भारत कोकिंग कोल लिमिटेड
(एक मिनिरत्न कम्पनी)
(कोल इंडिया लिमिटेड का एक अंग)
महाप्रबंधक का कार्यालय
पूर्वी झरिया क्षेत्र, भौरा
जिला - धनबाद)झारखण्ड(, पिन -828302
दूरभाष -0326-2320077,
ईमेल- cgmej@bccl.gov.in
CIN: U10101JH1972GOI000918

BHARAT COKING COAL LIMITED
(A Mini Ratna Company)
(*A Subsidiary of Coal India Ltd*)
OFFICE OF THE GENERAL MANAGER
Eastern Jharia Area, Bhowra
Dist: Dhanbad (Jharkhand), PIN- 828302
Tel.:0326-2320077, Email- cgmej@bccl.gov.in
Regd.Off: Koyla Bhawan, Koyla Nagar,
Dhanbad-825005, Tel.:0326-2230190
CIN: U10101JH1972GOI000918,
FAX: 0326-2230050, Email – cos@bccl.gov.in

Ref. No.: BCCL/EJ/GM/Env./2022/135 Date: 30/11/2022

To,
The Director
Ministry of Environment, Forests and Climate Change
Regional Office (ECZ)
2nd Floor, Heaquarter – Jharkhand State Housing Board,
Harmu Chowk, 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 2022 to September 2022.
(Ref.: EC Order No.- J-11015/380/2010-IA.II(M) dated 06.02.2013 & EC amended Vide letter no.- J-11015/380/2010-IA.II(M) dated 12.06.2019)

Dear Sir,

Kindly find the enclosed here with the six monthly compliance report of the conditions of Environmental Clearance for the period from April 2022 to September 2022 in respect of Cluster X group of mines of BCCL.

Thanking You.

Encl.: Six monthly compliance report with annexure

Yours faithfully

30/11/22

General Manager
Eastern Jharia Area, BCCL
Cluster X

CC to:

1. Director, 1A Monitoring Cell, Paryavaran Bhawan, CGO Complex, New delhi-110003.
2. Member Secretary, JSPCB, Ranchi
3. Regional Officer, JSPCB, Housing Colony, Dhanbad
4. Dy. GM / HOD (Env.), BCCL, Koyla Bhawan, Dhanbad
5. AGM, E.J. Area, Bhowra, BCCL
6. Area Manager (Env.), E.J. Area
7. Master File

ENVIRONMENTAL CLEARANCE COMPLIANCE OF CLUSTER-X

(GRANTED VIDE J-11015/380/2010-IA.II (M) Dated 06.02.2013 and EC AMENDED DATED 12.06.2019)
(Period: April 2022 to September 2022)

<table>
<tr><th>Sl. No.</th><th>A. Specific Conditions by MOEF:</th><th>Compliance</th></tr>
<tr><td>I.</td><td>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:</td><td>The production from the cluster is within the limit for which environmental clearance has been granted. The year wise and colliery wise production of coal in MTPA is as follows:
COAL PRODUCTION DATA (IN MT) OF CLUSTER X SINCE GRANT OF EC
<table>
<tr><th colspan="2">Mine Name</th><th>EC Capacity (Peak)</th><th>2013-14</th><th>2014-15</th><th>2015-16</th><th>2016-17</th><th>2017-18</th><th>2018-19</th><th>2019-20</th><th>2020-21</th><th>2021-22</th></tr>
<tr><td rowspan="2">Bhowra North</td><td>UG</td><td>0.143</td><td>0.024</td><td>0.032</td><td>0.028</td><td>0.023</td><td>0.012</td><td>0.006</td><td>0.0065</td><td>0.000015</td><td>0</td></tr>
<tr><td>OC</td><td>0.546</td><td>0.143</td><td>0.01</td><td>0.028</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td rowspan="2">Bhowra South</td><td>UG</td><td>0.377</td><td>0.037</td><td>0.032</td><td>0.025</td><td>0.022</td><td>0.01</td><td>0.007</td><td>0.0003</td><td>0</td><td>0</td></tr>
<tr><td>OC</td><td>1.2</td><td>0.185</td><td>0.11</td><td>0.28</td><td>0.413</td><td>0.458</td><td>0.892</td><td>0.318</td><td>0.675</td><td>0.261</td></tr>
<tr><td>ASP Colliery</td><td>OCP</td><td>0.709</td><td>0.139</td><td>0.085</td><td>0.219</td><td>0.267</td><td>0.277</td><td>0.239</td><td>0.175</td><td>0.225</td><td>0.406</td></tr>
<tr><td>Sudamdih Shaft</td><td>UG</td><td>0.24</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Amlabad UG</td><td>UG</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="2">Total (Cluster X)</td><td>2.289*</td><td>0.528</td><td>0.269</td><td>0.580</td><td>0.725</td><td>0.757</td><td>1.145</td><td>0.600</td><td>0.900</td><td>0.667</td></tr>
</table></td></tr>
<tr><td>II.</td><td>All the void /water bodies should be backfilled up to Ground level and no OB dump at the end of mining.</td><td>This activity is post closure mining activity and will be done as per approved mine closure plan. However, progressive backfilling is done, the year wise data of backfilling in Ha. is as follows:
UNIT WISE BACKFILLING DATA (IN HA) OF CLUSTER X
<table>
<tr><th>Mine Name</th><th>2013-14</th><th>2014-15</th><th>2015-16</th><th>2016-17</th><th>2017-18</th><th>2018-19</th><th>2019-20</th><th>2020-21</th><th>2021-22</th></tr>
<tr><td>Bhowra North-Mix</td><td>1.76</td><td>3.17</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td></tr>
<tr><td>Bhowra South- Mix</td><td>4.10</td><td>6.50</td><td>6.50</td><td>5.24</td><td>5.24</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td></tr>
<tr><td>ASP Colliery - OC</td><td>1.93</td><td>0.96</td><td>0.6</td><td>0.58</td><td>0.51</td><td colspan="3">16.4</td><td colspan="2">3.56</td></tr>
<tr><td>Sudamdih Shaft</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td></td></tr>
<tr><td>Amlabad UG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td></td></tr>
</table>
After physical reclamation/backfilling, biological reclamation has been done which is as follows:
AREA OF ECOLOGICAL RESTORATION SITES / PLANTATION / BIOLOGICAL RECLAMATION (in Ha.)
<table>
<tr><th>Colliery / Mine Name</th><th>2013-14</th><th>2014-15</th><th>2015-16</th><th>2016-17</th><th>2017-18</th><th>2018-19</th><th>2019-20</th><th>2020-21</th><th>2021-22</th></tr>
<tr><td>Bhowra North</td><td>-</td><td>-</td><td>-</td><td>5.20</td><td>3.10</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Bhowra South</td><td>-</td><td>4.78</td><td>-</td><td>-</td><td>-</td><td>4.50</td><td>-</td><td>-</td><td>2.60</td></tr>
<tr><td>ASP Colliery</td><td>-</td><td>3.95</td><td>5.71</td><td>-</td><td>-</td><td>-</td><td>-</td><td>19.5</td><td>-</td></tr>
<tr><td>Sudamdih Shaft</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Amlabad UG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total (in Ha.)</td><td>-</td><td>8.73</td><td>5.71</td><td>5.20</td><td>3.10</td><td>4.50</td><td>-</td><td>19.5</td><td>2.60</td></tr>
</table></td></tr>
<tr><td>III.</td><td>Extensive plantation should be provided on either side of Damodar River.</td><td>Extensive plantation is present along the Damodar river which is under cluster X. In addition to this, Plantation work is in progress under Riverside plantation scheme in area of 22.10 Ha. (19.5 Ha river side plantation + 2.6 Ha under compensatory plantation) near Damodar river in consultation with District Forest Officer, Dhanbad.
List of plant species present along the bank of Damodar river are given below:</td></tr>
</table>

List of the plants species

S. No.	Botanical Name	Local Name	Hindi Name
1	*Acacia arabica*	Babul	Babul
2	*Adina cordifolia*	Karam	Karam
3	*Ailanthus excelsa*	Ghorkaranj/ Ghorkaram	Ghorkaranj/ Ghorkaram
4	*Alangium Lamarckii*	Dhela	Dhela
5	*Albizzia lebbek*	Siris	Siris
6	*Albizzia procera*	Safed Siris	Safed Siris
7	*Alstonia scholaris*	Chatni	Chatni
8	*Azadirachta indica*	Neem	Neem
9	*Bombax ceiba*	Semal	Semal
10	*Butea frondosa*	Palas	Palas
11	*Casearia tomentosa*	Beri	Beri
12	*Cassia fistula*	Dhanraj/Amaltas	Dhanraj/Amaltas
13	*Dalbergia sissoo*	Shisham	Shisham
14	*Eugenia jamb*	Jamun	Jamun
15	*Ficus religiosa*	Pipal	Pipal
16	*Lagerostroemia parviflora*	Sidha	Sidha
17	*Mitragyna parviflora*	Guri/Gurikaram	Guri/Gurikaram
18	*Terminalia arjuna*	Arjun	Arjun
19	*Phoenix acaulis*	Khejur	Khejur
20	*Ficus racemosa*	Gular	Gular
21	*Calotropis procera*	Calotropis	Calotropis
22	*Ricinus communis*	Castor	Castor

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.

Details of Plantation in EJ Area (Cluster X)

DETAILS OF ECOLOGICAL RESTORATION / PLANTATION IN E.J. AREA

Colliery	Site Name	Area (Ha)	Taken up in	Plantation (No.)								
				2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Bh (N)	Bh N/BLA OB Site	5.2	2016-17	-	-	13000	2850		1360	500	200	17910
	New BLA Site	3.1	2017-18	-	-	-	4725		616	500	250	6091
Bh (S)	3 Pit OB Site	4.78	2014-15	12189		1000	2200			1500	200	17089
	Bhowra Chandan OB Site	4.5	2018-19	-	-	-	-	11500	1728	2000	800	16028
ASP Colliery	COCP/ Vrindavan Site	5.71	2015-16	-	6125	8150	3000		2650	250	2750	22925
	Kamini Kalyan Herbal Garden	3.32	1980 (old)	375 (planted before 2014)		40	50		150	150	200	590
	Mohalbani OB Site	3.95	2014-15	10874		1000	1200				200	13274
	Gaungram Site	19.5	2020-21								33000	33000
Plantation at other locations	Schools, along road, colony, etc.								1246	2380	2485	6111
Total		**50.06**		**23063**	**6125**	**23190**	**14025**	**11500**	**7750**	**7280**	**40085**	**133018**

IV.	Details of impact of mining on Damodar River should be assessed and provided;	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 (report enclosed as Annexure –I).

		CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II SURFACE WATER ANALYSIS TEST REPORT CMPDI, RI-II, KOYLA BHAWAN COMPLEX, DHANBAD, Phone: 0326-223-850, email: rdri2.cmpdi@coalindia.in

Month & Year	JUNE 2022	Cluster	X			Report No.	RI-2/SW/22-23/QE/01
Customer	Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)					Date of Issue	14.10.2022
Project	Sample Ref. No.		REM/BCCL/2022/06/SW/011		Sampling Method	(IS 3025, Part-1) CMPDI/RI-II/LPM 13	
Sampling Stations	(i) Upstream of Damodar River(SW21)		Date of Sampling		20.06.22	Period of Analysis	
	(ii) Downstream of Damodar River(SW22)		Date of Sampling		20.06.22	June'2022 TO Sept'2022	

Sl. No.	Parameter	Method of Analysis	Observed Values (i)	Observed Values (ii)	IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL
1	BOD (3 days 27°C), mg/l	IS 3025 (Part 44) : 1993, R-2019, 3 day incubation at 27°C	<2.0	<2.0	3	2.00-10.00	2
2	Colour,Hazen Units	APHA 23rd Edition, 2120-B-:2017	2	2	10	1-100.0	1
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 Argentometric Method	27	26	600	5.0-1500.0	5
4	Copper, mg/l	IS 3025 (Part 42) : 1992 R : 2019, AAS Flame Method	<0.2	<0.2	1.5	0.2-10.0	0.2
5	Dissolved Oxygen, mg/L	IS 3025 (Part 38) : 1989, R:2003 Winkler Azide Method	5.2	5.0	4	0.1 10.0	0.1
6	Fluoride, mg/l	APHA, 23rd Edition, SPADNS Method	0.73	0.51	1.5	0.2 2.00	0.2
7	Hexavalent Chromium, mg/l	APHA 23rd Edition, 1,5-Diphenylcarbohydrazide Method IS 3025 (Part 52) : 2003 R-2019	<0.01	<0.01	0.05	0.01-1.4	0.01
8	Iron, mg/l	IS 3025 (Part 53)-2003 R-2019, AAS-Flame Method	<2.0	0.43	50	0.2-10	0.2
9	Nitrate , mg/l	APHA, 23rd Edition, UV-Spectrophotometric Method	4.83	4.11	50	0.5-45.0	0.5
10	pH value	IS 3025, (Part 11) : 1983 R-2017 Electrometric (Ph Meter) method	6.03	6.15	6.5-8.5	2.0-12.0	2
11	Sulphate, mg/l	APHA -23rd Edition,4500- S, Turbidity Method	82	49	400	10.0-400.0	10
12	Total Dissolved Solids, mg/l	IS 3025 (Part 16): 1984 R-2017 Gravimetric method	253	252	1500	25.0-5000.0	25
13	Zinc, mg/l	IS 3025(Part 49) : 1994, R : 2019, AAS-Flame Method	<2.0	0.42	15	0.1 - 3.0	0.1

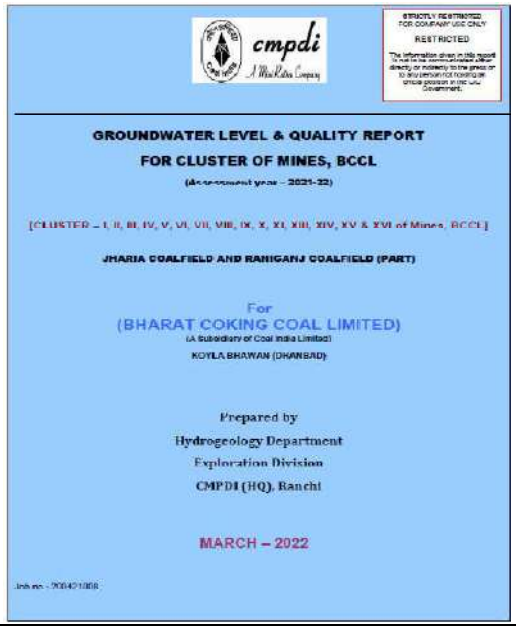
***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit*

****All units is mg/L unless specified otherwise Sample Collected in 5 Ltr Jerricane , Color as observed is transparent*

(Kumar Vaibhav) (Amit Raj Mishra)

Analysed by ***CHECKED BY*** ***HOD's Initial/Signature***

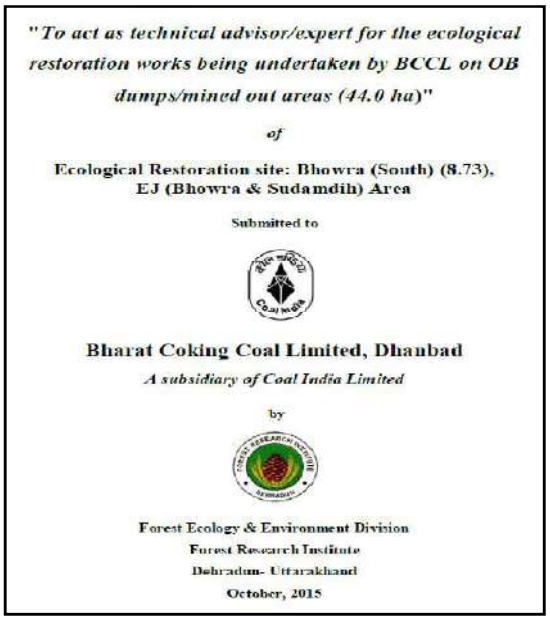
Note: *The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI II.*

V.	Impact of mining on ground water of the area (Impact Zone) should be provided;	Ground water monitoring is being carried out by CMPDI and the ground water analysis report is enclosed as Annexure – II.  cmpdi STRICTLY RESTRICTED FOR COMPANY USE ONLY RESTRICTED GROUNDWATER LEVEL & QUALITY REPORT FOR CLUSTER OF MINES, BCCL (Assessment year – 2021-22) [CLUSTER – I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XIV, XV & XVI of Mines, BCCL] JHARIA COALFIELD AND RANIGANJ COALFIELD (PART) For (BHARAT COKING COAL LIMITED) (A Subsidiary of Coal India Limited) KOYLA BHAWAN (DHANBAD) Prepared by Hydrogeology Department Exploration Division CMPDI (HQ), Ranchi MARCH – 2022
VI.	A Garland drain should be provided and the drain water should not be discharged into Damodar River;	Toe wall & retaining wall and Garland drain along the stabilized OB dump is present. OB dump is being stabilized through biological reclamation/ ecological restoration technique which can be seen in Picture attached. No mine water is being discharged into Damodar river.

<table>
<tr><td></td><td></td><td> 



</td></tr>
<tr><td>VII.</td><td>Excess water from mine after treatment should be supplied to the villagers;</td><td>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. However, at present, surplus mine water is being supplied to nearby villages / locality for domestic purpose (non-drinking purpose). List of villages for supplied water is as follows:
<table>
<tr><th>S. No.</th><th>Colliery/Mine Name</th><th>Village list for supply of water</th></tr>
<tr><td>1</td><td>ASP Colliery</td><td>Sudamdih colony, Patherdih colony, Patherdih Basti, Patherdih Basti, Supkar Basti, Hattala basti, etc</td></tr>
<tr><td>2</td><td>Bhowra Group of mines (Bhowra North & Bhowra South)</td><td>Gaurkhuti, 12 no. basti, 13 no.basti, 35 no. basti; 6 no. Bhowra, Manjhi Basti, Gandhi Nagar, 19 no. Basti upar, 19 no. Basti niche, Bhowra 16 no., Bhowra 9 no. etc.</td></tr>
<tr><td>3</td><td>Amlabad colliery</td><td>Amlabad colony and nearby basti</td></tr>
</table></td></tr>
<tr><td>VIII.</td><td>Rejects of washery along with dry carbon slurry should be utilized in power plant and other recognized vendors;</td><td>Rejects of washery along with dry carbon slurry was used to sale to power plants and other vendors through local sales. At present, Sudamdih Washery is non-operating. Year wise produced dry carbon slurry is given below:
<table>
<tr><th>Year</th><th>Dry Carbon Slurry Produced (in metric Ton)</th></tr>
<tr><td>2013-14</td><td>43488</td></tr>
<tr><td>2014-15</td><td>6775</td></tr>
<tr><td>2015-16</td><td>9880</td></tr>
<tr><td>2016-17</td><td>12609</td></tr>
<tr><td>2017-18</td><td>6513</td></tr>
<tr><td>2018-19</td><td>4405</td></tr>
</table></td></tr>
</table>

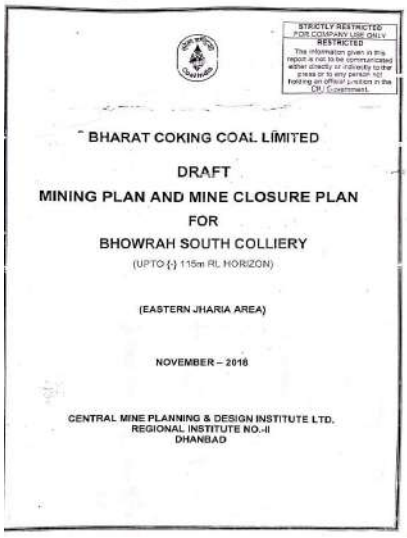
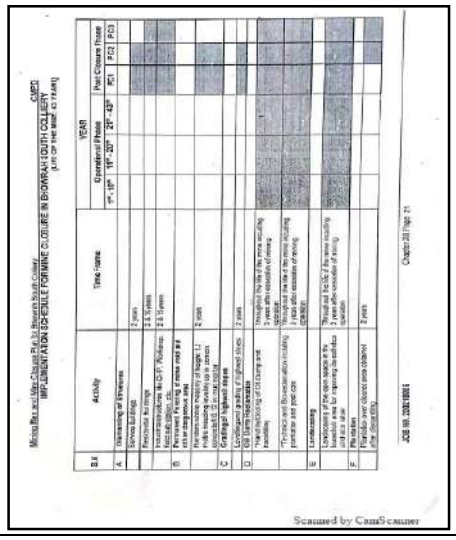
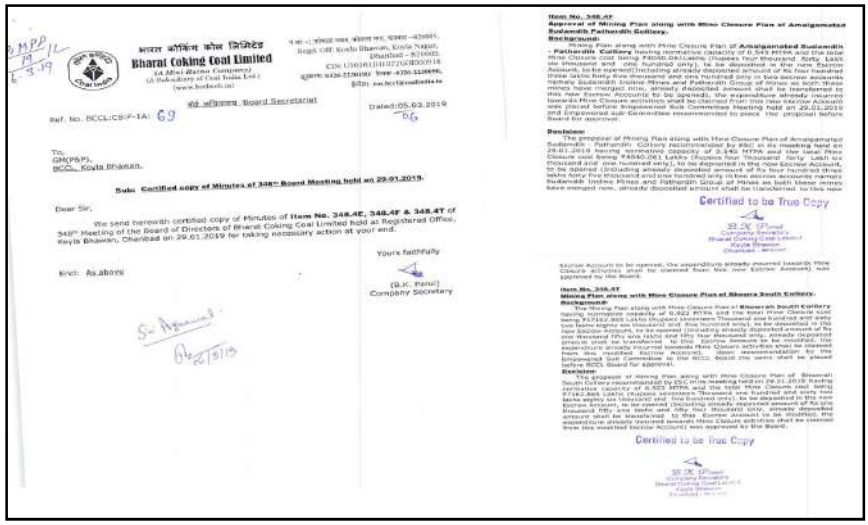
<table>
<tr><td></td><td></td><td>
<table>
<tr><td>2019-20</td><td>2255</td></tr>
<tr><td>2020-21</td><td>Nil</td></tr>
<tr><td>2021-22</td><td>Nil</td></tr>
</table>
</td></tr>
<tr><td>IX.</td><td>There should be no discharge from the Washery (Slurry) in to the Damodar River. The entire washery water should be recycled;</td><td>All the washeries of BCCL are designed on Closed Circuit System to ensure no discharge from the washery premises.
  
Zero Discharge System at Sudamdih Washery</td></tr>
<tr><td>X.</td><td>Damodar River should be protected by plantation on both sides;</td><td>Extensive plantation is present along the Damodar river which is under cluster X. In addition to this, Plantation work is in progress under Riverside plantation scheme in area of 22.10 Ha. (19.5 Ha river side plantation scheme + 2.6 Ha under compensatory plantation) near Damodar river in consultation with District Forest Officer, Dhanbad. List of plant species present along the bank of Damodar river are given in condition no. III.
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.
 
"To act as technical advisor/expert for the ecological restoration works being undertaken by BCCL on OB dumps/mined out areas (44.0 ha)"
of
Ecological Restoration site: Bhowra (South) (8.73), EJ (Bhowra & Sudamdih) Area
Submitted to
Bharat Coking Coal Limited, Dhanbad
A subsidiary of Coal India Limited
by
Forest Ecology & Environment Division
Forest Research Institute
Dehradun- Uttarakhand
October, 2015</td></tr>
<tr><td>XI.</td><td>A herbal garden with medicinal plants be developed;</td><td>Kamini Kalyan Herbal Garden with 3.32 Ha. area has been taken up and developed, it will be further enriched as thematic medicinal plants garden for conservation of germplasm and public awareness. Medicinal/ herbal plants have been planted as per BCCL Env. Dept. HQ guidelines.</td></tr>
</table>

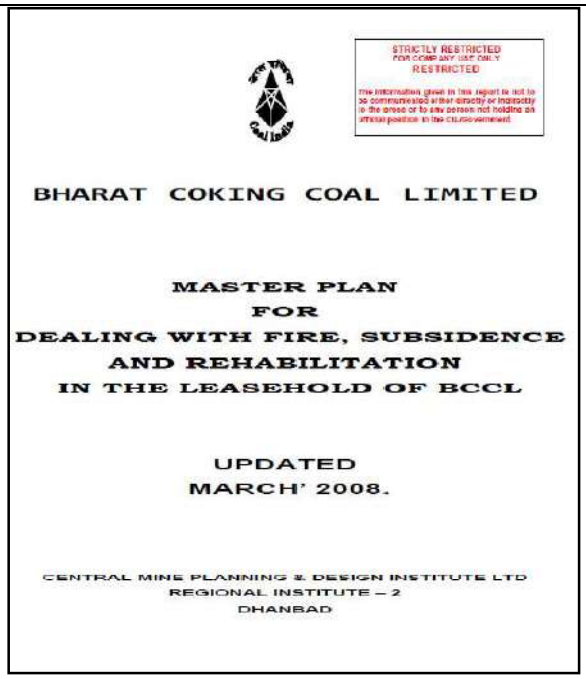
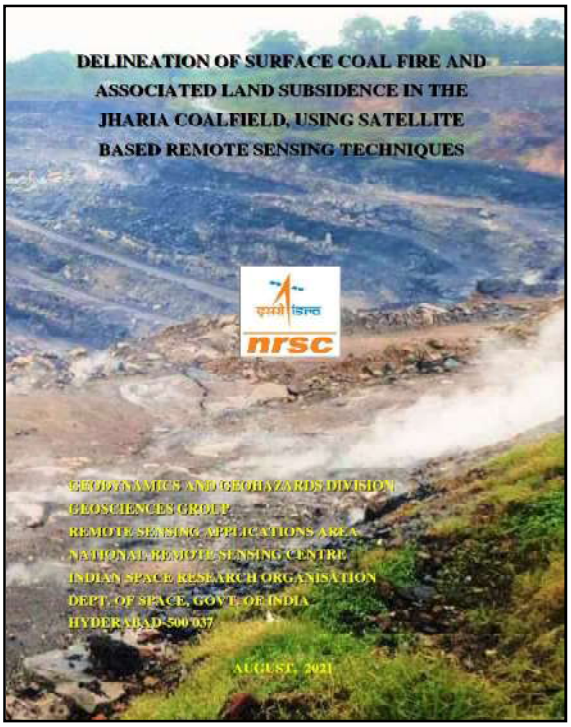
List of medicinal plants present in Kamini Kalyan herbal garden is:

S. No.	Biological Names	Local Names	Hindi Names
1	Aegle marmelos	Bel	Bel
2	Alangium Lamarckii	Dhela	Dhela
3	Albizzia lebbek	Siris	Siris
4	Alstonia scholaris	Chatni	Chatni
5	Azadirachta indica	Neem	Neem
6	Bombax ceiba	Semal	Semal
7	Butea frondosa	Palas	Palas
8	Casearia tomentosa	Beri	Beri
9	Dalbergia sissoo	Shisham	Shisham
10	Emblica officinalis	Amla	Amla
11	Eugenia jamb	Jamun	Jamun
12	Arotocarpus integrifolia	Kathal	Kathal
13	Ficus religiosa	Pipal	Pipal
14	Gmelina arborea	Gamhar	Gamhar
15	Mangifera indica	Mango	Mango
16	Pongamia glabra	Karanj	Karanj
17	Tectona grandis	Sagwan/Teak	Sagwan/Teak
18	Terminalia arjuna	Arjun	Arjun
19	Terminalia belerica	Bahera	Bahera
20	Dendro calamus strictus	Bans/Bamboo	Bans/Bamboo
21	Spondias mangifera	Amra	Amra
22	Saraca asoca	ashok	ashok
23	Cocos nucifera	Nariyal	Nariyal
24	Annona reticulata	Sarifaa	Sarifaa
25	Psidium guajava	amrud	amrud
26	Citrus limon	Nimboo	Nimboo
27	Ficus racemosa	Gular	Gular
28	Eucalyptus globulus	safeda	safeda
29	Neolamarckia cadamba	Kadamba	Kadamba
30	Alstonia scholaris	Chatri	Chatri
31	Araucaria heterophylla	Christmas tree	Christmas tree

List of medicinal herbs and shurbs present at Kamini Kalyan Garden

S. No.	Biological Names	Local Names	Hindi Names
1	*Ocimum tenuiflorum*	Tulsi	Tulsi
2	*Catharanthus roseus*	Sadabahar	Sadabahar
3	*Aloe vera*	Aloe vera	Aloe vera
4	*Jatropha curcas*	Ratanjot	Ratanjot
5	*Murraya koenigii*	Kari patta	Kari patta
6	*Sansevieria trifasciata*	Nagdaman	Nagdaman
7	*Euphorbia tithymaloides*	Nagdon	Nagdon
8	*Allium bisceptrum*	Janglee Pyaaj	Janglee Pyaaj

XII.	A time schedule for filling of existing and abandoned quarries be done.	Existing & abandoned quarries are being filled as per approved progressive mine closure plan of the colliery. Mining Plan and Mine Closure Plan of Amalgamated Sudamdih Patherdih and Bhowra (South) mines has been approved in 348th BCCL Board meeting dated 29.01.2019. Time schedule as per approved mine closure plan is attached as Annexure – III.  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. BHARAT COKING COAL LIMITED DRAFT MINING PLAN AND MINE CLOSURE PLAN FOR BHOWRAH SOUTH COLLIERY (UPTO (-) 115m RL HORIZON) (EASTERN JHARIA AREA) NOVEMBER – 2018 CENTRAL MINE PLANNING & DESIGN INSTITUTE LTD. REGIONAL INSTITUTE NO.-II DHANBAD  Scanned by CamScanner
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.	This is post mining closure activities and will be done as per approved mining plan & mine closure plan. Mining Plan and Mine Closure Plan of Amalgamated Sudamdih Patherdih and Bhowra (South) mines has been approved in 348th BCCL Board meeting dated 29.01.2019.  Bharat Coking Coal Limited Ref. No. BCCL/CSIP-1A/ 69 Dated:05.03.2019 To, GM(P&P), BCCL, Koyla Bhawan. Sub: Certified copy of Minutes of 348th Board Meeting held on 29.01.2019. Dear Sir, We send herewith certified copy of Minutes of Item No. 348.4E, 348.4F & 348.4T of 348th Meeting of the Board of Directors of Bharat Coking Coal Limited held at Registered Office, Koyla Bhawan, Dhanbad on 29.01.2019 for taking necessary action at your end. Yours faithfully (S.C. Patel) Company Secretary Encl: As above Certified to be True Copy Certified to be True Copy
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. Jharia Master Plan is attached as Annexure–IV.

		
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.	The Work Order for "Delineation of Surface Fire and associated land subsidence in Jharia Coal Field using satellite based remote sensing techniques" has been awarded to NRSC under the MoU signed with NRSC. NRSC has submitted the final report, in which Coal Mine fire map has been prepared based on the Satellite data of Landsat-8 and attached as Annexure V.  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

<table>
<tr><td></td><td></td><td>of re-starting of fresh/ spreading of fire into other areas.</td></tr>
<tr><td>XVI.</td><td>Underground mining should be taken up after completion of reclamation of Opencast mine area after 2 years.</td><td>All OC Mines are in developing stage and Mining is being done as per the Coal Mines Regulation (CMR) Act 1957.</td></tr>
<tr><td>XVII.</td><td>No mining shall be undertaken where underground fires continue. Measure shall be taken to prevent/check such fire including in old OB dump.</td><td>It is being complied.
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 Coal Mines Regulation (CMR) Act.</td></tr>
<tr><td>XVIII.</td><td>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 water of River Damodar.</td><td>CMPDI has prepared a report for design location and construction of 23 nos. of Piezometer covering all the 17 clusters of BCCL. For Drilling for establishment of 23 nos Piezometer wells for cluster of mines of BCCL command area for Ground water monitoring, LOA has been issued by Civil Department on 03.12.2021 and work has been completed. One Piezometric well system (PZ-10A) has been constructed under Cluster X. E.J. Area, BCCL. Details are given below:
<table>
<tr><th>Cluster</th><th>Location Details</th><th>No. of Wells</th><th>Depth</th><th>Latitude & Longitude</th></tr>
<tr><td>Cluster X</td><td>Bandhponda Village, East side of 17 no. incline of South Bhowra Colliery</td><td>01 (PZ-10A)</td><td>135 m</td><td>E.J. Area
23º40’28.14”N
86º23’34.56” E
RL: 476 ft
Depth: 135 m</td></tr>
</table>

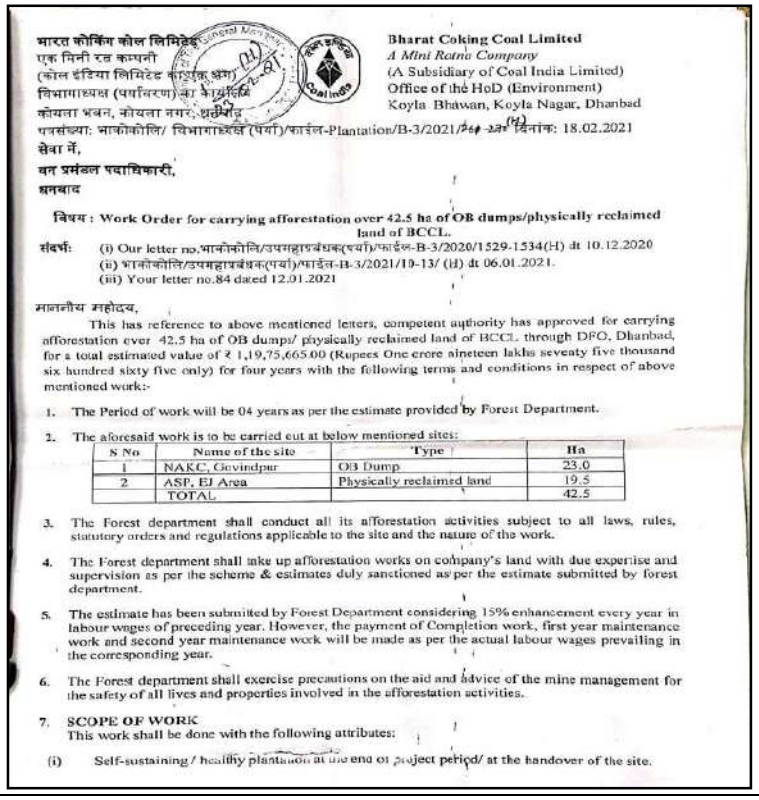
</td></tr>
<tr><td>XIX.</td><td>The rejects of washeries in Cluster –X should be send to FBC based plant.</td><td>At present Sudamdih washery is non operational. Previously, the Rejects generation was very low in operation of Sudamdih Washery as maximum portion was generated as middling. Rejects once significant in quantity will be checked for grade and auctioned to the users.</td></tr>
</table>

<table>
<tr>
<td>XX.</td>
<td>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.</td>
<td>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.
Year wise data of OB removal & excavated area is given below:
<u>UNIT WISE OB REMOVED (IN M^3) OF CLUSTER X</u>
<table>
<tr><th>Mine Name</th><th>2013-14</th><th>2014-15</th><th>2015-16</th><th>2016-17</th><th>2017-18</th><th>2018-19</th><th>2019-20</th><th>2020-21</th><th>2021-22</th></tr>
<tr><td>Bhowra North</td><td>502538</td><td>1172570</td><td>321554</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Bhowra South</td><td>581650</td><td>318400</td><td>6222675</td><td>4491830</td><td>3488184</td><td>2205725</td><td>3854237</td><td>3993684</td><td>3454029</td></tr>
<tr><td>ASP Colliery</td><td>260443</td><td>77444</td><td>1364138</td><td>1535176</td><td>1126630</td><td>923629</td><td>585637</td><td>2170162</td><td>2056041</td></tr>
<tr><td>Sudamdih Shaft</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Amlabad UG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total (Cluster X)</td><td>1344631</td><td>1568414</td><td>7908367</td><td>6027006</td><td>4614814</td><td>3129354</td><td>4439875</td><td>6163847</td><td>5510070</td></tr>
</table>
<u>UNIT WISE EXCAVATED AREA (IN Ha) OF CLUSTER X</u>
<table>
<tr><th>Mine Name</th><th>2013-14</th><th>2014-15</th><th>2015-16</th><th>2016-17</th><th>2017-18</th><th>2018-19</th><th>2019-20</th><th>2020-21</th></tr>
<tr><td>Bhowra North – Mix</td><td>12.50</td><td>10.42</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0</td><td>0</td></tr>
<tr><td>Bhowra South – Mix</td><td colspan="5">29.97*</td><td colspan="3">16.44*</td></tr>
<tr><td>ASP Colliery</td><td>0.96</td><td>0.60</td><td>0.58</td><td>0.51</td><td>0.52</td><td></td><td></td><td></td></tr>
<tr><td>Sudamdih Shaft</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Amlabad UG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>
* Data showing cumulative excavated area of Bhowra south (mix) from 2013-14 to 2017-18 & 2018-19 to 2020-21</td>
</tr>
<tr>
<td>XXI.</td>
<td>A detailed calendar plan of production with plan for
OB dumping and backfilling (for OC mines) and reclamation and final mine closure plan for each mine of cluster- X shall be drawn up and implemented.</td>
<td>Calendar year plan of coal production as per EMP / revised EC is given below:
<table>
<tr><th>Name of mine</th><th></th><th>Peak (MTY)</th><th>18-19</th><th>19-20</th><th>20-21</th><th>21-22</th><th>22-23</th></tr>
<tr><td>Bhowrah North</td><td>OC</td><td>0.546</td><td>0.3</td><td>0.3</td><td>0.3</td><td>0.3</td><td>0.35</td></tr>
<tr><td></td><td>UG</td><td>0.143</td><td>0.03</td><td>0.03</td><td>0.03</td><td>0.03</td><td>0.03</td></tr>
<tr><td>Bhowrah South</td><td>UG</td><td>0.377</td><td>0.03</td><td>0.03</td><td>0.03</td><td>0.03</td><td>0.03</td></tr>
<tr><td></td><td>OC</td><td>1.2</td><td>0.8</td><td>0.93</td><td>0.93</td><td>0.93</td><td>1.17</td></tr>
<tr><td>Amalgamated Sudamdih Patherdih Mine</td><td>OC</td><td>0.709</td><td>0.6</td><td>0.6</td><td>0.6</td><td>0.7</td><td>0.709</td></tr>
<tr><td>Sudamdih Shaft (UG)</td><td>UG</td><td>0.24</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Amlabad (UG) (Closed)</td><td>UG</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td></td><td>2.289</td><td>1.73</td><td>1.86</td><td>1.86</td><td>1.96</td><td>2.289</td></tr>
<tr><td colspan="3">Sanctioned Peak Capacity as per Existing EC</td><td>2.289</td><td>2.289</td><td>2.289</td><td>2.289</td><td>2.289</td></tr>
</table>
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.</td>
</tr>
<tr>
<td>XXII.</td>
<td>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</td>
<td>This is post mine closure activity.
A part of the void will be converted into the water body as specified in EMP at post mining stage and plantation, sitting arrangement etc. will be provided around the periphery of the reservoir & will be developed as water recreational park.</td>
</tr>
</table>

	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	
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.	Mining operation is being done as per Coal Mines Regulation Act. 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.	Eco-restoration sites covering an area of 50.06 Ha have been developed in consultations with institutes like FRI which was duly visited and appreciated during their visit.   In 2021-22 year, approx. 40,085 plants were planted under different programs like Gaurigram plantation site by DFO, Env. Day Celebration, Jal Shakti Abhiyan, Independence day Celebration, Eco-restoration sites, Swachh Bharat Abhiyan etc.

		Green belt is developed at available places and after the remaining area is decoaled, plantation will speed up in a time bound manner as per the EC conditions. Details of plantation in EJ Area is shown in point no. III.    
XXVI.	The road should be provided with avenue plantation on both side as trees act as sink of carbon and other pollutant.	Avenue plantation has been made along the permanent road near permanent structures to minimize the pollution. Approx 2500 plants have been planted as Avenue Plantation from Panchait dam to Ambona Jamkudur and in BIT Campus by DFO, Dhanbad. In 2021-22, approx 2485 plants were planted in different colonies, schools, office premises and free saplings were distributed to local residents for awareness towards environment and plantation.  Avenue Plantation in ASP Colliery

DFO was requested through a letter regarding need based survey for plantation (Block plantation / gabion/ avenue plantation) under the leasehold area of Cluster X. A Team from DFO, Dhanbad has visited the Cluster X and identified the area of 22.10 Ha. (19.5 Ha + 2.6 Ha) near Damodar river in joint field visit and work orders were issued for plantation under Riverside plantation scheme near Damodar River. Plantation work is in progress in area of 19.5 Ha. through DFO, Dhnabad. Copy of the work order is enclosed Annexure – VII.



भारत कोकिंग कोल लिमिटेड
एक मिनी रत्न कम्पनी
(कोल इंडिया लिमिटेड का पूर्ण स्वामित्व)
विभागाध्यक्ष (पर्यावरण) का कार्यालय
कोयला भवन, कोयला नगर, धनबाद

Bharat Coking Coal Limited
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Office of the HoD (Environment)
Koyla Bhawan, Koyla Nagar, Dhanbad

पत्रसंख्या: भाकोकोलि/ विभागाध्यक्ष (पर्या)/फाईल-Plantation/B-3/2021/ [illegible] दिनांक: 18.02.2021

सेवा में,
वन प्रमंडल पदाधिकारी,
धनबाद

विषय : Work Order for carrying afforestation over 42.5 ha of OB dumps/physically reclaimed land of BCCL.

संदर्भ: (i) Our letter no.भाकोकोलि/उपमहाप्रबंधक(पर्या)/फाईल-B-3/2020/1529-1534(H) dt 10.12.2020
(ii) भाकोकोलि/उपमहाप्रबंधक(पर्या)/फाईल-B-3/2021/19-13/ (H) dt 06.01.2021.
(iii) Your letter no.84 dated 12.01.2021

माननीय महोदय,

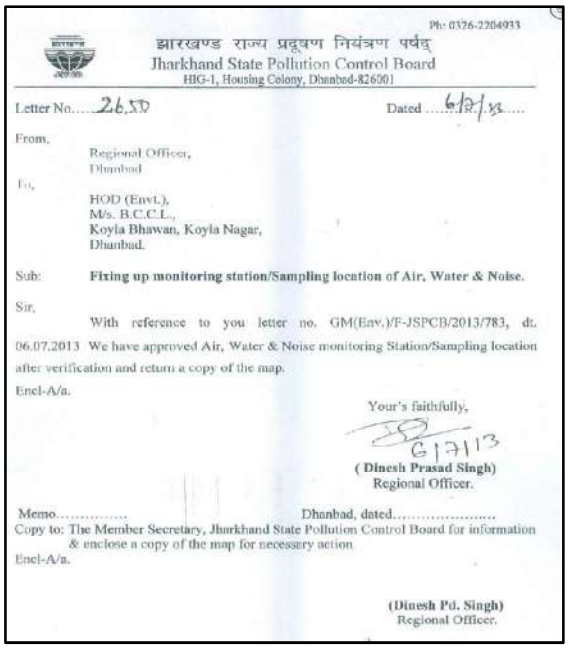
This has reference to above mentioned letters, competent authority has approved for carrying afforestation over 42.5 ha of OB dumps/ physically reclaimed land of BCCL through DFO, Dhanbad, for a total estimated value of ₹ 1,19,75,665.00 (Rupees One crore nineteen lakhs seventy five thousand six hundred sixty five only) for four years with the following terms and conditions in respect of above mentioned work:-

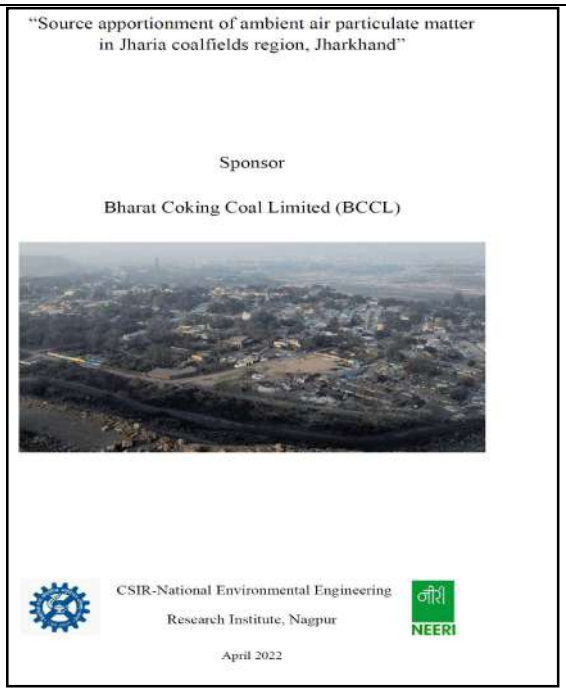
1. The Period of work will be 04 years as per the estimate provided by Forest Department.
2. The aforesaid work is to be carried out at below mentioned sites:

S No	Name of the site	Type	Ha
1	NAKC, Govindpur	OB Dump	23.0
2	ASP, EJ Area	Physically reclaimed land	19.5
	TOTAL		42.5

3. The Forest department shall conduct all its afforestation activities subject to all laws, rules, statutory orders and regulations applicable to the site and the nature of the work.
4. The Forest department shall take up afforestation works on company's land with due expertise and supervision as per the scheme & estimates duly sanctioned as per the estimate submitted by forest department.
5. The estimate has been submitted by Forest Department considering 15% enhancement every year in labour wages of preceding year. However, the payment of Completion work, first year maintenance work and second year maintenance work will be made as per the actual labour wages prevailing in the corresponding year.
6. The Forest department shall exercise precautions on the aid and advice of the mine management for the safety of all lives and properties involved in the afforestation activities.
7. **SCOPE OF WORK**
This work shall be done with the following attributes:

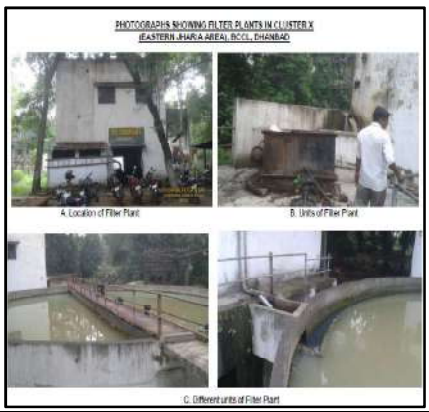
(i) Self-sustaining / healthy plantation at the end of project period/ at the handover of the site.

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.	A meeting was called by Chairman, Jharkhand Pollution control Board on 11.06.2019 and JSPCB directed to prepare an Environmental Action Plan which will be implemented by BCCL. Action Plan has been prepared in consultation with Jharkhand Pollution Control Board for entire BCCL and approved by Competent Authority of BCCL. It is being implemented comprehensively for all the mines of BCCL. Some of the salient steps of this action plan are as under: 1. Covered Transportation 2. Permanent Pucca Transportation Road 3. Fixed & Overhead Sprinklers and Mobile Sprinklers 4. AAQ & CQAAQMS Monitoring 5. Online PM10 Analyzer 6. Source Apportionment Study.
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 had 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. Report of Regular Environmental Monitoring is enclosed as Annexure – VIII.  Ph: 0326-2204933 झारखण्ड राज्य प्रदूषण नियंत्रण पर्षद Jharkhand State Pollution Control Board HIG-1, Housing Colony, Dhanbad-826001 Letter No.....2650 Dated .....6/7/13..... From, Regional Officer, Dhanbad To, HOD (Envt.), M/s. B.C.C.L., Koyla Bhawan, Koyla Nagar, Dhanbad. Sub: **Fixing up monitoring station/Sampling location of Air, Water & Noise.** Sir, With reference to you letter no. GM(Env.)/F-JSPCB/2013/783, dt. 06.07.2013 We have approved Air, Water & Noise monitoring Station/Sampling location after verification and return a copy of the map. Encl-A/a. Your's faithfully, 6/7/13 (Dinesh Prasad Singh) Regional Officer. Memo..... Dhanbad, dated..... Copy to: The Member Secretary, Jharkhand State Pollution Control Board for information & enclose a copy of the map for necessary action Encl-A/a. (Dinesh Pd. Singh) Regional Officer. BCCL had awarded the work order for the Project "Source Apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" to CSIR-NEERI, Nagpur vide Ref no. भाकोकोलि/उप महाप्रबंधक/पर्या/ SOURCE APPORTIONMENT (MoU) /NEERI /2018/ dated 12.05.2018. Workshop organized with NEERI, Nagpur on 04.10.2021. Comments/ Clarification submitted to NEERI, Nagpur for its incorporation. Further, comments of JSPCB and BCCL also submitted to NEERI and NEERI, Nagpur had submitted the final report on the source apportionment study and the mineralogical composition study in the Jharia Coalfields in April 2022 (Copy Enclosed as Annexure IX).

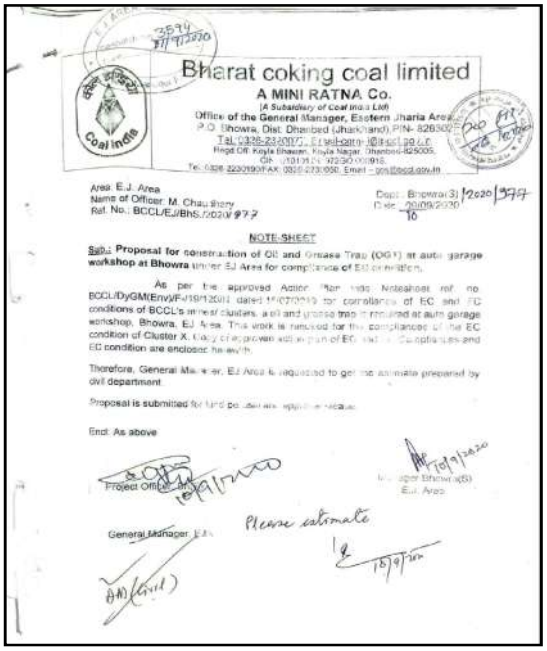
		 "Source apportionment of ambient air particulate matter in Jharia coalfields region, Jharkhand" Sponsor Bharat Coking Coal Limited (BCCL) CSIR-National Environmental Engineering Research Institute, Nagpur April 2022
XXIX.	No groundwater shall be used for the mining activities. Additional water required, 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.	No groundwater is drawn for mining activities however cutting of aquifer is integral part of mining. 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 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.

Detail of Water Treatment Plant/ Filter Plant in E.J. Area

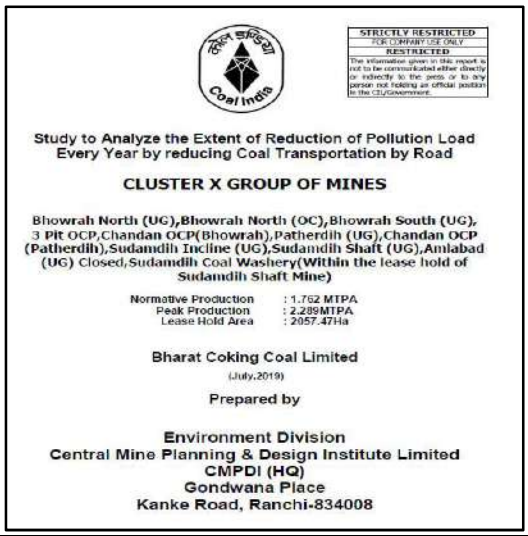
S. No.	Location of source of water	Treatment method	Capacity (MGD)	In use (MGD)	Supply of water
1	Sudamdih	Rapid gravity filter	0.8	0.47	Sudamdih colony, Patherdih colony, Patherdih Basti, Patherdih Basti, Supkar Basti, Hattala basti, etc
2	Bhowra	Rapid gravity filter	0.66	0.39	Gaurkhuti, 12 no. basti, 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

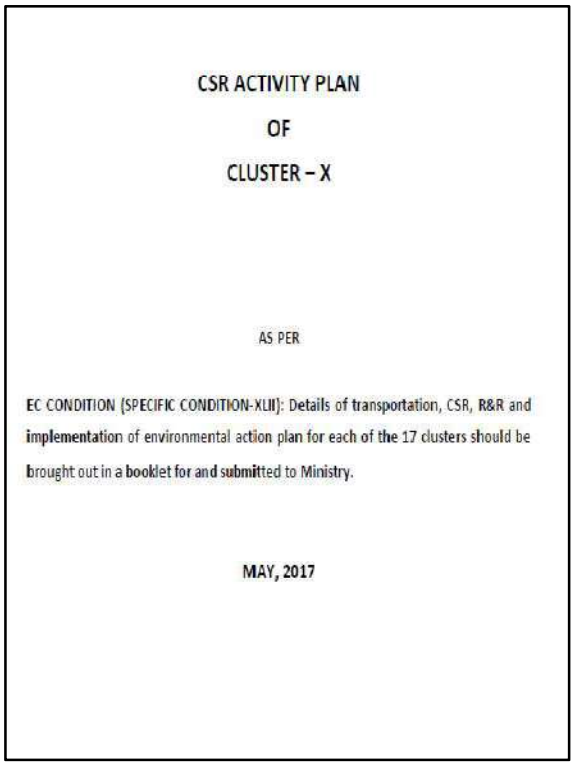


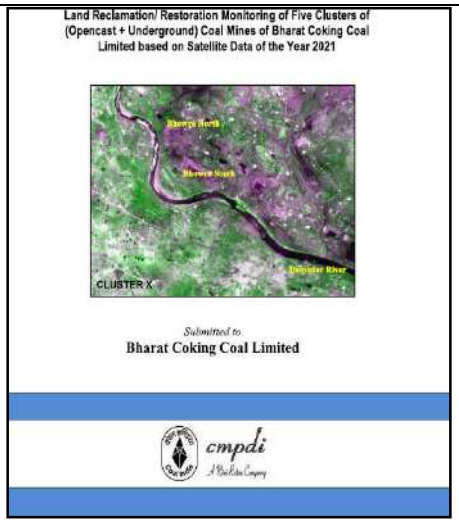
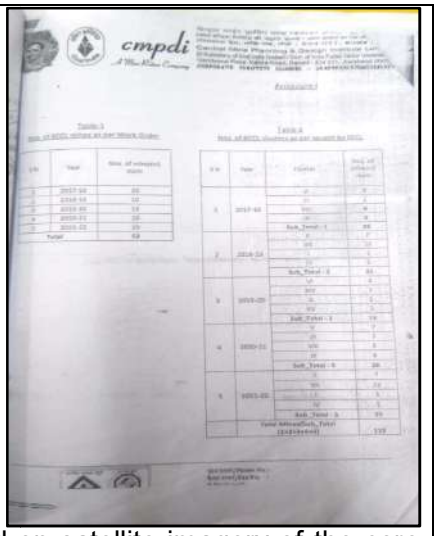
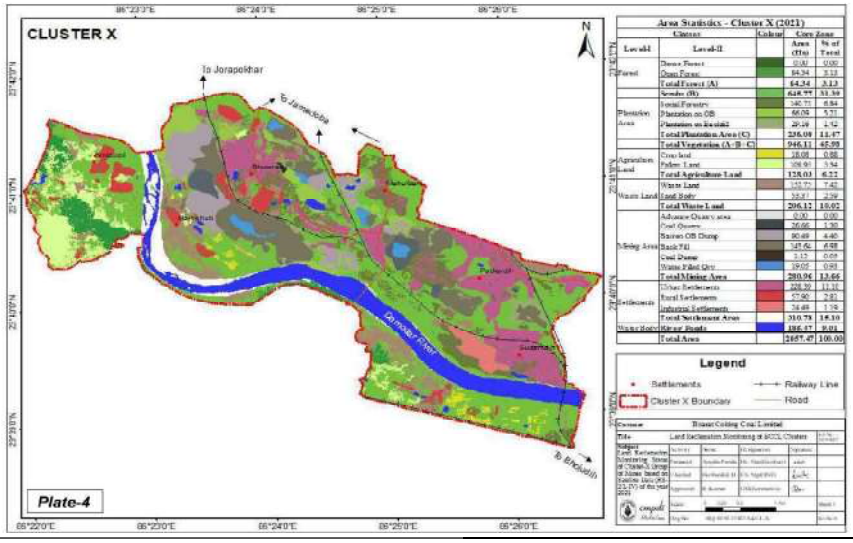
<table>
<tr><td></td><td></td><td>Report on Rain water harvesting and artificial recharge system in cluster X prepared by CMPDIL and attached as Annexure – X. Ponds & old quarries are being used for rain water harvesting & artificial recharge system in the area.
A proposal has been moved for construction of two (2) nos. Rooftop Rain Water Harvesting Structures in EJ Area under “Jal Shakti Abhiyan” program, which is in approval stage.</td></tr>
<tr><td>XXX.</td><td>Regular monitoring of groundwater level and quality of the study area shall be carried out by establishing a network of existing wells and construction of new peizometers. The monitoring for quantity shall be done four times a year in pre-monsoon (May), monsoon (August), post-monsoon (November) and winter (January) seasons and for quality including Arsenic and Fluoride during the month of May. Data thus collected shall be submitted to the Ministry of Environment & Forest and to the Central Pollution Control Board/SPCB quarterly within one month of monitoring. Rainwater harvesting measures shall be undertaken in case monitoring of water table indicates a declining trend.</td><td>Regular monitoring of Ground water quality is being carried out by CMPDIL. The Ground water Level and Quality report for Clusters of mines of BCCL (including Cluster X), have been submitted by CMPDIL & attached as Annexure II.
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. For Drilling for establishment of 23 nos Piezometer wells for cluster of mines of BCCL command area for Ground water monitoring, LOA has been issued by Civil Department on 03.12.2021 and work has been completed. One Piezometric well system (PZ-10A) has been constructed under Cluster X. E.J. Area, BCCL. Details are given below:
<table>
<tr><th>Cluster</th><th>Location Details</th><th>No. of Wells</th><th>Depth</th><th>Latitude & Longitude</th></tr>
<tr><td>Cluster X</td><td>Bandhponda Village, East side of 17 no. incline of South Bhowra Colliery</td><td>01 (PZ-10A)</td><td>135 m</td><td>E.J. Area
23º40’28.14”N
86º23’34.56” E
RL: 476 ft
Depth: 135 m</td></tr>
</table>
</td></tr>
<tr><td>XXXI.</td><td>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</td><td>Mine discharge water is being allowed to settle down in the mine sumps before disposal into storage reservoirs. The monitoring of mine water quality parameters is being done by CMPDIL and parameters are well within the prescribed limit provided by CPCB.</td></tr>
</table>

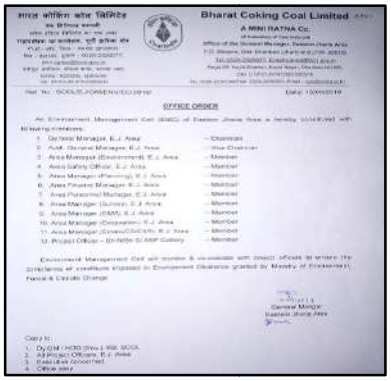
	company website.	CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II MINE EFFLUENT TEST REPORT CMPDIL, RI-II KOYLA BHAWAN COMPLEX DHANBAD. -826005 Phone:0326-223-850 email: rdri2cmpdi@coalindia.in **Test Report for Mine Effluent samples** Month & Year: 07/2022 — Cluster: Cluster X — Report No.: RI-II/WATER/2022-23/04 Customer: Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in) — Date of Issue: 26.10.2022 Project — Sampling Ref. No.: REM/BCCL/2022/07 — Sampling Method: IS 3025 (Part-1) CMPDI/RI-II/LPM 13 Sampling Stations: (i) Bhowrah North — Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent Date of Sampling: 11.07.2022 25.07.2022 Sl. No. / Parameter / Method of Analysis / Observed Values: First Fortnight / Second Fortnight / STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt. 25.09.2000) / LDL 1 Total Suspended Solids — IS 3025/17:1984, R :2017, Gravimetric — 50 / 55 — 100 (Max) — 10 2 pH — IS-3025/11:1983, R-2017, Electrometric — 8.29 / 8.21 — 5.5 - 9.0 — 0.2 3 Oil & Grease — IS 3025/39:1991, R : 2019, Partition Gravimetric — <2.0 / <2.0 — 10 (Max) — 2 4 COD — APHA 23rd Edition 5220 C Titrimetric Method — 32 / 28 — 250 (Max) — 4 *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit. **Grab sampling carried out for water samples. **All units in mg/L unless specified otherwise. ANALYSED BY — (Kumar Vaibhav) CHECKED BY — (Amit Raj Mishra) HOD's Signature ---- End of Report ---- Page -1 of 1
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.	There is no CHP in Cluster X. A proposal has been moved for the installation of Oil & Grease trap system at workshop under EJ Area.  Bharat coking coal limited A MINI RATNA Co. (A Subsidiary of Coal India Ltd) Office of the General Manager, Eastern Jharia Area P.O. Bhowra, Dist. Dhanbad (Jharkhand), PIN- 826302 Area: E.J. Area Name of Officer: M. Chau Bhary Ref. No.: BCCL/EJ/BhS./2020/977 Dept.: Bhopral(3) /2020/977 Date: 20/09/2020 NOTE SHEET Sub.: Proposal for construction of Oil and Grease Trap (OGT) at auto garage workshop at Bhowra under EJ Area for compliance of EC condition. As per the approved Action Plan vide Notesheet ref. no BCCL/DyGM(Env)/FJ-19/12011 dated 14/07/2019 for compliance of EC and CC conditions of BCCL's mines/ clusters, a oil and grease trap is provided at auto garage workshop, Bhowra, EJ Area. This work is required for the compliances of the EC condition of Cluster X. Copy of the proven action plan of EC vide Compliances and EC condition are enclosed herewith. Therefore, General Manager, EJ Area is requested to get the estimate prepared by civil department. Proposal is submitted for kind perusal and approval please. Encl: As above Project Officer Manager Bhowra (S) E.J. Area General Manager E.J.A. Please estimate
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	As per CMR, 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 is done. Currently there is no depillaring operation going on in underground mines of cluster X.

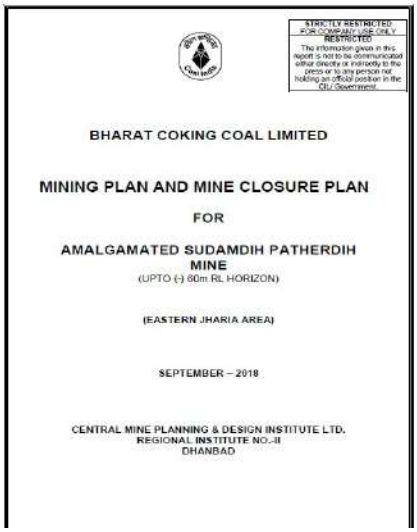
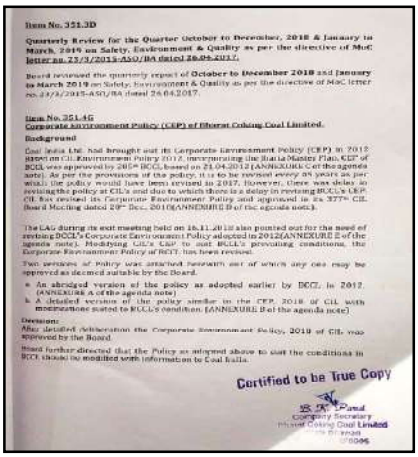
	material. Cracks shall be effectively plugged with ballast and clayey soil/suitable material.	
XXXIV.	Sufficient coal pillars shall be left unextracted around the air shaft (within the subsidence influence area) to protect from any damage from subsidence, if any.	Sufficient coal pillars have been left 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.	A list of high root density Plant species certified by FRI and its plantation in subsidence prone area will be taken-up at the time of depillaring operations. Nursery of high root density is also developed under EJ Area. List of high root density plant species is given below.  **Certificate of high root density plant for controlling subsidence** This is to certify that BCCL has been doing plantation/ecological restoration under the guidelines of Forest Research Institute. The various species selected for the restoration are having a tap root system with branches which serve the purpose. These species have high root density and are already being planted at all the reforestation/plantation sites of BCCL. The various species having tap root system are given below. S.No. Species Common name 1. *Acacia nilotica* Kikkar 2. *Albizia odoratissima* Kala siris 3. *Bauhinia variegata* Kachnar 4. *Cassia fistula* Amaltas 5. *Ficus bengholensis* Baniyan /bargad 6. *Ficus racemosa* Gular 7. *Ficus religiosa* Pipal 8. *Gmelina arborea* Ghamar 9. *Lagerstroemea parviflora* Jarul 10. *Lannea coromandelica* Jhingan 11. *Madhuca latifolia* Mahua 12. *Mangifera indica* Aam 13. *Morus alba* Shahtoot 14. *Phyllanthus emblica* Aonla 15. *Pithecellobium dulce* Jangal jalebi 16. *Pongamia pinnata* Karanj 17. *Tamarindus indica* Imli 18. *Trema orientalis* Tree 19. *Terminalia arjuna* Arjun 20. *Terminalia bellerica* Bahera 21. *Dalbergia sissoo* Shisham 22. *Syzigium cumini* Jamun 23. *Azadirachta indica* Neem 24. *Holoptelea integrifolia* Indian elm 25. *Butea monosperma* Palash /dhak
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. However, regular monitoring is being done through pit safety meeting and bipartite & tripartite safety meeting at area and HQ level.
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 CMR 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	Vehicles engaged in transportation are duly checked at Security Check-Post (CISF Check-Post) where security personnel also ensure proper covering of Trucks. No OEM is providing mechanically covered trucks. A communication in this regard has been made to Coal India Ltd for taking up with OEM.

