भारत कोकिंग कोल लिमिटेड
एक मिनिरत्न कम्पनी
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय, पूर्वी झरिया क्षेत्र
पो.ओ.- भौरा, जिला - धनबाद (झारखण्ड)
पिन - ८२८३०२, दूरभाष - ०३२६-२३२००७७,
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CIN: U10101JH1972GOI000918
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Bharat Coking Coal Limited
A MINI RATNA Co.
(A Subsidiary of Coal India Ltd)
Office of the General Manager, Eastern Jharia Area
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Ref. No.: BCCL/EJ/AM (Env.)/2017/ 492

Date: 25/11/17

To,
The Director
Ministry of Environment, Forests and Climate Change
Regional office (ECZ)
Bungalow No. A-2, Shyamali Colony
Ranchi – 834002
Jharkhand

Sub.: Six monthly compliance report of the conditions of Environmental Clearance granted to Cluster X group of mines of BCCL for the period from April 2017 to September 2017.
(Ref.: EC Order No.- J-11015/380/2010-IA.II(M) dated 06.02.2013.)

Dear Sir,

Kindly find the enclosed here with the six monthly compliance report of the conditions of Environmental Clearance for the period from April, 2017 to September, 2017 in respect of Cluster X group of mines of BCCL.

Thanking You.

Encl.: Six monthly compliance report with annexure

Yours faithfully

25/11/17

General Manager
Eastern Jharia Area, BCCL
Cluster X

CC to:
1. Director, 1A Monitoring Cell, Paryavaran Bhawan, CGO Complex, New delhi-110003.
2. Dy. GM / HOD (Env.), BCCL, Koyla Bhawan, Dhanbad
3. AGM, E.J. Area, Bhowra, BCCL
4. Area Manager (Env.), E.J. Area
5. Master File

ENVIRONMENTAL CLEAGRANCE COMPLIANCE OF CLUSTER-X

(GRANTED VIDE J-11015/380/2010-IA.II (M) Dated 06.02.2013)
(From April, 2017 to September, 2017)

Sl. No.	A. Specific Conditions by MOEF:	Compliance
I.	The maximum production from the opencast and underground section in the cluster shall not exceed beyond that for which environmental clearance has been granted for the cluster X as below:	Complied (100%). The production from the cluster is within the limit for which environmental clearance has been granted.
II.	All the void /water bodies should be backfilled up to Ground level and no OB dump at the end of mining.	It shall be complied. Action is being taken as specified in EMP.
III.	Extensive plantation should be provided on either side of Damodar River.	A proposal will be initiated for the plantation purpose along the Damodar river in the area which is under cluster X. In addition to this, Action has been taken for the plantation or eco-restoration work as per the Road Map prepared by Forest Research Institute (FRI), Dehradun. Annexure I – Details of Plantation in EJ Area (Cluster X)
IV.	Details of impact of mining on Damodar River should be assessed and provided;	Detail study on Damodar River will be taken up by CMPDI. However, CMPDI is carrying out the Environment Monitoring which comprises of sampling and analysis of water from Damodar River (SW 21 & SW 22) under surface water analysis. Result of upstream and downstream samples showing no major changes in water quality of Damodar river.
V.	Impact of mining on ground water of the area (Impact Zone) should be provided;	Study will be taken up by CMPDI. Ground water monitoring is being carried out by CMPDI.
VI.	A Garland drain should be provided and the drain water should not be discharged in to Damodar River;	No mine water is being discharged into Damodar river. Garland drain and toe wall will be provided along the stabilized O.B. dump and then it will be biologically stabilized through plantation/ eco-restoration works.
VII.	Excess water from mine after treatment should be supplied to the villagers;	An action plan for the utilization and treatment of surplus mine water has been prepared. In this regard 26 mines have been identified for implementation of the Phase-I of the action Plan.
VIII.	Rejects of washery along with dry carbon slurry should be utilized in power plant and other recognized vendors;	Being complied.
IX.	There should be no discharge from the Washery (Slurry) in to the Damodar River. The entire washery	All the washeries of BCCL are designed on Closed Circuit System to ensure no

	water should be recycled;	discharge from the washery premises.
X.	Damodar River should be protected by plantation on both sides;	A proposal will be initiated for the plantation purpose along the Damodar river in the area which is under cluster X. In addition to this, Action has been taken for the plantation or eco-restoration work as per the Road Map prepared by Forest Research Institute (FRI), Dehradun.
XI.	A herbal garden with medicinal plants be developed;	Kamini Kalyan Herbal Garden with 3.32 Ha. area has been taken up for 2016-17. Medicinal/ herbal plants have been planted as per FRI / BCCL Env. Dept. HQ guidelines.
XII.	A time schedule for filling of existing and abandoned quarries be done.	It is being complied.
XIII.	Of the total water bodies area of 286.54 ha in the post mining land use, consist of 243.97 ha of natural water bodies like Damodar river and no. of water ponds. Only 42.57 ha of mine voids were proposed to be converted to artificial water bodies for catering to domestic use of local villagers. Keeping in view the Damodar river in the vicinity, there should be no additional water bodies are created from mine.	It will be complied.
XIV.	The measure identified in the environmental plan for cluster X groups of mine and the conditions given in this environmental clearance letter shall be dovetailed to the implementation of the Jharia action plan.	Master plan/Jharia Action Plan is dovetailed with environmental clearance conditions.
XV.	As there is no fire in cluster X but the measure should be adopted by proponent to control the spread of neighboring fire to the cluster X. The proponent shall prepare time series maps of the Jharia Coalfields through NRSA to monitor and prevent fire problems in the Jharia Coalfield 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 XIV shall be undertaken.	Work has been awarded to NRSC (earlier NRSA) to monitor and prevent fire problems in the Jharia Coalfield and NRSC has submitted their final report. Fire affected area has been reduced from 9.00 Km^2 to 2.18 Km^2. For further dealing of fire and subsidence action has been taken and working as per the strategic plan of digging out of fiery coal followed by reclamation. A Global EOI was floated to control fire in Jharia Coalfield. None of the bidder qualified. Presently (i.e. in 2017) the Work Order for "Delineation of Surface Fire and associated land subsidence in Jharia Coal Field using satellite based remote sensing techniques" has already been awarded to NRSC under the MoU signed with NRSC. Measure to prevent ingress of air (ventilation) is being taken as specified in EMP and as per Jharia Master Plan. Further fire patches are under operation to

		dig out the fiery coal and combustible materials to save the coal from burning and to stop further spread of the fire. Once the fiery coal is dug-out/excavated there will be no more chance of re-starting of fresh/ spreading of fire into other areas. Annexure II – Work Order awarded to NRSA regarding delineation of the surface coal fire.
XVI.	Underground mining should be taken up after completion of reclamation of Opencast mine area after 2 years.	It is being complied. Mining is being done as per the guidelines and approval/permission of Directorate General of Mines Safety (DGMS).
XVII.	No mining shall be undertaken where underground fires continue. Measure shall be taken to prevent/check such fire including in old OB dump.	It is being complied. There is no fire in Cluster X. However action is being taken to control, mine fires including old OB dump areas 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).
XVIII.	A part of cluster X is under River Damodar. It was clarified that although the mine is underground, there is no coal underneath River Damodar, which would be mined. The Committee desired that the data of bore wells near River Damodar require to be monitored for permeability and seepage of waster of River Damodar.	CMPDI RI-II has been requested to conduct study of permeability and seepage of water of River Damodar.
XIX.	The rejects of washeries in Cluster –X should be send to FBC based plant.	It will be complied.
XX.	There shall be no external OB dumps. OB produce from the whole cluster will be 29.01 Mm3. OB from One Patch OCP mine shall be backfilled. At the end of the mining there shall be no void and the entire mined out area shall be re-vegetated. Areas where opencast mining was carried out and completed shall be reclaimed immediately thereafter.	Action is being taken as specified in EMP. O.B. removed from mine/ collieries are back filled in old/ abandoned quarry/voids. At the end of the mining, there shall not be voids and area will be re-vegetated and reclaimed with the proper eco-restoration techniques suggested by the experts available in BCCL and in external agencies i.e. FRI Dehradun, CEMDE Delhi
XXI.	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- X shall be drawn up and implemented.	Calendar plan of production and OB removal has been prepared for year 2015-16 to 2017-18. Mine closure plan as per the guidelines of Ministry of Coal have been prepared by Central Mine Planning and Design Institute (CMPDI) and it is being implemented. Annexure III – Calendar Year plan of cluster X for year 2015-16 to 2017-18.

XXII.	The void in 5 ha area shall be converted into a water reservoir of a maximum depth of 15-20 m in post mining stage and shall be gently sloped and the upper benches of the reservoir shall be recognized with plantation and the periphery of the reservoir fenced. The abandoned pits and voids should be backfilled with OB and biologically reclaimed with plantation and or may be used for pisciculture	It shall be complied. A part of the void will be converted into the water body as specified in EMP. Detailed plan of COCP Bhowra O/C to be prepared for Pisciculture and boat, plantation, sitting arrangement etc. will be provided around the periphery of the reservoir and which will be developed as water recreational park.
XXIII.	Mining shall be carried out as per statuette from the streams/nalas flowing within the lease and maintaining a safe distance from the Nalas flowing along the lease boundary. A safety barrier of a minimum 60 m width shall be maintained along the nalas/water bodies. The small water bodies in OC shall be protected to the extent feasible and the embankment proposed along water body shall be strengthened with stone pitching.	It is being followed. Action for construction of embankment has been taken as specified in EMP. Every year monsoon preparation programme is carried out by colliery / mines before the onset of monsoon for protection of mines from rain water flow and to maintain a safe distance from nalas flowing or small water bodies protection in the lease boundary.
XXIV.	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 water bodies. The OB dumps created earlier already stabilized & further action has been taken for their eco-restoration work as per Road Map prepared by FRI, Dehradun.
XXV.	Thick green belt shall be developed along undisturbed areas, mine boundary and in mine reclamation. During post mining stage, a total of 47.63 ha area would be reclaimed by planting native species in consultation with the local DFO/Agriculture Department/institution with the relevant discipline. The density of the trees shall be around 2500 plants per ha.	It is being complied. Yearly plantation is being done for development of green belts as per EMP. Eco-restoration sites of 19.64 Ha. has been already taken up and 3.10 Ha. has been started in 2017-18. In addition to this, 3.32 Ha. of area will be developed as Herbal garden center. All the Ecological restoration work in the BCCL is under the supervision of FRI Dehradun.
XXVI.	The road should be provided with avenue plantation on both side as trees act as sink of carbon and other pollutant.	Due to absence of permanent roads in the coalfield, avenue plantation couldn't be done but trees were planted near permanent structures to minimize the pollution. However, it has been requested from colliery to provide a proposal for plantation along the road approaching to colliery office.
XXVII.	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 –XIV shall be implemented.	Dhanbad Action Plan has been prepared in consultation with Jharkhand Pollution Control Board for entire BCCL. It is being implemented comprehensively for all the mines of BCCL. Some of the salient actions of this cluster are as under: 1. Construction of pucca road.

		2. Construction of water reservoir for mine water utilization 3. Plantation.
XXVIII.	The locations of monitoring stations in the Jharia Coalfields should be finalized in consultation with the Jharkhand State Pollution Control Board. The Committee stated that smoke/dust emission vary from source to source (fuel wood, coal, fly ash from TPPs, silica from natural dust, etc) and a Source Apportionment Study should be got carried out for the entire Jharia Coalfields. Mineralogical composition study should be undertaken on the composition of the suspended particulate matter (PM10 and PM2.5) in Jharia Coalfields and also quantified. These studies would help ascertain source and extent of the air pollution, based on which appropriate mitigative measures could be taken.	The locations of monitoring stations have been finalized in consultation with JSPCB. The monitoring work of ambient environment quality is being carried out by Central Mine Planning & Design Institute Limited (CMPDIL) which is having CSIR laboratory recognized under the EP Rules. Tender for conducting Source Apportionment Study for BCCL was floated twice, however, none of the bidders qualified. Therefore, as per the MoU "Sustainable Coal Mining in Coal India Limited" entered between CIL and NEERI, NEERI Nagpur was approached for conducting Source Apportionment Study BCCL for compliance of EC conditions. The proposal regarding Conducting the Source Apportionment Study has been submitted by NEERI. Presently it has been submitted to CIL for further scrutiny and approval.
XXIX.	No groundwater shall be used for the mining activities. Additional water required, if any, shall be met from mine water or by recycling/reuse of the water from the existing activities and from rainwater harvesting measures. The project authorities shall meet water requirement of nearby village(s) in case the village wells go dry to dewatering of mine.	It is being complied and mine water is being used for the industrial purpose like water sprinkling to suppress dust generation, etc. Further Mine water is also utilized for the community and irrigation purposes. Following action has been taken by the company: • Installation of Pressure filters for utilization of mine water. In cluster X, there is three nos. of Rapid Gravity Pressure Filter plant of total 1.72 MGD capacity, which is used for supply of water in nearby colonies, houses, quarters. Annexure IV – Details of water Filter plants in Cluster X.
XXX.	Regular monitoring of groundwater level and quality of the study area shall be carried out by establishing a network of existing wells and construction of new peizometers. The monitoring for quantity shall be done four times a year in pre-monsoon (May), monsoon (August), post-monsoon (November) and winter (January) seasons and for quality including Arsenic and Fluoride during the month of May. Data	Regular monitoring of Ground water quality is being carried out by CMPDIL. The Ground water Level and Quality report for Clusters of mines (including Cluster X), BCCL have been submitted by CMPDIL & attached as Annexure V. Annexure V – Ground water level and Quality report.

	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.	Establishment of new piezometers is under process. CMPDI has prepared a report for design location and construction of 23 Nos of Piezometer covering all the 17 clusters of BCCL. Tender for establishing and construction of a network of piezometer well system was opened on 05th May 2017, in which only one bidder has participated. The tender is under scrutiny.
XXXI.	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.	Mine discharge water is being allowed to settle down in the mine sumps before disposal into storage reservoirs. The monitoring of water quality parameters is being done by CMPDIL and parameters are well within the prescribed limit provided by CPCB.
XXXII.	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.	The work of installation of Oil and Grease Trap arrangement has been taken up with CMPDI. The subject assignment will be completed within eight months from the date of issue of work order.
XXXIII.	Regular monitoring of subsidence movement on the surface over and around the working area and impact on natural drainage pattern, water bodies, vegetation, structure, roads, and surroundings shall be continued till movement ceases completely. In case of observation of any high rate of subsidence movement, appropriate effective corrective measures shall be taken to avoid loss of life and material. Cracks shall be effectively plugged with ballast and clayey soil/suitable material.	At present only development districts are operational at UG mines in Cluster X and no depillaring district is taken up. However regular monitoring of subsidence will be undertaken on operating depillaring districts.
XXXIV.	Sufficient coal pillars shall be left unextracted around the air shaft (within the subsidence influence area) to protect from any damage from subsidence, if any.	Sufficient coal pillars have been left around air shafts as per the statutes and DGMS guidelines.
XXXV.	High root density tree species shall be selected and planted over areas likely to be affected by subsidence.	Identification of high root density Plant species and its plantation in subsidence prone area will be taken-up at the time of depillaring operations.
XXXVI.	Depression due to subsidence resulting in water accumulating within the low lying areas shall be filled up or drained out by cutting drains.	It shall be complied, where ever applicable.
XXXVII.	Solid barriers shall be left below the roads falling within the blocks to avoid any damage to the roads.	It is being followed. Sufficient barriers are left for saving the surface installation and infra structures as per the statute and DGMS guidelines.
XXXVIII.	No depillaring operation shall be carried out below the township/colony.	It is being followed.

XXXIX.	The Transportation Plan for conveyor-cum–rail for Cluster- X should be dovetailed with Jharia Action Plan. Road transportation of coal during Phase–I should be by mechanically covered trucks, which should be introduced at the earliest. The Plan for conveyor-cum–rail for Cluster-XIV should be dovetailed with Jharia Action Plan. The road transpiration of coal during phase–I should be by mechanically covered trucks.	Action has been taken for formulating the adequate transportation plan for conveyor cum rail system of dispatch. CMPDIL, RI-II has been requested to conduct study and prepare the plan in this regarding. By that time transportation is being done by covering vehicle with tarpaulin cover. Initiatives has been taken at corporate level of coal India Limited for developing the mechanically covered trucks and a vendor meeting for the same has been held with the OEM on dated 07.05.2016. Further, a proposal for inclusion of mechanically covered trucks in the Contract Terms has been initiated to ensure that the Outsourcing company should deploy Mechanically Covered Trucks for coal Transportation.
XL.	A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.	CMPDI is carrying out the study to analyze extent of reduction in pollution load every year by reducing road transport. Pollution load study report for Cluster IV, XIII, XIV and XVI have been submitted by CMPDI and reports for rest of the clusters (including cluster X) are awaited.
XLI.	R&R of 1670 nos of PAF's involved. They should be rehabilitated at cost of Rs 7087.75 Lakhs as per the approved Jharia Action Plan.	Implementation of master plan has already been started through Jharkhand Rehabilitation and Development Authority (JRDA), Dhanbad and 547 families (Non-BCCL) has been rehabilitated at well-established Jharia Vihar Township located at Belgoria.
XLII.	Details of transportation, CSR, R&R and implementation of environmental action plan for each of the 17 clusters should be brought out in a booklet for and submitted to Ministry.	A separate booklet comprising of CSR activities has been prepared and attached as annexure VI (B). Annexure VI (B) – Detail of CSR activity of Cluster X
XLIII.	A detailed CSR Action Plan shall be prepared for Cluster X group of mines. Specific activities shall be identified for CSR of Rs 20.25/annum @ of Rs 5/ton of coal production. As recurring expenditure. The 47.63 ha of area within Cluster XIV ML existing as waste land and not being acquired shall be put to productive use under CSR and developed with fruit bearing and other useful species for the local communities. Third party evaluation shall be got carried out regularly for the proper implementation of activities undertaken in the project area under CSR.	It being complied. BCCL is implementing CSR Activities. CSR action plan of BCCL for 2016-17 including CSR budget and expenditure during 2016-17 is enclosed as Annexure VI (A). A separate CSR committee has been formed at Area level of Bhowra for cluster-X, who will look after the works being executed under CSR. A booklet comprising of CSR activities conducted by E.J. area has been prepared and attached

	Issue raised in the Public Hearing shall also be integrated with activities being taken up under CSR. The details of CSR undertaken along with budgetary provisions for the village-wise various activities and expenditure thereon shall be uploaded on the company website every year. The company must give priority to capacity building both within the company and to the local youth, who are motivated to carry out the work in future.	as annexure VI (B) – Detail of CSR activity of Cluster X.
XLIV.	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. The Vegetation Cover Mapping of Jharia Coalfield based on Satellite Data of the Year- 2016 has been submitted by CMPDIL and attached as annexure VII. Annexure VII – Vegetation Cover Mapping of Jharia Coalfield based on Satellite Data of year 2016.
XLV.	A Final Mine Closure Plan along with details of Corpus Fund shall be submitted to the Ministry of Environment & Forests five year before mine closure for approval. Habitat Restoration Plan of the mine area shall be carried out using a mix of native species found in the original ecosystem, which were conserved in-situ and ex-situ in an identified area within the lease for reintroduction in the mine during mine reclamation and at the post mining stage for habitat restoration.	Mine closure plan as per the guidelines of Ministry of Coal has been prepared by CMPDI and it is being complied.
XLVI.	A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the Head of the company for implementing environment policy and socioeconomic 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 which includes Environment, Mining, Excavation, Civil executives and technicians has been established in Headquarters. They are also trained in ecological restoration, sustainable development, rainwater harvesting methods etc. At the project level, one Executive in each area has also been nominated as Project Nodal Officer (Environment) and is also entrusted with the responsibility of compliance and observance of the environmental acts/ laws including environment protection measures. The activities are monitored on regular basis at

		Area and at Head quarter levels. GM (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company. The team is multidisciplinary and very much motivated under the guidance of company's Director (Technical) and CMD. Further capacity building at both corporate and operating level is being done.
XLVII.	Implementation of final mine closure plan for Cluster X, subject to obtaining prior approval of the DGMS in regard to mine safety issues	Final Mine Closure Plan has been prepared for each Mine in this cluster. Before implementation of final mine closure plan, prior permission from DGMS has been taken in regard to mine safety issues.
XLVIII.	Corporate Environment Responsibility: A. The Company shall have a well laid down Environment Policy approved by the Board of Directors. B. The Environment Policy shall prescribe for standard operating process/procedures to bring into focus any infringements/deviation/violation of the environmental or forest norms/conditions. C. The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions shall be furnished. D. To have proper checks and balances, the company shall have a well laid down system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the company and/or shareholders or stakeholders at large.	A well-defined Corporate Environment Policy has already been laid down and approved by the Board of Directors. This is also posted on BCCL website. Complied. A hierarchical system of the company to deal with environmental issues from corporate level to mine level already exists. Being complied.
B.	**General Conditions by MOEF:**	
I.	No change in mining technology and scope of working shall be made without prior approval of the Ministry of Environment and Forests.	Being complied.
II.	No change in the calendar plan of production for quantum of mineral coal shall be made	Being followed. Production is being done well within production capacity of this cluster 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	The optimum location of monitoring stations in Jharia Coal Field finalized in consultation with the Jharkhand State Pollution Control Board. Ambient air quality is being regularly monitored by

	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.	CMPDIL. Annexure VIII – Environmental Monitoring Report for cluster X.
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.	Ambient air quality data (PM10, PM2.5, SO2 and NOx) and other monitoring data have been regularly monitored and analyzed by CMPDIL and submitted the report, which is attached. Annexure VIII – Environmental Monitoring Report for cluster X.
V.	Adequate measures shall be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in blasting and drilling operations, operation of HEMM, etc shall be provided with ear plugs/muffs.	It is being complied in mines and also the Noise levels are below the Ambient Noise Standard (Day time 75 dB & Night Time (70 dB for Industrial Area). However, ear muffs / ear plugs are provided to the workers engaged in blasting and drilling operations, HEMM operations etc.
VI.	Industrial wastewater (workshop and wastewater from the mine) shall be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May 1993 and 31st December 1993 or as amended from time to time before discharge. Oil and grease trap shall be installed before discharge of workshop effluents.	The optimum location of monitoring stations in Jharia Coal Field finalized in consultation with the Jharkhand State Pollution Control Board. Mine water & ground water quality is being regularly monitored by CMPDIL. Physico-Chemical characteristics of effluents are well within the prescribed limit. For installation of oil and grease trap, a proposal has been moved to CMPDIL through HQ coordination.
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.	Vehicular emissions are being under control and the pollution control certificate issued by state pollution control board is also provided to vehicles which are verified by area manager (transport) and area manger (E&M) regularly. All the vehicles used for coal transportation are covered with tarpaulins.
VIII.	Monitoring of environmental quality parameters shall be carried out through establishment of adequate number and type of pollution monitoring and analysis equipment in consultation with the State Pollution Control Board and data got analysed through a laboratory recognized under EPA Rules, 1986.	Monitoring of Environmental quality parameters have been regularly done by CMPDIL with proper analysis equipment.
IX.	Personnel working in dusty areas shall wear protective respiratory devices and they shall also be	It is being complied. All Personnel working in mines are provided with reparatory

	provided with adequate training and information on safety and health aspects.	masks and safety eyeglass to protect the dust inhalation. A separate full-fledged Human Resource Development Department is conducting regular training programme on these issues. Apart from this, Vocational Training Center exist in E.J. area (cluster X), which provides periodical training on the safety and occupational health issue to 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 and records maintained thereof. The quality of environment due to outsourcing and the health and safety issues of the outsourced manpower should be addressed by the company while outsourcing.	Initial Medical Examination (IME) and Periodical Medical Examination (PME) of all the personnel are carried out as per the Statutes and Director General of Mines Safety (DGMS) guideline. Annexure IX – List of IME and PME of cluster X (EJ Area) for 2016-17.
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 a HoD (Environment) along with a suitable qualified multidisciplinary team of executives which includes Environment, Mining, Excavation, Civil executives and technicians has been established in Headquarters. They are also trained in ecological restoration, sustainable development, rainwater harvesting methods etc. At the project level, one Executive in each area has also been nominated as Project Nodal Officer (Environment) and is also entrusted with the responsibility of compliance and observance of the environmental Acts/Laws including environment protection measures .The activities are monitored on regular basis at Area and at Headquarters levels. GM (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company. The team is multidisciplinary and very much motivated under the guidance of company's Director (Technical) and CMD. Further capacity building at both corporate and operating level is being done.
XII.	The funds earmarked for environmental protection measures shall be kept in separate account and shall	It is being complied.

	not be diverted for other purpose. Year-wise expenditure shall be reported to this Ministry and its Regional Office at Bhubaneswar.	
XIII.	The Project authorities shall advertise at least in two local newspapers widely circulated around the project, one of which shall be in the vernacular language of the locality concerned within seven days of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution control Board and may also be seen at the website of the ministry of Environment & Forests at http://envfor.nic.in.	It has been complied. Advertisement in local newspaper has also been done.
XIV.	A copy of the environmental clearance letter shall be marked to concern Panchayat/Zila Parishad, Municipal corporation or Urban local body and local NGO, if any, from whom any suggestion /representation has been received while processing the proposal. A copy of the clearance letter shall also be displayed on company's website.	Complied.
XV.	A copy of the environmental clearance letter shall be shall also be displayed on the website of the concerned State Pollution Control Board. The EC letter shall also be displayed at the Regional Office, District Industry Sector and Collector's Office/Tehsildar's Office for 30 days.	Complied.
XVI.	The clearance letter shall be uploaded on the company's website. The compliance status of the stipulated environmental clearance conditions shall also be uploaded by the project authorities on their website and updated at least once every six months so as to bring the same in public domain. The monitoring data of environmental quality parameter (air, water, noise and soil) and critical pollutant such as PM10, PM2.5, SO2 and NOx (ambient) and critical sectoral parameters shall also be displayed at the entrance of the project premises and mine office and in corporate office and on company's website.	Complied. The clearance letter has been uploaded on the BCCL website.
XVII.	The project proponent shall submit six monthly compliance reports on status of compliance of the stipulated environmental clearance conditions (both in hard copy and in e-mail) to the respective Regional Office of the Ministry, respective Zonal Offices of CPCB and the SPCB.	Being complied.
XVIII.	The Regional Office of this Ministry located at Bhubaneswar shall monitor compliance of the stipulated conditions. The Project authorities shall extend full cooperation to the office(s) of the Regional	Project authority is ready to extend its full cooperation for any kind of visit and inspection conducted by Regional Office in connection with EC Conditions

	Office by furnishing the requisite data/ information/monitoring reports.	Compliance.
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.	Environmental Statement (Form-V) has been regularly submitted for each financial year to Jharkhand State Pollution Control Board. Annexure X – Environmental statement (Form-V) of projects/collieries of E.J. Area attached.
C.	**Other Conditions by MOEF:**	
i.	The Ministry or any other Competent Authority may stipulate any further condition(s) for environmental protection.	Agreed.
ii.	Failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract the provisions of the Environment (Protection) Act, 1986.	Agreed.
iii.	The above conditions will be enforced inter-alia, under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and Rules. The Proponent shall ensure to undertake and provide for the costs incurred for taking up remedial measures in case of soil contamination, contamination of groundwater and surface water, and occupational and other diseases due to the mining operations.	It is being complied.
iv.	The Environmental Clearance is subject to the outcome of the Writ Petition filed by M/S Bharat Coking Coal Limited (BCCL) in response to the closure orders issued by the Jharkhand State Pollution Control Board which is pending in the Jharkhand High Court.	Agreed.

23/11/17
Area Manager (Env.)
EJ Area

Project Officer
Bhowra (North),
EJ Area

Project Officer
Bhowra (South),
EJ Area

24.11.17
Project Officer
ASP,
EJ Area

Project Officer
Amlabad,
EJ Area

25.11.17
Addl. General Manager
EJ Area, BCCL
Cluster X

25/11/17
General Manager
EJ Area, BCCL
Cluster X

ANNEXURE - I

Plantation Data of BCCL (Project wise)

S No	Name of the Area	Name of unit/Colliery	Afforestation/plantation by DFO		Ecological Restoration		Gabion plantation by DFO	Total Plantation area (ha)	Total Plantation (nos)
			Area (Ha)	No of Plants	Area (Ha)	No of Plants			
		Damoda (Mix)			7	31500		7	31500
		Muraidih OCP	183.71	565933	53.65	26645		237.36	592578
1	Barora	Phularitand	60	194730	2.5	7700	1000	62.5	203430
2	Block-II	Amalgamated Block-II OCP (ABOCP)	15	37500	10.8	27000	570	25.8	65070
		Maheshpur Colliery	6	15000			250	6	15250
		South Govindpur Colliery	20	50000				20	50000
		New Akashkinaree Mixed	12	30000	13.5	33750		25.5	63750
3	Govinpur	Kharkharee	14	35000				14	35000
		AKWMC	17.08	9075	6.42	16050	1685	23.5	26810
		Katras Choutdih	2	1060				2	1060
		salanpur	1	530				1	530
4	Katras	Gashitand	1	530				1	530
		Nichitpur OC Mine	5	10000	2.8	7000	1320	7.8	18320
		Tetulmari Colliery	5	10000	10.3	25750		15.3	35750
		Mudidih Colliery	5	10000				5	10000
		Sendra Bansjore Colliery	10	20000				10	20000
		Loyabad UG Mine	40	80000				40	80000
		Bansdeopur Colliery	5	10000				5	10000
5	Sijua	Kankanee Colliery	3	6000				3	6000
		East Bassuriya Colliery	19.5	39000				19.5	39000
6	Kusunda	Gondudih Khas kusunda (GKKC)	10.5	21000	6.79	16975	500	17.29	38475
		Burragarh	5	6035	7	42000	1390	12	49425
		Simlabahal	3	3621				3	3621
		Hurriladih	3	3621				3	3621
		Kustore	3	3624				3	3624
		Kachhu Balihari 10/12 Pit	5	6035				5	6035
7	PB	PB Project	2	2414				2	2414
		South Jharia/ Rajapur OCP			12	30000	500	12	30500
		East Bhuggatdih	29.5	59000				29.5	59000
		Bastacolla	10.8	21600				10.8	21600
		Bera			7.67	19175		7.67	19175
		Dobari	10	20000				10	20000
8	Bastacolla	Golurkdih	9.7	19400				9.7	19400

S No	Name of the Area	Name of unit/Colliery	Afforestation/plantation by DFO		Ecological Restoration		Gabion plantation by DFO	Total Plantation area (ha)	Total Plantation (nos)
			Area (Ha)	No of Plants	Area (Ha)	No of Plants			
		Kujama	20	40000			1848	20	41848
		Lodna	8	16000				8	16000
		NT/ST			15	37500		15	37500
		Jealgora	5	10000				5	10000
		Bagdigi	10	20000				10	20000
		Joyrampur	10	20000				10	20000
9	Lodna	Bararee	7	14000				7	14000
		Bhowrah North	10	12000	5.2	13000	2500	15.2	27500
		Bhowrah South			8.73	21825		8.73	21825
		Patherdih Mix	10	12000	5.71	14275		15.71	26275
		Sudamdih	70	84000				70	84000
10	EJ	Amlabad	10	12000				10	12000
		Moonidih	130	215000				130	215000
		Murulidih	20	20000	7.5	18750		27.5	38750
		Murulidih 20/21 Pit	10	10000				10	10000
		Bhurungiya	20	20000				20	20000
		Muchraidih	20	20000				20	20000
		Hantoodih	15	15000				15	15000
		Padugora	15	15000				15	15000
		Bhatdee	20	20000				20	20000
11	WJ	Lohapatti	10	10000				10	10000
		Damagoria	14.5	44515			7300	14.5	51815
		Jhurkundar	46	141235	5.6	15241		51.6	156476
12	CV	NL OCP			16.5	9879		16.5	9879
		Koyla Nagar	10.5	12600			4450	10.5	17050
		Jagjivan Nagar	3.4	4080				3.4	4080
		Washery division	35	110250			125	35	110375
		CCWO Colony	2.6	3120				2.6	3120
13	Others	Bhuli Township	8.9	10680				8.9	10680
		TOTAL	1056.69	2202188	204.67	414015	23438	1261.36	2639641

Detail of Ecological Restoration of E.J. Area as on 30th Sept., 2017									
Area/ Colliery		Site Name	Area (Ha)	Taken up in	Plantation (Nos)				
					2014-15	2015-16	2016-17	2017-18 as on 30th Sept. 2017	**Total**
Bh (N)		Bh N / BLA OB site	5.20	2016-17	-	-	13000	4810	**17810**
Bh (S)		3 Pit OB site	4.78	2014-15	12189		1000	3040	**16229**
ASP Colliery	Patherdih Mix	COCP / Vrindavan Site	5.71	2015-16	-	6125	8150	4650	**18925**
		Kamini Kalyan Herbal garden	3.32	1980 (old)	375 (planted before 2014)	-	40	50	**465**
	Sudamdih	Mohalbani Site	3.95	2014-15	10874		1000	1950	**13824**
		Sudamdih Incline / Gosaithan Site	3.10	2017-18	-	-	-	5925	**5925**
Amlabad		-	-	-	-	-	-		-
E.J. Area			**26.06**		**23063**	**6125**	**23190**	**20425**	**73178**

ANNEXURE - II

भारत कोकिंग कोल लिमिटेड
एक मिनीरत्न कंपनी
(कोल इंडिया लिमिटेड का एक अंग)
पंजीक्रत कार्यालय कोयला भवन ,कोयला नगर ,
(धनबाद)झारखंड826005(
CIN:U10101JH1972GOI000918
Tele: 0326 2230174 FAX: 0326 2230176
ईमेल :cgmsafety@bccl.gov.in

Bharat Coking Coal Limited
A Miniratna Company
(A subsidiary of Coal India Ltd)
Office of GM I/C(S&R)
Koyla Bhawan, Koyla Nagar,
Dhanbad, Jharkhand-826005
CIN:U10101JH1972GOI000918
Tele: 0326 2230174 FAX: 0326 2230176 Email: cgmsafety@bccl.gov.in

पत्र संख्या भाकोकोलि/उप महाप्रबंधक(एस&आर)I/C/संचिका-MP/17 323 दिनांक-:07.04.2017

To,
Dr, Vinod Kumar,
Group Head, Geosciences group
National Remote Sensing Center
India Space Research Organization
Dept of Space, Govt of India,
Balanagar, Hyderabad - 500037

Sub:- Work –Order for " Delineation of Surface Coal Fire and associated Land Subsidence in Jharia Coalfield, Jharkhand using satellite based remote – sensing techniques"

Dear Sir,

Consequent upon competent approval of proposal on aforesaid subject and subsequent signing o MOU between BCCL and NRSC, the aforesaid work is awarded to NRSC for Rs.18,10500/- (Eighteen lac ten thousand five hundred) only, against 100% payment in advance subject to terms and conditions listed in MOU. As per agreed payment terms and Demand Note No. 07/2016-17,

You are therefore requested to initiate all necessary activities for commencing the subject work as early as possible.

Thanking you,

Yours faithfully,

7/4/17

General Manager I/C (S & R)

Cc to :
1. Director (T) P&P, BCCL- for kind information.
2. TS to CMD, BCCL – for kind information.
3. Sri Mithilesh Kumar, Sr.Mgr.(M),Safety.Deptt., KoylaBhawan

ANNEXURE - III

COAL / OB PROGRAMME 2017-18.

YEARLY PRODUCTION PROGRAMME - UNIT-WISE, SEAM WISE, GRADE WISE, MONTH-WISE FOR THE YEAR 2017-2018.

Area- EJ Area — **Coal : 7.00 LTe.** — **OB : 42.00 LM3**

Year 2017-18																		(Coal in tonnes/ OB in cu.m.)	
Mine	Seam	Grade	Target 2017-18	Apr	May	Jun	1st Qtr.	Jul	Aug	Sep	2nd Qtr	Oct	Nov	Dec	3rd Qtr	Jan	Feb	Mar	4th Qtr	Total
Underground(Dept.)																				
Bhowra N	V	W-II	25600	2304	2304	2304	6912	1963	1963	1962	5888	2048	2048	2048	6144	2219	2218	2219	6656	25600
Bhowra S	IV (T)	W- IV	24200	2178	2178	2178	6534	1856	1855	1855	5566	1936	1936	1936	5808	2097	2097	2098	6292	24200
A/Total-U/G		Coal Prod.	49800	4482	4482	4482	13446	3819	3818	3817	11454	3984	3984	3984	11952	4316	4315	4317	12948	49800
Opencast (Dept.)																				
COCP	IB	W-III	20000	1800	1800	1800	5400	1534	1533	1533	4600	1600	1600	1600	4800	1733	1732	1734	5200	20000
	IT / IM	W-IV	22500	2025	2025	2025	6075	1725	1725	1725	5175	1800	1800	1800	5400	1950	1950	1950	5850	22500
	II	W-IV	10000	900	900	900	2700	767	767	766	2300	800	800	800	2400	867	866	867	2600	10000
		Coal	52500	4725	4725	4725	14175	4026	4025	4024	12075	4200	4200	4200	12600	4550	4548	4551	13650	52500
		OB	150000	13500	13500	13500	40500	11500	11500	11500	34500	12000	12000	12000	36000	13000	13000	13000	39000	150000
A/Total-O/C		Coal	52500	4725	4725	4725	14175	4026	4025	4024	12075	4200	4200	4200	12600	4550	4548	4551	13650	52500
		OB	150000	13500	13500	13500	40500	11500	11500	11500	34500	12000	12000	12000	36000	13000	13000	13000	39000	150000
A/G. Total Dept. (O/C + U/G)		Coal	102300	9207	9207	9207	27621	7845	7843	7841	23529	8184	8184	8184	24552	8866	8863	8868	26598	102300
		OB	150000	13500	13500	13500	40500	11500	11500	11500	34500	12000	12000	12000	36000	13000	13000	13000	39000	150000
Hired O.C.P.																				
3pit West	IX / X	W-II	175000	15750	15750	15750	47250	13417	13417	13416	40250	14000	14000	14000	42000	15167	15166	15167	45500	175000
	XI / XII	W-II	148700	13383	13383	13383	40149	11401	11400	11400	34201	11896	11896	11896	35688	12887	12887	12888	38662	148700
	XIII	W-II	100000	9000	9000	9000	27000	7667	7667	7666	23000	8000	8000	8000	24000	8667	8666	8667	26000	100000
		Coal	423700	38133	38133	38133	114399	32485	32484	32482	97451	33896	33896	33896	101688	36721	36719	36722	110162	423700
		OB	3120000	280800	280800	280800	842400	239200	239200	239200	717600	249600	249600	249600	748800	270400	270400	270400	811200	3120000
X-patch	IV / IVB	W-IV	160000	14400	14400	14400	43200	12267	12267	12266	36800	12800	12800	12800	38400	13867	13866	13867	41600	160000
	VI	W-IV	14000	1260	1260	1260	3780	1074	1073	1073	3220	1120	1120	1120	3360	1214	1213	1213	3640	14000
		Coal	174000	15660	15660	15660	46980	13341	13340	13339	40020	13920	13920	13920	41760	15081	15079	15080	45240	174000
		OB	930000	83700	83700	83700	251100	71300	71300	71300	213900	74400	74400	74400	223200	80600	80600	80600	241800	930000
A/Total (Hired OCP)		Coal	597700	53793	53793	53793	161379	45826	45824	45821	137471	47816	47816	47816	143448	51802	51798	51802	155402	597700
		OB	4050000	364500	364500	364500	1093500	310500	310500	310500	931500	324000	324000	324000	972000	351000	351000	351000	1053000	4050000
Departmental + Hired OCP																				
Area Total (Dept+O/S)		Coal	700000	63000	63000	63000	189000	53671	53667	53662	161000	56000	56000	56000	168000	60668	60661	60670	182000	700000
		OB	4200000	378000	378000	378000	1134000	322000	322000	322000	966000	336000	336000	336000	1008000	364000	364000	364000	1092000	4200000
QTRLY % (COAL)				27				23				24				26				

COAL /OB PROGRAMME 2016 - 2017

YEARLY PRODUCTION PROGRAMME - UNIT-WISE / MONTH-WISE FOR 2016- 2017

Coal : 6.50 LTe. **OB : 37.50 LM3**

Area- EJ Area																		
Year 2016-17													***(Coal in '000 tonnes/OB in '000 cu.m.)***					
Mine	**Grade**	**Apr**	**May**	**Jun**	**1st Qtr.**	**Jul**	**Aug**	**Sep**	**2nd Qtr**	**Oct**	**Nov**	**Dec**	**3rd Qtr**	**Jan**	**Feb**	**Mar**	**4th Qtr**	**Total**
Underground(Dept.)																		
Bhowra N	W-II	3.24	3.78	3.78	**10.80**	3.07	3.07	3.06	**9.20**	2.88	3.36	3.36	**9.60**	3.64	3.12	3.64	**10.40**	**40.00**
Bhowra S	W- III	2.42	2.84	2.84	**8.10**	2.30	2.30	2.30	**6.90**	2.16	2.52	2.52	**7.20**	2.73	2.34	2.73	**7.80**	**30.00**
ASP	W-IV	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	**0.00**
Bhutgoria	W-IV	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	**0.00**
A/Total-U/G	**Coal Prod.**	**5.66**	**6.62**	**6.62**	**18.90**	**5.37**	**5.37**	**5.36**	**16.10**	**5.04**	**5.88**	**5.88**	**16.80**	**6.37**	**5.46**	**6.37**	**18.20**	**70.00**
Opencast (Dept.)																		
COCP	W-IV	4.86	5.67	5.67	**16.20**	4.60	4.60	4.60	**13.80**	4.32	5.04	5.04	**14.40**	5.46	4.68	5.46	**15.60**	**60.00**
	OB	20.24	23.63	23.63	**67.50**	19.16	19.17	19.17	**57.50**	18.00	21.00	21.00	**60.00**	22.75	19.50	22.75	**65.00**	**250.00**
A/Total-O/C	**Coal**	**4.86**	**5.67**	**5.67**	**16.20**	**4.60**	**4.60**	**4.60**	**13.80**	**4.32**	**5.04**	**5.04**	**14.40**	**5.46**	**4.68**	**5.46**	**15.60**	**60.00**
	OB	**20.24**	**23.63**	**23.63**	**67.50**	**19.16**	**19.17**	**19.17**	**57.50**	**18.00**	**21.00**	**21.00**	**60.00**	**22.75**	**19.50**	**22.75**	**65.00**	**250.00**
A/G.Total (O/C + U/G)	**Coal**	**10.52**	**12.29**	**12.29**	**35.10**	**9.97**	**9.97**	**9.96**	**29.90**	**9.36**	**10.92**	**10.92**	**31.20**	**11.83**	**10.14**	**11.83**	**33.80**	**130.00**
	OB	**20.24**	**23.63**	**23.63**	**67.50**	**19.16**	**19.17**	**19.17**	**57.50**	**18.00**	**21.00**	**21.00**	**60.00**	**22.75**	**19.50**	**22.75**	**65.00**	**250.00**
Hired O.C.P.																		
C-1 Patch	ST-II	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	**0.00**
	OB	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	**0.00**	**0.00**
3pit West	**W-I**				**0.00**				**0.00**				**0.00**				**0.00**	**0.00**
	W-II	25.92	30.24	30.24	**86.40**	24.54	24.53	24.53	**73.60**	23.04	26.88	26.88	**76.80**	29.12	24.96	29.12	**83.20**	**320.00**
	OB	162.00	189.00	189.00	**540.00**	153.33	153.33	153.34	**460.00**	144.00	168.00	168.00	**480.00**	182.00	156.00	182.00	**520.00**	**2000.00**
X-patch	W-IV	16.20	18.90	18.90	**54.00**	15.34	15.33	15.33	**46.00**	14.40	16.80	16.80	**48.00**	18.20	15.60	18.20	**52.00**	**200.00**
	OB	121.50	141.75	141.75	**405.00**	115.00	115.00	115.00	**345.00**	108.00	126.00	126.00	**360.00**	136.50	117.00	136.50	**390.00**	**1500.00**
A/Total (Hired OCP)	**Coal**	**42.12**	**49.14**	**49.14**	**140.40**	**39.88**	**39.86**	**39.86**	**119.60**	**37.44**	**43.68**	**43.68**	**124.80**	**47.32**	**40.56**	**47.32**	**135.20**	**520.00**
	OB	**283.50**	**330.75**	**330.75**	**945.00**	**268.33**	**268.33**	**268.34**	**805.00**	**252.00**	**294.00**	**294.00**	**840.00**	**318.50**	**273.00**	**318.50**	**910.00**	**3500.00**
Departmental + Hired OCP																		
Area Total (Dept+O/S)	**Coal**	**52.64**	**61.43**	**61.43**	**175.50**	**49.85**	**49.83**	**49.82**	**149.50**	**46.80**	**54.60**	**54.60**	**156.00**	**59.15**	**50.70**	**59.15**	**169.00**	**650.00**
	OB	**303.74**	**354.38**	**354.38**	**1012.50**	**287.49**	**287.50**	**287.51**	**862.50**	**270.00**	**315.00**	**315.00**	**900.00**	**341.25**	**292.50**	**341.25**	**975.00**	**3750.00**
QTRLY % (COAL)		27				23				24				26				

