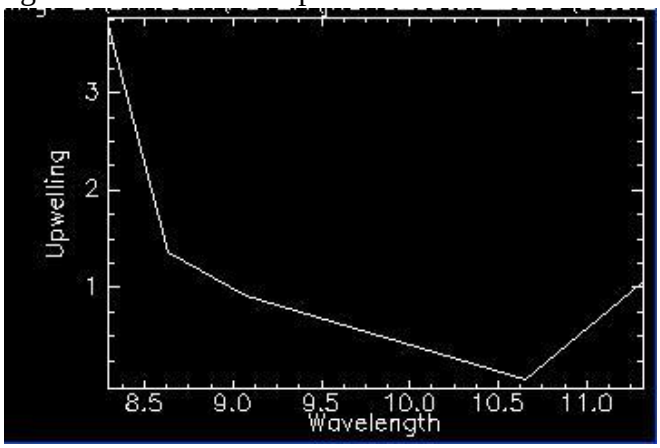


Figure 4: Up welling profile in ASTER thermal channel

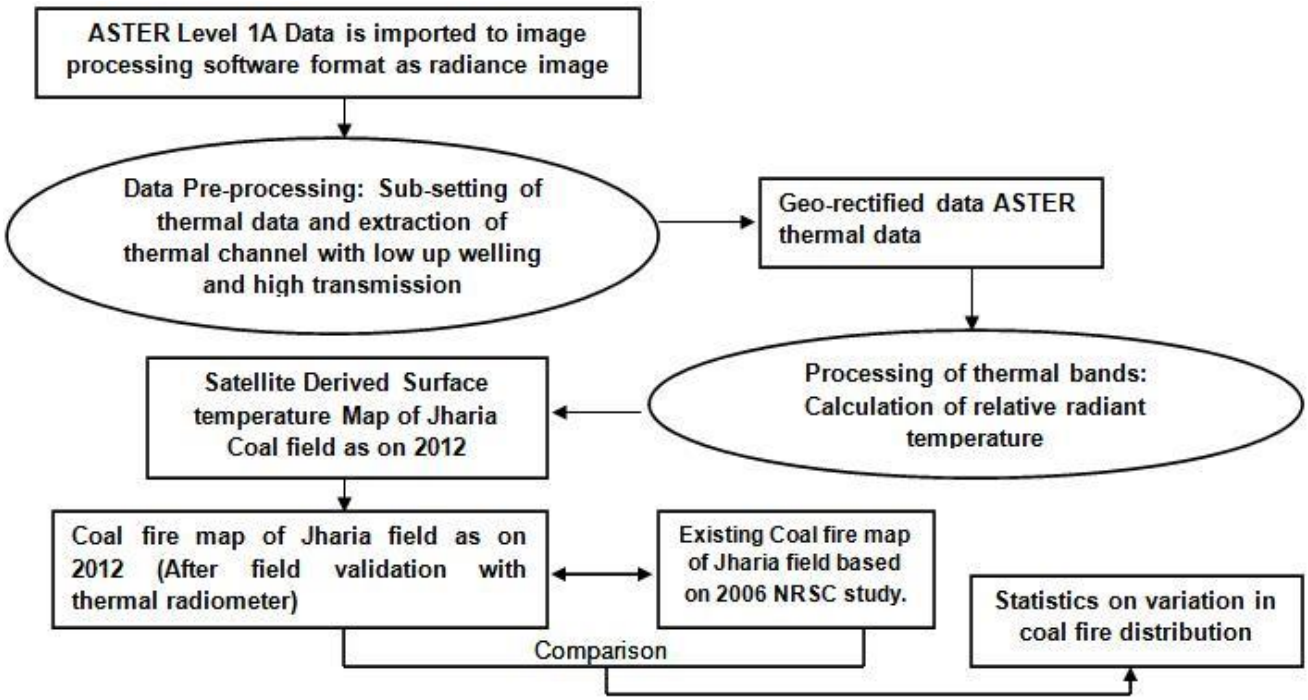
ASTER data is received as geocoded level 1B format from ERSDAC, Japan. This data is imported in ERDAS 9.1 software after converting in radiance by using facility module available for radiance conversion while importing the data in ERDAS software platform.