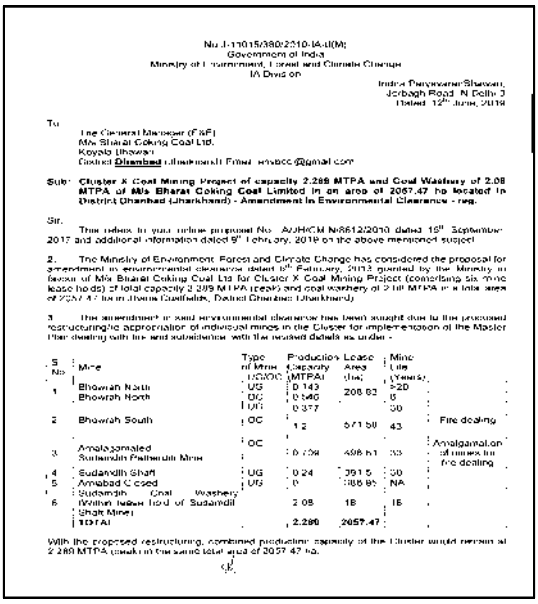
	be by mechanically covered trucks, which should be introduced at the earliest. The Plan for conveyor-cum–rail for Cluster-XIV should be dovetailed with Jharia Action Plan. The road transpiration of coal during phase–I should be by mechanically covered trucks.	In absence of availability of approved OEM of mechanically covered trucks, BCCL is ensuring trucks are covered with tarpaulin through mandatory clause of covering in transportation contracts. The transport Plan for conveyor-cum-rail for Cluster X is to be implemented in the Phase II of the Jharia Master Plan. At present, Phase -1 is under implementation and after completion of Pre-implementation (1st & 2nd Yr.) and Phase 1 (3rd to 7th year) and Phase 2 (8th to 12th year). The plan shall be prepared after the completion of the above said phases to have conveyor-cum-rail transportation as informed by CMPDIL to whom the said work of preparation of Rail-cum-conveyor plan has been awarded (Annexure XI). During Phase- 1 & 2, covering of trucks by tarpaulin covers is being ensured as can be seen in Picture attached.  
XL.	A study should be initiated to analyze extent of reduction in pollution load every year by reducing road transport.	CMPDI had carried out the study to analyze extent of reduction in pollution load every year by reducing road transport. Pollution load study report for Cluster X is attached in annexure XII.  STRICTLY RESTRICTED FOR COMPANY USE ONLY RESTRICTED Study to Analyze the Extent of Reduction of Pollution Load Every Year by reducing Coal Transportation by Road CLUSTER X GROUP OF MINES Bhowrah North (UG),Bhowrah North (OC),Bhowrah South (UG), 3 Pit OCP,Chandan OCP(Bhowrah),Patherdih (UG),Chandan OCP (Patherdih),Sudamdih Incline (UG),Sudamdih Shaft (UG),Amlabad (UG) Closed,Sudamdih Coal Washery(Within the lease hold of Sudamdih Shaft Mine) Normative Production : 1.762 MTPA Peak Production : 2.289MTPA Lease Hold Area : 2057.47Ha Bharat Coking Coal Limited (July,2019) Prepared by Environment Division Central Mine Planning & Design Institute Limited CMPDI (HQ) Gondwana Place Kanke Road, Ranchi-834008
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 to a well-established Jharia Vihar Township located at Belgoria. The rehabilitation data for EJ area is as follows: No. of Households | Shifted Non LTH | LTH | Non LTH + LTH 3125 | 528 | 81
XLII.	Details of transportation, CSR, R&R and	A separate booklet comprising of CSR activities has been prepared and attached as annexure XIII (A) – Detail of CSR activity of Cluster

	implementation of environmental action plan for each of the 17 clusters should be brought out in a booklet for and submitted to Ministry.	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. Issue raised in the Public Hearing shall also be integrated with activities being taken up under CSR. The details of CSR undertaken along with budgetary provisions for the village-wise various activities and expenditure thereon shall be uploaded on the company website every year. The company must give priority to capacity building both within the company and to the local youth, who are motivated to carry out the work in future.	It being complied. CSR action plan of BCCL is centralized and BCCL is implementing CSR Activities. CSR action plan of BCCL including CSR budget and expenditure is enclosed as Annexure XIII (B). A separate CSR committee has been formed at Area level 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 as annexure XIII (A) – Detail of CSR activity of Cluster X.  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
XLIV.	For monitoring land use pattern and for post mining land use, a time series of land use maps, based on	Presently a time series map of vegetation cover in the Jharia Coal Field has been carried out through CMPDI, Ranchi using satellite imagery for every 3 years.

	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.	  Time series of land use maps based on satellite imagery of the core zone and buffer zone is attached as Annexure – XIV. Details of vegetation cover under Cluster X is given below, as per the time series map of vegetation cover report: Land use / Reclamation status | Area (in Ha) | % a.) Plantation on OB dump | 66.09 | 3.21 b.) Plantation on Backfill area (Biological Reclamation) | 29.16 | 1.42 c.) Social Forestry / Avenue Plantation | 140.75 | 6.84 d.) Shrubs | 645.77 | 31.39 e.) Other Plantation area | 64.34 | 3.13 **Total area under Vegetation** | **946.11** | **45.98** 
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	Mining Plan and Mine Closure Plan of Amalgamated Sudamdih Patherdih and Bhowra (South) mines has been approved in 348th BCCL Board meeting dated 29.01.2019. Approval copy is attached in Specific condition no. XIII. Mine Closure Cost of different mine have been deposited every year in the Escrow account and Cluster X of BCCL had deposited the amount of Rs. 3956.98 lakh (including interest) to the escrow account till 31st March 2022. Details of the fund deposited till 31.03.2022 in the

<table>
<tr><td></td><td>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.</td><td>escrow account is given below:
STATEMENT SHOWING MINE CLOSURE COST (ESCROW ACCOUNT) DETAILS
<table>
<tr><th rowspan="2">S. No.</th><th rowspan="2">Name of Mine</th><th rowspan="2">Escrow account</th><th colspan="2">Amount deposited in Escrow account till 31st March 2022 (in Rs. Lakh)</th><th>Total amount in Escrow Fund</th></tr>
<tr><th>Deposited in Escrow account from 2013-14 to 2021-22</th><th>Interest incurred from 2013-14 to 2021-22</th><th>Principal & Interest upto 31.03.2022</th></tr>
<tr><td>1</td><td>Bhowra (N) Grp of Mines (UG+OC)</td><td>150100008868</td><td>532.31</td><td>238.30</td><td>770.61</td></tr>
<tr><td>2</td><td>Bhowra (S) Grp of Mines (UG+OC)</td><td>150100008830</td><td>1537.17</td><td>636.75</td><td>2173.92</td></tr>
<tr><td>3</td><td>Sudamdih Incline Mine</td><td>150100008868</td><td>93.75</td><td>59.20</td><td>152.95</td></tr>
<tr><td>4</td><td>Patherdih Grp of Mines</td><td>150100008872</td><td>389.21</td><td>153.43</td><td>542.64</td></tr>
<tr><td>5</td><td>Amalgamated Sudamdih-Patherdih Colliery (2019-20 onwards)</td><td>150100011524</td><td>116.26</td><td>4.8</td><td>121.06</td></tr>
<tr><td>6</td><td>Sudamdih Shaft Mine</td><td>150100011673</td><td>174.22</td><td>21.58</td><td>195.80</td></tr>
<tr><td colspan="3">Total Eastern Jharia Area (Cluster X)</td><td>2842.92</td><td>1114.06</td><td>3956.98</td></tr>
</table></td></tr>
<tr><td>XLVI.</td><td>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.</td><td>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.
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.
At the project level, two Executives in each area have been appointed as Environment Officer and are 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. HoD (Environment) at head quarter level, co-ordinates with all the Areas and reports to the Director (Technical) and in turn he reports to the CMD of the company.
Environment Management Cell at area level has been constituted for the management of Environment and monitoring of compliance of EC conditions.
 
Bharat Coking Coal Limited
A MINI RATNA Co.
OFFICE ORDER</td></tr>
<tr><td>XLVII.</td><td>Implementation of final mine closure plan for Cluster X, subject to obtaining prior approval of the DGMS in regard to mine safety issues</td><td>Final Mine Closure Plan has been prepared for each Mine in this cluster. Mining Plan and Mine Closure Plan of ASP Colliery is attached as Annexure – XV. Before implementation of final mine closure plan, prior permission from DGMS has been taken in regard to mine safety issues. Safety Management Plan (SMP) for each colliery has been prepared as per Coal Mines Regulation Act for the Safety of the mine and mining operations.</td></tr>
</table>

		 
XLVIII.	Corporate Environment Responsibility: A. The Company shall have a well laid down Environment Policy approved by the Board of Directors.	A revised Corporate Environment Policy 351.4(G) has already been laid down and approved in 377th Board meeting by the Board of Directors. This is also posted on BCCL website link- http://www.bcclweb.in/environment/CEP_04.11.2019.pdf
	B. The Environment Policy shall prescribe for standard operating process/ procedures to bring into focus any infringements/ deviation/ violation of the environmental or forest norms/conditions.	Complied. And attached as Annexure - XVI 
	C. The hierarchical system or Administrative Order of the company to deal with environmental issues and for ensuring compliance with the environmental clearance conditions shall be furnished.	A hierarchical system of the company to deal with environmental issues from corporate level to mine level already exists.
	D. To have proper checks and balances, the company shall have a well laid down system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the company and/or	Being complied. There is apex Committee constituted at Ministry of Coal & CIL level and an Environment Advisory Committee has been also formulated at BCCL level comprising of the HODs of different disciplinary, chaired by DT(P&P), for implementation and monitoring of compliances of EC Conditions of all the areas of BCCL.

	shareholders or stakeholders at large.	
B.	**General Conditions by MOEF:**	**Compliance**
I.	No change in mining technology and scope of working shall be made without prior approval of the Ministry of Environment and Forests.	For change in scope of working of cluster X, amended EC has been obtained vide letter no.J-11015/380/2010-IA-II(M) dated 12th June 2019. Copy of amended EC is attached as Annexure XVII. 

No.J-11015/380/2010-IA-II(M)
Government of India
Ministry of Environment, Forest and Climate Change
IA Division

Indira Paryavaran Bhawan,
Jorbagh Road, N Delhi-3
Dated: 12th June, 2019

To
The General Manager (E&F)
M/s Bharat Coking Coal Ltd.
Koyala Bhawan
District **Dhanbad** (Jharkhand) Email: [illegible]@gmail.com

Sub: Cluster X Coal Mining Project of capacity 2.289 MTPA and Coal Washery of 2.08 MTPA of M/s Bharat Coking Coal Limited in an area of 2057.47 ha located in District Dhanbad (Jharkhand) - Amendment in Environmental Clearance - reg.

Sir,
This refers to your online proposal No. [illegible] dated 15th September 2017 and additional information dated 9th February, 2019 on the above mentioned subject.

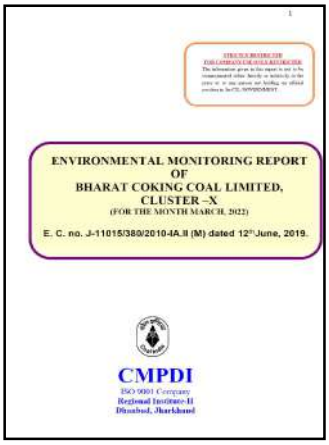
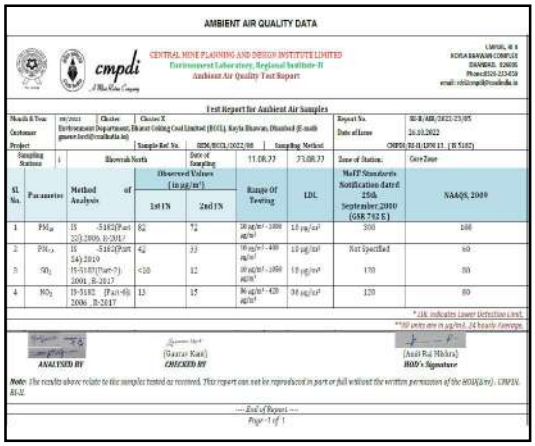
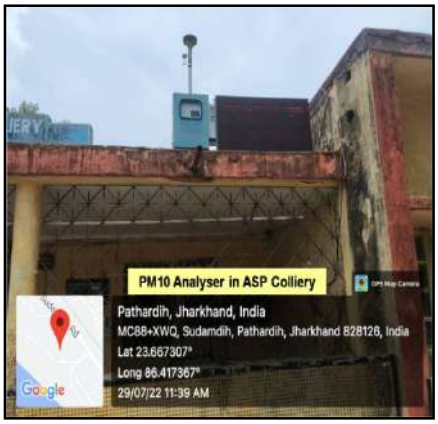
2. The Ministry of Environment, Forest and Climate Change has considered the proposal for amendment in environmental clearance dated [illegible] February, 2013 granted by the Ministry in favour of M/s Bharat Coking Coal Ltd for Cluster X Coal Mining Project (comprising six mine lease holds) of total capacity 2.289 MTPA (peak) and coal washery of 2.08 MTPA in a total area of 2057.47 ha in Jharia Coalfields, District Dhanbad (Jharkhand).

3. The amendment in said environmental clearance has been sought due to the proposed restructuring/re-appropriation of individual mines in the Cluster for implementation of the Master Plan dealing with fire and subsidence with the revised details as under:-

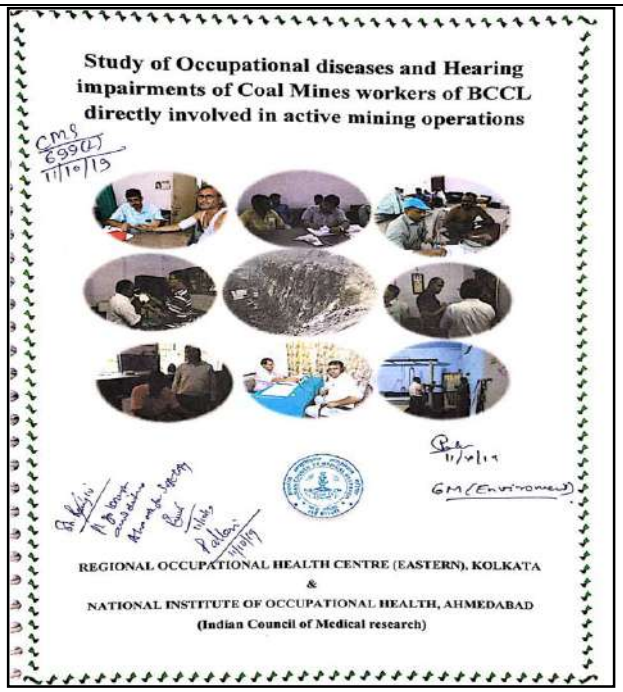
S No	Mine	Type of Mine UG/OC	Production Capacity (MTPA)	Lease Area (ha)	Mine Life (Years)	
1	Bhowrah North Bhowrah North	UG OC UG	0.143 0.546 0.377	208.83	>20 5 30	
2	Bhowrah South	OC	1.2	571.50	43	Fire dealing
3	Amalgamated Sudamdih Pathardih Mine	OC	0.[illegible]	4[illegible]	[illegible]	Amalgamation of mines for fire dealing
4	Sudamdih Shaft	UG	0.24	391.5	30	
5	Amlabad Closed	UG	0	[illegible]	NA	
6	Sudamdih Coal Washery (Within lease hold of Sudamdih Shaft Mine)		2.08	18	15	
	TOTAL		2.289	2057.47		

With the proposed restructuring, combined production capacity of the Cluster would remain at 2.289 MTPA (peak) in the same total area of 2057.47 ha.

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 environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr, etc carried out at least once in six months.	The 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 CMPDIL. Report is enclosed as Annexure VIII – Environmental Monitoring Report for cluster X. Water Sprinkling in Mine Premises has been regularly done to reduce PM10 and PM2.5 level. Picture showing water sprinkling is attached.  
IV.	Data on ambient air quality (PM10, PM 2.5, SO2 and NOx) and heavy metals such as Hg, As, Ni, Cd, Cr	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 as Annexure VIII. Also Continuous monitoring of PM10 level is monitored through

	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.	Online PM10 Analyser machines installed at Bhowra Gr. of Colliery and ASP Colliery of EJ area.  ENVIRONMENTAL MONITORING REPORT OF BHARAT COKING COAL LIMITED, CLUSTER –X (FOR THE MONTH MARCH, 2022) E. C. no. J-11015/380/2010-IA.II (M) dated 12th June, 2019. CMPDI ISO 9001 Company Regional Institute-II Dhanbad, Jharkhand  AMBIENT AIR QUALITY DATA CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED Environment Laboratory, Regional Institute-II Ambient Air Quality Test Report Test Report for Ambient Air Samples ANALYSED BY CHECKED BY HOD's Signature --- End of Report ---  
V.	Adequate measures shall be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in blasting and drilling operations, operation of HEMM, etc shall be provided with ear plugs/muffs.	It is being complied 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. A proposal has been moved for the installation of Oil & Grease trap system at workshop under EJ Area and it is under process for approval.

<table>
<tr><td>VII.</td><td>Vehicular emissions shall be kept under control and regularly monitored. Vehicles used for transporting the mineral shall be covered with tarpaulins and optimally loaded.</td><td>Vehicular emissions are being under control and the Pollution under control certificate has been attached as Annexure – XVIII. All the vehicles used for coal transportation are covered with tarpaulins.</td></tr>
<tr><td>VIII.</td><td>Monitoring of environmental quality parameters shall be carried out through establishment of adequate number and type of pollution monitoring and analysis equipment in consultation with the State Pollution Control Board and data got analyzed through a laboratory recognized under EPA Rules, 1986.</td><td>Monitoring of Environmental quality parameters have been regularly done by CMPDIL with proper analysis equipment.</td></tr>
<tr><td>IX.</td><td>Personnel working in dusty areas shall wear protective respiratory devices and they shall also be provided with adequate training and information on safety and health aspects.</td><td>It is being complied. All Personnel working in mines are provided with respiratory masks and safety eyeglass to protect the dust ingestion. Year wise details of protective respiratory devices / dust mask issued is given below:
DETAILS OF PROTECTIVE RESPIRATORY DEVICES / DUST MASK ISSUED
<table><tr><td>Mine Name</td><td>2016</td><td>2017</td><td>2018</td><td>2019</td><td>2020</td><td>2021</td></tr><tr><td>Bhowra North</td><td>200</td><td>180</td><td>70</td><td>220</td><td>Nil</td><td>Nil</td></tr><tr><td>Bhowra South</td><td>38</td><td>119</td><td>80</td><td>110</td><td>320</td><td>280</td></tr><tr><td>ASP Colliery</td><td>65</td><td>68</td><td>72</td><td>50</td><td>220</td><td>190</td></tr></table>
National Institute of Occupational Health (NIOH) has conducted a study on Occupational disease and Hearing impairments of Coal Mines workers of BCCL directly involved in active mining operations and submitted their final report which has already been scrutinized by Medical Department, BCCL. NIOH report is enclosed as Annexure - XIX.</td></tr>
</table>

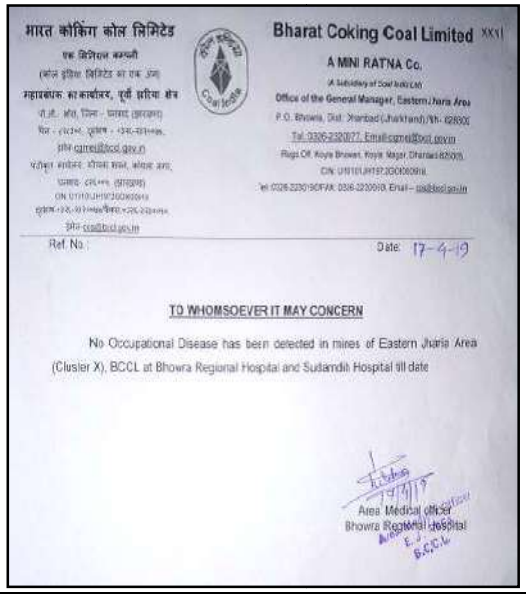


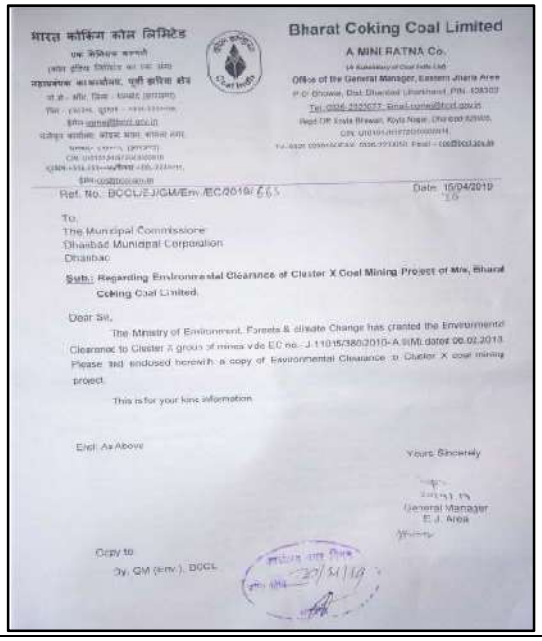
A separate full-fledged Human Resource Development (HRD) Department is conducting regular training programs on safety and health issues. Apart from this, Vocational Training Center (VTC) exist in E.J. area (cluster X), which provides periodical training on the safety and occupational health issue to workers working in the mines.

X.	Occupational health surveillance programs 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. IME, PME and VTC details are given below:

	Year	Target	Actual
PME	2016	951	993
	2017	891	927
	2018	385	464
	2019	1073	896
	2020	1221	1036
	2021	810	670
VTC	2016-17	472	488
	2017-18	338	392
	2018-19	343	386
	2019-20	414	455
	2020-21	461	557
	2021-22	360	325

Contractual Workers:	Training	IME	
2014-15	15	2014-15	15
2015-16	78	2015-16	74
2016-17	78	2016-17	62
2017-18	163	2017-18	124
2018-19	111	2018-19	111
2019-20		2019-20	Nil
2020-21		2020-21	Nil
2021-22		2021-22	96

		Certificate of the area medical officer showing no occupational disease has been detected in the Cluster X group of mines is attached.  भारत कोकिंग कोल लिमिटेड Bharat Coking Coal Limited A MINI RATNA Co. Ref. No. Date: 17-4-19 TO WHOMSOEVER IT MAY CONCERN No Occupational Disease has been detected in mines of Eastern Jharia Area (Cluster X), BCCL at Bhowra Regional Hospital and Sudamdih Hospital till date Area Medical officer Bhowra Regional Hospital
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.	Environment Management Cell at area level has been constituted for the management of Environment and monitoring of compliance of EC conditions.
XII.	The funds earmarked for environmental protection measures shall be kept in separate account and shall not be diverted for other purpose. Year-wise expenditure shall be reported to this Ministry and its Regional Office at Bhubaneswar.	Year wise and item wise expenditure made on environment protection measures is enclosed as Annexure – XX.
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	It has been complied. Advertisement in local newspaper has also been done.

	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.	 Advertisement of EC of cluster X in Newspaper Newspaper Detail: Hindustan date: 01.03.2013 भारत कोकिंग कोल लिमिटेड (कोल इण्डिया लिमिटेड का एक अंग)
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.	Copy of EC letter of cluster X has been displayed on BCCL website. Link- http://www.bcclweb.in/Environment%20Clearance/ECX.pdf Amended Environment clearance (New) letter link- http://www.bcclweb.in/Environment%20Clearance/ClusterX%20amendment.pdf A copy of EC letter sent to Municipal corporation / panchyat is attached.  भारत कोकिंग कोल लिमिटेड Bharat Coking Coal Limited A MINI RATNA Co. Ref. No.: BCCL/EJ/GM/Env./EC/2019/ 665 Date: 15/04/2019 To, The Municipal Commissioner Dhanbad Municipal Corporation Dhanbad. Sub.: Regarding Environmental Clearance of Cluster X Coal Mining Project of M/s. Bharat Coking Coal Limited. Dear Sir, The Ministry of Environment, Forests & climate Change has granted the Environmental Clearance to Cluster X group of mines vide EC no.: J-11015/380/2010-A.II(M) dated 06.02.2013. Please find enclosed herewith a copy of Environmental Clearance to Cluster X coal mining project. This is for your kind information. Encl: As Above Yours Sincerely General Manager E.J. Area Copy to Dy. GM (Env.), BCCL
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	Complied. Copy of EC letter and amended Environment clearance (New) letter of cluster X has been displayed on BCCL website.

	the Regional Office, District Industry Sector and Collector's Office/Tehsildar's Office for 30 days.	
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. Link-http://www.bcclweb.in/Environment%20Clearance/ECX.pdf Amended Environment clearance (New) letter link-http://www.bcclweb.in/Environment%20Clearance/ClusterX%20amendment.pdf The compliance status of the stipulated environmental clearance conditions has been uploaded on BCCL website, link-https://www.bcclweb.in/?page_id=4731&lang=en
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. Six monthly compliance report of Cluster X has been regularly submitted to the MoEFCC portal Parivesh https://parivesh.nic.in/ and also a copy of the report is being submitted to Jharkhand SPCB office.
XVIII.	The Regional Office of this Ministry located at Bhubaneswar shall monitor compliance of the stipulated conditions. The Project authorities shall extend full cooperation to the office(s) of the Regional Office by furnishing the requisite data/	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 Compliance.

	information/monitoring reports.	
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 XXI – 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	It is being complied.

	up remedial measures in case of soil contamination, contamination of groundwater and surface water, and occupational and other diseases due to the mining operations.	
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.	There is a status quo to be maintained by both the parties issued by Hon'ble High Court in the WPC no. 4944 of 2011 by order dated 18.1.2012. The case is still not disposed off and the status quo continues.

Area Manager (Env.)
EJ Area

30-11-22
Project Officer
ASP Colliery,
EJ Area

30.11.22
Project Officer
Bhowra (S) Colliery,
EJ Area

30.11.22
Project Officer
Bhowra (N) Colliery,
EJ Area

30/11/22
Addl. General Manager
EJ Area, BCCL
Cluster X

30/XI/22
General Manager
EJ Area, BCCL
Cluster X

WATER QUALITY REPORT
OF
BHARAT COKING COAL LIMITED,
CLUSTER – X

(FOR THE Q.E. JUNE 2022)

E. C. no. J-11015/380/2010-IA.II (M) dated 12th June, 2019.

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CLUSTER - X

(FOR THE Q.E. JUNE 2022)

CONTENTS

SL. NO.	CHAPTER	PARTICULARS
1.		EXECUTIVE SUMMARY
2.	CHAPTER - I	INTRODUCTION
3.	CHAPTER-II	WATER SAMPLING & ANALYSIS
	Plates:	
4.	Plate NO. - I	SURFACE PLAN SHOWING WATER MONITORING LOCATIONS

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.

WATER QUALITY REPORT
OF
BHARAT COKING COAL LIMITED
CLUSTER – X

(FOR THE Q.E. JUNE 2022)

E. C. no. J-11015/380/2010-IA.II (M) dated 12th June, 2019.

CMPDI

ISO 9001 Company

Regional Institute-II

Dhanbad, Jharkhand

EXECUTIVE SUMMARY

1.0 Introduction

The purpose of environmental monitoring is to assess the quality of various attributes that affects the environment around us. In accordance with the quality of these attributes appropriate strategy is to be developed to control the pollution level within the permissible limits. One of these major attributes is water.

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

The Water sampling stations were selected for mine effluent water, Ground water supply, well/ Hand pump water & also surface water samples.

3.0 Methodology of sampling and analysis

3.1 Water quality

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad

4.0 Results and interpretations

4.1 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, IS.10500/2012 (Ground water) and IS: 2296 (Surface water), are with in permissible limits.

CHAPTER - I

INTRODUCTION

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

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

Bharat Coking Coal has awarded Environmental Monitoring work of all Projects, Cluster wise, to Central Mine Planning & Design Institute Limited (CMPDIL). The environmental monitoring has been carried out as per conditions laid down by MoEF&CC while granting environmental clearance to different projects. 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 UG/OC, Bhowra South UG/OC , Amalgamated Sudamdih Patherdih Mine, Sudamdih Shaft, Sudamdih Coal Washery 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 and coal washery of 2.08 MTPA.

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 12thJune, 2019.

.

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

WATER QUALITY MONITORING

2.1 Location of sampling sites

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

i) Ground Water quality at **Bhowrah North (GW10)**

ii) Surface Water quality at **U/S of Damodar River (SW21)**

iii) Surface Water quality at **D/S of Damodar River (SW22)**

iv) Mine Water Quality at Bhowrah North **(MW10)**

2.2 Methodology of sampling and analysis

Water samples were collected as per standard practice. Effluent samples were analyzed for 25 parameters on quarterly basis & for 27 parameters on half yearly basis. The Ground and Surface water samples were collected and analyzed for 25 and 17 parameters respectively, on quarterly basis. Thereafter the samples were preserved and analyzed at the Environmental Laboratory at CMPDI RI-II, Dhanbad

2.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results show that most of the parameters are within the permissible limits.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II

GROUND WATER ANALYSIS TEST REPORT

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

Month & Year	**QUARTER ENDING JUNE 2022**	**Cluster**	**CLUSTERX**	**Report No.**	**RI-2/GW/22-23/QE/01**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**25.10.2022**
Project	**Bhowrah South**	**Sample Ref. No.**	**REM/BCCL/2022/DW/06/01**	**Sampling Method**	**CMPDI/RI-II/LPM 13,(IS 3025:Part -1)**
Sampling Stations	**GW10**	**Date of Sampling**	**09.05..22**	**Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**	
			Period of Analysis	**June to Sept'2022**	

Sl. No.	**Parameter**	**Method of Analysis**	**Observed Values**			**IS 10500: 2012**	
			GW10	**Range Of Testing**	**LDL**	**Acceptable Limit (Max)***	**Permissible Limit in the Absence of Alternate Source (Max)**
1	Colour, Hazen unit	APHA, 23rd Edition ,2120-c-Spectrophotometric Single Wavelength Method ,2017	2	1-500.0	1	5	15
2	Calcium, mg/l	IS 3025, (Part 40): 1991 R:2019,AAS-Flame Method & EDTA Method	89	2.0-800.0	2	75	200
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 , Argentometric Method	101	2.0-1500.0	5	250	1000
4	Fluoride, mg/l	APHA, 23rd Edition, SPADNS Method	0.68	0.2-2.00	0.2	1	1.5
5	Iron, mg/l	IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame Method	0.22	0.2-10	0.2	1	No relaxation
6	Magnesium	APHA 23rd Edition, 3500-Mg B: Calculation Method	0.05	6.0-700	6	30	100
7	Nitrate , mg/l	APHA, 23rd Edition, UV-Spectrophotometric Method	44.3	0.5-45.0	0.5	45	No relaxation
8	Odour	APHA, 23rd Edition, , 2150-C	Agreeable	Qualitative	Qualitative	Agreeable	Agreeable
9	pH value	IS 3025, Part 11 : 1983 R 2017 Electrometric(pH Meter) Method	7..67	1-14	0.1	6.5-8.5	No relaxation
10	Sulphate, mg/l	APHA –23rd Edition, 4500 S , Turbidity Method	112	10.0-400.0	10	200	400
11	Taste	APHA,23rd Edition, 2160-C	Acceptable	Qualitative	Qualitative	Acceptable	Agreeable
12	Total Alkalinity ($c_ac_{O_3}$), mg/l, Max	IS 3025, Part 23: 1986 R 2019 Titration Method	248	4.0-2000.0	4	200	600
13	Total Dissolved Solids, mg/l	IS 3025, Part 16: 1984 R 2017 Gravimetric method	613	25.0-5000.0	25	500	2000
14	Total Hardness, mg/l	IS 3025, (Part 21): 2019 EDTA Method	387	4.0-2000.0	4	200	600
15	Turbidity, NTU	IS 3025, (Part 10):1984, R-2017 Nephelometric/Turbiditimetric Method	1.6	1-800	0.1	1	5
16	Zinc, mg/l	IS 3025(Part 49) : 1994,R:2019, AAS-Flame Method	1.31	0.1 - 2.0	0.1	5	15

****All units in mg/L unless specified otherwise,*

***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

(Kumar Vaibhav)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

ANALYSED BY

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II

GROUND WATER ANALYSIS TEST REPORT

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

Month & Year	**QUARTER ENDING JUNE 2022**	**Cluster**	**CLUSTER X**	**Report No.**	**RI-2/GW/22-23/QE/01**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**25.10.2022**
Project	**Bhowrah South**	**Sample Ref. No.**	**REM/BCCL/2022/DW/06/01**	**Sampling Method**	**CMPDI/RI-II/LPM 13,(IS 3025:Part -1)**
Sampling Stations	**GW10**	**Date of Sampling**	**09.05..22**	**Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**	
			Period of Analysis	**June to Sept'2022**	

Sl. No.	**Parameter**	**Method of Analysis**	**Observed Values**			**IS 10500: 2012**	
			GW10	**Range Of Testing**	**LDL**	**Acceptable Limit (Max)***	**Permissible Limit in the Absence of Alternate Source (Max)**
1	Boron (as B), mg/l, Max	APHA, 23rd Edition ,Carmine	<0.2	0.2-10	0.2	0.5	1
2	Copper (as Cu), mg/l, Max	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA, 23rd Edition, AAS-GTA	<0.03	0.01-10	0.01	0.05	1.5
3	Free Residual Chlorine, mg/l, Min	APHA, 23rd Edition, , 4500-Cl-B. (Iodometric Method-I)	<0.04	0.04-5	0.04	0.2	1
4	Lead (as Pb), mg/l, Max	IS:3025(Part 47):1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA	<0.005	0.005-10	0.005	0.01	No relaxation
5	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 22nd Edition,4-Amino Autipyrine	<0.001	0.001-10	0.001	0.002	0.002
6	Selenium, mg/l, Max	APHA 23rd Edition IS-3025,part 56:2003, R-2019/, AAS-VGA	<0.007	0.007-10	0.007	0.01	No relaxation
7	Total Arsenic (as As), mg/l, Max	IS-3025,part 37:1988, R-2019/ APHA 23rd Edition AAS-VGA	<0.006	0.006-10	0.006	0.01	0.05
8	Total Chromium (as Cr), mg/l, Max	IS-3025 Part 52:2003, R:2019,AAS-Flame APHA, 23rd Edition, AAS-GTA	<0.04	0.01-10	0.01	0.05	No relaxation
9	Nickel as Ni, mg/l Max	IS 3025 Part 54 : 2003,R : 2019, AAS-Flame APHA, 23rd Edition, AAS-GTA	<0.01	0.005-10	0.005	0.02	No relaxation

****All units in mg/L unless specified otherwise,*

***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

ANALYSED BY

(Kumar Vaibhav)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone: 0326-223-850
email: rdri2.cmpdi@coalindia.in

SURFACE WATER ANALYSIS TEST REPORT

Month & Year	**JUNE 2022**	**Cluster**	**X**	**Report No.**	**RI-2/SW/22-23/QE/01**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**14.10.2022**
Project	**Sample Ref. No.**		REM/BCCL/2022/ 06 /SW /011	**Sampling Method**	**(IS 3025 , Part-1) CMPDI/RI-II/LPM 13**
Sampling Stations	**(i)**	**Upstream of Damodar River(SW21)**	**Date of Sampling**	20.06.22	**Period of Analysis**
	(ii)	**Downstream of Damodar River(SW22)**	**Date of Sampling**	20.06.22	June'2022 TO Sept'2022

Sl. No.	Parameter	Method of Analysis	Observed Values (i)	Observed Values (ii)	IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL
1	BOD (3 days 27°C), mg/l	IS 3025 (Part 44) : 1993, R-2019 , 3 day incubation at 27°C	<2.0	<2.0	3	2.00-10.00	2
2	Colour,Hazen Units	APHA 23rd Edition , 2120-B-:2017	2	2	10	1-100.0	1
3	Chlorides, mg/l	IS-3025(Part 32):1988, R-2019 Argentometric Method	27	26	600	5.0-1500.0	5
4	Copper, mg/l	IS 3025 (Part 42) : 1992 R : 2019, AAS-Flame Method	<0.2	<0.2	1.5	0.2-10.0	0.2
5	Dissolved Oxygen, mg/L	IS 3025 (Part 38) : 1989, R:2003 Winkler Azide Method	5.2	5.0	4	0.1-10.0	0.1
6	Fluoride, mg/l	APHA, 23rd Edition, SPADNS Method	0.73	0.51	1.5	0.2-2.00	0.2
7	Hexavalent Chromium, mg/l	APHA 23rd Edition, 1,5-Diphenylcarbohydrazide Method IS 3025 (Part 52) : 2003,R-2019	<0.01	<0.01	0.05	0.01-1.4	0.01
8	Iron, mg/l	IS 3025 (Part 53):2003,R:2019, AAS-Flame Method	<2.0	0.43	50	0.2-10	0.2
9	Nitrate , mg/l	APHA, 23rd Edition, UV-Spectrophotometric Method	4.83	4.11	50	0.5-45.0	0.5
10	pH value	IS 3025, (Part 11) : 1983 R-2017 Electrometric (Ph Meter) method	8.03	8.15	6.5-8.5	2.0-12.0	2
11	Sulphate, mg/l	APHA –23rd Edition,4500- S, Turbidity Method	82	49	400	10.0-400.0	10
12	Total Dissolved Solids, mg/l	IS 3025, (Part 16): 1984 R-2017 Gravimetric method	253	252	1500	25.0-5000.0	25
13	Zinc, mg/l	IS 3025(Part 49) : 1994, R : 2019, AAS-Flame Method	<2.0	0.42	15	0.1 - 3.0	0.1

***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit*

****All units in mg/L unless specified otherwise* ***Sample Collected in 5 Ltr Jerricane , Color as observed is transparent***

(Kumar Vaibhav)

(Amit Raj Mishra)

Analysed by ***CHECKED BY*** ***HOD's Initial/Signature***

Note*: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

---- End of Report ----

CMPDIL, RI-II
KOYLA BHAWAN COMPLEX
DHANBAD. -826005
Phone: 0326-223-850
email: rdri2.cmpdi@coalindia.in

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

SURFACE WATER ANALYSIS TEST REPORT

Month & Year	**Jun 2022**	**Cluster**	**X**	**Report No.**	**RI-2/SW/22-23/QE/01**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**14.10.2022**
Project	**Sample Ref. No.**		REM/BCCL/2022/ 06 /SW /011	**Sampling Method**	**(IS 3025 , Part-1) CMPDI/RI-II/LPM 13**
Sampling Stations	**(i)**	**Upstream of Damodar River(SW21)**	**Date of Sampling**	20.06.22	**Period of Analysis**
	(ii)	**Downstream of Damodar River(SW22)**	**Date of Sampling**	20.06.22	June'2022 TO Sept'2022

Sl. No.	Parameter	Method of Analysis	Observed Values (i)	Observed Values (ii)	IS : 2296 INLAND SURFACE WATER [1982] Class 'C	Range of Testing	LDL
1	Arsenic (as As), mg/l, Max	IS-3025,Part 37:1988, R-2019/ APHA 23rd Edition AAS-VGA	<0.006	<0.006	0.2	0.006-10	0.006
2	Lead (as Pb), mg/l, Max	APHA, 23rd Edition, AAS-GTA	<0.005	<0.005	0.1	0.005-10	0.005
3	Phenolic compounds (as C6H5OH), mg/l, Max	APHA, 22nd Edition 4-Amino Antipyrine	<0.002	<0.002	0.005	0.002-10	0.002
4	Selenium, mg/l, Max	IS-3025 ,Part 56:2003, R-2019/ APHA 23rd Edition, AAS-VGA	<0.007	<0.007	0.05	0.007-10	0.007

***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit*

****All units in mg/L unless specified otherwise* ***Sample Collected in 5 Ltr Jerricane , Color as observed is transparent***

(Kumar Vaibhav) (Amit Raj Mishra)

Analysed by ***CHECKED BY*** ***HOD's Initial/Signature***

Note*: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

---- End of Report ----

TC-10122

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II

MINE EFFLUENT ANALYSIS TEST REPORT

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

Month & Year	**QUARTER ENDING JUNE 2022**	**Cluster VI**	**CLUSTER X**	**Report No.**	**RI-2/MW/2022-23/HY/01**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**25.10.2022**
Project	**Bhowrah North**	**Sample Ref. No.**	**REM/BCCL/2022/MW/06/01**	**Sampling Method**	**CMPDI/RI-II/LPM 13,(IS 3025:Part -1)**
Sampling Stations	**MW10**	**Date of Sampling**	**20.06.22**	**Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**	

Period of Analysis **JUNE** **TO** **SEPT'2022**

Sl. No.	Parameter	Method of Analysis	MW10	Range Of Testing	LDL	MOEF -SCH-VI STANDARDS Class 'A'
1	B.O.D (3 days 27°C), mg/l, Max	IS 3025 /44:1993,R:20033 day incubation at 27°C	<2.0	2-1000.0	2	30
2	Colour	APHA,23RD Edition ,2120-B-:2017	4	1.0-500.0	1	-
3	COD, mg/l, Max	APHA 23rd Edition 5220 C Titrimetric Method	24	4.0-800.0	4	250
4	Copper (as Cu), mg/l, *Max*	IS 3025(Part42): 1992 R : 2019, AAS-Flame	<0.2	0.2-10.0	0.2	3
5	Dissolved Phosphate (as P), mg/l, Max	IS 3025/ 31, 1988 R 2019	<0.1	0.1-5	0.1	5
6	Fluoride (as F) mg/l, *Max*	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)	0.83	0.2-2	0.2	2
7	Hexavalent Chromium, mg/l, Max	IS 3025 (Part 52) : 2003,Reaffirmed 2019	<0.01	0.01-1.4	0.01	0.1
8	Iron (as Fe), mg/l, *Max*	IS 3025 (Part 53) : 2003, R : 2019 , AAS-Flame	<0.2	0.2-10	0.2	3
9	Manganese(as Mn), mg/l, Max	APHA, 23rd Edition, AAS-GTA	<0.2	0.1-10	0.005	0.1
10	Nickel (as Ni), mg/l, *Max*	IS-3025(Part 54):2003, R:2019 AAS-Flame	<0.2	0.1-10.0	0.1	3
11	Nitrate Nitrogen, mg/l, *Max*	APHA, 23 rd Edition,UV-Spectrphotometric	0.93	0.5-45	0.5	10
12	Oil & Grease, mg/l, Max	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	2.0-1000	2	10
13	pH value	IS-3025/11:1983, R-2017, Electrometric	8.22	1 -14	0.1	5.5 to 9.0
14	Temperature (°C)	IS-3025/09:1984, Thermometeric	33.6	1-100		Shall not exceed 5º C above the receiving temp
15	Total Chromium (as Cr), mg/l, *Max*	IS-3025(Part 52):2003, R:2019 AAS-Flame	<0.2	0.1-8	0.1	2
16	Total Suspended Solids, mg/l, Max	IS 3025/17:1984, R :2017, Gravimetric	54	10-5000	10	100
17	Zinc (as Zn), mg/l, *Max*	IS 3025 /49 : 1994, R : 2019, AAS-Flame	<0.2	0.1-2.0	0.1	5
18	Odour	APHA, 23rd Edition, , 2150-C	Agreeable	Qualitative	Qualitative	Qualitative

****All units in mg/L unless specified otherwise,*

***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

ANALYSED BY

(Kumar Vaibhav)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

MINE EFFLUENT ANALYSIS TEST REPORT

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

Month & Year	**QUARTER ENDING JUNE 2022**	**Cluster**	**CLUSTER X**	**Report No.**	**RI-2/MW/2022-23/HY/01**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**25.10.2022**
Project	**Bhowrah North**	**Sample Ref. No.**	**REM/BCCL/2022/MW/06/01**	**Sampling Method**	**CMPDI/RI-II/LPM 13,(IS 3025:Part -1)**
Sampling Stations	**MW10**	**Date of Sampling**	**20.06.22**	**Sample Collected in 5 Ltr Jerricane , Color as observed is transparent**	

Period of Analysis **JUNE** **TO** **SEPT'2022**

Sl. No.	Parameter	Method of Analysis	MW10	Range Of Testing	LDL	MOEF -SCH-VI STANDARDS Class 'A'
1	Ammonical Nitrogen, mg/l, Max	IS 3025/34:1988,R : 2009, Nessler's	<0.02	0.02-100	0.02	50
2	Arsenic (as As), mg/l, Max	IS-3025,part 37:1988, R-2019/ APHA 23rd Edition AAS-VGA	<0.006	0.006-5	0.006	0.2
3	Free Ammonia, mg/l, Max	IS:3025/34:1988, Nesseler's	<0.01	0.01-10	0.01	5
4	Lead (as Pb), mg/l, *Max*	IS-3025(Part 59):2006, R 2017 AAS-Flame /APHA, 23rd Edition, 3111B, AAS-Flame	<0.005	0.2-10	0.2	2
5	Phenolic compounds	APHA, 23rd Edition4-Amino Antipyrine	<0.002	0.002-5	0.002	1
6	Selenium, mg/l, Max	IS-3025,part 56:2003, R-2019/ APHA 23rd Edition, AAS-VGA	<0.007	0.007-5	0.007	0.05
7	Sulphide (as S^{2-}) mg/l Max.	APHA 23rd Edition Methylene Blue Method	<0.005	0.005-5	0.005	2
8	Total Kjeldahl Nitrogen, mg/l, Max	IS:3025/34:1988, Nesseler's	<1.0	1-200	1	100
9	Total Residual Chlorine, mg/l, Max	APHA, 23rd Edition, , 4500-Cl B. (Iodometric Method-I)	<0.04		0.04	1

****All units in mg/L unless specified otherwise,*

***Grab sampling carried out for water samples. *LDL indicates Lower Detection Limit & BDL indicates Below Detection Limit,*

ANALYSED BY

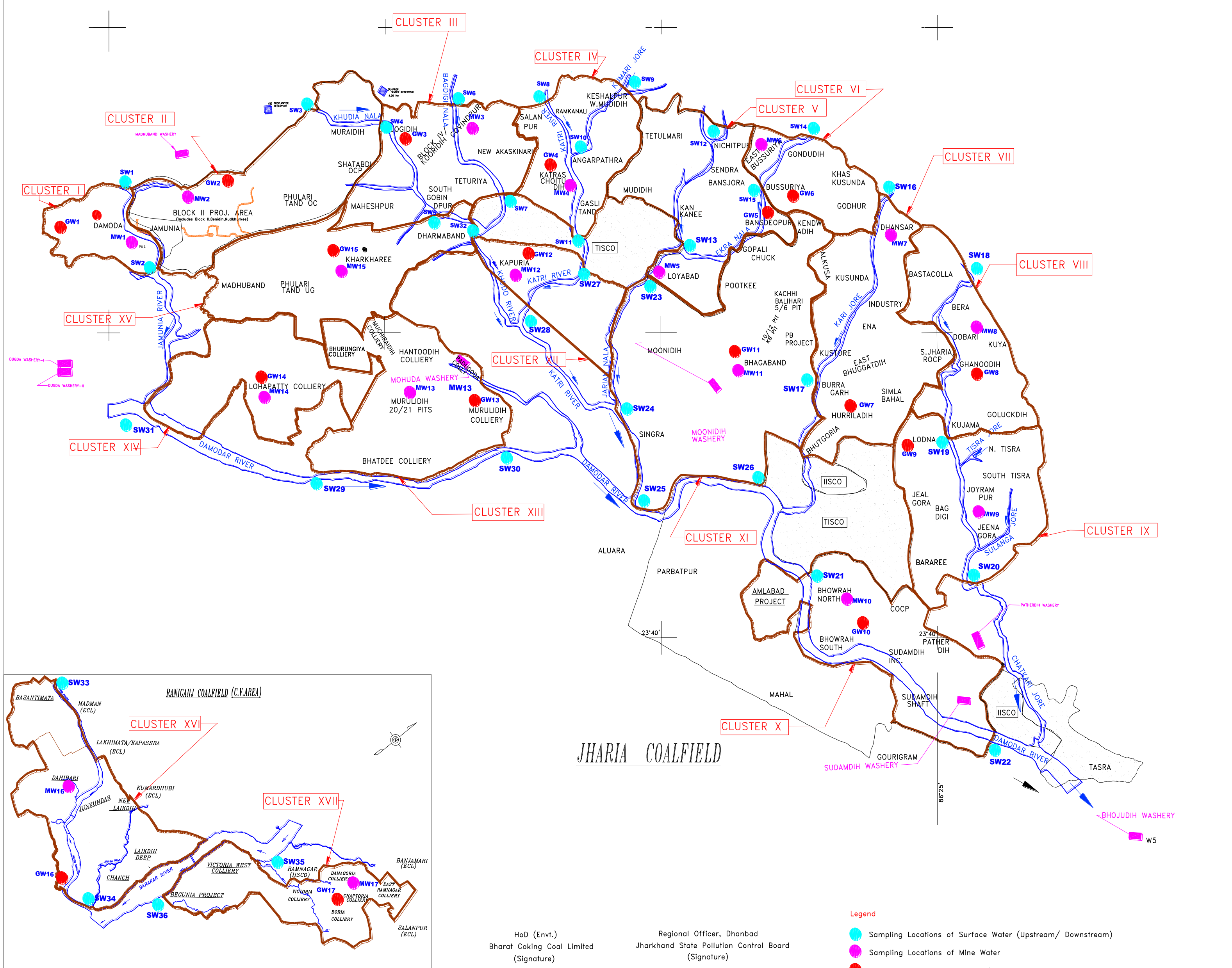
(Kumar Vaibhav)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

Water Sampling Locations in BCCL



INDEX

Cluster	Suface Water (U/S, D/S)	Name of River/ Nala / Jore	Mine/ Effluent Water	Sampling Location	Ground Water	Sampling Location
I	SW1, SW2	Jamunia River	MW1	Damoda Area	GW1	Ghutway Village
II	SW3, SW4	Khudia Nala	MW2	Block II OCP	GW2	Joyrampur Village
III	SW4, SW5, SW6, SW7	Khudia Nala, Bagdigi Nala	MW3	Govindpur Colliery	GW3	Jogidih Village
IV	SW8, SW11, SW9, SW10	Katri River, Kumari Jore	MW4	Chotudih	GW4	Kankanee Village
V	SW12, SW13, SW15	Jarian Nala, Ekra Nala	MW5	Mudidih	GW5	Nichitpur
VI	SW14, SW15	Ekra Nala	MW6	East Bassuria UGP	GW6	Bansjora Borewell
VII	SW16, SW17	Kari Jore	MW7	Dhansar UGP	GW7	Hurriladih
VIII	SW18, SW19	Kashi Jore	MW8	Dobari UGP	GW8	Ghanudih
IX	SW19, SW20	Kashi Jore	MW9	Jeenagora	GW9	Lodna
X	SW21, SW22	Damodar River	MW10	Bhowrah North	GW10	Bhowrah South
XI	SW23, SW24, SW25, SW26	Jarian Nala, Damodar River	MW11	Bhagabandh 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

Legend

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

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

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

Customer	BHARAT COKING COAL LIMITED
Title	WATER SAMPLING LOCATIONS
Subject	MONITORING STATIONS

HYDROGEOLOGICAL STUDY

FOR

STUDY OF BORE WELLS NEAR DAMODAR RIVER FOR PERMEABILITY AND SEEPAGE OF WATER OF RIVER DAMODAR CLUSTER-X MINES OF BCCL

EASTERN JHARIA AREA

JHARIA COALFIELD

FOR

BHARAT COKING COAL LIMITED

(A Subsidiary of Coal India Limited)

Dhanbad -826005

(Jharkhand State)

Prepared by

Central Mine Planning and Design Institute

(A Subsidiary of Coal India Limited)

Hydrogeology Section of Exploration Division

Ranchi-834008 (Jharkhand)

MARCH 2022

PERSONNEL ASSOCIATED

FIELD EXERTION

Debasis Bandyopadhyay	Manager (Geology)
Poulomi Baksi	Deputy Manager (Geology)
Swagata Dutta	Assisstant Manager (Geology)

DATA ANALYSIS AND INTERPRETATION

Debasis Bandyopadhyay	Manager (Geology)
Dr. Rambabu Singh	Deputy Manager (Geology)
Swagata Dutta	Assisstant Manager (Geology)
Kumar Vaibhav	Dy. Manager (Env.)

REPORT PREPARATION & DOCUMENTATION

Debasis Bandyopadhyay	Manager (Geology)

OVERALL GUIDANCE

Sri. V. K. Srivastav	GM (Exploration)

CONTENT

Index	Description	Page No.
	Objective & Scope of the Study	-
1.0	Introduction	01
2.0	Topography	04
3.0	Drainage System	04
4.0	Watershed description	05
5.0	Climate, Rainfall & Evapotranspiration	07
6.0	General Geology of the Area	08- 10
6.1	Geology of the Block	08
7.0	Hydrogeological setup	11 - 14
8.0	Coal Mining activities	15 - 23
8.1	Seepage from mines	21
9.0	Groundwater Level condition	23 - 28
10.0	Estimation of Hydraulic Properties	29
11.0	Base flow estimation	30
12.0	Water Quality data analysis	32
13.0	Observations	37
14.0	Summary and Conclusion	38
15.0	Recommendations	38

LIST OF ANNEXURES

Annexure No	Description	Page No
I	Aquifer Performance Test Report by CMPDI	-
II	Groundwater water major ion chemistry analysis data	-

Details about the Study

Cluster-X mines of BCCL consisting of one closed Underground mines (Amlabad UG), five operating Underground mines (Bhowrah North UG, Bhowrah South UG, Patherdih UG, Sudamdih Incline UG & Sudamdih Shaft UG), four opencast mines (Bhowrah North OC, 3 Pit OC, Chandan OCP [Bhowrah], Chandan OCP [Patherdih]) and one Coal Washery (Sudamdih Coal Washery). The Cluster of mines is located in Jharia administrative Block of Dhanbad District of Jharkhand state. This Coal mining area falls in the control of Eastern Jharia Area, Jharia Coalfield of Bharat Coking Coal Limited.

Environmental Clearance (EC) has already been issued by MoEF&CC, New Delhi for this Cluster of mines for coal production with a specific condition to comply. The condition no. xiii, it is stated that "***Study of bore wells near Damodar River for permeability and seepage of water of River Damodar***" has to be conducted by BCCL. Hydrogeology Section of Exploration Division of CMPDI (HQ), Ranchi has conducted the study as per the work order issued by BCCL (Job No- 200420017) during F.Y. 2021-22.

The objective of the study is to identifying the permeability and seepage of water from River (Damodar River, Gaurkhuti Jhor / adjacent aquifers) into coalmine voids/pits of Cluster-X mines, BCCL if any.

Objective of the study

Therefore, the detailed hydrogeological investigation would require to undertake following steps to identify the permeability and seepage of water from River (Damodar River, Gaurkhuti Jhor / adjacent aquifers) into coalmine voids/pits of Cluster-X mines, BCCL:

1. Quantification of groundwater seepage into the Cluster of Mines of BCCL.
2. Identification of the sources (primary and secondary) of groundwater seepage into the Cluster of Mines of BCCL.
3. Characterization of permeability of groundwater flow in the study area.
4. 2D aquifer disposition and probable Groundwater, surface water and mining activity interconnection in the study area.

The scope of the study

i. Monitoring of bore wells, dug wells and tube wells near Damodar River, Gaurkhuti Jhor in and around the Cluster-X mine area (study area).
ii. Delineation of the aquifers and their extant evaluated using borehole data available during coal exploration by MECL/CMPDI in the area.
iii. Hydrogeological cross-section has been configured considering the multi-aquifer flow system in the study area for understanding of the flow and interaction in between groundwater, surface/river water and mine water.
iv. Depth to groundwater level map and Water Table Contour map of the study area to identify groundwater flow direction.
v. Quantification of groundwater seepage into the Cluster of Mines of BCCL.
vi. The permeability of the aquifers has been determined using Aquifer Pump test in the study area.
vii. Surface water, groundwater and mine water quality data analysis and Major Ion Chemistry plot.
viii. Conclusion and Recommendations for future scope.

Approach, Methodology and Data collection

The detailed and integrated Hydrogeological study has been conducted starting from drainage pattern, aquifer delineation, water level and quality data analysis, surface and sub-surface mining activity, aquifer pumping test, major ion chemistry plot etc. The purpose of the study is to ***identify and establish the connectivity in between River water/surface water, groundwater and mine water and to identify permeability and seepage of water of River Damodar and Cluster-X mines of BCCL***. The field exertion and basic data collection has been done during 2020-21 and 2021-22. The data analysis, interpretation has been executed during 2021-22.

1.0 Introduction

Cluster-X mines of BCCL 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 & OC), Sudamdih incline UG mine, Sudamdih Shaft UG mine, Amlabad UG (Closed) and Sudamdih Coal Washery. All these mines are comes under the administrative control of Eastern Jharia Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). This cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand.

Table-1: The latitudes & longitudes of Cluster-X mines, BCCL.

Sl No.	Name of the Mine	Latitude	Longitude
1	Bhowrah North (UG)	23º 41' 07" N to 23º 41' 30" N	86º 24'15" E to 86º 24' 42" E
2	Bhowrah North (OC)		
3	Bhowrah South (UG)	23° 40' 00" N to 23° 41' 30" N	86° 23' 00" E to 86° 24' 45" E
4	3 Pit OCP		
5	Chandan OCP (Bhowrah)		
6	Patherdih (UG)	23º 40' 35" N to 23º 39' 39" N	86º 25' 03" E to 86º 26' 58" E
7	Chandan OCP (Patherdih)		
8	Sudamdih Incline (UG)	23º 40' 00" N to 23º 40' 30" N	86º 25' 09" E to 86º 25' 30" E
9	Sudamdih Shaft (UG)	23 º 39' 30" N to 23 º 40' 30" N	86º 24' 30 E to 86 º 26' 30" E
10	Amlabad (UG) Closed	23º 40' 00" N to 23º 41' 30" N	86º 22' 18" E to 86º 23' 00" E

The area is covered by Survey of India Toposheet No 73 I/6 (RF 1:50,000). The cluster is approachable by rail and road. The National Highway No.2 (NH-2) passes at a distance of about 18.0 km to the north and the industrial town of Dhanbad is about 11 km to the north of leasehold boundary of this cluster. Location map shown in **Figure 1.**

Figure 1: Location map

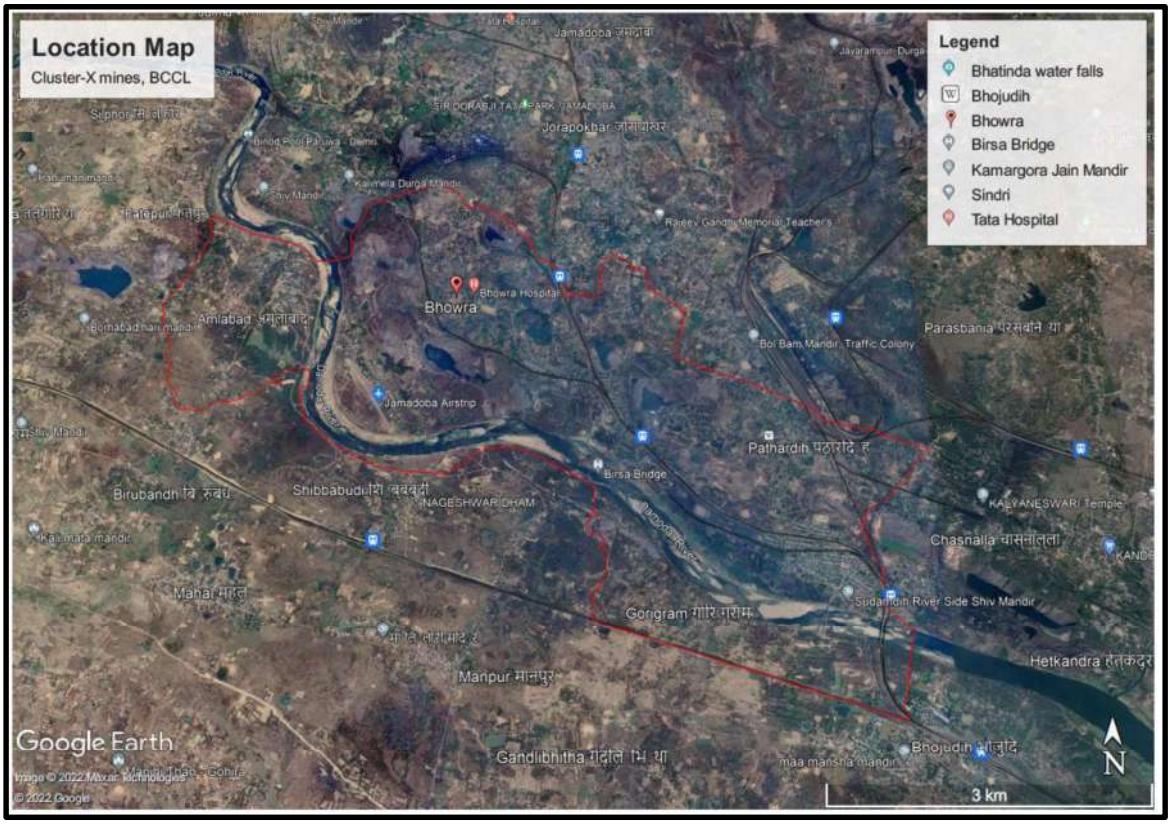


Table-2: Details of Cluster-X mines of BCCL

Name of mines	Mineable Reserve	Coal seam being Worked at present	Coal seam to be worked in future	Life of Mine
Bhowrah North UG	13.3 MT	IX, VI	IX,VIII,VII,VI,V,IV(Top) and IV (Bot)	>30 Yrs
Bhowrah North OC	1.6 MT	XIV, XIV A and XV	XIV, XIV A and XV	4 Yrs
Bhowrah South UG	48.47 MT	IV (Top),VI	III, IV Bot, IV Top, V, VI, VII, and XVII.	>30 Yrs
3 Pit OCP	0.485 MT	IX/X,XI/XII,XIII,XIV	IX/X,XI/XII,XIII,XIV	4.5 Yrs
Chandan OCP (Bhowra)	0.44 MT	II, I (Top) and I (Bot.).	IV (Top), IV (Bot.), III, II, I (Top), I(Bot)	2.5 Yrs
Patherdih UG	2.52 MT	VI	VI	>30 Yrs
Chandan OCP (Patherdih)	0.9 MT	II, I Top/I Middle and I Bot	IV (Top), IV (Bot), III, II, I (Top)/I (Middle) and I Bot.	4 Yrs
Sudamdih Incline UG	3.944 MT	VI and IV(Top)	VIII, VII, VI and IV	>30 Yrs
Sudamdih Shaft UG	6.748 MT	XI/XII	XI/XII, VIII A, VIII and VII.	>30 Yrs
Amlabad UG Closed	18.376 MT	Waterlogged and closed due to less in production		
Sudamdih Coal Washery	NA	NA	NA	18 Yrs

The method of mining in underground mines is Bord & Pillar development and depillaring with hydraulic sand stowing whereas Shovel and Dumper combination method used in the opencast mines.

Coal mining by underground and opencast method creates dis-equilibrium in environmental scenario of the area and disturbs the groundwater condition in particular. As a part of Environmental Management Plan, pre-mining hydrogeological scenario / parameters needs to be established as datum lines and these parameters are to be monitored periodically during active and post-mining stages to assess the impact on groundwater regime/environment due to the mining activity and to suggest remedial measures to minimize the impact. Hydrogeological regime controlled by topography, climate, geology and groundwater and associated phenomena such as the mode of occurrence, direction and velocity of water flow, the quantity of water present in the formation, the groundwater reserve, the recharge-discharge process, the infiltration phenomena and the type and change of chemical quality of water in space and time.