COAL /OB PROGRAMME 2015 - 2016

YEARLY PRODUCTION PROGRAMME - UNIT-WISE / MONTH-WISE FOR 2015 - 2016

Coal : 5.28 LTe. **OB : 33.15 LM3**

Area- EJ Area

Year 2015-16 *(Coal in '000 tonnes/OB in '000 cu.m.)*

Mine	Grade	Apr	May	Jun	1st Qtr.	Jul	Aug	Sep	2nd Qtr	Oct	Nov	Dec	3rd Qtr	Jan	Feb	Mar	4th Qtr	Total
Underground(Dept.)																		
Bhowra N	W-II	3.00	3.00	3.00	9.00	3.50	3.50	3.50	10.50	3.50	3.50	3.50	10.50	3.50	3.00	3.50	10.00	40.00
Bhowra S	W- III	2.50	2.50	2.50	7.50	2.50	2.50	2.50	7.50	2.50	2.50	2.50	7.50	2.50	2.50	2.50	7.50	30.00
ASP	W-IV	3.00	3.00	3.00	9.00	3.00	3.00	3.00	9.00	2.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	20.00
Bhutgoria	W-IV	5.00	5.00	5.00	15.00	5.00	5.00	5.00	15.00	5.00	5.00	5.00	15.00	5.00	5.00	5.00	15.00	60.00
A/Total-U/G	**Coal Prod.**	**13.50**	**13.50**	**13.50**	40.50	**14.00**	**14.00**	**14.00**	42.00	**13.00**	**11.00**	**11.00**	35.00	**11.00**	**10.50**	**11.00**	32.50	150.00
Opencast (Dept.)																		
COCP	W-IV	5.00	5.00	5.00	15.00	5.00	5.00	5.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00
	OB	15.00	15.00	15.00	45.00	15.00	15.00	15.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00
BLA Patch	ST-II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	OB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A/Total-O/C	**Coal**	**5.00**	**5.00**	**5.00**	15.00	**5.00**	**5.00**	**5.00**	15.00	**0.00**	**0.00**	**0.00**	0.00	**0.00**	**0.00**	**0.00**	0.00	30.00
	OB	**15.00**	**15.00**	**15.00**	45.00	**15.00**	**15.00**	**15.00**	45.00	**0.00**	**0.00**	**0.00**	0.00	**0.00**	**0.00**	**0.00**	0.00	90.00
A/G.Total (O/C + U/G)	**Coal**	**18.50**	**18.50**	**18.50**	55.50	**19.00**	**19.00**	**19.00**	57.00	**13.00**	**11.00**	**11.00**	35.00	**11.00**	**10.50**	**11.00**	32.50	180.00
	OB	**15.00**	**15.00**	**15.00**	45.00	**15.00**	**15.00**	**15.00**	45.00	**0.00**	**0.00**	**0.00**	0.00	**0.00**	**0.00**	**0.00**	0.00	90.00
Hired O.C.P.																		
C-1 Patch	ST-II	9.00	9.00	9.00	27.00	8.00	8.00	8.00	24.00	9.00	9.00	9.00	27.00	10.00	8.00	9.00	27.00	105.00
	OB	60.00	60.00	60.00	180.00	65.00	65.00	65.00	195.00	65.00	65.00	65.00	195.00	60.00	60.00	60.00	180.00	750.00
3pit West	**W-I**	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00	2.00	6.00	2.00	2.00	2.00	6.00	14.00
	W-II	10.00	10.00	10.00	30.00	12.00	12.00	10.00	34.00	12.00	11.00	11.00	34.00	11.00	11.00	11.00	33.00	131.00
	OB	100.00	100.00	100.00	300.00	110.00	110.00	110.00	330.00	110.00	110.00	110.00	330.00	100.00	100.00	100.00	300.00	1260.00
X-patch	W-IV	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	3.00	10.00	15.00	28.00	22.00	22.00	25.00	69.00	98.00
	OB	0.00	0.00	0.00	0.00	0.00	0.80	170.00	170.80	170.00	175.00	175.00	520.00	175.00	175.00	175.00	525.00	1215.80
A/Total (Hired OCP)	**Coal**	**19.00**	**19.00**	**19.00**	57.00	**20.00**	**20.00**	**21.00**	61.00	**26.00**	**32.00**	**37.00**	95.00	**45.00**	**43.00**	**47.00**	135.00	348.00
	OB	**160.00**	**160.00**	**160.00**	480.00	**175.00**	**175.80**	**345.00**	695.80	**345.00**	**350.00**	**350.00**	1045.00	**335.00**	**335.00**	**335.00**	1005.00	3225.80
Departmental + Hired OCP																		
Area Total (Dept+O/S)	**Coal**	**37.50**	**37.50**	**37.50**	112.50	**39.00**	**39.00**	**40.00**	118.00	**39.00**	**43.00**	**48.00**	130.00	**56.00**	**53.50**	**58.00**	167.50	528.00
	OB	**175.00**	**175.00**	**175.00**	525.00	**190.00**	**190.80**	**360.00**	740.80	**345.00**	**350.00**	**350.00**	1045.00	**335.00**	**335.00**	**335.00**	1005.00	3315.80
QTRLY % (COAL)		21				22				25				32				

EASTERN JHARIA AREA - BHOWRA
PRODUCTION PERFORMANCE 2017-18

UNIT	YEAR	APRIL	MAY	JUN	JULY	AUG	SEPT	Total
Bhowra (South) UG	Tar 2017-18	2178	2178	2178	1856	1855	1855	12100
	Actual	1220	1418	1163	870	1109	835	6615
Bhowra(North) UG	Tar 2017-18	2304	2304	2304	1963	1963	1962	12800
	Actual	1362	1484	1351	1346	1105	994	7642
Deptt. UG Total	Tar 2017-18	4482	4482	4482	3819	3818	3817	24900
	Actual	2582	2902	2514	2216	2214	1829	14257
COCP(Path)	Tar 2017-18	4725	4725	4725	4026	4025	4024	26250
	Actual	70	0	910	686	3052	4256	8974
3 PIT West (A.T.)	Tar 2017-18	38133	38133	38133	32485	32484	32482	211850
	Actual	42224	41734	45248	35686	38340	41006	244238
X-Patch.	Tar 2017-18	15660	15660	15660	13341	13340	13339	87000
	Actual	20784	24432	18300	11760	15096	5700	96072
Dept Coal Total	Tar 2017-18	9207	9207	9207	7845	7843	7841	51150
	Actual	2652	2902	3424	2902	5266	6085	23231
Hired Coal Total	Tar 2017-18	53793	53793	53793	45826	45824	45821	298850
	Actual	63008	66166	63548	47446	53436	46706	340310
Total Coal	Tar 2017-18	63000	63000	63000	53671	53667	53662	350000
	Actual	65660	69068	66972	50348	58702	52791	363541

EASTERN JHARIA AREA - BHOWRA

O.B.R. PERFORMANCE 2017-18.

UNITS		APRIL	MAY	JUN	JULY	AUG	SEPT	Total
COCP(Patherdih)	Tar 2017-18	18900	18900	18900	16100	16100	11500	100400
	Actual	5343	1188	4295	2436	2050	4020	19332.00
Dept.O/C Total.	Tar 2017-18	18900	18900	18900	16100	16100	11500	100400
	Actual	5343	1188	4295	2436	2050	4020	19332.00
3 PIT West (A.T.)	Tar 2017-18	266931	266931	266931	227386	227385	239200	1494764
	Actual	398013.29	369313.59	349345.44	274656.88	323620.36	272673.80	1987623.36
X-Patch.	Tar 2017-18	109620	109620	109620	93380	93380	71300	586920
	Actual	109617.90	120953.15	108570.70	68815.78	73034.78	23458.10	504450.41
Total Hired HEMM	Tar 2017-18	376551.00	376551.00	376551.00	320766.00	320765.00	310500.00	2081684
	Actual	507631.19	490266.74	457916.14	343472.66	396655.14	296131.90	2492073.77
Grand Total	Tar 2017-18	395451.00	395451.00	395451.00	336866.00	336865.00	322000.00	2182084
	Actual	512974.19	491454.74	462211.14	345908.66	398705.14	300151.90	2511405.77

EASTERN JHARIA AREA - BHOWRA

PRODUCTION PERFORMANCE 2016-17

UNIT	YEAR	APRIL	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC.	JAN	FEB	MAR	Total
Bhowra (South) UG	Tar-16-17	2420	2840	2840	2300	2300	2300	2160	2520	2520	2730	2340	2730	30000
	Actual	2810	2302	2023	1767	1833	1541	1539	1845	1768	1649	1354	1243	21674
Bhowra(North) UG	Tar-16-17	3240	3780	3780	3070	3070	3060	2880	3360	3360	3640	3120	3640	40000
	Actual	2472	2193	2077	1985	2039	1976	1778	2047	1978	1816	1740	1241	23342
A.S.P(Incline)	Tar-16-17	0	0	0	0	0	0	0	0	0	0	0	0	0
	Actual	0	0	0	0	0	0	0	0	0	0	0	0	0
Deptt. UG Total	**Tar-16-17**	**5660**	**6620**	**6620**	**5370**	**5370**	**5360**	**5040**	**5880**	**5880**	**6370**	**5460**	**6370**	**70000**
	Actual	**5282**	**4495**	**4100**	**3752**	**3872**	**3517**	**3317**	**3892**	**3746**	**3465**	**3094**	**2484**	**45016**
COCP(Path)	Tar-16-17	4860	5670	5670	4600	4600	4600	4320	5040	5040	5460	4680	5460	60000
	Actual	1554	2968	4242	2268	448	210	1666	2520	3122	5306	3808	16926	45038
Dept.O/C Total.	**Tar-16-17**	**4860**	**5670**	**5670**	**4600**	**4600**	**4600**	**4320**	**5040**	**5040**	**5460**	**4680**	**5460**	**60000**
	Actual	**1554**	**2968**	**4242**	**2268**	**448**	**210**	**1666**	**2520**	**3122**	**5306**	**3808**	**16926**	**45038**
New C 1 Bh(N)	Tar-16-17	0	0	0	0	0	0	0	0	0	0	0	0	0
	Actual	0	0	0	0	0	0	0	0	0	0	0	0	0
3 PIT West (A.T.)	Tar-16-17	25920	30240	30240	24540	24530	24530	23040	26880	26880	29120	24960	29120	320000
	Actual	28980	32970	33754	31934	29400	30954	37408	32858	38458	45752	34426	36428	413322
X-Patch.	Tar-16-17	16200	18900	18900	15340	15330	15330	14400	16800	16800	18200	15600	18200	200000
	Actual	19188	17928	17952	16452	16320	15672	17616	19740	20196	21228	20496	18840	221628
Total Hired HHEMM	**Tar-16-17**	**42120**	**49140**	**49140**	**39880**	**39860**	**39860**	**37440**	**43680**	**43680**	**47320**	**40560**	**47320**	**520000**
OCP	**Actual**	**48168**	**50898**	**51706**	**48386**	**45720**	**46626**	**55024**	**52598**	**58654**	**66980**	**54922**	**55268**	**634950**
Deptt. Coal Total	**Tar-16-17**	**10520**	**12290**	**12290**	**9970**	**9970**	**9960**	**9360**	**10920**	**10920**	**11830**	**10140**	**11830**	**130000**
	Actual	**6836**	**7463**	**8342**	**6020**	**4320**	**3727**	**4983**	**6412**	**6868**	**8771**	**6902**	**19410**	**90054**
Area Total	**Tar-16-17**	**52640**	**61430**	**61430**	**49850**	**49830**	**49820**	**46800**	**54600**	**54600**	**59150**	**50700**	**59150**	**650000**
	Actual	**55004**	**58361**	**60048**	**54406**	**50040**	**50353**	**60007**	**59010**	**65522**	**75751**	**61824**	**74678**	**725004**

EASTERN JHARIA AREA - BHOWRA

O.B.R. PERFORMANCE 2016-17.

UNITS		APRIL	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC.	JAN	FEB	MAR	Total
COCP(Patherdih)	Tar-16-17	20240	23630	23630	19160	19170	19170	18000	21000	21000	22750	19500	22750	250000
	Actual	5254	6830	6929	4759	3607	7898	6469	4859	5931	4654	6316	2589	66095.00
Dept.BH(N)	Tar-16-17	0	0	0	0	0	0	0	0	0	0	0	0	0
XV/XIVA	Actual	0	0	0	0	0	0	0	0	0	0	0	0	0.00
Dept.O/C Total.	**Tar-16-17**	**20240**	**23630**	**23630**	**19160**	**19170**	**19170**	**18000**	**21000**	**21000**	**22750**	**19500**	**22750**	**250000**
	Actual	**5254.00**	**6830.00**	**6929.00**	**4759.00**	**3607.00**	**7898.00**	**6469.00**	**4859.00**	**5931.00**	**4654.00**	**6316.00**	**2589.00**	**66095.00**
Hired HEMM - C1	Tar-16-17	0	0	0	0	0	0	0	0	0	0	0	0	0
	Actual	0	0	0	0	0	0	0	0	0	0	0	0	0.00
3 PIT West (A.T.)	Tar-16-17	162000	189000	189000	153330	153330	153340	144000	168000	168000	182000	156000	182000	2000000
	Actual	291993.46	402447.13	389938.18	371954.45	333370.48	321808	374595.89	398000.69	428999.79	402707.87	405514.34	401082.89	4522413.17
Hired HEMM	Tar-16-17	121500	141750	141750	115000	124730	115000	108000	126000	126000	136500	117000	136500	1509730
X-Patch.	Actual	175868.81	167306.25	155114.85	103181.29	109895.08	77586.63	117857.85	118430.25	96310.40	74236.23	137954.00	102617.53	1436359.17
Total Hired HEMM	**Tar-16-17**	**283500.00**	**330750.00**	**330750.00**	**268330.00**	**278060.00**	**268340.00**	**252000.00**	**294000.00**	**294000.00**	**318500.00**	**273000.00**	**318500.00**	**3509730**
	Actual	**467862.27**	**569753.38**	**545053.03**	**475135.74**	**443265.56**	**399394.63**	**492453.74**	**516430.94**	**525310.19**	**476944.10**	**543468.34**	**503700.42**	**5958772.34**
Grand Total	**Tar-16-17**	**303740.00**	**354380.00**	**354380.00**	**287490.00**	**297230.00**	**287510.00**	**270000.00**	**315000.00**	**315000.00**	**341250.00**	**292500.00**	**341250.00**	**3759730**
	Actual	**473116.27**	**576583.38**	**551982.03**	**479894.74**	**446872.56**	**407292.63**	**498922.74**	**521289.94**	**531241.19**	**481598.10**	**549784.34**	**506289.42**	**6024867.34**

ANNEXURE - IV

WATER TREATMENT PLANT/ FILTER PLANT

UNDER CLUSTER X, BHARAT COKING COAL LIMITED, DHANBAD

In cluster X (under Eastern Jharia area), there is three nos. of Rapid Gravity Pressure Filter plant of total 1.72 MGD capacity, which is used for supply of water in nearby colonies, houses, quarters. After treatment and filtration, treated water is supplied to nearby residents both employees and non employees peoples.

Effluent analysis is monitored by CMPDIL quarterly and gives environment monitoring report regularly for cluster X of BCCL. This report includes the effluent analysis report, air quality monitoring report, surface & ground water report and noise monitoring report.

Detail of Water Treatment Plant/ Filter Plant in E.J. Area are given below:

Detail of Water Treatment Plant/ Filter Plant in E.J. Area					
S. No.	Location of source of water	Treatment method	Capacity (MGD)	In use (MGD)	Supply of water
1	Sudamdih	Rapid gravity filter	0.8	0.47	Sudamdih colony, Patherdih colony, Patherdih Basti, Patherdih Basti, Supkar Basti, Hattala basti, etc
2	Bhowra	Rapid gravity filter	0.66	0.39	Gaurkhuti, 12 no. basti, 13 no.basti, 35 no. basti; 6 no. dhowra, Manjhi Basti, Gandhi Nagar, 19 no. Basti upar, 19 no. Basti niche, etc.
3	Amlabad	Rapid gravity filter	0.26	0.02	Amlabad colony and nearby basti

Encl.: i. Effluent analysis/ Env. Monitoring report of Q.E. Dec.2016

ii. Photos of different filter plants under cluster X

WATER QUALITY DATA

(EFFLUENT WATER-FOUR PARAMETERS)

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

Year : **2016-17.**

Name of the Cluster: **Cluster - X**

Month: **October, 2016.**

Name of the Stations & Code :

1. MW10- Mine Discharge of Bhowrah North

First Fortnight

Sl. No.	Parameters	MW10 (Mine Discharge) 13.10.2016	As per MOEF&CC General Standards for schedule VI
1	Total Suspended Solids	44	*100 (Max)*
2	pH	8.37	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	54	*250 (Max)*

Second Fortnight

Sl. No.	Parameters	MW10 (Mine Discharge) 19.10.2016	As per MOEF&CC General Standards for schedule VI
1	Total Suspended Solids	40	*100 (Max)*
2	pH	8.53	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	48	*250 (Max)*

All values are expressed in mg/lit unless specified.

Approved By
Dy.Technical Manager
Env. Lab, CMPDI (HQ),
(Authorized Signatory)

Analysed By

WATER QUALITY DATA

(EFFLUENT WATER-FOUR PARAMETERS)

Name of the Company: **Bharat Coking Coal Limited** Year : **2016-17.**

Name of the Cluster: **Cluster - X** Month: **November, 2016.**

Name of the Stations & Code : **1. MW10- Mine Discharge of Bhowrah North**

First Fortnight

Sl. No.	**Parameters**	**MW10** (Mine Discharge) 15.11.2016	**As per MOEF&CC General Standards for schedule VI**
1	Total Suspended Solids	36	*100 (Max)*
2	pH	8.29	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	46	*250 (Max)*

Second Fortnight

Sl. No.	**Parameters**	**MW10** (Mine Discharge) 23.11.2016	**As per MOEF&CC General Standards for schedule VI**
1	Total Suspended Solids	32	*100 (Max)*
2	pH	8.18	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	42	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By

Approved By
Dy.Technical Manager
Env. Lab, CMPDI (HQ),
(Authorized Signatory)

WATER QUALITY DATA

(EFFLUENT WATER-FOUR PARAMETERS)

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

Year : **2016-17.**

Name of the Cluster: **Cluster - X**

Month: **December, 2016.**

Name of the Stations & Code :

1. MW10- Mine Discharge of Bhowrah North

First Fortnight

Sl. No.	Parameters	MW10 (Mine Discharge) 12.12.2016	As per MOEF&CC General Standards for schedule VI
1	Total Suspended Solids	28	*100 (Max)*
2	pH	8.81	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	40	*250 (Max)*

Second Fortnight

Sl. No.	Parameters	MW10 (Mine Discharge) 22.12.2016	As per MOEF&CC General Standards for schedule VI
1	Total Suspended Solids	24	*100 (Max)*
2	pH	8.94	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	44	*250 (Max)*

All values are expressed in mg/lit unless specified.

Analysed By
JSA/SA/SSA

Checked By
Lab Incharge
Env. Lab, RI-2, CMPDI

Approved By
Dy.Technical Manager
Env. Lab, CMPDI (HQ),
(Authorized Signatory)

PHOTOGRAPHS SHOWING FILTER PLANTS IN CLUSTER X (EASTERN JHARIA AREA), BCCL, DHANBAD

A. Location of Filter Plant

B. Units of Filter Plant

C. Different units of Filter Plant

Fig.1: Sudamdih Filter Plant of Eastern Jharia Area, BCCL

A. Location of Filter Plant

B. Units of Filter Plant

C. Different units of Filter Plant

Fig.2: Amlabad Filter Plant of Eastern Jharia Area, BCCL

A. Location of Filter Plant

B. Units of Filter Plant

C. Different units of Filter Plant

Fig.3: Bhowra Filter Plant of Eastern Jharia Area, BCCL

ANNEXURE - V

STRICTLY RESTRICTED
FOR COMPANY USE ONLY

RESTRICTED

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

GROUNDWATER LEVEL & QUALITY

REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year - 2016)

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

JHARIA COALFIELD AND RANIGANJ COALFIELD (PART)

(BHARAT COKING COAL LIMITED)

MARCH – 2017

Regional Institute – II

Central Mine Planning & Design Institute Ltd.

(An ISO 9001:2000 Company)
(A Subsidiary of Coal India Ltd.)
Koyla Bhawan Complex, Koyla Nagar
DHANBAD – 826005

DETAILS OF THE REPORT

Sl No.	ITEMS	INFORMATIONS
1	Geographical Area	Jharia Coalfield (JCF): 453 sq. km. Raniganj Coalfield (RCF part): 19.64 sq. km. (Cluster-XVI area only)
2	Major Physiographic Units	Dissected Pediplain with surface Reduced Level (RL) varies from 160 m to 220 m above mean sea level (AMSL) in JCF and 100 m to 140 m AMSL in RCF.
3	Drainage System	Damodar River is the master drainage flowing along western boundary of the JCF. Jamunia River, Khudia River, Katri River, Jarian Nala, Ekra Jore, Kari Jore, Kashi Jore, Chatkari Jore and their tributaries are flowing through the JCF area. Damodar River, Barakar River is the master drainage of the part of RCF area (CV Area).
4	Annual Rainfall	JCF and part of RCF area – 1509 mm (2016) (Dhansar Mine Rescue Station rainfall data)
5	Geological Formations	Gondwana Formation
6	Aquifer System	Top Unconfined/Phreatic Aquifer – average thickness 25 m Semi-confined to confined Aquifer – average thickness 50–200 m
7	Hydrogeological properties	Unconfined Aquifer (Damoda BJ Section & Block-III): Hydraulic Conductivity – upto 0.50 m/day Transmissivity – 10 - 42 m^2/day Semi-confined to confined Aquifer (Sitanala & Kumari Block): Hydraulic Conductivity – 0.0006-1.44 & 0.05-0.0027 m/day Transmissivity – 0.06 – 0.573 m^2/day
8	Groundwater Level Monitoring Network	Out of total 254 no of monitoring stations 64 nos located within core mining area and rest comes within Buffers zone. 60 Nos. of Groundwater monitoring well (Dug Wells) network is established by CMPDI to record groundwater level data in and around the Core Zone of JCF and 4 Nos. of Groundwater monitoring well (Dug Wells) in RCF (CV Area).
9	Groundwater Levels Below Ground Level (bgl)	JCF area: Pre-monsoon – 0.78 to 16.73 m (Avg. 5.64 m bgl) in ‘2016 Post-monsoon – 0.30 to 12.43 m (Avg. 3.19 m bgl) in ‘2016 RCF area (part): Pre-monsoon – 3.61 to 10.65 m (Avg. 6.24 m bgl) in ‘2016 Post-monsoon – 0.90 to 6.50 m (Avg. 3.18 m bgl) in ‘2016
10	Groundwater Quality	Potable
11	Proposed Piezometers	New piezometers (23 nos.) have been proposed to monitor impact of coal mining on groundwater regime within the coalfield area (JCF & part of RCF) for maximum depth upto 290 m to monitor deeper aquifers.

1.0 INTRODUCTION

1.1 CLIMATE, TEMPERATURE & RAINFALL

The Jharia Coalfield (JCF) and part of Raniganj Coalfield (RCF) area in Dhanbad District belongs to sub-humid tropical climatic region. The maximum temperature during summer shoots upto 45^{o} C and falls between 10^{o} C to 5^{o} C in winter. The maximum rainfall occurs during the period between June and September.

The annual rainfall in the area is 1509 mm (Dhansar Mine Rescue Station, 2016) has been considered in year 2016 given in **Annexure-I**. IMD stations nearby the Coalfield area are Dhanbad, Baghmara and Asansol. The mean non-monsoon rainfall in the area is 15% and the monsoon rainfall is 85% of total annual rainfall. Rainfall is the primary source of groundwater recharge.

1.2 GEOMORPHOLOGY

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

1.3 DRAINAGE

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

The drainage map of the JCF and part of RCF has been prepared on topographic map of scale 1:50000 (**Figure No-1**). The watershed of all tributary rivers (Jamuniya River to Barakar River) falls within the north-western part of Damodar sub-basin which comes under Lower Ganga Basin.

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

2.0 GROUNDWATER SYSTEM

2.1 GEOLOGY OF THE AREA

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

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

2.2 HYDROGEOLOGY OF THE STUDY AREA

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

2.3 AQUIFER DISPOSITION

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

PHREATIC/UN-CONFINED AQUIFER

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

SEMI-CONFINED TO CONFINED AQUIFER

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

2.4 AQUIFER PARAMETERS

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

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

3.0 GROUNDWATER LEVEL MONITORING

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

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

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

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

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

3.1 HISTORICAL GROUNDWATER LEVEL

Historical GWL of JCF and part of RCF are given from 2005 to 2016 of CMPDI monitoring stations (total 64 stations within Coalfield area). Pre-monsoon water level within JCF varies from 0.07 m to 19.27 m bgl with an average varying from 4.92 m to 6.29 m. The post-monsoon water level varies from 0.10 m to 15.88 m bgl with an average varying from 2.72 m to 4.48 m. The annual water level fluctuation varies from 0.02 m to 16.15 m bgl with an average varies from 1.54 m to 3.17 m.

Within RCF (part) pre-monsoon water level varies from 1.70 m to 10.50 m bgl with an average varying from 4.57 m to 7.59 m. The post-monsoon water level varies from 1.55 m to 9.58 m bgl with an average varying from 2.63 m to 5.11 m. The annual water level fluctuation varies from 0.54 m to 6.60 m bgl with an average varies from 0.89 m to 3.87 m.

Table No – 1: Historical Groundwater Level

Period		(Water level in metre below ground level)								
		Pre-Monsoon (April/May)			Post-Monsoon (Nov/Dec)			Fluctuation		
		From	To	Average	From	To	Average	From	To	Average
JCF	2005	0.07	19.08	6.29	0.84	12.13	3.20	0.12	12.45	3.21
	2007	0.40	19.27	5.66	0.35	8.21	2.87	0.02	16.15	2.96
	2008	0.45	18.35	5.42	0.35	14.20	3.62	0.03	9.22	2.45
	2010	0.85	14.47	5.24	0.10	15.88	4.48	0.02	5.55	1.54
	2012	1.27	18.68	5.58	0.15	7.80	2.72	0.08	13.45	2.96
	2013	0.70	19.20	5.65	0.45	8.35	2.77	0.29	15.88	3.17
	2014	0.70	16.28	4.92	0.75	14.98	3.27	0.25	10.15	2.17
	2015	1.38	17.20	6.00	0.45	14.58	3.92	0.28	7.62	2.15
	2016	0.78	16.73	5.64	0.30	12.43	3.19	0.23	6.35	2.88
RCF (part)	2008	5.02	10.50	7.59	2.85	4.90	3.71	1.82	6.60	3.87
	2010	2.20	8.85	4.74	2.78	9.58	4.63	0.68	1.10	0.89
	2011	3.57	8.02	4.98	2.50	6.21	3.75	0.55	1.90	1.23
	2012	3.10	7.34	4.59	1.55	7.00	3.66	0.05	2.78	0.94
	2013	1.70	9.87	6.54	2.90	8.85	4.71	1.02	5.54	2.84
	2014	3.27	6.48	4.57	2.13	3.03	2.63	0.54	3.45	1.94
	2015	3.38	9.52	5.33	2.68	8.20	5.11	1.06	1.32	1.81
	2016	3.61	10.65	6.24	0.90	6.50	3.18	1.63	4.40	3.06

3.2 GROUNDWATER LEVEL SCENARIO IN NON-MINING/MINING AREA

Depth to water level (DTW) range in different formations with respect of mining and non-mining areas is summarized in the Table No-2.

Table No – 2: Depth to water table

Formation	***Area***		***DTW (bgl, m) [Year-2016]***		***Average GWL (m)***	
			Pre-monsoon	***Post-monsoon***	***Pre-monsoon***	***Post-monsoon***
Sedimentary (Gondwana)	Non-mining		0.78 to 7.37	0.30 to 4.645	5.12	3.23
	Mining	OC	1.30 to 10.20	0.70 to 9.08	5.30	3.55
		UG	1.50 to 16.73	1.10 to 12.43	7.21	4.89
Metamorphics	Peripheral part of the Coalfield		0.50 to 14.00	0.30 to 11.30	7.25	4.50

The study revealed that water table is in shallow depth and there is no significant stress in the water table due to coal mining activity. Mining and Non-mining areas shows barely any difference in water table condition in the JCF and RCF (part) area. The average hydraulic gradient of the water table within mining and non-mining areas is given in Table No-3. Flat hydraulic gradient has been observed within Non-Mining, Underground mines and Metamorphics areas w.r.t, Opencast mining areas. Relatively steep gradient near active opencast mining areas may be due to coal mining activity in addition with less rainfall in recent years within the study area.

Table No – 3: Average hydraulic gradient

Sl. No	***Formation***	***Area***		***Average hydraulic gradient***
1	Sedimentary (Gondwana)	Non-Mining		1.5×10^{-3} to 3.5×10^{-3}
2		Mining	OC	7.75×10^{-3} to 11.82×10^{-3}
3			UG	2×10^{-3} to 5×10^{-3}
4	Metamorphics	Peripheral part of the Coalfield		1.0×10^{-3} to 3.0×10^{-3}

3.3 QUARTERLY GROUNDWATER LEVEL, CLUATER OF MINES (BCCL)

3.3 A Monitoring of Ground Water Levels of Cluster-I

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

The present leasehold area of Cluster-I is 575 Ha. The Damoda block area is marked by more or less flat and gently undulating topography. The RL varies from 179 m to 208 m AMSL and the general slope of topography is towards east. Jamuniya River, Kari Jore, Podo Jore and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Jamuniya River.

4 hydrograph stations (**B-15, B-21A, B51 and B-53**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April and August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	B-15	Bera Basti	0.55	1.85	0.40	0.55
2	B-21A	Dugdha	6.45	5.55	1.45	4.50
3	B-51	Taranga	3.20	4.90	1.03	3.18
4	B-53	Karmatanr	3.47	4.62	-	1.37
Average WL (bgl)			***3.42***	***4.23***	***0.96***	***2.40***

Ground Water Level (in bgl) varies from 0.55 to 6.45 m during February’16, 1.85 to 5.55 m during April’16, 0.40 to 1.45 m during August’16 and 0.55 to 4.50 m during November‘16 within the Core Zone of Cluster-I area.

3.3 B Monitoring of Ground Water Levels of Cluster-II

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

The present leasehold area of Cluster-II is 2025.71 Ha. The Damoda block area is marked by more or less flat and gently undulating topography. The RL varies from 176 m to 235 m AMSL. Jamuniya River, Khudia River and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Jamuniya River and Khudia River.

5 hydrograph stations (**B-1, B-59, B-60, B-61A and B-62A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	B-1	Muraidih	2.53	3.58	1.43	1.93
2	B-59	Khodovaly	1.40	4.40	0.65	0.50
3	B-60	Bahiyardih	6.78	9.36	1.48	5.03
4	B-61A	Kesargora	5.36	6.58	1.09	3.87
5	B-62A	Sadiyardih	6.85	9.30	2.85	4.95
Average WL (bgl)			***4.58***	***6.64***	***1.50***	***3.26***

Ground Water Level (in bgl) varies from 1.40 to 6.85 m during February, 3.58 to 9.36 m during April, 0.65 to 2.85 m during August and 0.50 to 5.03 m during November‘2016 within the Core Zone of Cluster-II area.

3.3 C Monitoring of Ground Water Levels of Cluster-III

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

The present leasehold area of Cluster-III is 1420.0 Ha. The area is plain with gentle undulation with RL varies from 160 m to 208.80 m AMSL. The general slope of the area is towards south. Khudia River, Baghdihi Jore, Katri River and its tributaries are controlling the drainage system of the area. The area comes under the watershed of Khudia River.

5 hydrograph stations (**A-12, A-25, A-29, B-14 and B-60**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	A-12	Jamua	1.70	2.50	0.35	0.70
2	A-25	Sinidih	4.78	7.43	1.40	4.58
3	A-29	Dharmaband	3.95	5.92	1.54	6.96
4	B-14	Mathadih	1.92	2.44	1.26	0.47
5	B-60	Sonardih	6.31	10.33	2.21	5.03
Average WL (bgl)			***3.73***	***5.72***	***1.35***	***3.65***

Ground Water Level (in bgl) varies from 1.70 to 6.31 m during February, 2.50 to 10.33 m during April, 0.35 to 2.21 m during August and 0.70 to 6.96 m during November‘2016 within the Core Zone of Cluster-III area.

3.3 D Monitoring of Ground Water Levels of Cluster-IV

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

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

5 hydrograph stations (**A-26, A28A, B-63, B-64 and B-65A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	A-26	Malkhera	5.78	8.93	2.83	4.48
2	A28A	Lakarka	2.15	3.35	1.22	1.47
3	B-63	West Mudidih	1.35	2.44	0.95	
4	B-64	Keshalpur	1.35	2.35	0.35	0.55
5	B-65A	Jhinjipahari	5.20	7.15	1.40	2.68
Average WL (bgl)			***3.17***	***4.84***	***1.35***	***2.30***

Ground Water Level (in bgl) varies from 1.35 to 5.78 m during February, 2.35 to 8.93 m during April, 0.35 to 2.83 m during August and 0.55 to 4.48 m during November‘2016 within the Core Zone of Cluster-IV area.

3.3 E Monitoring of Ground Water Levels of Cluster-V

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

The present leasehold area of Cluster-V is 1957.08 Ha. The area has a general undulating topography, with an overall gentle south westerly slope. The RL varies from 210 m to 170 m AMSL. Jarian Nala, Nagri Jore, Ekra Jore and its tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Jarian Nala and Ekra Jore.

4 hydrograph stations (**A-3, A-16, A-27 and D-23**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	A-3	Sijua	3.02	4.87	0.20	0.47
2	A-16	Ekra	4.40	5.85	1.75	3.15
3	A-27	Tetulmari	2.40	4.85	0.40	1.80
4	D-23	Jogta	3.51	5.70	2.35	1.63
Average WL (bgl)			***3.33***	***5.32***	***1.18***	***1.76***

Ground Water Level (in bgl) varies from 2.40 to 4.40 m during February, 4.85 to 5.85 m during April, 0.20 to 2.35 m during August and 0.47 to 3.15 m during November‘2016 within the Core Zone of Cluster-V area.

3.3 F Monitoring of Ground Water Levels of Cluster-VI

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

The present leasehold area of Cluster-VI is 876.55 Ha. The area has a general undulating topography with general slope towards south. The RL varies from 180 m to 240 m AMSL. Ekra Jore, Kari Jore and their tributaries are controlling the drainage pattern of the area. The area comes under the watershed of Ekra Jore and Kari Jore.

2 hydrograph stations (**D-25 and D-30**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	D-25	Godhur	2.10	2.40	0.25	1.90
2	D-30	Borkiboa	3.32	4.45	1.10	3.20
Average WL (bgl)			***2.71***	***3.43***	***0.68***	***2.55***

3.3 G Monitoring of Ground Water Levels of Cluster-VII

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

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

7 hydrograph stations (**D-3, D-4, D-33, D-34, D-47, D-55 and D-80**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	D-3	Dhansar	2.10	2.35	1.20	1.90
2	D-4	Jharia	1.01	1.21	0.41	1.36
3	D-33	Kustore	1.00	2.50	0.20	1.95
4	D-34	Kusunda	0.75	2.30	0.22	0.30
5	D-47	Parastanr	3.05	3.18	3.35	2.95
6	D-55	Hariladih	2.72	2.52	1.62	3.62
7	D-80	Bastacolla	3.63	6.55	2.05	4.15
Average WL (bgl)			***2.04***	***2.94***	***1.29***	***2.32***

Ground Water Level (in bgl) varies from 0.75 to 3.63 m during February, 1.21 to 6.55 m during April, 0.20 to 3.35 m during August and 0.30 to 4.15 m during November‘2016 within the Core Zone of Cluster-VII area.

3.3 H Monitoring of Ground Water Levels of Cluster-VIII

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

The present leasehold area of Cluster-VIII is 1200.41 Ha. The area has a general undulating topography with general slope towards south and south-west. The ground elevation in the area ranges from 175 m to 221 m AMSL. Chatkari Jore, Tisra Jore and its tributaries controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

4 hydrograph stations (**D-8, D-43, D-49 and D-51**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	D-8	Alokdiha	4.65	8.00	2.70	3.43
2	D-43	Alagdih	4.17	8.20	1.90	3.35
3	D-49	Galucdih	2.00	2.45	0.28	1.72
4	D-51	Chankuiya	8.80	11.15	3.58	6.45
Average WL (bgl)			***4.91***	***7.45***	***2.12***	***3.74***

Ground Water Level (in bgl) varies from 2.0 to 8.80 m during February, 2.45 to 11.15 m during April, 0.28 to 3.58 m during August and 1.72 to 6.45 m during November‘2016 within the Core Zone of Cluster-VIII area.

3.3 I Monitoring of Ground Water Levels of Cluster-IX

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

The present leasehold area of Cluster-IX is 1942.12 Ha. The topography of the area is undulating with gentle slope towards south. The RL varies from 221 m to 188.44 m AMSL. Chatkari Jore, Tisra Jore, Sulunga Jore and its tributaries controlling the drainage pattern of the area. The area comes under the watershed of Chatkari Jore.

6 hydrograph stations (**D-5, D-7, D-39, D-40A, D-41 and D-74**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	D-5	Jiyalgora	7.54	9.40	2.20	6.40
2	D-7	Golden Pahari	5.63	7.53	1.63	4.03
3	D-39	Tilaboni	2.15	2.18	1.55	2.65
4	D-40A	Khapa Dhawra	0.70	1.40	0.45	0.85
5	D-41	Joyrampur	1.30	1.30	0.45	1.52
6	D-74	Bhulan Bararee	5.95	7.73	2.60	5.00
Average WL (bgl)			***3.88***	***4.92***	***1.48***	***3.41***

Ground Water Level (in bgl) varies from 0.70 to 7.54 m during February, 1.30 to 9.40 m during April, 0.45 to 2.60 m during August and 0.85 to 6.40 m during November‘2016 within the Core Zone of Cluster-IX area.

3.3 J Monitoring of Ground Water Levels of Cluster-X

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

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

4 hydrograph stations (**A-19, D-35, D-36 and D-77**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	A-19	Bhowrah	4.75	8.10	1.35	4.40
2	D-35	Patherdih	7.22	9.52	2.53	6.45
3	D-36	Sudamdih	0.46	0.78	0.25	0.95
4	D-77	Amlabad	3.75	4.60	2.49	2.90
Average WL (bgl)			***4.05***	***5.75***	***1.66***	***3.68***

Ground Water Level (in bgl) varies from 0.46 to 7.22 m during February, 0.78 to 9.52 m during April, 0.25 to 2.53 m during August and 0.95 to 6.45 m during November‘2016 within the Core Zone of Cluster-X area.

3.3 K Monitoring of Ground Water Levels of Cluster-XI

Cluster–XI consists of eight coal mines and one coal Washery namely; Gopalichak UG Project, Kachi Balihari 10/12 Pit UG, Pootkee Balihari Project UG, Bhagaband UG, Kendwadih UG (closed), Pootkee UG (closed), Kachi Balihari 5/6 Pit UG (closed) are under the administrative control of Pootkee Balihari Area and Moonidih UG & Moonidih Washery are under the administrative control of Western Jharia Area of BCCL. This Cluster of mines is located in central part of Jharia Coalfield in Dhanbad district of Jharkhand.

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

5 hydrograph stations (**A-17, A-18, A-20, A-32 and D-34**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water below (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	A-17	Kachi Balihari	2.31	2.44	0.37	2.69
2	A-18	Baghaband	0.74	1.14	1.84	0.89
3	A-20	Gorbudih	4.60	7.49	1.07	3.50
4	A-32	Baludih	2.99	4.75	0.65	2.10
5	A-34	Bhatdih	4.54	4.75	1.55	4.45
Average GW (bgl)			***3.04***	***4.11***	***1.10***	***2.73***

Ground Water Level (in bgl) varies from 0.74 to 4.60 m during February, 1.14 to 7.49 m during April, 0.37 to 1.84 m during August and 0.89 to 4.45 m during November‘2016 within the Core Zone of Cluster-XI area.

3.3 L Monitoring of Ground Water Levels of Cluster-XIII

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

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

5 hydrograph stations (**A-22, A-23, A-33, B-25 and B-48**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	A-22A	Nagdah Basti	2.00	3.25	0.40	1.75
2	A-23	Machhayara	8.83	11.87	2.99	8.13
3	A-33	Mahuda Washery	3.43	5.75	0.60	2.60
4	B-25	Mahuda More	4.53	7.90	1.79	2.55
5	B-48	Mahuda	5.35	9.35	2.03	4.60
Average GW (bgl)			***4.83***	***7.62***	***1.56***	***3.93***

Ground Water Level (in bgl) varies from 2.00 to 8.83 m during February, 3.25 to 11.87 m during April, 0.40 to 2.99 m during August and 1.75 to 8.13 m during November‘2016 within the Core Zone of Cluster-XIII area.