The georectified radiance data for 13th thermal channel is then used in a model for calculating the radiant temperature from the radiance values using equation - 2.

Table 2: Temperature class of coal mine fire map from ASTER data

Sl. No.	Temperature Class	Remark
1	< 49º C	Background temperature
2	>49º C - 51º C	Low intensity coal mine fire
3	>51º C - 55º C	Medium intensity coal mine fire
4	> 55° - 60º C	High intensity active coal mine fire

Methodology Flowchart for preparation of coal mine fire map from ASTER Data



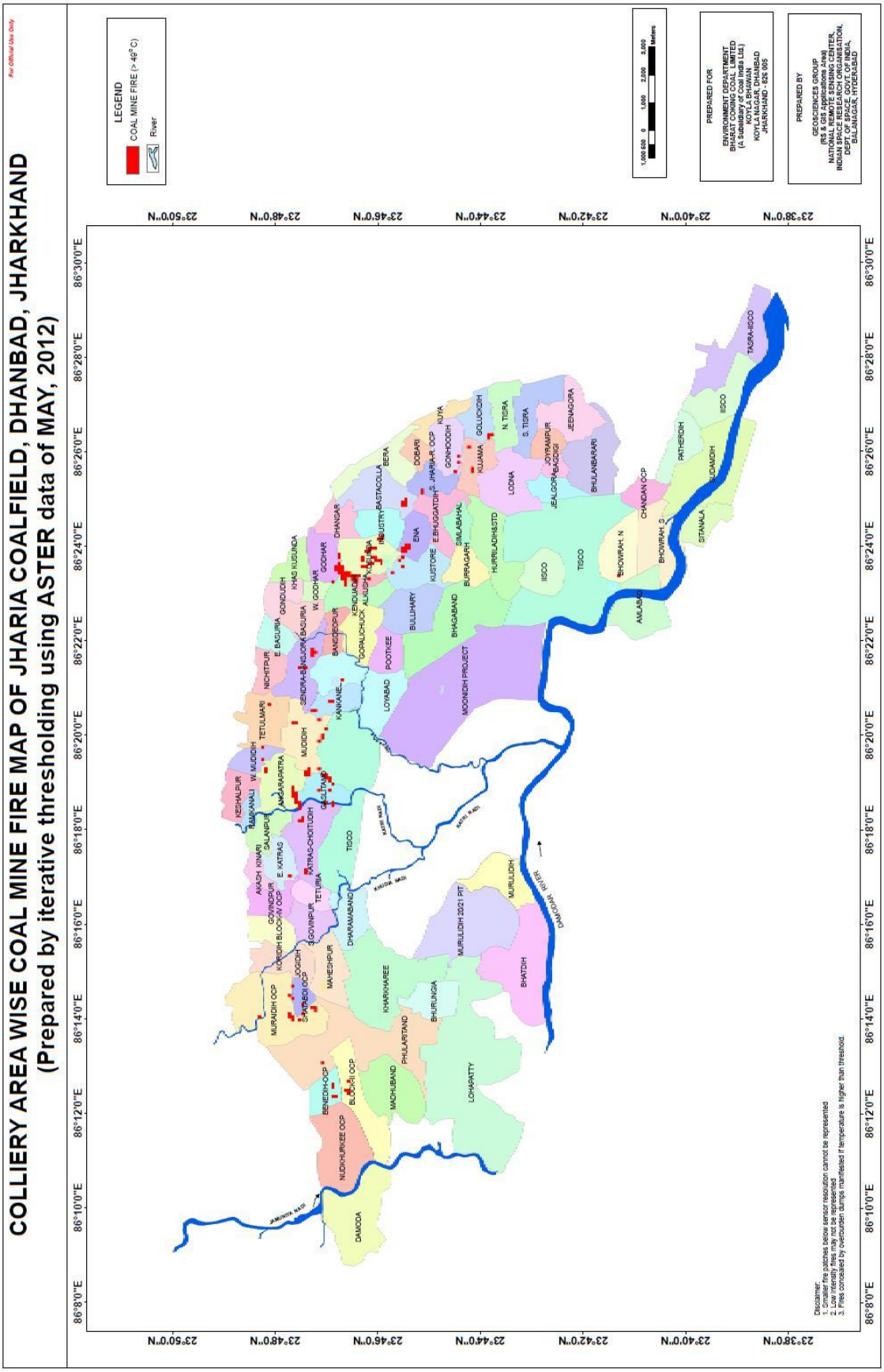


Figure 6: Colliery wise Coal mine fire map of Jharia coal field, Dhanbad, Jharkhand