Generally, changes to hydrogeological regime occur temporarily at different phases of mining activities are as below:

1. The pre-mining phase represents a system that has evolved over a long period, which is relatively unchanging set of hydrological and hydro-chemical constituents existed.
2. The active mining phase represents a period of continued disruption and dis-equilibrium of total hydrogeological regime.
3. The reclamation phase represents a period in which the hydrological and hydro-chemical system starts to adjust to the newly created conditions of reclamation.

The post-mining phase represents a period in which the system has a major extent, adjusted to the post-mining conditions so that the rate of change in the ground water system is small relative to phase 2 and 3.

2.0 Topography

The area has an undulating topography with gentle slope towards south and southeast. The maximum RL is 185 m above the mean sea level in the northern part of the area whereas the minimum RL is 150.0 m above mean sea level near the Damodar River. The original topography of the area has been obliterated to some extent due to mining activities by opencast method. There are a number of ponds and tanks in the area.

3.0 Drainage system

Master drainage Damodar River passes along the south boundary of the cluster mining area and flowing from west to east. The catchment's area of Damodar River is around 22000 sq. km. The run-off from the area during monsoon drains into Damodar River through a numbers of streams (1^{st} /2^{nd} / 3^{rd} order) including Gaurkuthi nala flowing across the area from north to south direction. Besides these streams, there are number of small ponds in the area The HFL of Damodar River is 149 m in Bhowra (South) area, 142.42 m in Bhowra (North) area, 136.2 m in Sudamdih Incline area and 126 m above MSL in Sudamdih Shaft area. The drainage map of the buffer zone was prepared on topographic map of scale 1:50 000. The drainage map of the area enclosed as **Figure 2**.

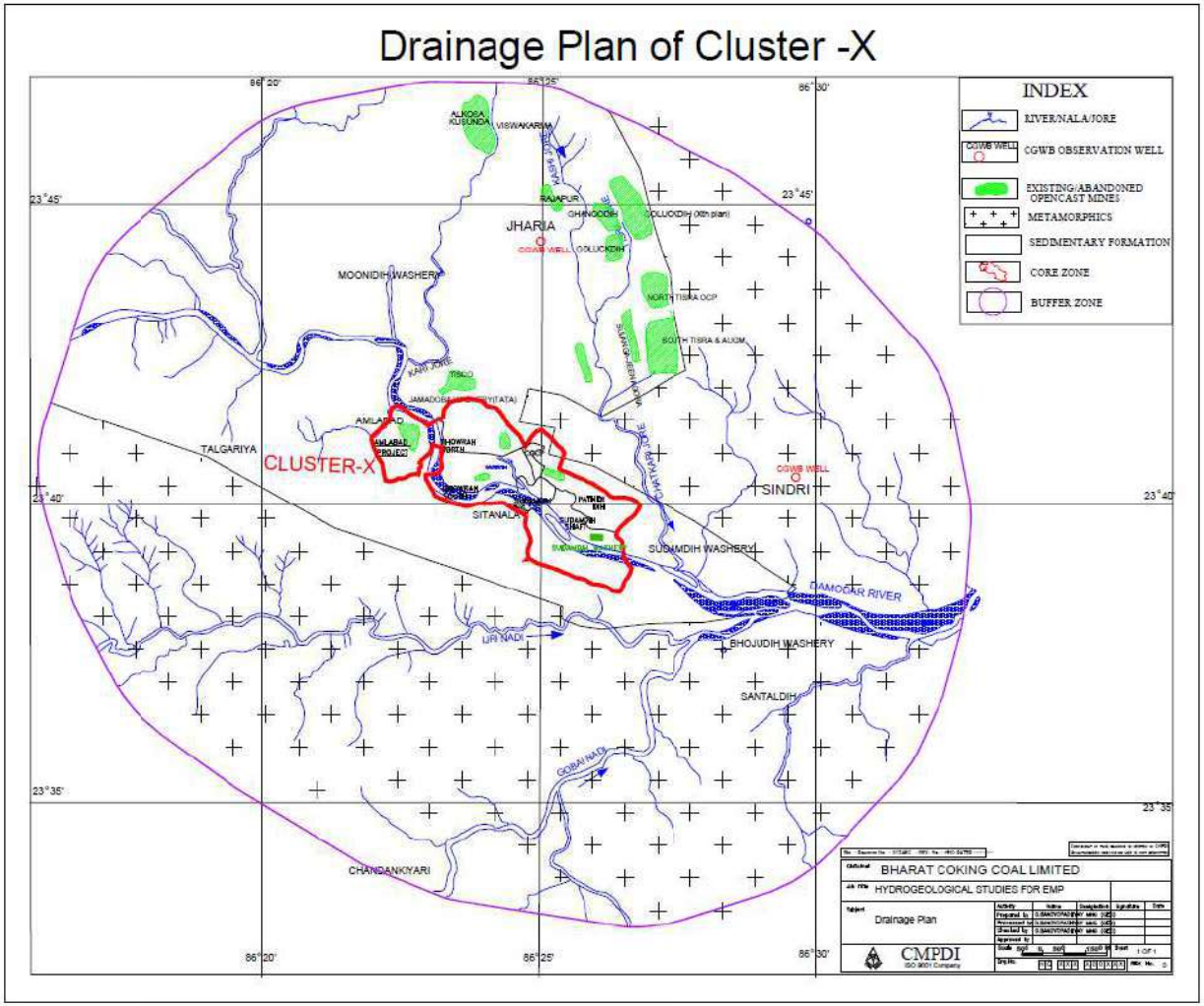


Figure 2: Drainage Plan

4.0 Mining area land use pattern

The Land use details of surrounding area (buffer zone of 10 km) given in table below:

Table 3: Land Use Details in Buffer Zone

Sl. No	Particulars	Buffer Zone	
		Qty in Ha	%
1	Cultivable Land	173.01	32.03
2	Waste Land	103.16	19.10
3	Vegetation	191.29	35.41
4	Surface water body	17.44	3.23
5	Built up area / settlement	41.51	7.68
6	Mining area	13.81	2.56
Total		**540.21**	**100**

Figure 3: Land use details

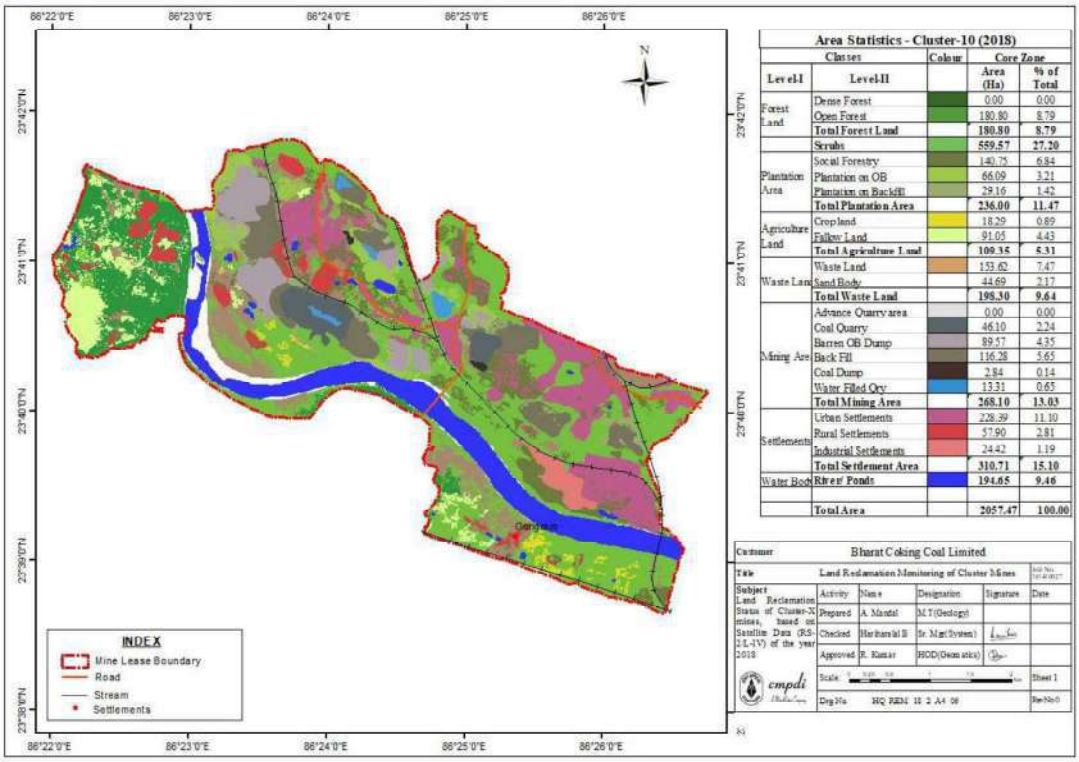


Table 4: Land Use Details of Cluster-X Area

Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	1085.72×10^4	0.0	1085.72×10^4
2	Open Land	661.04×10^4	0.0	661.04×10^4
3	Road/ Paved Area	228.39×10^4	0.0	228.39×10^4
4	Rooftop area of building/ sheds	82.32×10^4	0.0	82.32×10^4
5	Total	2057.47×10^4	0.0	2057.47×10^4

5.0 Climate & Rainfall

The study area falls in the sub-humid region Jharkhand state adjacent to West Bengal and Jharkhand order. The maximum temperature rises as high as 45°C during summer (April to middle of June) and falls down to minimum of 10°C during winter (December to January). The area receives fair to moderate rainfall, the annual precipitation is received between June to September. The rainfall detail (Source: IMD grid, Dhanbad) is given below:

Table – 2: Rainfall statistic of the study area.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (mm)
2005	44.49	23.11	26.16	17.90	28.95	272.26	388.86	158.86	69.03	117.63	0.09	1.67	1149.01
2006	0.00	0.00	3.11	12.64	86.68	113.20	505.72	316.06	339.51	9.80	3.73	0.00	1390.45
2007	0.00	58.69	35.76	21.08	25.33	139.60	666.30	416.85	363.93	43.63	1.57	0.00	1772.74
2008	16.44	1.96	6.27	6.78	37.26	180.58	422.25	275.33	198.31	27.64	0.00	0.00	1172.82
2009	0.00	0.26	5.81	0.19	105.82	78.32	232.20	370.39	429.16	68.56	11.31	0.98	1303.00
2010	0.59	19.64	7.62	38.24	93.72	146.68	157.31	198.97	239.75	78.76	5.26	40.53	1027.07
2011	0.00	1.60	18.25	12.81	102.58	294.61	174.35	445.43	214.88	30.35	0.69	0.00	1295.55
2012	18.45	2.13	1.55	53.93	9.53	95.95	408.57	261.07	174.01	63.01	51.10	12.85	1152.15
2013	0.07	17.62	0.79	15.24	105.51	176.77	170.14	276.70	135.76	304.46	0.00	0.00	1203.06
2014	9.27	35.71	21.21	8.16	62.77	112.58	283.73	223.38	214.48	30.30	0.00	0.00	1001.59
2015	12.06	3.33	26.71	45.73	32.91	162.96	385.21	239.38	71.34	15.62	0.00	0.61	995.86
2016	6.16	17.59	1.73	1.33	73.90	197.34	248.86	395.33	424.81	30.45	0.00	0.00	1397.50
2017	5.12	0.00	34.96	59.89	81.01	141.66	502.58	168.84	111.95	274.18	0.64	4.12	1384.95
2018	0.00	0.06	2.90	159.52	31.22	202.84	344.59	211.91	153.63	16.31	0.04	20.99	1144.01
2019	0.00	25.18	7.24	46.99	109.43	109.11	292.02	234.65	327.95	199.63	0.10	5.13	1357.43
2020	21.14	5.94	74.96	27.94	71.32	218.12	187.01	258.74	196.87	52.23	1.23	0.00	1115.50

The minimum Rainfall occurs during year 2015 of about 995.86 mm and maximum rainfall during year 2007 of about 1772.74 mm. The Normal average rainfall is 1256 mm in the study area.

6.0 General Geology of the Area

The Cluster-X mines of BCCL are located in the eastern part of Jharia Coalfield. The Jharia Coalfield represents the middle-east part of coal basin in the Damodar Valley Basin Belt. It is roughly sickle shaped on plan and covers an area of about 453 sq. km. The coalfield is bounded by the latitude $23^0$37' to $23^0$50' North and longitude 86^0 07' to 86^0 28' East and the major part falls in the Dhanbad district of Jharkhand. The Barakar Formations covering an area of 218 sq.km which are exposed in the northern, east & south eastern part of the Coalfield and contains over 40 coal seams some of which are exclusive store house of prime coking coal of India. The coal bearing formations in the cluster-X mines belong to Barakar Formation of the Lower Permian age.

6.1 Geology of the Block

The Cluster-X mining area covered by all the various types of rocks belonging to Barakar Formation of Lower Gondwana Group under a moderately thick cover of soil, alluvium and sandy soil. The stratigraphic succession and occurrence of the various coal seams of the block, have been deciphered mainly on the basis of the sub-surface data obtained both by exploratory drilling and the available mine plan from the collieries, is given below:

Table No-3: Stratigraphic Succession of the Geological Block

Age	Formation	Lithology
Recent	Alluvium	Soil (residual), sandy
Lower Jurassic		Intrusive – Mica Peridotite
Permian	Barakar	Fine to coarse grained sandstone, intercalation of sandstone and shale, sandy shale, carbonaceous shale etc with coal seams XI/XII to I Bot.
---------- UNCONFORMITY ----------		
Archean	Hard rock	Gneisses and schists

The thickness of alluvium/soil over the entire cluster-X mining area is varies from 5.0 to 12.0 m. The thickness of the alluvium/soil/subsoil including weathered sandstone varies from 25.0 to 30.0 m with an average thickness of 28 m in the whole cluster-X mining area.

The Barakar Formation consists of grits, fine to coarse grained sandstone, intercalation of sandstone and shale, sandy shale, grey shale, carbonaceous shale and coal seams. The sequence of coal seams present within this area is from seams XVIII to seam-I besides few local seams.

The Geological structure has been worked out on the basis of sub-surface data accrued in course of exploration coupled with the already available data of opencast and underground workings. The general strike of the formation is WNW-ESE in the eastern and central part of the area and NW-SE in the western part. The dip of the formation is southerly and ranges from 20^0 to 25^0 in the western part 27^0 to 30^0 in the eastern and central part. Based on sub-surface data, 45 nos. of strike/Dip/Oblique faults have been affected the whole study area. The throw of these faults varies from 5 m to 60 m.

(**Geological Report on Exploration for Coal, Bhowra Block of Jharia Coalfield**).

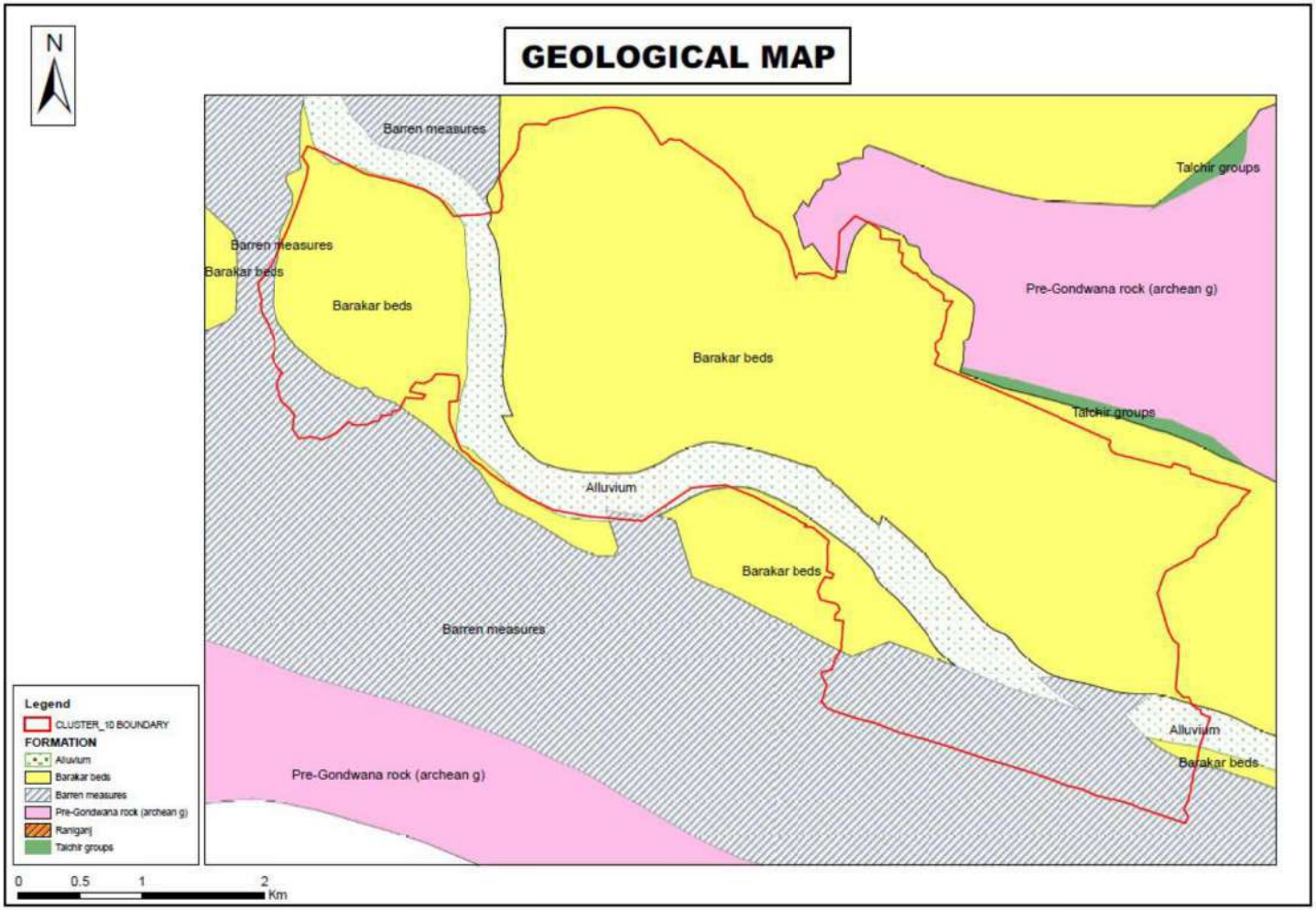


Figure 4: Geological map of the study area

7.0 Hydrogeological Setup of the study area

The permeable formation i.e., sandstone within Gondwana Formation behaves as an aquifer. The coal seams and shales developed act as impermeable beds i.e., Aquiclude. Barakar Formation mostly covers cluster-X mines area with recent soil, alluvium and sandy soil. Based on the sub-surface geological data generated from the exploratory boreholes, the disposition of aquifers has been described below:

Type of Aquifers/Hydro Stratigraphic Units (HSU)

1. Consolidated aquifer (Barakar sandstone and Barren Measure Formation)
2. Unconsolidated aquifer (top alluvium layer & river bed loose sand)

Unconfined aquifer: In the study area, alluvium/soil, sandy soil together with weathered sandstone of Barakar Formation laying above the top most seam constitute the material for top unconfined aquifer. The thickness varies from 5 m to 30 m and underlain by consolidated weathered Barakar sandstone.

In general, alluvium possess moderate to high porosity and infiltration factor. Thus, the ground water potential is generally moderate to high in alluvium while it is poor in hard, compact sandstone and metamorphic rocks. In the unconfined aquifer, ground water moves laterally through the inter-granular spaces in the sandstone.

Semi-confined aquifer: The deep-seated sandstone partings between top and bottom working coal seam in the area have favourable conditions for occurrence of semi-confined to confined aquifers. These aquifers are mainly made up of fine to coarse grained, hard, compact sandstone with intercalation of shale and sandstone are separated by impervious bed i.e. coal seams. The grain size mostly varies from fine to coarse, often gritty. Sandstone of lower part of Barakar Formation is coarse grained, often content pebble bed. In deeper aquifers, the ground water movement controlled mainly through joints and fractures (i.e., secondary porosity). Presence of intercalated shale and carbonaceous shale beds reduced the permeability of the aquifer with depth;

the deeper aquifers are generally poor in potential. These semi-confined aquifers can be called ***multi aquifer system*** due to the presence of clay, shale and persistent impervious thick coal seams.

Table 6: Hydro-Stratigraphic units (HSU) of the area

Hydrogeological Unit	Formation	Thickness in meters
Unconfined aquifer	Alluvium, soil, sandy soil, Sand and weathered sandstone	5 to 30 m
Aquiclude	Seam – XVIII	3.50 to 5.80
Semi-confined aquifer (21)	Fine to Medium grained sandstone with shale-sandstone intercalation	18.60 to 22.0
Aquiclude	Seam -XVII	3.0 to 7.70
Semi-confined aquifer (20)	Fine to coarse grained sandstone with shale-sandstone intercalation	18.60 to 40 .0
Aquiclude	Seam – XVI Top	1.70 to 4.30
Semi-confined aquifer (19)	Fine to coarse grained sandstone with shale-sandstone intercalation	10.50 to 30.60
Aquiclude	Seam – XVI Bot.	1.60 to 3.10
Semi-confined aquifer (18)	Fine to coarse grained sandstone with shale-sandstone intercalation, arenaceous shale.	51.78 to 96.60
Aquiclude	Seam – XVA	0.70 to 3.10
Semi-confined aquifer (17)	Shale and sandstone intercalation	10.50 to 54.0
Aquiclude	Seam – XV	7.05 to 16.20
Semi-confined aquifer (16)	Coarse grain sandstone and shale and sandstone intercalation.	11.50 to 30.60
Aquiclude	Seam – XIV A	2.10 to 4.60
Semi-confined aquifer (15)	Medium grained sandstone with shale	26 to 120
Aquiclude	Seam –XIV	2.25 to 13.0
Semi-confined aquifer (14)	Fine to coarse grain sandstone with shale and sandy shale intercalations	12.0 to 38.0
Aquiclude	Seam – XIII	0.81 to 2.50

Hydrogeological Unit	Formation	Thickness in meters
Semi-confined aquifer (13)	Coarse to fine grained sandstone and Shale	11.50 to 110
Aquiclude	Seam – XI/XII	4.20 to 7.00
Semi-confined aquifer(12)	Fine to coarse grain sandstone, Shale and sandstone intercalation.	11.50 to 64.0
Aquiclude	Seam –IX/X	11.80 to 27.0
Semi-confined aquifer(11)	Coarse grain sandstone with thin layers of shale and Shale and sandstone intercalation.	11.50 to 52.0
Aquiclude	Seam –VIII A	4.20 to 6.00
Semi-confined aquifer(10)	Fine to coarse grain sandstone, Shale and sandstone intercalation.	37 to 44.0
Aquiclude	Seam – Local	2.50 to 4.15
Semi-confined aquifer (9)	Medium grained sandstone with sandy shale	14.0 to 36.00
Aquiclude	Seam – VII	3.50 to 5.50
Semi-confined aquifer(8)	Coarse grain sandstone with thin layers of shale and Shale and sandstone intercalation.	9.0 to 70.0
Aquiclude	Seam –VI	2.88 to 4.50
Semi-confined aquifer(7)	Fine to coarse grain sandstone, Shale and sandstone intercalation.	6.0 to 50.0
Aquiclude	Seam – V	3.40 to 5.4
Semi-confined aquifer (6)	Coarse grained sandstone with thin layers of sale and Shale & sandstone intercalation	18.0 to 50.0
Aquiclude	Seam – IV Top	4.65 to 5.15
Semi-confined aquifer(5)	Fine to coarse grained sandstone and argillaceous shale	50.0
Aquiclude	Seam – IV Bot	4.35
Semi-confined aquifer (4)	Coarse grain sandstone with thin shale layer	50.00
Aquiclude	Seam – III	3.60 to 7.27
Semi-confined aquifer(3)	Coarse grain sandstone and Shale & sandstone intercalation	9.0 to 57.0
Aquiclude	Seam – II	12.00

Hydrogeological Unit	Formation	Thickness in meters
Semi-confined aquifer (2)	Coarse grain sandstone with thin shale layers	8.00
Aquiclude	Seam – I Top	5.00
Semi-confined aquifer (1)	Coarse grain sandstone with thin shale layers.	5.50
Aquiclude	Seam – I Bot	4.50

The hydrogeological regime considering the geological and hydrogeological data that may represent the existing hydrogeological set-up of Cluster-X mine area of BCCL.

The strike, dip and disposition of the coal seams as per the Geological map of the study area, there are two types of different aquifer system prevails in the study area with critical interaction with each other. These aquifers are; unconfined aquifer with riverbed/unconsolidated loose sand aquifer and semi-confined to confined sedimentary aquifer (Barakar Formation). The disposition of these aquifers considering the mining activity in the study area shown in **Figure 5**.

The typical groundwater movement within aquifers are shown in the schematic hydrogeological cross-section lines along A-A'. Considering the geological model of the area, along A-A' cross-section profile showing the movement and connectivity of the ground water in between Damodar River, coal mines of Cluster-X mines, BCCL and Gaurkhuti nala.

8.0 Present and previous coal mining activities

Cluster-X group of mines of BCCL is a group of six mines**,** Bhowrah North (Mixed UG and OC), Bhowrah South (Mixed UG and OC that are 3 Pit OCP Chandan OCP), Patherdih (Mixed UG and OC that is Chandan OCP), Sudamdih Incline (UG), Sudamdih Shaft (UG) are operating mines . There is one closed Amlabad (UG) mine. There is also one existing Sudamdih coal Washery.

CLUSTER X MINES

Sl No	Name of Mines	Production Capacity (MTY)		Lease Hold Area (Ha)
		Normative	Peak	
1	Bhowrah North (UG)	0.11	0.143	208.83
2	Bhowrah North (OC)	0.42	0.546	
3	Bhowrah South (UG)	0.29	0.377	571.58
4	3 Pit OCP	0.235	0.305	
5	Chandan OCP(Bhowrah)	0.158	0.205	
6	Patherdih (UG)	0.054	0.070	244.34
7	Chandan OCP (Patherdih)	0.22	0.286	
8	Sudamdih Incline (UG)	0.09	0.117	254.27
9	Sudamdih Shaft (UG)	0.185	0.240	391.50
10	Amlabad (UG) Closed	0	0	386.95
	Total	1.762	2.289	2057.47
11	Sudamdih Coal Washery (Within the lease hold of Sudamdih Shaft Mine)	1.6	2.08	18

All the mines in the Cluster started their operation prior to nationalization of the coalmines. This Report has been prepared based on Project Report / schemes / Feasibility Reports taking into account the present status of the mine in the area.

The purpose of this report is to compliance of environmental clearance condition for Cluster X mines of BCCL, under Cluster Concept, from Ministry of Environment & Forests, Govt. of India in view of EIA Notification, 2006. The Cluster will have a peak production capacity of mines 2.289 MTPA and that of Washery will be 2.08 MTPA.

Mine wise existing and future coal mining activity described below:

Bhowrah (North) UG

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
IX	7.6	1.748	1 in 6	W II
VIII	7.4	1.25	1 in 6	W II
VII	4.1	1.52	1 in 6	W II
VI	4.01	2.102	1 in 6	W II
V	3.4	2.2	1 in 6	W II
IVT	4.0	3.0	1 in 6	W IV
IVB	4.0	3.0	1 in 6	W IV
Total		14.82		

Bhowrah (North) OCP

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
XIV	12.00	1.1	1 in 6	ST-II
XV	8.60	0.40	1 in 2.5	ST-II
XIVA	2.3	0.1	1 in 2.5	ST-II
Total		1.60		

Bhowrah (South) UG

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
XVII	4.40	0. 89	1 in 2.2	Steel I
VII	4.50	4.36	1 in 3	W - III
VI	4.50	7.29	1 in 3	W - III
V	3.89	3.21	1 in 3	W-III
IV T/IV B	4.65/4.35	13.93	1 in 5 to 1 in 3	W - III
III	7.5	22.00	1 in 2.3	W - IV
Total		48.47		

3 Pit OC

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
XIV	9.75	0.193	1 in 2.5	ST-II
XIII	3.40	0.014	1 in 2.5	W-II
XI/XII	5.60	0.017	1 in 2.5	W-II
IX/X	3.55	0.255	1 in 2.5	ST-II
Total		**0.479 MT**		

COCP (Patherdih)

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
II	12.00	0.29	1 in 1.76	NLW-IV
Itop/Imidl.	6.0	0.26	1 in 1.76	NLW-IV
I Bot.	10.5	0.35	1 in 1.76	NLW-III
Total		**0.90**		

COCP (Bhowrah)

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
IV Top	5.5	0.080	1 in 2	NLW-IV
IV Bot.	5.5	0.08	1 in 2	NLW-IV
III	7.0	0.20	1 in 2	NLW-IV
II	13.71	0.14	1 in 2	NLW-IV
ITop	5	0.06	1 in 2	NLW-IV
I Bot.	4	0.06	1 in 2	NLW-IV
Total		**0.62**		

Patherdih (UG)

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
VI	3.64	2.52	1 in 1.8	W IV

Sudamdih Incline (UG)

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
VIII	4.00	0.03	1 in 1.8	W IV
VII	3.40	0.18	1 in 1.8	W IV
VI	2.88	0.44	1 in 1.8	W IV
IV	10.5	2.30	1 in 1.8	W IV
Total		2.95		

Sudamdih Shaft (UG)

Seam	Thickness in m	GR in MT	Gradient	Grade/ quality
XI/XII	6.6	0.86	1 in 1.2	W-I
VIII A	5.5	0.75	1 in 1.8	W-IV
LOCAL	3.0	0.19	1 in 1.8	W-IV
VIII	3.2	0.91	1 in 1.8	W-IV
VII	4.5	0.62	1 in 1.8	W-IV
Total		3.33		

Bhowra North UG & OCP

The seams are being mined in Bhowrah North UG is VI, IX &VIII seams. The minable reserve is 14.82 Mte. The present annual coal production is 0.05MT. The present mine is being operated with 23/8 incline, 23/9 incline, 23A incline for VI seam (W-II grade), 7B&7C incline for IX seam (W-II grade) &VIII seam (W-II grade). The mine developed extensively by manual and semi-mechanized (SDL) B&P method. Semi-mechanized (SDL) B&P method of mining is envisaged for future production also. The annual target of coal production is 0.11 Mty (Peak 0.143 MT). The total depth of the mine is 200 m and the life of the mine is more than 30 yrs.

The **Bhowrah North OC**P started during 2008-09 and mine working extended upto XIV seam. It covers an area of 25.41 Ha under Bhowrah North colliery and having minable reserve of 1.6MTY. Present production is 469TPD (avg.) and present stripping ratio is 1:9.Opencast mining with shovel-dumper combination is adopted here. The normative target production will be 0.42 MT with life of 4 years.

Bhowra South UG & OCP

The normative target production of the mine will be 0.29 MT/annum. The seams are being mined in Bhowrah-south (U/G) are V/VI seam (WIII grade) thro' 37/38 incline and IVT/IVB seam (WIII grade) thro'35/35A incline. The minable reserve is 48.47 Mte. The present annual coal production is 0.05MT. The present mine is being operated with 37/38 Incline and 35/35A Incline. The mine developed extensively by manual & semi-mechanized (SDL) B&P method.

3 Pit OCP Bhowrah South Colliery started in 2000 and extended upto IX/X seam. It covers an area of 44.53 Ha in Bhowrah South colliery. Present stripping ratio is 1:7.77. The depth varies from 30m to 110m with minable reserve of 0.479 MT and life of 4.5 yrs. The normative target production of the mine will be 0.235 MTe per annum. However, the Peak capacity of the mine will be 0.235 MTe.

Chandan OCP (Bhowrah) started in 1997 and extended upto seam I(B). It is within the leasehold area of Bhowrah South Colliery using an area of 34.5 Ha and minable reserve of 0.62 MTY. Present production is 400TPD (avg.) and present stripping ratio is 1:4.43. Opencast mining with shovel-dumper combination adopted here. The total depth of the mine is 50m and the life of the mine is 2.5 yrs. The normative target production of the mine will be 0.158 MTY.

Patherdih Colliery UG & OCP

The normative target production of the **Patherdih UG** mine will be 0.054 MTe per annum. The seams are being mined in Patherdih U/G is VI seam. The minable reserve is 2.52MT. The present annual coal production is 0.015MT. The present mine is being operated with VI incline. The mine has been developed extensively by manual B&P method with stowing and the same method of mining is envisaged for future production. The annual target of coal production is 0.054 Mty (Peak 0.07 MT). The total depth of the mine is 200 m and the life of the mine is more than 30 yrs.

The Chandan opencast project (Patherdih) mining started in 1992 and extends up to I(Bottom)seam. It covers an area of 30.16 Ha within leasehold of Patherdih colliery. Present production is 400TPD (avg.) and present stripping ratio is 1:4.43. Opencast mining with shovel & dumper combination adopted. Minable reserve is 0.9MT. The normative target production of the mine will be 0.22 MTY The depth of mine will go up to 100m and life of mine is 4 yrs.

Sudamdih Incline Mine UG

The normative target production of the mine will be 0.09 MT per annum. The seams are being mined in sudamdih incline mine is VI seam (W-IV grade) and IVT seam (W-IV grade). The minable reserve is 2.95 Mte. The present annual coal production is 0.04MT. The present mine is being operated with VIII seam incline/VI seam incline for VI seam with manual Bord & Pillar. Depillaring with stowing. IVT seam incline serves IVT seam for manual Bord & Pillar development. The annual target of coal production is 0.09 Mty (Peak 0.117 MT). The total depth of the mine is approx.200 m and the life of the mine is more than 30 yrs.

Sudamdih Shaft UG

The normative target production of the mine will be 0.185 MTe per annum. The seams are being mined in Sudamdih Shaft (UG**)** is XI/XII seam. Minable reserve

is 3.33 Mte. The present annual coal production is 0.02MT. The present mine is being operated with Shaft No. 1 for XI/XII seam (W-I grade). The mine has adopted Jankowice method of mining with hydraulic sand stowing and the same method of mining envisaged for future production. The annual target of coal production is 0.185 Mty (Peak 0.240 MT). The total depth of the mine is 440 m and the life of the mine is more than 30 yrs.

Amlabad Colliery

The Amlabad Colliery is located in the eastern part of the Jharia Coalfield and situated in Dhanbad district of Jharkhand. Dhanbad Railway Station is within 10 km from the mine on Kolkata – New Delhi Grand chord Line of East Central Railway. It has leasehold area of about 386.95 Ha and minable reserve of 18.376MTY. The mine is closed since 29 Feb 2008 due to safety and technical reasons.

Sudamdih Washery

It is an existing washery of 1.6 Mty throughput normative capacity within the property of Sudamdih Shaft mine under Cluster X. The throughput capacity may further increase to 2.08 Mty to meet the peak demand. The raw coal requirement is met from existing mine of this cluster.

8.1 MINE SEEPAGE ESTIMATION

The semi-consolidated Gondwana sediments are mostly stratified formations underlying the Alluvium/soil. The permeable beds (Sandstone horizons) of Barakar Formation act as individual hydrogeological units and develop multi-aquifer system**.** As such under these circumstances, the groundwater flow/velocity along the bedding planes is higher than across the plane. It is

imperative that horizontal hydraulic conductivity is many folds higher than the vertical hydraulic conductivity.

Open cast mine (Bhowra North OC, 3 Pit OC, Chandan OCP Bhowra and Chandan OCP Patherdih) can be simulated as a large diameter well/sink and the mine seepage is contributed mainly from the saturated formation lying above the working seam. Thus, the mine seepage is directly proportional to the aquifer and mine parameters.

Underground mining activity would exposed/ punctured the semi-confined aquifers, thereby the total system would be converted into water table condition and a cone of depression would be formed by the gravity drainage from different aquifer zones. The mine seepage is directly proportional to the mine void area and working mine depth. The all underground mines of Cluster-X (***Bhowrah North UG, Bhowrah South UG, Patherdih UG, Sudamdih Incline UG, Sudamdih Shaft UG and Amlabad UG***). Mine water seepage in abandoned UG mines may not be viable due to presence of unquantified water filled goaf areas.

Table - 5: Mine water seepage / Dewatering

Mine Seepage Estimation of Bhowrah North (OC & UG)

Sl No.	Year	Maximum/Avg Working Depth	Mine face length (L) in m.	Seepage Area(m^2)(Open Area) (A)	Hydraulic conductivity m/d (K)	Hydraulic gradient (I)	Mine inflow prediction (m^3/day) (Q)	Actual Mine Seepage(m^3/day) (Non- monsoon period)
1	Present date	100	Ranges between 6500-5900	650000	0.05	$6.0x10^{-2}$	1950	1950
2	2021-22	135		666900	0.05	$5.0x10^{-2}$	2000	-
3	2022-23	155		700600	0.05	$4.0x10^{-2}$	2100	-
4	2024-25	260/180		1062000	0.05	$4.0x10^{-2}$	2125	

Mine Seepage Estimation of Bhowrah South (OC & UG)

Sl No.	Year	Maximum/Avg Working Depth	Mine face length (L) in m.	Seepage Area(m^2)(Open Area) (A)	Hydraulic conductivity m/d (K)	Hydraulic gradient (I)	Mine inflow prediction (m^3/day) (Q)	Actual Mine Seepage(m^3/day) (Non- monsoon period)
1	Present date	90/150	Ranges between 6180-5300	927000	0.05	$6.0x10^{-2}$	2780	2780
2	2021-22	170		966660	0.05	$6.0x10^{-2}$	2900	-
3	2022-23	190		1050000	0.05	$6.0x10^{-2}$	3150	-
4	2024-25	350/220		1166000	0.05	$6.0x10^{-2}$	3500	

Mine Seepage Estimation of Patherdih OC & UG (abandoned)

Sl No.	Year	Maximum/Avg Working Depth	Mine face length (L) in m.	Seepage Area(m^2)(Open Area) (A)	Hydraulic conductivity m/d (K)	Hydraulic gradient (I)	Mine inflow prediction (m^3/day) (Q)	Actual Mine Seepage(m^3/day) (Non- monsoon period)
1	Present date	100/150	Ranges between 5600-4900	1020000	0.05	$5.0x10^{-2}$	2550	2550
2	2021-22	140		1040000	0.05	$5.0x10^{-2}$	2600	-
3	2022-23	175		1060000	0.05	$5.0x10^{-2}$	2650	-
4	2024-25	270/185		1080000	0.05	$5.0x10^{-2}$	2700	

Mine Seepage Estimation of Sudamdih Incline UG

Sl No.	Year	Maximum Working Depth	Mine face length (L) in m.	Seepage Area(m^2)(Open Area) (A)	Hydraulic conductivity m/d (K)	Hydraulic gradient (I)	Mine inflow prediction (m^3/day) (Q)	Actual Mine Seepage(m^3/day) (Non- monsoon period)
1	Present date	105	Ranges	303975	0.05	$5.0x10^{-2}$	760	760

2	2021-22	120		340000	0.05	$5.0x10^{-2}$	850	-
3	2022-23	145		392000	0.05	$5.0x10^{-2}$	980	-
4	2024-25	160		464000	0.05	$5.0x10^{-2}$	1160	

Mine Seepage Estimation of Sudamdih Shaft

Sl No.	Year	Maximum Working Depth	Mine face length (L) in m.	Seepage Area(m^2)(Open Area) (A)	Hydraulic conductivity m/d (K)	Hydraulic gradient (I)	Mine inflow prediction (m^3/day) (Q)	Actual Mine Seepage(m^3/day) (Non- monsoon period)
1	Present date	300	Ranges between 2800-2340	840000	0.05	$5.0x10^{-2}$	2100	2100
2	2021-22	330		868000	0.05	$5.0x10^{-2}$	2170	-
3	2022-23	375		900000	0.05	$5.0x10^{-2}$	2250	-
4	2024-25	400		936000	0.05	$5.0x10^{-2}$	2340	

Note: The actual present discharge from mine pit is about **10,140 m^3/day**. The proposed peak discharge is about **11,825 m^3/day.** The Closed Amlabad Colliery has no mine dewatering from groundwater.

9.0 Groundwater level condition

To collect the representative groundwater levels in the study area, CMPDI has established a monitoring network with 04 nos. of dug wells and 02 nos. of bore wells (BH) spread over the study area. The location map of these groundwater level-monitoring stations shown in **Figure 7**. Groundwater level data of the dug wells are representative of the top unconfined aquifer. The water level of the bore wells are representative of the deep-seated sedimentary aquifer of the

study area. Water level monitoring in these hydrograph stations has been done in pre-monsoon as well as in post monsoon season. The well field inventory data and groundwater level data shown below:

Table No-6: Well field inventory data of the study area.

Well No.	Location	Formation	Owner	Use	M.P (m)	Depth (m)	Dia. (m)	R.L AMSL
A-19	Bhowra	Barakar	Govt.	Domestic	0.54	3.15	11.65	162
D-35	Patherdih	Barakar	Govt	Domestic	0.40	2.00	11.20	160
D-36	Sudamdih	Barakar	Govt	Domestic	0.90	2.00	6.20	150
D-77	Amlabad	Barakar	Govt.	Domestic	0.40	3.15	6.70	156
BH-01	Sudamdih	Barakar	Private	Domestic	0.25	120.0	0.15	166
BH-02	Bhowra	Barakar	Private	Domestic	0.30	100.0	0.15	160

M.P-measuring point, R.L-Relative level, Dia-Diameter of well. All values in meters.

Table No-6A: Historical Groundwater level data of the study area.

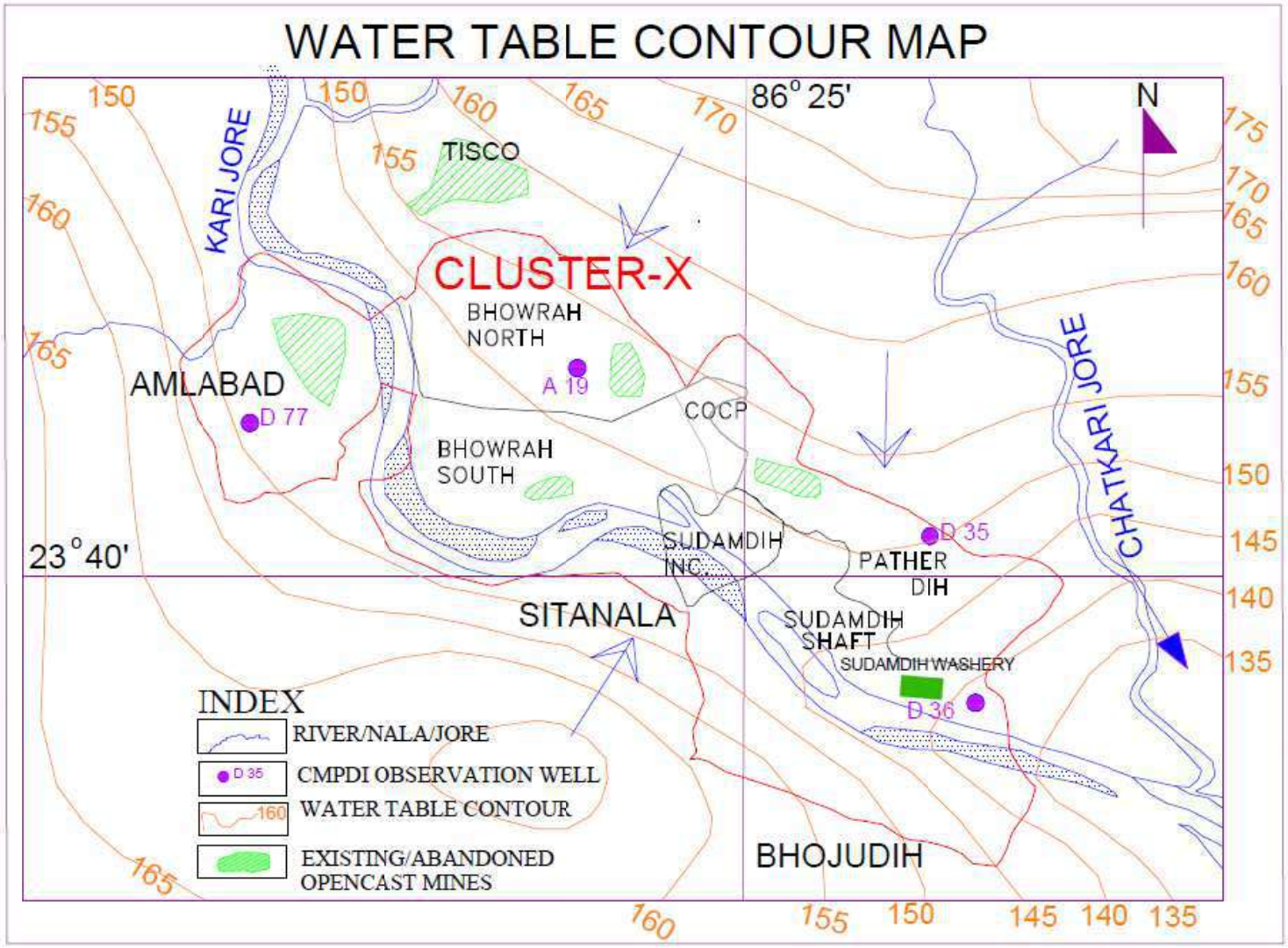
Sl No.	Well No.	Water level (bgl in meters)							
		2021-22				2020-21			
		May	Aug	Nov	Jan	May	Aug	Nov	Jan
1	A-19	3.30	1.95	1.90	2.20	6.05	2.30	3.25	3.70
2	D-35	6.60	2.70	2.90	4.30	8.20	2.98	5.40	5.62
3	D-36	2.02	0.45	0.55	0.55	2.10	0.06	1.00	1.15
4	D-77	5.98	2.60	4.69	5.60	6.40	5.90	3.50	4.25
Average WL (bgl)		4.48	1.93	2.51	3.16	5.69	2.81	3.29	3.68
1	BH01	18.50	-	13.10	-	-	-	-	-
2	BH02	25.65	-	16.20	-	-	-	-	-

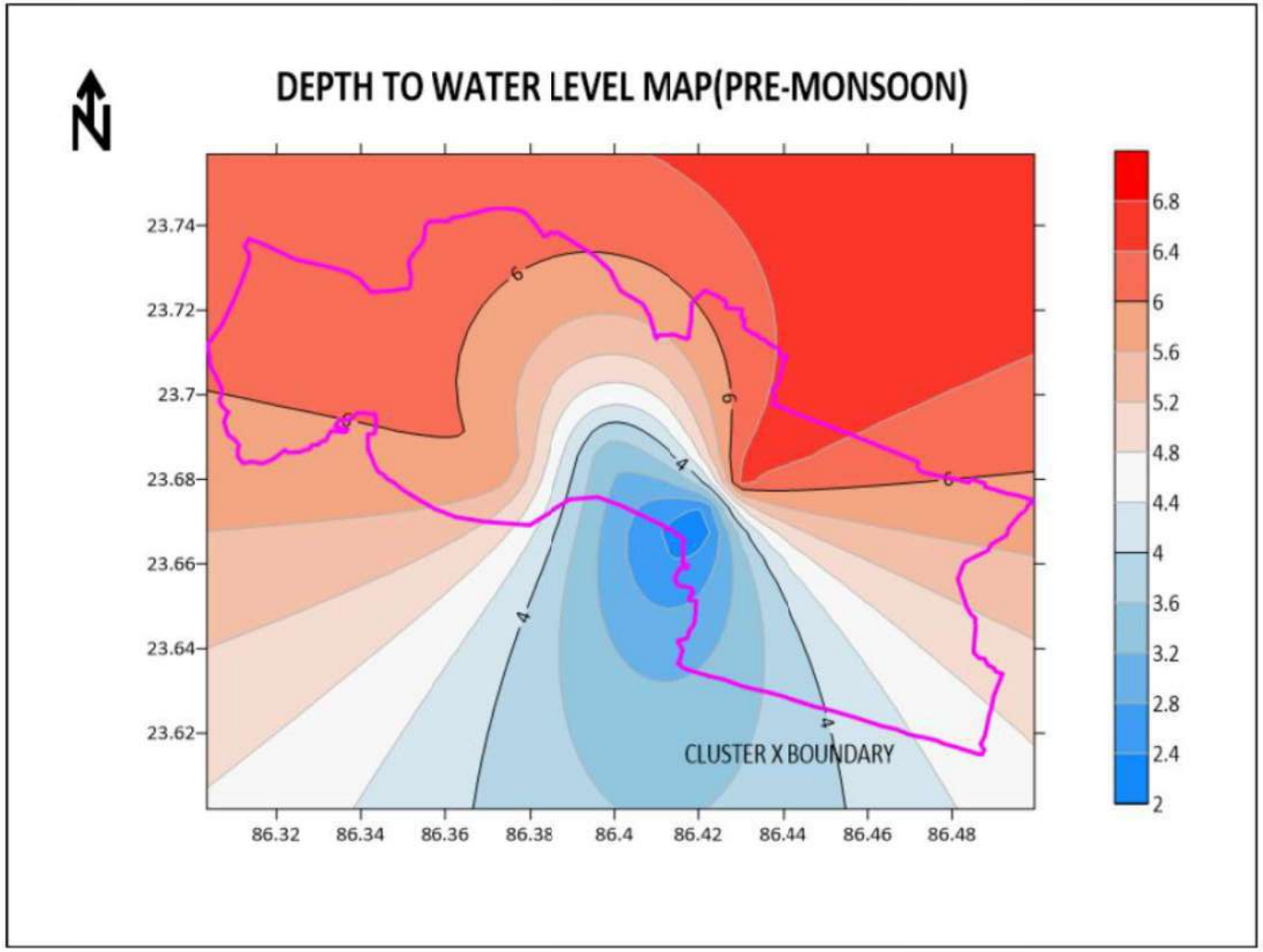
The Pre-monsoon water table contour map of the top unconfined aquifer of the study area has been prepared and shown in **Plate No-VIII**. The ground water flow direction is towards Damodar River and hydraulic gradient of water table is varying from 2.0×10^{-2} to 7.0×10^{-3} in average. It may be observed from the water table contour map that water table is a subdued replica of surface topography. It is also observed that the trend of water table contours, its gradient and configuration are mainly controlled by topography, drainage pattern, rainfall, geologic controls and induced flow of ground water towards mine quarries.

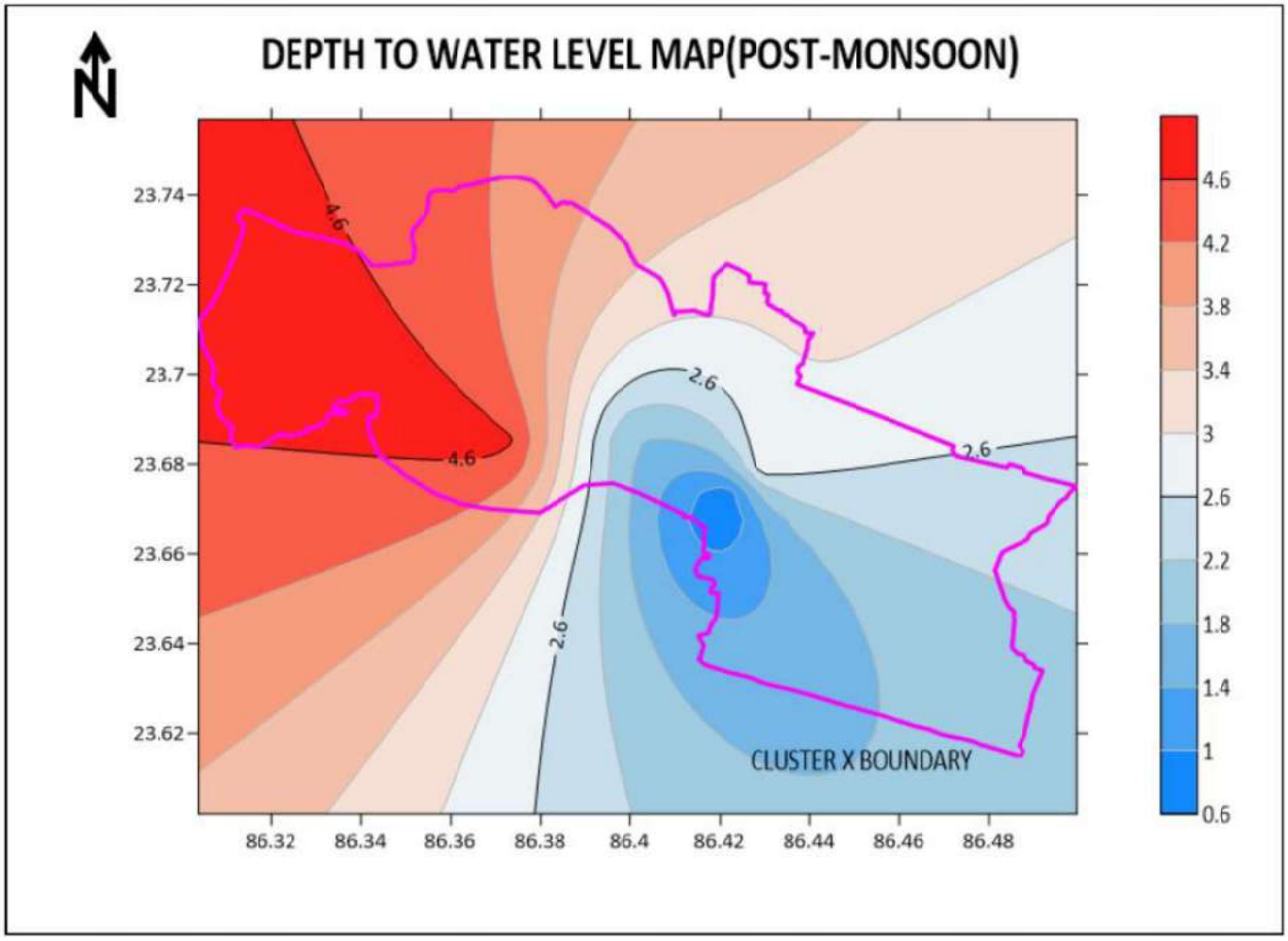
Recharge Area: Water table contour maps indicates that the recharge zone is the Northeast and Northwest higher plain along the water divide of the Khudia River, Barakar River and Damodar River. The recharge is mainly from rainfall to the unconfined aquifer.

Discharge Area: Water table contour map indicates that the discharge area is the low lying flat terrain, streams and master drainage, Damodar River valley area. The open cast mine also acts as local discharge zone for the aquifer.

However, change in natural path and increased hydraulic gradient in the vicinity of the active opencast mining activity has been found in the study area. There is no such affected water table condition in and around the abandoned underground mining areas has been noticed. It is also found that there is no change in natural groundwater flow path in and around the Damodar River watershed regime.


WATER TABLE CONTOUR MAP
86° 25'
N
23° 40'
KARI JORE
CHATKARI JORE
TISCO
CLUSTER-X
BHOWRAH NORTH
BHOWRAH SOUTH
A 19
AMLABAD
D 77
COCP
SUDAMDIH INC.
D 35
PATHER DIH
SITANALA
SUDAMDIH SHAFT
SUDAMDIH WASHERY
D 36
BHOJUDIH
INDEX
RIVER/NALA/JORE
CMPDI OBSERVATION WELL
WATER TABLE CONTOUR
EXISTING/ABANDONED OPENCAST MINES
150
155
160
165
170
175
145
140
135


DEPTH TO WATER LEVEL MAP(PRE-MONSOON)
N
23.74
23.72
23.7
23.68
23.66
23.64
23.62
86.32
86.34
86.36
86.38
86.4
86.42
86.44
86.46
86.48
6
4
CLUSTER X BOUNDARY
6.8
6.4
6
5.6
5.2
4.8
4.4
4
3.6
3.2
2.8
2.4
2


DEPTH TO WATER LEVEL MAP(POST-MONSOON)
N
23.74
23.72
23.7
23.68
23.66
23.64
23.62
86.32
86.34
86.36
86.38
86.4
86.42
86.44
86.46
86.48
4.6
2.6
CLUSTER X BOUNDARY
4.6
4.2
3.8
3.4
3
2.6
2.2
1.8
1.4
1
0.6

10.0 Estimation of Hydraulic Properties of Sedimentary Formation

Hydrogeological testing were carried out in the boreholes of Sitanala Block, located within the leasehold area of Cluster-X mines of BCCL. Permeability, Transmissivity and hydraulic conductivity of the sedimentary formation near Damodar River were evaluated. The details of the report is given as **Annexure-I**. However, the findings are summarized below:

EXECUTIVE SUMMARY :

Objective 1

Hydraulic characteristics of the grannular formations :

Zones Tested :

BOREHOLE NO. SNE–11

Sl. No.	Depth range in mts.	Transmissivity m^2 /day.	Permeability m/day.
1	2	3	4
ZONE-I	345.00-349.00 376.00-380.00	0.1	0.01

BOREHOLE NO. SNE–2 (A)

1	2	3	4
ZONE-I	46.00-52.00	0.6	0.1
ZONE-II	74.00-80.00	0.0038	0.00083
ZONE-III	156.40-163.00	8.06	1.22
ZONE-V	255.00-274.60	0,133	0.006
ZONE-VI	255.00-310.00	0.178	0.062

Objective 2

Hydraulic characteristics of the Coal formation
Borehole No. SNE-2 (A)

1	2	3	4
ZONE-IV COAL	220.00-230.00	0.294	0.0294

11.0 Base Flow estimation of Gaurkhuti Jhor

Rainfall runoff process is an important part of land phase of hydrological cycle. Runoff is defined as the portion of the precipitation flowing off from catchment through surface channels as surface or sub surface flow.

A stream hydrograph is the time-series record of stream conditions (such as water level or flow) at a gauging site. The hydrograph represents the aggregate of the different water sources that contribute to stream flow. These components can be subdivided into:

1. Storm flow – the direct response to a rainfall event including overland flow (runoff), lateral movement in the soil profile (interflow) and direct rainfall onto the stream surface (direct precipitation).
2. Base flow – the longer-term discharge derived from natural storages.

The relative contributions of storm flow and base flow components changes through the stream hydrographic record.

A. Data generation / Stream Gauging

Field survey was executed during November'2021 for data generation regarding river cross-section, river water level / velocity, groundwater level and mine pumping capacity etc. **The Panchet dam controls the discharge of Damodar River, i.e., natural river flow system in those rivers are not existed in the study area.** However, Gaurkhuti Jhor profiling and water level / velocity data was generated to calculate the river discharge.

Total three nos. of locations have been considered to assess the minimum River discharge at U/S, M/S and D/S of Gaurkhuti Jhor (**Figure No-11**, 03 nos. location) based on the **Area-Velocity Method**. The wetted area of the jhor/river has been measured using meter tape and the water velocity at those sections has been assessed using floaters. Accordingly, the **lowest discharge / base flow** of Gaurkhuti Jhor has been calculated.

B. Discharge / Base flow calculation

Gaurkhuti Jhor is an un-notified and ungauged river in the study area. River gauging has been conducted to determine the base flow of the jhor / nala in the desired locations. The locations of the stream gauging have been determined considering the coal mining activity in the area. The U/S location situated north where it starts flowing into the study area. M/S location situated in the middle of the Cluster-X mines. D/S location situated near the confluence of the Gaurkhuti Jhor and Damodar River, south corner of the study area.

Table No–25: Estimation of River Base Flow using Area-Velocity method.

Item	River Bed width		River Bed Profiling intervals (in meters)						Floater Velocity (m/sec)	Water level (m)	Discharge (MCM/ Month)
	Active channel	Total river bed	0-2	2-4	4-6	6-8	8-10	10-12		Min	Base Flow
U/S	14.0	25.0	0.3	0.05	0.3	0.48	0.3	0.3	0.30	0.23	2.503872
M/S	16.0	55.0	0.15	0.35	0.35	0.35	0.35	0.25	0.255	0.25	2.64384
D/S	18.0	70.0	0.3	0.45	0.5	0.5	0.5	0.45	0.16	0.37	2.762035

The Base Flow calculation using Area-Velocity method is shown in **Table No-25**. Therefore, Gaurkhuti Jhor base flow of 2.503872 MCM/month (34.287 Cusec) has been estimated. 2.64384 MCM/month or 36.029 Cusec of jhor / nala base flow is estimated in the M/S. 2.762035 MCM/month or 37.866 Cusec of base flow is estimated after crossing the Cluster-X mine area.

12.0 Water Quality data analysis

For investigating the source of seepage water, water samples were collected from the opencast and underground mine, wells (dug wells and tube wells) and surface sources (Damodar River and gaurkhuti Jhor) for hydro-geochemical analysis. Total 20 nos. of sample were collected which includes 06 nos. surface water samples, 04 nos. mine sump water samples and 10 nos. groundwater samples (shallow and deep aquifer) from the dug wells & tube wells.

The major cations and anions analyzed using Dionex IC-5000 Ion Chromatograph after filtering the samples through 0.45µm Millipore membrane filters. The concentration of bicarbonate (HCO3-) ions in the groundwater were assessed by the acid titration method (APHA 2012). All the chemicals used for preservation and analysis were of analytical reagent grade (Merck/BDH). Ionic balance was computed, and the error in the ionic balance is within 5% for the majority of the samples.

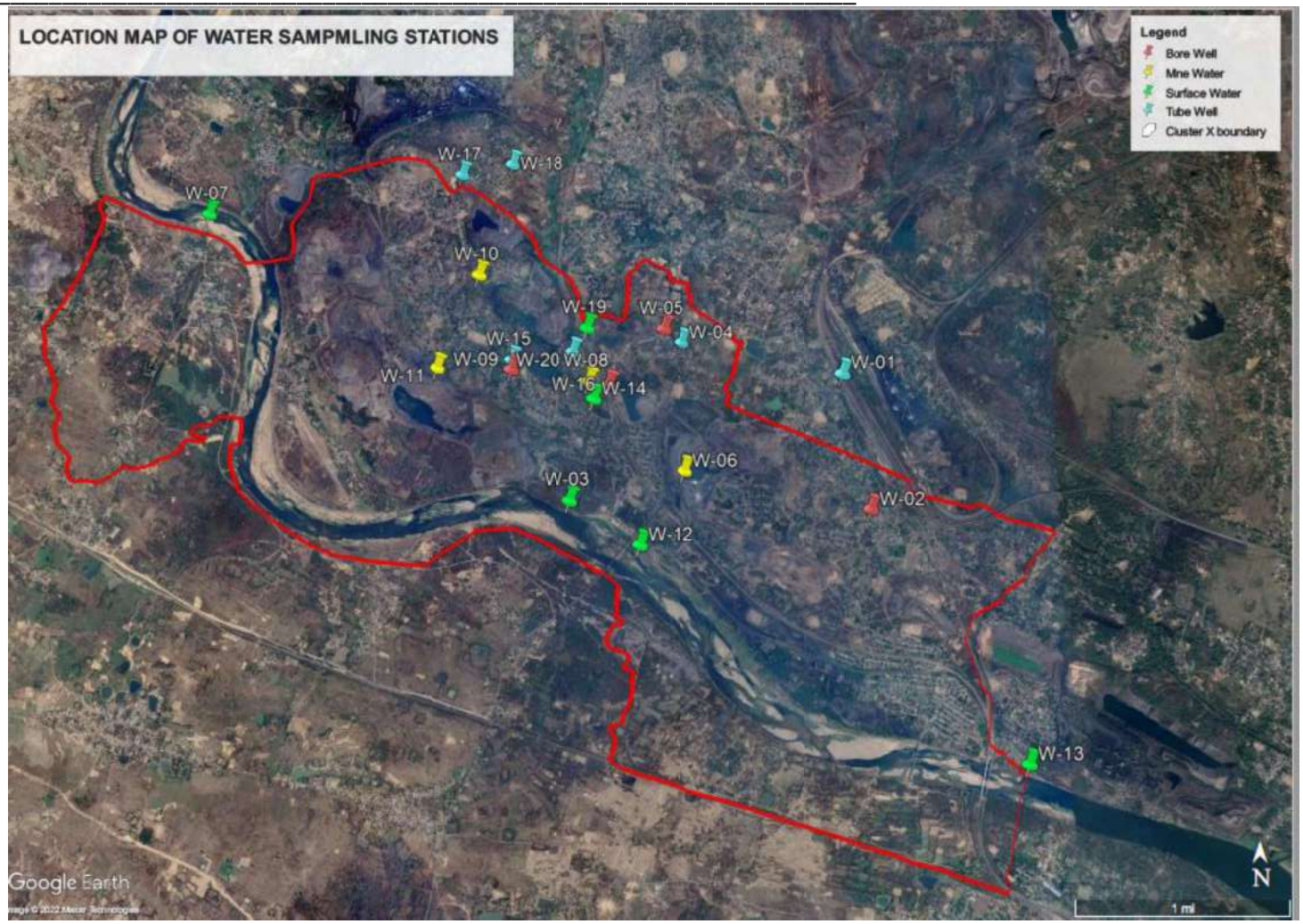
Sl No	Water Sample	Remarks	Location	Date of sampling	
1	W-01	Tube well	Patherdih Railway Colony	27.01.2021	17.06.2021
2	W-02	Bore well	Sudamdih Colony, House of Sri Aswin Mahato	27.01.2021	17.06.2021
3	W-03	Surface water	Damodar River	27.01.2021	17.06.2021
4	W-04	Tube well	Mahulbani Villafge	27.01.2021	17.06.2021
5	W-05	Bore well	BCCL Mahulbani Quarters	27.01.2021	17.06.2021
6	W-06	Mine water	ASP mine, X2 Patch, BCCL	27.01.2021	17.06.2021
7	W-07	Surface water	Damodar River, Amlabad Area, BCCL	27.01.2021	17.06.2021
8	W-08	Mine water	Bhowra South UG Mine water	27.01.2021	17.06.2021
9	W-09	Bore well	Bhowra South Area BCCL	27.01.2021	17.06.2021

10	W-10	Mine water	Bhowra North UG Mine water	27.01.2021	17.06.2021
11	W-11	Mine water	Bhowra South OC Mine water	28.01.2021	18.06.2021
12	W-12	Surface water	Damodar River, U/S location	28.01.2021	18.06.2021
13	W-13	Surface water	Damodar River, D/S location	28.01.2021	18.06.2021
14	W-14	Surface water	Gaurkhuti Jor, D/S location	28.01.2021	18.06.2021
15	W-15	Dug well	Gaurkhuti Village	28.01.2021	18.06.2021
16	W-16	Bore well	Gaurkhuti Village	28.01.2021	18.06.2021
17	W-17	Tube well	Lalbangla 7 no. Check post	28.01.2021	18.06.2021
18	W-18	Tube well	Jorapokhar Purnadi basti	28.01.2021	18.06.2021
19	W-19	Surface water	Gaurkhuti Jor, U/S location	28.01.2021	18.06.2021
20	W-20	Dug well	19 No. Birsa Colony, Bhowra Area	28.01.2021	18.06.2021

The water samples collected from the field visit were analyzed for hydrochemical analysis. The results indicate variation in the surface, groundwater and seepage water inside the mines. The results of the various parameters relevant to this investigation are presented in the table below:

The hydrogeochemical attributes indicating high residence time or rock water interaction of seepage water and hence high ionic concentration.