3.3 M Monitoring of Ground Water Levels of Cluster-XIV

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

The present leasehold area of Cluster-XIV is 1577.22 Ha. The topography of the area is undulating with slope towards south west. The maximum RL is 224 m in the north-eastern part whereas the minimum RL is 170 m above mean sea level on the south-western part of the area. Jamunia River and its tributaries are controlling the drainage of the area. The area comes under the watershed area of Jamunia River.

3 hydrograph stations (**B-23, B-24 and B-67**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'16	Apr'16	Aug'16	Nov'16
1	B-23	Lohapatti	3.32	6.81	1.09	2.41
2	B-24	Telmuchu	6.33	10.63	1.73	4.28
3	B-67	Simatanr	7.45	9.53	3.47	4.30
Average GW (bgl)			***5.70***	***8.99***	***2.10***	***3.66***

Ground Water Level (in bgl) varies from 3.32 to 7.45 m during February, 6.81 to 10.63 m during April, 1.09 to 3.47 m during August and 2.41 to 4.30 m during November'2016 within the Core Zone of Cluster-XIV area.

3.3 N Monitoring of Ground Water Levels of Cluster-XV

Cluster–XV consists of four coal mines; Kharkharee UG and Dharmaband UG are under the administrative control of Govindpur Area and Madhuband UG & Phularitand UG are under the administrative control of Barora Area of BCCL. This Cluster of mines is located in western part of Jharia Coalfield in Dhanbad district of Jharkhand.

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

3 hydrograph stations (**A-24, B-32A and B-61A**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November‘2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb’16	Apr’16	Aug’16	Nov’16
1	A-24	Pipratanr	12.80	16.73	2.48	12.43
2	B-32A	Madhuband	4.20	6.95	1.54	3.07
3	B-61A	Kesargora	5.48	6.58	1.09	3.87
Average GW (bgl)			***7.49***	***10.09***	***1.70***	***6.46***

Ground Water Level (bgl) varies from 4.20 to 12.80 m during February, 6.58 to 16.73 m during April, 1.09 to 2.48 m during August and 3.07 to 12.43 m during November‘2016 within the Core Zone of Cluster-XV area.

3.3 O Monitoring of Ground Water Levels of Cluster-XVI

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

The present leasehold area of Cluster-XVI is 1964.21 Ha. The topography of the area is undulating with slope towards south west. The area is plain with gently undulating with elevation varying from 100 m to 140 m AMSL. The general slope of the area is towards southeast. Barakar River and Khudia River are controlling the drainage of the area. The area comes under the watershed area of Barakar River.

4 hydrograph stations (**DB-22, DB-23, DB-24 and DB-25**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has been done in the months of February, April, August & November'2016 and the Ground water level data is enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)			
			Feb'16	Apr'16	Aug'16	Nov'16
1	DB-22	Dahibari, Niche Basti	3.63	5.38	1.13	3.33
2	DB-23	Dahibari OC	4.26	5.30	0.53	0.90
3	DB-24	Dahibari	8.40	10.65	1.70	6.50
4	DB-25	Palasya	3.33	3.61	1.28	1.98
Average GW Level			***4.91***	***6.24***	***1.16***	***3.18***

Ground Water Level (in bgl) varies from 3.33 to 8.40 m during February, 3.61 to 10.65 m during April, 0.53 to 1.70 m during August and 0.90 to 6.50 m during November'2016 within the Core Zone of Cluster-XVI area.

4.0 GROUNDWATER LEVEL SCENARIO

During the month of February'2016 the depth to water level (in bgl) within 15 nos Cluster of mines varies from 0.46 m to 12.80 m with an average varies from of 2.04 m to 7.49 m. During the month of April'2016 the depth to water level varies from 0.78 m to 16.73 m with an average varies from 2.94 m to 10.09 m. During the month of August'2016 the depth to water level varies from 0.20 m to 3.58 m with an average varies from 0.68 m to 2.12 m. During the month of November'2016 the depth to water level varies from 0.30 m to 12.43 m with an average varies from 1.76 m to 6.46 m. The summarized water level data of all clusters are given in **Table No – 4**.

Depth to water level (in bgl) values described that water level goes down to maximum 16.73 m during pre-monsoon'2016 and maximum upto 12.43 m during post-monsoon'2016. Un-confined aquifer is affected around 20 m to 30 m maximum close to active opencast mining areas, showing steep gradient towards mine void. Other than that, there is no mining effect in the water level within JCF area and RCF area (part). Historical water level data and hydrograph of permanent observation stations from CGWB shown in **Annexure–III**.

Monitoring groundwater (quantity & quality) to assess the present condition and resource has been done regularly in the coalfield areas. Well hydrographs (**Annexure–III**) are prepared and studied to identify potentially adverse trends so that appropriate action can be taken to protect groundwater resource. According to the hydrograph trend analysis of CGWB monitoring wells, no significant decline trend of water level is noticed in any particular area for the last 10 years within the coalfield area. Regarding quality monitoring, the water sample location map (**Figure No–2**) with collection points details (dug wells) are given in **Annexure–IV**.

Table No–4: Groundwater level data Cluster-wise

Sl. No.	Cluster of BCCL	No. of Monitoring Wells	Water level fluctuation Below ground level (Feb, Apr, Aug & Nov'16)	Formation
1	I	4 nos.	0.40 to 6.45 m	Barakar
2	II	5 nos.	0.50 to 9.36 m	Barakar
3	III	5 nos.	0.35 to 10.33 m	Barakar
4	IV	5 nos.	0.35 to 8.93 m	Barakar
5	V	4 nos.	0.20 to 5.70 m	Barakar
6	VI	2 nos.	0.25 to 4.45 m	Barakar
7	VII	6 nos.	0.20 to 6.55 m	Barakar
8	VIII	4 nos.	0.28 to 11.15 m	Barakar
9	IX	6 nos.	0.45 to 9.40 m	Barakar
10	X	4 nos.	0.25 to 9.52 m	Barakar
11	XI	5 nos.	0.65 to 7.49 m	Barakar & Barren Measure
12	XIII	5 nos.	0.40 to 11.87 m	Raniganj
13	XIV	3 nos.	1.09 to 10.63 m	Raniganj
14	XV	4 nos.	1.09 to 16.73 m	Barakar & Barren Measure
15	XVI	4 nos.	0.53 to 10.65 m	Barakar

5.0 GROUNDWATER QUALITY

The ground water sample of the study area (15 nos. of Cluster of mines, BCCL) have been collected from dug wells and analysed. Fifteen ground water samples (GW-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 & 16) were analysed quarterly (February, May, August and November'2016) at CMPDI (HQ), Ranchi. The water sampling details are given in **Annexure–IV** and Water sample locations are shown in **Figure No-2**. The water quality data are enclosed in **Annexure–VA, VB, VC and VD**.

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

During the month of February, May, August and November'2016:

The pH of the groundwater samples varies between 7.56 to 8.26 in February'16, 7.10 to 8.31 in May'16, 6.16 to 8.27 in August'16 and 7.85 to 8.57 in November'16. The pH is within the ISI standards of drinking water except in Cluster-VIII during November'16.

During the month of February, May, August and November'2016:

The mineral constituents dissolved in water constitute the dissolved solids. The total dissolve solids varies from 388 to 910 mg/l in February'16, from 370 to 1070 in May'16, from 320 to 1060 in August'16 and from 276 to 902 in November'2016. The TDS values are above the IS 10500 standards of drinking water.

During the month of February, May, August and November'2016:

During the month of February'16 the alkalinity of the water samples varies from 84 to 372 mg/l and are slightly above the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 40 to 122 mg/l and are slightly above the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 156 to 616 mg/l and the value of total hardness in water samples are above the permissible limit (200 mg/l). The sulphate ranges between 66 to 178 mg/l and the value of sulphate in water sample are within the permissible limit (200 mg/l). The Iron, Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

During the month of May'16 the alkalinity of the water samples varies from 80 to 504 mg/l and are above the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 42 to 133 mg/l and are slightly above the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 176 to 724 mg/l and the value of total hardness in water samples are above the permissible limit (200 mg/l). The sulphate ranges between 52 to 230 mg/l and the value of sulphate in water sample are slightly above the permissible limit (200 mg/l). The Iron, Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

During the month of August'16 the alkalinity of the water samples varies from 80 to 432 mg/l and are above the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 46 to 110 mg/l and are slightly above the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 172 to 496 mg/l and the value of total hardness in water samples are above the permissible limit (200 mg/l). The sulphate ranges between 60 to 224 mg/l and the value of sulphate in water sample are slightly above the permissible limit (200 mg/l). The Iron, Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

During the month of November'16 the alkalinity of the water samples varies from 32 to 408 mg/l and are slightly above the stipulated standard of (200 mg/l) drinking water. The concentrations of calcium in the water samples vary from 34 to 115 mg/l and are slightly above the permissible limit (75 mg/l) of drinking water standards. The total hardness ranges between 120 to 780 mg/l and the value of total hardness in water samples are above the permissible limit (200 mg/l). The sulphate ranges between 41 to 260 mg/l and the value of sulphate in water sample are within the permissible limit (200 mg/l). The Iron, Copper, Manganese, Lead, Zinc and Chromium concentration in the water samples are found to be below the upper ISI limits for drinking water.

6.0 STAGE OF GROUNDWATER DEVELOPMENT

The groundwater is mainly utilized for domestic needs and for irrigation purposes. The groundwater abstraction is mainly through dug wells and bore wells. The stage of groundwater development in Dhanbad district is 55.80%. The highest stage of development is in Dhanbad (143%) and Jharia (112%) blocks and lowest stage of development is in Nirsa (30%) block. The Gondwana sandstones in general, are known to constitute good aquifers at many places. However, the yield potential of the area adjoining to active mines in the coal belt is poor. The active mines often act as groundwater “sinks”. In contrast, the water logged abandoned mines and pits act as potential sources of groundwater. As per the assessment done by Central Ground Water Board (CGWB), Patna in 2011, the Block wise data of Dhanbad district is given below:

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

Sl No.	Administrative Unit	Stage of GW Development	Category
1	Baghmara	60%	safe
2	Baliapur	31%	safe
3	Dhanbad	143%	**Over- exploited**
4	Gobindpur	64%	safe
5	Jharia	112%	**Over- exploited**
6	Nirsa	30%	safe
7	Tundi	48%	safe
8	Topchachi	62%	safe

Table No–6: Cluster-wise Groundwater development scenario

Cluster/ Area	Adminis-trative Blocks/Stage Of GW Develo-pment	Total Water demand (cum/day)				Avg. GW level (bgl in m) 2016		GW level declining trend 2005-2016		Remarks
		Mine Discharge	Surface Water Source	Total Use (Domestic +Industrial +Others)	Excess Or other use	Pre-monsoon	Post-monsoon	Pre-monsoon	Post-monsoon	
Cluster-I	Bermo 44%	2950	NIL	2123	827	4.23	2.40	NO	NO	-
Cluster-II	Baghmara 60%	8350	Jamunia river	7265	1085	6.64	3.26	NO	NO	-
Cluster-III	Baghmara 60%	10,960	NIL	7290	3670	5.72	3.65	NO	NO	-
Cluster-IV	Baghmara 60%	5900	MADA (Damodar river)	5900	NIL	4.84	2.30	NO	NO	
Cluster-V	Baghmara 60%	11,025	MADA	9214	1811	5.32	1.76	YES	NO	Excess water stored into abandoned UG
Cluster-VI	Dhanbad 143%	4150	MADA (Damodar river)	4150	NIL	3.43	2.55	YES	YES	Artificial recharge structure needed
Cluster-VII	Dhanbad 143%	14,920	MADA	14,639	281	2.94	2.32	NO	NO	
Cluster-VIII	Jharia 112%	9320	MADA	5474	3846	7.45	3.74	NO	NO	Excess water stored into abandoned UG & FF
Cluster-IX	Jharia 112%	12,980	MADA	9714	3266	4.92	3.41	NO	NO	Excess water stored into abandoned UG & FF
Cluster-X	Jharia 112%	11,825	Damodar river	6525	5300	5.75	3.68	YES	NO	Excess water stored into abandoned UG & OC
Cluster-XI	Dhanbad 143%	31,530	MADA & DVC	18,825	12,705	4.11	2.73	NO	YES	Excess water used F.P
Cluster-XIII	Baghmara 60%	4774	Damodar river	4115	659	7.62	3.93	NO	NO	-
Cluster-XIV	Baghmara 60%	2600	DVC	1875	725	8.99	3.66	NO	NO	
Cluster-XV	Baghmara 60%	6200	Jamunia river	4147 +1800 (ponds)	253	10.09	6.46	NO	YES	Excess water store into surface bodies
Cluster-XVI	Nirsa 30%	3380	DVC (Barakar river)	2450	930	6.24	3.18	NO	NO	

7.0 CONSERVATION MEASURES & FUTURE STRATEGY

- BCCL has installed 25 Pressure Filter Plant of total capacity of 4.16 MGD to meet drinking water requirement nearby the area. At present 63 Water Treatment Plants are operational having capacity of 16.16 MGD within Jharia Coalfield area. Further installation of 28 more Pressure Filter Plants with the capacity of 5.84 MGD are in progress.

- BCCL participated in development of low cost technology for drinking water in a CSIR project along with CIMFR, Dhanbad and a pilot plant of 4000 Liters/hour is functional at PB Project site of BCCL. Similar plant has been proposed at other sites of BCCL.

- A scheme entitled 'Scheme for multi-purpose utilization of surplus mine water of Barora Area, Block II and Govindpur Area of BCCL' was prepared with a view to harness the excess water discharge to take care of the persistence problem of water scarcity in the nearby villages. In the scheme, two water reservoirs of capacity 27 MG and 17 MG have been proposed in the non-coal bearing area for storage of 3250 GPM and 2000 GPM surplus mine water which will be fed through pipe line by mine discharge at mines of Barora, Block-II and Govindpur Area.

- Roof-top rainwater harvesting (RWH) will be taken up in the project area using the administrative buildings. 138 no. of quarters having roof-top area of about 14950 sq. m. is already prepared to harvest rainwater and around 13150 cum/annum of water is going to be recharged the nearby groundwater system through RWH structures. Proposal already made to facilitate this kind of RWH structure at suitable locations i.e. Lodna Area, Kusunda Area (Jawahar Nagar, Matkuria, Coal Board Colony), Sijua Area (Nichitpur and Tetulmari Colony) within Jharia Coalfield to augment groundwater recharge.

- After cessation of mining, with plenty rainfall and abundant ground water recharge, the water levels will recoup and attain normalcy. Thus, the impact of mining on groundwater system may be considered as a temporary

phenomenon. The abandoned mine workings (UG) behave as water pool and improves the resources availability in the coalfield area.

- Utilization of treated mine water discharge by both industry and local people in the mine influence area. The excess mine water can be used to recharge groundwater system through connecting pipeline to abandoned dug wells. Utilization of mine water for irrigation use will also enhance the ground water recharge potential through artificial recharge in the area.

- Increase vegetative cover by plantation in the mine area under land amelioration measures. This will contain the surface run-off and increase the groundwater recharge.

- Creation of awareness among workers and local peoples about Rain water harvesting and artificial recharge will be given priority. This aspect is usually covered during the Environmental Week celebrated every year (5 to 12 June).

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

Annexure – I

Rainfall Data (in mm) At Dhansar (Rescue station) Observatory Station, State Sec Deptt of Coord, BCCL

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
January	34.20	0.00	0.00	5.80	0.00	0.00	7.60	17.6	0.0	12.40	23.80	3.0
February	22.80	0.00	22.00	4.80	0.00	12.20	0.00	13.4	32.0	36.80	0.0	20.60
March	41.80	34.40	37.80	17.80	1.60	7.60	18.0	1.0	3.0	21.80	6.20	5.50
April	32.20	33.80	0.00	18.40	2.20	9.20	11.40	9.0	33.90	2.60	76.20	0.0
May	33.00	87.60	78.70	18.00	112.00	64.30	121.60	6.60	190.40	79.80	35.80	99.40
June	193.00	214.20	167.20	216.10	72.80	206.20	344.20	52.0	244.20	217.60	122.10	181.60
July	542.00	477.70	545.00	433.48	269.20	199.40	163.40	328.20	192.80	305.30	407.60	248.80
August	107.80	246.30	426.40	183.80	192.80	212.60	452.0	315.10	364.40	315.60	244.40	456.70
September	185.60	172.00	351.40	297.80	333.00	230.10	374.0	367.70	304.70	178.0	145.20	443.60
October	39.20	0.00	52.00	85.80	98.20	45.30	41.80	11.60	233.60	6.40	25.60	50.40
November	0.00	1.00	0.00	0.00	10.20	3.4	0.00	61.60	0.0	0.0	0.0	0.0
December	2.00	0.00	0.00	0.00	0.00	----	0.00	18.0	0.0	0.0	6.20	0.0
Annual	1233.60	1267.00	1680.50	1281.78	1092.00	991.90	1534.20	1201.80	1599.0	1176.0	1093.10	1509.60

Annexure – IIA

Details of Hydrograph Stations (Dug Wells)

Well No	Location	M.P. (agl) in m	Well Dia in m	Well Depth (m bmp)	R.L. (G.L) (m)	Formation	Owner	Utility
A-3	Sijua	0.53	3.00	5.20	203	Barakar	Govt.	Domestic
A-12	Jamua	0.80	1.90	3.30	202	Barakar	Govt.	Domestic
A-16	Ekra, Kalali More	0.45	3.10	6.50	205	Barakar	Govt.	Domestic
A-17	Kachi Balihari	0.56	1.60	5.30	182	Barakar	Govt.	Domestic
A-18	Bhagabandh	0.61	1.45	3.37	182	Barakar	Govt.	Domestic
A-19	Bhaura	0.54	3.15	11.65	162	Barakar	Govt.	Domestic
A-20	Gorbhudih	0.43	3.30	8.30	181	BM	Govt.	Domestic
A-22	Nagdah, Niche tola	0.00	1.40	9.50	171	Raniganj	Govt	Irrigation
A-23	Machhyara	0.43	1.85	12.40	203	Raniganj	Govt	Domestic
A-24	Pipra Tanr	0.22	1.80	19.55	208	Raniganj	Govt	Domestic
A-25	Sinidih	0.22	2.00	11.30	203	Barakar	Govt	Domestic
A-26	Pasitanr (Malkera)	0.32	1.80	9.65	198	Barakar	Govt	Domestic
A-27	Chandor	0.60	2.50	5.50	221	Barakar	Govt	Domestic
A-28A	Lakarka 6 no.	0.65	1.30	5.25	199	Barakar	BCCL	Domestic
A-29	Aambagan (Gobindpur)	0.10	2.60	9.15	186	Barakar	Govt	Domestic
A-32	Baludih	0.55	2.30	6.85	182	BM	Govt	Domestic
A-33	Mahuda	0.75	2.00	10.80	195	BM	BCCL	Domestic
A-34	Bhatdih	0.55	3.50	24.50	162	Raniganj	BCCL	Domestic
B-1	Muraidih	0.47	1.80	5.35	212	Talchir	Govt	Domestic
B-14	Mathadih	0.76	2.15	3.75	201	Barakar	Govt	Domestic
B-15	Bera Basti	0.55	1.60	2.50	221	Talchir	Dhanu Roy	Domestic
B-21A	Dugdha	0.55	2.10	10.35	220	Metamorphics	Govt	Domestic
B-23	Lohapati	0.26	3.60	10.85	204	Raniganj	Govt	Domestic
B-24	Telmuchu	0.67	4.35	10.83	207	Raniganj	Govt	Domestic
B-25	Mahuda More	0.10	2.45	8.45	205	Raniganj	Govt	Domestic
B-32A	Madhuband	0.80	4.30	8.60	205	Barakar	BCCL	Domestic
B-48	Mahuda	0.65	2.10	11.50	181	Raniganj	Mosque	Domestic
B-51	Taranga	0.00	2.50	5.75	215	Metamorphics	Bisun	Irrigation
B-53	Karmatanr	0.58	2.70	13.25	195	Barakar	Govt	Domestic
B-53A	Karmatanr-Damoda OCP							
B-59	Khodovaly	0.60	2.40	9.30	202	Barakar	BCCL	Domestic
B-60	Bahiyardih	0.77	3.00	15.60	196	Barakar	BCCL	Domestic
B-61A	Kesargora	0.48	2.00	11.20	201	Barakar	BCCL	Domestic
B-62A	Sadariyadih	0.15	3.10	9.50	188	Barakar	Govt	Domestic

Annexure – IIA

Details of Hydrograph Stations (Dug Wells)

Well No	Location	M.P. (agl) in m	Well Dia in m	Well Depth (m bmp)	R.L. (G.L) (m)	Formation	Owner	Utility
B-63	West Mudidih	0.60	1.70	3.35	196	Barakar	BCCL	Domestic
B-64	Keshalpur	0.65	1.10	3.40	195	Barakar	BCCL	Domestic
B-65A	Jhinjipahari	0.95	2.20	12.40	196	Barakar	Shiv Temple	Domestic
B-67	Simatanr	0.55	2.20	11.80	198	Raniganj	Govt	Domestic
D-3	Dhansar	0.60	1.70	8.70	217	Barakar	Govt	Domestic
D-4	Jharia	0.59	1.90	5.73	218	Barakar	Govt	Domestic
D-5	Jiyalgora	0.70	2.80	10.55	183	Barakar	Govt	Domestic
D-7	Golden Pahari	0.67	2.85	10.05	201	Barakar	BCCL	Domestic
D-8	Alokdiha	0.35	1.75	7.57	201	Metamorphics	BCCL	Domestic
D-23	Jogta (Sindra)	0.40	3.10	7.25	205	Barakar	BCCL	Domestic
D-25	Godhar More	0.60	2.75	5.60	219	Barakar	Govt	Domestic
D-30	Borkiboa	0.70	2.00	5.60	221	Talchir	H.Kumbhakar	Domestic
D-33	Kustore-4	0.55	1.85	3.45	196	Barakar	BCCL	Domestic
D-34	Kusunda-7	0.60	1.50	3.45	201	Barakar	BCCL	Domestic
D-35	Patherdih	0.40	2.00	11.20	160	Barakar	BCCL	Domestic
D-36	Sudamdih	0.90	2.00	6.20	141	Barakar	BCCL	Domestic
D-39	Tilabani	0.85	2.00	5.90	178	Barakar	BCCL	Domestic
D-40A	Khapra Dhaora	0.55	1.95	3.70	180	Barakar	Panchayat	Domestic
D-41	Joyrampur	0.50	1.80	4.00	180	Barakar	BCCL	Domestic
D-43	Alagdih	0.45	2.20	8.90	200	Metamorphics	Govt	Domestic
D-47	Parastanr	0.45	3.20	23.80	206	Barakar	BCCL	Domestic
D-49	Goluckdih	0.55	1.80	6.15	192	Barakar	BCCL	Domestic
D-51	Chankuiya	0.55	3.70	11.90	197	Barakar	BCCL	Domestic
D-55	Hariladih	0.48	2.80	11.80	184	Barakar	Govt	Domestic
D-74	Bhulan Barari	0.10	1.60	12.80	173	Barakar	Govt	Domestic
D-77	Rohoniatanr	0.40	3.15	6.70	156	Barakar	Govt	Domestic
D-80	Bastacolla	0.70	2.50	24.95	219	Barakar	Govt	Domestic
DB-22	Nichebasti	0.67	2.40	10.65	121	Barakar	Govt	Domestic
DB-23	Dahibari OC	0.70	2.30	8.00	-	Barakar	BCCL	Domestic
DB-24	Dahibari	0.60	3.60	13.70	125	Barakar	BCCL	Domestic
DB-25	Palasya	0.37	1.55	5.25	127	Barakar	Govt	Domestic

MP: Measuring Point **R.L.: Reduced Level** **W.L.: Water Level m: Meter**

Abn.: Abandoned **b.g.l.: Below Ground Level** **a.g.l.: Above Ground Level**

G.L.: Ground Level **bmp: Below Measuring Point** **BM: Barren Measure**

Annexure – IIB

Historical Water Level data of Hydrograph Stations

Well No	Water level below ground level (bgl) in meters														
	May, 08	Nov, 08	May, 10	Nov, 10	May, 11	May, 12	Nov, 12	May, 13	Nov, 13	May, 14	Nov, 14	May, 15	Nov, 15	May, 16	Nov, 16
A-3	4.67	4.52	4.71	3.57	4.77	4.25	1.87	4.47	4.45	4.67	2.37	3.70	3.42	4.87	0.47
A-12	2.95	1.25	2.82	1.60	2.80	2.80	1.30	3.00	1.17	2.45	1.4	3.00	2.68	2.50	0.70
A-16	4.99	1.58	4.17	1.90	5.80	3.53	1.60	3.80	3.35	5.5	2.9	5.55	4.17	5.85	3.15
A-17	2.54	2.36	2.39	2.37	2.24	2.52	2.34	2.32	1.54	2.19	1.91	3.79	2.64	2.44	2.69
A-18	2.51	1.04	2.49	0.94	2.49	2.59	0.90	2.87	0.91	1.76	1.19	2.84	1.29	1.14	0.89
A19	9.76	2.81	3.61	2.81		9.61	2.46	7.46	4.46	3.00	2.75	3.05	2.75	7.81	4.11
A-20	0.52	1.43	7.42	1.87	7.87	7.17	1.57	6.47	0.67	3.97	2.55	4.59	2.93	7.49	3.50
A22A						1.90	1.05	1.79	1.00	1.50	2.0	3.20	1.96	3.25	1.75
A-23	10.01	5.37	10.67	11.07	11.92	9.87	4.75	10.57	5.82	8.76	6.82	11.3	9.37	11.87	8.13
A-24	18.35	9.13	14.47	15.88	18.28	18.68	5.23	16.01	3.25	16.28	14.98	17.2	14.5	16.62	12.43
A-25	7.12	4.53	7.23	5.10	6.83	10.23	4.43	10.23	2.98	7.03	5.28	7.78	5.85	7.43	4.58
A-26	5.53	4.13	7.77	3.95	9.18	8.76	4.28	7.56	4.28	7.71	4.58	7.73	3.18	8.93	4.48
A-27	1.60	1.20	1.98	1.42	3.00	2.13	1.10	1.62	1.25	1.63	1.55	4.40	3.95	4.85	1.80
A28A	2.92	3.25	3.29	2.73	3.90	2.90	2.45	3.35	2.45	3.29	1.91	4.35	3.60	3.35	1.47
A-29	2.85	1.50	3.80		5.50	9.30	1.42	6.95	1.67	3.3	2.35	4.55	4.60	5.92	6.96
A-32	1.20	1.72	1.95	1.35	2.30	2.19	1.10	2.45	1.95	3.15	2.45	4.41	2.13	4.75	2.10
A-33	1.55	2.73	3.03	1.85	3.07	5.25	1.25	4.13	1.80	4.08	1.57	4.91	1.97	5.75	2.60
A-34	3.05	2.85	2.85	3.77	2.90	6.95	2.90	6.21	2.50	4.45	4.45	8.40	4.81	4.75	4.45
B-1	2.73	1.73	2.43	1.73	1.78	2.08	1.73	1.53	1.83	2.43	1.81	3.28	2.75	3.58	1.93
B-14	2.89	3.02	1.35	1.09	2.49	1.34	1.42	1.74	1.45	3.24	4.44	2.94	2.29	2.44	0.47
B-15	1.37	0.37	1.40	1.38	1.37	1.27	0.45	1.20	0.55	0.95	1.45	1.50	0.45	1.85	0.55
B21A	8.75	4.79	9.15	5.65	7.60	9.00	5.05	8.01	4.95	9.54	3.7	7.37	4.65	5.55	4.50
B-23	5.19	2.22	6.14	3.56	9.14	3.71	1.74	5.27	1.39	6.57	2.74	7.86	4.29	6.81	2.41
B-24	10.51	5.21	9.45	4.95	10.33		3.09	8.88	2.83	9.40	2.21	10.0	5.78	10.63	4.28
B-25	7.95	2.60	5.88	7.00	8.35	8.35	2.60	7.08	2.15	5.82	5.15	6.88	-	7.05	1.70
B32A	7.50	3.36	6.50	4.32	7.80	7.75	3.22	6.25	2.68	8.33	2.05	7.55	3.32	6.95	3.07
B-48	3.70	3.50	4.10		5.75	5.43	3.85	4.69	3.20	6.38	4.35	7.90	5.42	9.35	4.60
B-51	3.90	2.38	3.94	2.38	3.95	3.60	2.05	3.35	2.49	2.09	1.98	4.65	3.40	4.90	3.18
B-53		1.32	1.77	1.72	1.67	6.97	1.42	4.15	1.12	3.39	-	5.58	2.82	4.70	1.45
B-59	3.95	0.45	6.75	1.00	8.25	6.90	0.60	7.56	0.30	2.65	1.0	4.12	1.60	4.40	0.50
B-60	6.13	5.28	10.56	5.24	11.44	10.18	5.13	11.29	5.23	9.82	4.59	9.21	5.28	10.33	5.03
B61A	10.62	2.49	4.96	3.36	10.72	5.42	2.40	8.17	2.02	6.93	3.57	6.15	4.52	6.58	3.87
B62A	8.12	5.95	8.37	7.90	8.85	7.85	4.90	7.73	4.63	8.83	5.85	9.10	5.21	9.30	4.95

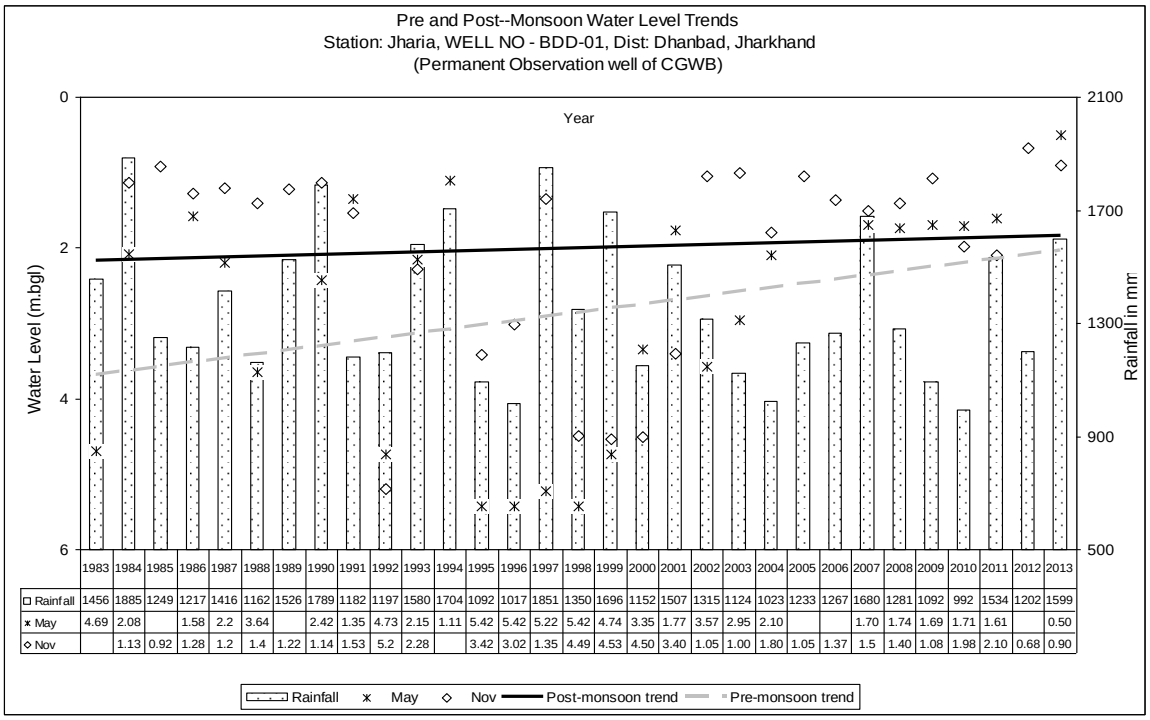
Annexure – IIB

Historical Water Level data of Hydrograph Stations

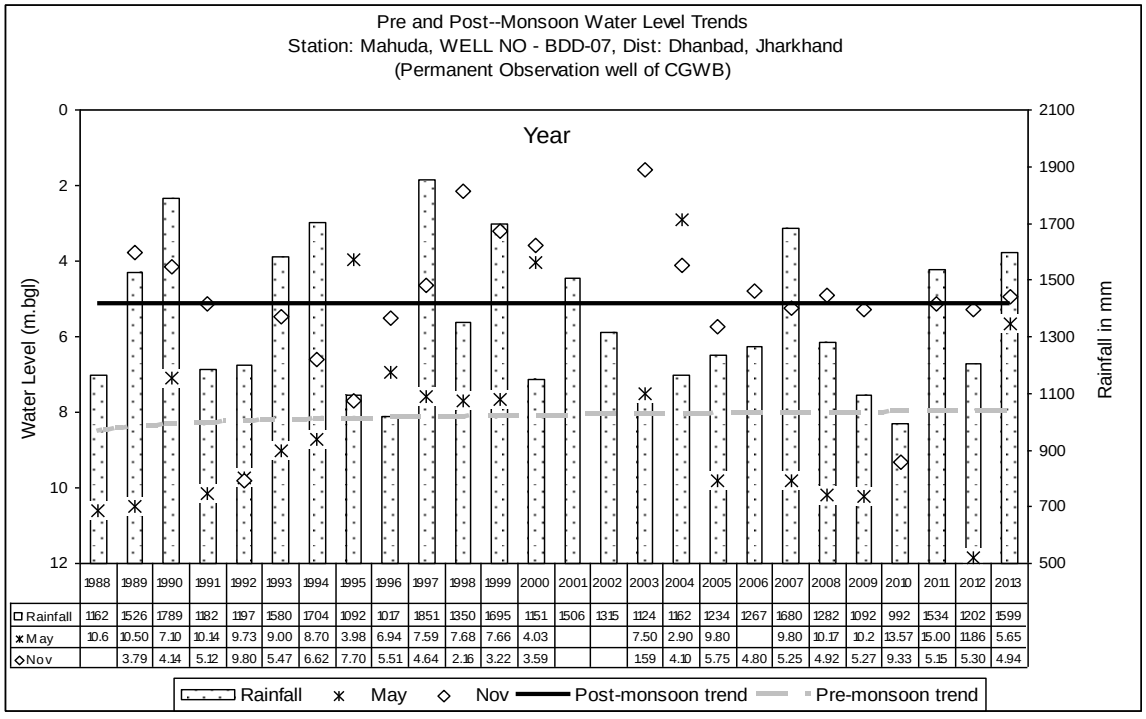
Well No	Water level below ground level (bgl) in meters														
	May, 08	Nov, 08	May, 10	Nov, 10	May, 11	May, 12	Nov, 12	May, 13	Nov, 13	May, 14	Nov, 14	May, 15	Nov, 15	May, 16	Nov, 16
B-63	1.57	0.50	1.03	1.00	1.05	1.09		1.32	0.80	1.22	0.92	2.46	1.40	2.44	-
B-64	0.77	0.75	0.79	1.05	0.85	1.05	1.00	1.35	0.85	0.7	1.15	1.38	0.95	2.35	0.55
B65A	11.53	3.35	11.45	3.39	9.65	11.45	1.73	10.11	1.82	10.45	2.4	7.82	5.87	7.15	2.68
B-67	8.75	6.85	11.00	10.69	11.25	8.55	6.50	9.73	5.31	9.80	3.72	9.23	5.53	9.53	4.30
D-3	3.25	2.20	3.15	2.55	2.55	2.93	1.80	3.45	1.68	2.54	2.11	4.25	2.25	2.35	1.90
D-4	3.13	1.41	2.61	1.46	1.51	1.94	0.91	2.41	0.98	1.23	0.91	2.41	1.27	1.21	1.36
D-5	9.40	7.85	9.05	6.65	9.05	9.50	6.45	9.32	4.59	9.0	7.8	9.37	8.33	9.40	6.40
D-7	9.23	5.23	9.23		9.33	6.08	5.83	7.19	4.63	5.28	5.53	8.25	5.61	7.53	4.03
D-8	6.70	1.87	6.85	6.73	7.75	6.15	3.75	6.65	2.85	7.73	-	6.24	4.38	8.00	3.43
D-23	2.20	1.70	5.85	4.85	6.80	6.00	3.30	6.60	1.20	6.38	2.4	6.55	3.48	5.70	1.63
D-25	4.70	4.75	5.10	2.30	4.70	5.20	3.65	4.26	3.45	4.42	2.9	4.48	2.45	2.40	1.90
D-30	4.70	1.37	2.90	2.23	5.10	3.88	1.80	4.38	3.08	4.17	3.3	4.55	3.15	4.45	3.20
D-33	0.45		0.94	0.70	0.95	2.85	0.35	1.80	0.45	1.72	0.35	2.25	1.10	2.50	1.95
D-34			2.85	2.65	2.85	2.35	2.50	2.50	2.13	2.80	0.30	2.55	1.45	2.30	0.30
D-35	6.25	4.90	7.30	6.15	8.20	8.05	5.55	7.70	4.10	6.94	6.15	9.80	7.90	9.52	6.45
D-36	2.22	0.35	0.85	0.10	1.95	1.55	0.15	1.28	0.80	1.82	0.75	1.66	1.13	0.78	0.95
D-39	4.95	3.85	4.75	3.40	5.05	5.05	3.65	3.98	2.50	5.03	2.25	5.00	2.61	2.18	2.65
D40A	1.97	2.07	2.50	1.65	1.95	2.45	1.70		2.25	2.35	2.45	3.07	2.45	1.40	0.85
D-41	1.70	1.65	1.60	1.55	1.55	1.50	1.50	1.72	1.35	3.20	1.35	2.65	2.32	1.30	1.52
D-43	8.20	3.33	7.95	4.95	7.65	7.05	4.00	6.23	4.05	6.0	4.75	6.61	5.05	8.20	3.35
D-47	4.10	3.60	2.95	2.75	4.35	1.95	2.12	2.60	2.97	8.0	2.37	9.60	3.60	3.18	2.95
D-49	2.77	1.75	1.40	1.81	1.55	1.60	1.65	1.30	1.45	2.51	1.65	3.55	2.35	2.45	1.72
D-51	10.65	7.57	11.03	8.93	10.85	10.00	7.85	8.94	8.35	9.60	9.05	10.48	9.15	11.15	6.45
D-55	2.57	2.42	4.62	2.44	5.97	1.93	1.82	3.90	1.45	1.95	2.07	6.15	1.57	2.52	3.62
D-74	4.32	3.80	4.04	3.80	4.05	4.95	3.60	4.55	3.41	5.0	4.0	10.05	7.20	7.73	5.00
D-77	6.38	5.30	6.40	6.30	6.30	6.50	4.75	4.79	5.10	6.23	6.0	6.44	5.60	4.60	2.90
D-80	16.55	4.10	19.20	3.05	17.45	14.20	3.35	15.25	3.32	13.3	3.15	10.97	3.35	6.55	4.15
RCF (part)		May, 10	Nov, 10	May, 11	Nov, 11	May, 12	Nov, 12	May, 13	Nov, 13	May, 14	Nov, 14	May, 15	Nov, 15	May, 16	Nov, 16
DB22		2.79	2.11	2.90	2.23	2.43	2.38	8.18	2.64	6.48	3.03	4.59	3.53	5.38	3.33
DB23		1.50	2.10	3.25	2.70	2.90	2.33	5.05	3.10	3.95	2.13	3.38	6.04	5.30	0.90
DB24		8.25	8.98						8.25	-	8.45	9.52	8.20	10.65	6.50
DB25		4.09	2.99	4.03	2.13	3.96	1.18	1.33	2.53	3.27	2.73	3.83	2.68	3.61	1.98

Annexure – III

HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS



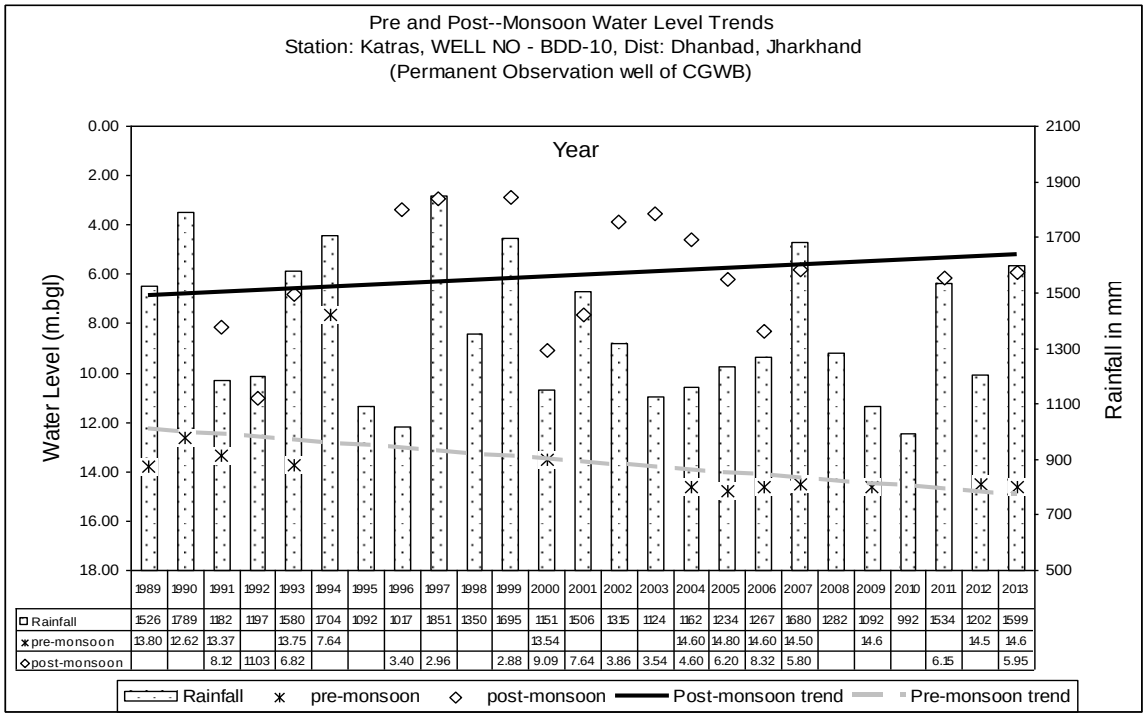
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Rainfall	1456	1885	1249	1217	1416	1162	1526	1789	1182	1197	1580	1704	1092	1017	1851	1350	1695	1152	1507	1315	1124	1023	1233	1267	1680	1281	1092	992	1534	1202	1599
May	4.69	2.08		1.58	2.2	3.64		2.42	1.35	4.73	2.15	1.11	5.42	5.42	5.22	5.42	4.74	3.35	1.77	3.57	2.95	2.10			1.70	1.74	1.69	1.71	1.61		0.50
Nov		1.13	0.92	1.28	1.2	1.4	1.22	1.14	1.53	5.2	2.28		3.42	3.02	1.35	4.49	4.53	4.50	3.40	1.05	1.00	1.80	1.05	1.37	1.5	1.40	1.08	1.98	2.10	0.68	0.90