CHAPTER V

FIELD WORK

A fieldwork for ground verification of the fire pixels as observed in the data was carried out in the month of January, 2014. As discussed previously, for the fieldwork a coal fire map as of December 2013 derived from LANDSAT 8 TIRS data (Figure 12, Annexure IV) was used as reference. The observations were then correlated back to the ASTER 2012 data. Metravi© infrared thermometer is used in the field work to measure the temperature of the coal fire. With this thermometer most of the measurements were recorded along the cracks emanating fire/smoke or the heat wave coming out from the fire at subsurface from a typical distance of ~1 m, except for some inaccessible areas. In those cases the measurements were recorded from a distance of ~ 5 m. The device has an accuracy of ~1.5% (in the range of -50°C to 1050°C), and hence is a highly reliable instrument for ground temperature measurement.

Broadly the fire affected area can be differentiated into three categories as follows:

i. Active fires: where surface expression of the fires are seen in the form of flames.
ii. Fume cracks: surface cracks emanating fumes arising from the fires below.
iii. Background: non fire areas in the vicinity comprising of either coal or sandstone.

Most of these fire affected areas are major open cast mines, where the coal has been exposed to the atmosphere and hence is prone to combustion. The locations with the recorded temperature data is tabulated (see Table 4) and shown in the map (marked by numbers in Figure 7). In the south-western flank of the area, fires are located in the region around Bhowra (Location 1) and are mostly fume cracks without the presence of any active fires. The temperature of fumes from these cracks is in the order of 80°C with the associated background temperature of around 60°C. Fire is mostly being dealt by excavating out burning coal in opencast workings. The quarry edges are covered with overburden to suppress the fire expression.

North of Tisra (Location 2), the open cast mines are heavily affected with fires and the same is seen in multiple pockets over a considerably large areal extent. Numbers of fume cracks are seen with temperatures ranging between 116°C to 136°C in reference to background temperatures of 30°C to 67°C. Places near to Bhulanbarari village are also marked by the presence of high intensity coal fires and the fire has created several fissures / fractures over the ground and overburden. Northwest of Tisra, areas around Kujama (Location 3) area also affected by multiple smaller pockets of fire with predominant manifestation of active fires associated with fume cracks. The active fire temperatures are in the order of 250°C and associated fume cracks measure around 90°C. The background sandstones and coal temperatures range between 20°C to 35°C. Similar smaller pockets of fire are seen in areas around Ghanoodih (Location 4). Here active fire temperatures range between 200°C to 400°C against a background of 35°C. Further on the north eastern flank, two smaller fire pockets are located in the areas near Bastacolla (Location 5) and South Jharia OCP (Location 6). Large scale excavations are ongoing to isolate the fire affected seams and control the spread of the fire. These areas are mostly manifested by fume cracks with temperatures around 70 °C to 80 °C against a background of 40°C to 60°C. Very occasionally surface active fires are seen with higher temperatures.

Active fires in the area have temperatures of around 260°C with associated fume cracks measuring 70°C against a background of 35°C. The open cast mines in Kusunda and Kenduadih are known to be the "exhibits" of active fire of the Jharia coalfield. The surface manifestations of these fires are in the form of blazing flames (Figure 12) with very high temperatures. The extent of the area affected is large. Fumes for the burning coal are also associated with the sulphur. Spontaneous burning of coal creates huge amount of obnoxious gases like sulphur dioxide and hydrogen sulphide etc.

Towards the northwest, Near Bansjora (Location 11) railway station a fire zone is seen in an excavation pit. This pit is constructed to thwart the progress of coal fire and hence the present manifestation of the fire is greatly diminished. Similarly, areas around Modidih, Jogta and Katras are affected by multiple fire pockets mainly associated with the ongoing mining in these areas. The expressions are mainly in the form of fume cracks with few active fires. The fume cracks have temperatures around 60°C to 70°C against an average background temperature 32°C. Though the fire

pockets are isolated from each other on the surface, they culminatively affect a large area around Katras, Modidih, Gaslitand and Jogta (Location 12 to 20).