Heavy metal analysis of drinking water samples indicates that all heavy metals. i.e., Iron, lead, mercury, selenium, zinc, nickel, arsenic, chromium, manganese etc. are well below the detection limit.


LOCATION MAP OF WATER SAMPMLING STATIONS
Legend
Bore Well
Mne Water
Surface Water
Tube Well
Cluster X boundary
W-17
W-18
W-07
W-10
W-19
W-05
W-04
W-15
W-09
W-20
W-08
W-11
W-16
W-14
W-01
W-06
W-03
W-02
W-12
W-13
Google Earth
N
1 mi

13.0 Observations

The observations of this hydrogeological study are summarized below-

i. The study area is located at the southeast part of the Jharia Coalfield in EJ Area of BCCL. Various types of rock belong to Quaternary age (top soil, alluvium, sandy soil), Gondwana age (Barakar Formation, Barren Measure Formation, Talchir Formation) and Archean metamorphic basement has been found in the Cluster-X mine area.
ii. The study area is located in the discharge zone of Gaukhuti Jhor and it is part of middle stage Damodar River Sub-basin. The area is also potential in terms of groundwater and surface water resources (Panchet dam on Damodar River) with fair to moderate rainfall received throughout the year.
iii. There are various aquifer systems found in the area, i.e., unconfined aquifers (top alluvium, soil and riverbed loose sand), semi-confined aquifers (Barakar Formation sandstones) and confined aquifers. Those semi-confined aquifers can be called **multi-aquifer system**.
iv. At present Cluster-X mines of BCCL consisting of one closed Underground mines (Amlabad UG), five operating Underground mines (Bhowrah North UG, Bhowrah South UG, Patherdih UG, Sudamdih Incline UG & Sudamdih Shaft UG), four opencast mines (Bhowrah North OC, 3 Pit OC, Chandan OCP [Bhowrah], Chandan OCP [Patherdih]) and one Coal Washery (Sudamdih Coal Washery).
v. Hydro geochemistry / Major Ion data analysis of 20 nos. of sampling points has been conducted in the study area.
vi. The Groundwater level and fluctuations (upto 2020-21) are given below:
    a. **Unconfined aquifer: 0.35 m to 12.10 m (BGL) [Dug wells]**
    b. **Confined aquifer: 14.10 m to 23.10 m (BGL) [Borehole]**
vii. The Water Table Contour map shows shallow water table with flow of groundwater towards major drainage system, i.e., Damodar River in the area.

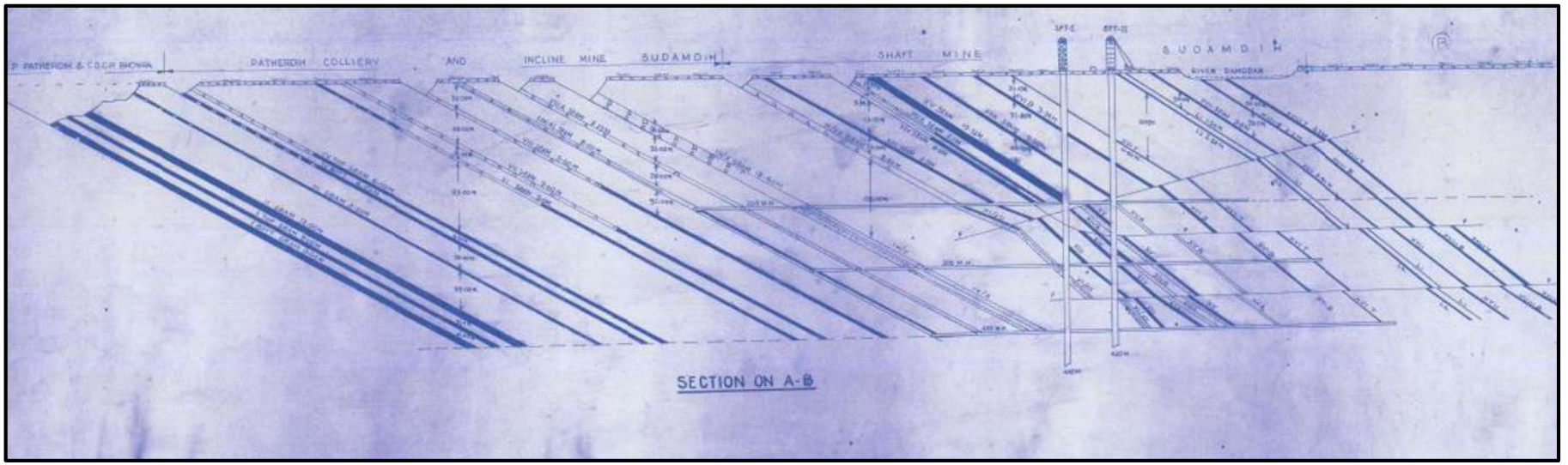
viii. **Aquifer Performance Test (APT)** results in Barakar Formation within the study area shows low permeability (K= 1.22 to 0.006 m/day and T= 8.06 to 0.133 m^2/day) of the semi-confined to confined aquifer in the study area.

ix. **Gaukhuti Jhor base flow** of 34.287 Cusec has been estimated before the nala is entering into Cluster-X mine area. 36.029 Cusec of base flow is estimated in the M/S and 37.866 Cusec of base flow is estimated after crossing the mine area.

x. In the A-B' cross-section line it is evident that, there may be no direct connection in between Damodar River and adjacent coal mine pit through shallow or deep aquifers. Mining activity adjacent to Damodar River has been done having safe barrier of at least 60-80 m. Seepage water from aquifer is the only source of water into mine pits of Cluster-X mine of BCCL. However, in Sudamdih Shaft and Incline UG Mine due to proximity of Damodar River and presence of fault can cause some connection. But these two UG mines are not operating at present.

xi. However, there is a possibility of connection of Gaukhuti Jhor and Cluster-X mine pit due to reversal of groundwater gradient as an impact of mining activity through deeper aquifers (sedimentary Formation).

xii.


PATHERDIH COLLIERY
AND
INCLINE MINE
SUDAMDIH
SHAFT MINE
SUDAMDIH
SECTION ON A-B

14.0 Summary and Conclusions

The objective of the study is to monitoring of wells for permeability and seepage of water from River (Damodar River) into coal mine voids/pits of Cluster-X mines, BCCL.

The permeability & seepage (Hydraulic property) from the aquifers has been determined using Aquifer Pump test in and around the study area.

Hydraulic properties of the sedimentary aquifer (Barakar formation)

Permeability (k):	1.22 m/d
Transmissivity:	8.06 m^2 /day

In the A-B cross-section line it is evident that, there is no connection in between Damodar River and Cluster-X mine pit through shallow or deep aquifers.

As per major ion chemistry analysis it also showing mixture of sources of groundwater and surface water. Gaukhuti Jhor surface water may be somewhat connected to adjacent mining activity within Cluster-X mine BCCL.

15.0 Recommendations

To establish the connection and source of mine seepage water in Cluster-X mines of BCCL with river system, stable isotope systematics coupled with hydro-geochemical assessment will be very useful. Stable isotopes ($\delta^{18}O$ and $\delta^{2}H$) with conventional hydro-geochemical parameters (Cations: calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}) and Anions: chlorine (Cl^{-}), nitrate (NO_3^{-}), sulphate (SO_4^{2-}), carbonate (CO_3^{2-}) bicarbonate (HCO_3^{-}), fluorine (F^{-}) analysis of groundwater, surface water and rainwater will help to conclude the study more scientifically.

STRICTLY RESTRICTED
FOR COMPANY USE ONLY

RESTRICTED

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

GROUNDWATER LEVEL & QUALITY REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year – 2021-22)

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

JHARIA COALFIELD AND RANIGANJ COALFIELD (PART)

For
(BHARAT COKING COAL LIMITED)

(A Subsidiary of Coal India Limited)

KOYLA BHAWAN (DHANBAD)

Prepared by

Hydrogeology Department

Exploration Division

CMPDI (HQ), Ranchi

MARCH – 2022

Job no - 200421008

GROUNDWATER LEVEL & QUALITY REPORT

FOR CLUSTER OF MINES, BCCL

(Assessment year – 2021-22)

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

JHARIA COALFIELD AND RANIGANJ COALFIELD (PART)

For
(BHARAT COKING COAL LIMITED)

(A Subsidiary of Coal India Limited)

KOYLA BHAWAN (DHANBAD)

Prepared by
Hydrogeology Department
Exploration Division
CMPDI (HQ), Ranchi

MARCH – 2022

PERSONS ASSOCIATED

Debasis Bandyopadhyay

Manager (Geology)

Hydrogeology Section

Exploration Division

CMPDI (HQ), Ranchi

Kumar Vaibhav

Dy. Manager (Environment)

OIC (Environment Lab.)

Regional Institute - II

CMPDI, Dhanbad

Swagata Dutta

Asst. Manager (Geology)

Regional Institute - II

CMPDI, Dhanbad

CMPDIL

CENTRAL MINE PLANING & DESIGN INSTITUTE

HYDROGEOLOGY SECTION, EXPLORATION DEPARTMENT

GONDWANA PLACE, KANKE ROAD, RANCHI, JHARKHAND– 834031

(Accredited Groundwater Professional Institutions by CGWA)

(Accredited as a GWCO by QCI-NABET)

(Accredited by NABL, CMPDI, RI-II, Lab)

CONTENT

Sl. No	Contents	Page No
1	Annexure-I Details of The Report	1
2	Annexure-II Groundwater Level and Quality Report for Cluster of Mines of BCCL	2-88
3	**Chapter-1.0 Introduction**	2-6
4	1.1 Location details and brief about the report	2
5	1.2 Objective of the study	2
6	1.3 Scope of the report	2
7	1.4 Topography and Drainage	4
8	1.5 Details regarding Wetland	4
9	1.6 Climate & Rainfall	5-6
10	**Chapter-2.0 Geology & Hydrogeological Set-up of the Area**	7-10
11	2.1 Regional Geology of the Coalfield	7
12	2.2 Hydrogeological setup	8
13	2.3 Aquifers Description	8-9
14	2.4 General Aquifer Parameters	9-10
15	**Chapter-3.0 Ground Water Level data of the Cluster of Mines of BCCL**	10-
16	3.1 Historical groundwater level	11
17	3.2 Groundwater level scenario (mining/non-mining)	12
18	3.3 Quarterly groundwater level, Cluster of mines during 2020-21	13
	A. Ground Water Levels of Cluster-I	13-14
	B. Ground Water Levels of Cluster-II	15-16
	C. Ground Water Levels of Cluster-III	17-18
	D. Ground Water Levels of Cluster-IV	19-20
	E. Ground Water Levels of Cluster-V	21-22
	F. Ground Water Levels of Cluster-VI	23-24
	G. Ground Water Levels of Cluster-VII	25-26
	H. Ground Water Levels of Cluster-VIII	27-28
	I. Ground Water Levels of Cluster-IX	29-30
	J. Ground Water Levels of Cluster-X	31-32
	K. Ground Water Levels of Cluster-XI	33-34
	L. Ground Water Levels of Cluster-XIII	35-36
	M. Ground Water Levels of Cluster-XIV	37-38

	N. Ground Water Levels of Cluster-XV	39-40
	O. Ground Water Levels of Cluster-XVI	41-42
19	**Chapter-4.0 Ground water level scenario**	43
20	**Chapter-5.0 Groundwater Quality**	44
21	**Chapter-6.0 Stage of Groundwater extraction**	47
22	**Chapter-7.0 Impact of Mining on Ground Water Regime**	49
23	7.1 General consequences of Coal Mines on ambient Hydrogeological Regime	49
24	7.2 Potential consequences of OC & UG coal mines on Hydrogeological Regime	49
25	7.3 Estimation of Radius of Mine Influence zone	50
26	**Chapter-8.0 Conservation measures & future strategy**	50
27	**Chapter-9.0 Existing / Proposed Rainwater harvesting structures in BCCL coal mines**	52-58
28	**Annexure-III List of RAMSAR Wetlands as given on official website of MoEF & CC**	59
29	**Annexure-IV Rainfall Data**	60
30	**Annexure-V Ground Water Level Monitoring Data**	62-66
31	**Annexure-VI Ground Water Level Hydrographs**	67-83
32	**Annexure-VII Ground Water Quality analysis data**	84-89
33	Abbreviations	90

LIST OF TABLES

Fig No	Contents	Page No
1	Regional Geological Succession of JCF	7
2	Generalized Hydrogeological Units developed in the study Area	9
3	Aquifer parameters considered for the study Area	10
4	Historical Groundwater Level	11
5	Depth to water table	12
6	Average hydraulic gradient	12
7	GW level data Cluster wise	43
8A, B	Block / Cluster wise GW Development scenario	47-48

LIST OF PLATES

Sl No	Plate No	Contents	Scale
1	I	Location Map of Groundwater Level Monitoring stations	1:50000
2	II	Location Map of Groundwater Quality Monitoring stations	1:50000
3	III	Location Map of Proposed Piezometers	1:50000
4	IV	Water table Contour Map of JCF	1:50000
5	V	Depth to Groundwater Level map of JCF	1:50000

LIST OF FIGURES

Table No	Contents	Page No
1 & 2	Historical Rainfall trend at Jharkhand	6
3 to 15	Existing / Proposed Rainwater Harvesting Structure	52-58

Annexure – I

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 (IMD-report)	Jharkhand State: 1264.10 mm Rainfall data given in **Annexure-IV**.
5	Geological Formations	Gondwana Formation (Talchir Formation, Barakar Formation, Barren Measure Formation & Raniganj Formation)
6	Aquifer System	Unconfined/Phreatic Aquifer – thickness 25 m (Avg.) Semi-confined to confined Aquifer – thickness from 25 m upto 650 m
7	Hydrogeological properties (Aquifer Pump Test)	Unconfined Aquifer (Damoda BJ Section & Block-II): Hydraulic Conductivity – upto 0.50 m/day Transmissivity – 10 - 42 m^2/day
		Semi-confined to confined Aquifer (Sitanala & Kumari Block): Hydraulic Conductivity – 0.0006-1.44 & 0.05-0.0027 m/day Transmissivity – 0.06 – 0.573 m^2/day
8	Groundwater Level Monitoring Network	Out of total 252 nos. of monitoring stations 64 nos located within core mining area and rest comes within Buffers zone. 60 Nos. of Groundwater monitoring well (Dug Wells) network established by CMPDI to record groundwater level data in and around the Core Zone of JCF and 4 Nos. of Groundwater monitoring well (Dug Wells) in RCF (CV Area).
9	Groundwater Levels Below Ground Level (bgl)	JCF area: Pre-monsoon – 0.62 to 11.26 m (Avg. 5.23 m bgl) in '2021-22 Post-monsoon – 0.05 to 7.62 m (Avg. 2.28 m bgl) in '2021-22 RCF area (part): Pre-monsoon – 2.0 to 6.20 m (Avg. 3.34 m bgl) in '2021-22 Post-monsoon – 1.10 to 5.25 m (Avg. 2.44 m bgl) in '2021-22
10	Groundwater Quality	Potable as per GEC-2015 Norms (**Annexure- VIII**)
11	Proposed Piezometers	Proposed piezometers (23 nos.) to monitor impact of coal mining on groundwater regime within the coalfield area (JCF & part of RCF) for maximum depth upto 290 m.
12	Stage of Groundwater Development (CGWB)	Dhanbad District-76.30% (GWRE-2017)

GROUNDWATER LEVEL & QUALITY REPORT FOR CLUSTER OF MINES OF BCCL

1.0 INTRODUCTION

1.1 LOCATION DETAILS AND BRIEF ABOUT THE PROJECT

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

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

1.2 OBJECTIVE OF THE STUDY:

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

1.3 SCOPE OF THE STUDY:

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

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

Table – 3: Aquifer parameters considered for the study Area

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

3.0 GROUND WATER LEVEL MONITORING

To collect the representative groundwater levels in the study area, CMPDI has established a monitoring network of total 252 monitoring stations out of which 64 located within core zone and rest comes within Buffer zone. Total 60 nos. dug well within JCF and 04 nos. dug well within RCF (part) area (Details of the Hydrograph stations & water level given in **Annexure-V, VA** & **VB**) spread over the entire BCCL leasehold area, **Plate-I**. Water level monitoring in all hydrograph stations has been done in pre-monsoon as well as in post monsoon whereas in 64 stations monitoring done in quarterly (May'21, Aug'21, Nov'21 and Jan'22) basis.

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

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

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

3.1 HISTORICAL GROUNDWATER LEVEL (GWL)

Historical GWL of JCF and part of RCF given from 2005 to 2021 of CMPDI monitoring stations (total 64 stations within Coalfield area). Pre-monsoon and Post-monsoon GWL with Fluctuation has been mentioned below in the table.

Table – 4: Historical Groundwater Level

Period		(Water level in metre below ground level)								
		Pre-Monsoon (April/May)			Post-Monsoon (Nov/Dec)			Fluctuation		
		From	To	Average	From	To	Average	From	To	Average
JCF	2005	0.07	19.08	6.29	0.84	12.13	3.20	0.12	12.45	3.21
	2007	0.40	19.27	5.66	0.35	8.21	2.87	0.02	16.15	2.96
	2008	0.45	18.35	5.42	0.35	14.20	3.62	0.03	9.22	2.45
	2010	0.85	14.47	5.24	0.10	15.88	4.48	0.02	5.55	1.54
	2012	1.27	18.68	5.58	0.15	7.80	2.72	0.08	13.45	2.96
	2013	0.70	19.20	5.65	0.45	8.35	2.77	0.29	15.88	3.17
	2014	0.70	16.28	4.92	0.75	14.98	3.27	0.25	10.15	2.17
	2015	1.38	17.20	6.00	0.45	14.58	3.92	0.28	7.62	2.15
	2016	0.78	16.73	5.64	0.30	12.43	3.19	0.23	6.35	2.88
	2017	0.67	16.28	5.61	0.15	6.97	2.41	0.10	12.10	3.25
	2018	1.20	14.58	5.55	0.40	7.17	2.83	0.20	9.45	2.68
	2019	0.95	15.88	5.46	0.45	5.95	2.34	0.20	13.40	3.05
	2020	0.80	16.25	4.95	0.75	10.10	3.26	0.25	11.05	2.15
	2021	0.62	11.26	5.23	0.05	7.62	2.28	0.15	9.03	2.94
RCF (part)	2008	5.02	10.50	7.59	2.85	4.90	3.71	1.82	6.60	3.87
	2010	2.20	8.85	4.74	2.78	9.58	4.63	0.68	1.10	0.89
	2011	3.57	8.02	4.98	2.50	6.21	3.75	0.55	1.90	1.23
	2012	3.10	7.34	4.59	1.55	7.00	3.66	0.05	2.78	0.94
	2013	1.70	9.87	6.54	2.90	8.85	4.71	1.02	5.54	2.84
	2014	3.27	6.48	4.57	2.13	3.03	2.63	0.54	3.45	1.94
	2015	3.38	9.52	5.33	2.68	8.20	5.11	1.06	1.32	1.81
	2016	3.61	10.65	6.24	0.90	6.50	3.18	1.63	4.40	3.06
	2017	1.93	5.80	3.25	1.63	3.78	2.47	1.63	3.78	0.78
	2018	2.34	8.70	4.35	1.75	5.70	2.75	0.41	2.55	1.59
	2019	1.60	9.35	5.29	0.80	3.88	2.10	0.80	5.47	3.20
	2020	2.30	9.70	4.30	1.75	5.50	2.70	0.40	2.75	1.60
	2021	2.00	6.20	3.34	1.10	5.25	2.44	0.80	0.95	0.90

3.2 GROUNDWATER LEVEL SCENARIO IN NON-MINING/MINING AREA

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

Table – 5: Depth to water table

Formation	*Area*		*DTW (bgl, m) [Year-2021-22]*		*Average GWL (m)*	
			Pre-monsoon (Apr/May)	*Post-monsoon (Nov/Dec)*	*Pre-monsoon*	*Post-monsoon*
Sedimentary (Gondwana)	Non-mining		1.45-8.20	0.35-3.70	5.10	2.00
	Mining	OC	1.40-10.35	0.84-5.65	4.66	2.15
		UG	1.09-10.13	0.55-7.62	5.75	2.80
Metamorphics (Hard rock)	Peripheral part of the Coalfield		0.62-11.75	0.50-7.45	6.80	3.60

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

Table – 6: Average hydraulic gradient

Sl. No	*Formation*	*Area*		*Average hydraulic gradient*
1	Sedimentary (Gondwana)	Non-Mining		1.0×10^{-3} to 3.25×10^{-3}
		Mining	OC	1.0×10^{-2} to 4.0×10^{-3}
			UG	1.0×10^{-2} to 3.0×10^{-3}
2	Metamorphics (Hard rock)	Peripheral part of the Coalfield		1.0×10^{-3} to 3.5×10^{-3}

J. GROUND WATER LEVEL OF CLUSTER-X

Cluster-X consists of Bhowrah North OC & UG, Bhowrah South OC & UG, Amalgamated Sudamdih Patherdih, Sudamdih Shaft, Amlabad UG (Closed) and Sudamdih Coal Washery comes under the administrative control of Eastern Jharia Area of Bharat Coking Coal Limited (B.C.C.L - A Subsidiary of Coal India Limited). This cluster of mines is located in eastern part of Jharia Coalfield in Dhanbad district of Jharkhand. The life of the project works out is more than 30 years considering annual target production of 2.289 MTY.

Cluster-X mine involves leasehold area of about 2057.47 Ha of land. It covered in Survey of India toposheet no. 73 I/6. The area of Bhowrah North OC & UG, Bhowrah South OC & UG, Amalgamated Sudamdih Patherdih, Sudamdih Shaft, Amlabad UG (Closed) are 280.83 Ha, 571.58 Ha, 498.61 Ha, 391.50 Ha and 386.95 Ha respectively.

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

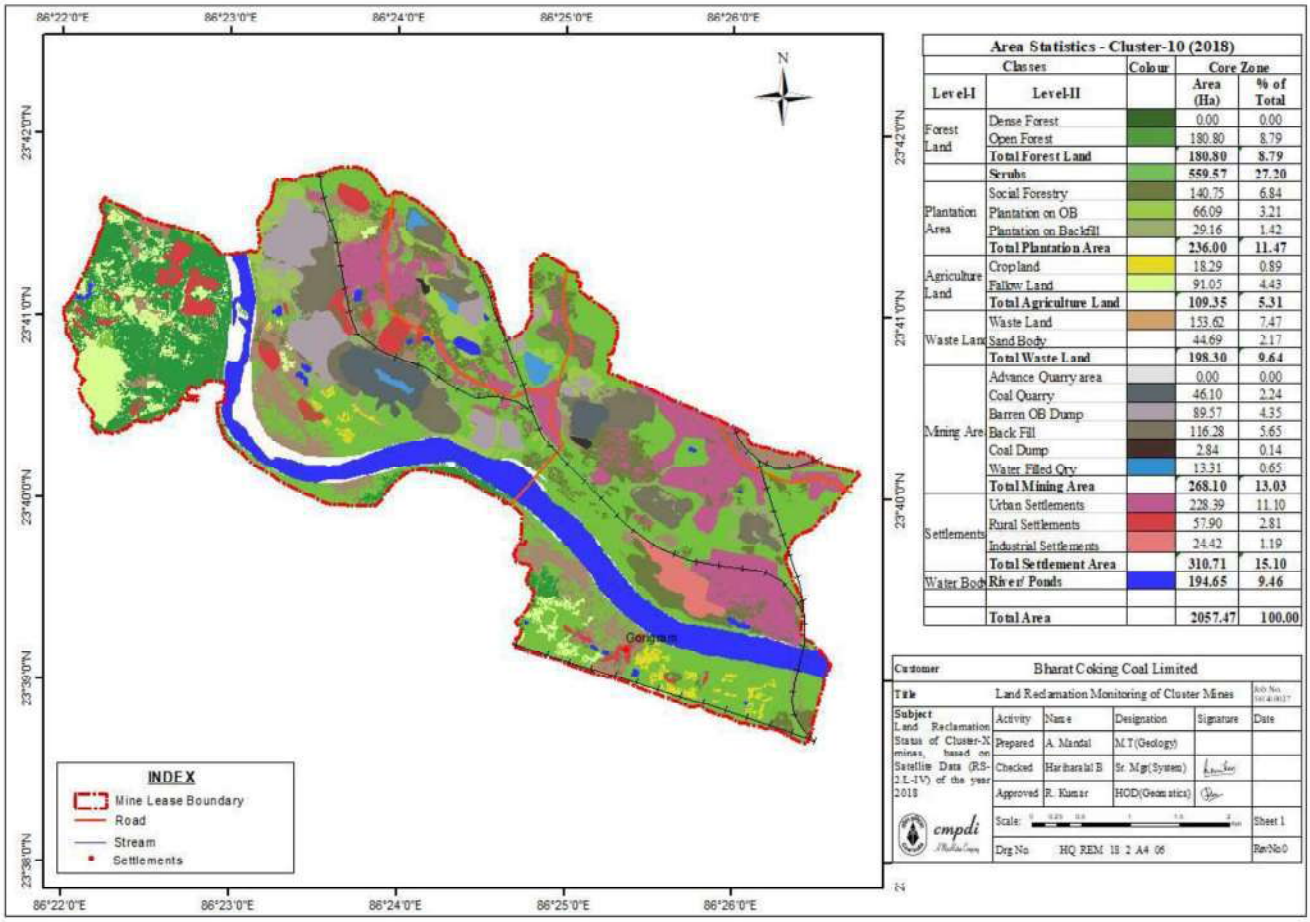
Monitoring stations (**A-19, D-35, D-36 and D-77**) are located in the core zone of the mine area. Water level monitoring in these monitoring stations has done in the months of May'21, August'21, and Nov'21 and January'22, the Ground water level data enclosed in the table below:

Sl No.	Well No.	Location	Water level (bgl in meters)											
			2021-22				2020-21				2019-20			
			May	Aug	Nov	Jan	May	Aug	Nov	Jan	May	Aug	Nov	Jan
1	A-19	Bhowrah	3.30	1.95	1.90	2.20	6.05	2.30	3.25	3.70	4.85	0.95	3.43	4.95
2	D-35	Patherdih	6.60	2.70	2.90	4.30	8.20	2.98	5.40	5.62	8.00	3.15	3.80	5.90
3	D-36	Sudamdih	2.02	0.45	0.55	0.55	2.10	0.06	1.00	1.15	1.20	0.10	0.55	0.65
4	D-77	Amlabad	5.98	2.60	4.69	5.60	6.40	5.90	3.50	4.25	6.40	2.80	3.20	4.50
Average WL (bgl)			4.48	1.93	2.51	3.16	5.69	2.81	3.29	3.68	5.11	1.75	2.75	4.00

LAST THREE-YEAR ASSESSMENT:

Pre-monsoon GW Level (m): Min – 1.20 m Max – 8.20 m
Post-monsoon GW Level (m): Min – 0.55 m Max – 4.69 m

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



Sl no	Land Use Details	Existing (sq. meter)	Proposed (sq. meter)	Grand Total (sq. meter)
1	Green Belt Area	1085.72 x 10^4	0.0	1085.72 x 10^4
2	Open Land	661.04 x 10^4	0.0	661.04 x 10^4
3	Road/ Paved Area	228.39 x 10^4	0.0	228.39 x 10^4
4	Rooftop area of building/ sheds	82.32 x 10^4	0.0	82.32 x 10^4
5	Total	2057.47 x 10^4	0.0	2057.47 x 10^4

4.0 GROUND WATER LEVEL SCENARIO

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

Table –7: Groundwater level data Cluster-wise

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

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

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

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

5.0 GROUND WATER QUALITY

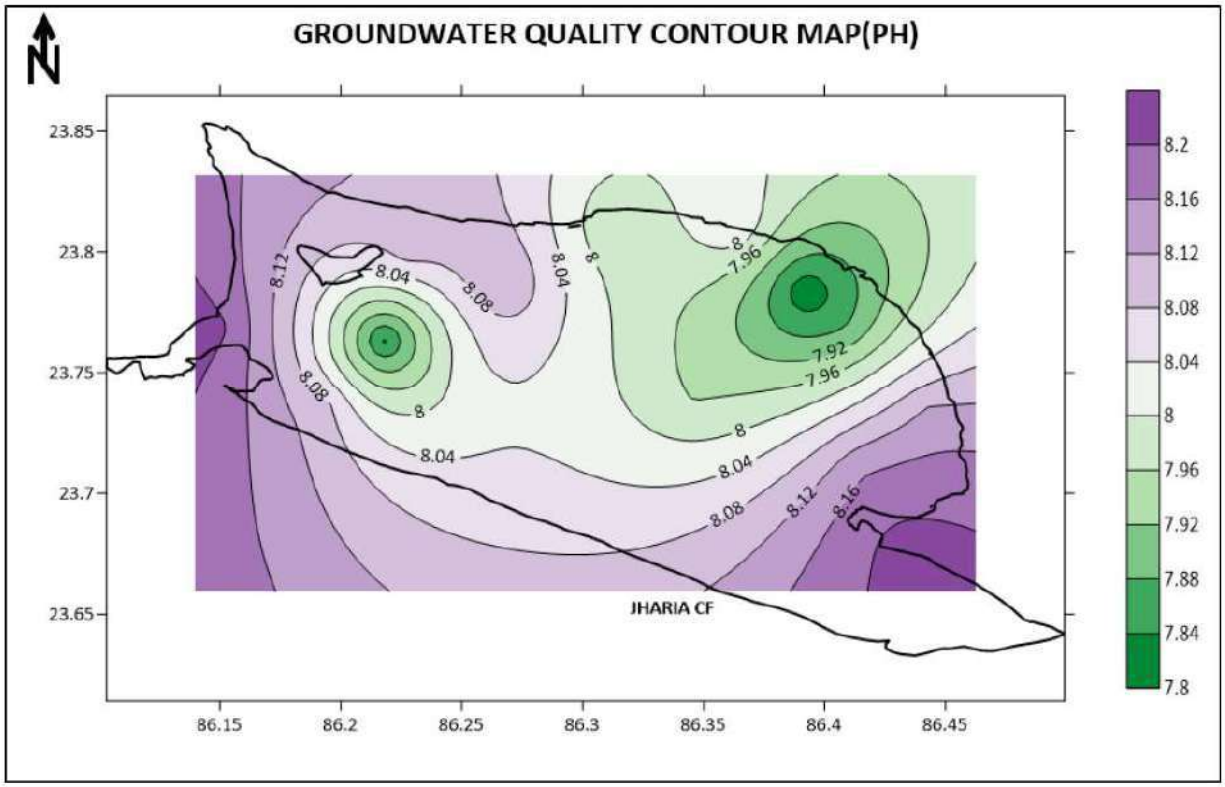
The ground water sample of the study area (15 nos. of Cluster of mines, BCCL) collected from dug wells and analyzed. Fifteen ground water samples (GW-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15 & 16) analyzed during the month of June'2021 at CMPDI, RI-II, Dhanbad. The water sampling details given in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

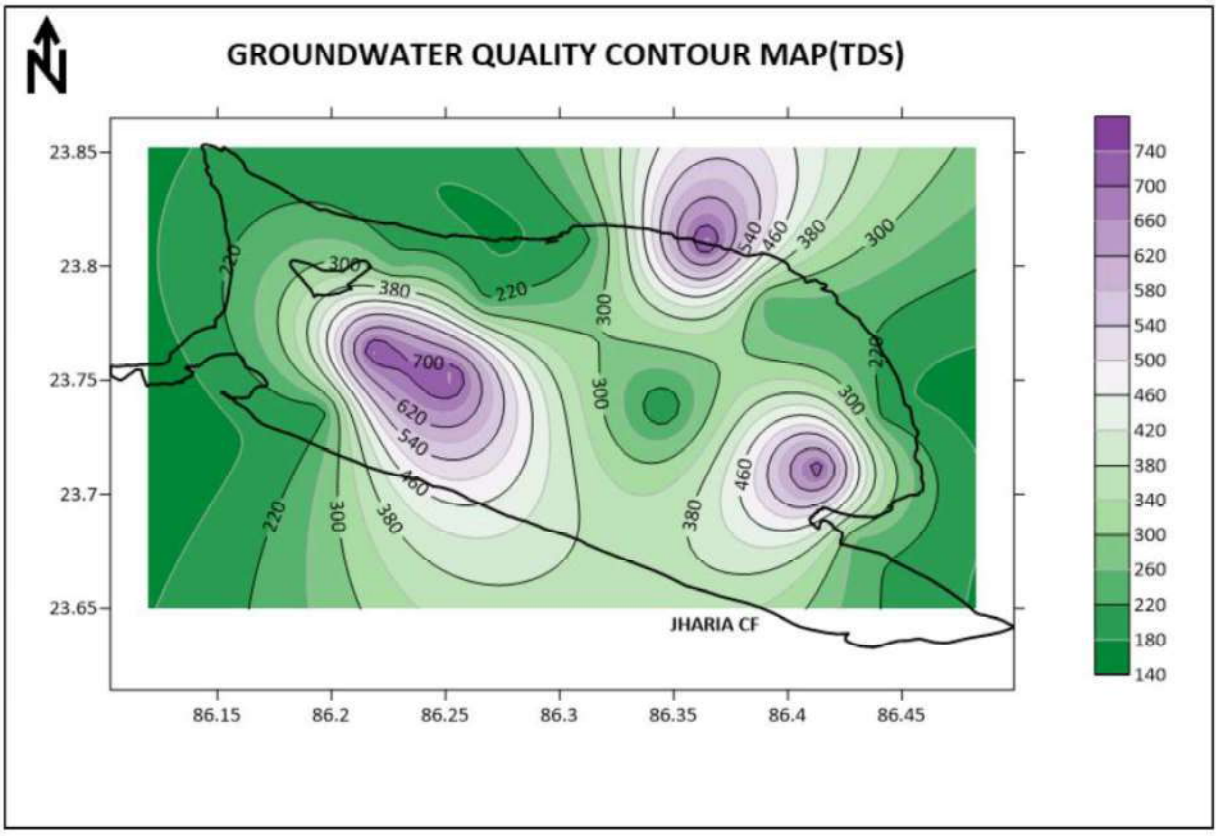
The study of the variations in water quality parameters described below:

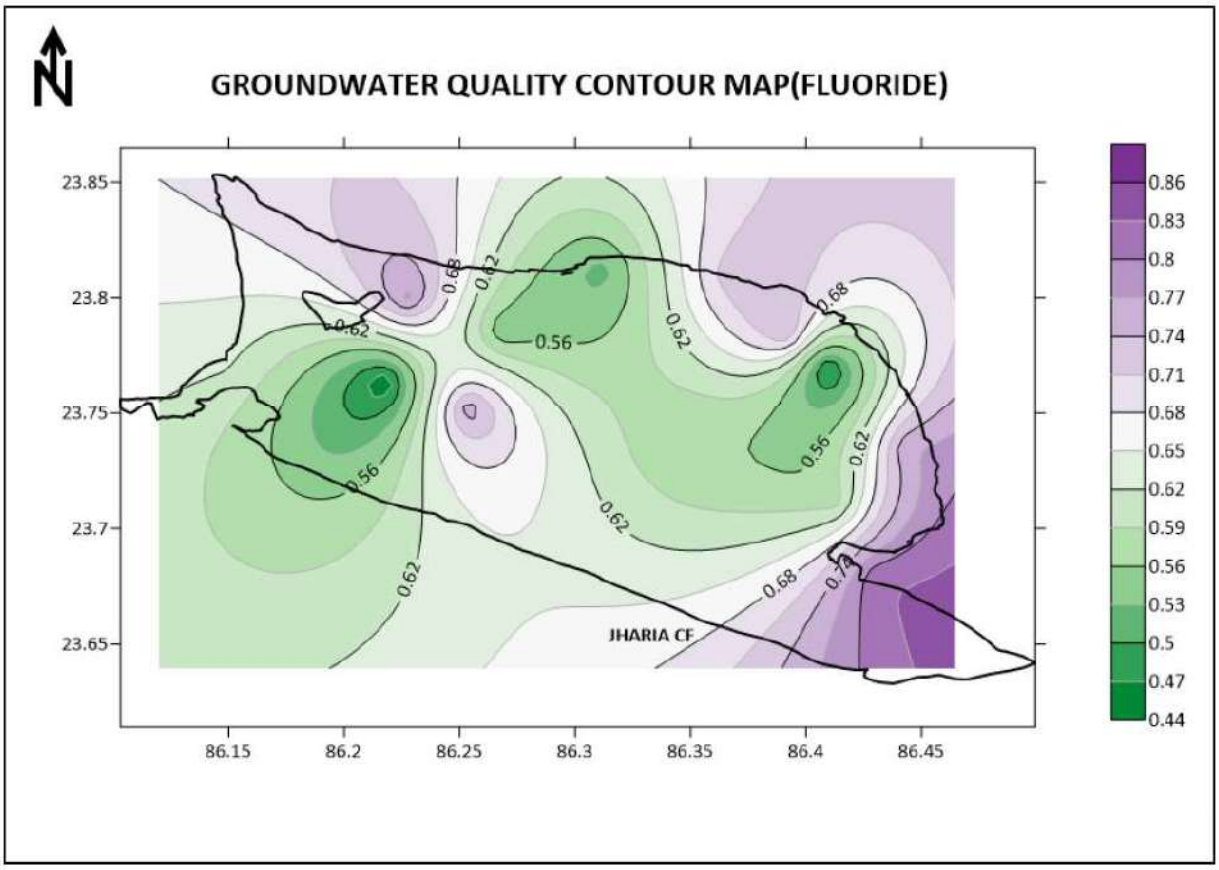
The pH of the groundwater samples varies between 7.65 (GW-5) to 8.15 (GW-11), the pH is within the IS 10500 limit of drinking water standard.

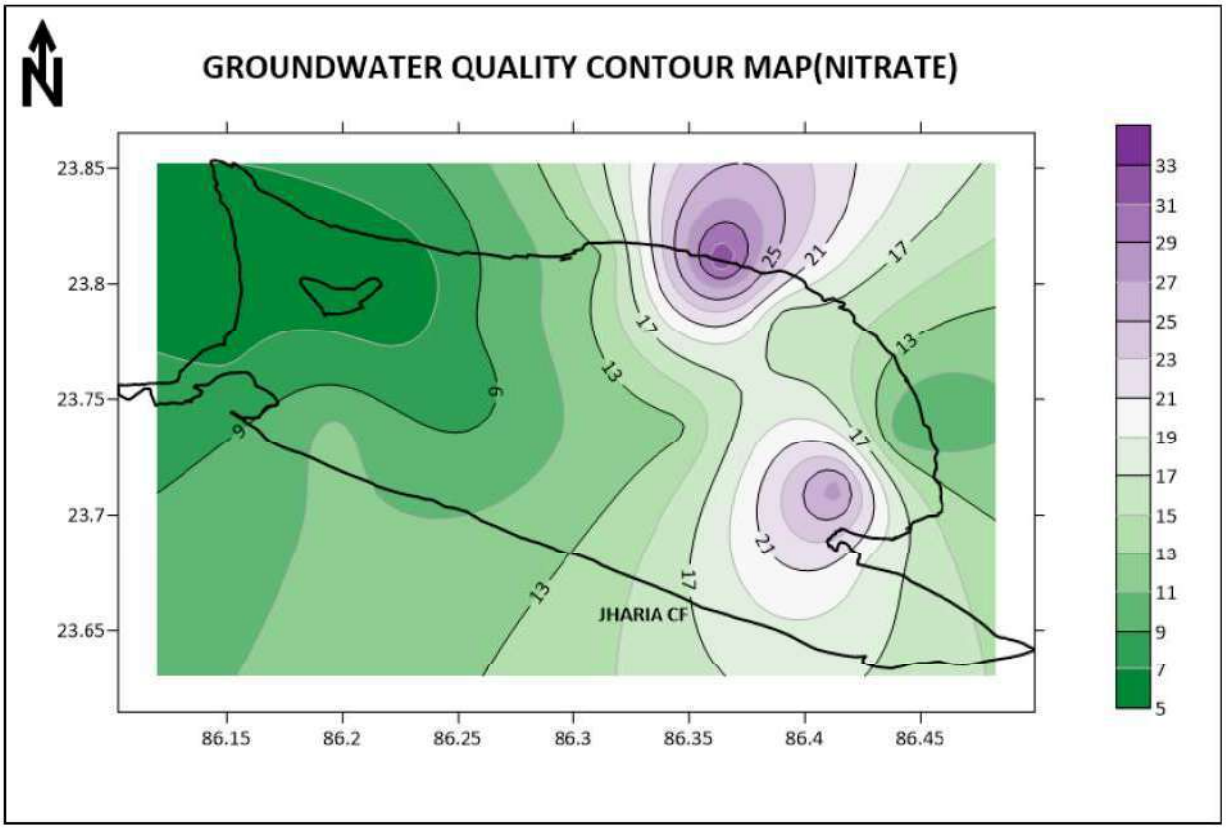
The mineral constituents dissolved in water constitute the dissolved solids. The total dissolve solids vary from 425 (GW-1) to 889 mg/l (GW-9), the TDS values ranges slightly above the IS 10500:2012 standards limits of drinking water.

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


GROUNDWATER QUALITY CONTOUR MAP(PH)
N
23.85
23.8
23.75
23.7
23.65
86.15
86.2
86.25
86.3
86.35
86.4
86.45
JHARIA CF
8.2
8.16
8.12
8.08
8.04
8
7.96
7.92
7.88
7.84
7.8


GROUNDWATER QUALITY CONTOUR MAP(TDS)
N
23.85
23.8
23.75
23.7
23.65
86.15
86.2
86.25
86.3
86.35
86.4
86.45
JHARIA CF
740
700
660
620
580
540
500
460
420
380
340
300
260
220
180
140


GROUNDWATER QUALITY CONTOUR MAP(FLUORIDE)
N
23.85
23.8
23.75
23.7
23.65
86.15
86.2
86.25
86.3
86.35
86.4
86.45
0.68
0.62
0.56
0.62
0.68
0.62
0.56
0.56
0.62
0.62
0.68
0.74
JHARIA CF
0.86
0.83
0.8
0.77
0.74
0.71
0.68
0.65
0.62
0.59
0.56
0.53
0.5
0.47
0.44


GROUNDWATER QUALITY CONTOUR MAP(NITRATE)
N
23.85
23.8
23.75
23.7
23.65
86.15
86.2
86.25
86.3
86.35
86.4
86.45
25
21
17
17
13
9
9
17
13
21
17
13
JHARIA CF
33
31
29
27
25
23
21
19
17
15
13
11
9
7
5

6.0 STAGE OF GROUNDWATER EXTRACTION

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

Table–8A: Block wise Stage of Groundwater development

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

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

Table–8B: Cluster wise Groundwater development scenario

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

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

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

7.0 IMPACT OF MINING ON GROUND WATER REGIME

7.1 GENERAL CONSEQUENCES OF COAL MINES ON AMBIENT HYDROGEOLOGICAL REGIME

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

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

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

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

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

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

During mining the hydraulic gradients generally, steeps down near mine i.e. within the mine influence area. In the up-dip region, only un-confined aquifer punctured through the mining process and thus only it

affected whereas in the down-dip region both un-confined and semi-confined aquifers may be affected. The confined aquifers of lower Barakar Formation in the mining area not punctured as it lies below the working coal seams and hence normally there is no noticeable effect in the aquifer related to this formation.

7.3 ESTIMATION OF RADIUS OF MINE INFLUENCE ZONE

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

The radius of influence (R) for Opencast and UG Mines within Jharia CF calculated by using Sichardt's formula based on present mining scenario.

$$R_0 = C*(H-h) * \sqrt{(K)}$$

Where, R_0- Radius of influence (m), C - Constant =3000,

(H-h)- Drawdown (m), K – Hydraulic conductivity (m/s).

Here, K has used for Barakar Formations i.e. 0.05 m/d or 5.7 x 10^{-7} m/sec.

It may be appropriate to mention here that the presence of prominent boundaries/water bodies, faults or interfringing of sandstone and shale beds may restrict propagation of the drawdown cone. With the presence of low permeable beds such as clay/shale and younger coal seams in the formation, laying above the working seams the water level in the phreatic aquifer not directly affected. During the working of board and pillar method, subsidence takes place during the extraction of total coal (depillaring), both the phreatic and semi-confined aquifers get affected. Surface vigilance and filling up subsided zone, if any, has to constantly in view. The effect on groundwater level for most of the coalmine in Jharia coalfield has been observed in the down-dip side, generally within a distance upto 500 m and becomes milder/ negligible thereafter.

8.0 CONSERVATION MEASURES & FUTURE STRATEGY

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

- BCCL participated in development of low cost technology for drinking water in a CSIR project along with CIMFR, Dhanbad and a pilot plant of 4000 Liters/hour is functional at PB Project site of BCCL. Similar plant has proposed at other sites of BCCL.
- A scheme entitled 'Scheme for multi-purpose utilization of surplus mine water of Barora Area, Block II and Govindpur Area of BCCL' was prepared with a view to harness the excess water discharge to take care of the persistence problem of water scarcity in the nearby villages. In the scheme, two water reservoirs of capacity 27 MG and 17 MG have been proposed in the non-coal bearing area for storage of 3250 GPM and 2000 GPM surplus mine water which will be fed through pipe line by mine discharge at mines of Barora, Block-II and Govindpur Area.
- Rooftop rainwater harvesting (RWH) will took up in the project area using the administrative buildings. 138 no. of quarters having roof-top area of about 14950 sq. m. is already prepared to harvest rainwater and around 13150 cum/annum of water is going to be recharged the nearby groundwater system through RWH structures. Proposal already made to facilitate this kind of RWH structure at suitable locations i.e. Lodna Area, Kusunda Area (Jawahar Nagar, Matkuria, Coal Board Colony), Sijua Area (Nichitpur and Tetulmari Colony) within Jharia Coalfield to augment groundwater recharge.
- After cessation of mining, with plenty rainfall and abundant ground water recharge, the water levels will recoup and attain normalcy. Thus, the impact of mining on groundwater system may considered as a temporary phenomenon. The abandoned mine workings (UG) behave as water pool and improves the resources availability in the coalfield area.
- Utilization of treated mine water discharge by both industry and local people in the mine influence area. The excess mine water can be used to recharge groundwater system through connecting pipeline to abandoned dug wells. Utilization of mine water for irrigation use will also enhance the ground water recharge potential through artificial recharge in the area.
- Increase vegetative cover by plantation in the mine area under land amelioration measures. This will contain the surface run-off and increase the groundwater recharge.
- Creation of awareness among workers and local peoples about Rainwater harvesting and artificial recharge will have priority. This aspect usually covered during the Environmental Week celebrated every year (5 to 12 June).
- 23 nos. of Piezometer proposed to install within JCF and RCF to monitor GW level (**Plate-III**).

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

9.0 EXISTING/PROPOSED RAINWATER HARVESTING STRUCTURES IN BCCL COAL MINES

Fig-3 to 4.

Proposed Rain Water Harvesting Site GVTC, Cluster-I, Barora Area

Proposed Rain Water Harvesting Site Nehru Balika Vidhalaya, Cluster-I, Barora Area

Fig-5 to 6.

Proposed Rain Water Harvesting Site Barora Area Guest House, Cluster-I, Barora Area

Proposed Rain Water Harvesting Site Regional Hospital Baghmara, Cluster-I, Barora Area

Fig-7 to 8.

Proposed Rain Water Harvesting Site – Barora Area Office, Cluster-I, Barora Area

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-9 to 10.

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

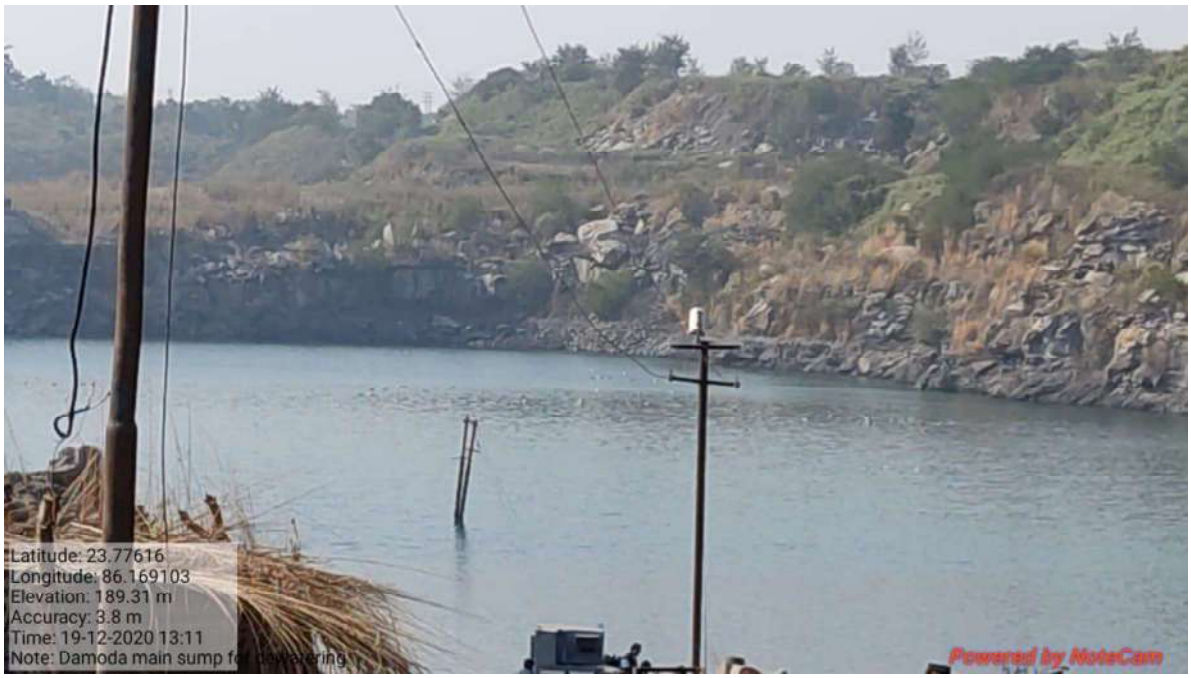
RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-11 to 12.

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

Fig-13 to 14.

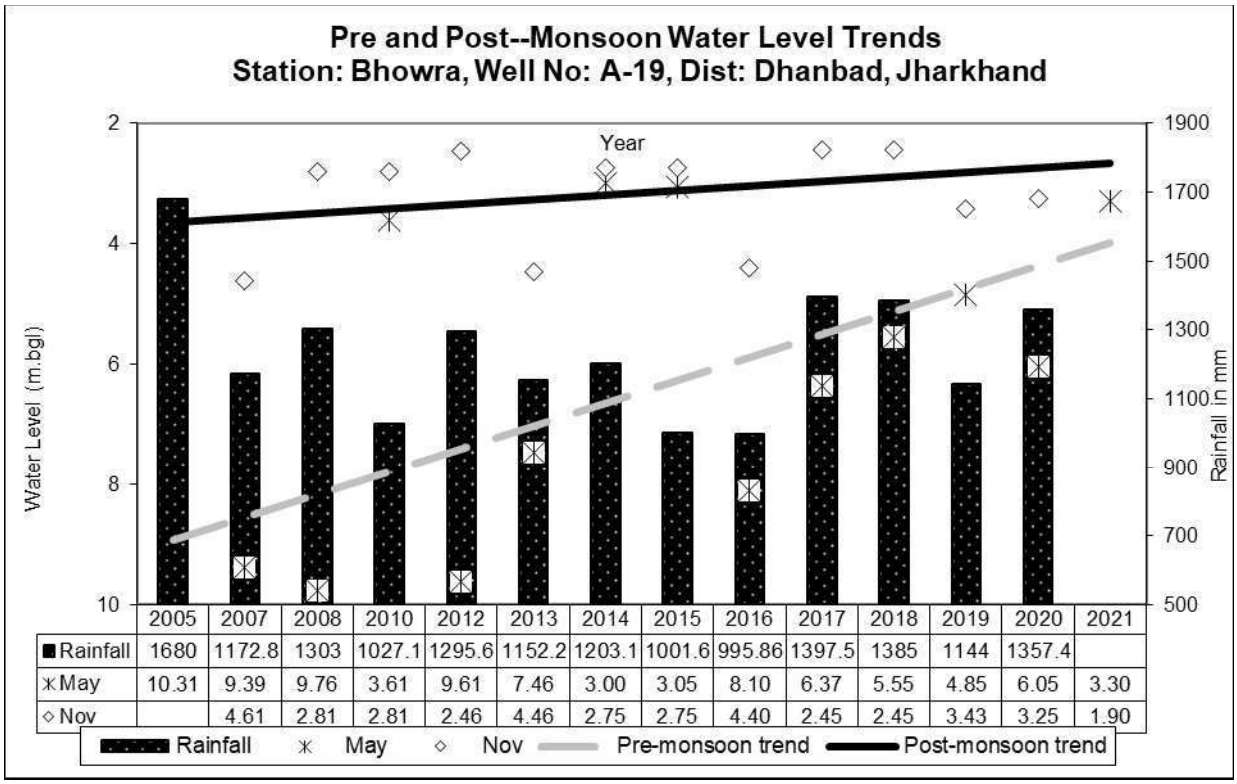


RECHARGE POND / ABANDONDED IN THE JCF MINE AREA

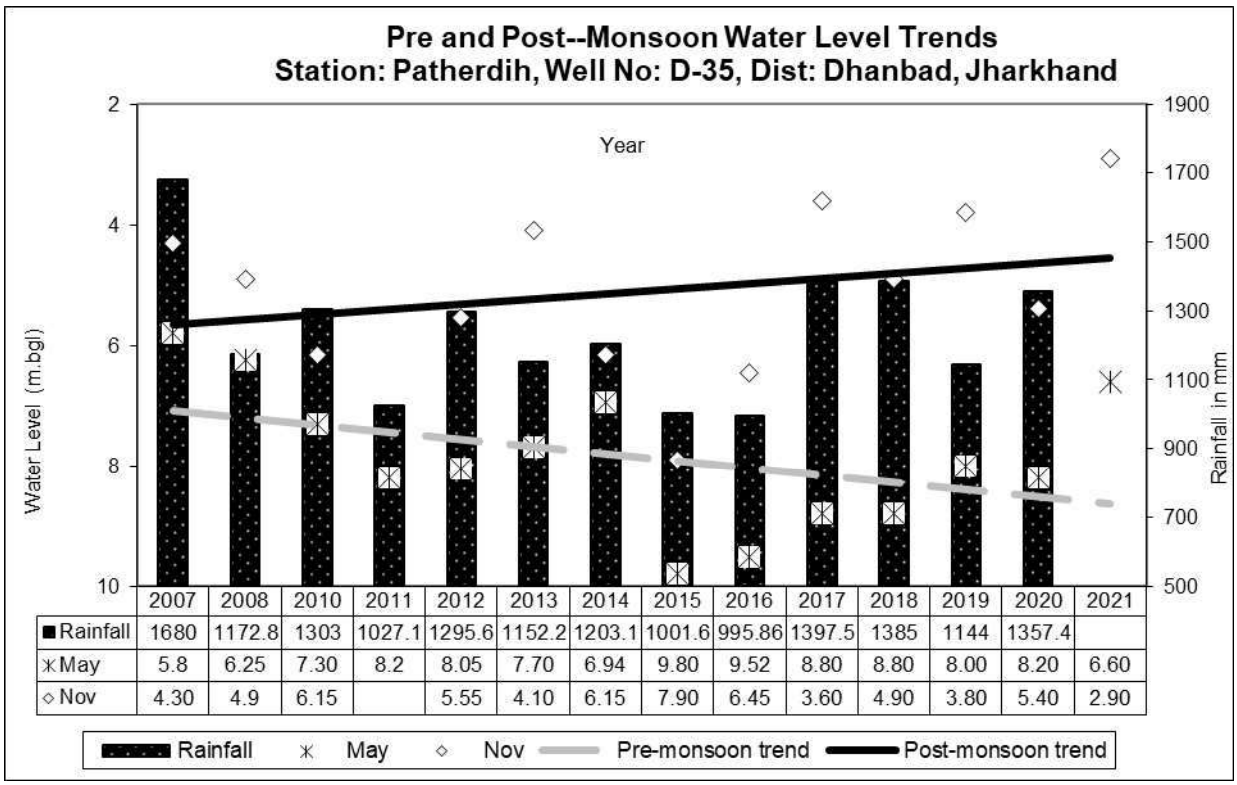
FILTER PLANT IN THE MINE AREA

Fig-15.

HYDROGRAPHS OF CLUSTER-X



	2005	2007	2008	2010	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Rainfall	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4	
May	10.31	9.39	9.76	3.61	9.61	7.46	3.00	3.05	8.10	6.37	5.55	4.85	6.05	3.30
Nov		4.61	2.81	2.81	2.46	4.46	2.75	2.75	4.40	2.45	2.45	3.43	3.25	1.90



	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Rainfall	1680	1172.8	1303	1027.1	1295.6	1152.2	1203.1	1001.6	995.86	1397.5	1385	1144	1357.4	
May	5.8	6.25	7.30	8.2	8.05	7.70	6.94	9.80	9.52	8.80	8.80	8.00	8.20	6.60
Nov	4.30	4.9	6.15		5.55	4.10	6.15	7.90	6.45	3.60	4.90	3.80	5.40	2.90

Annexure – VII

GROUNDWATER SAMPLE LOCATION DETAILS

Sampling month: June month of the assessment year of 2021-22

Sl No	Name of Cluster	Ground Water Sample	Dug well (CMPDI)	Location	Sampling Date
					June'2021
1	CLUSTER-I	GW-1	B-15	BERA VILLAGE	16.06.2021
2	CLUSTER-II	GW-2	B-59	KHODOVALY VILLAGE	16.06.2021
3	CLUSTER-III	GW-3	A-29	GOVINDPUR,AMBAGAN VILLAGE	16.06.2021
4	CLUSTER-IV	GW-4	B-64	KESHALPUR, BATIGHAR	16.06.2021
5	CLUSTER-V	GW-5	D-30	BORKIBOA VILLAGE	16.06.2021
6	CLUSTER-VI	GW-6	D-25	GODHUR MORE	16.06.2021
7	CLUSTER-VII	GW-7	D-80	DHANSAR MINE RESCUE STN.	16.06.2021
8	CLUSTER-VIII	GW-8	D-49	NEAR GHANOODIH OC	15.06.2021
9	CLUSTER-IX	GW-9	D-5	JEALGORA, NEAR P.O.	15.06.2021
10	CLUSTER-X	GW-10	D-35	PATHERDIH RLY. COLONY	15.06.2021
11	CLUSTER-XI	GW-11	A-32	MONNIDIH BAZAR	16.06.2021
12	CLUSTER-XIII	GW-13	A-23	MACHHAYARA	16.06.2021
13	CLUSTER-XIV	GW-14	B-23	LOHAPATTI VILLAGE	16.06.2021
14	CLUSTER-XV	GW-15	B-32A	MADHUBAND VILLAGE	16.06.2021
15	CLUSTER-XVI	GW-16	DB-22	DAHIBARI,NICHE BASTI	15.06.2021

WATER QUALITY

(GROUND WATER- ALL PARAMETERS)

Year: 2021-22

Sl. No	Parameter	Sampling Stations			Detection Limit	IS:10500 Drinking Water Standards	Standard / Test Method
		GW10 15.06.2021	GW11 16.06.2021	GW13 16.06.2021			
1	Boron (as B), mg/l, Max	<0.2	<0.2	<0.2	0.2	0.5	APHA, 23rd Edition ,Carmine
2	Colour,in Hazen Units	3	2	3	1	5	APHA, 23rd Edition ,Pt.-Co. Method
3	Calcium (as Ca), mg/l, Max	82	54	158	1.6	75	IS 3025, Part 40: 1991 R 2019 EDTA Method
4	Chloride (as Cl), mg/l, Max	80	39	103	2	250	IS-3025/32:1988, R-2019 Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	0.05	IS 3025 Part 42 : 1992 R : 2019, AAS-Flame APHA,23rd Edition, AAS-GTA
6	Fluoride (as F) mg/l, Max	0.54	0.60	0.43	0.2	1.0	APHA, 23RD Edition, Page 4-90 to , 4500 –F- D (SPADNS Method)
7	Free Residual Chlorine, mg/l, Min	<0.04	<0.04	<0.04	0.04	0.2	APHA, 23rd Edition, , 4500-Cl^- B. (Iodometric Method-I)
8	Iron (as Fe), mg/l, Max	<0.2	<0.2	0.2	0.2	1.0	IS 3025 Part 53 : 2003, R : 2019 , AAS-Flame Method
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	0.01	IS:3025(Part 47):1994 (Reaffirmed 2019) APHA, 23rd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	<0.02	<0.02	0.18	0.02	0.1	APHA, 23rd Edition, 3111B, Direct Air Acetylene Flame AAS-GTA
11	Nitrate (as NO_3), mg/l, Max	17.24	11.47	9.23	0.5	45	APHA, 23rd Edition, P-4-127, 4500 - NO_3^- B , UV-Spectrophotometric Screening Method
12	Odour	Agreeable	Agreeable	Agreeable	Qualitative	Agreeable	APHA, 23rd Edition, , 2150-C
13	pH value	7.75	8.15	8.05	0.2	6.5-8.5	IS 3025, Part 11 : 1983 R 2017 Electrometric method
14	Phenolic compounds (as C_6H_5OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	0.002	APHA, 22nd Edition,4-Amino Autipyrine
15	Selenium, mg/l, Max	<0.007	<0.007	<0.007	0.007	0.01	IS -3025,part 56:2003,R-2019/APHA 23rd Edition, AAS-VGA
16	Sulphate (as SO_4) mg/l, Max	99	44	183	2	200	APHA –23rd Edition. P-4-199, 4500 SO_4^{2-} E
17	Taste	Acceptable	Acceptable	Acceptable	Qualitative	Acceptable	APHA,23rd Edition, 2160-C Flavour Rating Assesment
18	Total Alkalinity (c_aco_3),, mg/l, Max	119	178	115	4	200	IS 3025, Part 23: 1986 R 2019 Titration Method
19	Total Arsenic (as As), mg/l,Max	<0.006	<0.006	<0.006	0.006	0.01	IS-3025, part 37:1988,R-2019/APHA23rd Edition AAS-VGA
20	Total Chromium (as Cr), mg/l, Max	<0.04	<0.04	<0.04	0.04	0.05	IS-3025 Part 52:2003, R:2019,AAS-Flame APHA, 23rd Edition, AAS-GTA
21	Total Dissolved Solids, mg/l, Max	666	578	782	25	500	IS 3025, Part 16: 1984 R 2017 Gravimetric method
22	Total Hardness (c_aco_3), mg/l, Max	356	246	566	4	200	IS 3025, Part 21, 2009 R 2019 EDTA Method
23	Turbidity, NTU, Max	3	1	1	1	5	IS 3025, Part 10 : 1984 R 2017 Nephelometric Method
24	Zinc (as Zn), mg/l, Max	0.1	<0.1	<0.1	0.1	5	IS 3025 Part 49 : 1994,R : 2019, AAS-Flame
25	Nickel as Ni, mg/l Max	<0.01	<0.01	<0.01	0.01	0.02	IS 3025 Pat 54 : 2003,R : 2019, AAS-Flame APHA 23rd Edition, AAS-GTA

REGISTERED OFFICE

Gondwana Place, Kanke Road
Ranchi -834 031
(Jharkhand)

REGIONAL INSTITUTES

क्षेत्रीय संस्थान-I
वेस्ट एंड, जी.टी.रोड
आसनसोल-713 301
(पश्चिम बंगाल)

क्षेत्रीय संस्थान-II
कोयला भवन, कोयला नगर
धनबाद- 826 005
(झारखंड)

क्षेत्रीय संस्थान-III
गोंदवाना प्लेस,कांके रोड
राँची- 834 031
(झारखंड)

क्षेत्रीय संस्थान-IV
जरीपटका, कस्तूरबा नगर
नागपुर-440 014
(महाराष्ट्र)

क्षेत्रीय संस्थान-V
सीपत रोड
बिलासपुर-495 001
(छत्तीसगढ़)

क्षेत्रीय संस्थान-VI
पोस्ट :जयंत कॉलरी,
जिला : सिंगरौली
पिन नं0- 486 890
(मध्य प्रदेश)

क्षेत्रीय संस्थान-VII
गृह निर्माण भवन
सचिवालय मार्ग
भुवनेश्वर-751001
(उड़ीसा)

Regional Institute - I
West End, G.T Road
Asansol - 713 301
(West Bengal)

Regional Institute - II
Koyla Bhawan, Koyla Nagar
Dhanbad - 826 005
(Jharkhand)

Regional Institute - III
Gondwana Place, Kanke Road
Ranchi- 834 031
(Jharkhand)

Regional Institute - IV
Jaripathka, Kasturba Nagar
Nagpur - 440 014
(Maharashtra)

Regional Institute - V
Seepat Road
Bilaspur - 495 001
(Chattisgarh)

Regional Institute - VI
P.O Jayant Colliery
Dist.- Singrauli
PIN - 486 890
Madhya Pradesh

Regional Institute - VII
Grih Nirman Bhawan
Sachivalaya Marg
Bhubneswar - 751 001
(Orissa)

सेन्ट्रल माईन प्लानिंग एंड डिजाइन इन्स्टीच्यूट लिमिटेड

(कोल इंडिया की अनुषंगी कम्पनी)
एक मिनी रत्न कम्पनी

Central Mine Planning & Design Institute Limited

(A Subsidiary of Coal India Limited)
A Mini Ratna Company

गोंदवाना प्लेस, काँके रोड, राँची - 834 031, भारत
दूरभाष : (91-0651) 2230002, 2230483
फैक्स : (91-0651) 2231447
वेबसाईट : www.cmpdi.co.in

Gondwana Place, Kanke Road, Ranchi - 834 031, INDIA
Phone : (91 - 0651) 2230002, 2230483
Fax : (91 - 0651) 2231447
website : www.cmpdi.co.in

BHARAT COKING COAL LIMITED

DRAFT

MINING PLAN AND MINE CLOSURE PLAN

FOR

BHOWRAH SOUTH COLLIERY

(UPTO {-} 115m RL HORIZON)

(EASTERN JHARIA AREA)

NOVEMBER – 2018

CENTRAL MINE PLANNING & DESIGN INSTITUTE LTD.
REGIONAL INSTITUTE NO.-II
DHANBAD

CHAPTER - XII

PROGRESSIVE AND FINAL MINE CLOSURE PLAN

12.0 MINE CLOSURE PLANNING

12.1 OBJECTIVES OF CLOSURE PLANNING

Mine closure planning has to be carried out at the starting of the mine and needs periodic reviewing and revision during its life cycle to cope with the geo-technical constraints, safety and economic risks, social and environmental challenges. Various other objectives are as follows.