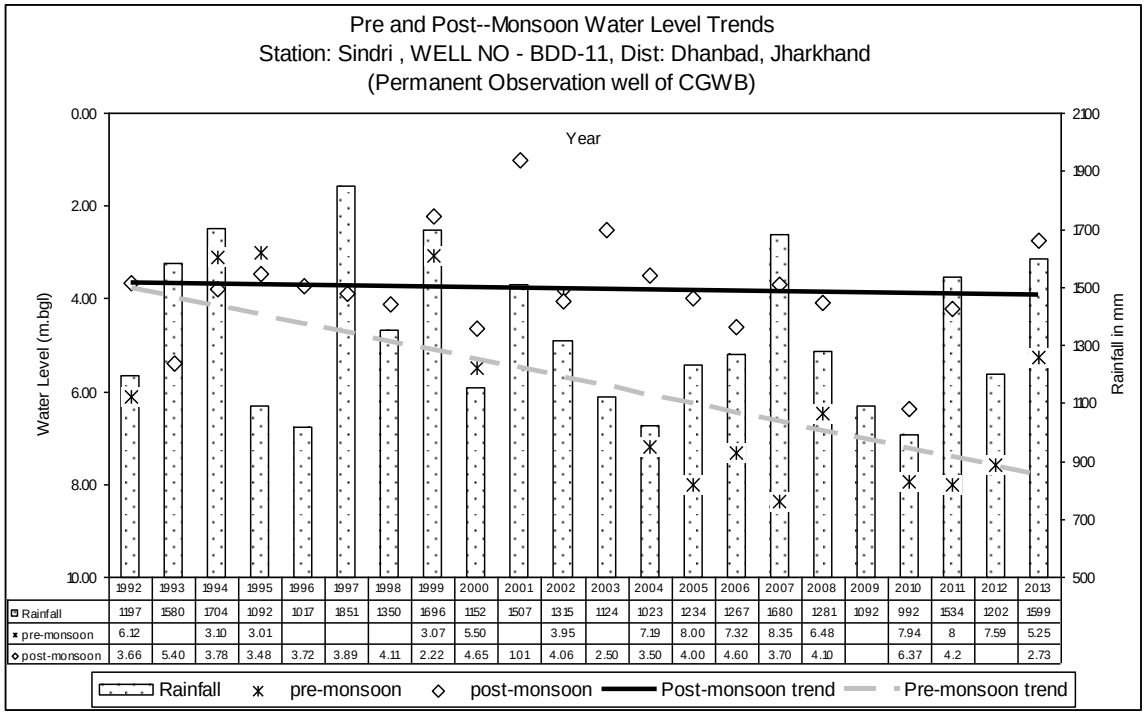
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Rainfall	1162	1526	1789	1182	1197	1580	1704	1092	1017	1851	1350	1695	1151	1506	1315	1124	1162	1234	1267	1680	1282	1092	992	1534	1202	1599
May	10.6	10.50	7.10	10.14	9.73	9.00	8.70	3.98	6.94	7.59	7.68	7.66	4.03			7.50	2.90	9.80		9.80	10.17	10.2	13.57	15.00	11.86	5.65
Nov		3.79	4.14	5.12	9.80	5.47	6.62	7.70	5.51	4.64	2.16	3.22	3.59			1.59	4.10	5.75	4.80	5.25	4.92	5.27	9.33	5.15	5.30	4.94

Annexure – III

HYDROGRAPHS OF CGWB PERMANENT OBSERVATION STATIONS



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Rainfall	1526	1789	1182	1197	1580	1704	1092	1017	1851	1350	1695	1151	1506	1315	1124	1162	1234	1267	1680	1282	1092	992	1534	1202	1599
pre-monsoon	13.80	12.62	13.37		13.75	7.64						13.54				14.60	14.80	14.60	14.50		14.6			14.5	14.6
post-monsoon			8.12	11.03	6.82			3.40	2.96		2.88	9.09	7.64	3.86	3.54	4.60	6.20	8.32	5.80				6.15		5.95



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Rainfall	1197	1580	1704	1092	1017	1851	1350	1696	1152	1507	1315	1124	1023	1234	1267	1680	1281	1092	992	1534	1202	1599
pre-monsoon	6.12		3.10	3.01				3.07	5.50		3.95		7.19	8.00	7.32	8.35	6.48		7.94	8	7.59	5.25
post-monsoon	3.66	5.40	3.78	3.48	3.72	3.89	4.11	2.22	4.65	1.01	4.06	2.50	3.50	4.00	4.60	3.70	4.10		6.37	4.2		2.73

Annexure – IV

GROUNDWATER SAMPLE LOCATION DETAILS

Sampling month: February, May, August & November month of assessment year'2016

Sl No	Name of Cluster	Ground Water Sample	Dug well (CMPDI)	Location	Sampling Date			
					Feb'16	May'16	Aug'16	Nov'16
1	CLUSTER-I	GW-1	B-15	BERA VILLAGE	28/02	20/05	23/08	23/11
2	CLUSTER-II	GW-2	B-59	KHODOVALY VILLAGE	28/02	20/05	23/08	23/11
3	CLUSTER-III	GW-3	A-29	GOVINDPUR,AMBAGAN VILLAGE	28/02	20/05	23/08	23/11
4	CLUSTER-IV	GW-4	B-63	KESHALPUR, BATIGHAR	28/02	20/05	23/08	28/11
5	CLUSTER-V	GW-5	D-30	BORKIBOA VILLAGE	28/02	20/05	23/08	28/11
6	CLUSTER-VI	GW-6	D-25	GODHUR MORE	28/02	21/05	30/08	28/11
7	CLUSTER-VII	GW-7	D-80	DHANSAR MINE RESCUE STN.	29/02	21/05	30/08	28/11
8	CLUSTER-VIII	GW-8	D-49	NEAR GHANOODIH OC	29/02	21/05	30/08	28/11
9	CLUSTER-IX	GW-9	D-5	JEALGORA, NEAR P.O.	29/02	21/05	30/08	29/11
10	CLUSTER-X	GW-10	D-35	PATHERDIH RLY. COLONY	29/02	21/05	30/08	29/11
11	CLUSTER-XI	GW-11	A-32	MONNIDIH BAZAR	28/02	20/05	24/08	29/11
12	CLUSTER-XIII	GW-13	A-23	MACHHAYARA, BESIDE NH-32	28/02	20/05	24/08	28/11
13	CLUSTER-XIV	GW-14	B-23	LOHAPATTI VILLAGE	28/02	20/05	24/08	28/11
14	CLUSTER-XV	GW-15	B-32A	MADHUBAND VILLAGE	28/02	20/05	24/08	28/11
15	CLUSTER-XVI	GW-16	D-22	DAHIBARI,NICHE BASTI	29/02	21/05	30/08	29/11

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: February'2016

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 28/02/2016
2. Cluster-II (GW-2), Khodovaly village, Date: 28/02/2016
3. Cluster-III (GW-3), Govindpur, Date: 28/02/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	1	1	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	70	79	51	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	130	96	50	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.94	1.11	0.57	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.05	0.06	0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	6	2	2	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.97	8.01	8.17	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	138	152	65	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	312	372	308	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	800	860	570	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	424	532	332	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2	3	3	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.015	0.017	0.016	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: February'2016

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 28/02/2016
5. Cluster-V (GW-5), Borkiboa village, Date: 28/02/2016
6. Cluster-VI (GW-6), Godhur, Date: 28/02/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	6	3	5	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	66	122	99	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	72	96	94	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.53	0.70	1.14	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.02	0.05	0.04	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	7	4	3	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.90	7.98	8.02	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	66	148	Acceptable	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	142	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{O3}),, mg/l, Max	172	176	364	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	460	900	890	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{O3}), mg/l, Max	236	616	528	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	7	3	7	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.013	0.020	0.017	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: February'2016

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 29/02/2016
8. Cluster-VIII (GW-8), Ghanudih, Date: 29/02/2016
9. Cluster-IX (GW-9), Jealgora, Date: 29/02/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	<1	3	<1	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	42	78	59	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	90	100	36	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.26	0.66	0.77	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.03	0.04	0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	16	9	5	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.93	8.06	8.26	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	76	88	78	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	152	244	228	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	388	650	420	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	156	408	256	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	<1	5	<1	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.045	0.024	0.018	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: February'2016

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 29/02/2016
11. Cluster-XI (GW-11), Moonidih, Date: 28/02/2016
12. Cluster-XIII (GW-13), Machhayara, Date: 28/02/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	3	4	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	120	40	74	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	106	94	140	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.82	0.27	1.01	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.03	0.03	0.06	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	6	17	3	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.71	7.56	8.12	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	178	70	132	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	172	84	308	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.06	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	910	390	790	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	600	160	428	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	3	5	3	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.020	0.04	0.022	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VA

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: February'2016

Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 28/02/2016
14. Cluster-XV (GW-15), Madhuband, Date: 28/02/2016
15. Cluster-XVI (GW-16), Dahibari, Date: 29/02/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	1	3	4	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	46	53	75	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	82	58	56	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.64	0.58	0.48	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.02	0.03	0.03	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	2	2	12	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.17	8.20	7.92	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	66	75	122	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	248	332	148	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	480	540	580	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	244	348	364	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2	4	6	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.012	0.01	0.149	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2016

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 20/05/2016
2. Cluster-II (GW-2), Khodovaly village, Date: 20/05/2016
3. Cluster-III (GW-3), Govindpur, Date: 20/05/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	5	2	6	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	77	80	96	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	102	56	60	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.10	0.73	0.72	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.06	0.07	0.04	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	4	5	4	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.78	8.04	7.81	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	172	230	98	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	336	236	360	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	1070	970	890	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	600	612	488	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	17	4	15	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.01	0.03	0.03	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2016

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 20/05/2016
5. Cluster-V (GW-5), Borkiboa village, Date: 20/05/2016
6. Cluster-VI (GW-6), Godhur, Date: 21/05/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	2	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	77	96	83	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	80	96	122	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.30	1.04	1.06	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.03	0.05	0.03	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	7	3	6	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.80	8.13	7.49	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	135	156	Acceptable	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	110	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{O3}),, mg/l, Max	224	368	136	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	790	820	620	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{O3}), mg/l, Max	520	496	352	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	6	5	6	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.03	0.01	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2016

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 20/05/2016
8. Cluster-VIII (GW-8), Ghanudih, Date: 21/05/2016
9. Cluster-IX (GW-9), Jealgora, Date: 21/05/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	1	1	1	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	130	42	64	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	76	136	52	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.49	0.89	0.29	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.07	0.02	0.04	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	4	17	7	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.16	7.26	7.83	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	104	63	114	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	296	104	128	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	770	460	540	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	560	220	336	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	3	2	3	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.02	0.08	0.03	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2016

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 21/05/2016
11. Cluster-XI (GW-11), Moonidih, Date: 20/05/2016
12. Cluster-XIII (GW-13), Machhayara, Date: 20/05/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	2	1	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	54	133	88	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	134	60	38	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.55	0.25	0.65	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.03	0.08	0.03	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	17	7	4	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.10	7.89	8.31	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	61	126	90	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	80	264	504	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.06	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	410	980	480	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	176	724	328	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	5	7	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.05	0.06	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VB

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: May'2016

Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 20/05/2016
14. Cluster-XV (GW-15), Madhuband, Date: 20/05/2016
15. Cluster-XVI (GW-16), Dahibari, Date: 21/05/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	4	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	72	109	46	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	80	100	62	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.37	1.03	0.27	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.04	0.07	0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	4	5	11	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.13	7.68	7.74	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	52	167	60	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	404	148	168	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	450	990	370	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	284	640	224	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	6	13	7	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	0.02	0.04	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2016

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 23/08/2016
2. Cluster-II (GW-2), Khodovaly village, Date: 23/08/2016
3. Cluster-III (GW-3), Govindpur, Date: 23/08/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	2	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	88	64	53	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	70	62	122	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.01	1.11	1.06	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.05	0.06	0.05	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	7	12	8	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.26	8.01	7.64	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.002	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	123	224	118	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	212	208	324	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	0.046	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	700	820	780	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	428	424	496	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	3	4	6	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.01	0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2016

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 23/08/2016
5. Cluster-V (GW-5), Borkiboa village, Date: 23/08/2016
6. Cluster-VI (GW-6), Godhur, Date: 30/08/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	5	4	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	56	80	110	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	38	188	154	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.34	1.24	1.08	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.04	0.08	0.09	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	6	18	15	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.16	7.79	8.02	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	90	144	Acceptable	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	168	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{O3}),, mg/l, Max	204	252	416	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	380	880	1060	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{O3}), mg/l, Max	172	432	452	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	12	10	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.01	0.01	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2016

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 30/08/2016
8. Cluster-VIII (GW-8), Ghanudih, Date: 30/08/2016
9. Cluster-IX (GW-9), Jealgora, Date: 30/08/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	1	1	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	50	46	92	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	54	52	66	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.37	0.38	1.23	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.04	0.03	0.05	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.043	0.059	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	20	18	14	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.55	6.16	7.99	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	62	60	124	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	128	80	280	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	320	340	670	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	176	200	400	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	3	2	2	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.07	0.06	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2016

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 30/08/2016
11. Cluster-XI (GW-11), Moonidih, Date: 24/08/2016
12. Cluster-XIII (GW-13), Machhayara, Date: 24/08/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	7	3	4	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	82	64	94	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	92	58	68	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.66	0.84	1.09	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.06	0.07	0.05	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	35	4	16	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.12	7.95	7.47	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	110	82	108	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	188	356	268	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.06	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	740	640	700	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	488	456	476	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	15	7	7	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.01	0.02	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VC

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: August'2016

Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 24/08/2016
14. Cluster-XV (GW-15), Madhuband, Date: 24/08/2016
15. Cluster-XVI (GW-16), Dahibari, Date: 30/08/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	1	2	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	46	67	70	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	50	30	30	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.40	0.81	1.05	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	0.02	0.03	0.03	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.055	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	24	27	30	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	6.55	8.27	7.83	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.002	<0.002	<0.002	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	62	102	108	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	64	260	192	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	320	570	590	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	172	368	364	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	2	3	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.10	0.01	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: November'2016

Stations: 1. Cluster-I (GW-1), Bera Village, Date: 23/11/2016
2. Cluster-II (GW-2), Khodovaly village, Date: 23/11/2016
3. Cluster-III (GW-3), Govindpur, Date: 23/11/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		1	2	3			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	3	3	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	59.2	86.4	94.4	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	66	106	88	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.39	0.80	1.00	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	10.19	1.33	2.66	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.35	8.18	8.04	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.002	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	68	136	102	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	128	200	304	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	446	618	704	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	220	440	460	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	4	4	3	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.01	0.01	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: November'2016

Stations: 4. Cluster-IV (GW-4), Keshalpur Village, Date: 28/11/2016
5. Cluster-V (GW-5), Borkiboa village, Date: 28/11/2016
6. Cluster-VI (GW-6), Godhur, Date: 28/11/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		4	5	6			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	2	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	60.8	65.6	51.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	76	70	122	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.47	0.81	0.81	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	9.30	1.33	3.10	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.57	8.31	8.51	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	58	41	Acceptable	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	260	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{O3}),, mg/l, Max	156	240	252	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	446	466	834	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{O3}), mg/l, Max	250	260	540	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	4	3	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.02	0.02	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: November'2016

Stations: 7. Cluster-VII (GW-7), Dhansar, Date: 28/11/2016
8. Cluster-VIII (GW-8), Ghanudih, Date: 28/11/2016
9. Cluster-IX (GW-9), Jealgora, Date: 29/11/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		7	8	9			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	3	2	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	33.6	110.4	33.6	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	58	64	58	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.19	0.48	0.18	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.10	<0.02	0.10	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	9.30	7.09	7.53	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	7.90	7.93	7.85	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	63	132	63	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	32	228	32	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	278	602	276	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	120	440	120	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	4	4	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.13	<0.01	0.12	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: November'2016

Stations: 10. Cluster-X (GW-10), Patherdih, Date: 29/11/2016
11. Cluster-XI (GW-11), Moonidih, Date: 29/11/2016
12. Cluster-XIII (GW-13), Machhayara, Date: 28/11/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		10	11	12			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	3	2	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	112	105.6	115.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	64	82	100	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.48	0.51	0.47	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	0.06	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	7.53	2.66	11.96	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.06	8.04	8.11	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	134	230	60	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_aco_3),, mg/l, Max	220	408	204	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.06	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	602	902	618	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_aco_3), mg/l, Max	440	780	480	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	4	3	2	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	0.01	0.01	<0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Annexure – VD

GROUNDWATER QUALITY DATA (DUG WELLS)
Month: November'2016

Stations: 13. Cluster-XIV (GW-14), Lohapatti, Date: 28/11/2016
14. Cluster-XV (GW-15), Madhuband, Date: 28/11/2016
15. Cluster-XVI (GW-16), Dahibari, Date: 29/11/2016

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		13	14	15			
1	Boron (as B), mg/l, Max	<0.20	<0.20	<0.20	0.20	0.5	APHA, 22nd Edition ,Carmine
2	Colour,in Hazen Units	2	3	3	1	5	APHA, 22nd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	59.2	65.6	76.8	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	68	42	60	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	0.25	0.34	0.28	0.02	1.0	APHA, 22nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	<0.02	0.02	0.2	APHA, 22nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	<0.06	<0.06	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	APHA, 22nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.055	<0.02	<0.02	0.02	0.1	IS-3025/59:2006, AAS-Flame
11	Nitrate (as NO_3), mg/l, Max	12.40	0.89	1.77	0.5	45	APHA, 22nd Edition, UV-Spectrphotometric
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
13	pH value	8.42	8.21	8.02	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.002	<0.002	<0.002	0.001	0.001	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium (as Se), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	APHA, 22nd Edition, AAS-GTA
16	Sulphate (as SO_4) mg/l, Max	55	90	170	2.00	200	APHA, 22nd Edition. Turbidity
17	Taste	Acceptable	Acceptable	Acceptable	Qualitat-ive	Acceptable	APHA, 22nd Edition. Taste
18	Total Alkalinity (c_ac_{03}),, mg/l, Max	124	264	76	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025/52:2003, AAS-Flame
21	Total Dissolved Solids, mg/l, Max	424	518	428	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
22	Total Hardness (c_ac_{03}), mg/l, Max	230	370	300	4.00	200	IS-3025/21:1983, R-2002, EDTA
23	Turbidity, NTU, Max	4	4	4	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
24	Zinc (as Zn), mg/l, Max	<0.01	0.03	0.03	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

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

Abbreviations

AMSL: Above mean sea level

Avg.: Average

APT: Aquifer Pumping Test

BCCL: Bharat Coking Coal Ltd.

bgl: Below Ground Level

Buffer zone: periphery of the 10 km radius from the project boundary

Core zone: Project / mine / colliery boundary (leasehold area)

CMPDI: Central Mine Plan & Design Institute

DVC: Damodar Valley Corporation

DTW: Depth to water level

GW: Groundwater

IMD: Indian Meteorological Division

JCF: Jharia Coalfield

RCF: Raniganj Coalfield

MADA: Mineral Area Development Authority

MCM: Million Cubic Meter

MGD: Million Gallon per day

NTU: Nephlometric Turbidity unit

OC / UG: Opencast / Underground

OCP / UGP: Opencast Project / Underground Project

RL: Reduced Level

RWH: Rainwater Harvesting

FF: Fire Fighting

ANNEXURE – VI A

BHARAT COKING COAL LIMITED

CSR BUDGET AND EXPENDITURE for FY 2016-17

Expenditure under CSR for the year 2016-17				
S. No.	CSR Project or Activity identified	Sector in which the project is covered	Amount spent on the projects or programs Sub-heads:(1) Direct Expenditure on projects or programs(2) Overheads: (lakhs)	
			Direct	Overheads
1	Construction of toilets in various school in Paschimi Singhbhum District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	389.32	3.00
2	Construction of toilets in various school in Bokaro District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	8.15	
3	Construction of toilet in various school in Dumka District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	341.96	
4	Construction of toilet in various school in Gumla District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	68.77	
5	Construction of toilet in various schools in Dhanbad District	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the	1.17	

		promotion of sanitation and making available safe drinking water		
6	Construction of toilet in various schools in Simdega District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	132.02	
7	Construction of toilets in various schools in Purbi Singhbhum district of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	2.00	
8	Constn. of Toilets in various School in Koderma District of Jharkhand.	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	16.91	
9	SVA LIABILITY	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	737.86	
10	SVA LIABILITY reversed	Eradicating hunger, poverty and malnutrition, promoting health care including preventive health care and sanitation including contribution to Swach Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water	(1,022.52)	
Total			675.63	3.00
Grand Total			**678.63**	

BHARAT COKING COAL LIMITED			
CSR BUDGET AND EXPENDITURE			
Year	**CSR Budget (Rs in lakh)**	**Projects/ Activities**	**Expenditure incurred (In Rs. Lakhs)**
2013-14	3050	Drinking Water/ Water Supply	278
		Education	20
		Infrastructure Development	351.15
		Skill Development	82
		Medical/Healthcare	49
		Others (Uttrakhand Chief Minister Relief fund)	2000
		Total of 2013-14	**2780.15**
2014-15	3080	Drinking Water/ Water Supply & Sanitation	4.69
		Education	2.87
		Infrastructure Development	244.9
		Skill Development	55.73
		Medical/Healthcare	32.55
		Forestry & Environment	73.43
		Others	18.29
		PMNRF	1000
		Total of 2014-15	**1432.46**
2015-16	3300	Drinking Water/ Water Supply & Sanitation	3.33
		Swachh Vidyalaya Abhiyan	5868.51
		Education	17.01
		Infrastructure Development	161.75
		Skill Development	0.12
		Medical/Healthcare	33.06
		Forestry & Environment	2.94
		Conservation of Natural resources	63.76
		Others	13.23
		Transfer of CSR Expenditure spent by BCCL CSR Budget allotted by CIL (CIL the Holding Company has also incurred CSR expenditure to the tune of Rs.10.97 crore through BCCL, which has been borne and accounted for the books of CIL)	-1096.58
		Total of 2015-16	**5067.13**

CSR ACTIVITY PLAN

OF

CLUSTER – X

AS PER

EC CONDITION (SPECIFIC CONDITION-XLII): Details of transportation, CSR, R&R and implementation of environmental action plan for each of the 17 clusters should be brought out in a booklet for and submitted to Ministry.

MAY, 2017

INTRODUCTION

Coal India has adopted CSR as a strategic tool for sustainable growth. For Coal India in the present context, CSR means not only investment of funds for Social Activity but also Integration of Business processes with Social processes. Even much before the issue of CSR became global concern; Coal India was aware of its Corporate Social Responsibility and was fulfilling the aspiration of the Society through well-defined "Community Development Policy" within the periphery of 8 Kms. of the Project sites. This has resulted into a harmonious relationship between Coal India and the peripheral Communities.

Coal India has identified land oustees, PAP and those staying within the radius of 25 Kms of the Project as primary beneficiaries. Poor and needy section of the society living in different parts of India are second beneficiaries. For carrying out CSR activities, 80% of the budgeted amount are be spent within the radius of 25 Km of the Project Site/Mines/Area HQ/Company HQ and 20% of the budget to be spent within the States in which operating.

SCOPE

As per Schedule VII Section 135 of New Companies Act 2013 the following should be the Scope of Activities under Corporate Social Activities:

i. Eradicating hunger, poverty and malnutrition, promoting healthcare including preventive health care and sanitation and making available safe drinking water.
ii. Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently able and livelihood enhancement projects;
iii. Promoting gender equality, empowering women, setting up homes and hostels for women and orphans, setting up old age homes, day care centers and such other facilities for senior citizens and measures for reducing inequalities faced by socially and economically backward groups;
iv. Ensuring environmental sustainability, ecological balance, protection of Flora and Fauna, animal welfare, agro-forestry, conservation of natural resources and maintaining quality of soil, air and water;
v. Protection of national heritage, art and culture including restoration of buildings and sites of historical importance and works of art; setting up public libraries, promotion and development of traditional arts and handicrafts;
vi. Measures for the benefit of armed forces veterans, war widows and their dependents
vii. Training to promote rural sports, nationally recognized sports, Paralympics sports and Olympic sports;
viii. Contribution to the Prime Minister's National Relief Fund or any other fund set up by the Central Government for socio-economic development and relief and welfare of the Scheduled Castes, the Scheduled Tribes, other backward classes, minorities and women;
ix. Contributions or funds provided to technology incubators located within academic institutions whichare approved by the Central Government;
x. Rural development projects

SOURCE OF FUND

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

CURRENT STATUS

Healthcare: Annual CSR (Healthcare) Expenditure for the year 2015-16 and 2016-17.

I. Mobile Medical Van (MMV):

S. No.	Year (financial year)	No. of Mobile Medical VanCamp	Beneficiaries	Amount (inRs.)	Remarks
1	2015-16	229	7012	215927.76	Till Dec. 2016

II. General Medical Camps:

S. No.	Year (financial year)	Name of Medical Camp	Beneficiaries	Date
1.	2015-16	Family Planning Camp	33	03.02.2016
2.		Family Planning Camp	40	16.02.2016

Highlights of CSR Work under taken during 2015-16 and 2016-17 at Cluster-X

S. No.	Details	No. of units		Total Amount (in Rs.)	Remarks
		Girls	Boys		
1.	Construction of toilets in various schools in Saraikela-Kharsawan district of Jharkhand under "Swachh Vidyalaya Abhiyaan"under CSR activities of BCCL.	89	89	29,548,000	Work was done by state government.
	Total	178		29,548,000	

PROPOSED STATUS

CSR Work to be under taken during 2017-18 at Cluster- X

S. No.	Details	Remarks
1.	Construction of Marriage/Multipurpose Hall in Mayurdubhi (मयुरदुभी) village in Amai Nagar (आमाई नगर(Panchayat of Block Chandankyari	Proposed activity

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BCCL

C.S.R. PERFORMANCE REPORT MONTHWISE
April 2015 to December 2016
BHowrah REGIONAL HOSPITAL. E.J. AREA.

MOBILE MEDICAL VAN.

Date: 29.04.2016

SL.NO.	MONTH	NO.OF.CAMP	NO.OF.BENEFICIARIES	TOTAL EXPENDITURE
1.	April 15	26	1122	₹ 39,171.33
2.	May	25	937	₹ 35,270.12
3.	June	25	941	₹ 32,950.08
4.	July	27	1028	₹ 38,685.08
5.	August	25	1003	₹ 31,288.24
6.	September	26	634	₹ 17,211.73
7.	October	24	443	₹ 7,963.19
8.	November	24	517	₹ 7870.23
9.	December	27	387	₹ 5,517.76
10.	January 16			
11.	February			
12.	March			
	Total ---	229	7012	₹ 2,15,927.76

Dy.C.M.O. I/C
Sudamdih R/ Hospital
E.J.Area.

NAME OF VILLAGES COVERED UNDER CSR/MMV PROGRAMME

E.J. AREA - VILLAGES

1. Bhowrah 19 No. Basti.
2. Parghabad Basti
3. Supker Basti
4. Manjhi Basti.
5. Mohubani Basti.
6. Sheobabudih
7. Bhowrah 7No Basti.
8. Bhowrah 4 No Basti.
9. Bhowrah Jahaj Tand.
10. Thana Basti.
11. Manpur Basti.
12. Amlabad Basti.
13. New Riverside Basti.
14. Gourkhutti Basti.
15. Sawardih Basti
16. Hattala Basti.

Dy.C.M.O. I/C
Sudamdih R/Hospital

65959

FAMILY PLANNING CAMP

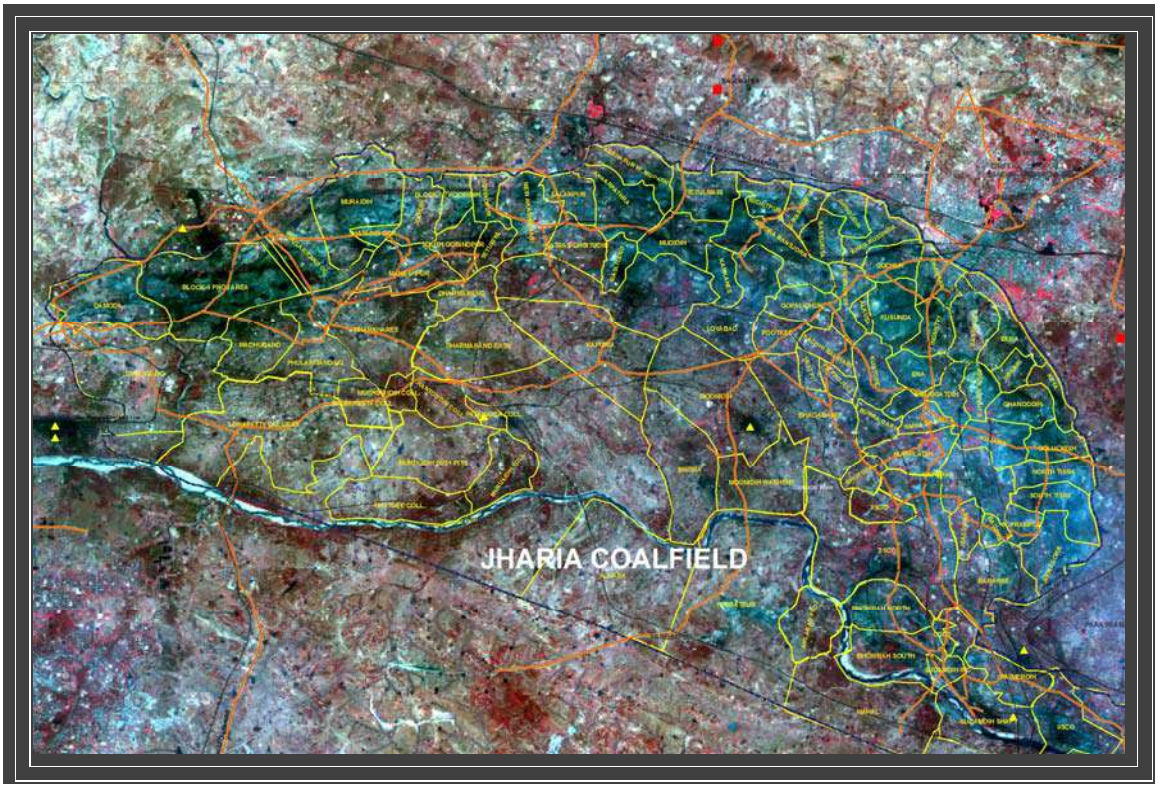
E.J.AREA

1. Sudamdih R/ Hospital date - 0 3.02.2016. Beneficiaries- 33
2. Bhowrah R/ Hospital date - 16.02.2016 Beneficiaries –40

Dy.C.M.O

Sudamdih R /Hospital

Vegetation Cover Mapping of Jharia Coalfield based on Satellite Data of the Year- 2016



Submitted to

Bharat Coking Coal Ltd (BCCL)

Dhanbad

March 2017

cmpdi

A Mini Ratna Company

Vegetation Cover Mapping of Jharia Coalfield based on Satellite Data of the Year- 2016

March-2017

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

Document Control Sheet

(1)	Job No.	RSC/561410027
(2)	Publication Date	March 2017
(3)	Number of Pages	49
(4)	Number of Figures	6
(5)	Number of Tables	10
(6)	Number of Plates	17
(7)	Title of Report	Vegetation cover mapping of Jharia Coalfield based on satellite data for the year 2016.
(8)	Aim of the Report	To prepare Land use and vegetation cover map of Jharia Coalfield on 1:50000 scale based on satellite data for monitoring the impact of coal mining on land use pattern and vegetation cover & also to prepare cluster wise Land use/ Cover maps falling under Jharia Coalfield.
(9)	Executing Unit	Remote Sensing Cell, Geomatics Division Central Mine Planning & Design Institute Limited, Gondwana Place, Kanke Road, Ranchi 834008
(10)	User Agency	Coal India Ltd.(CIL) / Bharat Coking Coal Ltd.(BCCL)
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(13)	No. of Copies	5
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Chapter 1

Introduction

1.1 Project Reference

To monitor the regional impact of coal mining on land use pattern and vegetation cover in the 28 major coalfields at regular interval of three years based on remote sensing satellite data, Coal India Ltd. issued a work order to CMPDI vide letter no.CIL/WBP/ENV/2011/4706 dated 12.10.12. As the Impact of coal mining on land environment has to be assessed regularly at interval of three years, Geo-environmental data base for Jharia coalfield based on satellite data was prepared earlier in the year 2010, 2012 under the above project. The present study is based on the satellite data of the year 2016. BCCL vide their letter No BCCL/ DGM(Env)/File-/16/276 dated 25.05.2016 requested that the map of each cluster under Jharia Coalfield shall also be incorporated in the report for EC compliance. Therefore cluster-wise land use/cover maps are also included in this report.

1.2 Objective

The objective of the present study is to prepare a regional land use and vegetation cover map of Jharia coalfield on 1:50,000 scale based on satellite data of the year 2016, using digital image processing technique for monitoring the impact of coal mining and other industrial activities on land use and vegetation cover in the coalfield area in period of last three years.

1.4 Location of the Area & Accessibility

The Jharia Coalfield (JCF) is located in the north east part of the State of Jharkhand, approximately 260 km west of Kolkata. It is linked to Kolkata and Delhi through NH 2, which is the part of Golden Quadrilateral highway network of India. The coalfield contains proven coal reserves of approximately one billion tonnes in a crescent-shaped basin of approximately 400 km^2. BCCL operates within an area of approximately 258 Sq km. The Jharia coalfield covers an area of about 393 sq km. it is bounded by Lat $23^0$49'0.63"N and $23^0$38'36.50"N and Long $86^0$08'49.91"E and $86^0$25'54.92E. The major part of coalfield (about 400 sq km) lies in Dhanbad district of Jharkhand. Coalfield is connected by Major Highways road with Ranchi (117 km), Asansol (60 km), Jamshedpur (108 km) and Dhanbad (8 km). The nearest major railway station is Dhanbad, located on Delhi-Howrah Grand Chord line oh East Central Railway which passes parallel to northern boundary of the coalfield.

1.5 Physiography and Geology

Jharia coalfield is characterized by gently undulating to a rolling topography with an overall slope towards east-southeast. The coalfield is roughly sickle shaped on plan and occurs as a basin with its axis trending broadly east-west and plunging towards the west. The southern flank is truncated by a major Boundary Fault. The general dip of the formation is 10 to 15 degrees. Flatter dips have also been noted at places. The entire southern part of Jharia coalfield in the vicinity of the Boundary Fault, however shows generally steep dipping beds with amounts increasing even up to 70 degrees.

The drainage pattern in the Jharia coalfield is dendritic in nature. This may be due to more or less homogeneous lithology and structural controls. Damodar river is the main control of drainage system along the Jharia coalfield. It is a fourth order stream to which a number of third to first order streams, viz.

Jamunia, Khudia, Katri, Ekra, Tisra, Chatkari etc. join. Damodar river flows along the southern periphery of the coalfield and is guided by the Main Boundary Fault. The main flow direction is from west to east.

The strike of the formation is generally WSW to ENE in the western part and WNW to ESE in the southern part of the coalfield. This gradually swings to EW in the centre of the coalfield and then to NS further east. In the south-eastern part the strike is generally WNW-ESE. Besides the boundary part the coalfield is traversed by a number of other major and minor faults.

The Barakar formation contains 18 standard coal horizons (numbered I to XVIII). Of the Barakar formations, the coal seams XIII and above are generally thin and of relatively superior quality. Seams XII to IX/X are of medium to superior quality and attain sizable thickness at places. The V, VI, VII, IV, III & II are generally thick seams of inferior quality. The bottom most seam I is of superior medium coking quality in the eastern part of the coalfield.

A map of India showing the location of Jharia Coalfield is given in Fig1.1.

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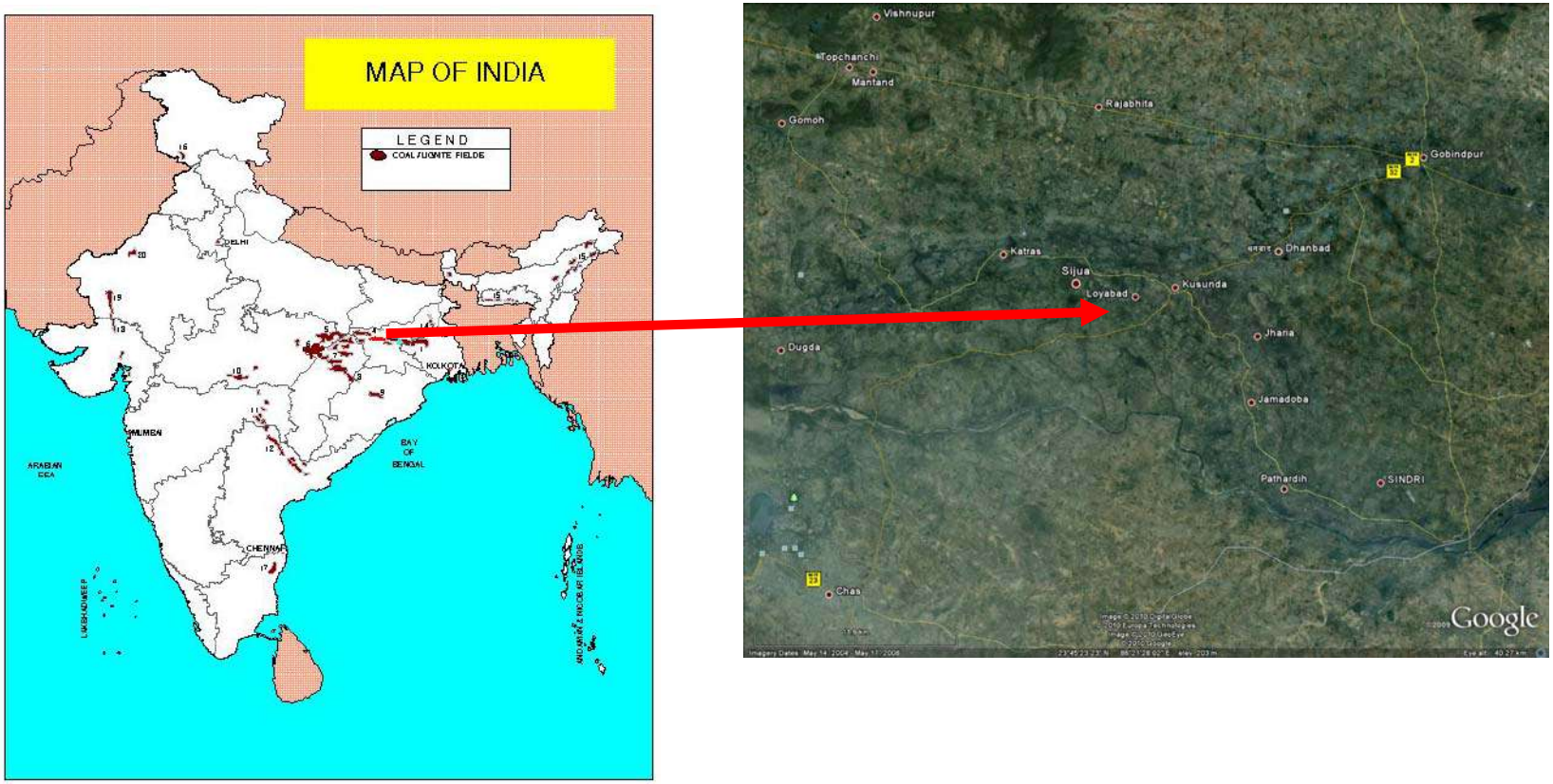


Fig 1.1: Map of India Showing the Location of Jharia Coalfields

Chapter 2

Remote Sensing Concepts and Methodology

2.1 Remote Sensing

Remote sensing is the science and art of obtaining information about an object or area through the analysis of data acquired by a device that is not in physical contact with the object or area under investigation. The term *remote sensing* is commonly restricted to methods that employ electro-magnetic energy (such as light, heat and radio waves) as the means of detecting and measuring object characteristics.

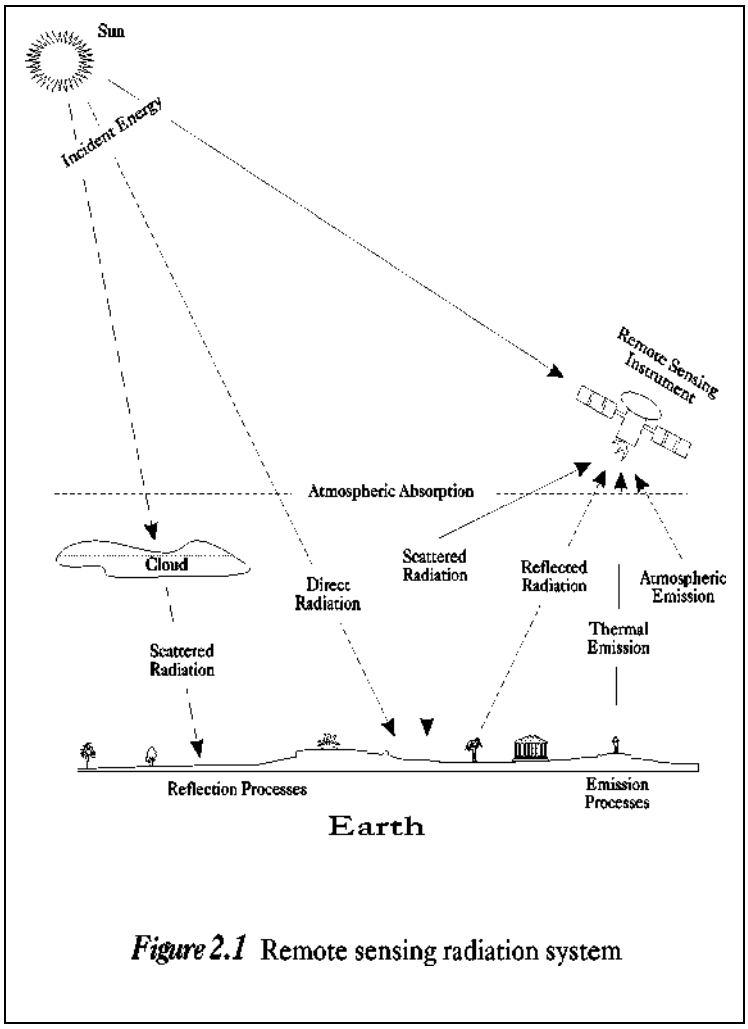


Figure 2.1 Remote sensing radiation system

All physical objects on the earth surface continuously emit electromagnetic radiation because of the oscillations of their atomic particles. Remote sensing is largely concerned with the measurement of electro-magnetic energy from the *SUN*, which is reflected, scattered or emitted by the objects on the surface of the earth. Figure 2.1 schematically illustrate the generalised processes involved in electromagnetic remote sensing of the earth resources.

2.2 Electromagnetic Spectrum

The electromagnetic (EM) spectrum is the continuum of energy that ranges from meters to nanometres in wavelength and travels at the speed of light. Different objects on the earth surface reflect different amounts of energy in various wavelengths of the EM spectrum.