In the western flank, mines in the Nadhkhurki (Block 2 OCP, Location 22) are highly affected by fire. The accessible mining area has been greatly reduced due to the presence of multiple fume cracks rendering the area highly unstable. The measured fume crack temperatures range between 90°C to 110°C against an average background of 40°C. North of Nadhkhurki, minor fire pockets are seen around the Jayramdih (Bendih, Location 21). The fire is mostly related to the overburden dumps in the region.

The fire zones in the Shatabdih (Location 24) and the Muraidih (Location 23) mines are continuously being excavated to isolate the affected coal seams. These efforts have resulted in overall decrease in the spatial extent of the fire and thereby its manifestation in the satellite data. However, multiple smaller pockets remain, mostly that of fume cracks with temperatures ranging from 85°C to 90°C against a background of around 35°C to 40°C. Further, in areas around New Akash Kinari (Location 25 and 26) situated near DC railway line, the fires have been blanketed with soil.

The fieldwork ascertained the major fire pockets as seen in from the data (figure 5). However, the observations also indicate the following:

The thresholding method as discussed in section 4.2.1 has masked a prominent fire location in the Bhulanbarari area (marked with "red star" in figure 7). Here, though active fire locations are seen on the surface, the same is not manifested in the data.

Considering the above mentioned observations, certain post field update is necessitated.

CHAPTER VII

DISCUSSIONS AND CONCLUSIONS

In summary, there is a change in the areal disposition of the fires from 2006 to 2012. Observations suggest the diminishing of the fire affected areas in the eastern and western flank but emergence of new areas in the northern sections in areas around Katras and Gaslitand. Concurrently, there is a decrease in extent of fire areas around Lodna, Tisra area in the eastern flank and Shatabdi, Nadkhurkee area in the western flank from 2006 to 2012. A quantitative comparison of the 2006 and 2012 data was carried out. As discussed previously, the inclusion of fires from the Bhulanbarai area was not detected by regional-iterative thresholding but was separately identified using "cluster analysis" method. Therefore, comparison of the 2006 fire area with 2012 was done including the fires from the Bhulanbarari colliery (considering them as a part of the active fire) derived independently for this area.

As compared 2006, when the total fire affected extent of about 3.01 km^2; in 2012 total fire affected extent is about 2.18 km^2. The colliery wise break-up of change in fire area from 2006 to 2012 is given in Annexure V.

Conclusions

The following conclusions can be made:

1. As of the date of study in the year 2012 and in comparison with the previous study done in 2006, there has been a change in areal extent and disposition of the fire affected areas.

2. Compared to 2006, the eastern flanks (Lodna, Tisra areas) and the western flank (Nadkhurkee, Shatabdi, Block II and Benedih area) show diminished fire presence.

3. New fire areas are observed in the northern flank in the areas around Katras, Gaslitand etc. These areas were not mapped as fire in the 2006 study.

4. The mines in Kusunda, Kenduadih and Ena remain to be the worst affected with maximum presence of active fires. This observation remains consistent to the findings as in 2006.

5. There is a decrease in areal extent of the fire (Figure 10) from 2006 to 2012.

Note: *Estimations of fire extent (in terms of sq.km.) both in 2006 and in the present 2012 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.*