- To allow a productive and sustainable after-use of the site which is acceptable to the mine owner and the regulatory authority;
- To protect public health and safety;
- To alleviate or eliminate environmental damage and thereby encourage environmental sustainability;
- To minimize adverse socio-economic impacts.

12.2 DIFFERENT ASPECTS OF MINE CLOSURE PLANNING

The mine closure planning broadly involves the following aspects:

(a) Technical aspects;

The following technical aspects would be reviewed in the final mine closure planning. Details can be worked in closure plans envisaged to be prepared.

Safety hazards including management of fire and subsidence: In the mine closure plan, action will be taken to cover all the safety aspects including management of fire & subsidence and mine inundation.

12.6 CLOSURE ACTION PLAN

Closure planning is a whole-of-life exercise that begins at the start of a mine and continues till post-closure. The dynamic nature of closure planning requires regular and critical review to reflect changing circumstances as a result of any operational change, new regulation, and new technology and remain flexible enough to cope with unexpected events.

The following steps have to be undertaken in relation to Mine Closure Planning:

Prior to the surface demolition/restoration a surface audit should be undertaken on all surface structures, spoil heaps, lagoons, etc. to assess whether there are any hazardous materials that could cause problems; viz. explosives, chemicals, etc. A list of surface assets should be prepared and made available to potential purchasers, prospective purchasers could be invited and asked to submit sealed bids, this could ensure that the sale of assets give better financial gain.

In order to identify potential impact, necessary hydro-geological studies into post-mining ground water recharge have to be done.

Work force on roll of BCCL may be re-deployed for gainful utilization in the same or other mines of BCCL.

As a detailed component of the Closure Plan, a Decommissioning Plan is to be developed towards the final stages preferably 5 years prior to tentative closure of the mine. Once established, it may be updated annually.

12.7 PROTECTIVE MEASURES TO BE TAKEN

Protective measures must include the following :

- The protection of mine Entries , building and other structure on the project site against access by unauthorized persons;

IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN BHOWRAH SOUTH COLLIERY

(LIFE OF THE MINE: 43 YEARS)

S.N	Activity	Time Frame	YEAR					
			Operational Phase			Post Closure Phase		
			1st - 10th	11th - 20th	21th - 43th	PC1	PC2	PC3
A	**Dismantling of Structures**							
	Service Buildings	2 years						
	Residential Buildings	2 & ½ years						
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years						
B	**Permanent Fencing of mine void and other dangerous area**							
	Random rubble masonry of height 1.2 metre including leveling up in cement concrete 1:6:12 in mud mortar	2 years						
C	**Grading of highwall slopes**							
	Levelling and grading of highwall slopes	2 years						
D	**OB Dump Reclamation**							
	*Handling/Dozing of OB Dump and backfilling	Throughout the life of the mine including 3 years after cessation of mining operation						
	*Technical and Bio-reclamation including plantation and post care	Throughout the life of the mine including 3 years after cessation of mining operation						
E	**Landscaping**							
	Landscaping of the open space in the leasehold area for improving its esthetics and eco value	Throughout the life of the mine including 3 years after cessation of mining operation						
F	**Plantation**							
	Plantation over cleared area obtained after dismantling	2 years						

S.N	Activity	Time Frame	YEAR					
			Operational Phase			Post Closure Phase		
			1st - 10th	11th - 20th	21th - 43th	PC1	PC2	PC3
	*Plantation around the quarry area and in safety zone	Throughout the life of the mine including 3 years after cessation of mining operation						
	*Plantation over the OB Dump	Throughout the life of the mine						
G	**Post Closure Env Monitoring / testing of parameters for three years**							
	Air Quality	3 years						
	Water Quality	3 years						
H	***Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine						
I	***Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation						
J	**Post Closure Manpower cost for supervision**	3 years						

NOTE: *: To be covered under Progressive Mine Closure activities also.

NOTE: The progressive mine closure will be done as per the provisions made out in the Mining Plan and as per the situation/requirement that may arise in course of execution of the Mining Plan

BHARAT COKING COAL LIMITED

MASTER PLAN
FOR
DEALING WITH FIRE, SUBSIDENCE AND REHABILITATION
IN THE LEASEHOLD OF BCCL

UPDATED
MARCH' 2008.

CENTRAL MINE PLANNING & DESIGN INSTITUTE LTD
REGIONAL INSTITUTE – 2
DHANBAD

I) As the manpower in BCCL is continuously reducing due to super -annuation, only 25000 BCCL houses shall be constructed against 42650 houses as proposed in the Master Plan. Therefore fund for construction of only 25000 houses shall be considered in the Master Plan.

II) The cost estimate of the fire projects should be reduced to the extent possible. Whenever fire is handled by direct removal of coal and OB, the cost shall be set off considering that 50% of coal will be available for selling.

III) A sample survey should be carried out for private (Pucca & Kutcha) for ascertaining suitable fund provision as compensation in the Master Plan.

IV) For the purpose of income generation scheme, it has been decided that head of every displaced house shall be paid wage of 250 days in a year for two years as per minimum wage rate of respective state Govts.

The Master plan, July'2006 has been prepared considering the above decision and was submitted to State Govt. of Jharkhand for their acceptance vide letter no.GM (ENV)/F-rhab/2007/138 dated 6.3.2007. Jharkhand state Govt. has not given acceptance as yet.

Cost up-dation of the Master Plan July'o6 has been done up to Feb'08 considering the increase in WPI and Civil Cost Index.. Increase in WPI was about 7% and Civil cost index was 14.28%

5.O SCOPE OF WORK OF MASTER PLAN '2008

Master Plan now covers only following two aspects:

i) **Dealing with fire**, which includes identification of fire areas, selection of technologies to deal with the fires, prioritization for implementation and assessment of tentative fund requirement.

ii) **Rehabilitation & Resettlement** of the affected people from the areas affected by fire & subsidence including identification of affected sites, identification of resettlement sites and assessment of tentative fund requirement.

Note: "BCCL vide letter no GM(Env)/F- /06 dated 22nd April, 2006 suggested that diversion of railway lines and NH 32 road passing through coal bearing areas of JCF should also be included in the Master Plan'2006.

Diversion of rails and roads passing over the coal bearing areas are affected by fire and subsidence at many places and may further be affected. As the diversion will affect the operation of other coal producing companies like TISCO & SAIL, other industries operating in the coalfield and State Govt. as well as Railway, a joint decision is to be taken involving all the above stakeholders.

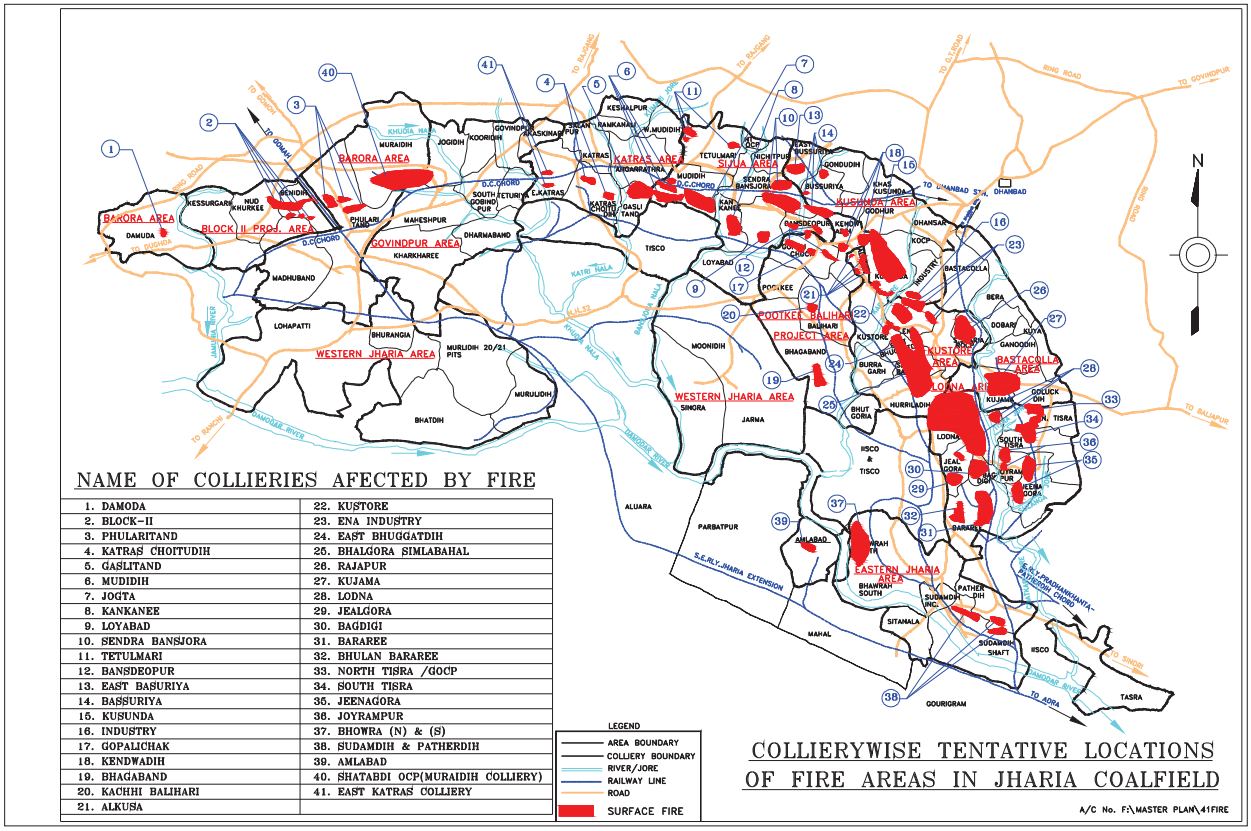
Moreover, the diversion of rail and road requires survey of the alternative routes, detail layout planning by expert agencies like RITES and likely to take about two years time.

Therefore, in this Master Plan, a lump sum provision of Rs.20 Crs has been kept for survey and planning only as an advance action. The detail proposal for diversion may be taken up as a separate Master Plan in future. "

As per the recommendation of the committee constituted by DGMS, all the sites proposed for stabilization in the Master Plan '99, have now been considered for rehabilitation. The time frame for implementation of Revised Master Plan has been considered as 10 years proposed to be implemented in two Phases (Phase – I & II each of 5 years duration), excluding 2 years of pre-implementation period.

Implementation of the Fire control measures and rehabilitation of BCCL houses from the endangered area will be the responsibility of BCCL, where as rehabilitation of Non-BCCL houses/structures from the endangered areas will be the responsibility of State Govt. of Jharkhand and West Bengal. Land acquisition for BCCL employees shall be done in association with State Govt. of Jharkhand.

Rehabilitation sites will be located on non-coal bearing area along the fringe / periphery of Jharia coalfield. The sites will have the basic infrastructural facilities like Water & Electricity, School, Banks, Hospitals, Market Complex, Play Ground, and Community Center etc.



NAME OF COLLIERIES AFECTED BY FIRE

1. DAMODA	22. KUSTORE
2. BLOCK-II	23. ENA INDUSTRY
3. PHULARITAND	24. EAST BHUGGATDIH
4. KATRAS CHOITUDIH	25. BHALGORA SIMLABAHAL
5. GASLITAND	26. RAJAPUR
6. MUDIDIH	27. KUJAMA
7. JOGTA	28. LODNA
8. KANKANEE	29. JEALGORA
9. LOYABAD	30. BAGDIGI
10. SENDRA BANSJORA	31. BARAREE
11. TETULMARI	32. BHULAN BARAREE
12. BANSDEOPUR	33. NORTH TISRA /GOCP
13. EAST BASURIYA	34. SOUTH TISRA
14. BASSURIYA	35. JEENAGORA
15. KUSUNDA	36. JOYRAMPUR
16. INDUSTRY	37. BHOWRA (N) & (S)
17. GOPALICHAK	38. SUDAMDIH & PATHERDIH
18. KENDWADIH	39. AMLABAD
19. BHAGABAND	40. SHATABDI OCP(MURAIDIH COLLIERY)
20. KACHHI BALIHARI	41. EAST KATRAS COLLIERY
21. ALKUSA	

COLLIERYWISE TENTATIVE LOCATIONS OF FIRE AREAS IN JHARIA COALFIELD

A/C No. F:\MASTER PLAN\41FIRE

TABLE -1

LIST OF FIRES IN THE LEASEHOLD OF BCCL

Sl. No.	Name of the fire	Fire Status
1	Ganeshpur X, XI , XII & XIII seam fire	Active
2	Burwabera X seam fire	Active
3	Phularitand X, XI, XII seam fire	Active
4	Angarpathra XII, XI, X, IX Spl. seam fire	Extinguished
5	Gaslitand XVT, XVB seam fire	Active
6	Jogta XV, XIV, XIII, XII, XI seam fire	Active
7	Kankanee XIII & XIV seam fire	Active
8	Ekra XI & XII seam fire	Active
9	Ekra XIII & XIV seam fire	Active
10	Loyabad XV, XIV, XIII seam fire	Active
11	Bassuriya XIV, XIII & XII, XI and X seam fire	Active
12	Sendra Bansjora XIV, XIII, XII, XI seam fire	Active
13	Bansdeopur XIV, XII seam fire	Active
14	Gopalichak XVI, XV, XIV, XIII, XII,XI seam fire	Active
15	Industry XII, XI seam fire	Active
16	Kusunda XII, XI seam fire	Active
17	Alkusa XII, XIV seam fire	Active
18	Kustore XIV, XIII, XII, XI seam fire	Active
19	Ena XII, XI seam fire	Active
20	Pure jharia X seam fire	Active
21	K.P. Dobari X, V/VI/VII/VIII/VIIA seam fire	Active
22	Rajapur X seam fire	Active
23	Kujama XII, XI seam fire	Active
24	Kujama IX, X seam fire	Active
25	Bhalgora XIV seam fire	Dormant
26	Bhalgora XV seam fire	Dormant
27	East Bhuggatdih XV, XIV seam fire	Active
28	Ena XIV seam fire	Active
29	Ena XV seam fire	Active
30	Simlabahal XIV seam fire	Dormant
31	N.S. Lodna XIII, XIIIA, XIV seam fire	Active
32	Bagdigi XIV, XIA, XV seam fire	Active
33	Baniahar XV, XIVA, XIV seam fire	Active
34	Bhaga XV seam fire	Active
35	South Tisra VII, VIII, IX, X seam fire	Active
36	Bhowra XIII, XIV seam fire	Active
37	Bararee XV, XIVA, XIV seam fire	Active
38	Bhulan Bararee XIII, XIV seam fire	Active
39	Bhulan Bararee XVI, XV seam fire	Active
40	Sudamdih IX to XIV seam fire	Active
41	Patherdih IX to XIII seam fire	Active

Sl. No.	Name of the fire	Fire Status
42	Bhowra IX , X seam fire	Active
43	Block –II XII, XI/XII, X Spl. seam fire	Active
44	Katras-Choitudih XIII seam fire	Active
45	Katras-Choitudih XIV, XV seam fire	Active
46	Tetulmari IV seam fire	Active
47	Tetulmari VI/VII seam fire	Active
48	Kendwadih XIII seam fire	Dormant
49	Kendwadih XIV, XIII seam fire	Dormant
50	Pootkee XV seam fire	Extinguished
51	East Bassuriya V/VI seam fire	Active
52	East Bassuriya VIII seam fire	Active
53	Kessurgarh V, VI, VII seam fire	Extinguished
54	Bhagaband XVI seam fire	Dormant
55	Amlabad XIV seam fire	Dormant
56	Sudamdih XV seam fire	Extinguished
57	Moonidih XVIIT seam fire	Extinguished
58	Damoda V, VI, VII seam fire	Dormant
59	Mudidih fire	Dormant
60	Jogidih X seam fire	Extinguished
61	Kooridih X seam fire	Extinguished
62	Nudkhurkee X seam fire	Extinguished
63	West Mudidih IX/X seam fire	Extinguished
64	East Katras XIV seam fire	Extinguished
65	North Tisra VII, VIII, IX seam fire	Active
66	North Tisra X seam fire	Active
67	Jeenagora IX, X, XI seam fire	Active
68	Jeenagora IX, X, XI,XII seam fire	Active
69	Joyrampur XI, XII, XIII seam fire	Active
70	Jealgora XV, XIV, XIIIB, XIIIA seam fire	Dormant
71	Bassuriya IX,I X Spl. seam	Active
72	Industry X seam	Active
73	Kachhi Balihari XV seam	Dormant
74	Kendwadih XI, XII seam	Active
75	Shatabdi V/VI/VII seam	Active
76	Sendra Bansjora X seam	Active
77	East Katras XI,XIII & XIV seam fire	Active

7.0 MASTER PLAN FOR REHABILITATION OF INHABITATED FIRE & SUBSIDENCE PRONE AREAS.

7.1 Introduction:

In the updated Master Plan of April'04, altogether 532 sites (271 in full & 261 in part) were considered for rehabilitation as the houses over these sites were declared unstable & uncontrollable (UU) as ground movement can not be controlled by stowing. Total no. of houses proposed to be evacuated from 532 sites were 65300 which includes

BCCL houses	:	36208
Non-BCCL : Private houses	:	15571
Non- BCCL : Un-authorised houses (Encroacher)	:	12719
Others : (Religious places, schools, Hospitals, Post offices, Police stations etc).	:	802

Apart from these 532 sites, 121 sites were considered unstable but controllable (UC) i.e where ground movement could be controlled by stowing.

In accordance with the directive of Supreme court of India, on 3rd May, 2005, Director General of Mines Safety (DGMS) constituted a Committee to go through the Action Plan and subsequent affidavit/ATR filed by UOI and to verify the same in connection with PIL case filed by Sri Haradhan Roy, Ex MP.

The Committee concluded that as there are no scientific methods available to check long term stability, it might not be possible to certify that the areas thus stabilized. The present stabilization work may restrict the effect of subsidence and allow some time. The final and permanent solution is evacuation of the affected area and rehabilitation.

In view of the above, 121 sites which were proposed for stabilization have now been considered for rehabilitation.

7.2 Total no. of houses in the endangered areas

Over the period of time from original Master Plan of March'1999 to date, 24 Nos. of sites have been demolished and shifted to other places by BCCL management. These sites have been deleted from this Master Plan.

Where fire dealing has been proposed by excavation method some stable parts are necessarily to be evacuated for digging out the fire. Such stable parts have now been

10 The community facilities like primary schools, community centre, small dispensary and shopping centre will also be included in the town planning. These common facilities will be constructed as per the plan under the proposed compensation package. However, the running cost of all the facilities, i.e. water supply, power supply, schools, dispensary etc. shall not be the part of compensation package and will have to be looked after by the Panchayat and other bodies of the State Government.

11 Common structures such as religious places etc. shall be built at resettlement site on mutual agreement basis from Rehabilitation fund of Master Plan.

12 The proposed location of resettlement site is guided by the following considerations:-

a) Preferably the proposed resettlement site should be either land owned by BCCL or vested to the state Government.

b) In case such land are not available, then the required land may be purchased from private owner by State Govt.

13. No employment shall be offered for any rehabilitation under the Master Plan

7.4.2 BCCL Houses:

BCCL houses from the endangered areas are proposed to be rehabilitated in four Satellite Township in non-coal bearing areas along the periphery of JCF. The houses over endangered houses will be rehabilitated with equivalent type of house in satellite township in triple storied building having all basic infrastructural facilities. As soon as an employee residing in the identified endangered area retires, the house shall be demolished.

It is proposed that Rehabilitation/resettlement work of BCCL houses shall be the responsibility of BCCL whereas the same for Non BCCL houses including encroachers shall be the responsibility of concerned state Govt. However acquisition of land for rehabilitation of BCCL employees shall be done in association with State Govts of Jharkhand/West Bengal.

7.5 Amenities & Infrastructures:

The resettlement sites of the affected population for BCCL & Non-BCCL has been identified exclusively on non coal bearing areas sufficiently away from the impact of future mining. For this purpose, it is proposed that satellite township should be constructed along the fringe of Jharia Coal Field. The size of township should be large enough to accommodate at least 12500 Non-BCCL families and 6000 BCCL families. In each locality, there will be separate town ship for BCCL houses and Non-BCCL (both private & encroachers) adjacent to each other. In each township the following amenities will be provided as per BPE norm.

40	E. Jharia	Sudamdih Inc.	Main Colony Miners house/05	19200
41	E. Jharia	Sudamdih Inc.	Main Colony/ O3	16000
42	E. Jharia	Sudamdih Inc.	Old Incline Colony/06	4800
43	E. Jharia	Sudamdih S.M.	New Miners colony/02	33600
44	E. Jharia	Sudamdih S.M.	River side colony/01	30400
45	**Gobindpur**	Akashkinaree	Akashkinare Colony/ O6	3837
46	Gobindpur	Akashkinaree	Labour Qtrs. Along PWD Road/ O2	19139
47	Gobindpur	Akashkinaree	Part of Bhatmurna Bastee/O3	6996
48	Gobindpur	Akashkinaree	Qtrs. Along office compound/O4	37973
49	Gobindpur	Akashkinaree	Qtrs.on South side of Akashkinaree/O5	32070
50	Gobindpur	Block-IV / Kooridih	Kooridih 3 seam Area Hutment/ O4	1870
51	Gobindpur	Block-IV / Kooridih	LCH Dhowrah Govindpur/18	720
52	Gobindpur	Block-IV / Kooridih	Near Block-IV Office/15	26846
53	Gobindpur	Block-IV / Kooridih	Near Gobindpur Hospital/14	24280
54	Gobindpur	Block-IV / Kooridih	NHS Qrts/12	1400
55	Gobindpur	Block-IV / Kooridih	South Gobindpur Bastee/16	7040
56	Gobindpur	Block-IV / Kooridih	South Gobindpur Dhowra/17	1562
57	Gobindpur	Gobindpur	Agardih Labour Qtrs/O7	17580
58	Gobindpur	Gobindpur	Darpan Bastee/O5	132
59	Gobindpur	Gobindpur	Imli Dhowrah/O3	31145
60	Gobindpur	Gobindpur	IV Seam Colony/O1	57408
61	Gobindpur	Gobindpur	Labour Qrts./O6	1174
62	Gobindpur	Gobindpur	Mehtadih Colony & Bunglow/O4	31145
63	Gobindpur	Jogidih	Baihardih Colony 'B'/ 1B	8365
64	Gobindpur	Jogidih	Baihardih Village/1A	5118
65	Gobindpur	Kharkharee	Nawagarh More & Phularitand Village/ O3	14400
66	Gobindpur	Kharkharee	Part of Phularitand Village/ 3A	24000
67	Gobindpur	Maheshpur	Maheshpur Bastee/O1	33309
68	Gobindpur	Maheshpur	NHS Qtrs. & House North of DB Road/11	43823
69	Gobindpur	Maheshpur	Premnagar Colony Bastee etc./ 14	13418
70	Gobindpur	Maheshpur	Staff Qtrs. & Hutment/O4	2806
71	Gobindpur	S.Gobindpur	Bilbera - C/13	8000
72	Gobindpur	S.Gobindpur	Bilbera 'A'/ O7	1600
73	Gobindpur	S.Gobindpur	Kali Nagar Bilbera/12	8000
74	Gobindpur	S.Gobindpur	South Govindpur 'B/O6	2400
75	Gobindpur	S.Gobindpur	Tandabari-A/O1	18400
76	Gobindpur	Teturia	Colliery Office Area/O3	22400
77	Gobindpur	Teturia	NHS Qtrs.& Hutment/O1	43600
78	Gobindpur	Teturia	No.2 Locality/O2	32800
79	**Katras**	Angarpathra	AP Section-2 /O2	16800
80	Katras	Angarpathra	JK Khas/O4	2200
81	Katras	Angarpathra	JK Section/O3	62400
82	Katras	Angarpathra	National Angarpathra-2/O6	6500
83	Katras	East Katras	Akashkinaree 04/06	2800
84	Katras	East Katras	Akashkinaree -2/O2	400
85	Katras	East Katras	Akashkinaree 3/O4	3840
86	Katras	East Katras	Akashkinaree 5/O7	1000
87	Katras	East Katras	Akashkinaree-6/O8	4350
88	Katras	East Katras	Bhandardih 2 /11	2500
89	Katras	East Katras	Koiludih 01/03	3900
90	Katras	East Katras	Koiludih 3/10	40180
91	Katras	East Katras	Koiludih 4/15	65752

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

GEODYNAMICS AND GEOHAZARDS DIVISION
GEOSCIENCES GROUP
REMOTE SENSING APPLICATIONS AREA
NATIONAL REMOTE SENSING CENTRE
INDIAN SPACE RESEARCH ORGANISATION
DEPT. OF SPACE, GOVT. OF INDIA
HYDERABAD-500 037

AUGUST, 2021

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

7.2 Conclusions

The following conclusions can be made:

1. As of the date of study in the year 2020 and in comparison with the previous study done in 2017, there has been a change in areal extent and disposition of the fire affected areas. On the other hand, persistent subsidence is seen in the Moonidih area due to underground mining activities.
2. Compared to 2012, the eastern flanks (Lodna, Tisra, Bhulanbarai areas) show considerable decrease in fire disposition and the western flank (Shatabdi and Block II area) show diminished fire presence.
3. The fires are continuation of existing fire affected areas as seen in the 2017 study.
4. The mines in Kusunda remain to be the worst affected with maximum presence of active fires.
5. There is a decrease in areal extent of the fire from 2017 to 2020. As compared 2017, when the total fire affected extent of the JCF was about 3.28 km^2; in 2020 total fire affected extent is about 1.89 km^2 (including TISCO mines). Within the mining lease of BCCL (excluding TISCO) in comparison 2017, when the total fire affected extent of the JCF was about 3.27 km^2; in 2020 total fire affected extent is about 1.86 km^2.

Note: *The minimum mapable unit from satellite image it 30m by 30m or 0.0009 km^2.* ***.*** *Estimations of fire extent (in terms of sq.km.) both in 2017 and in the present 2020 study are pixel based. They may differ from the actual ground area under fire. These estimations are made for comparative purpose only, to indicate the increase or decrease of areal disposition of fire. Hence, they should not be quoted as fire area on the ground.*

भारत कोकिंग कोल लिमिटेड
(कोल इंडिया लिमिटेड का एक अंग)
BHARAT COKING COAL LIMITED
(A Subsidiary of Coal India Limited)
Civil Engineering Department, Koyla Nagar, Dhanbad – 826 005 (JH)
Corporate Identity No. (CIN): U10101JH1972GOI000918
GSTIN: *20AAACB7934MFZB (JH), 19AAACB7934M2Z7 (WB)*
e-mail: gmcivil.bccl@coalindia.in;
Website – www.bcclweb.in

NIT Ref. BCCL/CED/TC/eNIT-12/2021-22/225; dated: 05.07.2021

Notice Inviting Tender

1. Tenders are invited on-line under two part system on the website **https://coalindiatenders.nic.in** from the eligible bidders having Digital Signature Certificate (DSC) issued from any agency authorized by Controller of Certifying Authority (CCA), Govt. of India and which can be traced up to the chain of trust to the Root Certificate of CCA, for the following work:

Description of work	Location	Estimated Cost of Work (Including GST) (In Rs.)	Period of Completion (In Days)
Drilling and installation of 23 nos of piezometric wells in the command area of BCCL	BCCL Dhanbad	2,16,19,913.33	175 days

Provident fund is applicable for this work.

(i). For Site visit of location of work, the prospective bidder(s) may contact …….

Tender inviting authority	Contact Person(s)/Tender Dealing Officer(s)	
GM(Civil/Industrial), BCCL	Sri Sunil Nigam GM(Geology) Contact : 9470596404	Preety Priya Assistant Manager(Civil) CED, HQ, BCCL

2. Time Schedule of Tender:

Sl. No	Particulars	Date	Time
a.	Tender e-Publication date	09.07.2021	15:00
b.	Document download start date	09.07.2021	15:00
c.	Document download end date	27.07.2021	15:00
d.	Bid Submission start date	10.07.2021	15:00
e.	Bid submission end date	27.07.2021	15:00
f.	Start date for seeking Clarification on-line	09.07.2021	15:00
g.	Last date for seeking Clarification on-line	20.07.2021	15:00
h.	Technical Bid (Cover I) opening date	28.07.2021	16:00
i.	Price Bid (Cover II) opening date(tentative)	28.08.2021	11:00

Note: The auto extension of submission of bid shall be applicable as per details mentioned in clause No.14 of NIT.

3. Bid Securing Declaration:

3.1 In place of a bid security/EMD, Bidders shall have to sign a Bid securing declaration accepting that if they withdraw or modify their bids during the period of validity, or if they are awarded the contract and they fail to sign the contract, or to submit a performance security before the deadline or any other default which attracts forfeiture of EMD (as prescribed in the existing Manuals) as defined in the request for bid document/Tender Document, they will be banned for two years from being eligible to submit bids in CIL and its subsidiaries. This banning shall be done under the provisions of NIT with the approval of Tender Accepting Authority by Application Admin of CIL e-Procurement Portal.(In case of a JV/Consortium all partners will be banned)

3.2 Micro and Small Enterprises (MSEs) as defined in MSE Procurement Policy issued by Department of Micro, Small and Medium Enterprises (MSME) will be exempt from the payment of earnest money (applicable only for Services tenders).

Such exempted MSE bidders shall upload the scanned copy of document (attested by notary public) in support of exemption will have to be uploaded by the bidder during bid submission. However, this option is to be enabled only in those cases where the exemption of EMD to some bidders is allowed as per NIT.

Bid Securing Declaration in the Undertaking at **Annexure II** shall be accepted by bidder unconditionally in GTE (General Technical Evaluation).

4. Pre-bid Meeting:

The pre-bid meeting if applicable shall be held in the office of Tender Inviting Authority, on the scheduled date & time, if specified in the NIT. The purpose of the pre-bid meeting is to clarify the issues and to answer the questions on any matter that may be raised at that stage. Non-attendance at the pre-bid meeting will not be a cause for disqualification of bidder and it shall

(b) Valid registration from competent authority (if applicable). Registration should be valid at the time of submission of bid and at the time of acceptance of bids.

2. Regarding registration with Competent Authority, **Annexure-XIII** may please be referred. Regarding exclusion from restriction, **Annexure-XIV** may please be referred.

Tender Inviting Authority

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

Bharat Coking Coal Limited
A Mini Ratna Company
(A Subsidiary of Coal India Limited)
Office of the HoD (Environment)
Koyla Bhawan, Koyla Nagar, Dhanbad

पत्रसंख्या: भाकोकोलि/ विभागाध्यक्ष (पर्या)/फाईल-Plantation/B-3/2021/264-27 (H) दिनांक: 18.02.2021

सेवा में,

वन प्रमंडल पदाधिकारी,

धनबाद

विषय : Work Order for carrying afforestation over 42.5 ha of OB dumps/physically reclaimed land of BCCL.

संदर्भ: (i) Our letter no.भाकोकोलि/उपमहाप्रवंधक(पर्या)/फाईल-B-3/2020/1529-1534(H) dt 10.12.2020
(ii) भाकोकोलि/उपमहाप्रवंधक(पर्या)/फाईल-B-3/2021/10-13/ (H) dt 06.01.2021.
(iii) Your letter no.84 dated 12.01.2021

माननीय महोदय,

This has reference to above mentioned letters, competent authority has approved for carrying afforestation over 42.5 ha of OB dumps/ physically reclaimed land of BCCL through DFO, Dhanbad, for a total estimated value of ₹ 1,19,75,665.00 (Rupees One crore nineteen lakhs seventy five thousand six hundred sixty five only) for four years with the following terms and conditions in respect of above mentioned work:-

1. The Period of work will be 04 years as per the estimate provided by Forest Department.

2. The aforesaid work is to be carried out at below mentioned sites:

S No	Name of the site	Type	Ha
1	NAKC, Govindpur	OB Dump	23.0
2	ASP, EJ Area	Physically reclaimed land	19.5
	TOTAL		42.5

3. The Forest department shall conduct all its afforestation activities subject to all laws, rules, statutory orders and regulations applicable to the site and the nature of the work.

4. The Forest department shall take up afforestation works on company's land with due expertise and supervision as per the scheme & estimates duly sanctioned as per the estimate submitted by forest department.

5. The estimate has been submitted by Forest Department considering 15% enhancement every year in labour wages of preceding year. However, the payment of Completion work, first year maintenance work and second year maintenance work will be made as per the actual labour wages prevailing in the corresponding year.

6. The Forest department shall exercise precautions on the aid and advice of the mine management for the safety of all lives and properties involved in the afforestation activities.

7. **SCOPE OF WORK**
This work shall be done with the following attributes:

(i) Self-sustaining / healthy plantation at the end of project period/ at the handover of the site.

(ii) The plants planted shall be of native species, high root density, soil binding species, thick canopy and/or fruit bearing. The following suggested native species shall preferably but not limited to be planted at the sites:

S.No.	Botanical Name	Common name	S.No.	Botanical Name	Common name
1.	*Ailanthus excelsa*	Mahanim	2.	*Ficus hispida*	Kath gular
3.	*Albizzia lebbeck*	Siris	4.	*Ficus religiosa*	Pipal
5.	*Alstonia scholaris*	Chatni	6.	*Albizia Procera*	Safed Siris
7.	*Azadirachta indica*	Neem	8.	*Madhuca indica*	Mahua
9.	*Bombax ceiba*	Semal	10.	*Melia composita*	Bakain
11.	*Butea monosperma*	Palas	12.	*Tamarindus indica*	Imli
13.	*Cassia fistula*	Amaltas	14.	*Terminalia arjuna*	Arjun
15.	*A. Odoratissima*	Kala Siris	16.	*Aegle marmelos*	Bel
17.	*Dalbergia sissoo*	Shisham	18.	*Mangifera indica,*	Aam
19.	*Ehretia laevis*	Chamror	20.	*Zizyphus nummularia*	Ber
21.	*Ficus glomerata*	Gular	22.	Embilica officianlis	Awala
23.	*Syzygium cumini*	Jamun	24.	Anthocephalus indicus	Kadamb
25.	*Acacia Catechu*	*Desi Kher*	26.	Gmelina arbora	Gamhar
27.	And other fruit bearing native species or the species deemed suitable by the Forest deptt.				

(iii) Survival of the plantation shall not be less than 80 per cent at the end of the project period.

8. Annual Joint Inspection report of the inspection carried out by joint team of Forest Department and BCCL personnel after the completion of each year work should indicate name of the site, year of plantation, number of plants, name of the species present, date of inspection and survival rate.

9. The display boards shall be installed at all the plantation sites indicating, the name of the company, the no. of plantation, species planted, name of site of plantation and plantation year.

10. All the materials & manpower required with regard to the aforesaid work shall be arranged by you at your own cost.

11. The Forest department shall pay wages not less than the minimum wages fixed by the Govt of Jharkhand to the labourers engaged in the execution of the aforesaid work and it will be the responsibility of the Forest department to ensure the compliance of the payment of wages to its workmen/labourers as per law and company shall not be held responsible for the same.

12. In case of revision of minimum wages by the Govt of Jharkhand during the work, a revised estimate of the corresponding year of the scheme as per the work order shall be submitted to the company by Forest Department and claim the amount of difference in wages payable due to increase in labour wages on the basis of man days works on revised wage for which the forest department shall certify.

13. As the afforestation work has been directly monitored by Ministry of Coal, every year on monthly basis; therefore, you will provide the plantation data from June 2021 to October 2021 on monthly basis during the completion year (2021-22).

14. The afforestation sites as mentioned in the this work order shall be handed over to mine management after the Joint inspection at the end of the Maintenance year-2 and having survival rate not less than 80%.

15. **TERMS OF PAYMENT**

Total project cost is ₹ 1,19,75,665.00 (Rupees One crore nineteen lakhs seventy five thousand six hundred sixty five only) as per the estimate submitted by Forest Department. The payment schedule will be as follows: -

S. No	Financial Year	Details of the work	Amount (Rs.)	Remarks
1.	2020-21	Advance Work	44,41,205.00	Wages @ ₹ 295.80 per MD
2.	2021-22	Completion work	46,85,034.00	Wages @ ₹ 340.17 per MD
3.	2022-23	Maintenance work-1	17,03,227.00	Wages @ ₹ 391.19 per MD
4.	2023-24	Maintenance work-2	11,46,199.00	Wages @ ₹ 449.87 per MD
Total			11975665.00	

16. The estimate for the Completion work, Maintenance work-1 and Maintenance work-2 is based on the tentative increase in the labour wages @ 15% of preceding year's wages as submitted in the estimate by the Forest Department. Therefore, the forest department shall certify the rate of labour wages for the corresponding year and demand letter/ bill based on the actual rates of labour wages to that corresponding year.

17. **Paying Authority:** HOD (Pay), Pay Office, BCCL HQ, Koyla Bhawan, Dhanbad.

18. All the payment will be made by ELECTRONIC MODE through bank in the account of DFO, Dhanbad. You are required to fill the format of Electronic Fund Transfer (EFT) in triplicate which is enclosed as annexure-A.

19. For release of the payment, you have to submit
    a) The letter of acceptance of the work order along with the Demand letter/Bill for the Advance work.

    And for further payments regarding this work order
    a) Utilization certificate of the preceding payment made to you in respect of this work order
    b) Joint inspection report of preceding year's work.
    c) Demand letter/Bill based on the actual rates of labour wages to that corresponding year for payment.

    The utilization certificates along with joint inspection report shall be accepted by the accepting authority i.e. HOD (Env), BCCL.

20. BCCL shall not have any liability in case of any accident etc. towards Forest Department's personnel/ staffs /workers during the execution of the work.

21. Child labour is prohibited under Mines Act, therefore, child labour shall not be deployed in the aforesaid work.

22. All other conditions stipulated in aforementioned reference letters shall be complied.

23. Matter relating to any dispute or difference arising out of this work order shall be subject to the jurisdiction of Dhanbad court only.

18/2/21

विभागाध्यक्ष (पर्यावरण)

Copy to:-

1. TS to D (T) OP/ D(T) PP, BCCL..... for kind information please.
2. GM (Vigilance), BCCL..... .....for kind information please.
3. GM, Govindpur/ EJArea ....for kind information please
4. Project Officer, NAK Colliery, Govindpur/ ASP Colliery, EJ Area
5. HOD, (Pay)/ In-charge Pay Office, BCCL HQ, Koyla Bhawan, Dhanbad.
6. Master File/Office Copy

18/2/21

विभागाध्यक्ष (पर्यावरण)

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

(FOR THE MONTH AUGUST, 2022)

E. C. no. J-11015/380/2010-IA.II (M) dated 12th June, 2019.

CMPDI
ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

CONTENTS

SL. NO.	CHAPTER	PARTICULARS	PAGE NO.
1.	CHAPTER - I	EXECUTIVE SUMMARY	3-5
2.	CHAPTER-II	INTRODUCTION	6
3.	CHAPTER-III	RESULTS	7-22
4.	CHAPTER-IV	STANDARDS AND PLANS	23-24

EXECUTIVE SUMMARY

1.0 Introduction

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

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

2.0 Sampling location and rationale

2.1 Ambient air sampling locations

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

2.2 Water sampling stations

The Water sampling stations were selected for mine sump water.

2.3 Noise level monitoring locations

Noise levels vary depending on the various activities in mining areas. The monitoring of noise level in different locations will be helpful to take appropriate mitigating measures. The noise levels were recorded in mining area, washery and in residential area.

3.0 Methodology of sampling and analysis

3.1 Ambient air quality

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

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

3.2 Water quality

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

3.3 Noise level monitoring

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

4.0 Results and interpretations

4.1 Air quality

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

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

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

4.2 Water quality

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

INTRODUCTION

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

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

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

1.1 The Cluster-X is in the Eastern part of the Jharia coalfield. It includes a group of 6 Mines (viz. Amlabad UG, Bhowra north UG/OC, Bhowra South UG/OC , Amalgamated Sudamdih Patherdih Mine, Sudamdih Shaft, Sudamdih Coal Washery 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 and coal washery of 2.08 MTPA.

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 12thJune, 2019.

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

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

AMBIENT AIR QUALITY MONITORING

2.1 Location of sampling station and their rationale:

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

2.1.1 Ambient Air Quality Sampling Locations

I. CORE ZONE Monitoring Location

i) Bhowrah North (A14): Industrial Area

The location of the sampling station is 23°41'37.00"N 86°23'54.00"E. The sampler was placed at an elevated platform of around 1.5m height from ground level at Guest House of EJ Area.

ii) Sudamdih Washery (A15): Industrial Area

The location of the sampling station is 23°39'31.00"N 86°25'48.00"E. The sampler was placed at elevated platform of around 1.5m height from ground level at Coal lab near washery.

iii) Sudamdih Mine shaft (A41): Industrial Area

The location of the sampling station is 23°39'37"N 86°25'39"E.The sampler was placed at elevated platform of around 1.5m height from ground level at electric substation of sudamdih shaft mine.

II. BUFFER ZONE Monitoring Location

i) Jeenagora (A13): Industrial Area

The location of the sampling station is 23°42'31.00"N 86°26'38.00"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 of the sampling station is 23°41'15.00"N 86°22'39.00"E, 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.

AMBIENT AIR QUALITY DATA

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

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

Test Report for Ambient Air Samples

Month & Year	**08/2022**	**Cluster**	**Cluster X**	**Report No.**	**RI-II/AIR/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**26.10.2022**
Project		**Sample Ref. No.**	**REM/BCCL/2022/08**	**Sampling Method**	**CMPDI/RI-II/LPM 13 , (IS 5182)**

Sampling Stations	**i**	**Bhowrah North**	**Date of Sampling**	11.08.22	23.08.22	**Zone of Station:**	**Core Zone**

Sl. No.	**Parameter**	**Method of Analysis**	**Observed Values (in µg/m³)**		**Range Of Testing**	**LDL**	**MoEF Standards Notification dated 25th September,2000 (GSR 742 E)**	**NAAQS, 2009**
			1st FN	**2nd FN**				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	82	72	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	42	33	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	<10	12	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	13	15	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

***Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

---- End of Report ----

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

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

Test Report for Ambient Air Samples

Month & Year	**08/2022**	**Cluster**	**Cluster X**			**Report No.**	**RI-II/AIR/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project			**Sample Ref. No.**	**REM/BCCL/2022/08**	**Sampling Method**	**CMPDI/RI-II/LPM 13 , (IS 5182)**	
Sampling Stations	**i**	**Sudamdih Washery**	**Date of Sampling**	10.08.22	18.08.22	**Zone of Station:**	**Core Zone**

Sl. No.	**Parameter**	**Method of Analysis**	**Observed Values (in µg/m³)**		**Range Of Testing**	**LDL**	**MoEF Standards Notification dated 25th September,2000 (GSR 742 E)**	**NAAQS, 2009**
			1st FN	**2nd FN**				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	83	92	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	30	34	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	14	12	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	16	15	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

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

***Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

---- End of Report ----

Page -1 of 1

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

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

Test Report for Ambient Air Samples

Month & Year	**08/2022**	**Cluster**	**CLUSTER X**			**Report No.**	**RI-II/AIR/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project		**Sample Ref. No.**	**REM/BCCL/2022/08**		**Sampling Method**	**CMPDI/RI-II/LPM 13 , (IS 5182)**	
Sampling Stations	**i**	**Sudamdih Mine Shaft**	**Date of Sampling**	10.08.22	18.08.22	**Zone of Station:**	**Core Zone**

Sl. No.	**Parameter**	**Method of Analysis**	**Observed Values (in µg/m³)**		**Range Of Testing**	**LDL**	**MoEF Standards Notification dated 25th September,2000 (GSR 742 E)**	**NAAQS, 2009**
			1st FN	**2nd FN**				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	97	92	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	47	40	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	<10	11	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	8	6	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

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

ANALYSED BY

(Gaurav Kant)
CHECKED BY

(Amit Raj Mishra)
HOD's Signature

***Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

---- End of Report ----

Page -1 of 1

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

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

TC-10122

Test Report for Ambient Air Samples

Month & Year	**08/2022**	**Cluster**	**Cluster X**	**Report No.**	**RI-II/AIR/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**			**Date of Issue**	**26.10.2022**
Project		**Sample Ref. No.**	**REM/BCCL/2022/08**	**Sampling Method**	**CMPDI/RI-II/LPM 13 , (IS 5182)**
Sampling Stations	**i**	**Jeenagora**	**Date of Sampling**	02.08.22 – 22.08.22	**Zone of Station:** **Buffer Zone**

Sl. No.	Parameter	Method of Analysis	Observed Values (in µg/m³)		Range Of Testing	LDL	MoEF Standards Notification dated 25th September,2000 (GSR 742 E)	NAAQS, 2009
			1st FN	2nd FN				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	116	87	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	65	53	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	10	11	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	8	12	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

** LDL indicates Lower Detection Limit,*

***All units are in µg/m3, 24 hourly Average,*

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

***Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

---- End of Report ----

Page -1 of 1

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

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

Test Report for Ambient Air Samples

Month & Year	**08/2022**	**Cluster**	**CLUSTER X**			**Report No.**	**RI-II/AIR/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project			**Sample Ref. No.**	**REM/BCCL/2022/08**	**Sampling Method**	**CMPDI/RI-II/LPM 13 , (IS 5182)**	
Sampling Stations	**i**	**Sitanala**	**Date of Sampling**	09.08.22	17.08.22	**Zone of Station:**	**Buffer Zone**

Sl. No.	**Parameter**	**Method of Analysis**	**Observed Values (in µg/m³)**		**Range Of Testing**	**LDL**	**MoEF Standards Notification dated 25th September,2000 (GSR 742 E)**	**NAAQS, 2009**
			1st FN	**2nd FN**				
1	PM_{10}	IS -5182(Part 23):2006, R-2017	81	69	10 µg/m³ - 1000 µg/m³	10 µg/m³	300	100
2	$PM_{2.5}$	IS -5182(Part 24):2019	40	31	10 µg/m³ - 400 µg/m³	10 µg/m³	Not Specified	60
3	SO_2	IS-5182(Part-2): 2001 , R-2017	<10	<10	10 µg/m³ - 1050 µg/m³	10 µg/m³	120	80
4	NO_2	IS-5182 (Part-6): 2006 , R-2017	18	20	06 µg/m³ - 420 µg/m³	06 µg/m³	120	80

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

ANALYSED BY

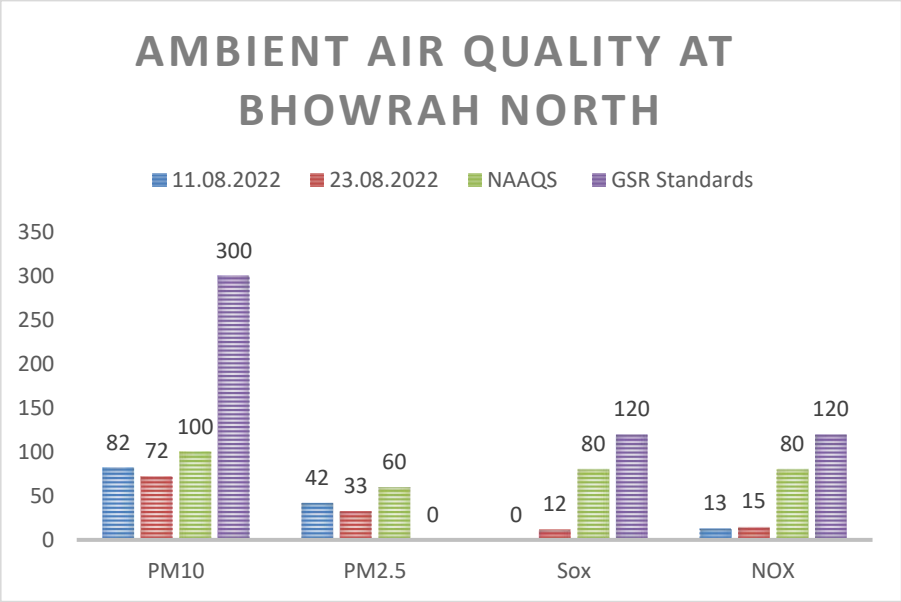
(Gaurav Kant)
CHECKED BY

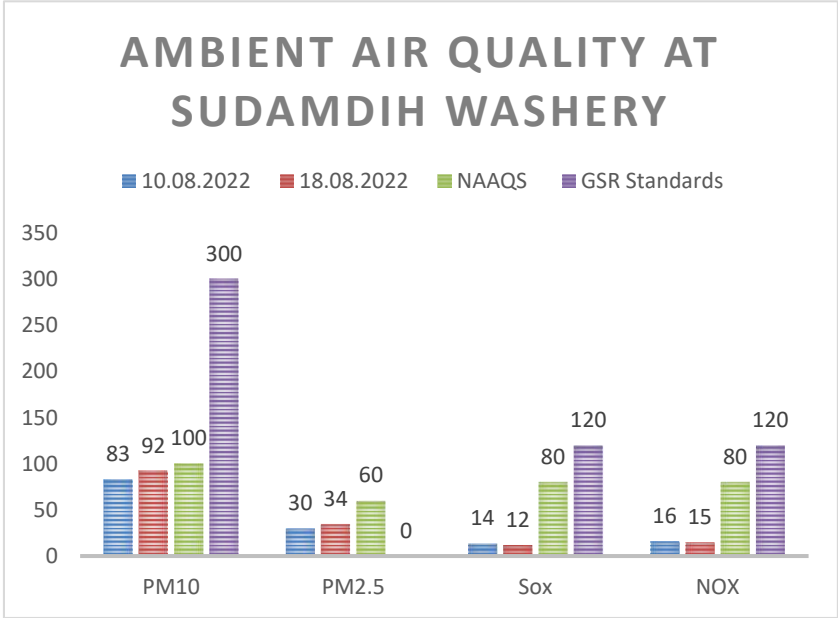
(Amit Raj Mishra)
HOD's Signature

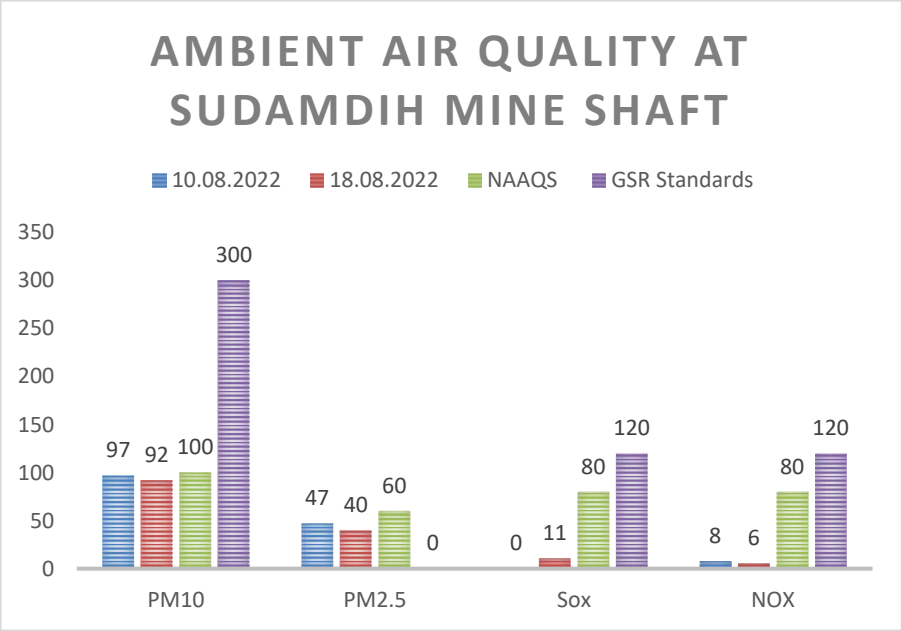
***Note**: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.*

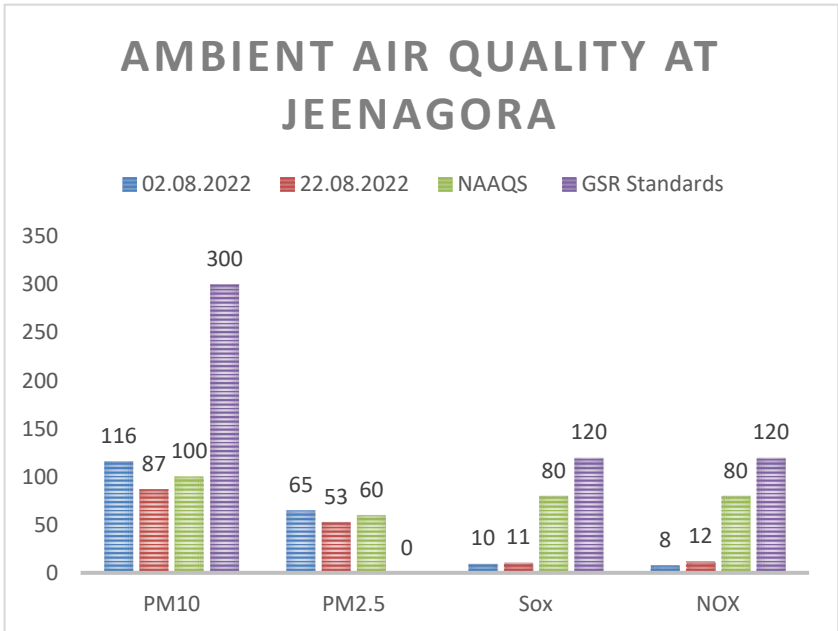
---- End of Report ----

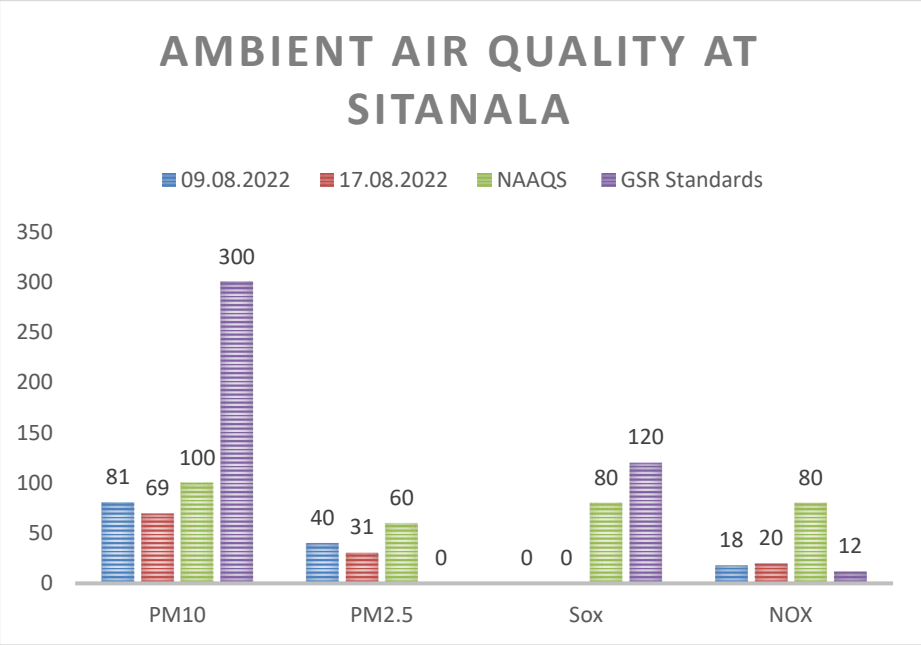
Page -1 of 1


AMBIENT AIR QUALITY AT BHOWRAH NORTH
11.08.2022
23.08.2022
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
82
72
100
300
42
33
60
0
0
12
80
120
13
15
80
120
PM10
PM2.5
Sox
NOX


AMBIENT AIR QUALITY AT SUDAMDIH WASHERY
10.08.2022
18.08.2022
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
83
92
100
300
30
34
60
0
14
12
80
120
16
15
80
120
PM10
PM2.5
Sox
NOX


AMBIENT AIR QUALITY AT SUDAMDIH MINE SHAFT
10.08.2022
18.08.2022
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
97
92
100
300
47
40
60
0
0
11
80
120
8
6
80
120
PM10
PM2.5
Sox
NOX


AMBIENT AIR QUALITY AT JEENAGORA
02.08.2022
22.08.2022
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
116
87
100
300
65
53
60
0
10
11
80
120
8
12
80
120
PM10
PM2.5
Sox
NOX


AMBIENT AIR QUALITY AT SITANALA
09.08.2022
17.08.2022
NAAQS
GSR Standards
350
300
250
200
150
100
50
0
81
69
100
300
40
31
60
0
0
0
80
120
18
20
80
12
PM10
PM2.5
Sox
NOX

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 analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED
Environment Laboratory, Regional Institute-II
MINE EFFLUENT TEST REPORT

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

Test Report for Mine Effluent samples

Month & Year	**07/2022**	**Cluster**	**Cluster X**	**Report No.**		**RI-II/WATER/2022-23/04**	
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project		**Sampling Ref. No.**	**REM/BCCL/2022/07**	**Sampling Method**	**IS 3025 (Part-1) CMPDI/RI-II/LPM 13**		
Sampling Stations	**(i)**	**Bhowrah North**	**Sample Collected in 2.5 Ltr Jerricane , Color as observed is transparent**				
			Date of Sampling	11.07.2022	25.07.2022		

Sl. No.	**Parameter**	**Method of Analysis**	**Observed Values**		**STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)**	**LDL**
			First Fortnight	**Second Fortnight**		
1	Total Suspended Solids	IS 3025/17:1984, R :2017, Gravimetric	50	55	*100 (Max)*	10
2	pH	IS-3025/11:1983, R-2017, Electrometric	8.29	8.21	*5.5 - 9.0*	0.2
3	Oil & Grease	IS 3025/39:1991, R : 2019, Partition Gravimetric	<2.0	<2.0	*10 (Max)*	2
4	COD	APHA 23rd Edition 5220 C Titrimetric Method	32	28	*250 (Max)*	4

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

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

---- End of Report ----

NOISE LEVEL QUALITY MONITORING

4.1Location of sampling sites

1. **Bhowrah North (N14)**
2. **SudamdihWashery (N15)**
3. **Jeenagora (N13)**
4. **Sitanala (N30)**
5. **Sudamdih Mine shaft (N41)**

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).