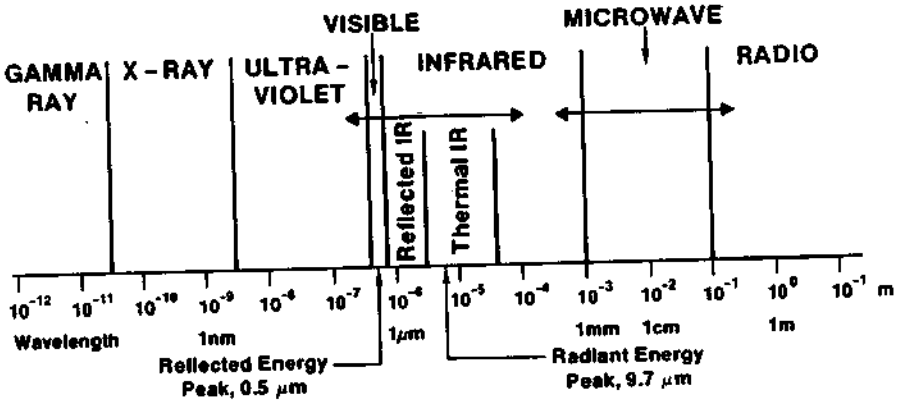


Figure 2.2 Electromagnetic spectrum. Expanded versions of the visible, infrared and microwave regions are shown in Figure 2.3.

Figure 2.2 shows the electromagnetic spectrum, which is divided on the basis of wavelength into different regions that are described in Table 2.1. The EM spectrum ranges from the very short wavelengths of the gamma-ray region to the long wavelengths of the radio region. The visible region (0.4-0.7µm wavelengths) occupies only a small portion of the entire EM spectrum.

Energy reflected from the objects on the surface of the earth is recorded as a function of wavelength. During daytime, the maximum amount of energy is reflected at 0.5µm wavelengths, which corresponds to the green band of the visible region, and is called the *reflected energy peak* (Figure 2.2). The earth also radiates energy both day and night, with the maximum energy 9.7µm wavelength. This *radiant energy peak* occurs in the thermal band of the IR region.

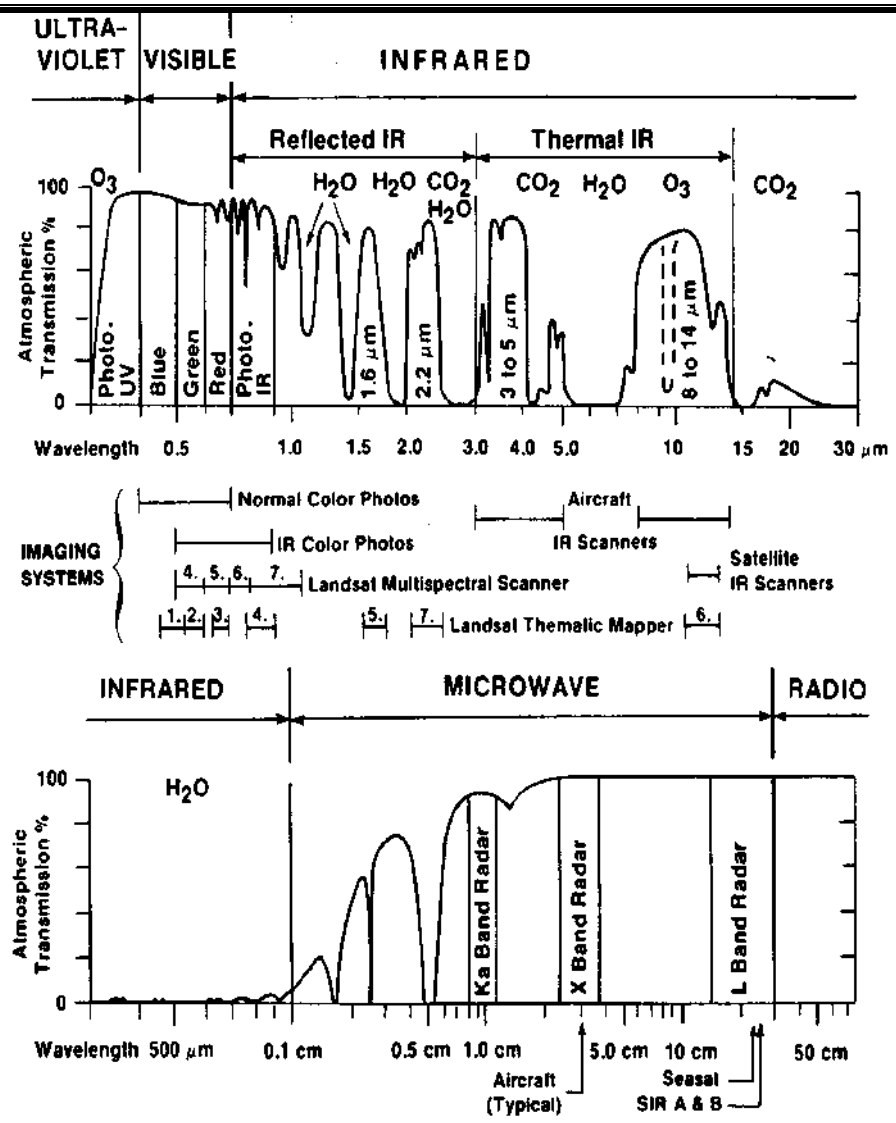


Figure 2.3 Expanded diagrams of the visible and infrared regions (upper) and the microwave regions (lower) showing atmospheric windows. Wavelength bands of commonly used remote sensing systems are indicated. Gases responsible for atmospheric absorption are shown.

Table 2.1 Electromagnetic spectral regions

Region			Wavelength		Remarks
Gamma ray		<	0.03	**nm**	Incoming radiation is completely absorbed by the upper atmosphere and is not available for remote sensing.
X-ray	0.03	to	3.00	**nm**	Completely absorbed by atmosphere. Not employed in remote sensing.
Ultraviolet	0.03	to	0.40	**µm**	Incoming wavelengths less than 0.3mm are completely absorbed by Ozone in the upper atmosphere.
Photographic UV band	0.30	to	0.40	**µm**	Transmitted through atmosphere. Detectable with film and photo detectors, but atmospheric scattering is severe.
Visible	0.40	to	0.70	**µm**	Imaged with film and photo detectors. IBCCLudes reflected energy peak of earth at 0.5mm.
Infrared	0.70	to	100.00	**µm**	Interaction with matter varies with wavelength. Absorption bands separate atmospheric transmission windows.
Reflected IR band	0.70	to	3.00	**µm**	Reflected solar radiation that contains no information about thermal properties of materials. The band from 0.7-0.9mm is detectable with film and is called the *photographic IR band*.
Thermal IR band	3.00	to	5.00	**µm**	Principal atmospheric windows in the thermal region. Images at these wavelengths are acquired by optical-mechanical scanners and special Videocon systems but not by film.
	8.00	to	14.00	**µm**	
Microwave	0.10	to	30.00	**cm**	Longer wavelengths can penetrate clouds, fog and rain. Images may be acquired in the active or passive mode.
Radar	0.10	to	30.00	**cm**	Active form of microwave remote sensing. Radar images are acquired at various wavelength bands.
Radio		>	30.00	**cm**	Longest wavelength portion of electromagnetic spectrum. Some classified radars with very long wavelength operate in this region.

The earth's atmosphere absorbs energy in the gamma-ray, X-ray and most of the ultraviolet (UV) region; therefore, these regions are not used for remote sensing. Details of these regions are shown in Figure 2.3. The horizontal axes show wavelength on a logarithmic scale; the vertical axes show percent atmospheric transmission of EM energy. Wavelength regions with high transmission are called *atmospheric windows* and are used to acquire remote sensing data. The major remote sensing sensors record energy only in the visible, infrared and micro-wave regions. Detection and measurement of the recorded energy enables identification of surface objects (by their characteristic wavelength patterns or spectral signatures), both from air-borne and space-borne platforms.

2.3 Scanning System

The sensing device in a remotely placed platform (aircraft/satellite) records EM radiation using a *scanning system*. In scanning system, a *sensor*, with a narrow field of view is employed; this sweeps across the terrain to produce an image. The sensor receives electromagnetic energy radiated or reflected from the terrain and converts them into signal that is recorded as numerical data. In a remote sensing satellite, multiple arrays of linear sensors are used, with each array recording simultaneously a separate band of EM energy. The array of sensors employs a spectrometer to disperse the incoming energy into a spectrum. Sensors (or *detectors*) are positioned to record specific wavelength bands of energy. The information received by the sensor is suitably manipulated and transported back to the ground receiving station. The data are reconstructed on ground into digital images. The digital image data on *magnetic/optical media* consist of picture elements arranged in regular rows and columns. The position of any picture element, *pixel*, is determined on a x-y co-ordinate system. Each pixel has a numeric value, called digital number (DN), which records the intensity of electromagnetic energy measured for the ground resolution cell represented by that pixel. The range of digital numbers in an image data is controlled by the radiometric resolution of the satellite's sensor system. The digital image data are further processed to produce master images of the study area. By analysing the digital data/imagery, digitally/visually, it is possible to detect, identify and classify various objects and phenomenon on the earth surface.

Remote sensing technique provides an efficient, speedy and cost-effective method for assessing the changes in vegetation cover certain period of time due to its inherited capabilities of being multi-spectral, repetitive and synoptic aerial coverage.

2.4 Data Source

The following data are used in the present study:

- **Primary Data** –Raw satellite data, obtained from National Remote Sensing Centre (NRSC), Hyderabad, as follows, was used as primary data source for the study.

  IRS R2/ L4FMX; Band 2,3,4,5; Path # 106, Row # 055; Date of pass 5.01.2016*.

  The detail specification of the data is also given in Table 2.2.

- **Secondary Data**

  Secondary (ancillary) and ground data constitute important baseline information in remote sensing, as they improve the interpretation accuracy and reliability of remotely sensed data by enabling verification of the interpreted details and by supplementing it with the information that cannot be obtained directly from the remotely sensed data.

2.5 Characteristics of Satellite/Sensor

The basic properties of a satellite's sensor system can be summarised as:

(a) Spectral coverage/resolution, i.e., band locations/width; (b) spectral dimensionality: number of bands; (c) radiometric resolution: quantisation; (d) spatial resolution/instantaneous field of view or IFOV; and (e) temporal resolution. Table 2.2 illustrates the basic properties of IRS-R2 satellite/sensor that is used in the present study.

Table 2.2 Characteristics of the satellite/sensor used in the present project work										
Platform	Sensor	Spectral Bands in µm					Radiometric Resolution	Spatial Resolution	Temporal Resolution	Country
IRS- P-6	LISS-IV	B2 B3 B4 B5	0.52 0.62 0.77 1.55	- - - -	0.59 0.68 0.86 1.70	Green Red NIR MIR	10 bits (7 bits transmitted with DPCM)	5.8m	24 days	India
NIR: Near Infra-Red MIR: Middle Infra-Red										

2.6 Data Processing

The methodology for data processing carried out in the present study is shown in Figure 2.4. The processing involves the following major steps:

(a) Geometric correction, rectification and geo-referencing;

(b) Image enhancement;

(c) Training set selection;

(d) Signature generation and classification;

(e) Creation/overlay of vector database;

(f) Validation of classified image;

(g) Layer wise theme extraction using GIS

(g) Final vegetation map preparation.

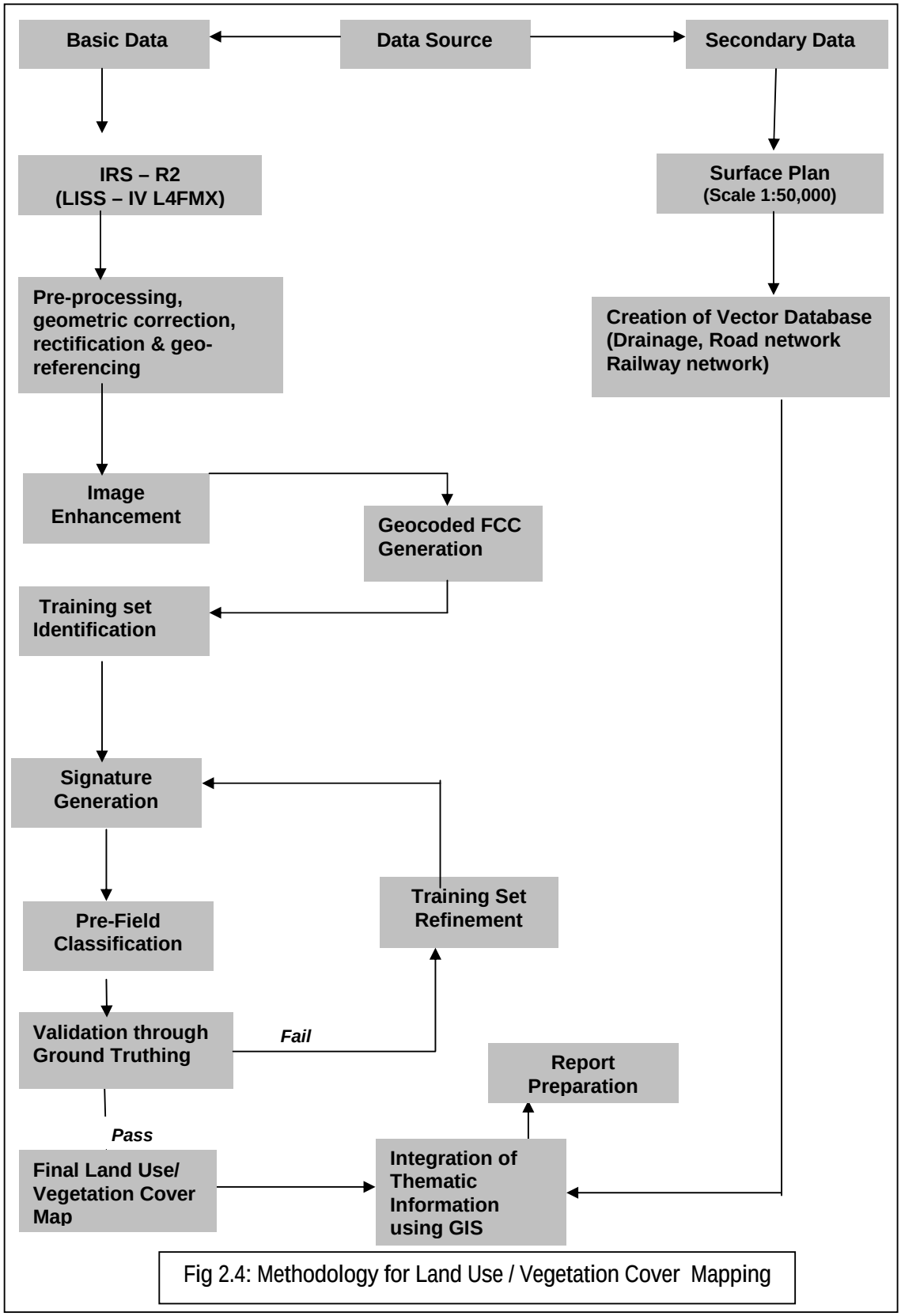


Fig 2.4: Methodology for Land Use / Vegetation Cover Mapping

2.6.1 Geometric correction, rectification and georeferencing

Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to intermittent sensor malfunctions, etc. Systematic errors are corrected at the satellite receiving station itself while non-systematic errors/ random errors are corrected in pre-processing stage.

In spite of 'System / Bulk correction' carried out at supplier end; some residual errors in respect of attitude attributes still remains even after correction. Therefore, fine tuning is required for correcting the image geometrically using ground control points (GCP).

Raw digital images contain geometric distortions, which make them unusable as maps. A map is defined as a flat representation of part of the earth's spheroidal surface that should conform to an internationally accepted type of cartographic projection, so that any measurements made on the map will be accurate with those made on the ground. Any map has two basic characteristics: (a) scale and (b) projection. While *scale* is the ratio between reduced depiction of geographical features on a map and the geographical features in the real world, *projection* is the method of transforming map information from a sphere (round Earth) to a flat (map) sheet. Therefore, it is essential to transform the digital image data from a generic co-ordinate system (i.e. from line and pixel co-ordinates) to a projected co-ordinate system. In the present study geo-referencing was done with the help of Survey of India (SoI) topo-sheets so that information from various sources can be compared and integrated on a GIS platform, if required.

An understanding of the basics of projection system is required before selecting any transformation model. While maps are flat surfaces, Earth however is an irregular sphere, slightly flattened at the poles and bulging at the Equator. Map projections are systemic methods for "*flattening the orange peel*" in measurable ways. When transferring the Earth and its irregularities onto the plane surface of a map, the following three factors are involved: (a) geoid (b) ellipsoid and (c) projection. Figure 2.5 illustrates the relationship between these three factors. The *geoid* is the rendition of the irregular spheroidal shape of the Earth; here the variations in gravity are taken into account. The observation made on the geoid is then transferred to a regular geometric reference surface, the *ellipsoid*. Finally, the geographical relationships of the ellipsoid (in 3-D form) are transformed into the 2-D plane of a map by a transformation process called map projection. As shown in Figure 2.5, the vast majority of projections are based upon *cones*, *cylinders* and *planes*.

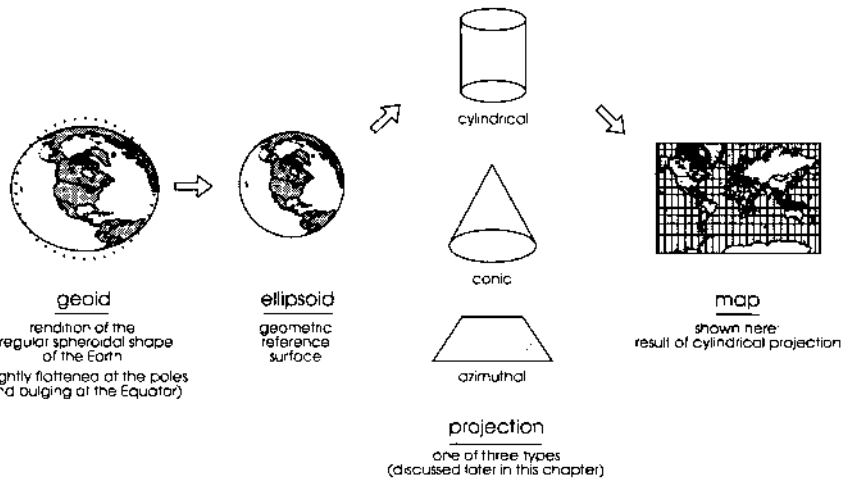


Fig 2.5 : Geoid – Ellipsoid – Projection Relationship

In the present study, ***UTM projection*** *along with* ***WGS 84 model*** was used so as to prepare the map compatible with the SoI topo-sheets**.** UTM projection is used in SoI topo-sheets as it is best suited for small-scale mapping and larger area as well as for areas with North-South orientation (viz. India). Maps prepared using this projection is a compromise of many properties; it is neither conformal perspective nor equal area. Distances, areas and shapes are true only along central meridian. Distortion increases away from central meridian. Image transformation from generic co-ordinate system to a projected co-ordinate system was carried out using ERDAS Imagine 2014 digital image processing system.

2.6.2 Image enhancement

To improve the interpretability of the raw data, image enhancement is necessary. Most of the digital image enhancement techniques are categorised as either point or local operations. Point operations modify the value of each pixel in the image data independently. However, local operations modify the value of each pixel based on brightness value of neighbouring pixels. Contrast manipulations/stretching technique based on local operation were applied on the image data using ERDAS Imagine 2014 s/w. The enhanced and geocoded FCC (False colour composite) image of Jharia Coalfield is shown in Plate No. 1 for the year 2013.

2.6.3 Training set selection

The image data were analysed based on the interpretation keys. These keys are evolved from certain fundamental image-elements such as tone/colour, size, shape, texture, pattern, location, association and shadow. Based on the image-elements and other geo-technical elements like land form, drainage pattern and physiography; training sets were selected/ identified for each land use/cover class. Field survey was carried out by taking selective traverses in order to collect the ground information (or reference data) so that training sets are

selected accurately in the image. This was intended to serve as an aid for classification. Based on the variability of land use/cover condition and terrain characteristics and accessibility, 90 points were selected to generate the training sets.

2.6.4 Signature generation and classification

Image classification was carried out using the minimum distance algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e. signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels.

After evaluating the statistical parameters of the training sets, reliability test of training sets was conducted by measuring the statistical separation between the classes that resulted from computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data. The aerial extent of each land use class in the coalfield was determined using ERDAS Imagine 2014 s/w. The classified image for the year 2016 for Jharia Coalfield is shown in Drawing No. HQREMA10002.

2.6.5 Creation /overlay of vector database in GIS

Plan showing leasehold areas of mining projects supplied by BCCL are superimposed on the image as vector layer in the GIS database. Road network, rail network and drainage network are digitised on different vector layers in GIS database. Layer wise theme extraction was carried out using Arc GIS s/w and imported the same on GIS platform for further analysis.

2.6.6 Validation of classified image

Ground truth survey was carried out for validation of the interpreted results from the study area. Based on the validation, classification accuracy matrix was prepared.

The overall classification accuracy was found to be 88.59%.

2.6.7 Interpretation of Data

Interpretation of data for Land Use/vegetation cover was carried out through GIS by analysing the Land Use/ vegetation Cover map of the year 2016. Final Land Use/vegetation cover maps (on 1:50,000 scale) were printed using HP Design jet 4500 Colour Plotter.

Chapter 3

Land Use/ Vegetation Cover Monitoring

3.1 Introduction

Land is one of the most important natural resource on which all human activities are based. Therefore, knowledge on different type of lands as well as its spatial distribution in the form of map and statistical data is vital for its geospatial planning and management for optimal use of the land resources. In mining industry, the need for information on land use/ vegetation cover pattern has gained importance due to the all-round concern on environmental impact of mining. The information on land use/vegetation cover inventory that includes type, spatial distribution, aerial extent, location, rate and pattern of change of each category is of paramount importance for assessing the impact of coal mining on land use/ cover.

Remote sensing data with its various spectral and spatial resolution offers comprehensive and accurate information for mapping and monitoring of land use/cover pattern, dynamics of changing pattern and trends over a period of time.. By analysing the data of different cut-off dates, impact of coal mining on land use and vegetation cover can be determined.

3.2 Land Use / Vegetation Cover Classification

The array of information available on land use/cover requires be arranging or grouping under a suitable framework in order to facilitate the creation of database. Further, to accommodate the changing land use/vegetation cover pattern, it becomes essential to develop a standardised classification system that is not only

flexible in nomenclature and definition, but also capable of incorporating information obtained from the satellite data and other different sources.

The present framework of land use/cover classification has been primarily based on the '***Manual of Nationwide Land Use/ Land Cover Mapping Using Satellite Imagery***' developed by National Remote Sensing Agency, Hyderabad, which has further been modified by CMPDI for coal mining areas. Land use/vegetation cover map was prepared on the basis of image interpretation carried out based on the satellite data for the year 2016. Following land use/cover classes are identified in the Jharia coalfield region (Table 3.1).

Table 3.1
Land use / Vegetation Cover classes identified in Jharia Coalfield

	LEVEL –I	LEVEL-II
1	Vegetation Cover	3.1 Dense Forest 3.2 Open Forest 3.3 Scrub 3.4 Plantation under Social Forestry 3.5 Plantation on OB Dumps
2	Mining Area	5.1 Coal Quarry 5.2 Barren OB Dump 5.3 Area Under Backfilling 5.4 Coal Dump 5.5 Water Filled Quarry
3	Agricultural Land	2.1 Crop Land 2.2 Fallow Land
4	Wasteland	4.1 Waste upland with/without scrubs 4.2 Slurry Pond 4.3 Sand Body
5	Settlements	1.1 Urban 1.2 Rural 1.3 Industrial
6	Water Bodies	6.1 River/Streams /Reservoir

3.3 Data Analysis of Jharia Coalfiled

Satellite data of the year 2016 was processed using ERDAS Imagine v.2014 image processing s/w in order to interpret the various land use and vegetation cover classes present in the Jharia coalfield. The analysis was carried out for entire coalfield covering about 393 sq. km.

The area of each class was calculated and analysed using *ERDAS Digital Image Processing* s/w and *ArcGIS* s/w. Analysis of land use / vegetation cover pattern in Jharia Coalfield in the year 2016 has been done and details are and shown in table 3.2.

TABLE – 3.2: STATUS OF LAND USE/COVER PATTERN IN JHARIA COALFIELD DURING YEAR 2013 & 2016

LAND USE CLASSES	Year 2013		Year 2016		Change		Reasons for change
SETTLEMENTS	**Area (Km^2)**	**%**	**Area (Km^2)**	**%**	**Area (Km^2)**	**%**	
Urban Settlement	35.05	8.92	35.05	8.92	0.00	0.00	No change
Rural Settlement	3.17	0.81	3.74	0.95	0.57	0.15	Migration of population to mining areas
Industrial Settlement	3.35	0.85	2.29	0.58	-1.06	-0.27	Dismantling of some industrial structures, eg Lodna Washery
Total Settlements	**41.57**	**10.58**	**41.08**	**10.46**	**-0.49**	**-0.12**	
VEGETATION COVER							
FORESTS							
Dense Forest	0.29	0.07	0.29	0.07	0.00	0.00	No Change
Open Forest	8.51	2.16	6.27	1.60	-2.24	-0.56	Minor decrease due to deforestation
Total Forest (A)	**8.8**	**2.23**	**6.56**	**1.67**	**-2.24**	**-0.56**	
SCRUBS							
Scrubs (B)	**122.5**	**31.2**	**105.87**	**26.95**	**-16.63**	**-4.25**	Coversion of UG mines into OC mines, Land with scrubs were used
PLANTATION							
Social forestry	19.41	4.94	19.52	4.97	0.11	0.03	Increase in plantation along roads, creation of ecological resoration parks
Plantation on OB Dump	11.94	3.04	8.59	2.19	-3.35	-0.85	Decrese due to increase in mining activity & conversion of UG mines into OC mines
Total Plantation (C)	**31.35**	**7.98**	**28.11**	7.16	-3.24	-0.82	
Total Vegetation (A+B+C)	**162.65**	**41.4**	**140.54**	**35.77**	**-22.11**	**-5.63**	
MINING AREA							
Coal Quarry	6.98	1.78	11.36	2.89	4.38	1.11	Increase in mining activity
Coal Dump	1.3	0.33	0.23	0.06	-1.07	-0.27	Places where coal dumps were obeserved have been shifted
Quarry filled with water	0.25	0.06	0.77	0.20	0.52	0.13	Minor change in places with water filled quarries
Barren OB Dump	19.06	4.85	12.55	3.19	-6.51	-1.66	Some area under small OB dumps coming under new amalgamated projects
Area Under Backfilling	7.36	1.87	15.62	3.98	8.26	2.10	Due to increase in excavation due to opencast mining activities
Toal Mining Area	**35.22**	**8.97**	**40.53**	**10.32**	**5.31**	**1.35**	
AGRICULTURE							
Crop Lands	3.94	1	3.71	0.94	-0.23	-0.06	Derease due to crop land being converted into fallow land
Fallow Lands	35.85	9.13	40.68	10.36	4.83	1.23	Conversion of scrub land into fallow land
Total Agriculture	**39.79**	**10.13**	**44.39**	**11.30**	**4.60**	**1.17**	
WASTELANDS							
Wastelands	100.05	25.47	113.97	29.01	13.92	3.54	Scrubland converted to wasteland
Ash pond/Slurry/ Tailing Ponds	0.26	0.07	0	0.00	-0.26	-0.07	
Sand Body	1.53	0.39	4.85	1.23	3.32	0.85	Temporal change over period
Total Wastelands	**101.84**	**25.92**	**118.82**	**30.25**	**16.98**	**4.32**	
WATERBODIES							
River, Lakes, Nallas, ponds, etc	11.78	3	7.48	1.90	-4.30	-1.09	Temporal change over period
TOTAL	**392.85**	**100**	**392.85**	**100.00**	**0.00**	**0.00**	

3.3.1 Vegetation Cover

Vegetation cover in the coalfield area comprises following five classes:

- Dense Forest
- Open Forest
- Scrubs
- Plantation on Over Burden(OB) Dumps / Backfilled area, and
- Social Forestry

There has been significant variation in the land use under the vegetation classes within the area as shown below in Table 3.3.

TABLE – 3.3

Status of change in Vegetation Cover in Jharia Coalfield during the year 2013 & 2016

VEGETATION COVER	Year 2013		Year 2016		Change	
FORESTS	Area (sq Km)	%	Area (sq Km)	%	Area (sq Km)	%
Dense Forest	0.29	0.07	0.29	0.07	0.00	0.00
Open Forest	8.51	2.16	6.27	1.60	-2.24	-0.56
Total Forest (A)	**8.80**	**2.23**	**6.56**	**1.67**	**-2.24**	**-0.56**
SCRUBS						
Scrubs (B)	**122.50**	**31.20**	**105.87**	**26.95**	**-16.63**	**-4.25**
PLANTATION						
Social forestry	19.41	4.94	19.52	4.97	0.11	0.03
Plantation on OB Dump	11.94	3.04	8.59	2.19	-3.35	-0.85
Total Plantation (C)	**31.35**	**7.98**	**28.11**	7.16	-3.24	-0.82
Total Vegetation (A+B+C)	**162.65**	**41.40**	**140.54**	**35.78**	**-22.11**	**-5.63**

Dense forest – Forest having crown density of above 40% comes in this class. Dense forest over the area is same as in year 2013.. A total dense forest is estimated to be 0.29

sq km, i.e. 0.07% of the coalfield area. The area of the dense forest within the coalfield has remained same since 2013.

Open Forest – Forest having crown density between 10% to 40% comes under this class. Open forest cover over Jharia coalfield which was estimated to be 8.51 sq km (2,16%) in 2013 has marginally decreased to 6.27 sq km, i.e. 1.60 % of the coalfield area. Thus the area reduced is 2.24 sq km which is 0.56 % of the total coalfield area. This reduction is due to deforestation by local inhabitants.

Scrubs – Scrubs are vegetation with crown density less than 10%. Scrubs in the coalfield are seen to be scattered signature all over the area mixed with wastelands. There is 105.87 sq km, of scrubs, ie 26.95% of the coalfield area. In year 2013 the scrubs covered 122.50 sq km which were 31.20% of the coalfield area. There is a decrease of 16.63 sq km which is 4.25% of the coalfield area .The decrease is due to increase in mining areas and conversion of underground mine into open cast ones & also increase in agricultural land & waste land.

Social Forestry – Plantation which has been carried out on wastelands, along the roadsides and colonies on green belt come under this category. Analysis of data reveals Social Forestry covers 19.52 sq km, which is 4.97% of the coalfield area. In 2013 the area covered under social forestry was 19.41 sq km (4.94%) . there is an increase of 0.11 sq km (0.03%). This increase is due to creation of some ecological restoration sites.

Plantation over OB Dump and backfilled area – Analysis of the data reveals that BCCL has carried out significant plantation on OB dumps as well as backfilled areas during the period for maintaining the ecological balance of the area. The plantation on the OB dumps and backfilled areas are estimated to be 8.59 sq km, i.e. 2.19% of the coalfield area. In year 2013 the plantation on OB Dumps were estimated to cover an area of 11.94 sq km which was 3.04% of the coalfield area. There is a decrease of 3.35 sq km (0.85%) in plantation over OB dumps. This is due to increase in mining activity & conversion of UG mines into OC mines.

3.3.2 Mining Area

The mining area was primarily been categorized as.

- Coal Quarry
- Barren OB Dump

To make the study more relevant and to give thrust on land reclamation, in the current study some more classes have been added as follows:

- Barren Backfilled Area
- Coal Dumps
- Water filled Quarry

The overall area where mining operations are being carried out has increased significantly by 5.31 sq km which is 1.35% of the total area. In the year 2013 this area was estimated to be 35.22 sq km (8.97%) which has increased to 40.53 sq km (10.32%) in the year 2016. This increase is due to increase in production of coal from Open cast areas. The status of land Use in the mining area over the Jharia Coalfield is shown in the table 3.4 below.

TABLE – 3.4

Status of change in Mining Area in Jharia Coalfield during the year 2013 & 2016

	2013		2016		Change	
MINING AREA	**Area (Sq km)**	**%**	**Area (Sq km)**	**%**	**Area (Sq km)**	**%**
Coal Quarry	6.98	1.78	11.36	2.89	4.38	1.11
Coal Dump	1.30	0.33	0.23	0.06	-1.07	-0.27
Quarry filled with water	0.25	0.06	0.77	0.20	0.52	0.14
Barren OB Dump	19.06	4.85	12.55	3.20	-6.51	-1.65
Area Under Backfilling	7.36	1.87	15.62	3.97	8.26	2.10
Total Mining Area	**35.22**	**8.97**	**40.53**	**10.32**	**5.31**	**1.35**

3.3.3 Agricultural Land

Land primarily used for farming and production of food, fibre and other commercial and horticultural crops falls under this category. It includes crop land (irrigated and unirrigated) and fallow land (land used for cultivation, but temporarily allowed to rest)

Total agricultural land is 44.39 sq km in year 2016, which is 11.31 % of the coalfield area.. in year 2013 the total agricultural area was estimated to be 39.79 sq km which was 10.12% of the coalfield area. There is an increase on 4.60 sq km which is 1.19% of the coalfield area. The details are shown below in Table 3.5**.**

TABLE – 3.5

Status of change in Agricultural land in Jharia Coalfield during the year 2013 & 2016

	2013		2016		Change	
AGRICULTURE	**Area (Sq km)**	**%**	**Area (Sq km)**	**%**	**Area (Sq km)**	**%**
Crop Lands	3.94	1.00	3.71	0.95	-0.23	-0.05
Fallow Lands	35.85	9.12	40.68	10.36	4.83	1.24
Total Agriculture	**39.79**	**10.12**	**44.39**	**11.31**	4.60	1.19

3.3.4 Wasteland

Wasteland is degraded and unutilised class of land which is deteriorating on account of natural causes or due to lack of appropriate water and soil management. Wasteland can result from inherent/imposed constraints such as location, environment, chemical and physical properties of the soil or financial or management constraints. There are two types of wastelands predominant within the coalfield area, viz waste upland and fly ash pond.

The land use pattern within the area for waste lands is shown below in Table – 3.6. The waste land was estimated to be 101.84 sq km (25.93%) in the year 2013. This has increased by 16.98 sq km (4.32%) to 118.82 sq km (30.24%) over the 3 year period because some scrubland has been converted to wasteland.

TABLE – 3.6

Status of Change in Wastelands in Jharia Coalfield during the year 2013 & 2016

	2013		2016		Change	
WASTELANDS	**Area (Sq km)**	**%**	**Area (Sq km)**	**%**	**Area (Sq km)**	**%**
Wastelands	100.05	25.47	113.97	29.01	13.92	3.54
Ash pond/Slurry/ Tailing Ponds	0.26	0.07	0.00	0.00	-0.26	-0.07
Sand Body	1.53	0.39	4.85	1.23	3.32	0.85
Total Wastelands	**101.84**	**25.93**	**118.82**	**30.24**	16.98	4.32

3.3.5 Settlements

All the man-made constructions covering the land surface are included under this category. Built-up land has been further divided in to rural, urban and industrial classes. In the present study, industrial settlement indicates only industrial complexes excluding residential facilities. In the year 2013 the total area covered by settlements were estimated to be 41.57 sq km (10.58%). In year 2016 the estimated area under settlements has grown to 41.08 sq km (10.45%). There is a decrease in settlements by 0.49 sq km which is about 0.12% of the total area. This decrease is due to decrease in industrial settlement which may be due to dismantling of some establishments.

The details of the land use under this category are shown in Table 3.7 as follows:

TABLE 3.7

Status of Change in Settlements in Jharia Coalfield during the year 2013 & 2016

	2013		2016		Change	
SETTLEMENTS	Area (Sq km)	%	Area (Sq km)	%	Area (Sq km)	%
Urban Settlement	35.05	8.92	35.05	8.92	0.00	0.00
Rural Settlement	3.17	0.81	3.74	0.95	0.57	0.15
Industrial Settlement	3.35	0.85	2.29	0.58	-1.06	-0.27
Total Settlements	**41.57**	**10.58**	**41.08**	**10.45**	-0.49	-0.12

3.3.6 Water bodies

It is the area of impounded water includes natural lakes, rivers/streams and man made canal, reservoirs, tanks etc**.** The water bodies in the study area have found to be 11.78 sq km in year 2013, which is 3.00% of the coalfield area. In 2016 there is a reduction in the area of water bodies 4.30 sq km (1.10%) of the total area.

3.4 Data Analysis of clusters under Jharia Coalfield

Land use and vegetation cover classes present in each cluster (Cluster I to Cluster XV) falling under the Jharia coalfield has also been prepared. The map of each cluster is included in this report under pages 31 to 45. Each map contains the area statistics of Land use/cover classes present in them. The cluster wise Land Use/Cover statistics for cluster I to cluster XV falling under Jharia Coalfield is given under Table 3.8.

Table-3.8

(Area in Hectare)

		CLUSTER I		CLUSTER II		CLUSTER III		CLUSTER IV		CLUSTER V		CLUSTER VI		CLUSTER VII		CLUSTER VIII		CLUSTER IX		CLUSTER X		CLUSTER XI		CLUSTER XII		CLUSTER XIII		CLUSTER XIV		CLUSTER XV		TOTAL	
		Area	%	Area	%	Area	%	Area	%																					Area	%	Area	%
FORESTS	Dense Forest	14.56	2.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.56	0.06
	Open Forest	15.11	2.43	0.00	0.00	32.73	2.11	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.02	0.00	0.00	0.00	0.00	65.50	3.16	0.00	0.00	0.00	0.00	172.73	9.23	0.00	0.00	63.05	3.46	349.50	1.38
	Total Forest	29.67	4.77	0.00	0.00	32.73	2.11	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.02	0.00	0.00	0.00	0.00	65.50	3.16	0.00	0.00	0.00	0.00	172.73	9.23	0.00	0.00	63.05	3.46	364.06	1.44
SCRUBS	Scrubs	182.00	29.24	233.14	10.31	274.77	17.70	87.26	7.04	237.06	13.74	63.71	7.66	301.39	14.59	117.43	8.82	275.34	14.00	482.12	23.25	1470.72	40.79	256.27	29.60	583.41	31.19	494.37	34.86	610.87	33.58	5669.86	22.45
PLANTATION	Social Forestry	16.60	2.67	150.07	6.64	110.03	7.09	82.10	6.62	60.01	3.48	33.83	4.07	99.35	4.81	12.99	0.97	163.31	8.30	136.29	6.57	269.08	7.46	24.30	2.81	125.11	6.69	54.94	3.87	138.17	7.59	1476.18	5.85
	Plantation on OB Dump	47.32	7.60	105.98	4.69	23.17	1.49	38.25	3.08	20.80	1.21	21.03	2.53	20.08	0.97	23.80	1.79	30.68	1.56	92.78	4.47	0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	424.01	1.68
	Plantation on Backfill	10.65	1.71	81.89	3.62	12.96	0.83	0.01	0.00	30.64	1.78	31.36	3.77	60.62	2.93	33.98	2.55	57.92	2.94	44.31	2.14	1.18	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	365.52	1.45
	Total Plantation *(Biological Reclamation)*	74.57	11.98	337.94	14.95	146.16	9.41	120.36	9.70	111.45	6.47	86.22	10.37	180.05	8.71	70.77	5.31	251.91	12.80	273.38	13.18	270.38	7.50	24.30	2.81	125.11	6.69	54.94	3.87	138.17	7.59	2265.71	8.97
	Total Vegetation	286.24	45.99	571.08	25.26	453.66	29.22	207.62	16.74	348.51	20.21	149.93	18.03	481.82	23.32	188.20	14.13	527.25	26.80	821.00	39.59	1741.10	48.29	280.57	32.41	881.25	47.11	549.31	38.73	812.09	44.63	8299.63	32.87
ACTIVE MINING	Coal Quarry	11.60	1.86	148.85	6.58	82.36	5.30	178.26	14.37	117.63	6.82	57.63	6.93	86.60	4.19	180.71	13.57	112.86	5.74	31.34	1.51	34.83	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1042.67	4.13
	Coal Face	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Coal Dump	0.00	0.00	9.32	0.41	1.94	0.13	0.62	0.05	1.03	0.06	0.65	0.08	2.99	0.14	3.13	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.68	0.08
	Advance Quarry Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Quarry Filled With Water	7.30	1.17	20.45	0.91	13.26	0.85	0.00	0.00	8.62	0.50	1.18	0.14	4.13	0.20	0.70	0.05	4.82	0.25	3.68	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.14	0.25
	Total Area under *Active Mining*	18.90	3.03	178.62	7.90	97.56	6.28	178.88	14.42	127.28	7.38	59.46	7.15	93.72	4.53	184.54	13.85	117.68	5.99	35.02	1.69	34.83	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1126.49	4.46
RECLAIMED	Barren OB Dump	16.32	2.62	194.48	8.60	93.67	6.03	181.14	14.61	150.31	8.72	64.88	7.80	81.38	3.94	112.23	8.42	135.88	6.91	94.20	4.54	18.22	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1142.71	4.53
	Area Under Backfilling	28.54	4.58	393.74	17.42	77.77	5.01	66.69	5.38	181.89	10.55	99.13	11.92	312.89	15.15	162.24	12.18	106.51	5.41	107.49	5.18	18.20	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1555.09	6.16
	Total Area under *Technical Reclamation*	44.86	7.20	588.22	26.02	171.44	11.04	247.83	19.99	332.20	19.27	164.01	19.72	394.27	19.09	274.47	20.60	242.39	12.32	201.69	9.72	36.42	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2697.80	10.68
	Total Area under Mine Operation	63.76	10.23	766.84	33.92	269.00	17.32	426.71	34.41	459.48	26.65	223.47	26.87	487.99	23.62	459.01	34.45	360.07	18.31	236.71	11.41	71.25	1.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3824.29	15.15
WASTELAND	Waste Lands	133.62	21.47	624.95	27.65	503.68	32.44	350.38	28.25	585.22	33.93	318.55	38.29	528.08	25.56	415.58	31.20	683.07	34.72	404.11	19.48	917.12	25.44	275.00	31.76	705.27	37.71	504.15	35.55	640.16	35.19	7588.94	30.05
	Sand Body	10.66	1.71	4.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.55	4.85	7.03	0.19	0.00	0.00	22.18	1.18	42.35	2.99	0.00	0.00	186.77	0.74
	Total Wasteland	144.28	23.18	628.95	27.83	503.68	32.44	350.38	28.25	585.22	33.93	318.55	38.29	528.08	25.56	415.58	31.20	683.07	34.72	504.66	24.33	924.15	25.63	275.00	31.76	727.45	38.89	546.50	38.54	640.16	35.19	7775.71	30.79
WATERBODIES	Reservoir, nallah, ponds	14.75	2.37	20.39	0.90	14.71	0.95	8.82	0.71	5.45	0.32	8.97	1.08	13.55	0.66	8.11	0.61	16.01	0.81	126.31	6.09	33.20	0.92	19.37	2.24	25.94	1.39	18.24	1.29	19.94	1.09	353.76	1.40
	Total Waterbodies	14.75	2.37	20.39	0.90	14.71	0.95	8.82	0.71	5.45	0.32	8.97	1.08	13.55	0.66	8.11	0.61	16.01	0.81	126.31	6.09	33.20	0.92	19.37	2.24	25.94	1.39	18.24	1.29	19.94	1.09	353.76	1.40
AGRICULTURE	Crop Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.88	0.40	0.00	0.00	39.16	1.89	16.12	1.21	0.31	0.02	19.11	0.92	94.10	2.61	2.90	0.33	60.45	3.23	6.88	0.48	6.51	0.36	252.42	1.00
	Fallow Lands	91.85	14.76	77.09	3.41	58.05	3.74	53.69	4.33	40.02	2.32	1.02	0.12	20.38	0.99	65.11	4.89	42.59	2.16	62.64	3.02	323.90	8.98	254.61	29.40	93.18	4.98	224.53	15.83	211.56	11.63	1620.22	6.42
	Total Agriculture	91.85	14.76	77.09	3.41	58.05	3.74	53.69	4.33	46.90	2.72	1.02	0.12	59.54	2.88	81.23	6.10	42.90	2.18	81.75	3.94	418.00	11.59	257.51	29.73	153.63	8.21	231.41	16.31	218.07	11.99	1872.64	7.42
SETTLEMENTS	Urban Settlement	0.00	0.00	163.66	7.24	243.23	15.67	192.99	15.56	269.93	15.65	113.08	13.59	475.46	23.02	169.76	12.75	332.56	16.91	243.91	11.76	375.11	10.40	23.83	2.75	26.10	1.40	0.00	0.00	83.80	4.61	2713.42	10.75
	Rural Settlement	20.73	3.33	24.84	1.10	8.33	0.54	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.07	0.00	0.00	0.00	0.00	41.47	2.00	12.11	0.34	9.64	1.11	54.28	2.90	72.37	5.10	42.38	2.33	287.50	1.14
	Industrial Settlement	0.87	0.14	7.69	0.34	1.87	0.12	0.00	0.00	9.03	0.52	16.81	2.02	17.90	0.87	10.06	0.76	5.36	0.27	18.27	0.88	30.76	0.85	0.00	0.00	1.82	0.10	0.42	0.03	2.86	0.16	123.72	0.49
	Total Settlement	21.60	3.47	196.19	8.68	253.43	16.33	192.99	15.56	278.96	16.17	129.89	15.61	494.71	23.96	179.82	13.51	337.92	17.18	303.65	14.64	417.98	11.59	33.47	3.86	82.20	4.40	72.79	5.13	129.04	7.10	3124.64	12.37
	Grand Total	622.48	100.00	2260.54	100.00	1552.53	100.00	1240.21	100.00	1724.52	100.00	831.83	100.00	2065.69	100.00	1331.95	100.00	1967.22	100.00	2074.08	100.00	3605.68	100.00	865.92	100.00	1870.47	100.00	1418.25	100.00	1819.30	100.00	25250.67	100.00

Chapter 4

Conclusion & Recommendations

4.1 Conclusion

In the present study, land use/ vegetation cover mapping has been carried out based on IRS-R2/ L4FMX satellite data of January, 2016 in order to monitor the impact of coal mining on land environment which may helps in formulating the mitigation measures required, if any.