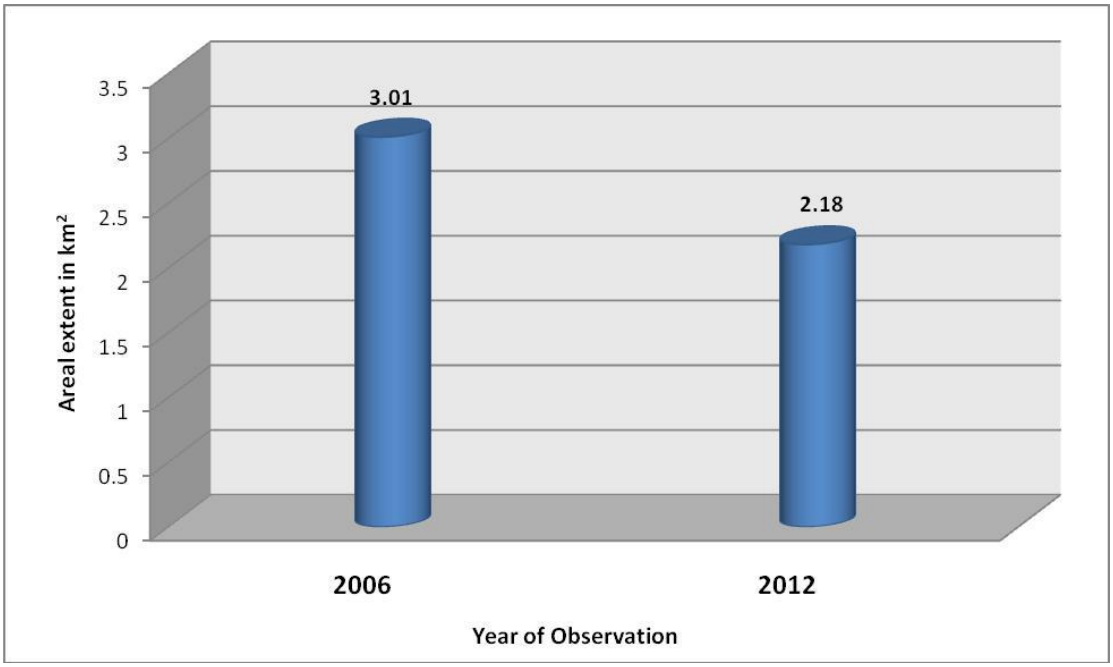


Figure 10: Total fire area statistics

Annexure –I

Table 3: Sensor details of ASTER data

Subsystem	Band No.	Spectral Range (μm)	Spatial Resolution (m)	Quantization Levels
VNIR	1	0.52-0.60	15	8 bits
	2	0.63-0.69		
	3N	0.78-0.86		
SWIR	4	1.60-1.70	30	8 bits
	5	2.145-2.185		
	6	2.185-2.225		
	7	2.235-2.285		
	8	2.295-2.365		
	9	2.360-2.430		
TIR	10	8.125-8.475	90	12 bits
	11	8.475-8.825		
	12	8.925-9.275		
	13	10.25-10.95		
	14	10.95-11.65		