4.2 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

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

TC-10122

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

Month & Year	**08/2022**	**Cluster**	**Cluster X**			**Report No.**	**RI-II/NOISE/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project		**Sample Ref. No.**	**REM/BCCL/2022/08**		**Sampling Method**	**CMPDI/RI-II/LPM 13**	
Sampling Stations	**i**	**Bhowrah North**	**Date of Sampling**	11.08.22	23.08.22	**Zone Category of Station:**	**Core Zone**

Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	51.8	53.4	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	54.5	56.2					
3		08:00 - 09:00	57.4	58.8					
4		09:00 – 10:00	62.3	63.2					
5		10:00 - 11:00	65.3	66.9					
6		11:00 - 12:00	64.6	65.4					
7		12:00 - 13:00	67.6	69.3					
8		13:00 - 14:00	69.0	65.2					
9		14:00 - 15:00	63.0	63.8					
10		15:00 - 16:00	62.0	62.8					
11		16:00 - 17:00	61.4	62.2					
12		17:00 - 18:00	60.9	61.7					
13		18:00 - 19:00	60.0	60.8					
14		19:00 - 20:00	58.9	59.6					
15		20:00 - 21:00	58.9	59.6					
16		21:00 - 22:00	58.3	59.1					
		Leq DAY	**63.0**	**63.4**					
1	Noise Level dB(A)Leq -Night	22:00-23:00	46.1	45.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	45.4	44.1					
3		00:00- 01:00	44.3	43.9					
4		01.00-02.00	44.0	43.5					
5		02.00-03.00	41.9	43.1					
6		03.00-04.00	41.2	40.8					
7		04.00-05.00	40.0	40.2					
8		05:00-06:00	39.8	40.1					
		Leq NIGHT	**43.4**	**43.1**					

**LDL indicates Lower Detection Limit*

***All noise measurements are integrated for a 01 hour period, All units in dB(A)*

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

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

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

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

Month & Year	**08/2022**	**Cluster**	**Cluster X**			**Report No.**	**RI-II/NOISE/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project		**Sample Ref. No.**	**REM/BCCL/2022/08**		**Sampling Method**	**CMPDI/RI-II/LPM 13**	
Sampling Stations	**i**	**Sudamdih Washery**	**Date of Sampling**	10.08.22	18.08.22	**Zone Category of Station:**	**Core Zone**

Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	51.4	52.7	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	54.8	55.4					
3		08:00 - 09:00	57.4	58.1					
4		09:00 – 10:00	63.8	64.5					
5		10:00 - 11:00	65.3	66.1					
6		11:00 - 12:00	64.5	64.5					
7		12:00 - 13:00	66.8	67.6					
8		13:00 - 14:00	68.3	67.2					
9		14:00 - 15:00	62.2	63.0					
10		15:00 - 16:00	61.3	62.0					
11		16:00 - 17:00	60.7	61.4					
12		17:00 - 18:00	64.2	60.9					
13		18:00 - 19:00	59.3	60.0					
14		19:00 - 20:00	58.2	58.9					
15		20:00 - 21:00	57.6	58.8					
16		21:00 - 22:00	57.6	58.3					
		Leq DAY	**62.8**	**62.9**					
1	Noise Level dB(A)Leq -Night	22:00-23:00	45.6	45.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	43.8	44.7					
3		00:00- 01:00	42.1	44.2					
4		01.00-02.00	42.3	43.1					
5		02.00-03.00	42.0	42.1					
6		03.00-04.00	41.2	40.8					
7		04.00-05.00	40.8	40.2					
8		05:00-06:00	39.7	38.9					
		Leq NIGHT	**42.5**	**43.0**					

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

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

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

Page -1 of 1

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

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

Month & Year	**08/2022**	**Cluster**	**Cluster X**			**Report No.**	**RI-II/NOISE/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project		**Sample Ref. No.**	**REM/BCCL/2022/08**		**Sampling Method**	**CMPDI/RI-II/LPM 13**	
Sampling Stations	**i**	**Jeenagora**	**Date of Sampling**	02.08.22	22.08.22	**Zone Category of Station:**	**Buffer Zone**

Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	45.3	45.1	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	47.7	47.4					
3		08:00 - 09:00	48.6	48.2					
4		09:00 – 10:00	55.5	54.5					
5		10:00 - 11:00	56.8	55.9					
6		11:00 - 12:00	55.5	55.2					
7		12:00 - 13:00	58.1	58.5					
8		13:00 - 14:00	57.2	57.2					
9		14:00 - 15:00	59.3	56.8					
10		15:00 - 16:00	53.3	54.1					
11		16:00 - 17:00	52.8	52.6					
12		17:00 - 18:00	52.3	52.1					
13		18:00 - 19:00	51.6	51.3					
14		19:00 - 20:00	52.1	52.0					
15		20:00 - 21:00	50.6	49.7					
16		21:00 - 22:00	44.2	45.9					
		Leq DAY	**54.4**	**53.9**					
1	Noise Level dB(A)Leq -Night	22:00-23:00	46.1	45.6	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	45.1	44.2					
3		00:00- 01:00	42.5	42.9					
4		01.00-02.00	42.0	42.0					
5		02.00-03.00	40.8	41.5					
6		03.00-04.00	40.2	41.5					
7		04.00-05.00	41.5	39.5					
8		05:00-06:00	40.0	39.2					
		Leq NIGHT	**42.8**	**42.5**					

**LDL indicates Lower Detection Limit*

***All noise measurements are integrated for a 01 hour period, All units in dB(A)*

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

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

Page -1 of 1

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

TC-10122

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

Month & Year	**08/2022**	**Cluster**	**Cluster X**			**Report No.**	**RI-II/NOISE/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**					**Date of Issue**	**26.10.2022**
Project		**Sample Ref. No.**	**REM/BCCL/2022/08**		**Sampling Method**	**CMPDI/RI-II/LPM 13**	
Sampling Stations	**i**	**Sitanala**	**Date of Sampling**	09.08.22	17.08.22	**Zone Category of Station:**	**Buffer Zone**

Sl. No.	Parameter	Hour / Time of day	Observed Values (in Leq dB(A)) First Fortnight	Observed Values (in Leq dB(A)) Second Fortnight	Method of Analysis	Range Of Testing	LDL	NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones	Limits in dB
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	45.8	46.7	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	48.2	49.2					
3		08:00 - 09:00	53.4	51.6					
4		09:00 – 10:00	56.1	57.2					
5		10:00 - 11:00	57.4	58.6					
6		11:00 - 12:00	62.3	57.2					
7		12:00 - 13:00	58.8	60.0					
8		13:00 - 14:00	60.0	61.3					
9		14:00 - 15:00	55.6	55.9					
10		15:00 - 16:00	53.9	55.0					
11		16:00 - 17:00	53.4	54.5					
12		17:00 - 18:00	52.9	54.0					
13		18:00 - 19:00	52.1	53.2					
14		19:00 - 20:00	51.2	52.2					
15		20:00 - 21:00	50.6	52.2					
16		21:00 - 22:00	50.4	51.7					
		Leq DAY	**55.9**	**56.0**					
1	Noise Level dB(A)Leq -Night	22:00-23:00	45.1	45.3	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	44.5	44.2					
3		00:00- 01:00	42.3	43.1					
4		01.00-02.00	43.0	43.8					
5		02.00-03.00	41.5	43.2					
6		03.00-04.00	41.0	42.5					
7		04.00-05.00	41.3	41.0					
8		05:00-06:00	40.3	41.9					
		Leq NIGHT	**42.7**	**43.3**					

**LDL indicates Lower Detection Limit*

***All noise measurements are integrated for a 01 hour period, All units in dB(A)*

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

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

Page -1 of 1

TC-10122

CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED

Environment Laboratory, Regional Institute-II

Ambient Noise Level Test Report

Month & Year	**08/2022**	**Cluster**	**Cluster X**					**Report No.**	**RI-II/NOISE/2022-23/05**
Customer	**Environment Department, Bharat Coking Coal Limited (BCCL), Koyla Bhawan, Dhanbad (E-mail: gmenv.bccl@coalindia.in)**							**Date of Issue**	**26.10.2022**
Project			**Sample Ref. No.**	**REM/BCCL/2022/08**		**Sampling Method**		**CMPDI/RI-II/LPM 13**	
Sampling Stations	**i**	**Sudamdih Mine Shaft**		**Date of Sampling**	10.08.22	18.08.22	**Zone Category of Station:**	**Core Zone**	

Sl. No.	**Parameter**	**Hour / Time of day**	**Observed Values (in Leq dB(A)) First Fortnight**	**Observed Values (in Leq dB(A)) Second Fortnight**	**Method of Analysis**	**Range Of Testing**	**LDL**	**NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000 Standards Zones**	**Limits in dB**
1	Noise Level dB(A)Leq - Day	06:00 - 07:00	46.5	46.1	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	75 65 55 50
2		07:00 - 08:00	48.9	48.6					
3		08:00 - 09:00	51.3	50.9					
4		09:00 – 10:00	56.9	56.5					
5		10:00 - 11:00	58.3	57.9					
6		11:00 - 12:00	56.9	57.8					
7		12:00 - 13:00	59.7	59.2					
8		13:00 - 14:00	60.9	60.5					
9		14:00 - 15:00	55.6	55.2					
10		15:00 - 16:00	54.7	62.2					
11		16:00 - 17:00	54.2	53.8					
12		17:00 - 18:00	53.7	53.3					
13		18:00 - 19:00	52.9	52.5					
14		19:00 - 20:00	52.0	51.6					
15		20:00 - 21:00	52.0	51.4					
16		21:00 - 22:00	51.5	51.1					
		Leq DAY	**55.7**	**56.3**					
1	Noise Level dB(A)Leq -Night	22:00-23:00	45.2	44.9	CPCB, Protocol for Ambient Level Noise Monitoring - 2015	35 dB-135 dB	35 dB(A)	Industrial Commercial Residential Silence	70 55 45 50
2		23:00- 00:00	44.9	43.7					
3		00:00- 01:00	43.7	42.9					
4		01.00-02.00	42.8	43.1					
5		02.00-03.00	42.1	43.0					
6		03.00-04.00	41.9	42.7					
7		04.00-05.00	40.9	42.6					
8		05:00-06:00	39.9	42.1					
		LeqNIGHT	**43.0**	**43.2**					

**LDL indicates Lower Detection Limit*

***All noise measurements are integrated for a 01 hour period, All units in dB(A)*

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

Note: The results above relate to the samples tested as received. This report can not be reproduced in part or full without the written permission of the HOD(Env) , CMPDI, RI-II.

---- End of Report ----

Page -1 of 1

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
	Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average * 24 hours **	250 µg/m^3 300 µg/m^3	Respirable Particulate Matter sampling and analysis
	Sulphur Dioxide (SO_2)	Annual Average * 24 hours **	80 µg/m^3 120 µg/m^3	1.Improvedwest and Gaeke method 2.Ultraviolet fluorescene
	Oxide of Nitrogen as NO_2	Annual Average * 24 hours **	80 µg/m^3 120 µg/m^3	1. Jacob & Hochheiser Modified (Na-Arsenic) Method 2. Gas phase Chemilumine-scence

Note:

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

** 24hourly/8hourly 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 November 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect.

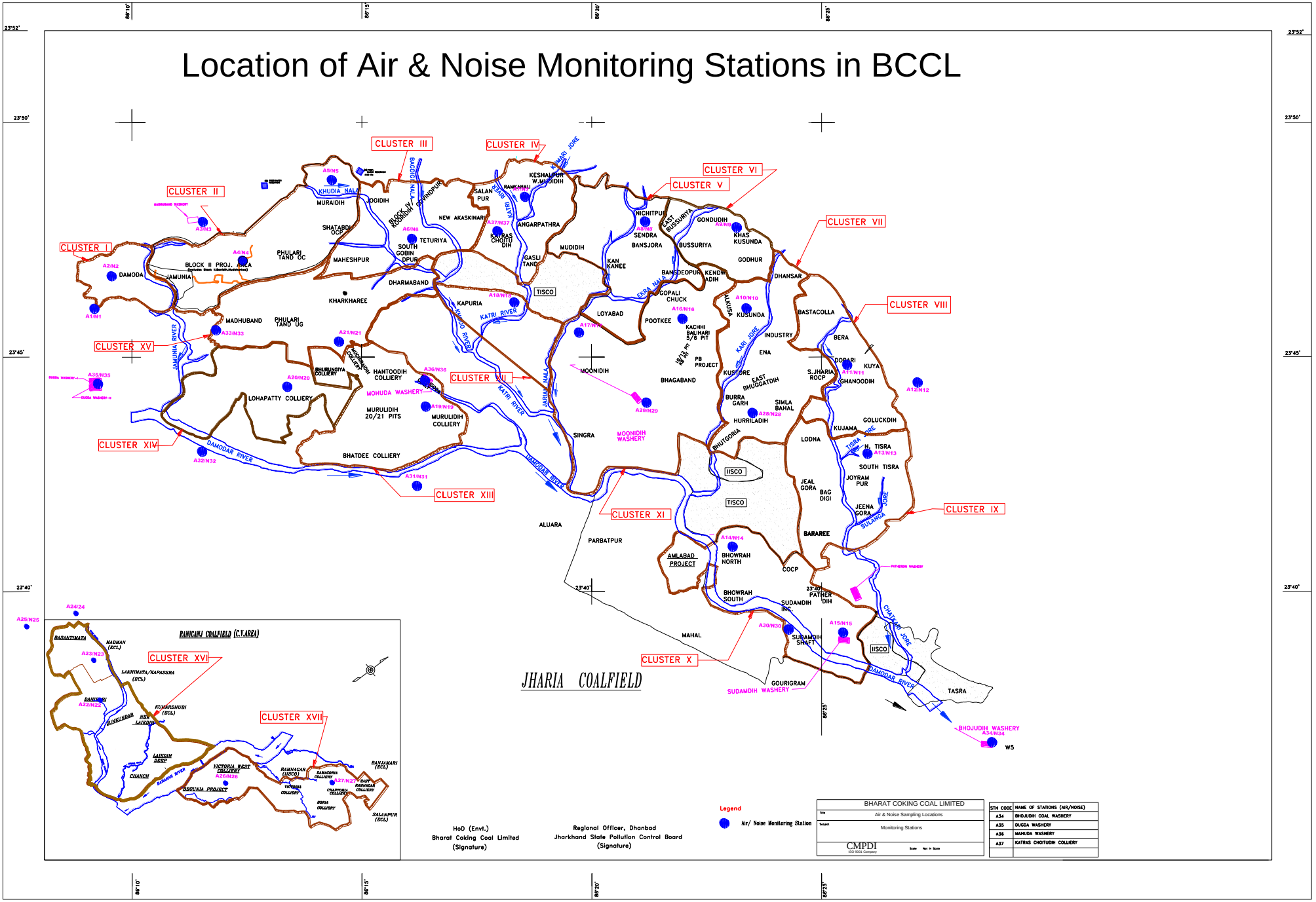
Pollutant	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (Notified by Central Government)	
Sulphur Dioxide (SO_2), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet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

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

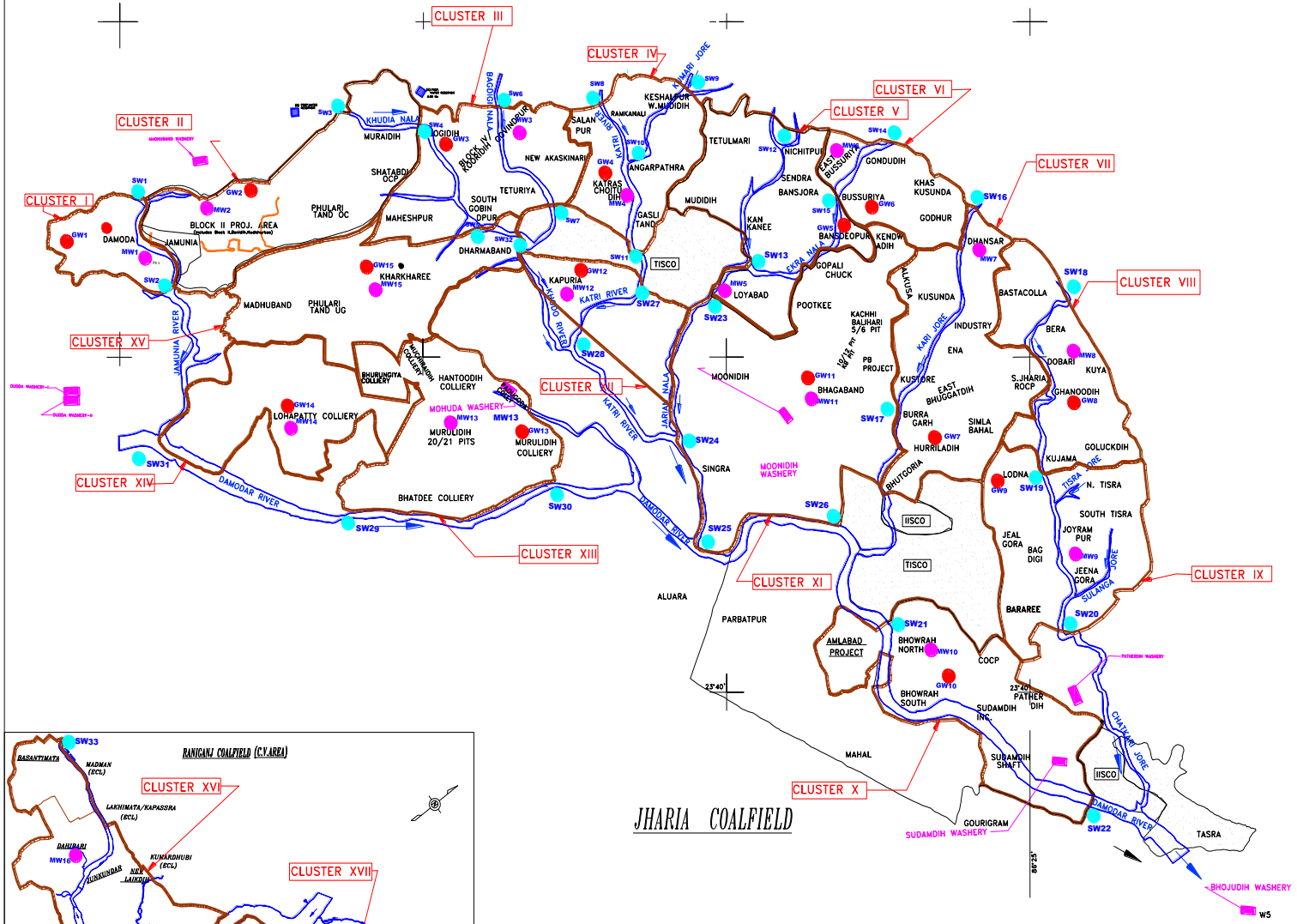
** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

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

Location of Air & Noise Monitoring Stations in BCCL



Water Sampling Locations in BCCL



INDEX

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

ACTION PLAN FOR IMPLEMENTATION OF POLLUTION CONTROL MEASURES IN BCCL COMMAND AREA

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	**Medium Term (12 Months)**	**Long term (24 Months)**		
1	**Air Pollution Control measures**	***Covered Transportation*** A) Responsibility of CISF personnel appointed at weigh-bridge will be to maintain a Register for tarpaulin covering of coal loaded trucks. B) GMs of respective areas will insure the implementation of the above within 15 days of order/Action Plan released.	✔ ***3 Months*** *Ensuring proper mechanism of inspection and implementation of Covered truck is in Place* **Continuing**	-	-	• Area Environment Engineer • Area GM • HOD(Env), HQ BCCL	NA
2		***Permanent Pucca Transportation Road*** ***A)*** Roads under BCCL will be Paved/Black topped in Non-Coal Bearing Area ***B)*** *Cost Estimate*: Area Civil Engineer (**4 Months**) ***C)*** *Capital Indent*: Area Civil Engineer (3 Months) ***D)*** *Approvals/Tender/ Work start and completion*: Area Civil Deptt. & CED, HQ (**12 Months**)	-	-	✔	• Area Civil Engineer • Area GM BCCL	Capital Budget Respective Areas 3 crores
3		***Drilling with Dust extractor/wet drilling*** ***A)*** All Existing drills are equipped with dust containment or water injection system. All new procurements of drills shall be with dust containment system. ***B)*** *Cost Estimate*:Excavation Deptt. ***C)*** *Capital Indent*: Excavation Deptt.		✔ At present no drills procurement is in-line.		• GM Excavation • Area GM BCCL	- Capital Budget will be reapportioned as required

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	Medium Term (12 Months)	Long term (24 Months)		
		D) *Approvals/Tender/ Work start and completion*: E&M Deptt.					
4		***Fixed Sprinkling arrangements at Siding (preferably at height)*** ***A)*** Sprinklers shall be installed ***B)*** *Cost Estimate*: Siding in-charge & Area E&M Manager, E&M In-charge washery (3 **Months**) ***C)*** *Capital Indent*: Colliery Manager &Area E&M Manager, Area Env Engineer (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: Area E&M Deptt. & MM deptt, HQ (7 **Months**)	-	✓	-	• Area GM • GM WCD, CCWO • HOD(Env) BCCL	Capital Budget Environment Head: 2.5 Crores. Othr Heads : 6.5 Lakhs
5		***Overhead sprinklers at Loading site*** ***A)*** At loading points overhead water showering arrangement shall be provided. ***B)*** *Cost Estimate*: Colliery Engineer& Area E&M Manager (**2 Months**) ***C)*** *Capital Indent*: Colliery Manager &Area E&M Manager (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: Area E&M Deptt.& Project officer (**7 Months**)	-	✓	-	• Project Officer • Area GM • HOD(Env) BCCL	Capital Budget Environment Head: 2.5 Crores.
6		***Mobile sprinklers/ Mist Sprinkler*** ***A)*** Mobile sprinklers trips will be increased and Mist sprinklers procurement will be done	-	✓	-	• GM E&M • HOD (Env)	Capital Budget Environment Head: 2.5 Crores

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	Medium Term (12 Months)	Long term (24 Months)		
		B) *Cost Estimate*: E&M Deptt., HQ(**3 Months**) ***C)*** *Capital Indent*: Area E&M Manager (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: MM deptt, HQ (**6 Months**)					
7		***Wheel washing ditches after weigh-bridge for tire cleansing*** ***A)*** Wheel washing arrangement shall be provided at Weigh- Bridge site ***B)*** *Cost Estimate*: Colliery Manager & Area Civil Engineer (**2 Months**) ***C)*** *Capital Indent*: Colliery Manager, Project officer&Area Civil Engineer (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: Area E&M Deptt. & MM deptt, HQ (**6 Months**)	-	✔	-	• Project Officer, BCCL • Area GMBCCL • Project Officer, Washery, BCCL	Capital Budget New commitment
8		***Enclosure of CHP/covered crushing*** ***A)*** CHP/Crushers shall be covered ***B)*** *Cost Estimate*: Area Manager Transport & Area E&M Manager (**2 Months**) ***C)*** *Capital Indent*: Colliery Manager & Project officer (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: Area E&M Deptt. & MM deptt, HQ (**6 Months**)	-	✔	-	• Area Manager transport • Area Manager Sales BCCL	Capital Budget New Commitment
9		***Grass covering over inactive OB dumps.*** ***A)*** Inactive OB dumps shall be identified and will be covered with	-	✔ Continuing	✔	• HOD (Env) • SRM (Min), Eco-Restoration Team	Revenue Budget Rs 5 crores

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	**Medium Term (12 Months)**	**Long term (24 Months)**		
		grass ***B)*** *Cost Estimate*: Area Environment Engineer (**2 Months**) ***C)*** *Proposal*: HQ Env Deptt. (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: HQ, Env Deptt. (**6 Months**)				• Area Env Manager	
10		***Building boundaries around railway siding made of coconut choirs or GI sheets.*** ***A)*** Railway sidings will be surrounded with boundaries of GI Sheets/Coconut coir/Jute Cloths B) *Cost Estimate*: Siding in-charge & Area Civil Manager (**2 Months**) C) *Capital Indent*: Colliery Manager & Project officer (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: Area E&M Deptt. & MM deptt, HQ (**6 Months**)	-	✔	-	• Area GM • HOD(Env) BCCL	Capital Budget New Commitment
11		***Introducing Bioswale as Pilot Project*** A) Cost Estimate: GM Civil, CED, HQ B) Capital Indent: GM Civil, CED,HQ C) Approval/Tender/Work start and completion: CED, HQ			✔	• Concerned Area GM • GM Civil • HOD(Env)	Capital Budget New Commitment

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	Medium Term (12 Months)	Long term (24 Months)		
12		***Fiery coal/OB should be dumped in-pit/ wetted completely before transporting*** ***A)*** Fiery coal shall not be transported on elevated OB dumps and shall be dumped in-pit/ transported after complete wetting B) Project officer & Area manager planning to site the location prior to excavating fiery coal/OB. ***C)*** Water Pools to be used for drenching of fire and wetting of fiery coal/OB ***D)*** Strict instructions to be issued from Functional Technical Directors.	✓	-	-	• Area GM • HOD (Env)	-
13		***Pollution under control Certificate to be ensured by Transporter/ BCCL transport in-charge*** A) *CMC Deptt: To be included in contracts of transporter* B) *Area Transport In-Charge shall ensure PUC is issued to all plying vehicles*	✓	-	-	Area Manager Transport HOD(Env)	-
14	**Inspection/ Monitoring measures/ Complaint Redressal**	***AAQ Monitoring*** A) 39 Air and Noise Monitoring Stations in JCF B) Stations established in consultation with JSPCB	✓ ***Ongoing***	-	-	• CMPDIL, RI-II, Dhanbad	Revenue Budget Rs 3.5 crores
15		***COAAQMS,*** A) COAAQMS shall be installed at Jagjeevan Nagar	-	✓	✓	• CMPDIL • HOD(Env) BCCL	Capital Budget Rs 3 crores

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	Medium Term (12 Months)	Long term (24 Months)		
		B) *Cost Estimate*: CMPDIL, RI-II, Dhanbad (**2 Months**) C) *Capital Indent*: CMPDIL, RI-II, Dhanbad (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: CMPDIL, RI-II, Dhanbad (**6 Months**) ***Online PM10 Analyser*** Online PM10 Analyzer shall be installed at Mines and Railway sidings ***A)*** *Cost Estimate*: Area Environment Manager (**2 Months**) ***B)*** *Capital Indent*: Colliery Manager (**2Months**) ***C)*** *Approvals/Tender/ Work start and completion*: MM Deptt, HQ (**6 Months**)					
16		***Source Apportionment Study*** Work awarded to NEERI, Nagpur on 12.05.2018. Monitoring work started Final report shall be submitted in One year	-	✓	-	HOD(Env)	Revenue Budget Rs 1.41 Crores
17		***HQ Environment Deptt. review and report the status of compliances to FDs and Board*** • Structured meetings with all the areas/washeries • Inspection of Areas by HQ Compliance team	✓ ***Ongoing***	-	-	SRM (Min) HOD (Env)	-

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	Medium Term (12 Months)	Long term (24 Months)		
18		***All the areas to inspect each other's progress monitored under Environment Department, HQ*** ***A)*** Schedule and teams already formulated for inspections	✓	-	-	Area Inspection Team	-
18		***An Inspecting team to be formed consisting local activist/NGO for regular inspection of above practices*** ***A)*** Area Environment Committee to be formulated for monitoring of Environment Compliances (1 Month)	✓	-	-	Area Environment Committee	-
19	**Water Environment**	***Township wise STP/ETP*** ***A)*** STP will be installed in Koyla Nagar, Jagjeevan Nagar with 2 MLD capacity **DMC will collect septage for whole Jharia and Koyla Nagar, Bhuli Township** B) *Cost Estimate*: CED, HQ (3 **Months**) C) *Capital Indent*: CED, HQ (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: CED,HQ (12 **Months**)			✓	GM (Civil)	Capital Budget: 3.85 crores
20		***Workshop effluents treatment*** ***A)*** Oil & Grease Trap B) *Cost Estimate*: Workshop In-charge (**2 Months**) C) *Capital Indent*: Workshop in-charge & Area Civil Engineer (**2Months**) ***D)*** *Approvals/Tender/ Work start and completion*: CED, HQ (8 **Months**)	-	✓	-	• Area Environment Manager • Workshop Incharge • HOD (Env) BCCL	Capital Budget: Rs 5 crores

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	**Medium Term (12 Months)**	**Long term (24 Months)**		
21		***Garland Drains/Retaining Walls around OB Dumps*** A) *Cost Estimate*: Area Civil Engineer & Area Survey officer (**2 Months**) B) *Capital Indent*: Area Civil Engineer, Area Environment Manager & Area Survey Officer (**2Months**) ***C)*** *Approvals/Tender/ Work start and completion*: CED, HQ (8 **Months**)	-	✔	-	• Area Civil Manager • Area GM BCCL	Capital Budget 2.00 crores
22	**Others**	***Biodiversity*** A) Plantation over OB dumps/Backfilled Areas/ Avenue & Boundary Plantation B) स्नेह स्मृति उपवन shall be developed in all areas.	✔ Eco-restoration with three tier plantation practiced. For 2019-20, plantation of area of 54 Ha will be done by State Forest Department.	✔	✔	• HOD(Env) • Area GM BCCL	Revenue Budget Plantation: 5 crores
23		***Mechanical Sweeper*** Proposal: CSR Deptt. Handed over to Dhanbad Municipal Corporation	-	✔	-	Dhanbad Municipal Corporation	CSR Budget

ACTION PLAN FOR FOREST CLEARANCE COMPLIANCE

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	**Medium Term (12 Months)**	**Long term (24 Months)**		
1	Soil Management	*Mitigative measures to minimize soil erosion* • Contour Trenching • Gully Plugging • Brushwood Checkdam *Cost Estimate: Area Civil Engineer* *Capital Indent: Area Civil Engineer* Rate Consultation: State Forest Department		✔		• Area Environment Engineer • Area GM • HOD(Env), HQ BCCL	**Revenue Budget** 30 Lakhs (Bastacolla Area) **Capital Budget** Bastacolla Area: 10 Lakhs Environment: 5 crores
2		*Plantation of drought hardy plant species* *Cost Estimate: Area Environment Manager* *Rate Consultation: State Forest Department*	✔ Continuing			• Area GM • HOD(Env), HQ BCCL	**Revenue Budget** Plantation: Rs 6 Crores
3		***Construction of check dams, retention/toe walls*** ***Cost Estimate: Area Civil Engineer*** ***Capital Indent: Area Civil Engineer***		✔		• Area GM • HOD(Env), HQ BCCL	**Capital Budget** Bastacolla Area: 10 Lakhs Environment Settling Pond: 5 crores
4	Demarcation	***Boundary of Safety Zone and Mining Lease*** Ensure demarcation exists for safety zone and Mining lease by erection of Concrete Pillars (4 feet high from ground)	✔ Demarcated (Safety Zone already demarcated)	✔ Mining lease will be demarcated.		• Area GM • Area Environment Manager	-

SL No.	Type of Action	Activities and Executing Responsibilities	Timeline			Monitoring and Reporting	Budget
			Short term (3 to 6 Months)	Medium Term (12 Months)	Long term (24 Months)		
5	**Others**	***Plantation in Blanks within Lease*** Area Identification: Project Officer, Concerned Colliery Cost Estimate: Area Environment Manager	-	✓	-	• Project Officer • Area GM • HOD(Env) BCCL	**Revenue Budget** Plantation Head: 6 Crores.
6		***De-silting of Village tanks and water bodies located within 5 Kms*** Identification of Site: Project Officer Cost Estimate: Area Civil Engineer	-	✓	-	• Area GMs • Area Environment Manager	**Revenue Budget** Environment Head: 2 Crores

EXISTING STATUS OF VARIOUS POLLUTION CONTROL MEASURES

ANNEXURE-1

Existing Mobile Sprinklers

Sl no.	Unit/area	Mobile Sprinklers (No.)	
		No. of Mobile Tankers	Capacity of Tankers (KL)
1	Barora Area	5	92
2	Block II	5	124
3	Govindpur Area	4	68
4	Katras Area	16	284
5	Sijua Area	11	204
6	Kusunda Area	16	170
7	PB	7	42
8	Bastacolla Area	19	240
9	Lodna Area	9	156
10	E J Area	8	112
11	W J Area	3	20
12	C V Area	6	118
13	WWZ Area	5	35.2
14	EWZ Area	2	20
TOTAL		**116**	**1685.2**

ANNEXURE-2

Existing Fixed Sprinklers:

Unit/area	No. of Fixed Sprinklers
Block II	Working (Nudkhrkhi)
Govindpur Area	Working
Katras	95
Sijua Area	10
Kusunda Area	Working (Godhur)
Lodan	10
W J Area	34
WWZ Area	143
EWZ Area	7
Total	**299**

ANNEXURE-3

Status Garland Drains

Sl. no.	Total OB dumps (Mine wise)	Dumps to be rehandled /used for backfilling and so do not require wall	Old dumps that require wall/ garland drain in Mtrs.	Work Completed as on date in Mtrs.
1	Jamunia		480	480
2	Gopalichak	Dump to be rehandled for backfilling	-	-
3	Muralidih		100	100
4	Bhowra(North)		150	150
	Bhowra(South)		150	150
5	Damoda		300	300
6	Block-IV		660	460
7	Muraidih	Dump to be rehandled for backfilling	400	400
8	Mudidih		250	250
9	Akashkinari		700	500
10	West Mudidih		-	-
11	Gaslitand		250	
12	Tetulmari	Dump to be rehandled for backfilling	-	-
13	Nichitpur		175	-
14	SendraBansjora		175	175

ANNEXURE-4

Plantation Status:

S. No.	Area/colonies	Total Plantation area (Ha)	Gabion/ Avenue / Road side Plantation	Total afforestation/ eco-restoration (Nos)
1.	Barora	320.86	1000	854908
2.	Block-II	27	570	67500
3.	Govindpur	74.5	250	184050
4.	Katras	36.78	2285	40695
5.	Sijua	97.1	1320	194230
6.	Kusunda	41.78	500	89457
7.	PB Area	28	1390	67350
8.	Bastacolla	87.2	1600	188000
9.	Lodna	85.8	1848	178655
10.	EJ Area	127.74	2500	185075
11.	WJ Area	269.4		366550
12.	CV Area	94.6	7300	238870
13.	Koyla Nagar	10.5	4450	12600
14.	Jagjivan Nagar	3.4		4080
15.	Washery division	35	125	110250
16.	CCWO Colony	2.6		3120
17.	Bhuli Township	8.9		10680
	Others			13297
Total		1350.66	25138	2809367
Total Plantation by BCCL (including Gabion/ Avenue / Road side & eco-restoration)				2834505

ANNEXURE-5

Oil & Grease Trap in Workshop

Sl no.	Area	Completed	Proposed
1	Barora	**Completed**	
2	PB	**Completed**	
3	Sinidih	**Completed**	
4	Block-II	**Completed**	
5	Sijua	**Completed**	
6	Lodna	**Completed**	
7	Govindpur		**Proposed**
8	Katras	**Completed**	
9	Bastacolla		**Proposed**
10	Kusunda		**Proposed**
11	EJ		**No Workshop**
12	CV		**Proposed**

ANNEXURE-6

DrillsDust suppression system status:

Sl. no.	Mine	Total No. of drills	No. of drills with dust containment system
1	Jamunia	2	2
2	Block-II	7	7
3	Damoda	3	3
4	Muraidih	5	5
5	Shatabdi	4	4
6	Akashkinari	1	1
7	Block-IV	4	4
8	AKWMC	6	6
9	Nichitpur	4	4
10	SendraBansjora	2	2
11	East Bassuria	2	2
12	Dhansar	3	3
13	ROCP	3	3
14	Ena	2	2
15	Ghanoodih	3	3
16	KOCP	3	3
17	NT/ST	4	4
18	Jeenagora	3	3
19	COCP-Bhowra	2	2
20	COCP-Patherdih	4	3
21	Dahibari-Basantimata	7	7

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

Sponsor

Bharat Coking Coal Limited (BCCL)

CSIR-National Environmental Engineering

Research Institute, Nagpur

April 2022

Principal Investigator

Dr. Rajesh Biniwale
Senior Principal Scientist
CSIR-National Environmental
Engineering Research Institute
Nagpur-440020, Maharashtra
rb_biniwale@neeri.res.in

Scientific Team

Dr. Yogesh Pakade
Er. S.A. Praveen
Dr. Rakesh Kadaverugu
Dr.Anirban Middey
Dr. A. D. Bhanarkar

Project Team

Mr. Pankaj Kaware

Mr. Ariz Ahmed

Ms. Anshu Pandey

Ms. Samiksha Ashtikar

Ms. Shruti Pande

Ms. Punam Bagde

Ms. Pratiksha Thombre

Mr. Mohit Mahurkar

Mr. Rahul Pawar

Ms. Smita Aditya

Mr. Ankush Rai

Mr. Vijay Selvaraj

Contents

List of Tables 6
Chapter 1 Introduction 7
1.1. Climate 8
1.2. Land use & Land cover 8
1.3. Population 9
1.4. Purpose of Study 9
1.5. Approach of study 11
Chapter 2 Emission Inventory 12
2.1. Inventory of Point Sources 12
2.2. Inventory of Area Sources 12
2.3. Inventory of Line Sources 12
2.4. Methodology 14
2.5. Results 15
2.5.1. Industrial Emission 15
2.5.2. Area/Distributed source 16
- Emission load from mining activities 17
- Cooking operations in non-slum household 17
- Cooking operations in slum households 18
- Emissions from crematorium 18
- Emissions from bakeries 18
- Emissions from hotels and restaurants 18
- Emission from open eat-outs 19

2.5.3. Grid wise emission inventory 19
Chapter 3 Air Quality Monitoring and Receptor modelling 22
3.1. Sampling Method and Schedule 24
3.2. Chemical Analysis 26
3.2.1. Gravimetric analysis 26
3.2.2. Elemental analysis 26
3.2.3. Analysis of SO_2 and NO_2 26
3.2.4. Ion analysis 27
3.2.5. Polycyclic Aromatic Hydrocarbons (PAH) analysis 27
3.2.6. EC & OC analysis 27
3.3. Results 28
3.3.1. Mass concentration of PM_{10} and $PM_{2.5}$ 28
3.3.2. Elemental concentration of PM_{10} and $PM_{2.5}$ in summer 30
3.3.3. Elemental Concentration of PM_{10} and $PM_{2.5}$ in Winter 31

3.3.4. SO_2 and NO_2 concentration in ambient air in the Summer season 33
3.3.5. SO_2 and NO_2 concentration in ambient air in Winter season 33
3.3.6. Carbonaceous Aerosol/EC & OC in Summer 34
3.3.7. Carbonaceous Aerosol/EC & OC in winter 34
3.3.8. Ionic composition of PM_{10} and $PM_{2.5}$ in Summer season 36
3.3.9. Ionic composition of PM_{10} and $PM_{2.5}$ in Winter season 36
Chapter 4 Receptor modelling 40
4.1. Source Apportionment 40
4.1.1. Chemical Mass Balance (CMB) 40
4.1.2. Source profiling 42
4.1.3. Ambient profiling 42
4.2. Results of the Chemical Mass Balance 43
4.2.1. Domestic combustion 43
4.2.2. Industrial Emission 44
4.2.3. Coal Mining 44
4.2.4. Transportation 44
4.2.5. Secondary Inorganic Aerosol 44
4.2.6. Agriculture 45
4.2.7. Open burning 45
4.2.8. Road Resuspension dust 45
4.2.9. Other emission Contribution 45
Chapter 5 Dispersion Modelling 52
5.1. Wind data analysis 52
5.2. Dispersion of Particulate matter 54
Chapter 6 Recommendation 59
6.1. Mine industries 59
6.2. Area Sources 59
6.3. Line Source 60
6.4. Others 61

List of Figures

Figure 1.1: Geographical location of Jharia Coalfield in India 7
Figure 1.2: Land Use land cover map of Jharia coal field area 8
Figure 1.3: Air quality Monitoring & emission source apportionment studies 11
Figure 2.1 Percentage of different types of vehicle surveyed on the road network during the field survey 14
Figure 2.2 PM_{10} emission load for different categories of vehicle 15
Figure 2.3 Grid-wise emission inventory of PM_{10} in tons/year over the study area 20
Figure 2.4 Grid-wise emission inventory of PM2.5 in tons/year over the study area 20
Figure 2.5 (a) and (b) represents emission load from various sectors over JCF region for PM_{10} and $PM_{2.5}$ respectively 21
Figure 3.1: Air monitoring sites under 30 km buffer area 23
Figure 3.2: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region in summer compared to NAAQS (2009) 29
Figure 3.3: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region during Winter compared to NAAQS (2009) 30
Figure 3.4: Metal concentration of PM_{10} in the summer season 31
Figure 3.5: Metal concentration of $PM_{2.5}$ in the summer season 31
Figure 3.6: Metal concentration of PM_{10} in winter season 32
Figure 3.7: Metal concentration of PM 2.5 in winter season 32
Figure 3.8: NO_2 and SO_2 Concentration of all monitoring sites in summer season 33
Figure 3.9: NO_2 and SO_2 Concentration of all monitoring sites in Winter season 34
Figure 3.10: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Summer season 35
Figure 3.11: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Winter Season 36
Figure 3.12: Anion and Cation concentration in PM_{10} in summer 37
Figure 3.13: Anion and Cation concentration in $PM_{2.5}$ in summer 38
Figure 3.14: Anion and Cation concentration in PM_{10} in winter 38
Figure 3.15: Anion and Cation concentration in $PM_{2.5}$ in winter 39
Figure 4.1: General methodology followed in the source apportionment studies 43
Figure 4.2: Source contribution at receptor locations of PM_{10} and $PM_{2.5}$ in summer 47
Figure 4.3: Source contribution at receptor locations of PM_{10} and $PM_{2.5}$ in winter 47
Figure 5.1: Methodology followed in the study. 52
Figure 5.2: Windrose of the study area during March-June, 2019 (wind direction blowing towards the center) 53
Figure 5.3: Windrose of the study area during November-December 2019 (wind direction blowing towards the centre) 54
Figure 5.4: AERMOD grid covering the Jharia Coal Fields (JCF). The line, area, and point sources covered in the study are indicated in red color. The UTM coordinates of the left bottom point are x=406111 and y=2603492, and the coordinates of the right top point are x=456248 and y=2653417. 56
Figure 5.5: Windrose diagram for the summer (left) and winter seasons (right) at Jharia Coal Fields during the sampling period. Wind direction is flowing towards the centre. 56
Figure 5.6: 24-hour average maximum ground level concentration of PM contours in the study area simulated during the study periods in summer (left) and winter (right) seasons (a) PM_{10} ($\mu g/m^3$) and (b) $PM_{2.5}$ ($\mu g/m^3$) 57

List of Tables

Table 1.1: LULC classification of Dhanbad study area 9
Table 1.2: Population in the study area as per 2011 census 9
Table 2.1: Daily average vehicle activity on different road network considered during the field survey 13
Table 2.2: Utilization Factors for different types of vehicle 14
Table 2.3: Emission estimate for road transport 14
Table 2.4: Emission rate for the paved and unpaved road 15
Table 2.5: Emission factor for coal mining activities 16
Table 2.6: Emission load from Industrial sector in Dhanbad 16
Table 2.7: Emission load from coal mine activities in Jharia coalfield region 17
Table 2.8: Emissions from the use of LPG in non-slum households in Dhanbad 18
Table 2.9: Emission from coal as fuel 18
Table 2.10: Emission from Crematoria using Wood as fuel 18
Table 2.11: Emission from Bakeries using Coal as fuel 18
Table 2.12: Emission from Hotel & Restaurants using Coal 19
Table 2.13: Emission from Hotel & Restaurants using LPG 19
Table 2.14: Emission loads from open eat-outs 19
Table 3.3.1: The details of mine cluster in Jharia Coalfield 22
Table 3.3.2: Frequency of Air pollutants sampling in Jharia Coalfields 24
Table 3.3.3: Ambient Air Quality Sampling/Analysis Methodology for Target Pollutants 24
Table 3.3.4: National Ambient Air Quality Standards (2009) 25
Table 3.3.5 Standards for Coal Mines (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000) 26
Table 4.1: Summary of relevant air quality studies from major Indian cities. 48
Table 5.1 Performance Stimulation Metric 58

Chapter 1 Introduction

Jharia Coalfield (JCF) is one of the oldest coalfields of India and has been subjected to coal exploitation for more than 100 years. JCF is one of the significant coal-producing areas in the country and occupies an important place in India's industrial and energy scenario by virtue of prime coking coal and is an essential source of coal. Jharia coalfield is crucial and a large coalfield situated in Dhanbad and Bokaro district, Jharkhand. Geographically the JCF is bounded by latitude 23°38' N to 23°49' N and longitude 86°09'E to 86°30'E and encompassing a total area of about 450sq km (Figure 1.1). Jharia is the largest coal producer in India and has an estimated reserved of 19.4 billion tonnes of coking coal. The coalfield contributes to the local economy and directly or indirectly employs the local population.

Bharat Coking Coal Limited, a subsidiary of Coal India Limited, has been operating the majority of the coal mines in the Jharia coalfield regions since its inception in 1972. Jharia, one of the eight blocks in Dhanbad and the main source of metallurgical coal in India can be termed as the country powerhouse since its mines are the only source for the best quality coking coal required by the steel industries and others in the country.

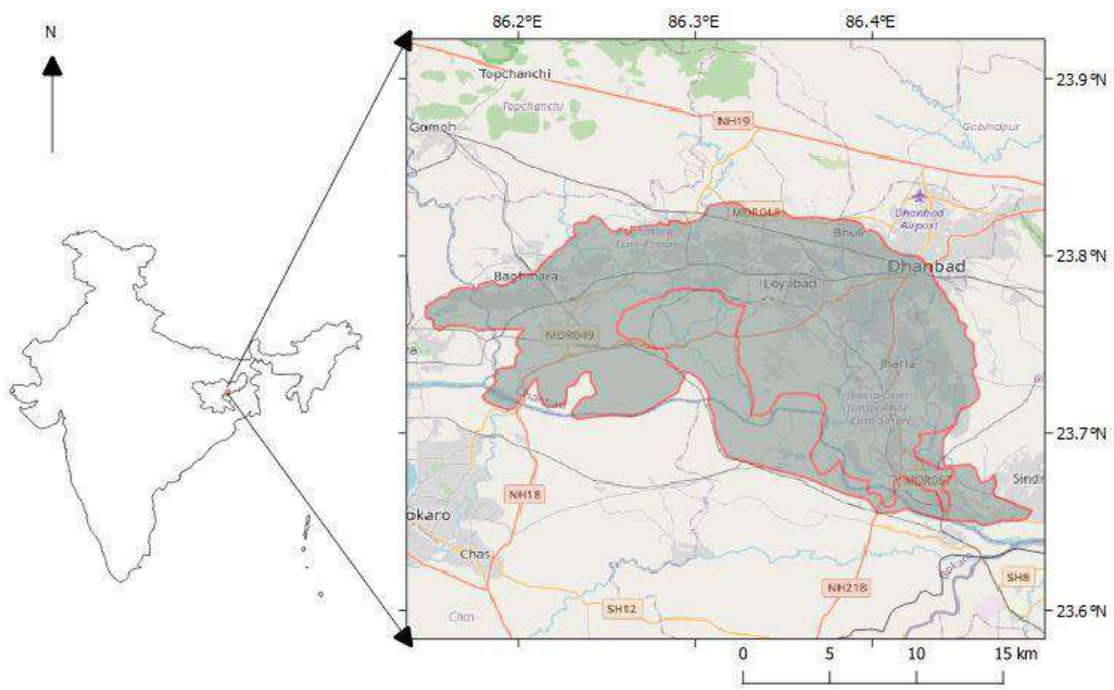


Figure 1.1: Geographical location of Jharia Coalfield in India

1.1. Climate

Dhanbad lies 236 m above the mean sea level and experiences the tropical climate. When compared with the winter, the summers have much more rainfall. The Köppen-Geiger climate classification is Aw (Tropical wet-dry climate) and experiences an average temperature of 25.9 °C and 1203 mm of precipitation falls annually. The driest month is December. There is 3 mm of precipitation in December. In July, the precipitation reaches its peak, with an average of 321 mm. With an average of 32.5 °C, May is the warmest month. At 18.4 °C on average, January is the coldest month of the year. The windrose for the March-June months is presented in Figure 1.2.

1.2. Land use & Land cover

In the present investigation, the Jharia coalfield area (2827.43 sq km) has been undertaken to study the Land use land cover (LULC), For this study, Sentinel-2A satellite image is used in the month of 17 February 2019 having a minimum cloud. These images were downloaded from the United States Geological Survey (USGS) Earth Explorer. Each Sentinel 2A satellite imagery band was geo-referenced to the WGS_84 datum and Universal Transverse Mercator Zone 45 North coordinate system. The Sentinel 2A satellite image stacking of the band-2, band-3, band-4 and band-8 of 10 m resolution was performed on the ArcGIS 10.5 software for studying the LULC of the Jharia coalfield.

For LULC classification, supervised classification was carried out in the study area. Thus allocations of each classified area in sq. km and its percentages are tabulated in Table 1.1. The percentage of areas as classified as; agriculture (74.5%), barren land (7.45%) built-up areas (5.14%), mining (2.64%), vegetation (9.40%) and water body (0.86%) (Figure 1.2).

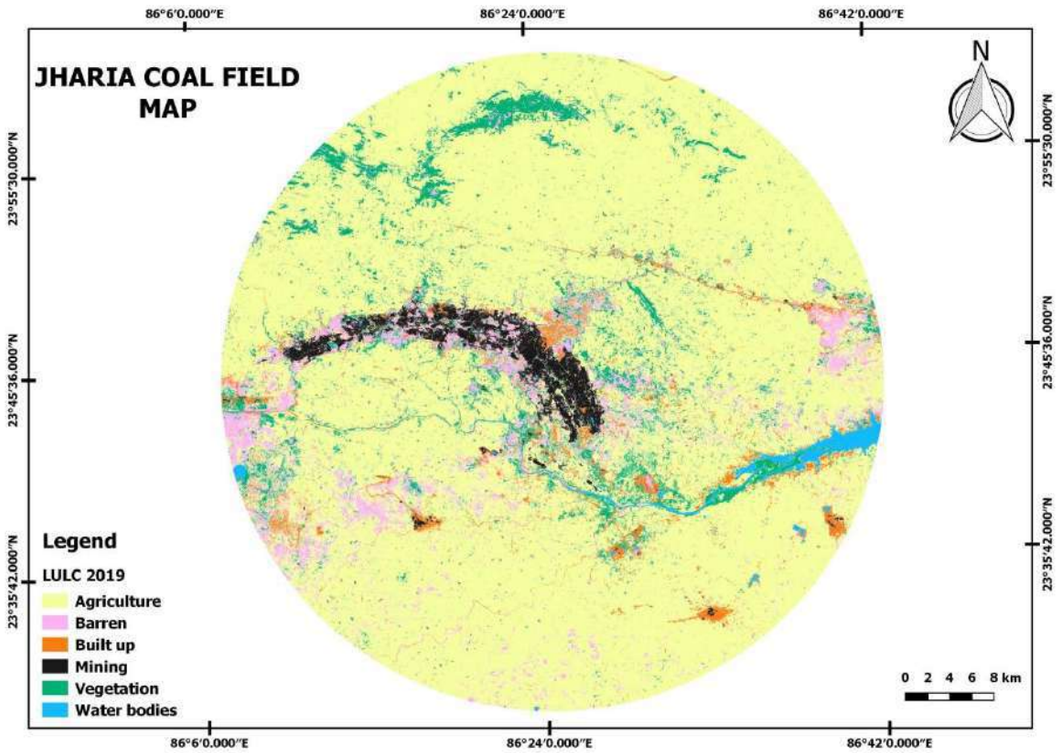


Figure 1.2: Land Use land cover map of Jharia coal field area

Table 1.1: LULC classification of Dhanbad study area

Sr. No	Name	Area in sq. km	Area in %
1.	Agriculture	2106.7	74.51
2.	Barren	210.64	7.45
3.	Built up	145.31	5.14
4.	Mining	74.67	2.64
5.	Vegetation	265.74	9.40
6.	Water bodies	24.37	0.86
Total		**2827.43**	**100**

1.3. Population

The study area covers four district boundaries; namely Dhanbad (1710.2sq km), Bokaro (620.43sq km), Giridih (29.8sq km) in Jharkhand and Puruliya (465.85sq km) district in West Bengal state. The Dhanbad district covers the maximum study area and the population is around 23, 94,434 in the year 2001 and is around 26,84,487 in 2011. The Bokaro district total population is in 2001 is 17, 75,961 and in 2011 it is 20, 62,330. The Giridih district total population is 19, 01,564 in 2001 and is 24,45,474 in 2011. The Puruliya district in West Bengal state total population is in 2001 is 25, 35,233 and in 2011 are 29, 30,115.

Based on the covered study area the total population in the study area is tabulated in Table 1.2. The total population in the study area based on Census book 2001 is 25,32,195 and 2011 is 28,62,600.

Table 1.2: Population in the study area as per 2011 census

District Name	District Area Covered by Study Area	% of Area Covered of District by Study Area	Population of 2001	Population 2001 in Study Area	Population of 2011	Population 2011 in Study Area
Bokaro	620.43	21.50	17,75,961	3,81,791	2,062,330	4,43,353
Dhanbad	1710.2	81.51	23,94,434	19,51,645	2,684,487	21,88,060
Giridih	29.8	0.59	19,01,564	11,275	2,445,474	14,500
Puruliya	465.85	7.40	25,35,233	1,87,484	2,930,115	2,16,686
Total	2826.28		Total Population 2001	25,32,195	Total Population 2011	28,62,600

1.4. Purpose of Study

Urban air pollution is a notable concern across the world. Inferring to the rapid rates of industrialization and urbanization in Indian cities, polluted air quality is considered a key factor in crumbling the quality of life with an adverse effect on the human being. Hence air quality gained a significant role in recent decades since it is worsened by emission from major pollutants including particulate matter (PM_{10} and $PM_{2.5}$), NO_2, SO_2 and O_3 were found to exceed the national ambient air quality standard (NAAQS) limits.

Particulate pollution is a major concern in the field of air pollution. The particulate matter in the air result from dispersion of dust from industrial (mining and non-mining) and allied activities, transportation, local vehicular movement and domestic fuel (Coal, wood-burning etc.) burning. Assessment of the air quality can provide useful insight for the development of the air quality management plan. The database developed on air quality also helps the regulatory agency identify the locations where natural resources and human health could be at risk.

Jharia coal mines having low ash content and high calorific value coals are subjected to intensive mining activities because of the easy availability of coal at shallow depths in thick seams. Therefore, they are often used directly in iron and steel plants for metal oxide reduction after washing. Although these coal mines are highly-priced for their high-quality coal, they are notorious for their mine fires, which cause a lot of fugitive gaseous and PM emissions. Hence, the Jharia region has been under scrutiny by various public authorities and the common public with a vision to improve the ambient air quality.

Various sources contribute to high particular matter concentration in the Jharia region: vehicles, mining activities, re-suspended dust, fugitive emissions, fuel oils, household LPG. The percentage contribution of these factors in the ambient depends exclusively on a particular region's economic activities. To improve the existing ambient air quality, the major sources of PM emissions first need to be identified.

Hence, the environmental clearance committee of MoEFCC has directed BCCL to conduct a source apportionment study for particulate matter. In this context, BCCL has approached CSIR-NEERI to conduct a source apportionment study of ambient air particulate matter in the Jharia coalfields region to quantify the various sources of PM emissions and suggest an effective environmental management plan.

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

The detailed objectives are as follows:

i. Ambient Air Monitoring

- Monitoring of ambient air quality at selected receptor locations for pollutants including PM_{10}, $PM_{2.5}$(limited), SO_x, NO_x, PAHs to establish the status of the air quality in Jharia Coalfields and an area up to 10 K.M from the periphery/boundary of BCCL mines. Also, review of the available air quality monitoring data from Central Pollution Control Board (CPCB) /Jharkhand State Pollution Control Board (JSPCB).
- To validate dispersion modelling predictions using measured air quality parameters
- To draw supportive data through the specific site-related monitoring regarding impact causing sources such as kerbside monitoring
- To establish the impact of meteorological conditions on a few select indicator pollutants in different micrometeorological conditions of the Jharia Coalfields

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

ii. To identify the pollution load grid wise for point, line and area source

- To establish possibilities of receptor level concentrations of air pollutants by matching dispersion modelling and air quality monitoring data
- Source apportionment
- To identify and apportion the pollution load at receptor level to various sources in the Jharia Coalfields along with an area up to 10 Km from the periphery/boundary of BCCL mines
- To carry out the source apportionment using molecular markers for a limited number of samples through a time-resolved sample collection at various periods of the day and day-of-the-week.
- Any other item in consensus between both BCCL/CIL & NEERI evolved during the study.

1.5. Approach of study

The study approach has many components, each one of them having its importance and interdependence as shown in Figure 1.3. The ultimate objective is source apportionment of ambient air of JCF that primarily requires knowledge of ambient air quality status, sources and emission load. These three objectives were achieved by monitoring air pollutants at 13 locations in Jharia Coalfield using various instruments and multiple analyses. These locations were selected based on land use and activity profile. All monitoring was carried out using varied instruments and all attributes were analysed using standards methodologies. The study's methodology of the study was divided into three parts namely ambient air quality monitoring, sources emission inventory and source apportionment analysis.

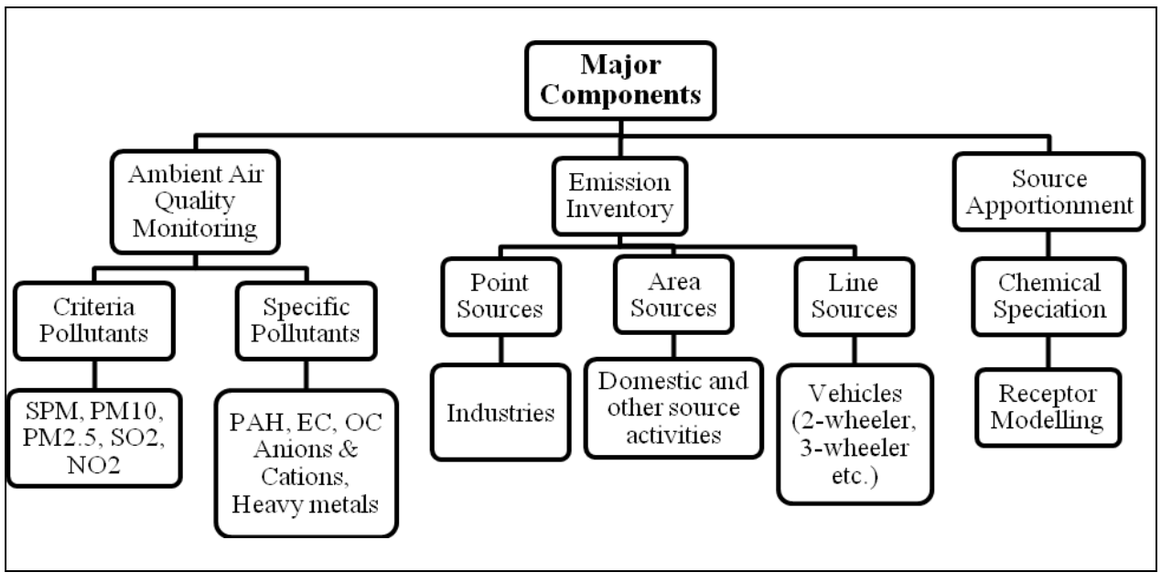


Figure 1.3: Air quality Monitoring & emission source apportionment studies

Chapter 2 Emission Inventory

This section consists of all methodologies that have been applied for the emission inventory and dispersion modelling in the Jharia Coalfield. The emission inventory is the process to identify the possible source and its contribution. Emission inventory and dispersion modelling are based on the primary data collection to calculate emission load from a particular source. It provides fundamental information for air quality modelling and air pollution control strategy development. In the coal mining area, mining, non-mining, industrial, vehicular and other sources are contributing. Air quality monitoring includes the suitable location selected based on the metrological conditions, chemical characterization for identification of the source, CMB model to estimate the source apportionment to $PM_{2.5}$.

Air pollutant emission inventory is a process to identify the possible sources and their contribution. It provides fundamental information for air quality modelling and air pollution control strategy development. Mining, non-mining, industrial, vehicular and other sources are contributing to critical coal mining zone like JCF, India. According to possible emission sources, sources are divided into three categories like point sources, area sources and line sources. The inventory of these sources is important to make a proper source profile.

2.1. Inventory of Point Sources

A point source of pollution is a single identifiable source that is responsible for significant pollution load in the study area, like thermal power stations. A comprehensive list of different point-like industries in the study area was obtained from the regional office of the Jharkhand State Pollution Control Board (JSPCB), at Dhanbad. The industries specific information of includes production capacities, raw material used, manufacturing process, fuel consumption, etc. also collected from the regional office by the CSIR-NEERI team.

2.2. Inventory of Area Sources

Area sources are sources of pollution that emit a substance or radiation from a specified area. Mining activities, domestic/hotel fuel (coal) burning, garbage burning, etc. are the major contributor to area sources. In order to assess the fuel consumption in the study area, the necessary information was collected through surveys at petrol pumps, hotels and restaurants, bakeries, open eat out and crematoria. Also, surveys collected data on the seasonal implication of fuel used particularly wood and coal. The data on trash burning and solid waste generated in the study were collected from Municipal Corporation Dhanbad.

2.3. Inventory of Line Sources

Vehicles contribute a whole range of HCs besides contributing SO_x, NO_x (as NO_2), HC and lead. Diesel vehicles are the primary source of smoke and NO_x in addition to CO and HCs. However, CO and HCs per litre of fuel consumed by diesel vehicles in relatively low compared to gasoline-powered vehicles. In gasoline-powered vehicles, the exhaust is the major source of pollution that contributes 100 % CO and NO_x and 80% of HCs emitted to the atmosphere. The remaining 20% of HCs are emitted from crankcase blow-by and evaporative emissions. In the

two-stroke engine, the crankcase blow-by is absent. The exhaust emissions are the principal sources of pollutants emitting about 40% of fuel supplied without burning due to short circulating, contributing high concentration of HCs. In diesel vehicles, practically all pollutants are emitted through exhaust gases and the contribution to crankcase blow-by and evaporative fuel emission are negligible.

Though the quantity of pollutants emitted by the vehicles is directly proportional to the number of vehicles playing on the road, the intensity of pollution potential depends on several contributory factors such as a geographical location, unplanned development of central business areas, inadequate and ill-maintained road as well as the type of vehicle, unplanned traffic management, meteorological conditions, and non-availability of adequate emission control technology.

Vehicle activity data were collected during the field campaign at 12 road networks in the study area, and the daily average vehicular activity is presented in Table 2.1.

Table 2.1: Daily average vehicle activity on different road network considered during the field survey

Label	Road Network	HDV	LMV	3W	2W	Total
L1	Jharia to Lodna -5 km	1254	1385	3640	9560	15839
L2	Pathardih to Sindri -7 km	1539	5356	4362	15633	26890
L3	Bastacola to Pathardih -13km	2153	8325	3678	10233	24389
L4	Bhuli to Bankmore - 6km	1475	13832	12965	18241	46513
L5	Katras to Harina–12.5 km	1802	7290	3156	15329	27577
L6	Bankmore to Kusunda -5 km	658	2685	1896	10235	15474
L7	Kusunda to Katras - 10 km	1306	4521	5327	15689	26843
L8	Monidih to Kusunda -7 Km	1208	7659	3985	14698	27550
L9	Lohpiti to Mahuda Area Colony - 8 km	1535	4523	2235	6356	14649
L10	Mahuda to Parasia Chowk -7 km	1223	4023	1759	5623	12628
L11	Parasia Chowk To Moonidih - 3 km	269	2159	236	2347	5011
L12	Bhowra to Parbatpur - 13 Km	2135	7856	4258	14578	28827

The vehicle utilization factors (km travelled per day per vehicle type) were adapted from the Auto Fuel Policy Report (Table 2.2). Two-to-four-wheelers Emission factors were taken from various project reports conducted by CPCB and Indian Clean Air Programmed (ICAP) (CPCB 2010; ARAI 2007). The percentage distribution of various types of vehicles moving on the road network considered during the field survey is presented in Fig 2.1. It shows that major numbers of vehicles moving in the considered Road network are two-wheelers (51%), followed by light motor vehicles (26%), three-wheeler (17%) and heavy-duty diesel vehicles (6%).