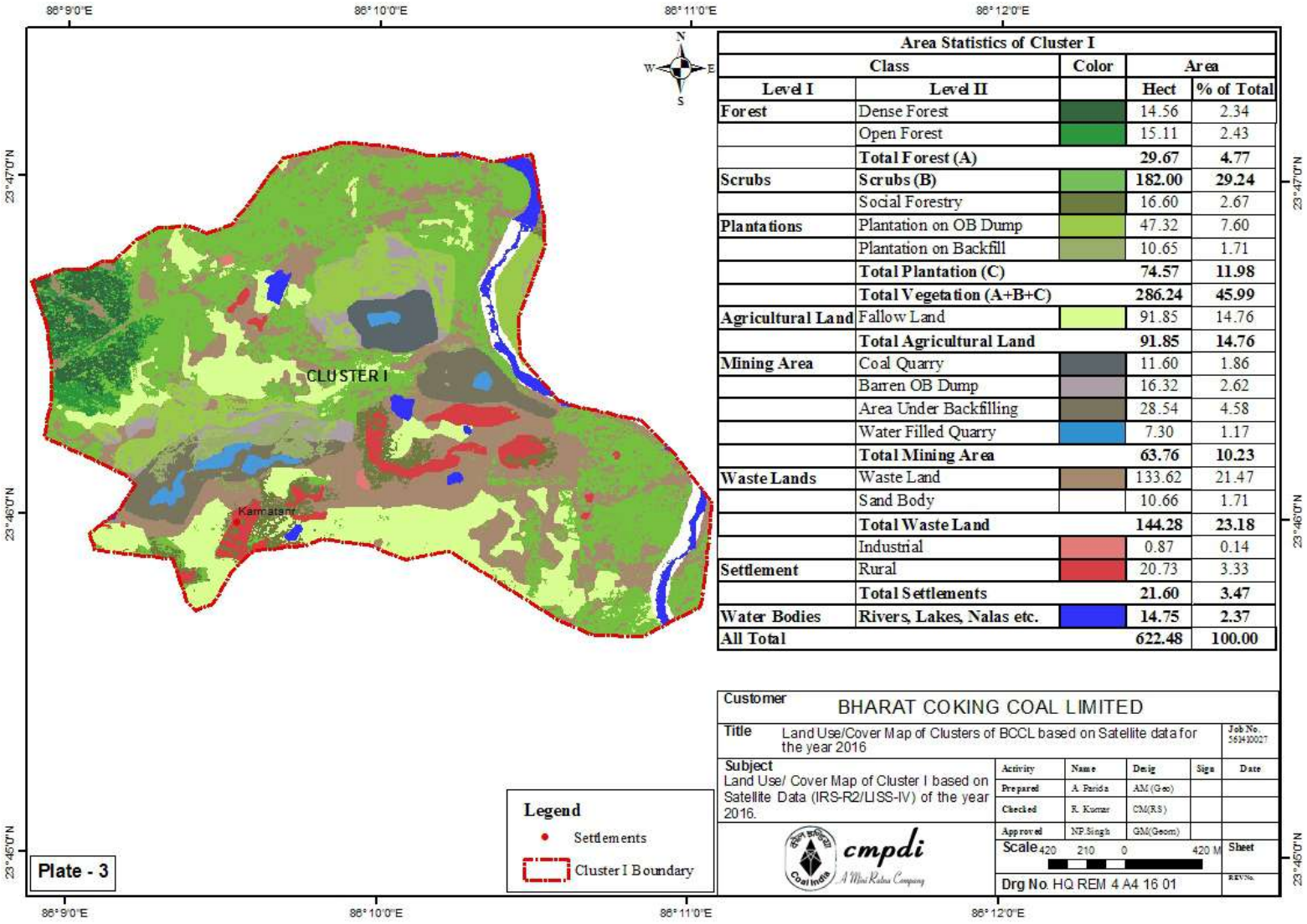
Study reveals that the total area of settlements which includes urban, rural and industrial settlements in the Jharia coalfields covers 41.08 km^2 (10.45%) area. There is a decrease in settlements by 0.49 sq km over the 2013 study primarily because dismantling of some industrial establishments. Vegetation cover which includes dense forests, open forests, scrubs, avenue plantation & plantation on over-burden dumps, covers an area of 140.54 km^2 (35.78%). As compared to 2013 study there is a decrease in overall vegetation cover by 22.11 sq km (5.62%) this is mainly because there is a reduction in scrubs areas. Area of scrubs has decreased by 16.63 sq km. because of its use in opencast mines and use of scrub land for agriculture. The analysis further indicates that total agricultural land which includes both crop and fallow land covers an area of 44.39km^2 (11.31%) has increased 4.60 sq km (1.19%) from that was in 2013. The increase in 4.60 sq km is due to some scrubland getting converted into agricultural land. The mining area which includes coal quarry, advance quarry site, barren OB dump, area under backfilling, covers 40.53 km^2 (10.32%). There is a significant increase in areas under mining operations because large areas have now been taken up for Open cast mining in BCCL. As compared to 2013 there is an increase of 5.31 sq km (1.35%) in the areas under mining operation. Wasteland covers 118.82 km^2

(30.24%). Waste lands have increased because some scrubland has been converted to wasteland. Surface water bodies covered area of 7.48 km^2 (1.90).

The detail statistical analysis is given under Table-3.2.

4.2 Recommendations

It is essential to maintain the ecological balance for sustainable development of the area together with coal mining in Jharia Coalfield. It is recommended that land reclamation of the mining area should be taken up on top priority by BCCL. Such studies should be carried out regularly to assess the impact of coal mining on land use pattern and vegetation cover in the coalfield to formulate and take remedial measures, if any, required for mitigating the adverse impact of coal mining on land environment. Regional study will also be helpful in assessing the environmental degradation / up gradation carried out by different industries operating in the coalfield area.



Area Statistics of Cluster I				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Forest	Dense Forest		14.56	2.34
	Open Forest		15.11	2.43
	Total Forest (A)		**29.67**	**4.77**
Scrubs	**Scrubs (B)**		**182.00**	**29.24**
	Social Forestry		16.60	2.67
Plantations	Plantation on OB Dump		47.32	7.60
	Plantation on Backfill		10.65	1.71
	Total Plantation (C)		**74.57**	**11.98**
	Total Vegetation (A+B+C)		**286.24**	**45.99**
Agricultural Land	Fallow Land		91.85	14.76
	Total Agricultural Land		**91.85**	**14.76**
Mining Area	Coal Quarry		11.60	1.86
	Barren OB Dump		16.32	2.62
	Area Under Backfilling		28.54	4.58
	Water Filled Quarry		7.30	1.17
	Total Mining Area		**63.76**	**10.23**
Waste Lands	Waste Land		133.62	21.47
	Sand Body		10.66	1.71
	Total Waste Land		**144.28**	**23.18**
	Industrial		0.87	0.14
Settlement	Rural		20.73	3.33
	Total Settlements		**21.60**	**3.47**
Water Bodies	**Rivers, Lakes, Nalas etc.**		**14.75**	**2.37**
All Total			**622.48**	**100.00**

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 561410027

Subject: Land Use/ Cover Map of Cluster I based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Farida	AM (Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP.Singh	GM(Geom)		

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Drg No. HQ REM 4 A4 16 01

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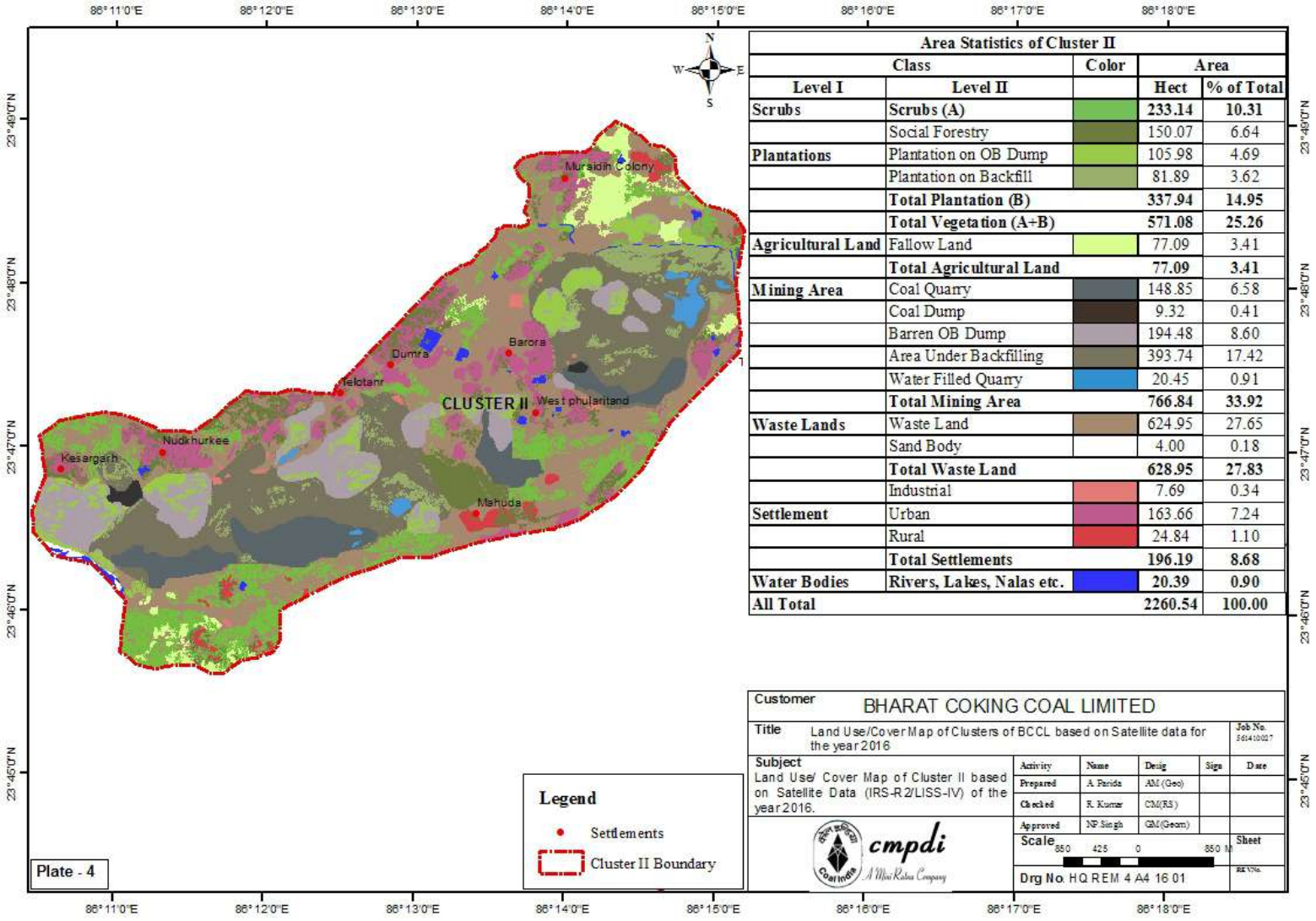

Area Statistics of Cluster II				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		233.14	10.31
	Social Forestry		150.07	6.64
Plantations	Plantation on OB Dump		105.98	4.69
	Plantation on Backfill		81.89	3.62
	Total Plantation (B)		**337.94**	**14.95**
	Total Vegetation (A+B)		**571.08**	**25.26**
Agricultural Land	Fallow Land		77.09	3.41
	Total Agricultural Land		**77.09**	**3.41**
Mining Area	Coal Quarry		148.85	6.58
	Coal Dump		9.32	0.41
	Barren OB Dump		194.48	8.60
	Area Under Backfilling		393.74	17.42
	Water Filled Quarry		20.45	0.91
	Total Mining Area		**766.84**	**33.92**
Waste Lands	Waste Land		624.95	27.65
	Sand Body		4.00	0.18
	Total Waste Land		**628.95**	**27.83**
	Industrial		7.69	0.34
Settlement	Urban		163.66	7.24
	Rural		24.84	1.10
	Total Settlements		**196.19**	**8.68**
Water Bodies	Rivers, Lakes, Nalas etc.		20.39	0.90
All Total			2260.54	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 561410027

Subject: Land Use/ Cover Map of Cluster II based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A Parida	AM (Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP Singh	GM(Geom)		

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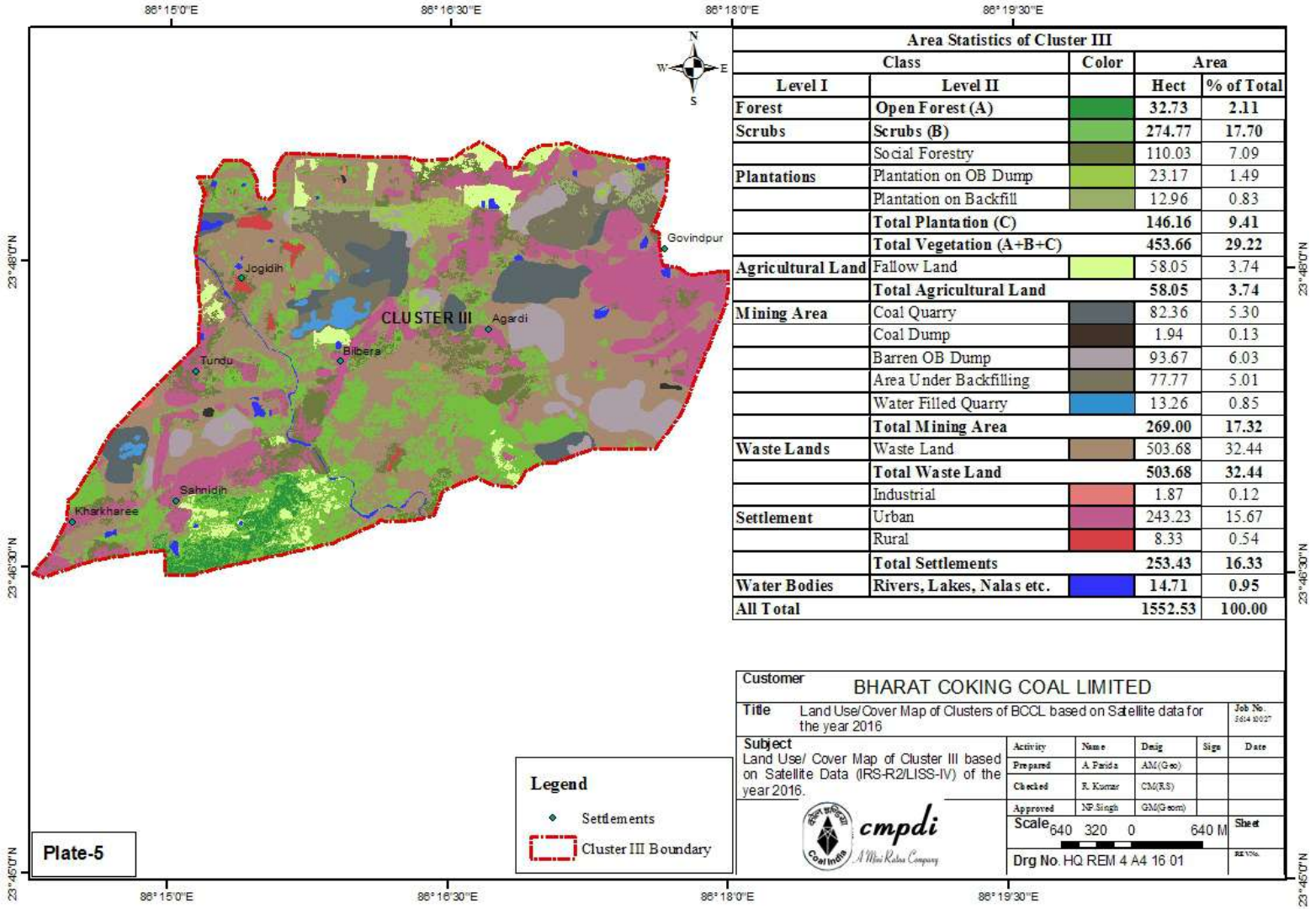

Area Statistics of Cluster III

Class		Color	Area	
Level I	**Level II**		**Hect**	**% of Total**
Forest	**Open Forest (A)**		**32.73**	**2.11**
Scrubs	**Scrubs (B)**		**274.77**	**17.70**
	Social Forestry		110.03	7.09
Plantations	Plantation on OB Dump		23.17	1.49
	Plantation on Backfill		12.96	0.83
	Total Plantation (C)		**146.16**	**9.41**
	Total Vegetation (A+B+C)		**453.66**	**29.22**
Agricultural Land	Fallow Land		58.05	3.74
	Total Agricultural Land		**58.05**	**3.74**
Mining Area	Coal Quarry		82.36	5.30
	Coal Dump		1.94	0.13
	Barren OB Dump		93.67	6.03
	Area Under Backfilling		77.77	5.01
	Water Filled Quarry		13.26	0.85
	Total Mining Area		**269.00**	**17.32**
Waste Lands	Waste Land		503.68	32.44
	Total Waste Land		**503.68**	**32.44**
	Industrial		1.87	0.12
Settlement	Urban		243.23	15.67
	Rural		8.33	0.54
	Total Settlements		**253.43**	**16.33**
Water Bodies	**Rivers, Lakes, Nalas etc.**		**14.71**	**0.95**
All Total			**1552.53**	**100.00**

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 5614 10027

Subject: Land Use/ Cover Map of Cluster III based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Parida	AM(Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP.Singh	GM(Geom)		

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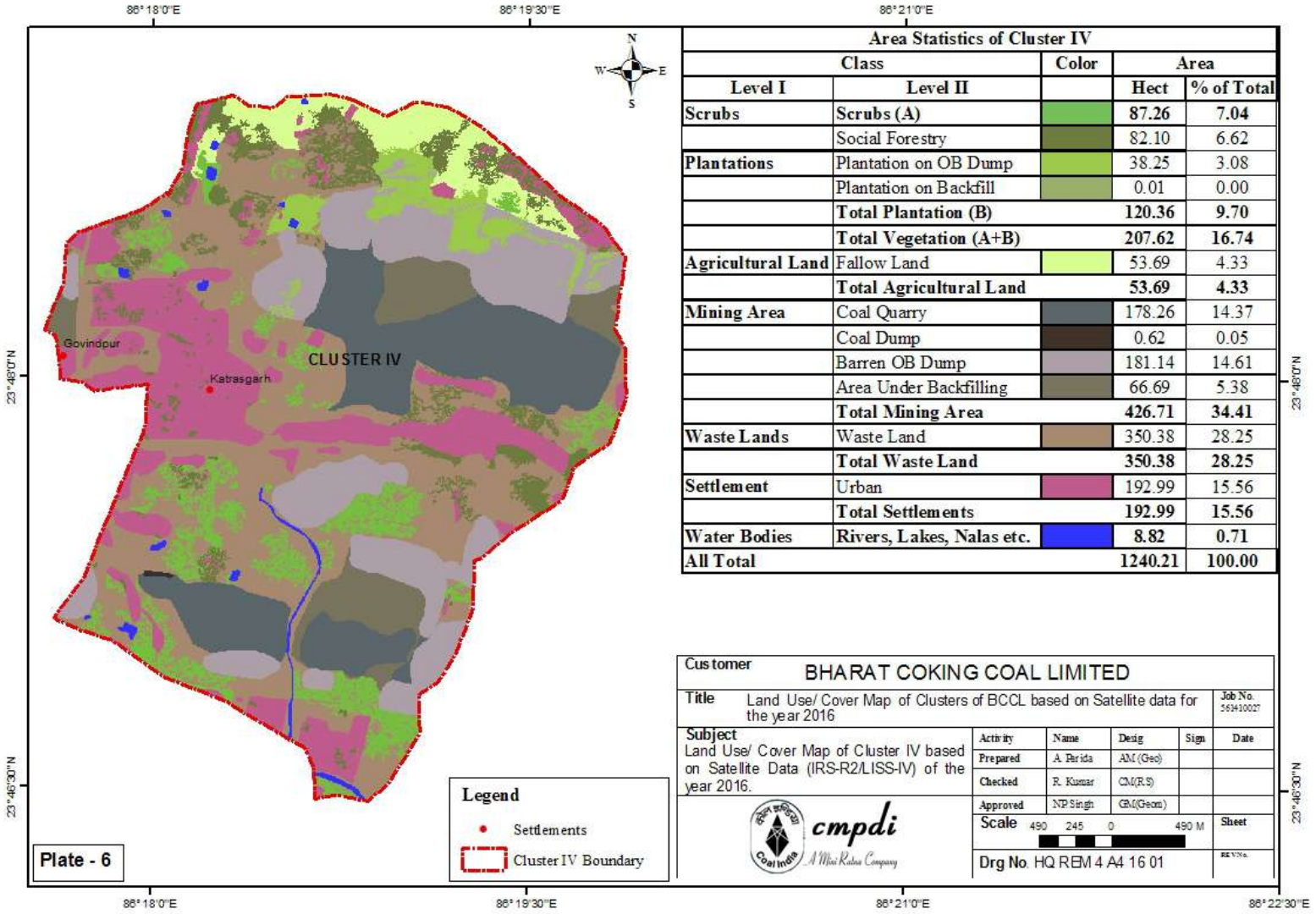

Area Statistics of Cluster IV

Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		87.26	7.04
	Social Forestry		82.10	6.62
Plantations	Plantation on OB Dump		38.25	3.08
	Plantation on Backfill		0.01	0.00
	Total Plantation (B)		**120.36**	**9.70**
	Total Vegetation (A+B)		**207.62**	**16.74**
Agricultural Land	Fallow Land		53.69	4.33
	Total Agricultural Land		**53.69**	**4.33**
Mining Area	Coal Quarry		178.26	14.37
	Coal Dump		0.62	0.05
	Barren OB Dump		181.14	14.61
	Area Under Backfilling		66.69	5.38
	Total Mining Area		**426.71**	**34.41**
Waste Lands	Waste Land		350.38	28.25
	Total Waste Land		**350.38**	**28.25**
Settlement	Urban		192.99	15.56
	Total Settlements		**192.99**	**15.56**
Water Bodies	Rivers, Lakes, Nalas etc.		8.82	0.71
All Total			1240.21	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 561410027

Subject: Land Use/ Cover Map of Cluster IV based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Parida	AM (Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP Singh	GM(Geom)		

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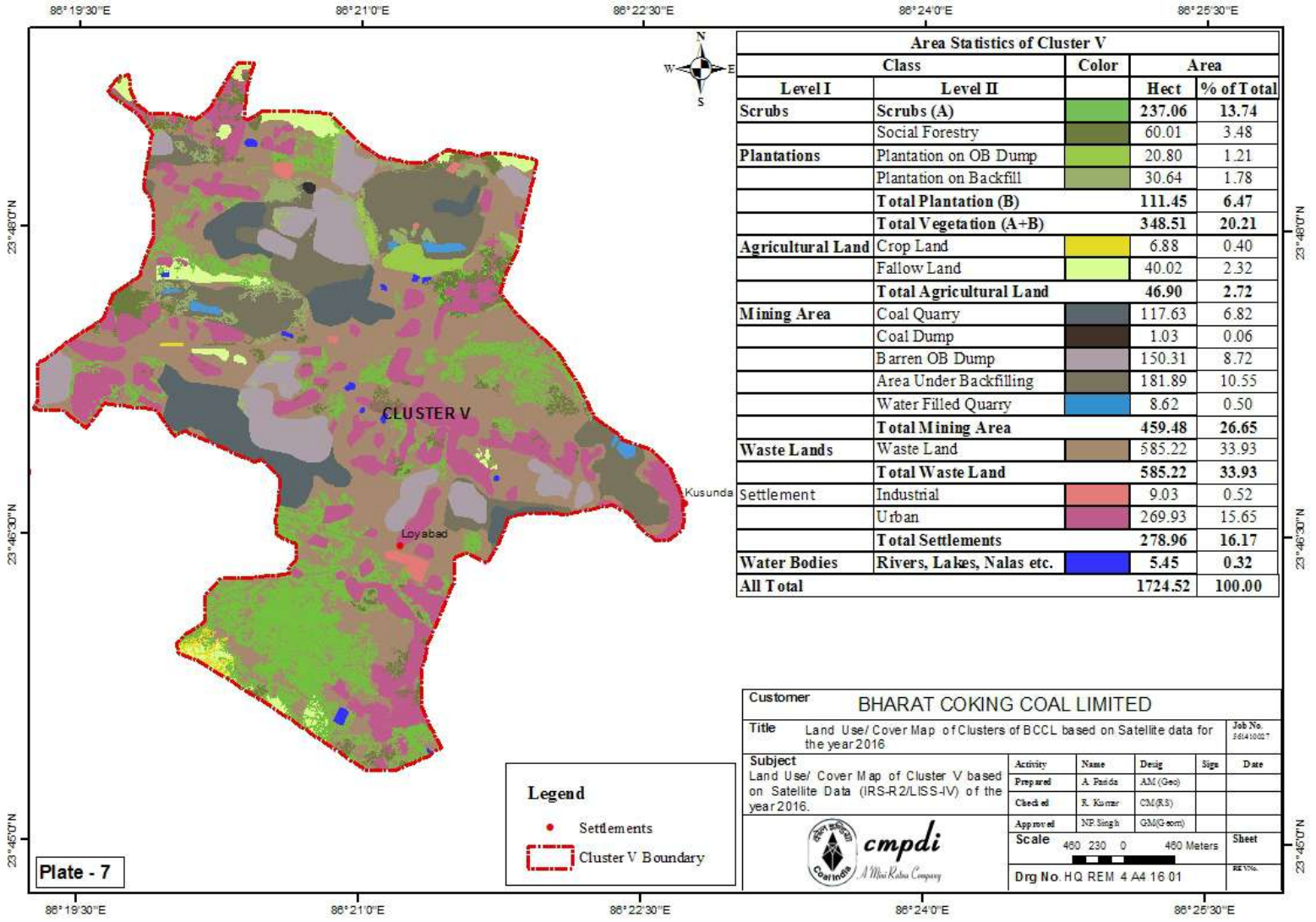

Area Statistics of Cluster V				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		237.06	13.74
	Social Forestry		60.01	3.48
Plantations	Plantation on OB Dump		20.80	1.21
	Plantation on Backfill		30.64	1.78
	Total Plantation (B)		**111.45**	**6.47**
	Total Vegetation (A+B)		**348.51**	**20.21**
Agricultural Land	Crop Land		6.88	0.40
	Fallow Land		40.02	2.32
	Total Agricultural Land		**46.90**	**2.72**
Mining Area	Coal Quarry		117.63	6.82
	Coal Dump		1.03	0.06
	Barren OB Dump		150.31	8.72
	Area Under Backfilling		181.89	10.55
	Water Filled Quarry		8.62	0.50
	Total Mining Area		**459.48**	**26.65**
Waste Lands	Waste Land		585.22	33.93
	Total Waste Land		**585.22**	**33.93**
Settlement	Industrial		9.03	0.52
	Urban		269.93	15.65
	Total Settlements		**278.96**	**16.17**
Water Bodies	Rivers, Lakes, Nalas etc.		5.45	0.32
All Total			1724.52	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 561410027

Subject: Land Use/ Cover Map of Cluster V based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Panda	AM (Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP Singh	GM(Geom)		

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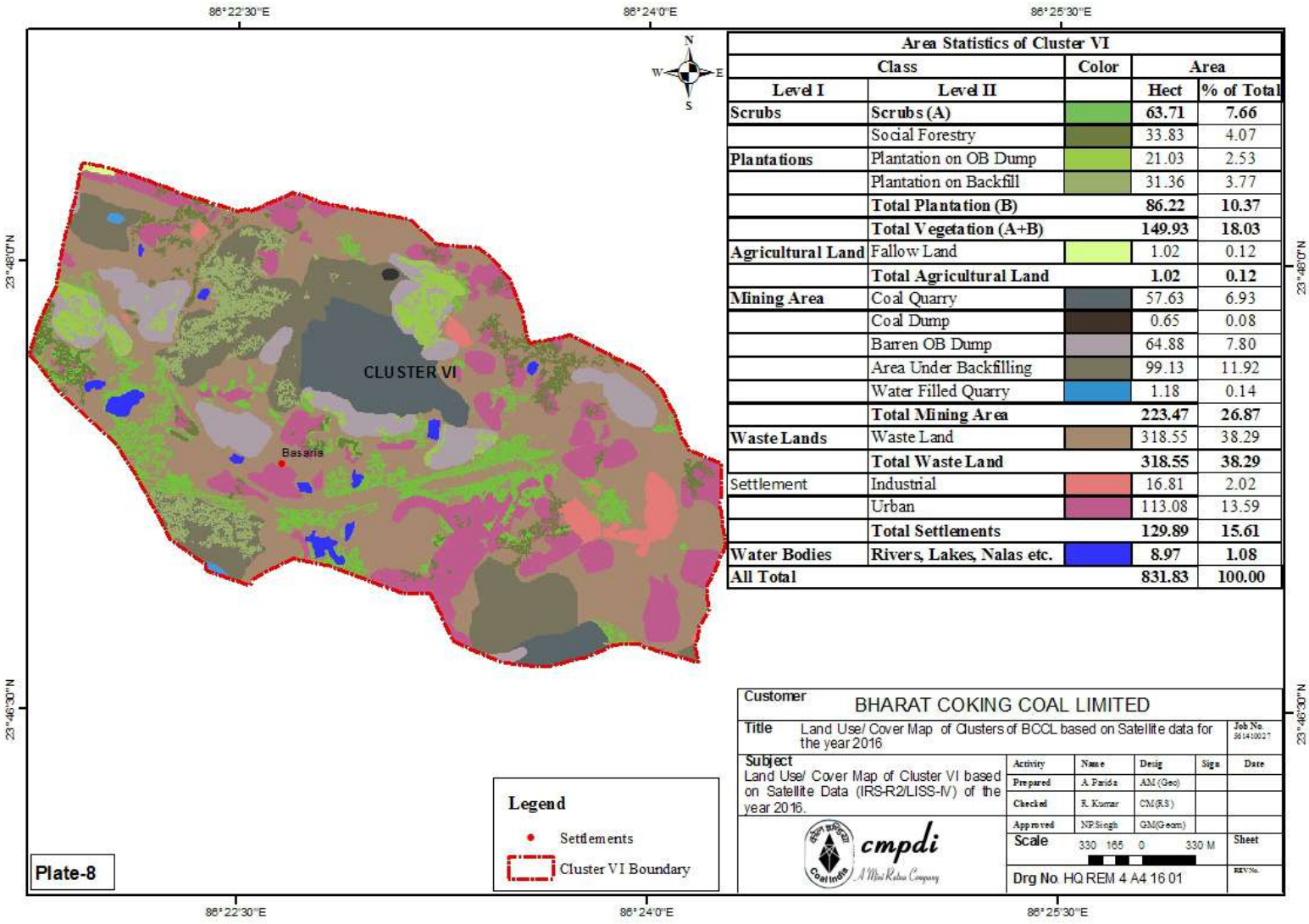

Area Statistics of Cluster VI				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		63.71	7.66
	Social Forestry		33.83	4.07
Plantations	Plantation on OB Dump		21.03	2.53
	Plantation on Backfill		31.36	3.77
	Total Plantation (B)		86.22	10.37
	Total Vegetation (A+B)		149.93	18.03
Agricultural Land	Fallow Land		1.02	0.12
	Total Agricultural Land		1.02	0.12
Mining Area	Coal Quarry		57.63	6.93
	Coal Dump		0.65	0.08
	Barren OB Dump		64.88	7.80
	Area Under Backfilling		99.13	11.92
	Water Filled Quarry		1.18	0.14
	Total Mining Area		223.47	26.87
Waste Lands	Waste Land		318.55	38.29
	Total Waste Land		318.55	38.29
Settlement	Industrial		16.81	2.02
	Urban		113.08	13.59
	Total Settlements		129.89	15.61
Water Bodies	Rivers, Lakes, Nalas etc.		8.97	1.08
All Total			831.83	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 561410027

Subject: Land Use/ Cover Map of Cluster VI based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Parida	AM (Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP.Singh	GM(Geom)		

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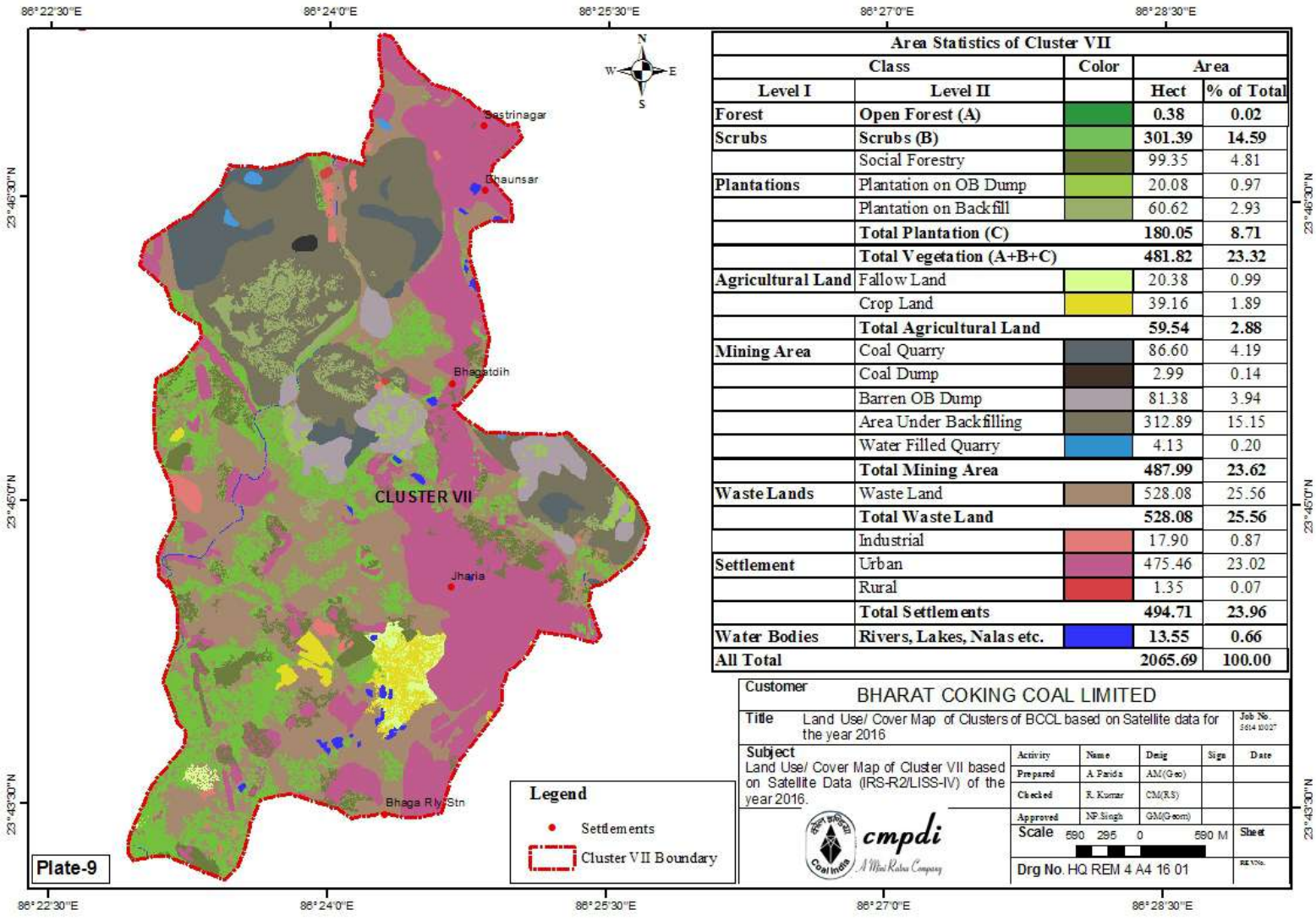

Area Statistics of Cluster VII				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Forest	Open Forest (A)		0.38	0.02
Scrubs	Scrubs (B)		301.39	14.59
	Social Forestry		99.35	4.81
Plantations	Plantation on OB Dump		20.08	0.97
	Plantation on Backfill		60.62	2.93
	Total Plantation (C)		180.05	8.71
	Total Vegetation (A+B+C)		481.82	23.32
Agricultural Land	Fallow Land		20.38	0.99
	Crop Land		39.16	1.89
	Total Agricultural Land		59.54	2.88
Mining Area	Coal Quarry		86.60	4.19
	Coal Dump		2.99	0.14
	Barren OB Dump		81.38	3.94
	Area Under Backfilling		312.89	15.15
	Water Filled Quarry		4.13	0.20
	Total Mining Area		487.99	23.62
Waste Lands	Waste Land		528.08	25.56
	Total Waste Land		528.08	25.56
	Industrial		17.90	0.87
Settlement	Urban		475.46	23.02
	Rural		1.35	0.07
	Total Settlements		494.71	23.96
Water Bodies	Rivers, Lakes, Nalas etc.		13.55	0.66
All Total			2065.69	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 5614 10027

Subject: Land Use/ Cover Map of Cluster VII based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A.Parida	AM(Geo)		
Checked	K. Kumar	CM(RS)		
Approved	NP.Singh	GM(Geom)		

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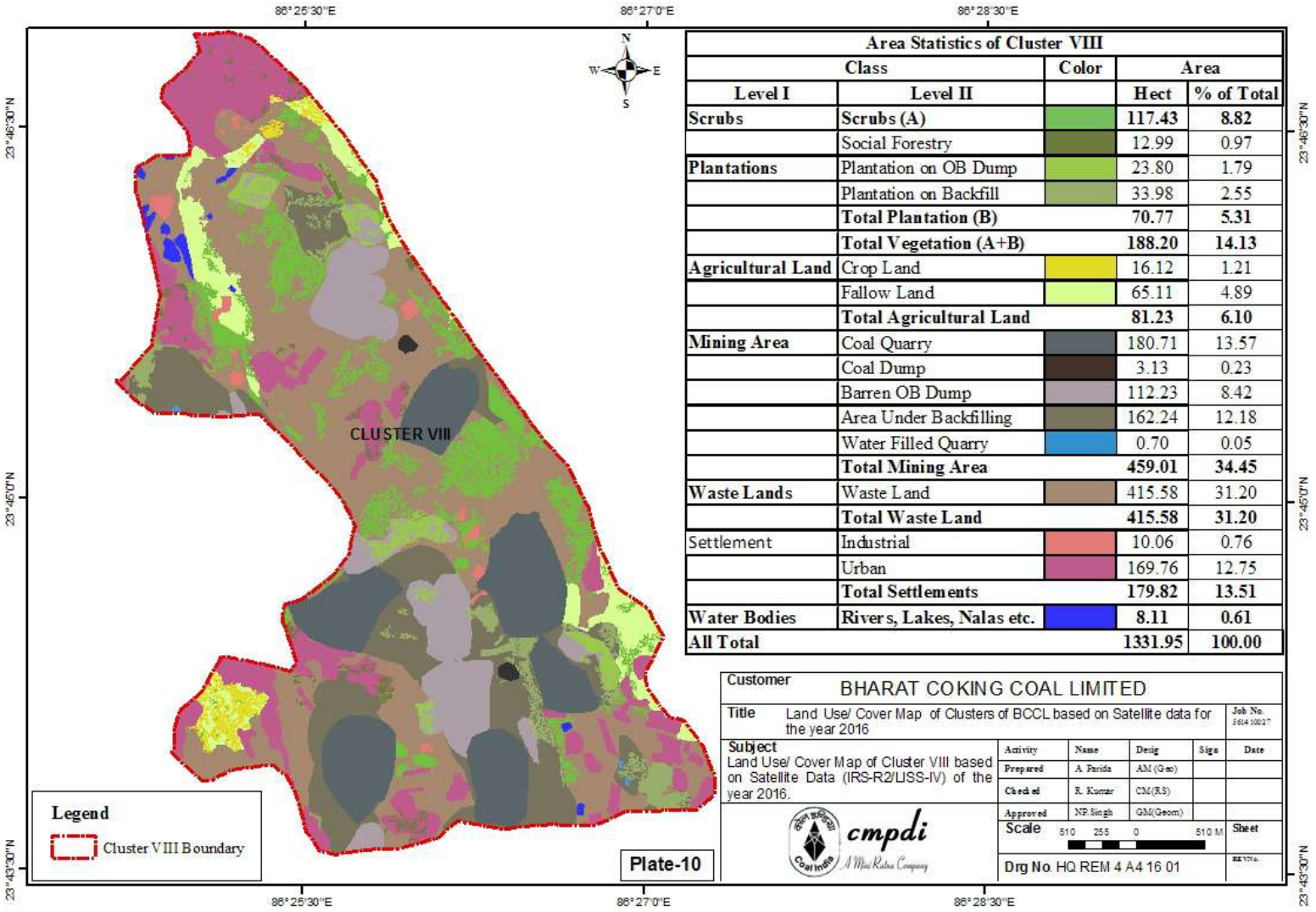