Annexure –II

Table – 4: Ground Temperature measured during fieldwork

No.	Location Name (ASTER)	Location Coordinates	Seen in L8 TIRS 2013 data (Y/N)	Feature	Approximate Size	Temperature	Background temperature
1	Bhaunra	86°23'21.694"E 23°41'18.314"N	Y	Opencast mine and related OB dumps	800m by 500 m	80	62
2	East of Basra (North Tisra)	86°26'19.605"E 23°43'47.937"N	Y	Open cast mining	Multiple fire pockets, Large area affected	varies from 116 to 136	varies from 30 to 67
3	Kujama	86°25'36.418"E 23°44'9.206"N	Y	Open cast mining	Large area affected	Active fire: 260 Smoky coal: 90	Sst: 20 Coal: 35
4	East of Jharia (Dhanudih)	86°25'33.867"E 23°44'30.028"N	N	Open cast mining	moderate area affected. Excavations on going to remove fire.	Fume cracks: 79 Active fire: 180 to 440	average background : 35
5	Bastakola	86°24'54.284"E 23°45'26.751"N		Open cast mining	moderate area affected	Fume cracks: 76 Active fire: 560	average background : 37 to 56
6	South Jharia OCP	86°25'8.432"E 23°45'7.39"N		Open cast mining	moderate area affected	Fume cracks: 160	56
7	Ena OCP	86°23'57.187"E 23°45'26.267"N	Y	Open cast mining	Large area affected	Fume cracks: 70 Active fires: 263	varies from 23 to 32
8		86°23'41.772"E 23°46'1.53"N	Y				
9		86°23'57.006"E 23°46'5.665"N	Y				Active fire. Temperatures greater than 1000
10	Kusunda - Kendudhi OCP	86°23'20.94"E 23°46'37.223"N	Y	Open cast mining	Large area affected	Large area of active fires	
11	NE of Loyabad (Bansjora Railway Station)	86°21'45.788"E 23°47'14.425"N	N	Old OCP abandoned	moderate	Fume cracks: 60	32
12	Katras OCP	86°20'31.487"E 23°47'12.755"N	Y	Ob dump fire	moderate	Active fire: 280 to 500	53
13	Katras OCP (Modidih/Jogta Sector)	86°19'56.592"E 23°47'4.001"N	Y	Open cast mining	Large area affected	not accessible	varies from 35 to 42
14	N of shyambazar (AWMC outsourced)	86°20'15.618"E 23°47'36.688"N	Y	Open cast mining	small area affected	Fume cracks: 72	varies from 30 to 40
15	Modidih (Sijuah)	86°20'15.908"E 23°47'35.058"N		Open cast mining	small area affected	Fume cracks: 1120	varies from 30 to 41
16	Katras	86°18'46.53"E 23°47'39.016"N	Y	OB dump associated to OCP	moderate area affected	not accessible	not accessible
17	Katras	86°19'13.206"E 23°47'19.661"N	Y	Open cast mining	Large area affected	fume cracks: 60-70 Active fire: 559	varies from 29 to 40
18	Katras	86°19'2.992"E 23°46'56.521"N	Y				
19	Katras	86°19'4.247"E 23°46'58.769"N	Y	Large OCP			
20	W of Shyambazar (From L8)	86°18'55.812"E 23°47'11.417"N	---	ongoing	Large area affected	not accessible	varies from 22 to 30
21	Jayaramdih (Bendih)	86°12'35.373"E 23°46'52.837"N	N	OB dump	moderate	fume cracks: 85	varies from 35 to 40
22	Nadkharki : Block 2 OCP	86°12'28.599"E 23°46'33.323"N	Y	Open cast mining	Large area affected	fume cracks: 110-90	varies from 35 to 43
23	Murardih OCP	86°14'2.223"E 23°47'41.296"N	N	Open cast mining	moderate area affected	fume cracks: 85 - 90	varies 35 to 40
24	Shatabdi OCP	86°14'13.223"E 23°47'12.357"N	N	Open cast mining	moderate area affected	not accessible	varies 35 to 40
25	Govindpur area: New Akash	86°17'0.438"E 23°47'43.058"N	N	underground			
26	kinari colliery	86°17'6.953"E 23°47'22.249"N	N	mining activity	Moderate Area affected	fume cracks : 67 to 70	varies from 31 to 35

Annexure –V

Table 6: Colliery wise break-up of change in fire area from 2006 to 2012

SL. NO.	COLLIERY AREA NAME	FIRE AREA 2006 (SQ. KM.)	FIRE AREA 2012 (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)	0.0000	0.0885	0.089	INCREASE
5	NUDKHURKEE OCP	0.0000	0.0000	0.000	NO FIRE
6	BENEDIH OCP	0.0050	0.0530	0.048	INCREASE
7	BLOCK-II OCP	0.0891	0.0530	-0.036	DECREASE
8	MURAIDIH OCP	0.0425	0.1478	0.105	INCREASE
9	SHATABDI OCP	0.2005	0.0378	-0.163	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	0.0030	0.0133	0.010	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	0.0000	0.0133	0.013	INCREASE
21	KATRAS-CHOITUDIH	0.0000	0.1021	0.102	INCREASE
22	KESHALPUR	0.0000	0.0000	0.000	NO FIRE
23	RAMKANALI	0.0000	0.0000	0.000	NO FIRE
24	NICHITPUR	0.0000	0.0000	0.000	NO FIRE
25	E. BASURIA	0.0162	0.0000	-0.016	DECREASE
26	KHAS KUSUNDA	0.0000	0.0000	0.000	NO FIRE
27	GONDUDIH	0.0000	0.0000	0.000	NO FIRE
28	W. GODHAR	0.0000	0.0012	0.001	INCREASE
29	BASURIA	0.0003	0.0000	-0.0003	DECREASE
30	TETULMARI	0.0041	0.0223	0.018	INCREASE
31	DHANSAR	0.0000	0.0000	0.000	NO FIRE
32	GODHAR	0.0017	0.1073	0.106	INCREASE
33	INDUSTRY	0.0193	0.0119	-0.007	DECREASE
34	KUSUNDA	0.7816	0.4243	-0.357	DECREASE
35	SENDRA-BANSJORA	0.1221	0.0796	-0.043	DECREASE
36	BASTACOLLA	0.0384	0.0663	0.028	INCREASE
37	BERA	0.0000	0.0000	0.000	NO FIRE
38	KUYA	0.0000	0.0000	0.000	NO FIRE
39	GOLUCKDIH	0.3109	0.0301	-0.281	DECREASE