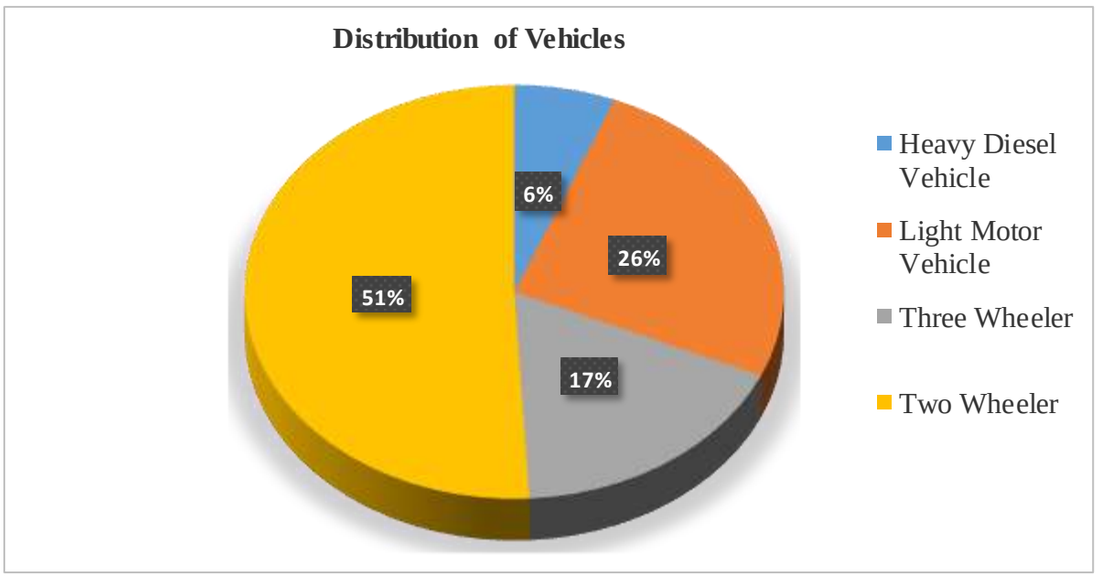


Figure 2.1 Percentage of different types of vehicle surveyed on the road network during the field survey

Table 2.2: Utilization Factors for different types of vehicle

Vehicle Type	km per day
LMV (Car Jeep)	52.6
LMV (Taxi)	77.89
2 Wheeler	25.1
3 Wheeler (Auto)	97.72
HCV	45.5

2.4. Methodology

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

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

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

N_v is the number of vehicles of a particular type

VKT is the vehicle km travelled

E_i, km is the emission factor for a specific vehicle

Table 2.3: Emission estimate for road transport

Label	Road Network	Emission (kg/day)	
		PM_{10}	$PM_{2.5}$
L1	Jharia to Lodna -5 km	230.12	113.08
L2	Pathardih to Sindri -7 km	379.07	180.37
L3	Bastacola to Pathardih -13km	632.21	451.98
L4	Bhuli to Bankmore - 6km	331.41	187.69
L5	Katras to Harina–12.5 km	719.42	415.63
L6	Bankmore to Kusunda -5 km	308.69	194.34
L7	Kusunda to Katras - 10 km	576.31	277.95
L8	Monidih to Kusunda -7 Km	317.83	114.25
L9	Lohpiti to Mahuda Area Colony - 8 km	360.24	151.99
L10	Mahuda to Parasia Chowk -7 km	241.56	148.24

L11	Parasia Chowk To Moonidih - 3 km	94.26	57.23
L12	Bhowra to Parbatpur - 13 Km	592.82	379.80

Re-suspension of the unpaved and paved roads depends on the 'silt loading' factor and 'vehicles weight' roaming on the road (Table 2.4). The silt loading (S_L) is the mass of the silt-sized material per unit area of the road surface. The amount of dust produces by vehicles movement on a paved road can be appraised by the following equation:

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

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

SL is silt load (g/m2);

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

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

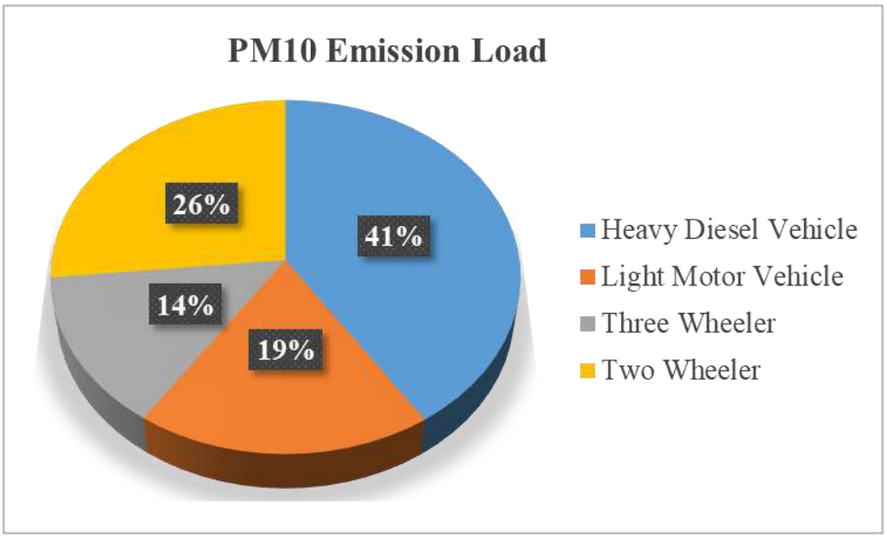


Figure 2.2 PM_{10} emission load for different categories of vehicle

It is observed that 41% of PM_{10} emission is contributed by the Heavy-duty diesel vehicles followed by two-wheelers (26%), Light motor vehicles (19%) and three-wheelers (14%) in the considered road network during the study period.

Table 2.4: Emission rate for the paved and unpaved road

	Emission Rate	
Emission Sector	**PM_{10} (kg/day)**	**$PM_{2.5}$ (kg/day)**
Re-suspension dust from Paved & Unpaved Road	1756	843

2.5. Results

2.5.1. Industrial Emission

Emission inventory estimates are determined based on considering available industrial activity information, emission factors (Table 2.5) and observations. For the current study, industrial and mining information was collected for emission inventory development. Emission inventory information for industries was collected from the regional office of JSPCB. In Dhanbad, the major industries are the power plant and the coking industry. Other

than those are coal mines, thus coal as a fuel is majorly used in industries and households. Emission loads by point source are depicted in Table 2.6 as per emission inventory.

Table 2.5: Emission factor for coal mining activities

EF	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2
g/Mg Coal	1914	1864	1176	420	820

Table 2.6: Emission load from Industrial sector in Dhanbad

Sr. No	Name of Industry	Type of Fuel	Fuel consumption	Unit	TSP (Ton/ yr)	PM_{10} (Ton/ yr)	$PM_{2.5}$ (Ton/ yr)	SO_2 (Ton/ yr)	NO_2 (Ton/ yr)
1	M/s Mahalaxmi Industries	Coal	4	MT/Oven/ cycle (24hrs)	2.79	2.72	1.72	0.61	1.20
2	GEETEE Hard Coke Traders	Coal	100	TPD	69.86	68.04	42.92	15.33	29.93
3	M/s Shree Gopal Coke Industries	Coal	77.4	TPD	54.07	52.66	33.22	11.87	23.17
4	M/s Laxmi Hard coke Manufacturing Company	Coal	102	TPD	71.26	69.40	43.78	15.64	30.53
5	M/s - Sanjay Hard Coke Industries	Coal	70	TPD	48.90	47.63	30.05	10.73	20.95
6	M/s Inder Hard Coke Industries	Coal	36	TPD	25.15	24.49	15.45	5.52	10.77
7	M/s Shiv Shakti Coke Industries	Coal	80	TPD	55.89	54.43	34.34	12.26	23.94
8	Khetawat Coke Manufacturing Company	Coal	4.5	MT/ Oven/ Batch (24hrs)	3.14	3.06	1.93	0.69	1.35
9	M/s Pawan Hard Coke Industries	Coal	100	TPD	69.86	68.04	42.92	15.33	29.93
10	M/s Ganapati Udyog	Coal	135	TPD	94.31	91.85	57.95	20.70	40.41
11	M/s Aman Soft Coke Industries	Coal	29.76	TPD	20.79	20.25	12.77	4.56	8.91

2.5.2. Area/Distributed source

An area source emission inventory estimates the pollutant loads emanating from several small but numerous individual sources in a specific geographic area and which cannot be included underline no point sources.

Area sources considered for emission inventory for Dhanbad city are:

- Cooking operations in households: Slum and non-slum
- Cooking operations in hotels, restaurants, open eat-outs and bakeries
- Crematoria

The following sections will detail the methodology adopted for estimating emissions from each of the above-mentioned sources and the results thus obtained.

- **Emission load from mining activities**

The emission loads from coal mine activities are depicted in Table 2.7. The emission load is calculated based on the secondary data collected from the BCCL mines covered in the study. The data includes coal and overburden quantity handled per day during loading and unloading, transfer from pit to stockyard through haul road and conveyor, vehicular movement frequency and diesel consumption for HEMM and DG sets. Emission factors from EEA air pollutant emission inventory guidebook 2019 were considered for the estimations of TSP and PM load.

Table 2.7: Emission load from coal mine activities in Jharia coalfield region

Mine	Area (m^2)	PM_{10} (Tone/y)	$PM_{2.5}$ (Tone/y)
ABOCP	2355283	156.1	78.0
ADI Colliery	1444818	47.9	23.9
ASP Colliery	19540	27.7	13.8
Bhowra south	78079	26.9	13.4
Block IV Govindpur	432827	22.5	11.2
DBOCP	605747	64.7	32.4
East Bassuriya Colliery	576494	24.3	12.2
Gopalichuck Colliery	37573	3.7	1.9
Jeenagora OCP	2079123	208.0	104.0
Kuya OCP	1134723	90.1	45.1
NAKC	245205	78.3	39.1
NGK	261847	126.0	63.0
Nichitpur colliery	791140	61.4	30.7
Phularitand colliery	335887	84.1	42.1
Rajapur OCP	1170784	90.4	45.2
Sendra Bansjora	472760	63.0	31.5
Shatabdi colliery (Muraidhih)	34270	77.0	38.5
Tetulmari	876320	23.3	11.7
Total		**1275.4**	**637.7**

- **Cooking operations in non-slum household**

A survey of 20 non-slum household areas was conducted in randomly selected areas of Dhanbad to understand which fuels are being used in these households and their quantities. The survey results indicated that Liquefied Petroleum Gas (LPG) was the fuel of choice in all the households and that each household used about 1 cylinder per month on average. It was assumed that LPG use remains the same for all 365 days of the year. The results obtained are presented in Table 2.8.

Table 2.8: Emissions from the use of LPG in non-slum households in Dhanbad

LPG Pollutant	PM_{10}	SO_2	NO_2	CO	HC
Emission Factor (g/kg)	2.1	0.4	1.8	0.25	0.07
Emission (T/Year)	0.00575	0.0011	0.0049	0.0007	0.0002

- **Cooking operations in slum households**

A survey of 15 areas having slum households was conducted, spread in Jharia Coalfield which was known to have significant slum populations, to understand which fuels are being used in these households and their quantities. It was seen that a majority of the slum households use coal as a cooking fuel (Table 2.9).

Table 2.9: Emission from coal as fuel

Pollutant	SPM	SO_2	NO_2	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	28.354	18.856	5.657	35.330	0.709

- **Emissions from crematorium**

In order to calculate emission from crematoria data were obtained from crematoriums in Dhanbad. Emission from the burning of bodies using woods mainly produces PM_{10}, CO and HC majorly as depicted in Table 2.10.

Table 2.10: Emission from Crematoria using Wood as fuel

Pollutant	PM_{10}	SO_2	NO_2	CO	HC
Emission Factor (g/Kg)	17.3	0.2	1.3	126.3	114.5
Emission (kg/day)	7.178	0.083	0.537	52.183	47.308

- **Emissions from bakeries**

Data were collected from 34 bakeries operating in Dhanbad in which 12 bakeries were using electrical ovens. The emissions from such bakeries were not considered. All the other bakeries were using coal as fuel. Emissions from such bakeries are given in Table 2.11.

Table 2.11: Emission from Bakeries using Coal as fuel

Pollutant	SPM	SO_2	NO_2	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	6.26	4.16	1.25	7.80	0.16

- **Emissions from hotels and restaurants**

Data were collected from 35 hotels in Dhanbad city. It has been found that most hotels/restaurants were using a combination of coal and LPG as cooking fuel. Emission

from coal and LPG were calculated and depicted in Table 2.12 and 2.13.

Table 2.12: Emission from Hotel & Restaurants using Coal

Pollutant	SPM	SO_2	NO_2	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	8.110	5.393	1.618	10.105	0.203

Table 2.13: Emission from Hotel & Restaurants using LPG

Pollutant	PM_{10}	SO_2	NO_2	CO	HC
Emission Factor (g/kg)	2.1	0.4	0.8	0.25	0.07
Emission (T/Year)	0.136	0.026	0.117	0.016	0.005

- **Emission from open eat-outs**

From the survey it has been observed that most of the open eat-outs were using coal as cooking fuel, only a few were using LPG (Table 2.14).

Table 2.14: Emission loads from open eat-outs

Pollutant	SPM	SO_2	NO_2	CO	HC
Emission Factor (g/kg)	20	13.3	3.99	24.92	0.5
Emission (T/Year)	14.07	9.36	2.81	17.54	0.35

2.5.3. Grid wise emission inventory

The grid-wise particulate emission inventory maps were prepared from the primary and secondary data collected during the field surveys and the information received from the open cast mines, respectively. The PM emissions from restaurants, eat-outs, domestic chullahs, vehicles, crematoria, etc. were estimated based on the primary data obtained from the filed campaigns, whereas, the emissions from the mine operations were estimated based on the data received from the mines and the emission factors reported in the literature. Once the emissions rates were estimated, the cumulative emissions (including all types of sources like line, point, and area) were calculated falling under the grid defined (shown in Figure 2.3 and Figure 2.4). From the figures, it can be interpreted that the PM emissions are high on the northeast side of the study area. Whereas, the actual transport and dispersion of these emissions can be interpreted through the dispersion modelling carried out using the AERMOD model.

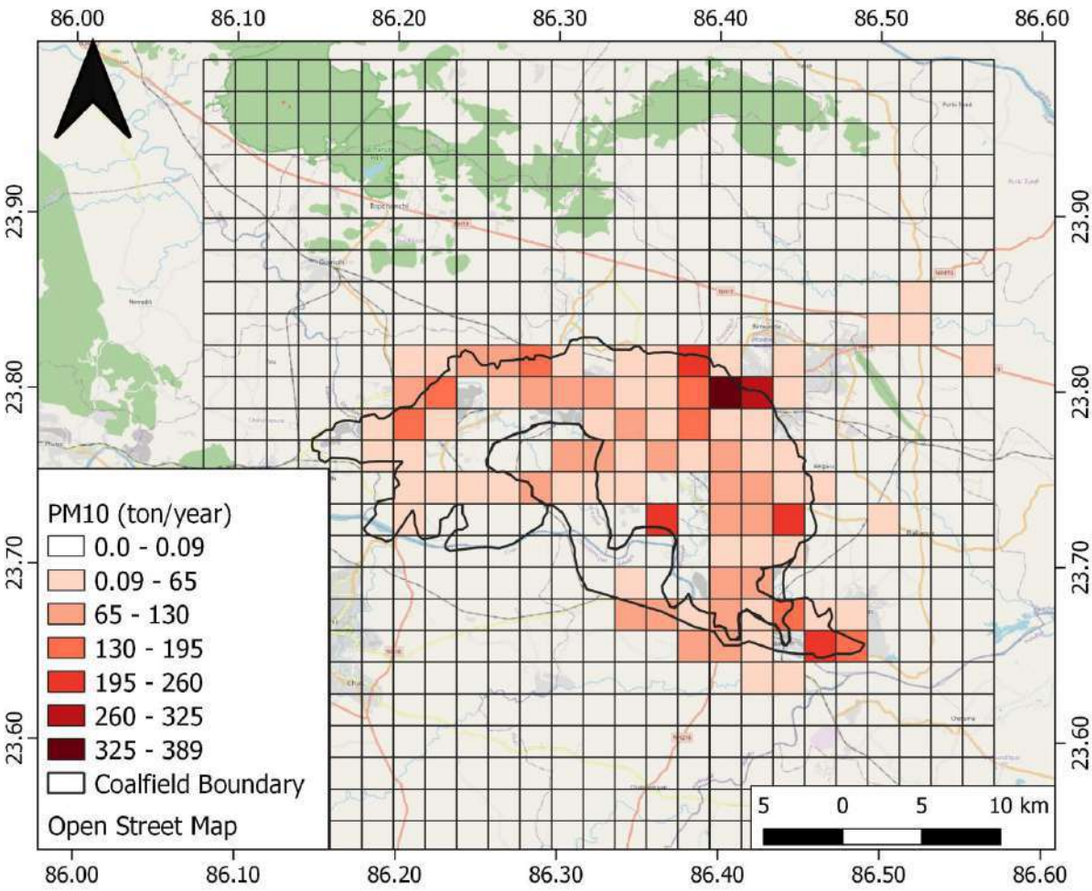


Figure 2.3 Grid-wise emission inventory of PM_{10} in tons/year over the study area

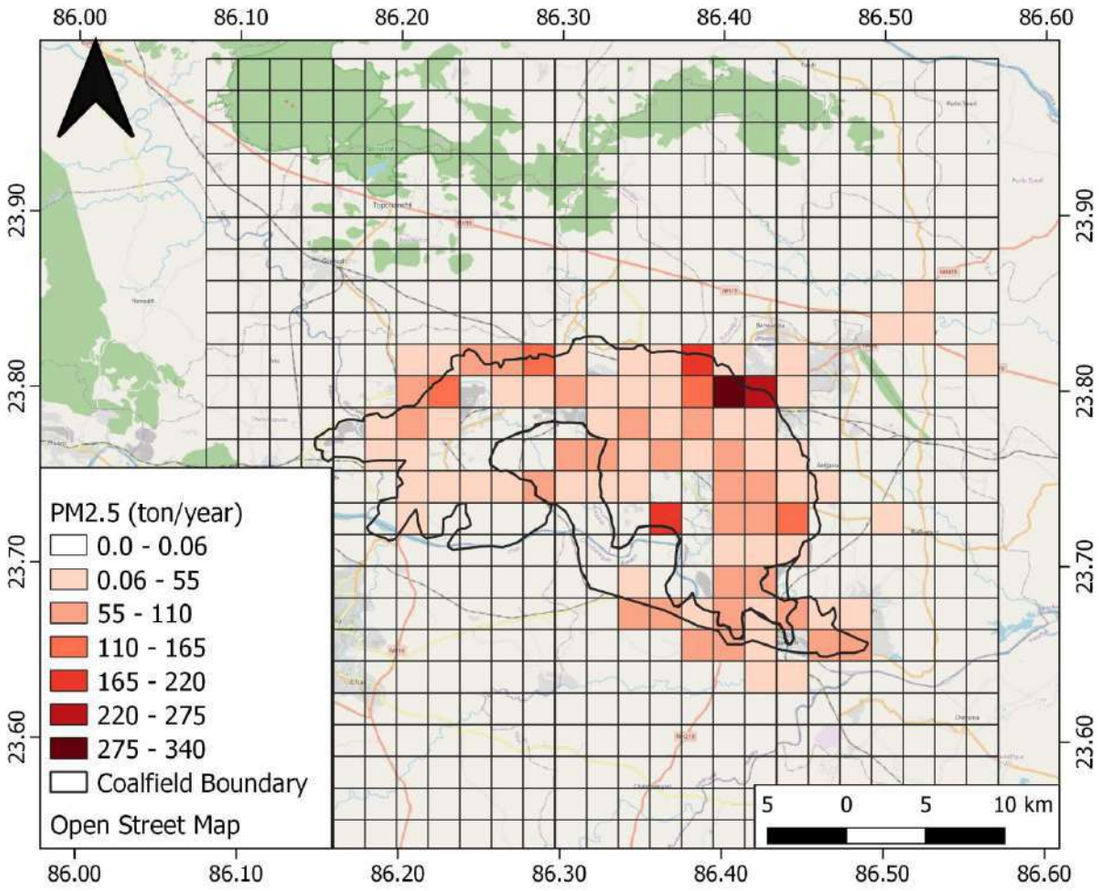
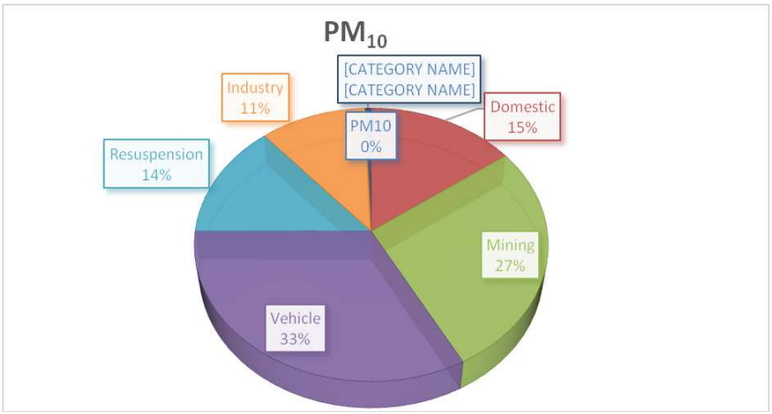


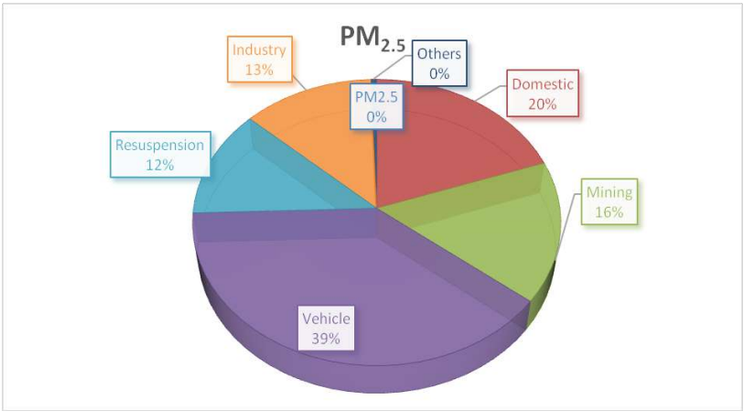
Figure 2.4 Grid-wise emission inventory of PM2.5 in tons/year over the study area

The respective share of various emission sources is represented through pie diagrams shown in Figure 2.5. Data shows that PM_{10} emissions are contributed mostly from vehicular emissions

followed by emissions from the mines whereas, $PM_{2.5}$ emissions are contributed mostly from vehicular emissions, domestic burning and mine activities. The grid-wise emission inventory maps and the information on the pollution sources provide the basis for the policymakers to target the hotspots of pollution generation in order to take effective mitigation actions.



(a)



(b)

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

References

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

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

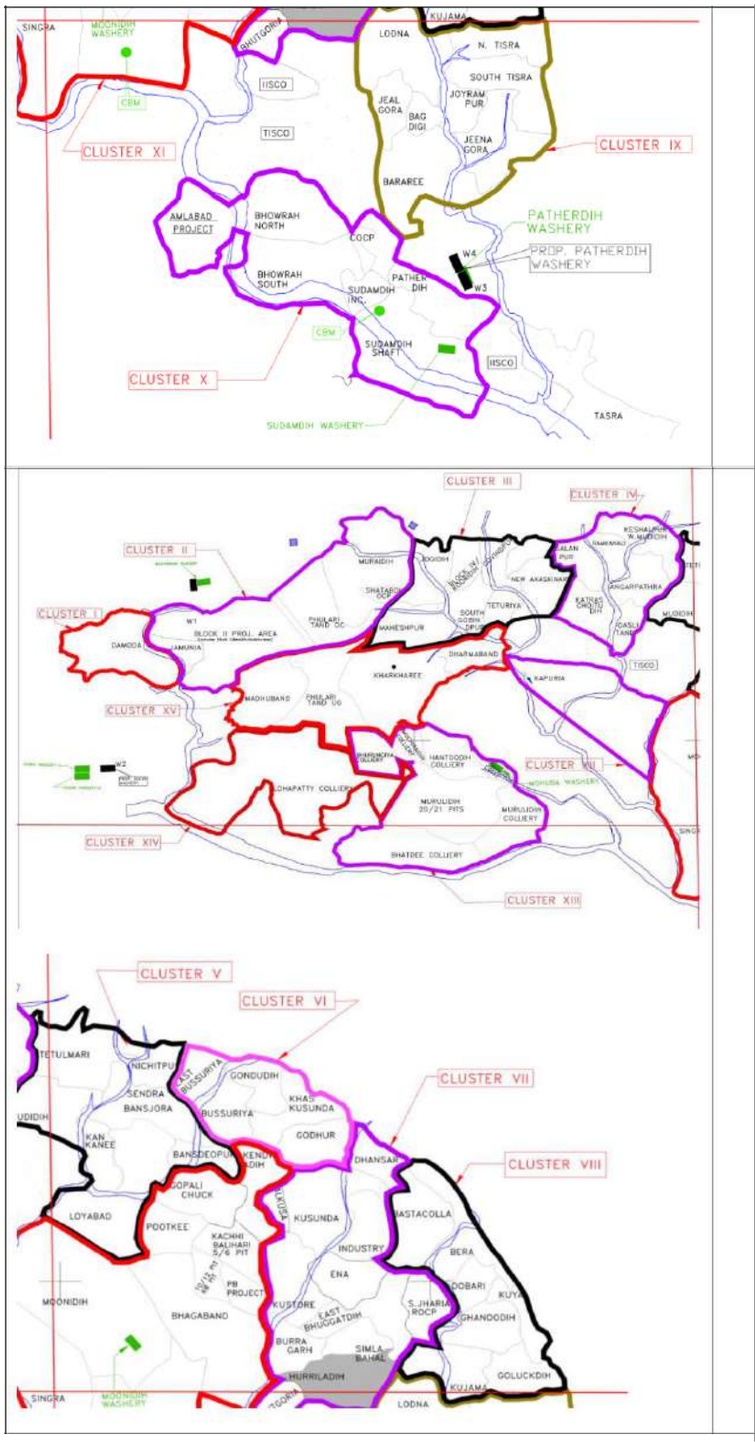
Apoorva Pandey, Chandra Venkataraman, Estimating emissions from the Indian transport sector with on-road fleet composition and traffic volume, Atmospheric Environment, Volume 98, 2014, Pages 123-133, ISSN 1352-2310, https://doi.org/10.1016/j.atmosenv.2014.08.039.

Roy, D., Singh, G., Sinha, S., Park, J., & Seo, Y. C. (2021). Emission inventory of PM10 in Dhanbad/Jharia coalfield (JCF), India: an intricate coal mining sector. *Environment, Development and Sustainability*, *23*(3), 3048-3061. https://doi.org/10.1007/s10668-020-00702-4.

Chapter 3 Air Quality Monitoring and Receptor modelling

BCCL environmental department provided the map of the Jharia region. The site visit was carried out with assistance from BCCL's team. The 15 Jharia mines coal fields were segregated into three parts. The details of the visit and mine cluster names are given in Table 3.3.1. The Entire Jharia Coal Field (JCF) is divided into 16 clusters. Both open cast and underground mines are operational in JCF. Standard mining operations like drilling, blasting, hauling, accumulation, and transfer are the major sources of emissions and air pollution. Apart from that, a typical emission source, mine fire, is prevailing at JCF. Besides, JCF encompasses large non-mining regions with their emission sources like vehicular emission in congested traffics, road dust, Power Plant emission, other industrial emissions (coke oven plants, brick kilns, stone crushers, etc.), crematoria, domestic burning, open burning, etc.

Table 3.3.1: The details of mine cluster in Jharia Coalfield



Day 1: Cluster I, II, III, IV, XII, XIII, XV and XIV

Day 2: Cluster V, VI, VII, and VIII

Day 3: Cluster IX, X and XI

Based on preliminary field visit by NEERI Scientists along with BCCL staffs, the following locations (Figure 3.1) were selected for the establishment of Air Quality Monitoring Stations for source apportionment study;

- **Core Zone**

1. Cluster XIV Lohapatty– nearby sources: Chandrapura Thermal Power Plant
2. Cluster VII Mine rescue station- nearby sources: Coal Mine, Industry
3. Cluster V- Katras
4. Cluster IX Lodhna
5. Cluster XI Moonidih nearby sources: Coal Mine
6. Cluster X Patherdih: nearby sources: Coal Mine, Steel Industry
7. Cluster VIII Bastacola nearby sources: Coal Mine

- **Buffer Zone**

8. Bank More
9. Harina
10. Bhuli
11. Sindri
12. Parbatpur Electro steel/ Bhaga
13. Background

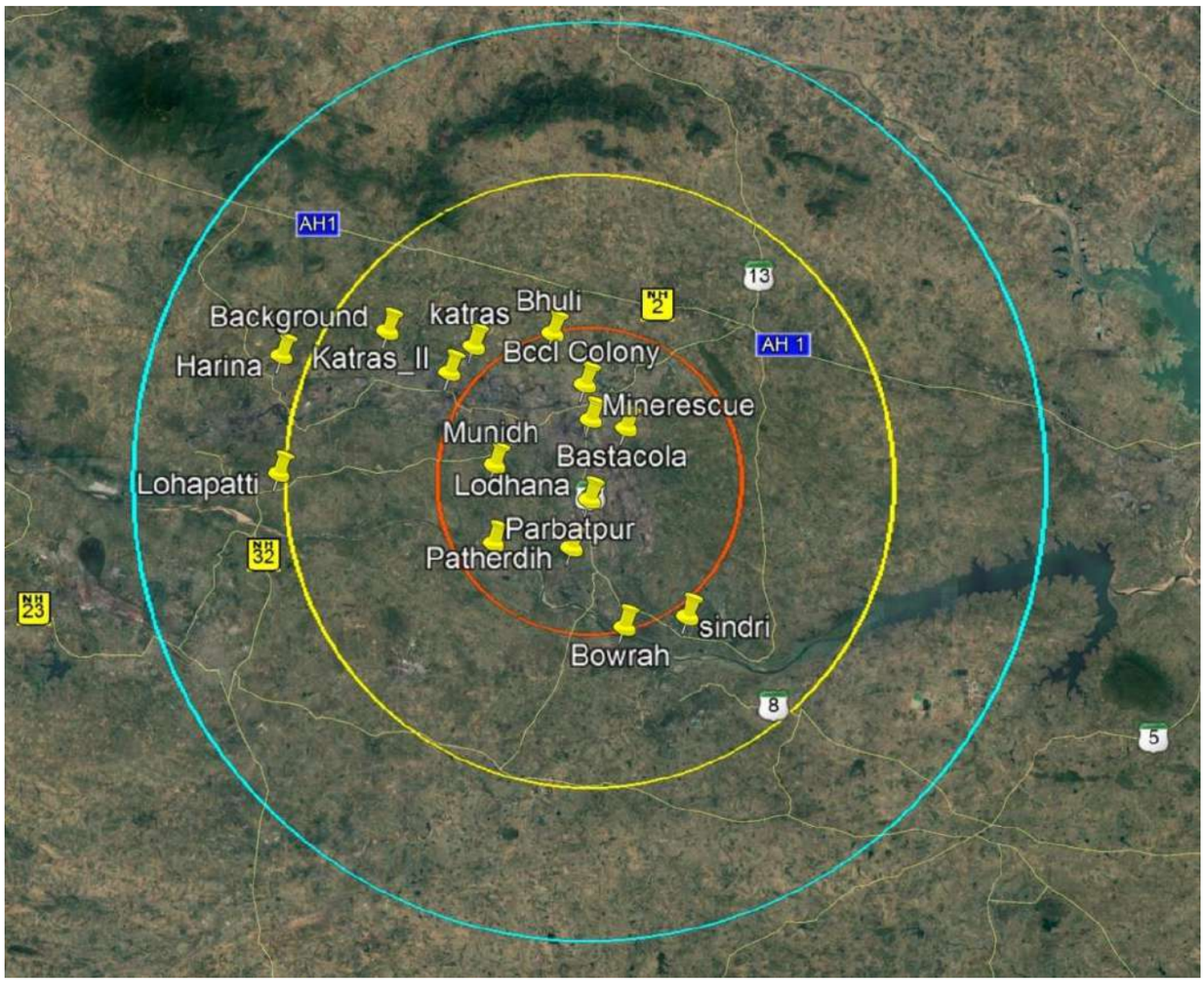


Figure 3.1: Air monitoring sites under 30 km buffer area

3.1. Sampling Method and Schedule

The PM_{10} and $PM_{2.5}$ sampling for Jharia Coalfields was done at all the 13 sampling sites for the period of 24 h using low volume respirable suspended particulate matter samplers (Instrumax, ARA and Envirotech) on Quartz and polytetrafluoroethylene (PTFE) filter paper of 47 mm diameter. Samplers at a flow rate of 16.67 LPM were used. The filter papers were desiccated before and after sampling for 24h at a temperature of 27 ± 3°C and at a relative humidity (RH) of 55 ± 2% to remove the moisture present in them. The PM_{10} and $PM_{2.5}$ field samples were collected periodically throughout the sampling period. The sampling frequency and types of equipment used for monitoring are described in Table 3.3.2 and 3.3.3. The national Ambient quality and Standards for Coal Mines (Stipulated by Ministry of Environment and Forests are depicted in Table 3.3.4. and Table 3.3.5.

Table 3.3.2: Frequency of Air pollutants sampling in Jharia Coalfields

Parameter	Number of Days	Change of Filter/ absorbing media	Reporting
PM_{10}	10	24 hourly, Teflon: 5 Days Quartz: 5 Days	24 hourly
$PM_{2.5}$	10	24 hourly Teflon: 5 Days Quartz: 5 Days	24 hourly
NO_2	10	8 hourly	8 hourly
SO_2	10	8 hourly	8 hourly

Table 3.3.3: Ambient Air Quality Sampling/Analysis Methodology for Target Pollutants

Particulars	Parameters			
	PM_{10}	**$PM_{2.5}$**	**NO_2**	**SO_2**
Sampling Instrument	INSTUMEX and ARA-N-FRM Sampler	INSTUMEX and ARA-N-FRM Sampler	APM sampler	APM sampler
Sampling Principle	Cyclonic Flow Technique	Cyclonic Flow Technique	Chemical absorption in suitable media	Chemical absorption in suitable media
Flow rate	16.7 LPM	16.7 LPM	0.5 LPM	0.5 LPM
Sampling Period	24 hourly	24 hourly	8 hourly	8 hourly
Sampling Frequency	7 days continuous, Teflon and quartz on alternate days	7 days continuous, Teflon and quartz on alternate days	7 days continuous	7 days continuous
Analytical Instrument	Electronic Micro Balance	Electronic Micro Balance	Spectrophotometer	Spectrophotometer
Analytical Method	Gravimetric	Gravimetric	Modified Jacob and Hochheiser method	Colorimetric Improved West & Gaeke Method
Minimum reportable value	5µg/m^3	5µg/m^3	9µg/m^3	4µg/m^3

Table 3.3.4: National Ambient Air Quality Standards (2009)

Sr. No.	Pollutant	Time Weighted Average	Concentration in ambient Air (in µg/m^3) Industrial, Residential Rural & Other Areas	Concentration in ambient Air (in µg/m3) Ecologically Sensitive Area	Concentration In ambient Air (in µg/m^3) Methods of Measurement
1	Sulphur Dioxide (SO_2)	Annual*	50	20	Improved West & Geake, Ultraviolet fluorescence
		24Hours**	80	80	
2	Nitrogen Dioxide (NO_2)	Annual*	40	30	Modified Jacob & Hochheiser (Na-Arsenite) Chemiluminescence
		24Hours**	80	80	
3	Particulate matter (Size less than 10µm) or PM_{10}	Annual*	60	60	Gravimetric, TOEM, Beta attenuation
		24Hours**	100	100	
4	Particulate matter (Size less than 2.5µm) or $PM_{2.5}$	Annual*	40	40	Gravimetric, TOEM, Beta attenuation
		24Hours**	60	60	
5	Ozone (O_3)	8 Hours*	100	100	UV photometric, Chemiluminescence chemical method
		1 Hour	180	180	
6	Lead (Pb)	Annual*	0.5	0.5	ASS / ISP method after sampling on EPM 2000 or equivalent filter paper ED-XRF using Teflon filter
		24Hours**	1	1	
7	Carbon Monoxide (CO)	Annual*	0.2	0.2	Non-dispersive Infra-Red (NDIR) Spectroscopy
		24Hours**	0.4	0.4	
8	Ammonia (NH_3)	Annual*	100	100	Chemiluminescence, Indo-phenol's blue method
		24Hours**	400	400	
9	Benzene (C_6H_6)	Annual*	0.5	0.5	Gas Chromatography based continuous analyzer. Adsorption and description followed by GC analysis
10	Benzo (a) Pyene (BaP)- particulate phase only	Annual*	0.1	0.1	Solvent extraction followed by HPLC / GC analysis
11	Arsenic (As)	Annual*	0.6	0.6	AAS/ ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni)	Annual*	20	20	

Table 3.3.5 Standards for Coal Mines (Stipulated by Ministry of Environment and Forests (MoEF), Vide Notification No. GSR 742(E), Dt: 25.09.2000)

Pollutant	Time weighted Average	Concentration in Ambient Air	
		New Coal Mines (commenced after 25.09.2000)	Existing Coal Mines (commenced prior to 25.09.2000)
Suspended Particulates Matter (SPM)	Annual Average 24 hours	360µg/m3 500µg/m3	430µg/m3 600µg/m3
Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average 24 hours	180µg/m3 250µg/m3	215µg/m3 300µg/m3
Sulphur Dioxide (SO_2)	Annual Average 24 hours	80µg/m3 120µg/m3	80µg/m3 120µg/m3
Oxides of Nitrogen as NO_2	Annual Average 24 hours	80µg/m3 120µg/m3	80µg/m3 120µg/m3

3.2. Chemical Analysis

3.2.1. Gravimetric analysis

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

3.2.2. Elemental analysis

PM_{10} samples collected on glass fibre filters were digested in a microwave digester. The samples were made up to 50ml using deionized distilled water. Similarly, the exposed filters containing $PM_{2.5}$ particles were cut equally into 2 halves. A part of the exposed filter was used for ions analysis. Whereas, the other half was cut into tiny fragments and digested and made up to 15mL using distilled deionized water. The obtained samples (both PM_{10} and $PM_{2.5}$) after digestion were stored in vials and refrigerated at 4°C until further analysis. These samples were later subjected to estimate the elemental composition using ICP-OES (Thermo Scientific, USA).

3.2.3. Analysis of SO_2 and NO_2

SO_2 analysis: Modified West and Gaeke method was followed for sampling and analysis of Sulfur dioxide in ambient air. SO_2 from the air is absorbed in a solution of potassium tetracholo-mercute (TCM). A dichlorosulphitomercurate complex, which resists oxidation by the oxygen in the air was formed. Once formed, that complex was stable to strong oxidants such as ozone and oxides of nitrogen and therefore, the absorber solution may be stored for some time prior to analysis. The complex was made to react with pararosaniline and formaldehyde to form the intensely colored pararosanline methylsulphonic acid. The absorbance of the solution was measured by means of a suitable spectrophotometer.

NO_2 analysis: Modified Jacobs and Hochheiser method was followed for sampling and analysis of NO_2 in ambient air. Ambient NO_2 was collected by bubbling air through a solution of sodium hydroxide and sodium arsenite. The concentration of nitrite ion produced during sampling was determined calorimetrically by the nitrite ion reaction with phosphoric acid, sulphanilamide, and N-(1-napthyl)-ethlylenediamine di-hydrochloride (NEDA) and the absorbance of the highly colored azo dye was measured at 540nm.

3.2.4. Ion analysis

The filter papers containing both PM_{10} and $PM_{2.5}$ samples were extracted and subjected to ion analysis as per standards. The filter papers were divided into tiny fragments and moistened with isopropanol slightly before extraction since the filters are hydrophobic. Further 25 mL of deionized distilled water was added and sonicated using an ultrasonic bath for 60 min at 60°C. The samples were then kept overnight after sonication. Furthermore, the samples were then filtered using nylon filter discs (25mm, 0.45mm) and were refrigerated at 4°C until further analysis. The extracted samples were subjected to IC to analyse the ions (anions and cations) present in them.

3.2.5. Polycyclic Aromatic Hydrocarbons (PAH) analysis

Filter papers were cut into pieces using scissors and transferred to a 100 ml beaker and 50 ml of Dichloromethane (DCM) (GC/HPLC grade) was added. The samples were extracted with DCM using an ultrasonic bath for about 30 minutes. The extracted samples were filtered with Whatman filter paper containing 2gm Anhydrous Sodium Sulphate. After filtration, the filtrate is concentrated using a rotary vacuum evaporator to 2ml final volume. Solid-phase extraction may be used to clean up the impurities of the sample and re-concentrated in a rotary evaporator. The samples were analyzed through GC with conditions as injector 300°C and FID temperature 320°C.

3.2.6. EC & OC analysis

This is a thermal/optical-transmittance (TOT) method that speciates carbon in particulate matter collected on a quartz-fiber filter into OC, EC, and CC. In the first (or non-oxidizing) heating stage, organic and carbonate carbon is thermally desorbed from the filter under a flow of helium with controlled temperature ramps. The oven is then partially cooled, and the original flow of helium is switched to an oxidizing carrier gas (He/O_2). In the second (or oxidizing) heating stage, the original elemental carbon component plus pyrolyzed organic carbon formed during the first heating stage are oxidized/desorbed from the filter with another series of controlled temperature ramps. All carbon evolved from the sample is converted to CO_2 in an oxidizing oven immediately downstream from the desorption oven, and the CO_2 is converted to methane (CH_4) by a methanator oven before being measured with a flame ionization detector (FID). (https://www3.epa.gov/ttnamti1/files/ambient/pm25/spec/RTIOCECSOP.pdf)

3.3. Results

3.3.1. Mass concentration of PM_{10} and $PM_{2.5}$

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

The average concentrations of PM_{10} and $PM_{2.5}$ in two seasons are described in Table 3.6 and 3.7. Results revealed that the average concentrations of PM_{10} are within the prescribed limits of MoEF notification guidelines for coal mine areas. In the case of $PM_{2.5}$, there is no Govt. notified standard for mining areas but in the case of buffer zones, National Ambient Air Quality Standard, NAAQS, 2009 may be applicable. The highest PM_{10} and $PM_{2.5}$ concentrations were found in Mine rescue and Harina (Figure 3.2 and 3.3).

Table 3.6: Average concentration of PM_{10} and $PM_{2.5}$ in Summer of Jharia Coalfield

Monitoring Sites		**Average Concentration (µg/m^3)-Summer**	
	Site Description	**PM_{10} (µg/m^3)**	**$PM_{2.5}$ (µg/m^3)**
Lohapatti	Core Zone	133.7	49.42
		(83-203)	(44-83)
Mines Rescue	Core Zone	184.8	83.43
		(124-255)	(55-205)
Katras	Core Zone	141.4	80.01
		(100-216)	(42-150)
Lodhna	Core Zone	156.8	63.98
		(100-303)	(32-99)
Moonidih	Core Zone	118.4	62.84
		(80-153)	(34-94)
Patherdih	Core Zone	94.7	67.22
		(50-119)	(37-91)
Bastacola	Core Zone	74.21	62.85
		(52 -209)	(36-96)
BCCL colony	Buffer Zone	157.35	74.37
		(113-222)	(47-103)
Harina	Buffer Zone	177.7	117.3
		(73-265)	(42-175)
Bhuli	Buffer Zone	141.7	105.89
		(85-243)	(44-161)
Sindri	Buffer Zone	122.2	76.05
		(82-139)	(18-127)
Parabatpur	Buffer Zone	122.4	110.98
		(86-171)	(70-150)
Background	Buffer Zone	144.4	57.13
		(24-255)	(23-97)

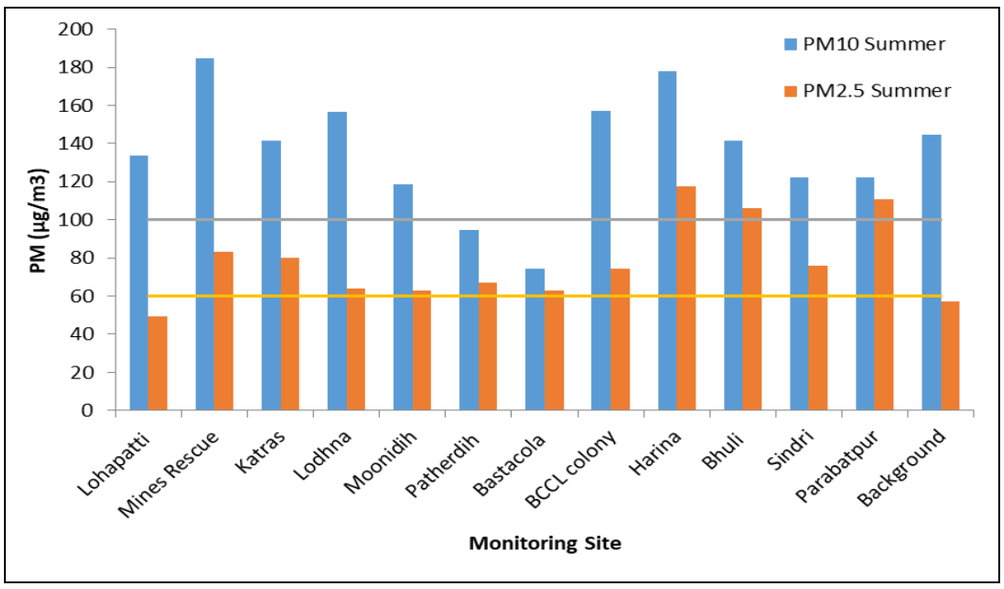


Figure 3.2: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region in summer compared to NAAQS (2009)

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

Monitoring Sites	**Site Description**	**Average Concentration (µg/m^3)-Winter**	
		PM_{10} (µg/m^3)	**$PM_{2.5}$ (µg/m^3)**
Lohapatti	Core Zone	174.28	139.59
		(122-241)	(114-236)
Mines Rescue	Core Zone	303.49	176.97
		(175-350)	(114-233)
Katras	Core Zone	230.06	50.87
		(134-332)	(24-78)
Lodhna	Core Zone	322.8	112.17
		(243-412)	(98-209)
Moonidih	Core Zone	300.16	188.27
		(128-728)	(64-600)
Patherdih	Core Zone	222.71	113.23
		(182-246)	(111-167)
Bastacola	Core Zone	332.05	176.48
		(251-663)	(54-425)
BCCL colony	Buffer Zone	219.98	128.79
		(155-300)	(94-175)
Harina	Buffer Zone	130.73	42.93
		(65-215)	(44-98)
Bhuli	Buffer Zone	174.75	151.66
		(150-200)	(89-180)
Sindri	Buffer Zone	171.82	167.07
		(81-210)	(142-184)
Parabatpur	Buffer Zone	228.76	148.16
		(75-660)	(101-192)
Background	Buffer Zone	233	121.18
		(195-254)	(63-170)
Katras II		107.13	98.42
	Core Zone	(128-181)	(94-104)

Whereas in winter monitoring, the highest PM_{10} mass concentration was found to be 332µg/m^3 at Bastacola site (exceeding the prescribed limit of **GSR 742(E)**) along with other core mining zones like Mines Rescue, Moonidih. The lowest average concentration of PM_{10} was found in Katras II (Table 3.7).

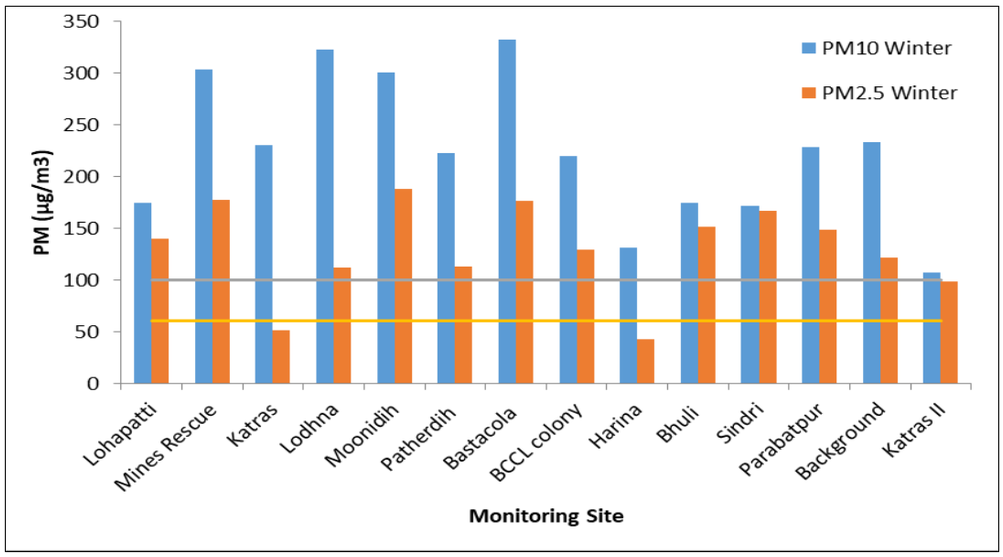


Figure 3.3: Average concentration of PM_{10} and $PM_{2.5}$ in JCF region during Winter compared to NAAQS (2009)

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

The digested samples of PM_{10} and $PM_{2.5}$ particles from all the 13 sampling sites were subjected to estimate the elemental composition using ICP-OES. The analysis of PM_{10} particles yields 11 different elements such as Al, As, Cd, Co, Cu, M, Ni, Pb, Zn, Fe and Cr. Similarly, the samples containing $PM_{2.5}$ particles revealed the same elements as PM_{10}. It was observed that Al and Fe were found to be higher for both PM_{10} and $PM_{2.5}$ particles. Al is the most abundant element. The concentration of Al was detected in the range of 6.32-14.62µg/m^3. Maximum Al concentrations were found at BCCL colony, Parbatpur, Harina and Background. The concentrations of Fe and Cr were estimated as 0.78-7.74µg/m3 and 0.075-1.32µg/m3 respectively. The highest concentrations of both Fe (7.74µg/m3) & Cr (1.32µg/m3) were found at the Bastacola site Figure 3.4. Similarly, in the case of PM2.5 particles the concentrations of Al (4.87-14.47µg/m3), Fe (0.44-11.77µg/m3) and Cr (0.066-2.17µg/m3) were found higher than other elements. For PM2.5 particles, maximum concentrations of Fe (11.77µg/m3) and Cr (2.17µg/m3) were obtained at the Mine Rescue site and Al (14.47µg/m3) at Katras. Since, the elements such as Al, Fe and Cr possess higher concentrations in the PM10 elemental composition, Al would have been emitted from road dust, whereas Fe would have been emitted from the re-suspension of dust containing deposits from the emissions of vehicular and other anthropogenic activities Figure 3.5.

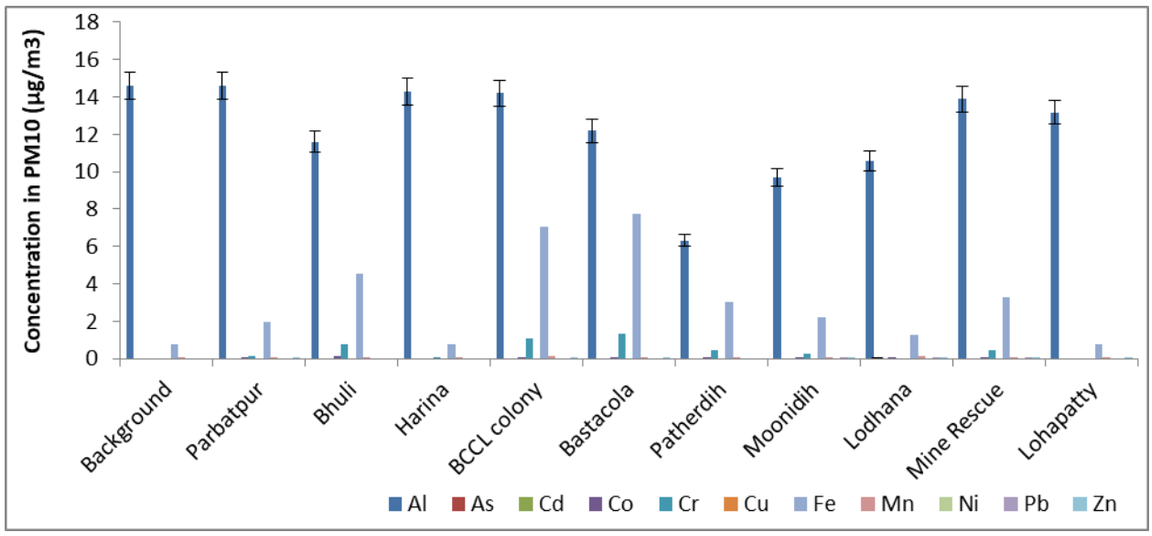


Figure 3.4: Metal concentration of PM_{10} in the summer season

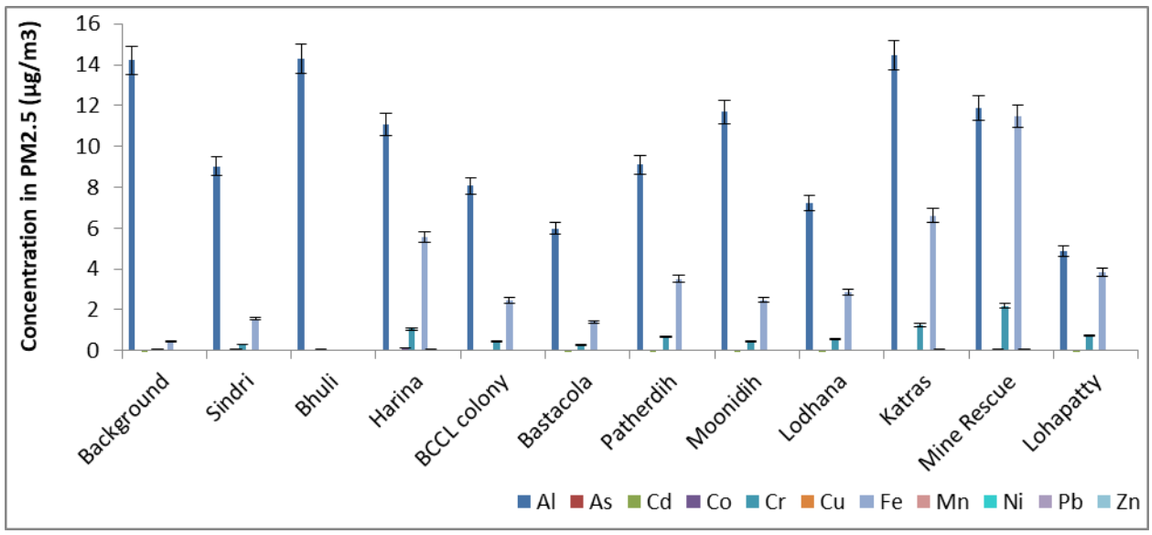


Figure 3.5: Metal concentration of $PM_{2.5}$ in the summer season

3.3.3. Elemental Concentration of PM_{10} and $PM_{2.5}$ in Winter

The elemental analysis was performed using inductively coupled plasma optical emission spectroscopy (ICP-OES). For the air quality assessment, the concentrations of 11 elements i.e. Al, As, Cd, Cr, Cu, Fe, K, Mn, Ni, Pb, and Zn in PM_{10} and $PM_{2.5}$ samples, were measured. Among all the elements, Al, Fe, and K concentrations were found considerably higher for PM_{10} samples in the winter season. Al was observed in the range of 2.02-10.77µg/m3 followed by Fe (0.79-9.26µg/m3) and K (0.90-4.19µg/m3). Maximum Al concentration (10.77µg/m^3) was observed at the BCCL colony, followed by Lodhna (10.29µg/m^3). The Highest Fe concentration (9.26µg/m^3) was observed at Bastacola while K (4.19µg/m^3) at the Lodhna site. This may be due to vehicular emissions, paved roads, construction dust, coal combustion, soil dust, etc. The concentration of As, Ni, Pb was found within the limits of CPCB standards. The remaining elements i.e. Cd, Cr, Cu, Mn, and Zn were found very low (Figure 3.6).

Similarly, in the case of $PM_{2.5}$ samples concentrations of Al, Fe and K were detected higher than other elements. The concentration of Al, Fe, and K was obtained as 0.11-2.91µg/m^3, 0.05-1.93µg/m^3 and 0.08-2.12µg/m^3. For $PM_{2.5}$ particles, maximum Al and K were found at the Munidih site, which were 2.91µg/m^3 and 2.12µg/m^3 respectively. The highest concentration of

Fe i.e. 1.93µg/m^3 was detected at Lodhna site. The concentrations of all other analysed elements were low (Figure 3.7).

From the elemental analysis of the summer and winter seasons, it was observed that the average Al concentration obtained was more in the summer season than in the winter season. In contrast, the average concentration of Cr was more in the winter season.

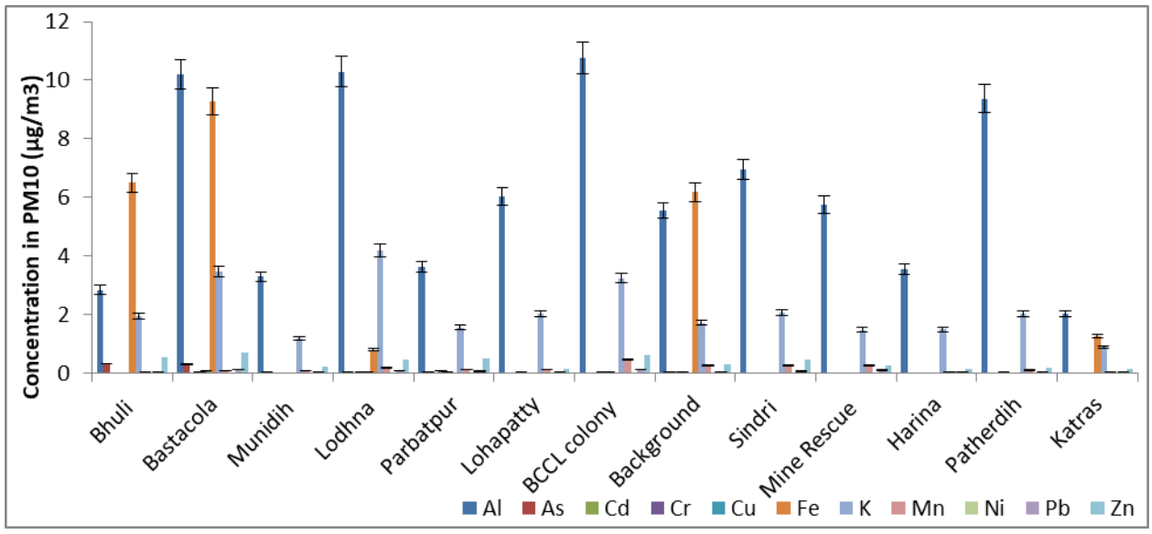


Figure 3.6: Metal concentration of PM_{10} in winter season

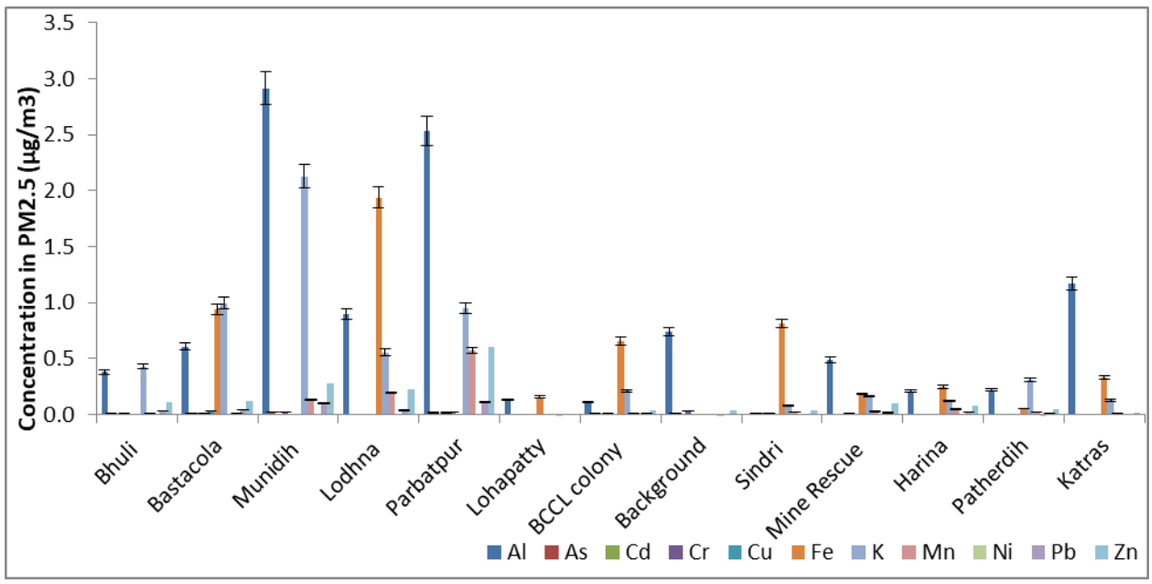


Figure 3.7: Metal concentration of PM 2.5 in winter season

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

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

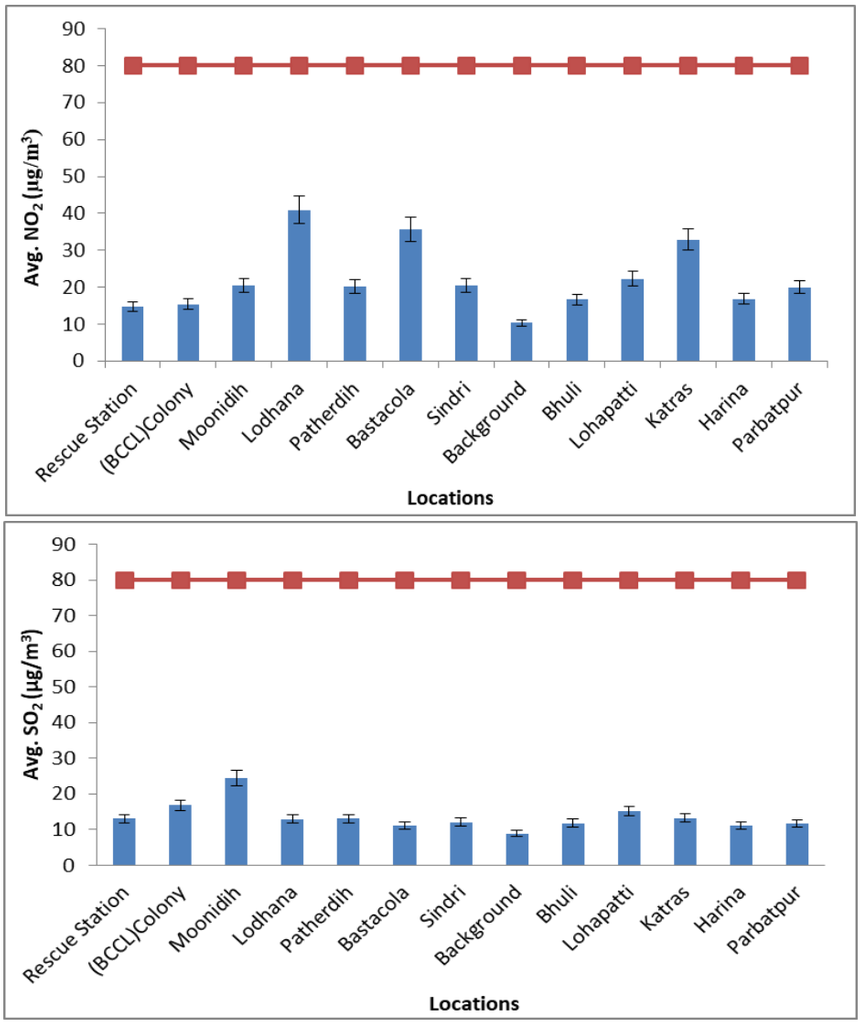


Figure 3.8: NO_2 and SO_2 Concentration of all monitoring sites in summer season

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

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

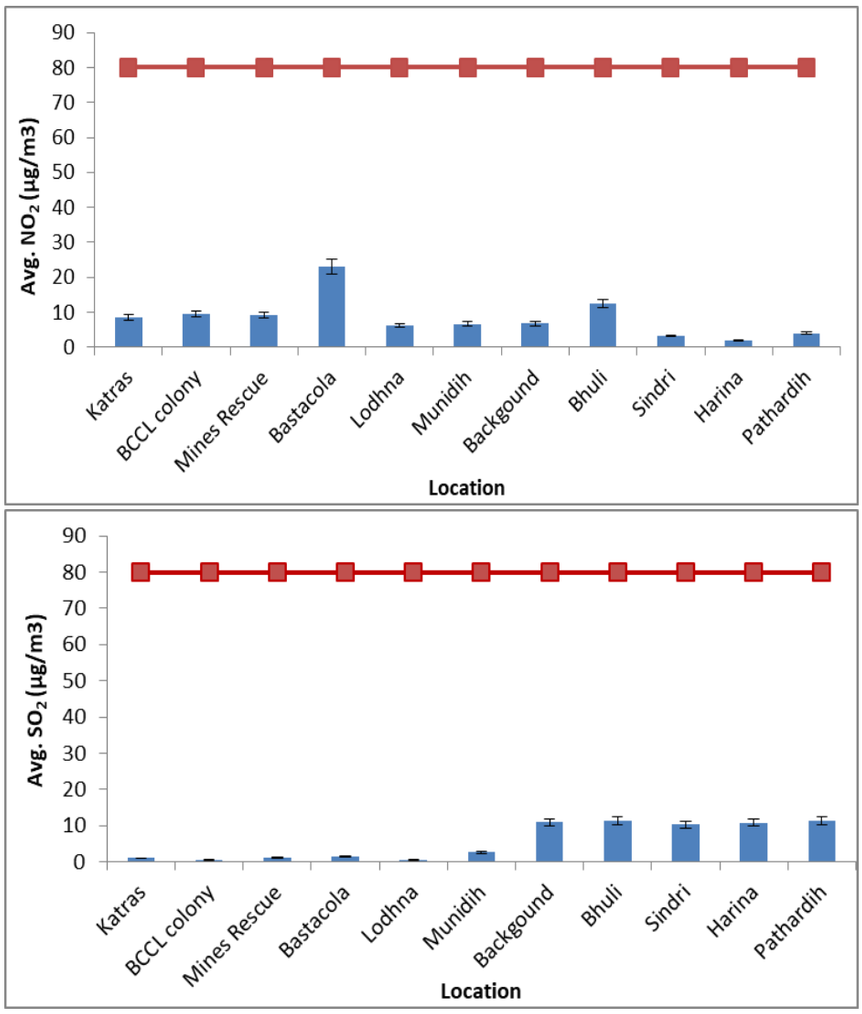


Figure 3.9: NO_2 and SO_2 Concentration of all monitoring sites in Winter season

3.3.6. Carbonaceous Aerosol/EC & OC in Summer

Data were obtained for four OC fractions (OC1, OC2, OC3 and OC4 in He atmosphere at 140, 280, 480 and 580°C, respectively) and three EC fractions (EC1, EC2, and EC3 in a 2% O2/98% He atmosphere at 580, 740 and 840°C, respectively). The IMPROV protocol defines OC as OC1 + OC2 + OC3 + OC4 and EC as EC1 + EC2 + EC3. The mass concentration of organic matter (OM) in the atmosphere was estimated by multiplying OC by 1.6 (conversion factor for urban aerosol). The total carbonaceous aerosol (TCA) was calculated as the sum of OM and EC. The highest concentration of OC and EC in $PM_{2.5}$ was found in the BCCL colony site i.e. 37.85 and 42.33µg/m^3, respectively, and the lowest OC concentration was 15.36µg/m^3 and EC was 13.08µg/m^3 in Sindri site. In comparison, the concentration of OC (67.35µg/m3) and EC (81.67µg/m^3) in PM_{10} were higher in the BCCL colony among all the sites. The lowest OC concentration as 17.95µg/m^3 was in Bastacola and EC in Parbatpur i.e. 15.44µg/m^3 (Figure 3.10).