Area Statistics of Cluster VIII				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		117.43	8.82
	Social Forestry		12.99	0.97
Plantations	Plantation on OB Dump		23.80	1.79
	Plantation on Backfill		33.98	2.55
	Total Plantation (B)		70.77	5.31
	Total Vegetation (A+B)		188.20	14.13
Agricultural Land	Crop Land		16.12	1.21
	Fallow Land		65.11	4.89
	Total Agricultural Land		81.23	6.10
Mining Area	Coal Quarry		180.71	13.57
	Coal Dump		3.13	0.23
	Barren OB Dump		112.23	8.42
	Area Under Backfilling		162.24	12.18
	Water Filled Quarry		0.70	0.05
	Total Mining Area		459.01	34.45
Waste Lands	Waste Land		415.58	31.20
	Total Waste Land		415.58	31.20
Settlement	Industrial		10.06	0.76
	Urban		169.76	12.75
	Total Settlements		179.82	13.51
Water Bodies	Rivers, Lakes, Nalas etc.		8.11	0.61
All Total			1331.95	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 5614 10027

Subject: Land Use/ Cover Map of Cluster VIII based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Farida	AM (Geo)		
Checked	R. Kumar	CM (RS)		
Approved	NP. Singh	GM(Geom)		

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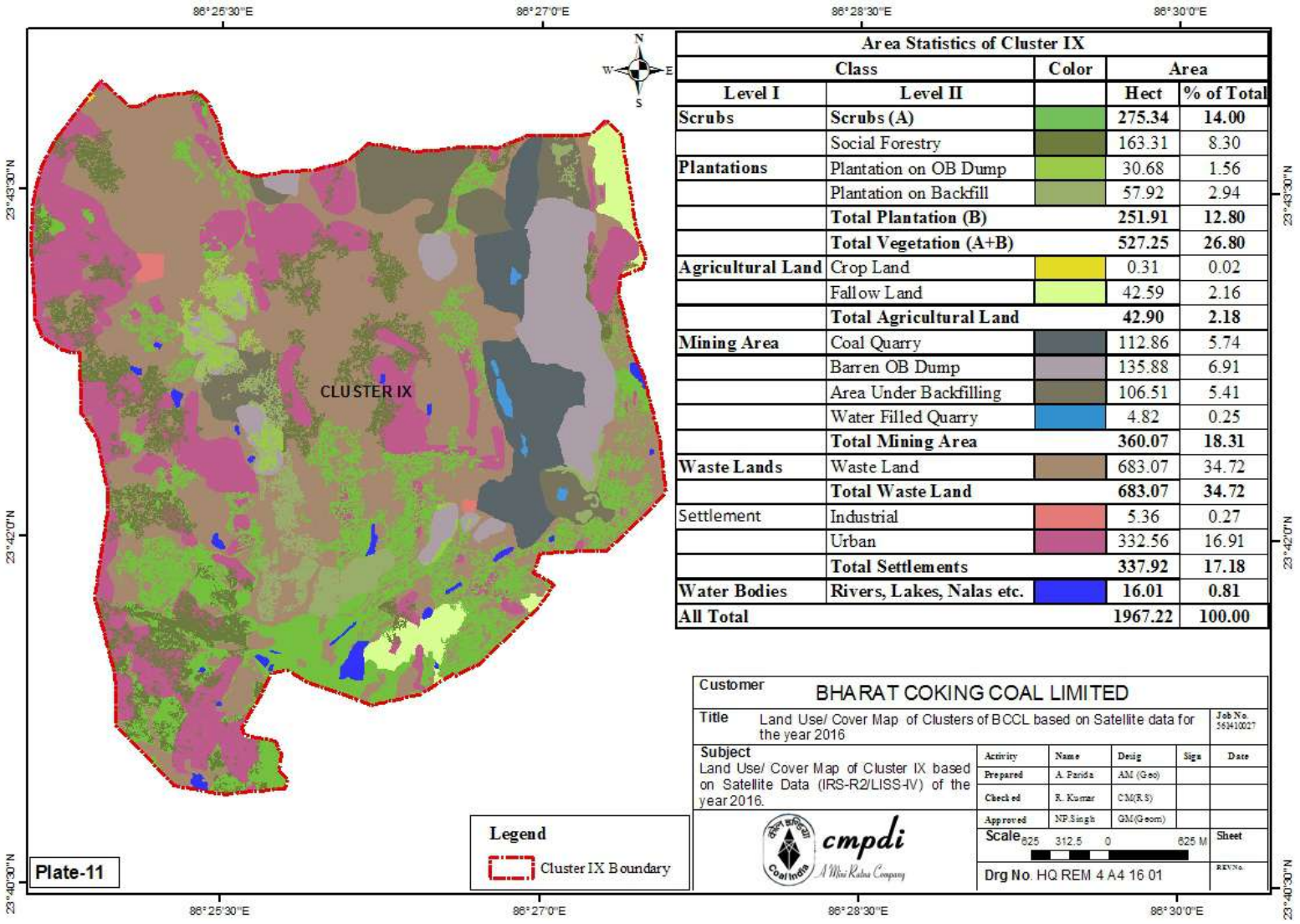

Area Statistics of Cluster IX

Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		275.34	14.00
	Social Forestry		163.31	8.30
Plantations	Plantation on OB Dump		30.68	1.56
	Plantation on Backfill		57.92	2.94
	Total Plantation (B)		**251.91**	**12.80**
	Total Vegetation (A+B)		**527.25**	**26.80**
Agricultural Land	Crop Land		0.31	0.02
	Fallow Land		42.59	2.16
	Total Agricultural Land		**42.90**	**2.18**
Mining Area	Coal Quarry		112.86	5.74
	Barren OB Dump		135.88	6.91
	Area Under Backfilling		106.51	5.41
	Water Filled Quarry		4.82	0.25
	Total Mining Area		**360.07**	**18.31**
Waste Lands	Waste Land		683.07	34.72
	Total Waste Land		**683.07**	**34.72**
Settlement	Industrial		5.36	0.27
	Urban		332.56	16.91
	Total Settlements		**337.92**	**17.18**
Water Bodies	Rivers, Lakes, Nalas etc.		16.01	0.81
All Total			1967.22	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 561410027

Subject: Land Use/ Cover Map of Cluster IX based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Farida	AM (Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP.Singh	GM(Geom)		

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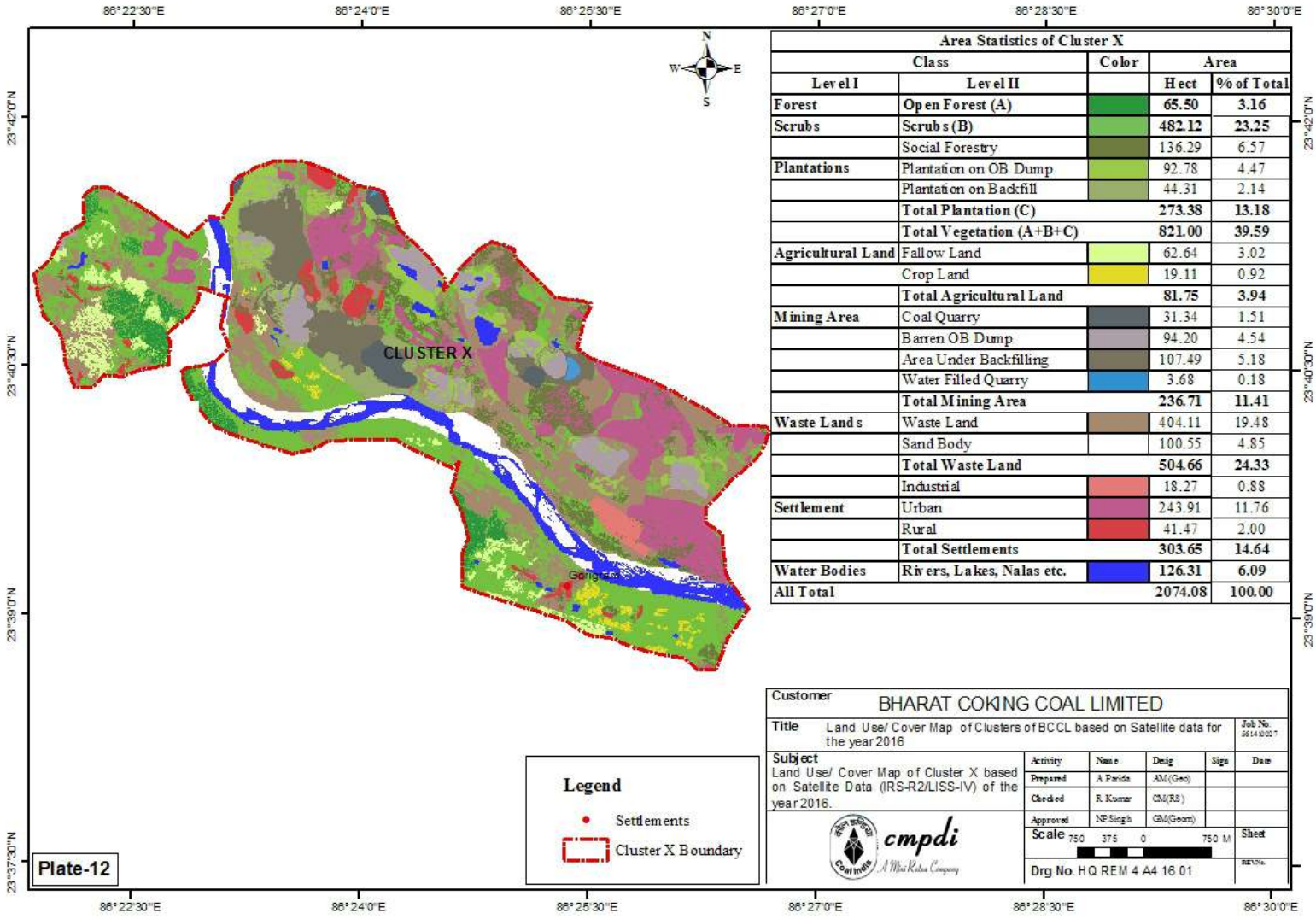

Area Statistics of Cluster X				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Forest	Open Forest (A)		65.50	3.16
Scrubs	Scrubs (B)		482.12	23.25
	Social Forestry		136.29	6.57
Plantations	Plantation on OB Dump		92.78	4.47
	Plantation on Backfill		44.31	2.14
	Total Plantation (C)		273.38	13.18
	Total Vegetation (A+B+C)		821.00	39.59
Agricultural Land	Fallow Land		62.64	3.02
	Crop Land		19.11	0.92
	Total Agricultural Land		81.75	3.94
Mining Area	Coal Quarry		31.34	1.51
	Barren OB Dump		94.20	4.54
	Area Under Backfilling		107.49	5.18
	Water Filled Quarry		3.68	0.18
	Total Mining Area		236.71	11.41
Waste Lands	Waste Land		404.11	19.48
	Sand Body		100.55	4.85
	Total Waste Land		504.66	24.33
	Industrial		18.27	0.88
Settlement	Urban		243.91	11.76
	Rural		41.47	2.00
	Total Settlements		303.65	14.64
Water Bodies	Rivers, Lakes, Nalas etc.		126.31	6.09
All Total			2074.08	100.00

Customer	BHARAT COKING COAL LIMITED				
Title	Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016				Job No. 561410027
Subject	Land Use/ Cover Map of Cluster X based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.	Activity	Name	Desig	Sign	Date
		Prepared	A Parida	AM(Geo)		
		Checked	R. Kumar	CM(RS)		
		Approved	NP Singh	GM(Geom)		
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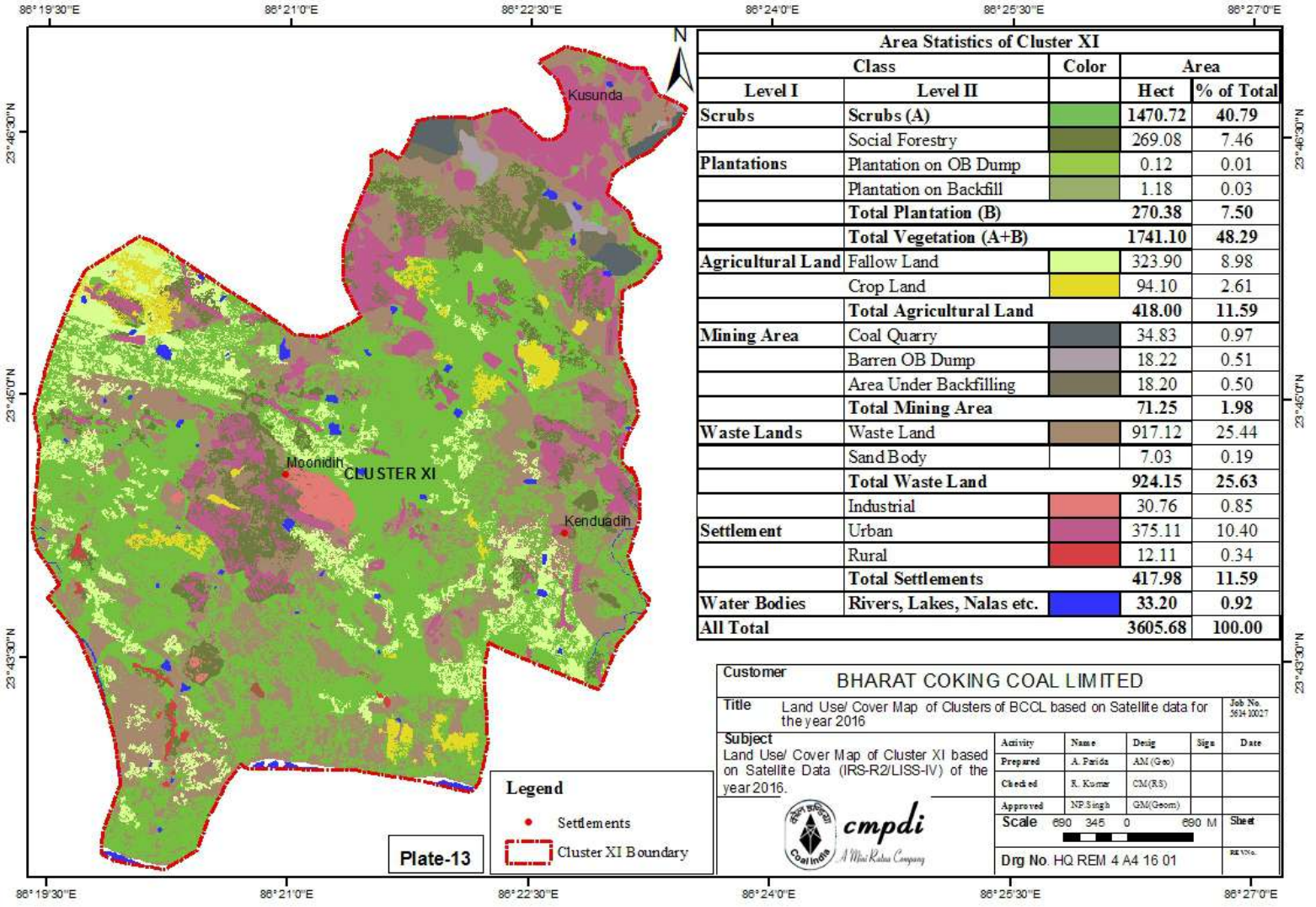

Area Statistics of Cluster XI				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		1470.72	40.79
	Social Forestry		269.08	7.46
Plantations	Plantation on OB Dump		0.12	0.01
	Plantation on Backfill		1.18	0.03
	Total Plantation (B)		**270.38**	**7.50**
	Total Vegetation (A+B)		**1741.10**	**48.29**
Agricultural Land	Fallow Land		323.90	8.98
	Crop Land		94.10	2.61
	Total Agricultural Land		**418.00**	**11.59**
Mining Area	Coal Quarry		34.83	0.97
	Barren OB Dump		18.22	0.51
	Area Under Backfilling		18.20	0.50
	Total Mining Area		**71.25**	**1.98**
Waste Lands	Waste Land		917.12	25.44
	Sand Body		7.03	0.19
	Total Waste Land		**924.15**	**25.63**
	Industrial		30.76	0.85
Settlement	Urban		375.11	10.40
	Rural		12.11	0.34
	Total Settlements		**417.98**	**11.59**
Water Bodies	Rivers, Lakes, Nalas etc.		33.20	0.92
All Total			3605.68	100.00

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 5614 10027

Subject: Land Use/ Cover Map of Cluster XI based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A. Parida	AM (Geo)		
Checked	R. Kumar	CM (RS)		
Approved	NP Singh	GM (Geom)		

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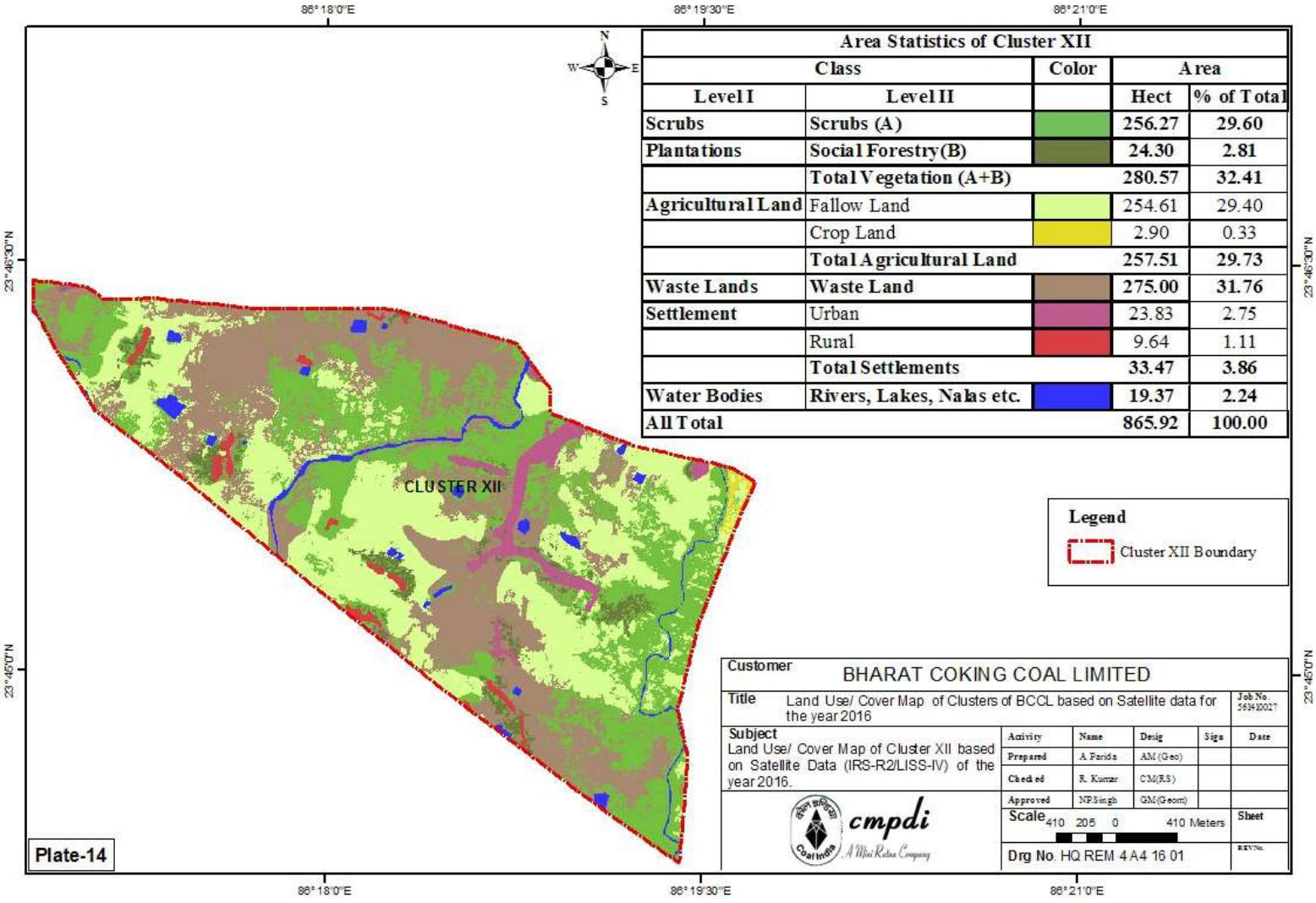


Area Statistics of Cluster XII

Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		256.27	29.60
Plantations	Social Forestry(B)		24.30	2.81
	Total Vegetation (A+B)		280.57	32.41
Agricultural Land	Fallow Land		254.61	29.40
	Crop Land		2.90	0.33
	Total Agricultural Land		257.51	29.73
Waste Lands	Waste Land		275.00	31.76
Settlement	Urban		23.83	2.75
	Rural		9.64	1.11
	Total Settlements		33.47	3.86
Water Bodies	Rivers, Lakes, Nalas etc.		19.37	2.24
All Total			865.92	100.00

Legend

Cluster XII Boundary

Customer: BHARAT COKING COAL LIMITED

Title: Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016

Job No. 561410027

Subject: Land Use/ Cover Map of Cluster XII based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.

Activity	Name	Desig	Sign	Date
Prepared	A Farida	AM (Geo)		
Checked	R. Kumar	CM(RS)		
Approved	NP Singh	GM(Geom)		

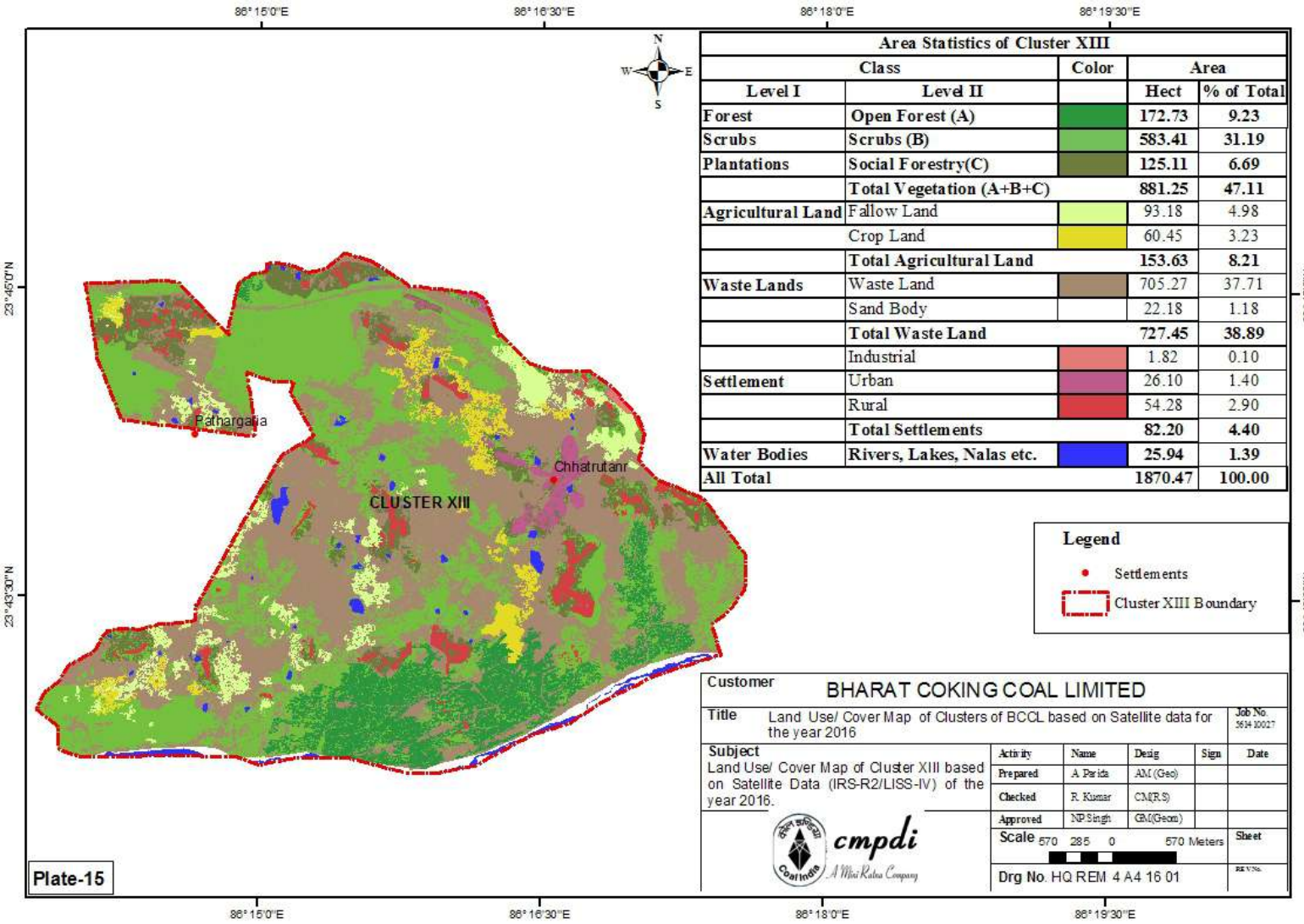
Scale 410 205 0 410 Meters

Sheet

Drg No. HQ REM 4 A4 16 01

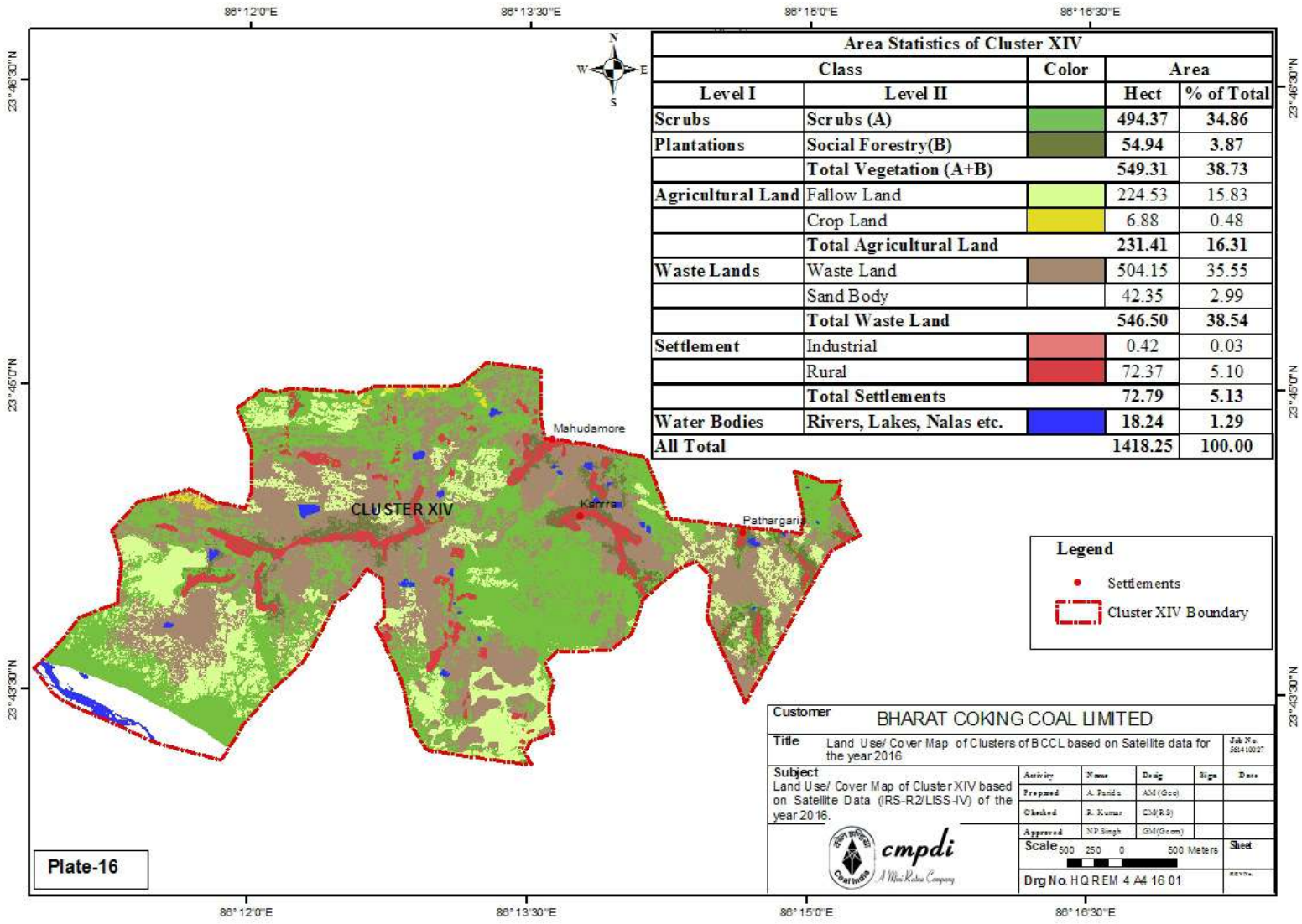
REV No.

cmpdi — A Mini Ratna Company



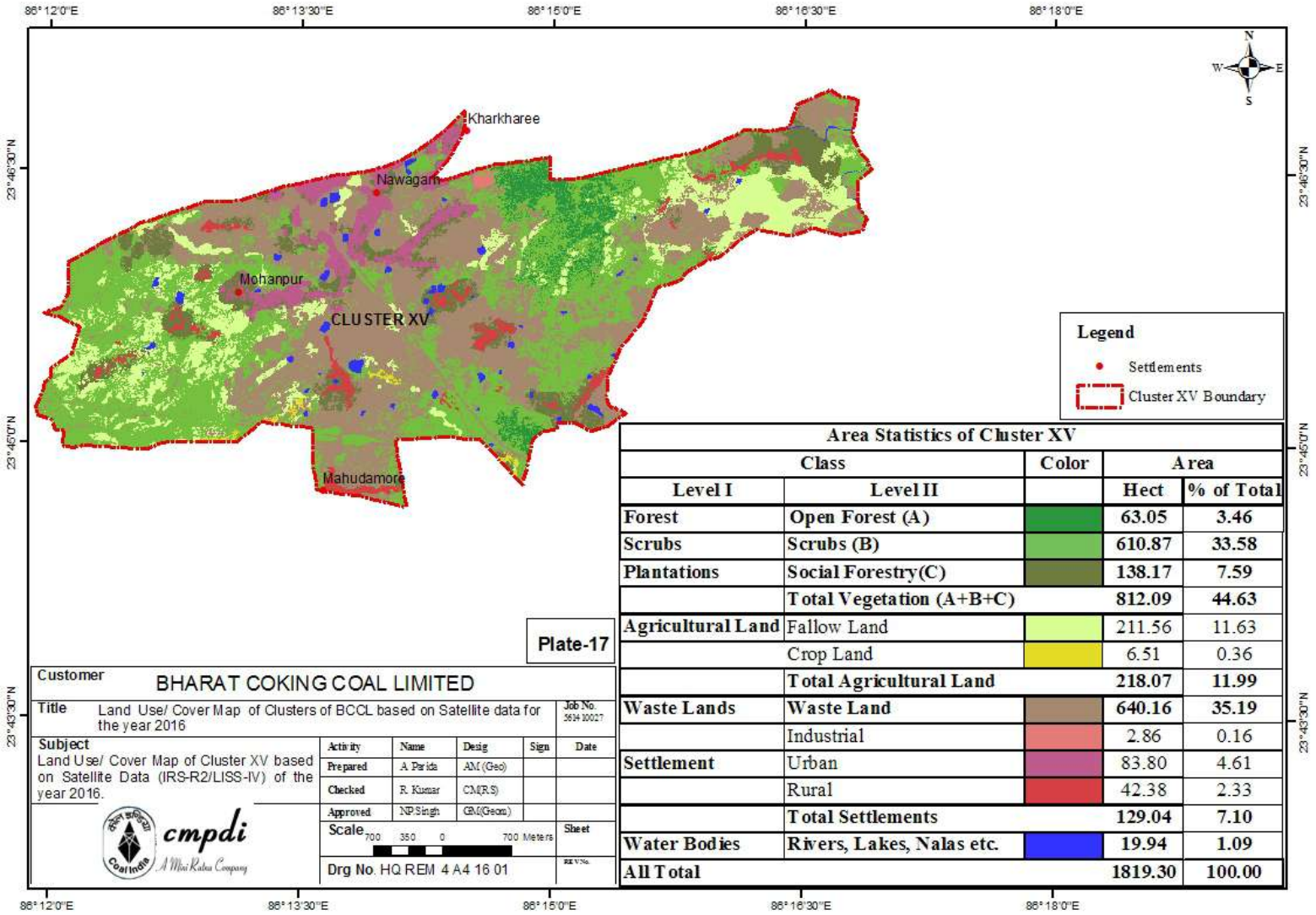
Area Statistics of Cluster XIII				
Class		Color	Area	
Level I	Level II		Hect	% of Total
Forest	Open Forest (A)		172.73	9.23
Scrubs	Scrubs (B)		583.41	31.19
Plantations	Social Forestry(C)		125.11	6.69
	Total Vegetation (A+B+C)		881.25	47.11
Agricultural Land	Fallow Land		93.18	4.98
	Crop Land		60.45	3.23
	Total Agricultural Land		153.63	8.21
Waste Lands	Waste Land		705.27	37.71
	Sand Body		22.18	1.18
	Total Waste Land		727.45	38.89
	Industrial		1.82	0.10
Settlement	Urban		26.10	1.40
	Rural		54.28	2.90
	Total Settlements		82.20	4.40
Water Bodies	Rivers, Lakes, Nalas etc.		25.94	1.39
All Total			1870.47	100.00

Customer	BHARAT COKING COAL LIMITED				
Title	Land Use/ Cover Map of Clusters of BCCL based on Satellite data for the year 2016				Job No. 5614 10027
Subject	Land Use/ Cover Map of Cluster XIII based on Satellite Data (IRS-R2/LISS-IV) of the year 2016.	Activity	Name	Desig	Sign	Date
		Prepared	A Parida	AM (Geo)		
		Checked	R. Kumar	CM(RS)		
		Approved	NP Singh	GM(Geom)		
		Scale 570 285 0 570 Meters				Sheet
		Drg No. HQ REM 4 A4 16 01				REVNo.



Area Statistics of Cluster XIV

Class		Color	Area	
Level I	Level II		Hect	% of Total
Scrubs	Scrubs (A)		494.37	34.86
Plantations	Social Forestry(B)		54.94	3.87
	Total Vegetation (A+B)		549.31	38.73
Agricultural Land	Fallow Land		224.53	15.83
	Crop Land		6.88	0.48
	Total Agricultural Land		231.41	16.31
Waste Lands	Waste Land		504.15	35.55
	Sand Body		42.35	2.99
	Total Waste Land		546.50	38.54
Settlement	Industrial		0.42	0.03
	Rural		72.37	5.10
	Total Settlements		72.79	5.13
Water Bodies	Rivers, Lakes, Nalas etc.		18.24	1.29
All Total			1418.25	100.00



Area Statistics of Cluster XV

Class		Color	Area	
Level I	**Level II**		**Hect**	**% of Total**
Forest	**Open Forest (A)**		**63.05**	**3.46**
Scrubs	**Scrubs (B)**		**610.87**	**33.58**
Plantations	**Social Forestry(C)**		**138.17**	**7.59**
	Total Vegetation (A+B+C)		**812.09**	**44.63**
Agricultural Land	Fallow Land		211.56	11.63
	Crop Land		6.51	0.36
	Total Agricultural Land		**218.07**	**11.99**
Waste Lands	**Waste Land**		**640.16**	**35.19**
	Industrial		2.86	0.16
Settlement	Urban		83.80	4.61
	Rural		42.38	2.33
	Total Settlements		**129.04**	**7.10**
Water Bodies	**Rivers, Lakes, Nalas etc.**		**19.94**	**1.09**
All Total			**1819.30**	**100.00**

Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)
Gondwana Place, Kanke Road, Ranchi - 834 008,India
Phone : (+91-0651) 2230001, 2230002, 2230483, Fax (91-0651) 2231851, 2231447
Email : cmpdi2@hub.nic.in, cmpdihq@cmpdi.co.in

ANNEXURE - VIII

STRICTLY RESTRICTED
FOR COMPANY USE ONLY RESTRICTED
The information given in this report is not to be communicated either directly or indirectly to the press or to any person not holding an official position in the CIL / GOVERNMENT.

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

(FOR THE Q.E. MARCH, 2017)

E. C. no. J-11015/380/2010-IA.II (M) dated 06.02.2013.

April, 2017

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CLUSTER - X

(FOR THE Q.E. March, 2017)

CONTENTS

ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED CLUSTER – X

(FOR THE Q.E. MARCH, 2017)

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ISO 9001 Company
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EXECUTIVE SUMMARY

1.0 Introduction

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

Bharat Coking Coal Limited (BCCL), a Subsidiary company of Coal India Limited is operating Underground and Opencast Mines in Jharia Coalfield (JCF) is a part of Gondwana Coalfields located in Dhanbad district of Jharkhand, the JCF is bounded by $23^0$37' N to $23^0$52' N latitudes and $86^0$09' E to $86^0$30' E longitude occupying an area of 450 Sq.km. BCCL has awarded Environmental monitoring work of Jharia Coalfield (JCF) to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per the conditions laid down by the MoEF&CC while granting environmental clearance of project, consent letter issued by the respective SPCB, and other statutory requirements.

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

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

2.2 Water sampling stations

The Water sampling stations were selected for mine sump water, drinking water supply, well/ Hand pump water 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, washray 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. The samples were analyzed in Environmental Laboratory of CMPDI, RI-I, Asansol.

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.

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, are 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, Forests and Climate Change (MoEF&CC), Govt. of India.

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

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

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

1.1 The Cluster-X is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Amlabad UG, Bhowra north, Bhowra South, Patherdih, Sudamdih Incline & Sudamdih Shaft. The Cluster – X is situated about 25 - 30 kms from Dhanbad Railway Station. The mines of this Cluster – X 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 Damodar River.

1.2 The Cluster-X is designed to produce 1.762 MTPA (normative) and 2.289 MTPA (peak) capacity of coal.

The Project has Environmental Clearance from Ministry of Environment, Forests and Climate Change (MoEF&CC) for a rated capacity 1.762 MTPA (normative) and 2.289 MTPA (peak) capacity of coal production vide letter no. J-11015/380/2010-IA.II (M) dated 06th February, 2013.

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

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

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

i) Bhowrah North (A14): Industrial Area

The location of the sampling station is 23º40.977' N 86º23.963'E. The sampler was placed at an elevated platform of around 1.5m height from ground level at Guest House of EJ Area. The station was selected to represent the impact of mining activities of Eastern Jharia area, Coal washery, poor roads condition, heavy public traffic, burning of coal by the surrounding habitants.

ii) Sudamdih Washery (A15): Industrial Area

The location of the sampling station is 23^0 39'32" N 86^0 26'13" E. The sampler was placed at elevated platform of around 1.5m height from ground level at Coal lab near washery. The station was selected to represent the impact of mining activities of Eastern Jharia area, Washery, poor roads condition.

II. BUFFER ZONE Monitoring Location

i) Jeenagora (A13): Industrial Area

The location of the sampling station is 23^0 42. 536' N & 86^0 24. 664' E. The sampler was placed elevated platform of around 1.5m height from ground level at Safety Office.

ii) Sitanala (A30): Industrial Area

This location is at the Amlabad Project office which is currently in-operational. It has been selected to study the impact of Air pollution in the buffer zone on the Cluster.

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 PM_{10} & $PM_{2.5}$ respectively at 24 hours interval once in a fortnight and the same for the gaseous pollutants. The samples were analysed in Environmental Laboratory of CMPDI, RI-I, Asansol.

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 from 96 to 142 µg/m^3
In **buffer zone** in **Industrial area** varies from 124 to 125 µg/m^3

Particulate Matter $PM_{2.5}$

In **core zone** under **Industrial area** varies from 62 to 76 µg/m^3
In **buffer zone** in **Industrial area** varies from 68 to 70 µg/m^3

Sulphur Dioxide:

In **core zone** under **Industrial area** varies from 10 to 12 µg/m^3
In **buffer zone** in **Industrial area** varies from 10 to 12 µg/m^3

Oxides of Nitrogen:

In **core zone** under **Industrial area** varies from 24 to 28 µg/m^3
In **buffer zone** in **Industrial area** varies from 26 to 30 µg/m^3

AMBIENT AIR QUALITY DATA

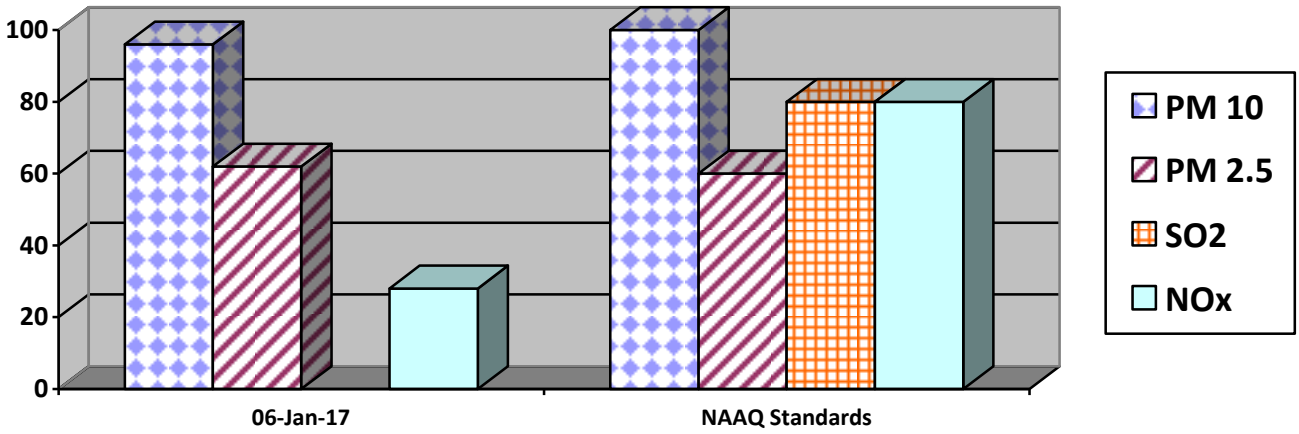
Name of the Company: **Bharat Coking Coal limited** Year : **2016-17.**
Name of the Cluster : **Cluster – X** Q.E.: **March, 2017**

Station Code/Name: (a) A14 Bhowrah North **Category: Industrial.**
(b) A15 Sudamdih Washery

ZONE: Core

(a). Station Code/Name: A14 Bhowrah North, Category: Industrial[1].