SL. NO.	COLLIERY AREA NAME	FIRE AREA 2006 (SQ. KM.)	FIRE AREA 2012 (SQ. KM.)	AREA CHANGE (SQ. KM.)	INCREASE/ DECREASE
40	KUJAMA	0.0988	0.0398	-0.059	DECREASE
41	S. JHARIA-R. OCP	0.1284	0.0244	-0.104	DECREASE
42	DOBARI	0.0000	0.0000	0.000	NO FIRE
43	GONHOODIH	0.0844	0.0398	-0.045	DECREASE
44	SIMLABAHAL	0.0000	0.0000	0.000	NO FIRE
45	HURRILADIH&STD	0.0000	0.0000	0.000	NO FIRE
46	ENA	0.1972	0.0918	-0.105	DECREASE
47	BURRAGARH	0.0000	0.0000	0.000	NO FIRE
48	N. TISRA	0.1244	0.0098	-0.115	DECREASE
49	LODNA	0.1689	0.0000	-0.169	DECREASE
50	S. TISRA	0.0153	0.0000	-0.015	DECREASE
51	BARAREE	0.1578	0.1037	-0.054	DECREASE
52	AMLABAD	0.0000	0.0000	0.000	NO FIRE
53	PATHERDIH	0.0020	0.0000	-0.002	DECREASE
54	SUDAMDIH	0.0547	0.0000	-0.055	DECREASE
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	0.0000	0.0610	0.061	INCREASE
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	GASLITANO	0.0000	0.1194	0.119	INCREASE
69	KANKANEE	0.0000	0.0530	0.053	INCREASE
70	MUDIDIH	0.0000	0.1141	0.114	INCREASE
71	W. MUDIDIH	0.1125	0.0171	-0.095	DECREASE
72	LOYABAD	0.0000	0.0133	0.013	INCREASE
73	BHAGABAND	0.0000	0.0000	0.000	NO FIRE
74	MOONIDIH PROJECT	0.0000	0.0000	0.000	NO FIRE
75	E.BHUGGATDIH	0.0194	0.0022	-0.017	DECREASE
76	ALKUSHA	0.0000	0.0326	0.033	INCREASE
77	KUSTORE	0.0289	0.0524	0.024	INCREASE
78	ANGARAPATRA	0.0292	0.1331	0.104	INCREASE
79	SALANPUR	0.0000	0.0000	0.000	NO FIRE
80	BHOWRAH. N	0.0081	0.0133	0.005	INCREASE

SL. NO.	COLLIERY AREA NAME	FIRE AREA 2006 (SQ. KM.)	FIRE AREA 2012 (SQ. KM.)	AREA CHANGE (SQ. KM.)	INCREASE/ DECREASE
81	BHOWRAH. S	0.0162	0.0000	-0.016	**DECREASE**
82	BAGDIGI	0.0373	0.0000	-0.037	**DECREASE**
83	JEALGORA	0.0227	0.0000	-0.023	**DECREASE**
84	JEENAGORA	0.0000	0.0000	0.000	**NO FIRE**
85	JOYRAMPUR	0.0567	0.0099	-0.047	**DECREASE**
86	CHANDAN OCP	0.0000	0.0000	0.000	**NO FIRE**
87	BANSDEOPUR	0.0072	0.0000	-0.007	**DECREASE**
	TOTAL AREA	**3.01**	**2.18**	**-0.823**	**DECREASE**

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 2006 study

3) "**DECREASE**" implies, decrease in fire area OR fire areas in 2006 not identified in present study *(either absent or below sensor resolution)*

4) Estimations of fire extent (in terms of sq.km.) both in 2006 and in the present 2012 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 14: Active fire exposed in Kusunda/Kenduadih area

Figure 15: Excavations to isolate fire affected seams Ena area