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_X
1	06 - Jan - 17	96	62	<10	28
	NAAQ Standards	100	60	80	80



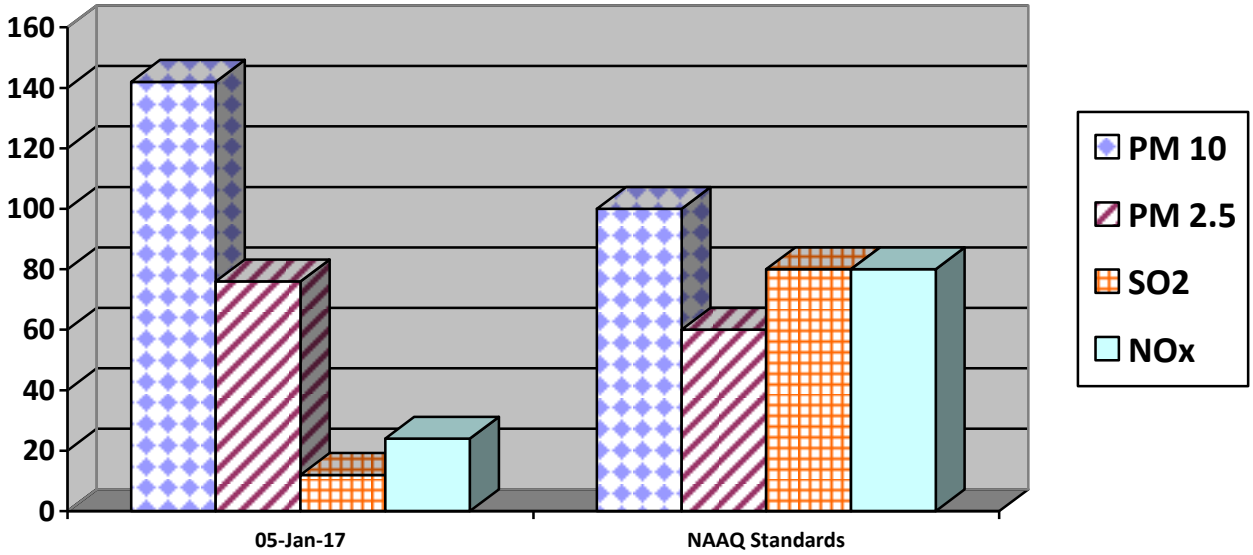
Note:

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

Analysed By	Checked By	Approved By
JSA/SA/SSA	Lab In Charge	HOD(Mining/Environment)
	RI-2, CMPDI, Dhanbad	RI-2, CMPDI, Dhanbad

(b). Station Code/Name: A15- Sudamduh Washery Category: Industrial[2].

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	05- Jan - 17	142	76	12	24
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

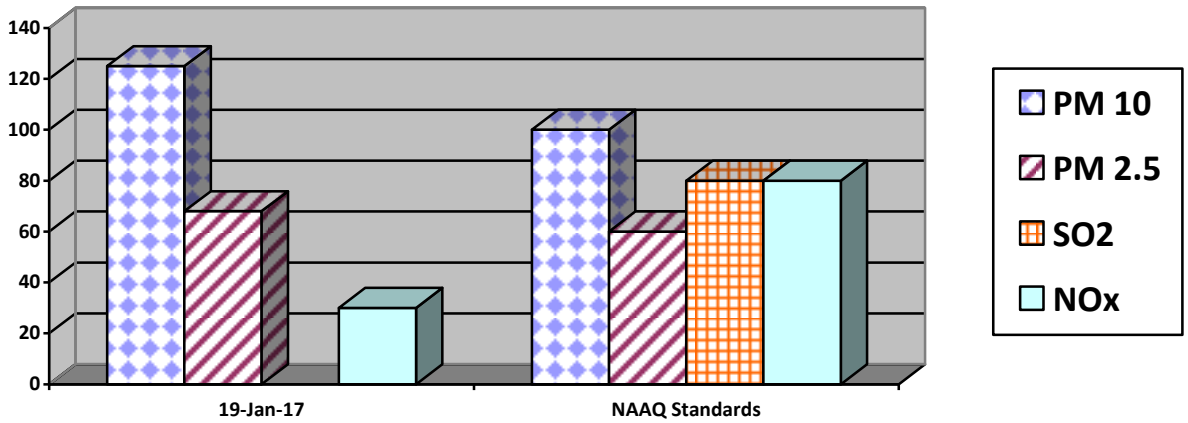
Name of the Company: **Bharat Coking Coal limited** Year : **2016-17.**
Name of the Cluster : **Cluster – X** Q.E.: **March, 2017**

Station Code/Name: (a) A13- Jeenagora **Category: Industrial.**
(b) A30 – Sitanala

ZONE: BUFFER

(a). Station Code/Name: A13 – Jeenagora, Category: Industrial[3].

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_X
1	19 - Jan -17	125	68	<10	30
	NAAQ Standards	100	60	80	80



Note:

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

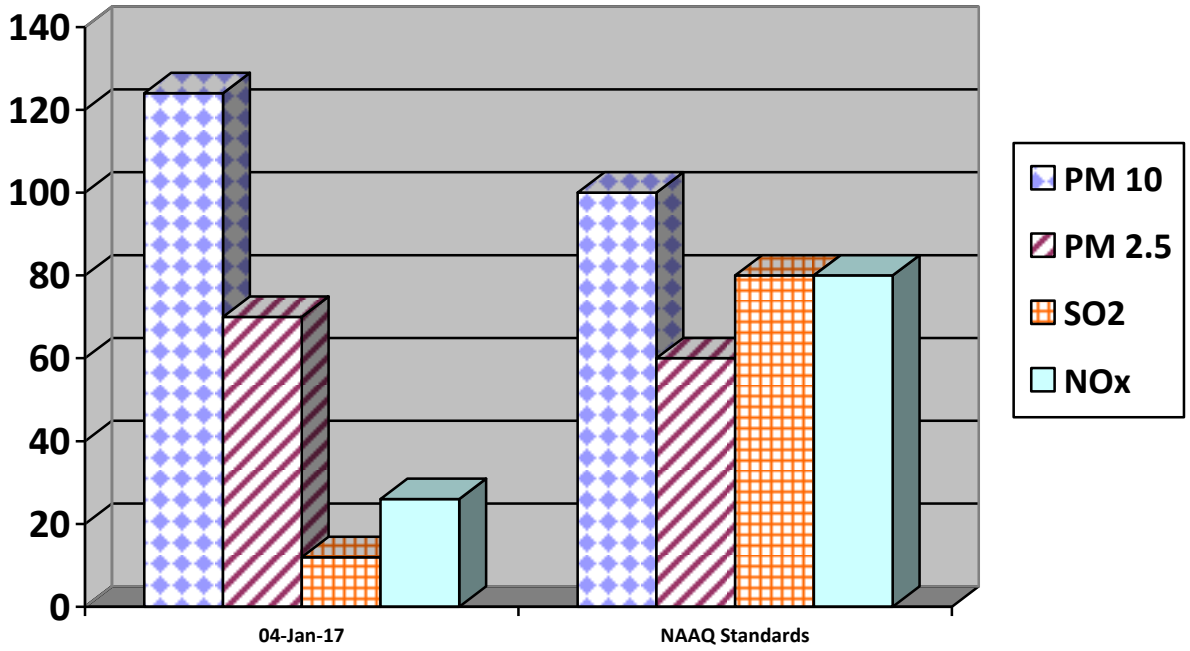
Analysed By
JSA/SA/SSA

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

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

(b). Station Code/Name: A30 – Sitanala, Category: Industrial[4].

Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_X
1	04 - Jan - 17	124	70	12	26
	NAAQ Standards	100	60	80	80



Note:

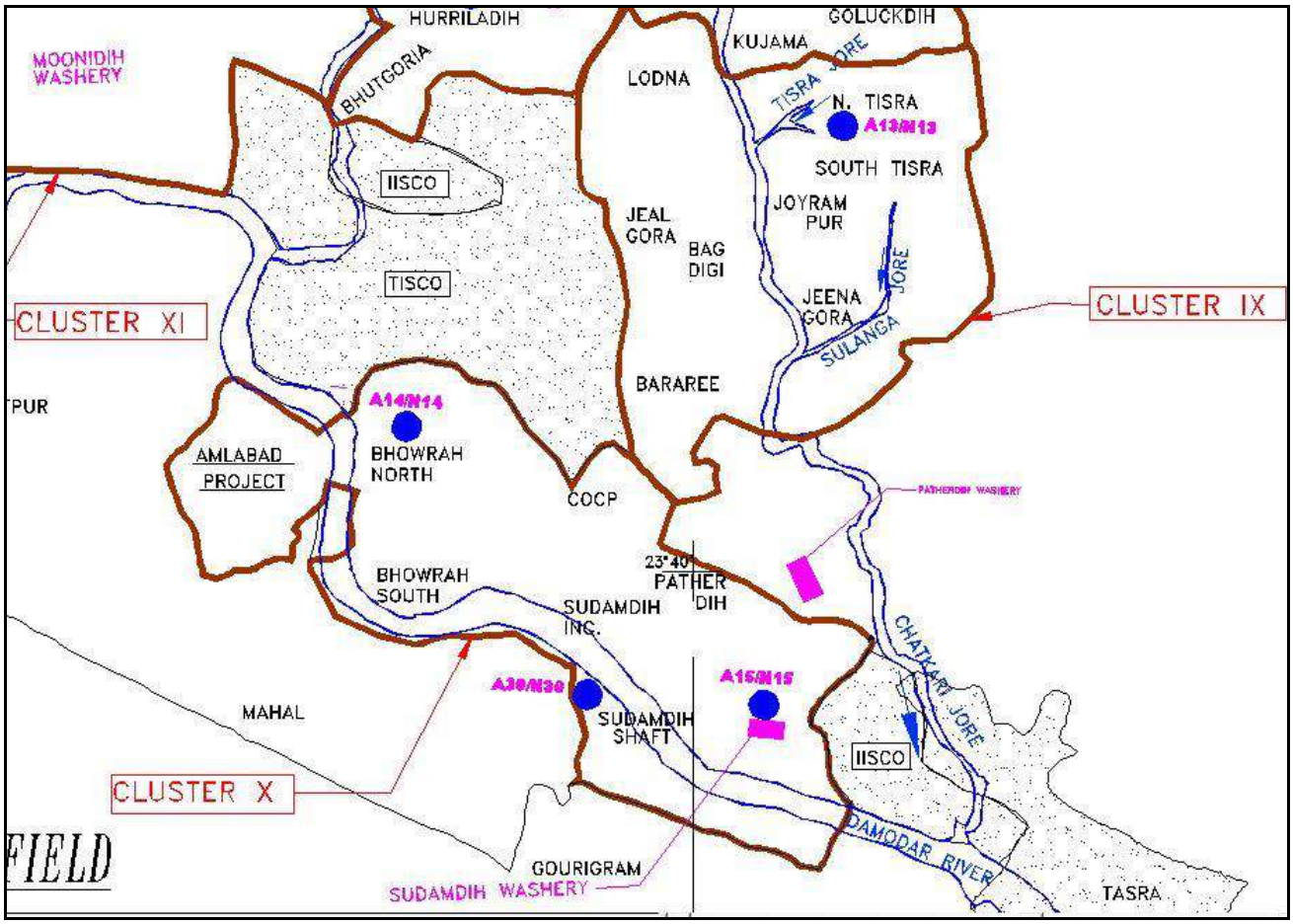
- *All values are expressed in microgram per cubic meter.*
- *24 hours duration*

Analysed By
JSA/SA/SSA

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

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

Ambient Air Monitoring Stations in Cluster- X 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 Bhowrah North (MW10)**

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

3.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. The effluent samples were collected and analysed for four parameters on fortnightly basis at the Environmental Laboratory at CMPDI.

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 all the parmeters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER-FOUR PARAMETERS)

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

Year : **2016-17.**

Name of the Cluster: **Cluster - X**

Month: **January, 2017.**

Name of the Stations & Code :

1. MW10- Mine Discharge of Bhowrah North

First Fortnight

Sl. No.	**Parameters**	**MW10** (Mine Discharge) 06.01.2017	**As per MOEF&CC General Standards for schedule VI**
1	Total Suspended Solids	64	*100 (Max)*
2	pH	9.24	*5.5 - 9.0*
3	Oil & Grease	<2.0	*10 (Max)*
4	COD	44	*250 (Max)*

Second Fortnight

Sl. No.	**Parameters**	**MW10** (Mine Discharge) 19.01.2017	**As per MOEF&CC General Standards for schedule VI**
1	Total Suspended Solids	36	*100 (Max)*
2	pH	9.05	*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 Incharge
Env. Lab, RI-2, CMPDI

Approved By
Dy.Technical Manager
Env. Lab, CMPDI (HQ),
(Authorized Signatory)

CHAPTER - IV

NOISE LEVEL QUALITY MONITORING

4.1 Location of sampling sites and their rationale

i) **Bhowrah North (N14)**
To assess the noise level nearby the mine area, the noise levels were recorded.

ii) **Sudamdih Wahery (N15)**
To assess the noise level in washery area, the noise levels were recorded.

iii) **Jeenagora (N13)**
To assess the noise level in the vicinity of the Safety Office, the noise levels were recorded.

iv) **Sitanala (N30)**
To assess the noise level in the vicinity of the Amlabad Project office, the noise levels were recorded.

4.2 Methodology of sampling and analysis

Noise level measurements in form of 'L_{EQ}' were taken using Integrated Data Logging Sound Level Meter (NL-52 OF RION CO. Ltd. Make) during day time. Noise levels were measured for about one hour time in day time. Noise levels were measured in Decibels, 'A' weighted average, i.e. dB (A).

4.3 Results & Interpretations

Ambient noise levels were recorded during day time and the observed values were compared with standards prescribed by MoEF&CC.

The results of Noise levels recorded during day time on fortnightly basis are presented in tabular form along with the applicable standard permissible limits. The observed values in terms of L_{EQ} are presented**.**

The observed values at all the monitoring locations are found to be within permissible limits.

NOISE LEVEL DATA

Name of the Company: **Bharat Coking Coal Limited** Year : **2016-17.**

Name of the Cluster: **Cluster -X** Month: **January, 2017.**

Name of the Stations & Code :

1. **Bhowrah North (N14)**
2. **Sudamdih Washery (N15)**
3. **Jeenagora (N13)**
4. **Sitanala (N30)**

(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	**Bhowrah North (N14)**	**Industrial area**	06.01.2017	57.8	*75*
2.	**Sudamdih Washery (N15)**	**Industrial area**	05.01.2017	54.4	*75*
3.	**Sitanala (N30)**	**Industrial area**	04.01.2017	59.2	*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	**Jeenagora (N13)**	**Industrial area**	19.01.2017	54.6	*75*

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

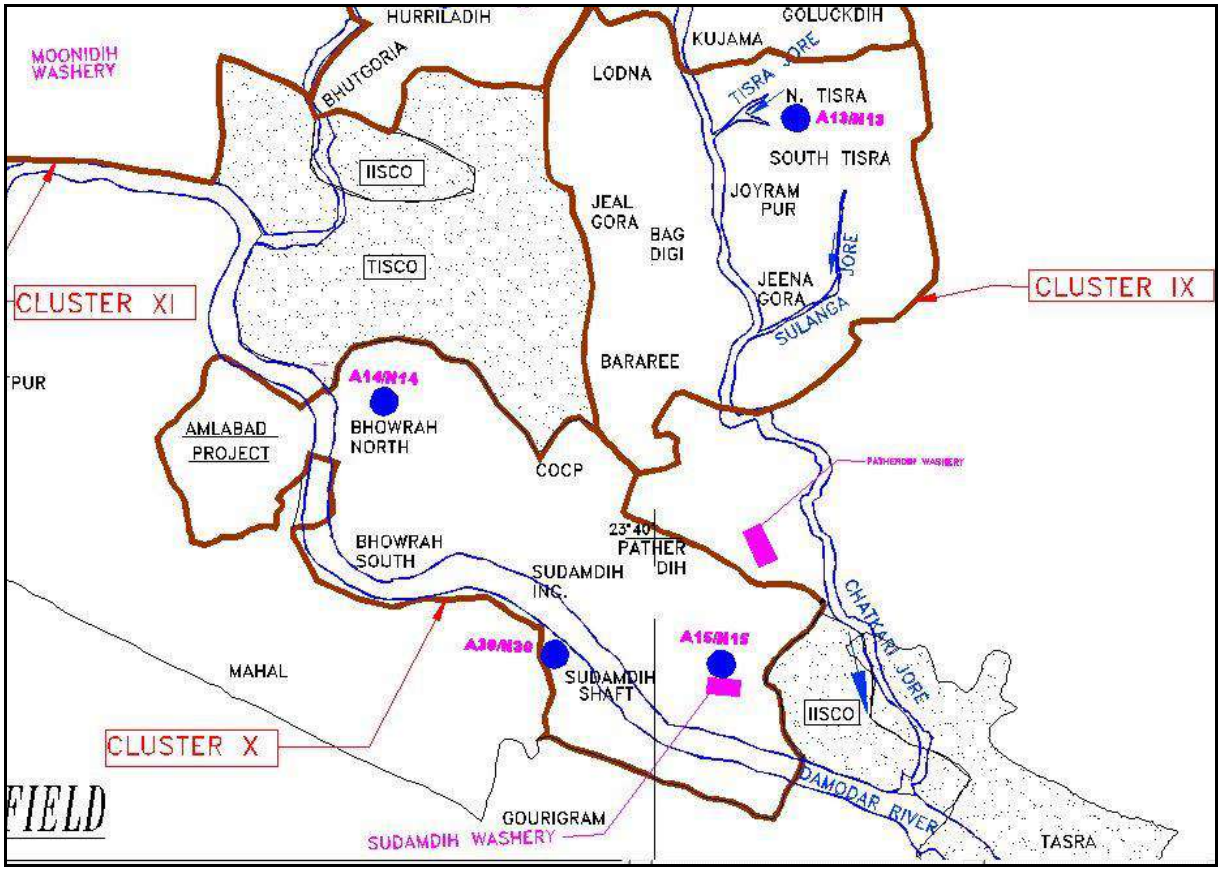
*** Day Time: 6.00 AM to 10.00 PM .**

Analysed By
JSA/SA/SSA

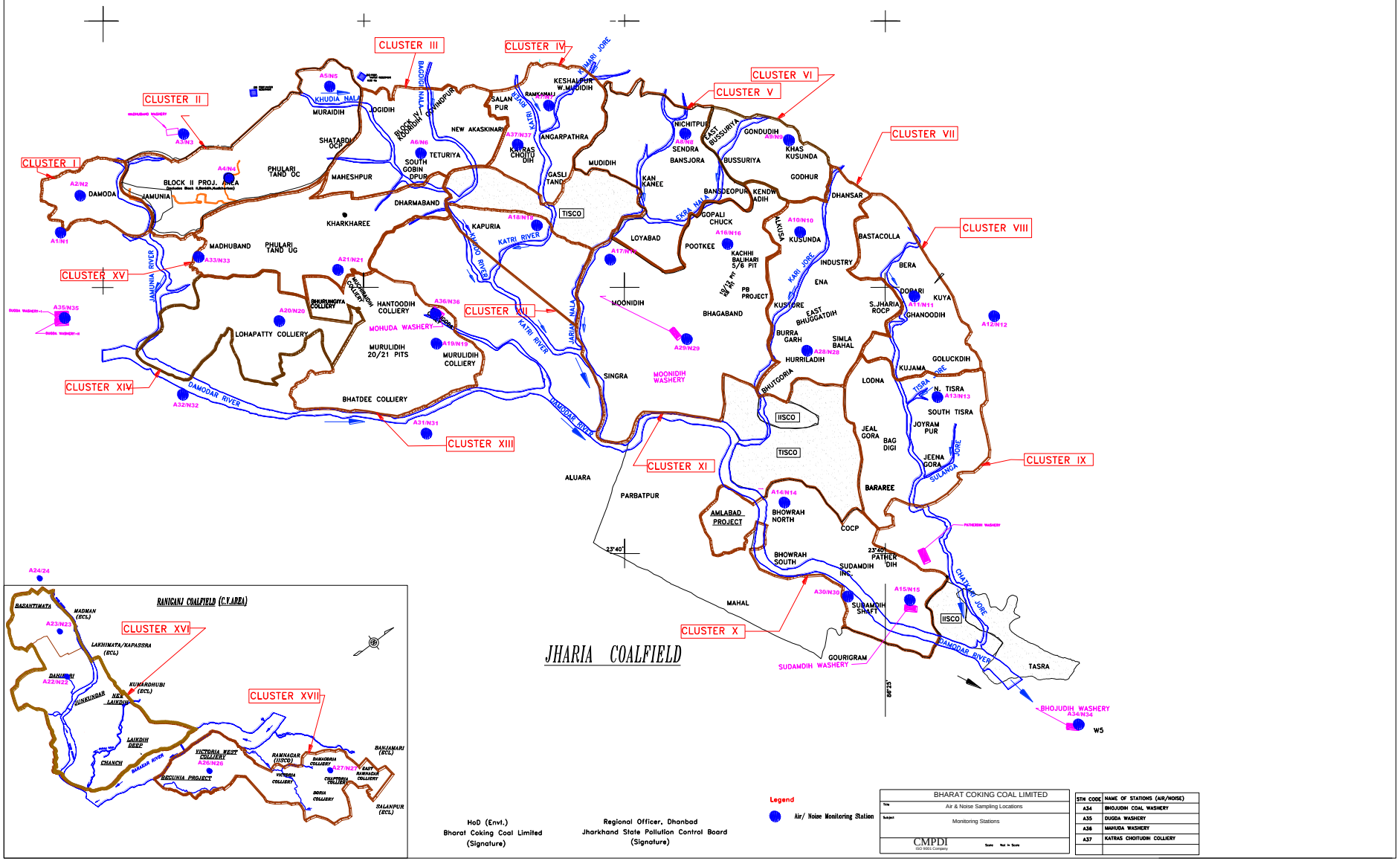
Checked By
Lab In Charge
RI-2, CMPDI, Dhanbad

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

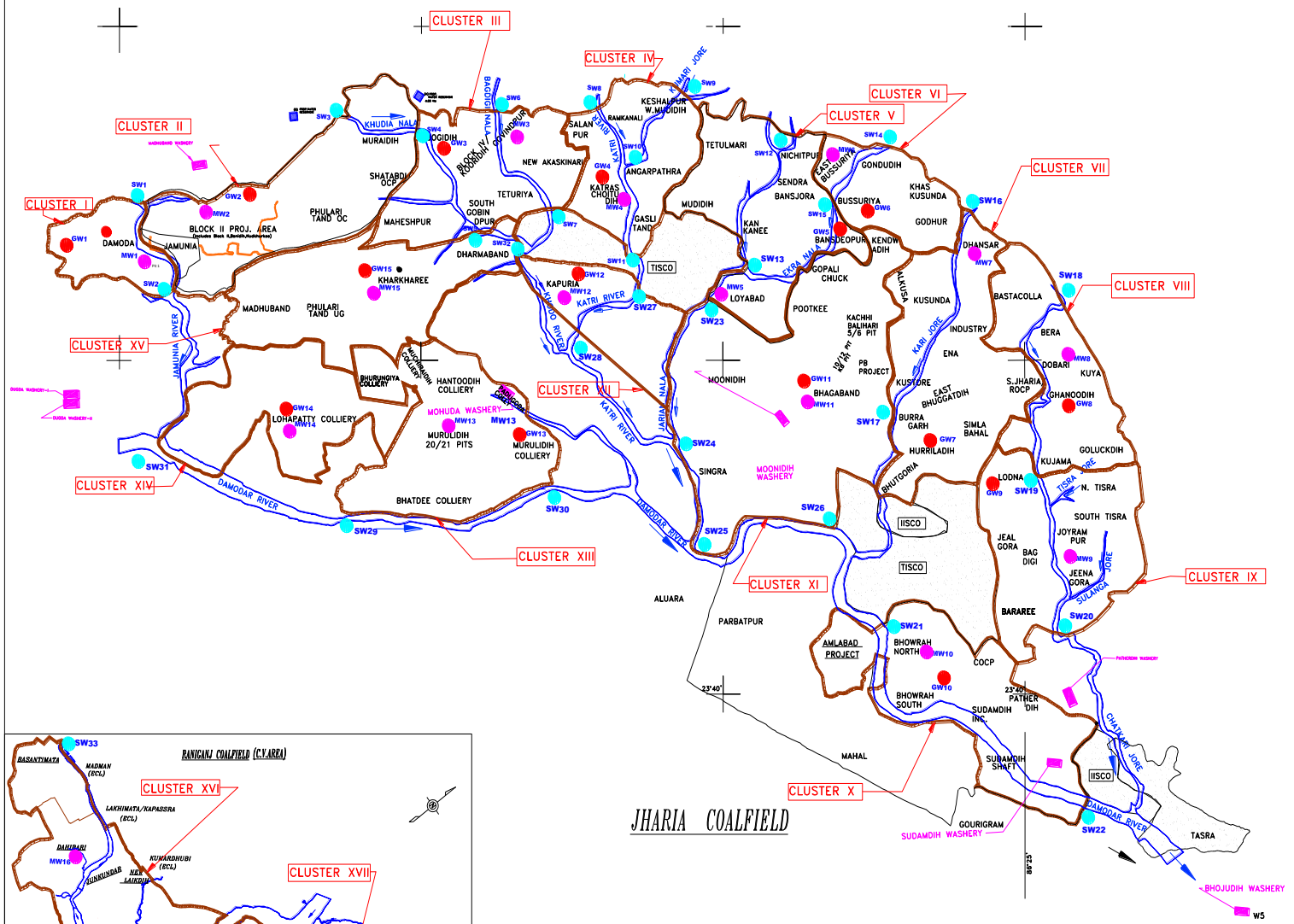
Noise Level Monitoring Location of Cluster X



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	Miner 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	Janian 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	Janian Nala, Damodar River	MW11	Bhagaband UGP	GW11	Bhagabandh
XII	SW27, SW28	Katri River	MW12	Kapuria	GW12	Kapuria
XIII	SW29, SW30	Damodar River	MW13	Murulidih (20/21)	GW13	Murilidih
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 - IX

LIST OF INITIAL MEDICAL EXAMINATION & PERIODICAL MEDICAL EXAMINATION FOR 2016-17

PME & VTC

	Target Annual	Target From April 16 to March17	Actual Up to March 17	Achievement
PME (2016-17)	951	951	993	>100%
VTC (2016-17)	472	472	488	>100%

Contractual Workers : Training		IME	
2014-15	15	2014-2015	15
2015-16	78	2015-2016	74
2016-17	78	2016-17 (till Dec.16)	62

ANNEXURE - X

Bharat coking coal limited

(A Subsidiary of Coal India Ltd)

Office of the Project Officer, Bhowra (N), Eastern Jharia Area,

P.O. Bhowra, Dist: Dhanbad (Jharkhand),PIN- 828302

Ref. No:- BCCL/EJA/BH(N)//2017/ 333 Date:-17-6-2017

To,
The Member Secretary,
Jharkhand State Pollution Control Board
T. A. Division Building (Ground Floor)
H. E. C. Dhurva.
Ranchi – 834004

Sub: - Submission of Environmental Statement in From – V

Dear Sir,

Environmental Statement is Form – V is being submitted to you for financial year 2016-17 in respect of Bhowra (N) U/G Mines.

Enclosures: - As above.

Yours Faithfully

Project Officer
Bhowra (N) U/G Mines

PROJECT OFFICER
BHOWRA (N) U/G MINES

Distribution:-
1. The Regional Office, JSPCB Office, HIG Dhanbad
2. The General Manager (Env.), BCCL, Koyla Bhawan.
3. The Area Manager (Env.), E. J. Area, Bhowra.
4. Office File.

(Form – V)

(See rule 14)

Environmental Statement for the financial year ending the 31st March 2017

PART – A

(i) Name and address of the owner/occupier of the industry operation or process : D. Gangopadhayay, D.T. (P&P) BCCL, Koyla Nagar, Dhanbad

(ii) Industry category : Coal Mining Industry

(iii) Production capacity : U/G - 0.143 MTY
OCP – 0.546 MTY
(EC no: - J-11015/380/2010-1A-II(M), dt: 06/02/13)

(iv) Year of establishment : Colliery operating since pre nationalization period and vested in BCCL through Coal Mine Nationalisation Act 1972-73

(v) Date of last environmental statement submitted : 19.08.2016, (Ref.No: Bh(N)/U/G/Mines/2016/405)

PART - B

Water and River Material Consumption

Water Consumption	
Process (Dust separation)	60M^3/day
Cooling	Nil
Domestic	120M^3/day

Name of Products	Process water consumption pre unit of product output	
	During the previous financial year	During the current financial year
N/A	N/A	N/A

Raw Material Consumption

Name of materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial year (2015-16)	During the current financial year (2016-17)
Diesel	Coal	3.26 L/Te	0.1368 L/Te
Explosive	Coal	1.58 Kg/ Te	0.2347 Kg/ Te
Timber	Coal	--	S- 0.081 nos./Te; P- 0.019 nos./Te *

*S – wooden sleepers, P- wooden props.

PART- C

Pollution discharged to environment/unit of output (parameter as specified in the consent issued)

Pollutants	Quantity of pollutants discharge	Concentrations of pollutants in discharge(mass/volume)	Percentage of variation from prescribed standards with reasons
Water	--	*(MW- 10 , 15.11.16)* TSS – 36 PH – 8.29 Oil & Grease - <2.0 COD - 46	Within Limit
Air	--	*(as on 22.12.16)* PM 10 – 97 PM 2.5 – 55 SO_2 – 12 NO_x – 29	Within Limit

PART – D

Hazardous Wastes

(as specified under Hazardous waste management and handling rules, 1989)

Hazardous Waste	Total Quantity (Kg.)	
	During the previous financial year (2015-16)	During the current financial year (2016-17)
From process	Burnt oil - 420 Litre	Burnt oil – 200 Litre
From pollution control facilities	N/A	N/A

PART – E

Solid Wastes

Solid Wastes		Total Quantity	
		During the previous financial year	During the current financial year
(a) Process		Removal of OB from OCP 321554.58M^3	Nil
(b) Pollution control facility		Nil	Nil
(c)	1.Quantity recycled or re-utilized within the unit	-------	Quantity of Burnt oil used in u/g mine for lubrication in transportation system/haulage system – 200 Litre.
	2. Sold	-------	Nil
	3. Disposed	-------	Nil

PART – F

Please specify the characterizations (in terms of composition of quantum) of hazardous as well as solid waste and indicate disposal practice adopted for both these categories of wastes.

(i)	Type of Rocks	: -	N/A
(ii)	Type of soil	: -	N/A
(iii)	Chemical properties of soil: -		N/A
(iv)	Disposal process for Solid Waste (backfilling practice): -		N/A

PART – G

Impact of pollution abatement measures taken on conservation of nature resources and on the cost of production

(i)	No. of plants planted	:	Done by area level
(ii)	Cost of piants	:	
(iii)	Plantation cost incurred	:	
(iv)	Backfilling cost	:	

PART – H

Additional measures/investment proposal for environmental protection including abatement of pollution, prevention of pollution

(i) Water sprinkling is done in transporting road, siding, working faces, etc. to reduce dust emission.

(ii) Proper and timely maintenance of dumper, SDL machine, fan, pumps etc. is being done to control noise pollution.

(iii) Monitoring of air quality, water quality and noise levels are being done periodically.

PART – I

Any other particulars for improving the quality of the environment

---

Project Officer
Bhowra (M) U/G Mines

PROJECT OFFICER
BHOWRA (M) U/G MINES.

भारत कोकिंग कोल लिमिटेड
एक मिनी रत्न कंपनी
(कोल इण्डिया लिमिटेड का एक अंग)
परियोजना पदाधिकारी का कार्यालय, भौरा दक्षिण कोलियरी
पो0 - भौरा, जिला - धनबाद (झारखण्ड), PIN - 828302

BHARAT COKING COAL LIMITED
A MINI RATNA COMPANY
(A SUBSIDIARY OF COAL INDIA LIMITED)
OFFICE OF THE PROJECT OFFICER, BHOWRA SOUTH COLLIERY
P.O - BHOWRA, DIST. - DHANBAD (JHARKHAND), PIN - 828302

Ref. no – BII(S)/2017/ 906

Date – 22-06-2017

To,
The Member Secretary,
Jharkhand State Pollution Control Board, Ranchi,
T.A Division Building H.E.C,
Ground Floor, Dhurwa, Ranchi – 834004

Dear Sir,

We are enclosing herewith Form – V (Environmental Statement) in respect of Bhowra (South) Colliery (U/G + 3 PIT OCP + Chandan OCP) for the year 2016-2017.

This is for your kind information & record Pl.

C.C. to :-
1. The Regional Officer, Jharkhand State Pollution Board, Housing Board Colony, Patel Nagar, Dhanbad
2. Office File

Yours Faithfully

Project Officer
Bhowra South Colliery

Received
22/06/2017
Jharkhand State Pollution Control Board
Regional Office
Dhanbad

BCCL

05 (a)(i)

FORM V

(See rule 14)

ENVIRONMENTAL STATEMENT FOR THE FINANCIAL YEAR ENDING THE 31ST MARCH.....2016-2017

PART A

(i) Name and address of the owner/occupier of the industry operation or process.

(ii) Industry category Primary—(STC Code) Secondary—(STC Code).

(iii) Production capacity-Units— 0.887 M.T.Y.

(iv) Year of establishment. —

(v) Date of the last environmental statement submitted. 1.07.2016.

PART B

Water and Raw Material Consumption Spraying by Sprinkler or bix Sprinkalers-10K4d

(1) Water consumption m^3/d

Process

Cooling

Domestic

Name of products	Process water consumption per unit of product output	
	During the previous financial year	During the current financial year
	(1)	(2)
(1)	NU	NU.
(2)		
(3)		

(2) Raw material consumption

*Name of raw materials	Name of products	Consumption of raw material per unit	
		During the previous financial year	During the current financial year
Explosive	Coal	within Limit	within Limit.

*Industry may use codes if disclosing details of raw material would violate contractual obligations, otherwise all industries have to name the raw materials used.

PART C

Pollution discharged to environment/unit of output.

(Parameter as specified in the consent issued)

(1) Pollution	Quantity of pollutants discharged (mass/day)	Concentrations of pollutants in discharges (mass/volume)	Percentage of variation from prescribed standards with reasons
(a) Water	NU	NU	- NU.
(b) Air	NU	NU	NU.

PART D

Hazardous Wastes

(as specified under Hazardous Wastes (Management and Handling) Rules, 1989)

Hazardous Wastes	Total Quantity (Kg)	
	During the previous financial year	During the current financial year
(a) From process	NU	NU.
(b) From pollution control facilities.	NU	NU.

PART E

Solid Wastes

	Total Quantity	
	During the previous financial year	During the current financial year
(a) From process	NU	NU.
(b) From pollution control facility	Spraying	Spraying
(c) (1) Quantity recycled or re-utilised within the unit	NU	NU.
(2) Sold	NU	NU
(3) Disposal		

PART – F

Please specify the characterization (in term of composite and quantum) of Hazardous as well as solid wastes and indicate disposal practice adopted f or both these categories of wastes.

a) For Underground/Collieries - Not applicable as neither Hazardous Wastes nor solid wastes are generated.

PART –G

Impact of the pollution abatement measure taken on conservation of natural resource and on production. Various pollution abatement measure are practiced by which the impacts on the environment has become positive. Due cares is taken to conserve the natural resources and protect the environment and all its component. The following pollution abatement measure are undertaken:-

1. Water Sprinkling is done in road , sidings , coal transportation points CHP crushers to control dust. The water sprinkling greatly reduces fugitive dust emission thereby reducing the air pollution levels. Water sprinklers are provided on tipplers and in coal stock.
2. Road maintenance:
   Maintenance of all roads within the unit lease hold area is being done to control dust. This also helps in *reducing the vehicle exhausts.*
3. Tree plantation :
   Tree plantation is done as a apart of biological reclamation. Plantation help in reducing noise, dust and soil erosion (check).
4. Noise abatement in done by proper maintenance of the vehicle, drills and other machines. Workers are provided with car muffs. Tree planted near the work place which help in dampening the extra notice.
5. **Soil erosion control** – various soil erosion control measure like tree plantation. Construction of diversion channels, Check dame, settling ponds/ditchen contour terrecting storm water discharge drain etc is done.
6. **Machine maintenance** – Proper and timely maintenance of the machine/ vehicles operating in the unit are done which help in reduction of vehicle exhausts and noise pollution.
7. **Vehicles exhaust control** – Exhaust monitoring in some vehicle exhaust are controlled by proper and timely maintenance of the vehicles.
8. **Ambient Air/Water and noise monitoring** – Monitoring for ambient air, water quality and noise levels are periodically done.
9. **Community Awareness** – Welfare officers are there in the unit to propagate awareness regarding environment protection measures like tree plantation for soil erosion control, domestic exhaust control etc among colony/ villages residents and also nearby natives and tribats. Tree plantation and cultural programmes (June 5th) postres/ bannrers are displayed and tree plantation is done to create awareness.
10. **Occupational Health/Safety Measure** – Occupational Health and safety measure are taken care stipulated by DGMS in case of dust, fire, light, noise etc. Dust mask and Ear plugs/muffs are provided in critical zones.
11. **Improved sanitation and drainage and water treatment** – Improved sanitation and drainage is being practiced in all houses of the colony. Residents are advised to dispose minimum amount of wastes and river water is treated and supplied to the residents for drinking purpose.
12. All families are shifted/ being shifted to new and safe location/ sides as per the companies policy. The rehabilitation sites are provided with infrastructural facilities like water, electricity, roads, parks, and dispensary.
13. **Environment impact Assessment (EIA) and preparation of environment impact statement (EIS)** – EIS is being done at corporate levels. This helps in indentifying the environment impact and thereby adopting necessary mitigation measures. The FIA is also extended for a distance of 10 KM (Buffer zone) beyond the actual project/ units area for the project which requires clearance of MOBF.

Project Officer
Bhowra (South) U/G Mines

परियोजना पदाधिकारी
Project Officer
भौंरा दक्षिण कोलियरी
Bhowra South Colliery
पुर्वी झरिया क्षेत्र
E. J. Area

भारत कोकिंग कोल लिमिटेड
(कोल इंडिया लिमिटेड का एक अंग)
BHARAT COKING COAL LIMITED
A Mini Ratna Company)
(A Subsidiary of Coal India Limited)
Office of the Project Officer, ASP Colliery

A.S-P Colliery
P.O.- Sudamdih
Dist.–Dhanbad
Jharkhand 828126

Ref No– EJA/ASP/SMD/17 / 1665

Dated: 21.09.17

To,
The Member Secretory,
Jharkhand State Pollution Control Board,
TA. Division Building
HEC, Dhurwa.
RANCHI – 834004

Sub. :- **Submission of Environmental Statement (From V) for the year 2016-17.**

Dear Sir,

Please find herewith the Environmental Statement duly filled in the financial year 2016 – 17 in respect of Amal. S – P. Colliery.

Encl. - As Above

Yours faithfully

20.9.17

Project Officer
Amal. S – P. Colliery

20.9.17

1. J.S.P.C.B. R/Officer, Dhanbad
2. Area Manager (Env.)E.J. Area.
3. Safety Officer, A.S – P. Colliery
4. Office copy

"FORM – V"

(See rule 14)

Environmental statement for the financial year ending 31st March 2017

PART – A

Name and address of the owner / Occupier of the industry operation or process : Sri D.Gangopadhyay, (D.T.), Koyla Bhawan, Koyla Nagar, BCCL, Dhanbad

Industry category primary (STD Code) :Coal Mining Industry (A.S-P. Colliery)

Production capacity : 0.473 MTY.

Year of establishment : 1962

Date of last environmental statement submitted : Dt. 29.09.2017(Ref.No. EJA/ASP/SMD/16/1436)

PART – B

1. **Water and Raw Material consumption:**

Water Consumption	
1. Process (Dust suppression)	80 KL/Day
2. Cooling	Nil
3. Domestic	254 KL/Day

Name of products	**Process water consumption per unit of product point**	
	During the previous Financial year 2015-16	**During the current Financial year 2016-17**
N/A	N/A	N/A

2. **Raw material consumption:**

Name of products	**Name of products**	**Consumption of Raw Materials per unit of product output**	
		During the previous Financial year 2015-16	**During the current Financial year 2016-17**
Diesel	Coal	0.57 Ltrs./Ton.	0.25 Ltrs./Ton.
Explosive	Coal	0.41 Kg. /Ton.	3.98 Kg. /Ton.

Industry may two codes if disclosing details of raw material would violate cojntractu8al Obligations otherwise all industries have to name the material used.

PART – C

Pollution discharged to Environment / Unit of output (Parameter as specified in the consent issued):

Pollution	Quantity of pollutants discharged (mass /day)	Concentrations of pollution in discharges (mass / volume)	Percentage of variation from prescribed stack with reason.
a) Water	Nil	Sample of mine water Total suspended solid – 36 pH – 9.05 Oil & Grease - < 2.0 COD - 36	 Within the limit Within the limit Within the limit Within the limit
b) Air	4x106M^3/day	PM10 – 96 PM 2.5 – 62 SO_2 – < 10 NOx - 28	Within the limit Within the limit Within the limit Within the limit

PART – D

Hazardous wastes (As specified under Hazardous wastes Management and Handling rule 1989.

Hazardous waste	Total Quantity	
	During the previous Financial year 2015-16	During the current Financial year 2016-17
a) From Process	Quantity of Burnt Oil – 100 Ltrs. Cotton waste – 60 Kg. Oil soaked filters – 18 Nos.	Quantity of Burnt Oil – 65 Ltrs. Cotton waste – Nil Oil soaked filters – 21 Nos.
b) From pollution control facilities	N/A	N/A

PART – E

Solid wastes

Hazardous waste	Total Quantity	
	During the previous Financial year 2015-16	During the current Financial year 2016-17
c) From Process	Quantity of Overburden generated – 1359096 M^3	Quantity of Overburden generated – 1884424 M^3
d) From pollution control facilities	Oil & Grease trap's bottom sludge – N/A	Oil & Grease trap's bottom sludge – N/A
1. Quantity recycled or reutilized with the unit	Quantity of O/B used for back filling - 1359096 M^3	Quantity of O/B used for back filling - 1884424 M^3
2. Solid	Nil	Nil
3. Disposal	Nil	Nil

PART – F

Please specify the characterization (in terms of composition of quantum) of hazardous as well as soled wastes and indicate disposal practice adopted for both these categories of wastes soled wastes and indicate disposal practice adopted for both these categories of wastes.

Type of rock	: Sedimentary
Type of soil	: There is no soil. All soil has been removed earlier.
Chemical properties of soil	: N/A
Disposal process for soled waste (Back filling practice)	: By dumper for back filling of the excavated area.

PART – G

Impact of the pollution abatement measures taken on conservation of natural resources and on the cost of production:

Ecological restoration work is going on. 5.71Ha + 3.95Ha land has been planted by 8150 + 1000 nos. of plants respectively.

PART – H

Additional measures / investment proposal for environmental protection including abatement pollution, prevention of pollution:

(i) There is a water tanker of 20 KL capacity, which sprinkles 04 trips water daily.
(ii) Fencing of ecological restoration site is being done.
(iii) Black toping of roads has been done.
(iv) Avenue plantation / Gabion plantation is going on.

PART – I

Any other particulars for improving the quality of the environment:

1. Carbon sequestration studies done by Forest Research Institute, Dehradun through H.Q. level. A report on the Carbon sequestration study has been submitted by FRI, Dehradun, for ecological restoration site of E.J.Area (Cluster –X), BCCL, which is attached.
2. Source appointment study and reduction in pollution load by reducing road transport study being done by CMPDIL group study.