3.3.7. Carbonaceous Aerosol/EC & OC in winter

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

Harina followed by Lohapatti and Patherdih. In the case of $PM_{2.5,}$ Parbatpur was found to have the lowest concentration among other sites.

The higher mean concentration of EC and OC in winter were likely related to the influence of emissions from residential heating (in addition to traffic source) and, on the other hand, to the unfavourable meteorological conditions leading to more excellent dispersion of pollutants in the atmosphere during this season. Elemental carbon is emitted directly into the atmosphere during incomplete combustion emissions, such as motor vehicle exhaust, fuel burning, and biomass burning (Figure 3.11).

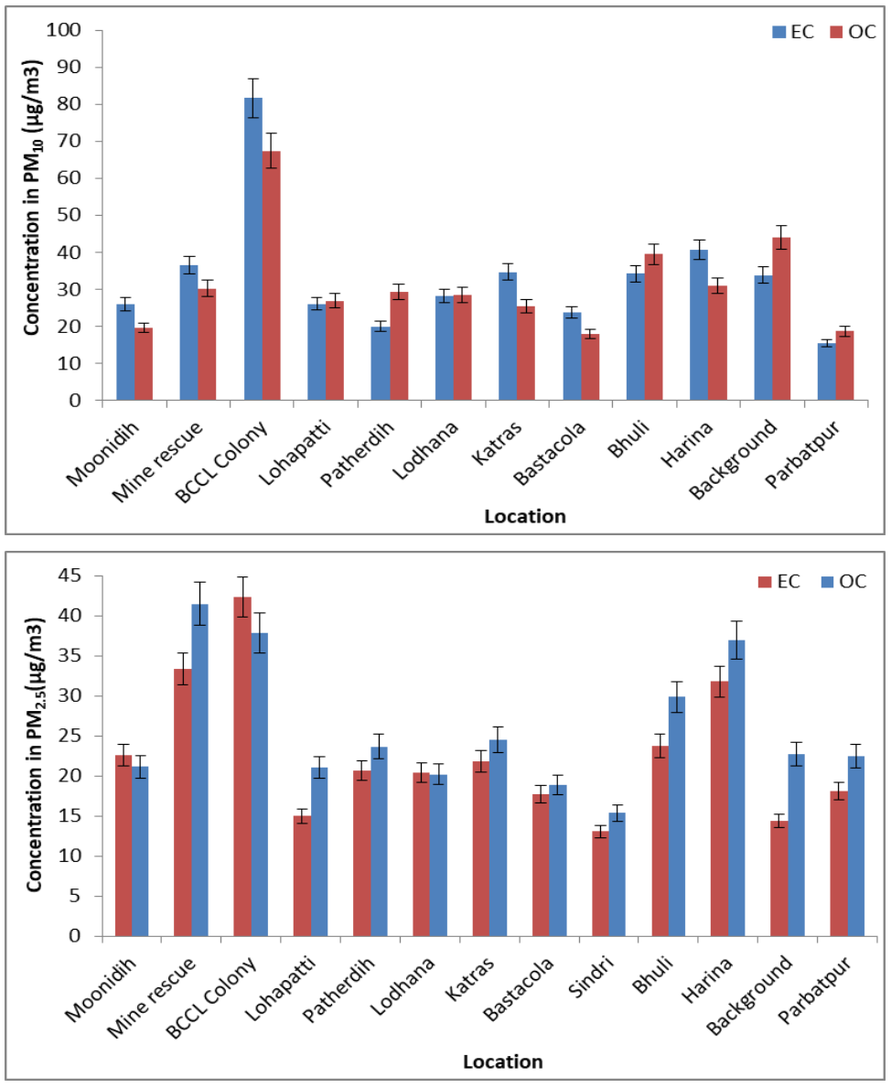


Figure 3.10: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Summer season

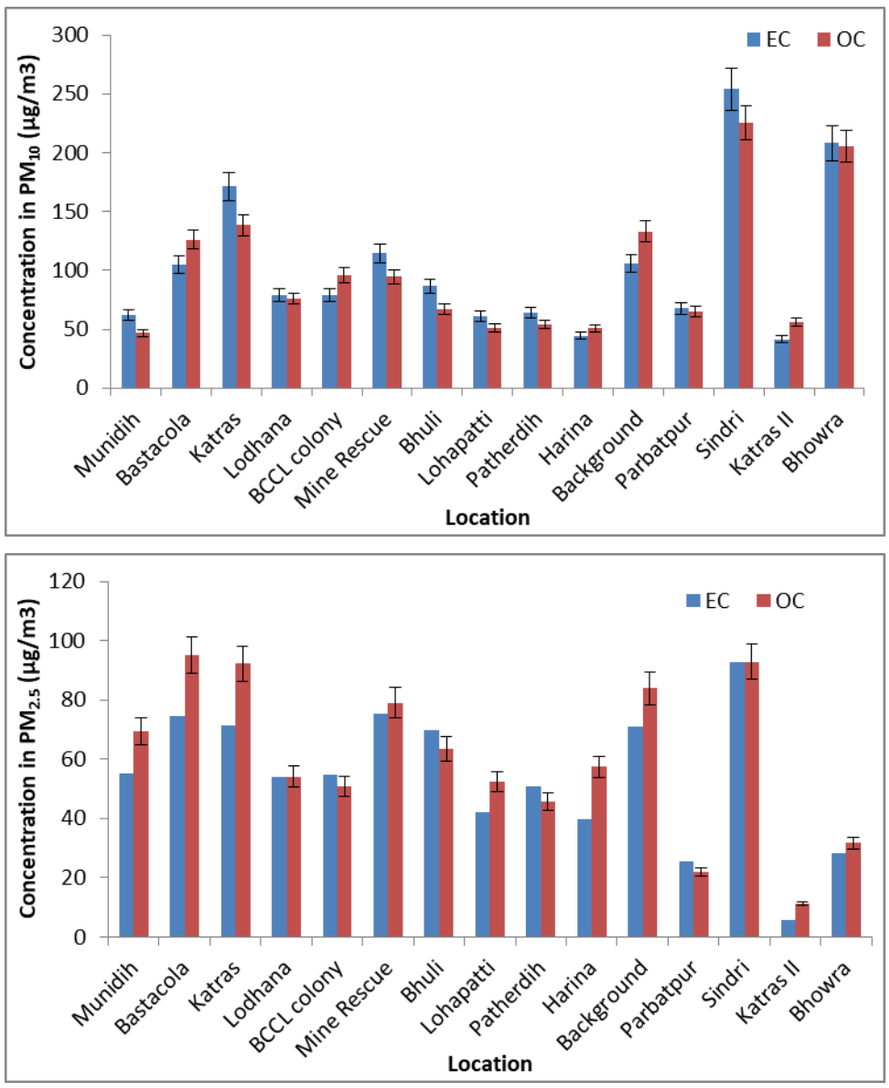


Figure 3.11: EC & OC concentration in PM_{10} and $PM_{2.5}$ in Winter Season

3.3.8. Ionic composition of PM_{10} and $PM_{2.5}$ in Summer season

The anions (SO_4^{2-}, NO_3^- and Cl^-) and cations (NH_4^+, Na^+, Ca^{2+}, K^+) are the water-soluble inorganic ions found in abundance. In summer, the mass concentration of SO_4^{2-} in PM_{10} was in the range of 1.06-20.17µg/m^3 where a higher concentration was observed in Harina, BCCL colony, and Lodhana sites. Likewise, NO_3^- was in the range of 0.32-19.2µg/m^3 with the highest in the Harina site. PO_4^{3-} and Cl^- concentration was highest in Harina and < 2µg/m^3 in other locations. NH_4^+ was in the range of 0.75-16.24µg/m^3, Harina with the highest concentration, and Bastacola with the lowest concentration. Na^+ concentration (0.18-8.6µg/m^3) was highest in Harina followed by BCCL colony and less than 2µg/m^3 in remaining sites. Ca^{2+} concentration (1.5-11.77µg/m^3) was highest in Lohapatti and BCCL colony while lowest in Katras. K^+ ion was also observed in the Harina site with a concentration of 5.85µg/m^3 (Figure 3.12).

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

3.3.9. Ionic composition of PM_{10} and $PM_{2.5}$ in Winter season

PM_{10} ions concentration in Bastacola and Background were highest among all the monitoring

sites which followed the increasing order of $Na^+ < Mg^{2+} < F^+ < K^+ < Ca^{2+} < Cl^- < NH_4^+ < SO_4^{2-} < NO_3^-$. It has been observed that SO_4^{2-}, NO_3^- and NH_4^+ ions were present in abundant in PM_{10} mass concentration, and concentration of NO_3^- in these sites contributes majorly to PM_{10}. Ions concentration in Katras, Lohapatti, and Bhuli sites were observed having lower ionic concentration Figure 3.14.

The ionic composition of $PM_{2.5}$ comprises mainly of SO_4^{2-}, NO_3^-, Cl^-, NH_4^+, Ca_2^+ and K^+ ions. Locations such as Bastacola and Parbatpur have higher concentration of ions compared to remaining sites in following order: $Mg^{2+} < Na^+ < Ca^{2+} < K^+ < Cl^- < NH_4^+ < SO_4^{2-} < NO_3^-$. The same trend has been observed i.e. SO_4^{2-}, NO_3^- and NH_4^+ ions contribute mainly in $PM_{2.5}$ mass concentration. The average concentration of SO_4^{2-} and NO_3^- in winter was higher than in summer.

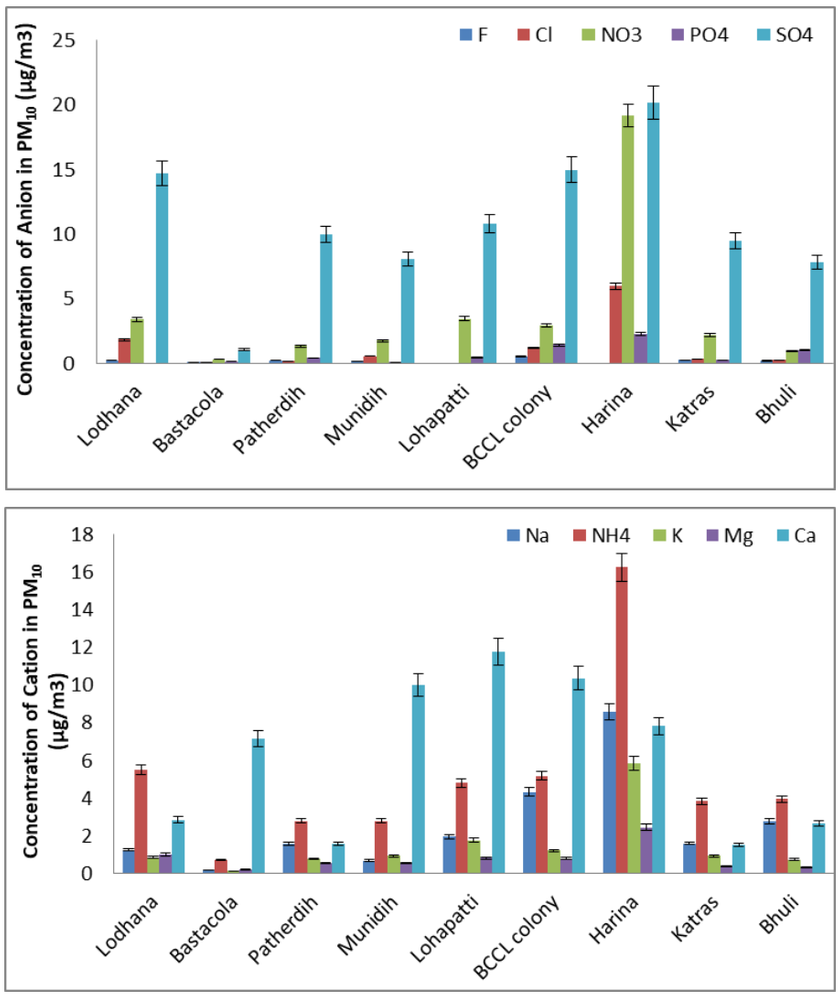


Figure 3.12: Anion and Cation concentration in PM_{10} in summer

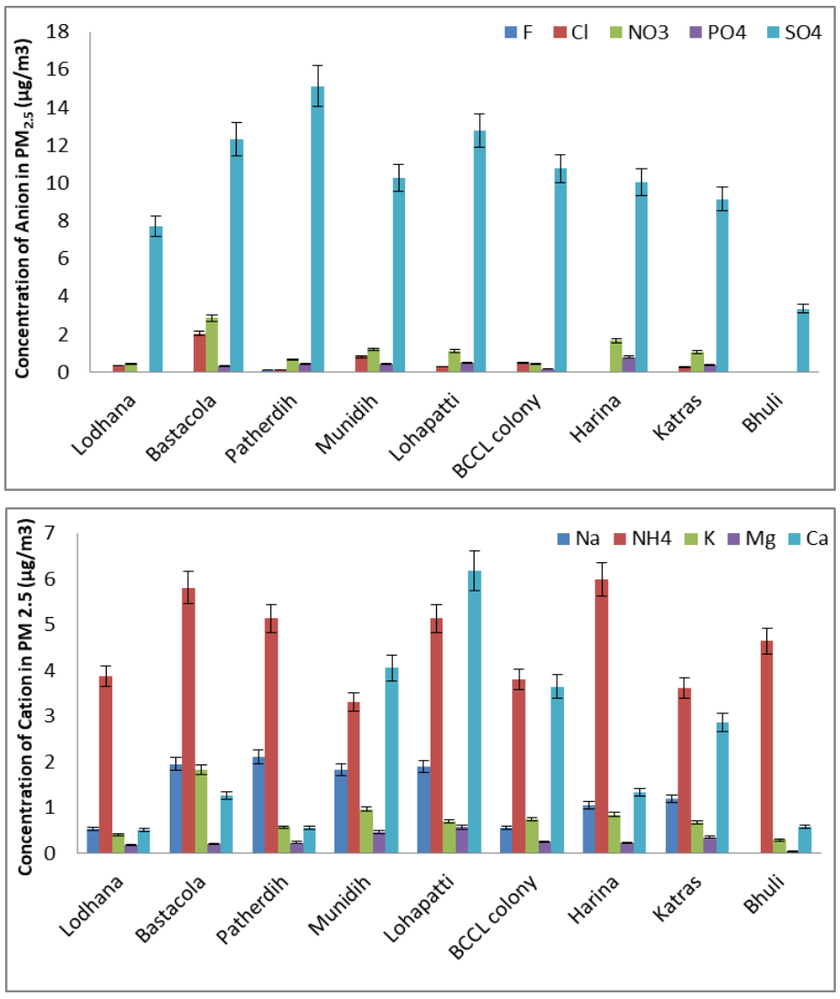


Figure 3.13: Anion and Cation concentration in $PM_{2.5}$ in summer

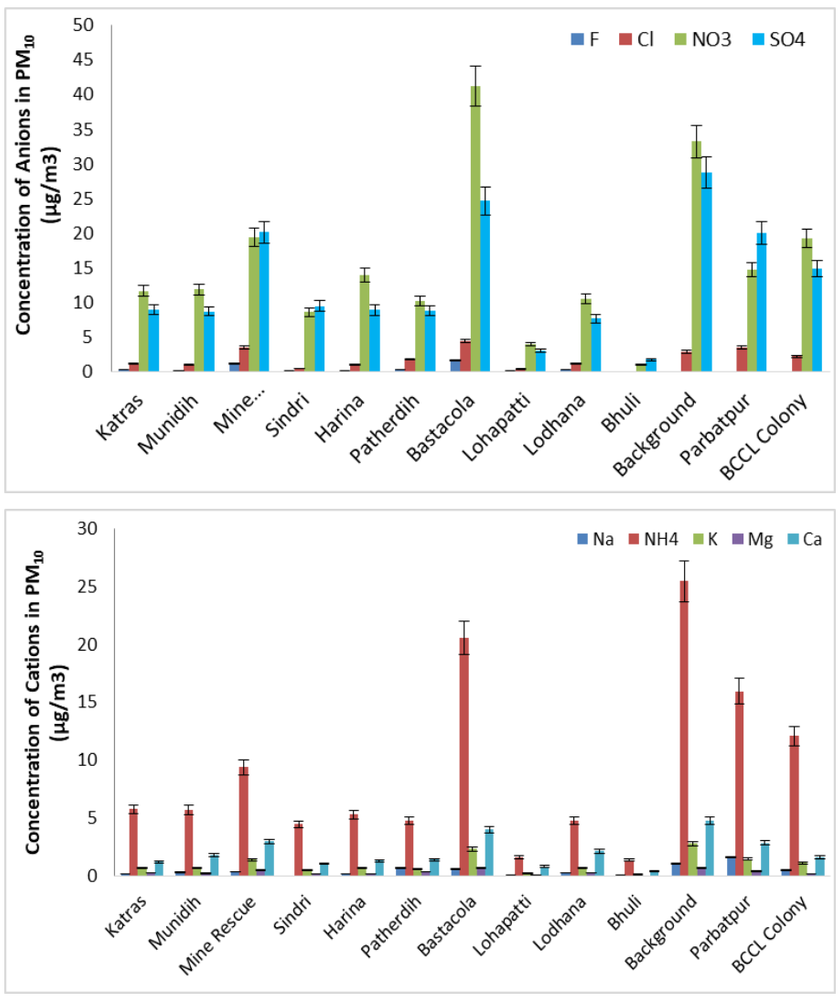


Figure 3.14: Anion and Cation concentration in PM_{10} in winter

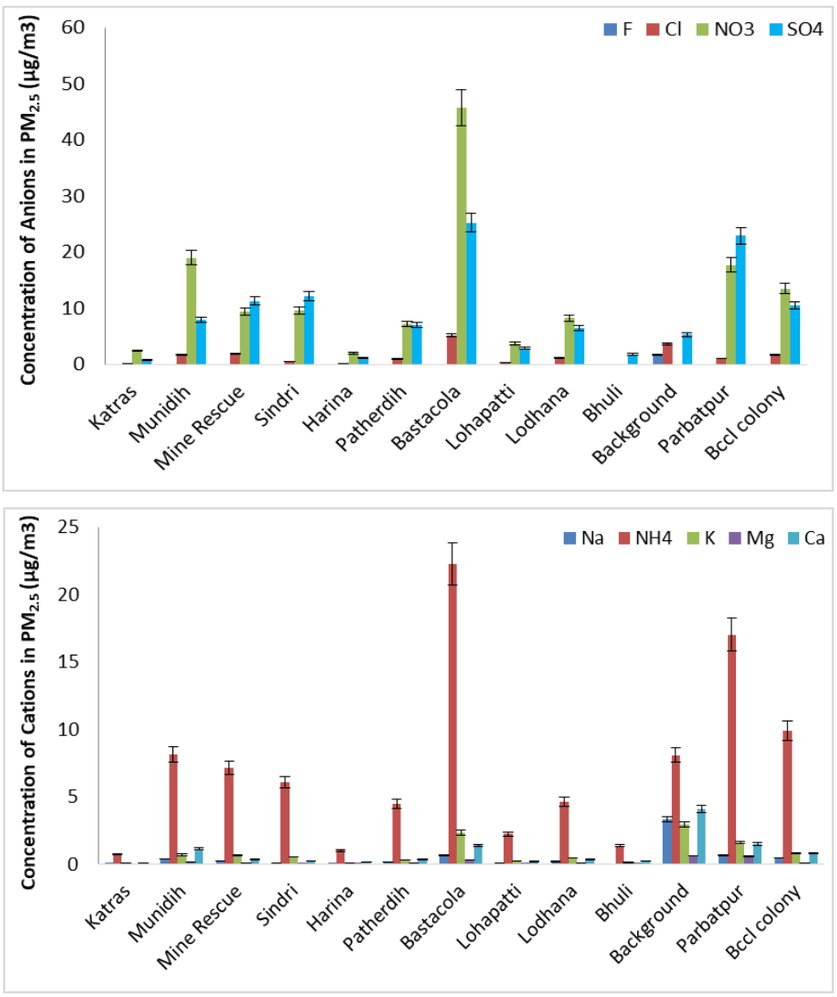


Figure 3.15: Anion and Cation concentration in $PM_{2.5}$ in winter

Chapter 4 Receptor modelling

4.1. Source Apportionment

The source apportionment study was carried out to identify the potential sources contributing to the particulate matter of aerodynamic size less than 10 µm in the Jharia coalfield (JCF) using a receptor modelling approach. In receptor modelling, the particulate matter (PM_{10}) characterization in terms of metal, ions, elementary and organic carbon profiles is statistically matched with that of various source profiles in the study area. For the source apportionment study of JCF, the area is divided into various zones (buffer, core and background zone). And the ambient PM_{10} characterization obtained from the multiple monitoring locations in the study area is conflated and compared with source profiles viz. industrial (mining and non-mining) and allied industrial activities, transportation, local vehicular movement and domestic fuel (coal wood burning, etc.). The chemical mass balance (CMB) model EPA-CMB v8.2 is one of the several receptor models and is most trusted for coarse and fine particulate matter source apportionment. The CMB model estimates source contributions by determining the best linear combination of emission source profiles and the chemical composition of ambient particulate, aerosol, and volatile organic compound samples. The study is studying the apportionment of particulate matter is considered owing to the nature of high particulate matter pollution in the study area. The source apportionment study is useful for devising an effective action plan for abatement of emission load in the region; thereby the region's overall air quality can be improved.

Jharia is one of the eight blocks in Dhanbad and is the main source of metallurgical coal in India, and is termed as the powerhouse of the country owing to its best quality coking coal, which is required by the steel and other industries in India. Dhanbad lies between 23°37'3" N and 24°4' N latitude and between 86°6'30" E and 86°50' E longitude with an average elevation of 222 m. Its geographical length, extending from North to South, is 43 miles and width 47 miles, stretching across East to West. It shares its boundaries with West–Bengal in the Eastern and Southern parts, Dumka and Giridih in the North, Bokaro in the west. It is the administrative headquarter of the district and Dhanbad Municipal Corporation (DMC).

The air quality status is determined by dividing the study area into background, core, and buffer zones. Thirteen sites were selected to represent various regions, including two references or background sites. The sampling locations are shown in Figure 3.1.

4.1.1. Chemical Mass Balance (CMB)

A mass balance equation can be written to account for all the chemical species in the samples as contributions from independent sources:

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

C_i is the concentration of species i measured at a receptor site (derived from the chemical analysis), X_{ij} is the i^{th} elemental concentration measured in the j^{th} sample, and m_j is the airborne mass concentration of material from the j^{th} source contributing to the j^{th} sample. The term a_{ij} is

included as an adjustment for any gain or loss of species i between the source and receptor. The term is assumed to be unity for most of the chemical species.

The CMB 8.2 software (USEPA 1997) is used in this study. It is windows-based software that requires input data on ambient (at receptor locations) and source profiles of PM characterization. The model runs multiple iterations to provide optimum goodness of fit among the sources and receptors and verifies the model with various checks viz. Chi-square statistic, t-tests, mass percentage, and correlation coefficient. The following assumptions should be understood before proceeding with the CMB analysis.

The CMB model assumptions are:

- The concentration of emissions sources is constant throughout ambient and source sampling;
- Chemical species do not react with each other (i.e., they add linearly);
- All sources with potential for contributing to the receptor have been identified and have had their emissions characterized;
- The number of sources or source categories is less than or equal to the number of species;
- The source profiles are linearly independent of each other; and
- Measurement uncertainties are random, uncorrelated, and normally distributed.

The following steps are followed for running the CMB model:

- Identification of the contributing emission source types based on primary survey and emission inventory data collected around the monitoring sites.
- The selection of chemical species to be included in the CMB modelling calculation is based on the Central pollution control board (CPCB) guidelines.
- The source profiles with the fraction of each chemical species and uncertainty are withdrawn from the SPECIATE 5.1 database. SPECIATE 5.1 is US-EPA's repository of organic gas and particulate matter (PM) speciation profile of air pollution sources.
- Estimate ambient concentration (ambient data) is based on chemical analysis of the PM samples collected at the respective site during monitoring. The uncertainty of the chemical species is mainly based on the instrument uncertainty.
- The CMB 8.2 model run provides the solution of the chemical mass balance equation.

For source apportionment of PM_{10}, CMB 8.2 software (USEPA 1997) provides many goodness's of fit tests to verify the accuracy of the model. The normal checks, as specified in the manual by USEPA (1997) to accept the model are; t-statistics i.e., source contribution divided by the error of source contribution should be greater than 2, χ^2 (chi-square) is the weighted sum of squares of the differences between calculated and measured fitting species concentrations divided by the effective variance and the degrees of freedom, it should be less than 4. The weighting is inversely proportional to the squares of the precision in the source profiles and ambient data for each species. Ideally, χ^2 would be zero, there would be no difference between calculated and measured species concentrations. The χ^2 less than one indicate a very good fit for the data. Values greater than 4 indicate that one or more of the fitting species concentrations are

not well-explained by the source contribution estimates (SCE). The source contribution estimate approximates the total mass concentration which is a convenient check on the %mass explained value. When the SCE is less than its standard error, the source contribution is undetectable. Two or three times the standard error may be taken as the upper limit of the SCE in this case. Assuming that the errors are normally distributed, there is about a 66% probability that the true source contribution is within one standard error and about a 95% probability that the true concentration is within two standard errors of the SCE.

R^2 is determined by the linear regression of the measured versus model-calculated values for the fitting species. R^2 ranges from 0 to 1. The closer the value is to 1.0, the better the SCEs explain the measured concentrations. When R^2 is less than 0.8, the SCEs does not explain the observations very well with the given source profiles. The percentage mass explained should be between 80% and 120%, the ratio of the computed and the measured concentration of each element (C/M ratio) should be close to 1 and R/U ratio, i.e., the ratio of residuals to uncertainty should be less than 2. As the model requires the source contribution estimates and receptor concentrations in ambient air, the significant sources in the area need to be identified first. The investigation of sources of PM_{10} to be accounted for in the CMB model is carried out using emission inventory studies.

4.1.2. Source profiling

The Chemical profile needs to be developed for the air-polluting source as input to the receptor-oriented source apportionment models like CMB8.2 (chemical mass balance). The U.S Environmental Protection Agency's (EPA) SPECIATE database and several studies carried out in other parts of the world provide an extensive collection of source profiles. The source profiles required in this study are extracted from SPECIATE5.1 the database.

The source of the particulate matter in JCF accompanies various coal handling activities such as opencast coal mining and its associated activities, thermal power stations, automobiles, generator sets fuel burning, construction activities, domestic coal, cooking gas burning, etc. and even the background contribution of natural dust (crustal origin) cannot be ruled out, particularly, in the zones having loose topsoil (Roy and Singh 2014). So, the sources profiles considered here are coal dust, coal combustion, road dust, heavy vehicle diesel, light vehicle gasoline, etc.

4.1.3. Ambient profiling

As discussed in Chapter 3**,** the samples collected from the sampling location undergo chemical characterization. The species obtained from the chemical analysis used in ambient profile structuring and the uncertainty is based on the instrument.

The overall methodology used in the source apportionment study is depicted by the flow diagram as follows:

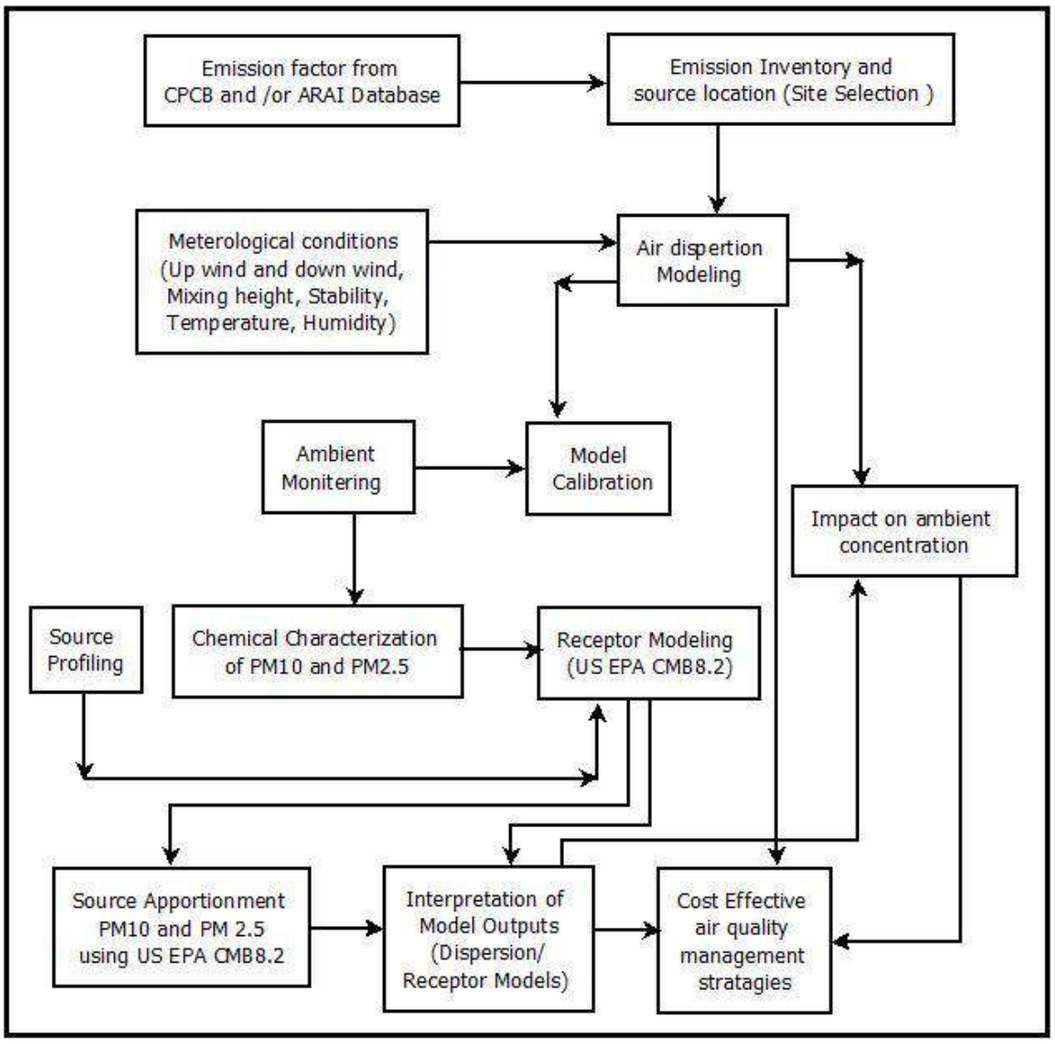


Figure 4.1: General methodology followed in the source apportionment studies

4.2. Results of the Chemical Mass Balance

CMB8.2 is performed for all the air quality monitoring locations. The significant sources in the area are identified first based on the field surveys. The general category of sources included in the model for all the sites are composites of all the vehicular sources, domestic combustion, road dust, agricultural waste burning, Industries, etc (Summary of relevant air quality studies from major Indian cities is given in Table 4.1). However, the choice of sources varies concerning the activities prevailing in the area and CMB model performance. A similar approach also applies to the selection of species. Efforts were made to include as many species in the model as possible. The choice was, however, restricted based on model performance. The source contributions are shown in the following Figures 4.3. The CMB model performance with respect to various sources is shown in Annexure 1.

4.2.1. Domestic combustion

In the summer season, the foremost emission source was domestic combustion for PM_{10} and $PM_{2.5}$. The domestic combustion percentage was observed at 22% and 25% for PM_{10} and $PM_{2.5}$ in the summer season. In the winter season, domestic combustion contribution was the second most percentage contributor for PM_{10} and $PM_{2.5}$. The PM_{10} percentage was 23% while the $PM_{2.5}$

percentage contribution was 28% in this season. The higher concentration of Cl^-, F^-, Cr, and Br. Cl^- and F^- are the markers of coal-burning and wood-burning (Jain et al., 2020). High Br along with Cl^- suggests the contributions from coal combustion.

4.2.2. Industrial Emission

The industrial combustion percentage contribution observed 16% in PM_{10} and 13% in $PM_{2.5}$ in the summer season. In the winter season, contribution to industries is determined to be 15% in PM_{10} and 24% in $PM_{2.5}$. The abundances of elements like As, Zn, Fe, Cu, Cr, Pb, and S indicate the industrial source's emissions. Kumar et al. (2001) used Cu, Mn, and Ni as tracers for industrial emissions in Mumbai; Sharma et al. (2014b) used Cu, Cr, Mn, Ni, Co, and Zn as industrial emission tracers for metal manufacturing plants in Delhi; Kulshrestha et al. (2009) used a combination of Ni, Cu, Fe, and Cr as a marker for construction activities in Agra; and Karet al. (2010) used Zn, Cu, and Ni as tracers of galvanizing, metallurgy, and electroplating industries while Cr from tannery industry in Kolkata.

4.2.3. Coal Mining

Opencast coal mining activity comprises heavy-duty diesel vehicle usage, blasting, Coal handling and overburden management. During the summer season, the coal mining activity in PM_{10} and $PM_{2.5}$ is observed to be 8% and 7% respectively while in the winter season it contributes somewhat 6% and 5% in PM_{10} and $PM_{2.5}$ respectively.

4.2.4. Transportation

The overall transportation contribution is 25% for PM_{10} and 32% for $PM_{2.5}$ in the summer season. In the winter season, the transportation emission contribution is examined at 16% for PM_{10} and 18% for $PM_{2.5}$. The OC/EC ratio is a convenient diagnostic tool for investigating the sampling site and its emission sources. In the present study, the OC/EC ratio shows significant seasonal variations for a coarser fraction of PM than for a finer fraction. It is well established that OC/EC ratio values between 1.4 and 4 indicate emissions from gasoline catalyst vehicles and 0.3 to 1 suggest diesel vehicle emissions (Amato et al., 2016; Cesari et al., 2018). Assessing the ratio of nss-K+/EC is another diagnostic check for estimating the relative loading of vehicular emissions, where nss-K+ is a non-sea-salt water-soluble potassium ion (calculated as K+- 0.129Na+) (Andreae and Merlet, 2001).

4.2.5. Secondary Inorganic Aerosol

During summer, the secondary inorganic aerosol contribution to PM_{10} and $PM_{2.5}$ is about 8% and 16%, respectively. Secondary inorganic aerosols contribution found in winter is about 14% and 17%, respectively for PM_{10} and $PM_{2.5}$. The secondary inorganic aerosol source is a high concentration of nitrate (NO_3^-), sulphate (SO_4^{2-}), and ammonium ((NH_4^-). These secondary products are formed in the atmosphere, being emitted either by natural or anthropogenic sources. The oxidation of NO_x forms the secondary nitrate. It is favoured by low temperature (Li et al.2004), while high temperature and strong solar radiations favour the formation of secondary sulfates through photochemical reactions (Seinfieldand Pandis, 2016). Secondary inorganic aerosol formation from precursors (SO_2 and NO_2) enhances the pollution burden over the

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

4.2.6. Agriculture

The agriculture contribution observed that 5% for PM_{10} and 2% for $PM_{2.5}$ in the study period during the summer season. In the winter season, the contribution is 3% and 2% for PM_{10} and $PM_{2.5}$ respectively. Agricultural activities contribute ammonium to the atmosphere (Pant and Harrison, 2012; Jain et al., 2019). The OC and EC are also significant agricultural activity sources (Ram and Sarin 2011; Sharma et al.2016a).

4.2.7. Open burning

The contribution of open burning in the summer season is 5% for both PM_{10} and $PM_{2.5.}$ In winter, the garbage burning contribution is 6% and 2% for PM_{10} and $PM_{2.5}$ respectively during study time. The abundance of tracers like K^+, Pb, Br and consider-able Cl^- marks this garbage/biomass burning source. K^+ and levoglucosan are globally employed as biomass burning markers. Biomass consists of residential and agricultural wastes, post-harvest residue, cow dung, dry leaves, fuelwood, and wildfires (Almeida et al., 2006; Khare and Baruah, 2010; Shridhar et al., 2010). The OC and EC are also traced insignificant amounts along with K+, indicating the biomass burning emanations (Cesari et al., 2018; Sharma et al., 2014; Jain et al., 2018).

4.2.8. Road Resuspension dust

The re-suspension dust is a significant contributor to PM_{10}. The contribution of resuspension dust is during the summer season 12% while in the winter season the emission contribution is 10% for PM_{10}. In the summer season, resuspension dust's contribution is higher because of the high wind velocity and dry condition. The lower percentage contribution of road dust to fine particulate matter is attributed to substantial road dust particulates in coarse mode, found in other studies (Gupta et al., 2007; Masri et al., 2015). Crustal elements are significant constituents of airborne soil and re-suspension road dust. Generally, they contribute to coarse aerosols, including Al, Si, Ca, Ti, Mg, Fe, and Na used as tracers for soil dust or crustal re-suspension (Lough et al.2005; Begum et al. 2011). The marker elements that have been used in India for the identification of soil dust include Al, Si, Ca, Ti, Fe, Pb, Cu, Cr, Ni, Co, and Mn (Sharma et al., 2017). Cu, Zn, and Ba are associated with road dust/re-suspension dust due to the release of these marker elements from cars and non-exhaust sources.

4.2.9. Other emission Contribution

Other area sources contributed in the summer season is 12% for PM_{10} and 7% for $PM_{2.5}$ during the study period. In the winter season, emission contribution is 14% for PM_{10} and 9% for $PM_{2.5}$.

4.3 Inferences

The receptor modelling (CMB) results (Figure 4.3) revealed that the transport sector and domestic combustion are the predominant emission sources contributing to the receptor levels. During the summer season, the contribution of the transport sector was found maximum in both PM_{10} (23%) and $PM_{2.5}$ (30%) followed by the contribution of domestic combustion (17% and 23% for PM_{10} & $PM_{2.5}$ respectively). While in the winter season, the contribution of domestic combustion outruns the contribution of the transport sector. During the winter season, domestic combustion has contributed 22% (PM_{10}) and 28% ($PM_{2.5}$) whereas the transport sector has contributed 16% (PM_{10}) and 21% ($PM_{2.5}$) of the total emission.

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

In $PM_{2.5}$ source contribution, secondary inorganic aerosol formation contributed majorly (16% & 15% in summer and winter seasons respectively) after domestic combustion and transport sector. Secondary inorganic aerosol formation from precursors (SO_2 and NO_2) enhances the pollution burden over the vicinity. Biomass burning, the presence of metal traces (Fe, Al, Mn, Zn, Cr etc.) from vehicular or industrial emission play a key role to neutralise the oxides of nitrogen and sulphur and thus raises the amount of secondary inorganic aerosols in the atmosphere.

Industrial activity contributed 12% and 11% of total PM_{10} load in summer and winter respectively but in the case of finer dust ($PM_{2.5}$), it contributed 17% in the winter season at the receptor level. This may be due to the calm winter conditions that allow finer dust ($PM_{2.5}$) to settle near to ground than that of summer conditions that allow more turbulence mixing in the atmosphere.

Road re-suspension of dust contributes significantly in PM_{10} load at receptor both in summer (12%) and in winter (8%). As these are larger and heavier particles, they contribute to PM_{10} fraction and are not found in $PM_{2.5}$ fraction at the receptor.

After the contribution of the industrial sector, coal-mining activity contributed around 8% and 6% of the total PM_{10} receptor dust load during summer and winter respectively. In the case of $PM_{2.5}$ dust load at the receptor, coal-mining activity contributed 7% and 5% during summer and winter respectively.

From the results and analysis of receptor modelling, it can be summarised that mitigation and abatement of the emissions from domestic combustion and transport sector alone may reduce receptor dust load by 40% (approx.).

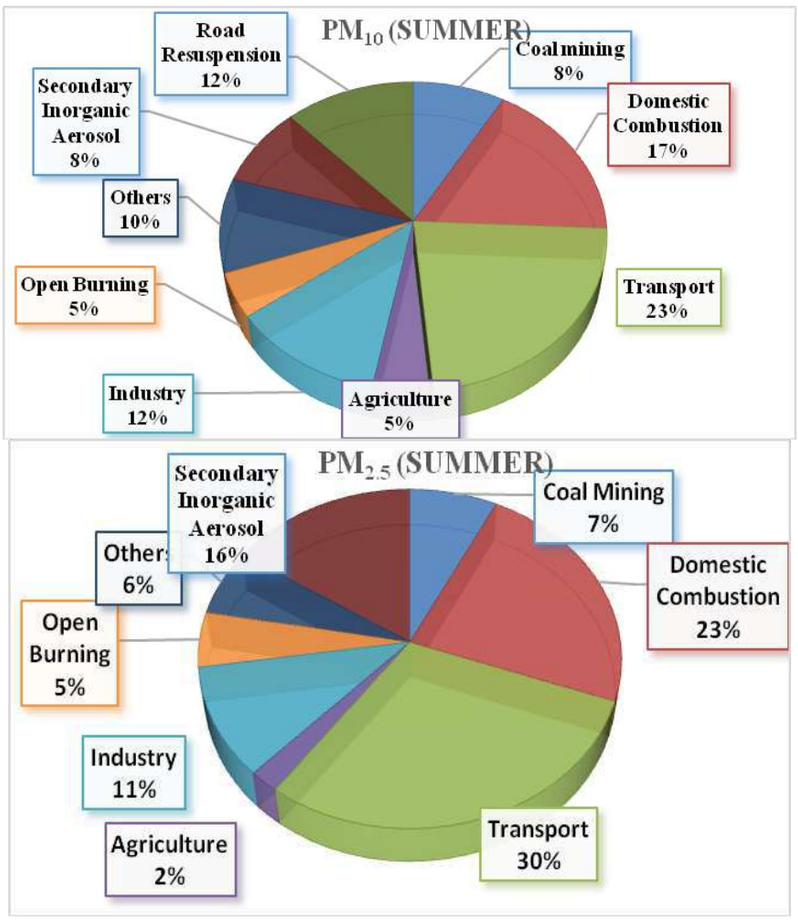


Figure 4.2: Source contribution at receptor locations of PM_{10} and $PM_{2.5}$ in summer

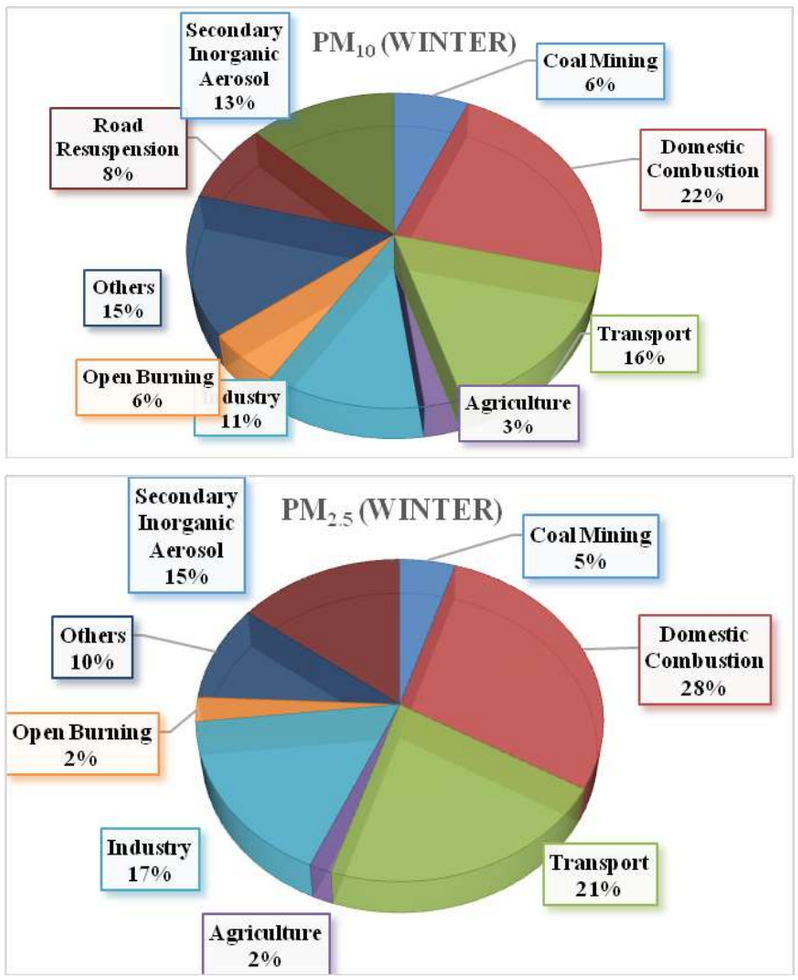


Figure 4.3: Source contribution at receptor locations of PM_{10} and $PM_{2.5}$ in winter

Table 4.1: Summary of relevant air quality studies from major Indian cities.

Area/Location	**Particle size**	**Sources**	**Elements and Ions**	**References**
Delhi	PM_{10} and $PM_{2.5}$	Secondary Nitrate, Secondary Sulfate, Vehicular emission, Biomass burning, Soil dust, Fossil fuel combustion, Sodium and magnesium salt, Industrial emission	Al, Mg, Ca, Ti, Fe, Cr, Mn, Zn, As, Pb, Br, M, F^-, Cl^-, NO_3^-, SO_4^{2-}, K^+, NH_4^+, and Na^+	Jain et. Al., 2020
Mangalore	PM_{10} and $PM_{2.5}$	Construction dust, Diesel generator, Tyre wear emission, Brake lining emission, Sand dust emission, gasoline vehicle emission, Diesel vehicle emission, Unpaved and paved road emission, Biomass burning, LPG stove emission, Solid fuel emission, Ferrous and steel industries emission, Fabrication and welding emission, Kerosene stove emission	As, Ba, Cd, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sr, Zn, F^-, Cl^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, Na^+, K^+, Mg^{2+} and Ca^{2+}	G. Kalaiarasan et al. 2018
Delhi NCR	PM_{10} and $PM_{2.5}$	Dust construction, Vehicle emission, Biomass Burning, Industrial emission, Secondary Pollutants, DG sets emission,	Al, Si, P, S, Cl, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ca, F^-, Cl^-, NO_3^-, Br^-, NO_2^-, SO_4^{2-}, Na^+, K^+, Mg^{2+} and Ca^{2+}	Report No. ARAI/16-17/DHI-SA-NCR/Final Report August 2018
Delhi	$PM_{2.5}$	Secondary Aerosol, Vehicular emission, Biomass burning, Soil dust, Fossil fuel combustion, Sea salt, Industrial emission	Al, Mg, S, Si, Cl, K, Ca, Ti, Cu, Mn, Fe, Zn, Br, Cr, As, Pb, F^-, Cl^-, NO_3^-, SO_4^{2-}, K^+, NH_4^+, and Na^+	Jain et. Al., 2017
Nagpur	$PM_{2.5}$	DG sets, biomass burning, resuspended dust, secondary aerosol and mobile sources.	Al, Ba, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Si, Zn. F^-, Cl^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, Na^+, K^+, Mg^{2+} and Ca^{2+}	Pipalatkar et al., 2014
Raipur	$PM_{2.5}$	Brick kiln process, steel re-rolling mills, steel processing industries, biomass burning, metallurgical industrial emissions and coal burning	Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, Pb, S, Sb, Se, V, Zn, Na^+, K^+, Mg^{2+} NH_4^+, F^-, Cl^-, NO_3^-, SO_4^{2-}, and Ca^{2+}	Matawle et al., 2014
Hyderabad	PM_{10} and $PM_{2.5}$	Vehicles exhaust, resuspension of dust, secondary sulfates, secondary nitrates, biomass	Na, Mg, K, Al, Si, Ca, Fe, Cl, SO_4^{2-}, NO_3, NH_4^+	Guttikunda et al., 2013

		burning, coal burning.		
Pune	PM_{10} and $PM_{2.5}$	Vehicles, DG sets, construction dust, solid fuels emissions, resuspended dust	Al, Pb, Cu, Zn, As, Se, Br, Ni, Fe, Mn, Mg, Cr, Ti, Ca, Cd, S, Si, Na, Ba, Sb, Cd, Sr, Cl^-, NO_3^-, SO_4^{2-}, K^+, NH_4^+	ARAI, 2010
Kanpur	PM_{10} and $PM_{2.5}$	Vehicles, open burn, road dust, domestic wood, coal and LPG, metal smelting, DG sets.	Cl^-, NO_3^-, SO_4^{2-}, K^+, NH_4^+, Na^+, Ca^{2+}, Mg^{2+} Si, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Cd, Sn, Sb, Pb	CPCB, 2010b
Mumbai	PM_{10} and $PM_{2.5}$	Wood combustion, Fuel oil combustion, kerosene combustion, biomass burning, LPG, ammonium sulfate, ammonium nitrate, heavy duty diesel vehicles emissions, soil dust.	Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La, Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb. F^-, Cl^-, Br., NO_2^-, NO_3^-, SO_4^{2-}, K^+, NH_4^+, Na^+, Ca^{2+}, Mg^{2+}	CPCB, 2010a
Chennai	PM_{10} and $PM_{2.5}$	Vehicles, DG sets, bakeries, soil dust, construction dust, paved road dust, kerosene and LPG emissions.	As, Ag, Ca, Na, Fe, Mg, Cu, Zn and other metals. Cl^-, $NO3^-$, $SO4^{2-}$, K^+, NH_4^+, Na^+, Mg^{2+}	IIT Madras, 2010
Bangalore	PM_{10} and $PM_{2.5}$	Petrol vehicles, diesel vehicles, secondary particulates, fuel oil burning, wood domestic wood burning, DG set, kerosene generator set, paved road dust re suspension, soil dust.	Na, Mg, Al, Si, P, S, Cl, Ca, Br, V, Mn, Fe, Co, Ni, Cu, Zn, As, Ti, Ga, Rb, Y, Zr, Pd, Ag, In, Sn, La, Se, Sr, Mo, Cr, Cd, Sb, Ba, Hg, and Pb. F^-, Cl^-, Br^-, NO_2^-, NO_3^-, SO_4^{2-}, Na^+, K^+, Mg^{2+} and Ca^{2+}	TERI, 2010

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

References:

Srishti Jaina, S. K. Sharma, N. Vijayan, T. K. Mandal, Seasonal characteristics of aerosols ($PM_{2.5}$and PM_{10}) and their source apportionment using PMF: A four-year study over Delhi, India. Environmental Pollution 262 (2020) 114337.

G. Kalaiarasan, R. M. Balakrishnan, N. A. Sethunath, S. Manoharan. Source apportionment studies on particulate matter ($PM_{10}$and $PM_{2.5}$) in ambient air of urban Mangalore, India. Journal of Environmental Management 217 (2018) 815e824816.

Source Apportionment of $PM_{2.5}$ & PM_{10} of Delhi NCR for Identification of Major Sources. Report No. ARAI/16-17/DHI-SA-NCR/Final Report August 2018.

Jain, Srishti; Sharma, Sudhir Kumar; Choudhary, Nikki; Masiwal, Renu; Saxena, Mohit; Sharma, Ashima; Mandal, Tuhin Kumar; Gupta, Anshu; Gupta, Naresh Chandra; Sharma, Chhemendra (2017). Chemical characteristics and source apportionment of PM2.5using PCA/APCS, UNMIX, and PMF at an urban site of Delhi, India. Environmental Science and Pollution Research, 24(17), 14637–14656. doi:10.1007/s11356-017-8925-5.

Pipalatkar, P., Khaparde, V.V., Gajghate, D.G., Bawase, M. a, 2014. Source apportionment of PM2.5 using a CMB model for a centrally located Indian city. Aerosol Air Qual. Res. 14, 1089-1099.

Matawle, J.L., Pervez, S., Dewangan, S., Tiwari, S., Bisht, D.S., Pervez, Y.F., 2014. PM2.5 chemical source profiles of emissions resulting from industrial and domestic burning activities in India. Aerosol Air Qual. Res. 14, 2051-2066.

Guttikunda, S.K., Kopakka, R.V., Dasari, P., Gertler, A.W., 2013. Receptor model-based source apportionment of particulate pollution in Hyderabad, India. Environ. Monit. Assess. 185, 5585-5593.

Gummeneni, S., Yusup, Y. Bin, Chavali, M., Samadi, S.Z., 2011. Source apportionment of particulate matter in the ambient air of Hyderabad city, India. Atmos. Res. 101, 752-764.

ARAI, 2010. In: C.P.C.B (Ed.), Air Quality Monitoring and Emission Source Apportionment Study for Pune, India. The Automotive Research Association of India, Pune, India.

CPCB, 2010b. In: C.P.C.B (Ed.), Air Quality Assessment, Emissions Inventory and Source Apportionment Studies for Kanpur City, India. Indian Institute of Technology Kanpur, India.

CPCB, 2010a. In: C.P.C.B (Ed.), Air Quality Assessment, Emissions Inventory and Source Apportionment Studies Mumbai, India. National Environmental Engineering Research Institute, India.

IIT Madras, 2010. In: C.P.C.B (Ed.), Air Quality Monitoring, Emission Inventory and Source Apportionment Study for Chennai, India. Indian Institute of Technology Madras, India.

TERI, 2010. In: C.P.C.B (Ed.), Air Quality Assessment, Emission Inventory and Source Apportionment Study for Bangalore City, India. The Energy and Resources Institute, India.

D. Cesari, G.E. De Benedetto, P. Bonasoni, M. Busetto, A. Dinoi, E. Merico, D. Chirizzi, P. Cristofanelli, A. Donateo, F.M. Grasso, A. Marinoni, Seasonal variability of $PM_{2.5}$ and PM_{10} composition and sources in an urban background site in Southern Italy**.** Sci. Total Environ., 612 (2018), pp. 202-213.

F. Amato, A. Alastuey, A. Karanasiou, F. Lucarelli, S. Nava, G. Calzolai, M. Severi, S. Becagli, L.G. Vorne, C. Colombi, C. Alves, D. Custódio, T. Nunes, M. Cerqueira, C. Pio, K. Eleftheriadis, E. Diapouli, C. Reche, M.C. Minguillón, M.I. Manousakas, T. Maggos, S. Vratolis, R.M. Harrison, X. Querol, AIRUSE-LIFEC: a harmonized PM speciation and source apportionment in five southern European cities. Atmos. Chem. Phys., 16 (2016), pp. 3289-3309.

M.O. Andreae, P. Merlet, Emission of trace gases and aerosols from biomass burning. Glob. Bio Geochem. Cycles, 15 (2001), pp. 955-966.

Li Z, Hopke PK, Husain L, Qureshi S, Dutkiewicz VA, Schwab JJ, Demerjian KL (2004) Sources of fine particle composition in NewYork city. Atmos Environ 38(38):6521–6529.

Seinfeld J H, Pandis S N (2016) Atmospheric chemistry and physics:from air pollution to climate change. John Wiley & Sons.

Kumar AV, Patil RS, Nambi KSV (2001) Source apportionment of suspended particulate matter at two traffic junctions in Mumbai, India. Atmos Environ 35(25):4245–4251.

Sharma SK, Mandal TK, Saxena M, Sharma A, Datta A, Saud T (2014b)Variation of OC, EC, WSIC and trace metals of PM_{10} in Delhi, India. J Atmos Solar-Terres Phy 113:10–22.

Kulshrestha A, Satsangi PG, Masih J, Taneja A (2009) Metal concentration of $PM_{2.5}$and PM_{10} particles and seasonal variations in urban and rural environment of Agra, India. Sci Total Environ 407(24):6196–6204.

Kar S, Maity JP, Samal AC, Santra SC (2010) Metallic components of traffic-induced urban aerosol, their spatial variation, and source apportionment. Environ Monit Asses 168(1–4):561–574.

S.M. Almeida, C.A. Pio, M.C. Freitas, M.A. Reis and M.A. Trancoso. Source apportionment of atmospheric urban aerosol based on weekdays/weekend variability: evaluation of road re-suspended dust contribution. Atmos. Environ., 40 (11) (2006), pp. 2058-2067.

P. Khare and B.P. Baruah. Elemental characterization and source identification of PM2.5 using multivariate analysis at the suburban site of north-east India. Atmos. Res., 98 (1) (2010), pp. 148-162.

V. Shridhar, P.S. Khillare, T. Agarwal and S. Ray. Metallic species in ambient particulate matter at rural and urban location of Delhi. J. Hazard Mater., 175 (1) (2010), pp. 600-607.

D. Cesari, G.E. De Benedetto, P. Bonasoni, M. Busetto, A. Dinoi, E. Merico, D. Chirizzi, P. Cristofanelli, A. Donateo, F.M. Grasso and A. Marinoni. Seasonal variability of $PM_{2.5}$ and PM_{10} composition and sources in an urban background site in Southern Italy. Sci. Total Environ., 612 (2018), pp. 202-213.

S. Jain, S.K. Sharma, T.K. Mandal and M. Saxena. Source apportionment of PM_{10} in Delhi, India using PCA/APCS, UNMIX and PMF. Particuology, 37 (2018), pp. 107-118.

Ram K, Sarin MM (2011) Day–night variability of EC, OC, WSOC and inorganic ions in urban environment of Indo-Gangetic Plain: implications to secondary aerosol formation. Atmos Environ 45(2):460–468.

Sharma SK, Mandal TK, Srivastava MK, Chatterjee A, Jain S, Saxena M, Ghosh SK (2016a) Spatio-temporal variation in chemical characteristics of PM_{10}over Indo-Gangetic Plain of India. Environ Sci PollRes 23(18):18809–18822.

Chapter 5 Dispersion Modelling

Air quality modeling includes four major processes (a) emission of pollutants, (b) transportation of the pollutants due to mean wind profile (c) chemical transformations and (d) deposition/removal. In the present study the particulate matter emissions, transportation and dispersion are carried out using the AERMOD model, which is developed by USEPA. AERMOD model estimates the spatial profile of pollutants based on the Gaussian plume equation, which is an analytical solution to the steady-state approximation of the advection-diffusion phenomenon. The boundary conditions about the atmospheric mixing height and other thermodynamic vertical profiles for the simulations are derived from the mesoscale model. The model relies on the atmospheric stability classes for deriving the dispersion coefficients across the multiple dimensions with respect to the distance away from the sources. In this study, only the ground level concentrations of the particulate matter are simulated during the study period. The study domain envelops the Jharia Coal Fields situated in the Jharkhand state of India. The methodology followed in the present study is shown in Figure 5.1. The southwest part of the Dhanbad City shares borders with the study area, but the majority of emission load used in the study is included from the JCF.

5.1. Wind data analysis

The nearest IMD (India Meteorological Department) observations are at Patna and Kolkata, which are approximate >150km from the study area. Hence, hourly meteorological observations required for the study for the AERMOD dispersion model were simulated through the Weather Research and Forecast, version-3.9 (WRF), which is a meteorological model that dynamically downscales the global NCAR/UCAR meteorological data to the regional level data (www.mmm.ucar.edu). Nested domains of grid resolution 12km and 4km, respectively were laid over the study area for simulation of hourly meteorological variables using the WRF model (Figure 5.2). Hourly meteorological data, including both the surface variables and upper atmosphere variables, were simulated for the study period viz. 23 May to 12 June 2019 and 23 January to 12 February 2020, representing the summer and winter seasons, respectively.

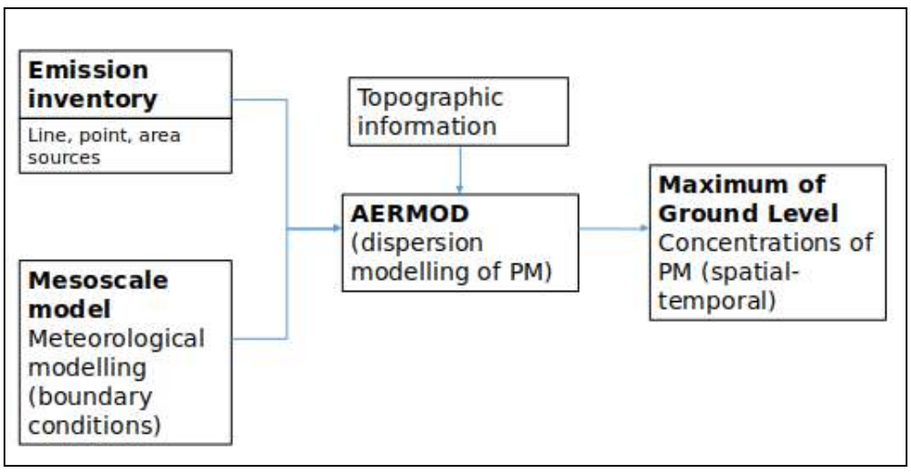


Figure 5.1: Methodology followed in the study.

The mesoscale model interface program MMIF (https://www.epa.gov/) converter tool was used

to convert the inner domain's gridded WRF model simulated meteorological data into a format suitable for the AERMOD model. The AERMOD receptor grid covering the study area is shown in Figure 5.3. A Cartesian receptor grid having 21 rows and 21 columns with a resolution of 2000 m was laid for the simulation of particulate matter dispersion /concentration at the receptor locations. Overall there are 20 grids in each direction covering an area of 40 km by 40 km enveloping the JCF.

The spatial pattern of the predominant wind profile over the study area is plotted using the windrose diagrams for the summer (March to May 2019) and winter season (November 2019 to February 2020), shown in Figures 5.2 and 5.3, respectively. Results show that the study area is experiencing the predominant wind (having high frequency) flow from east to west direction followed by north-west to south-east direction during summer, while in winter the predominant wind direction is from north to south. The wind speeds vary in the range of 0.5 to 11.1m/s during the summer predominantly in the range of 2.1 to 3.6m/s whereas wind speeds vary in the range of 0.5 to 8.8m/s during the winter, predominantly in the range of 2.1 to 3.6m/s.

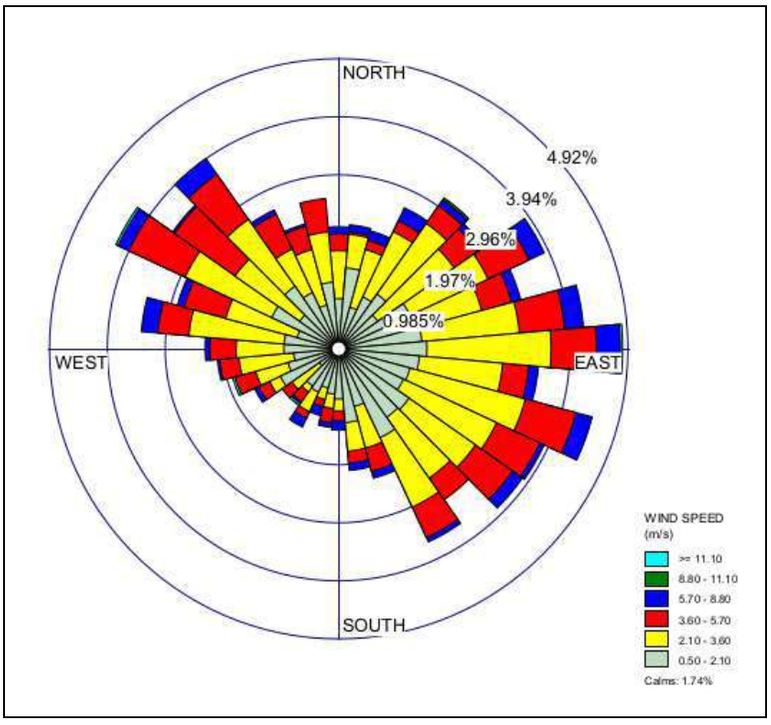


Figure 5.2: Windrose of the study area during March-June, 2019 (wind direction blowing towards the center)

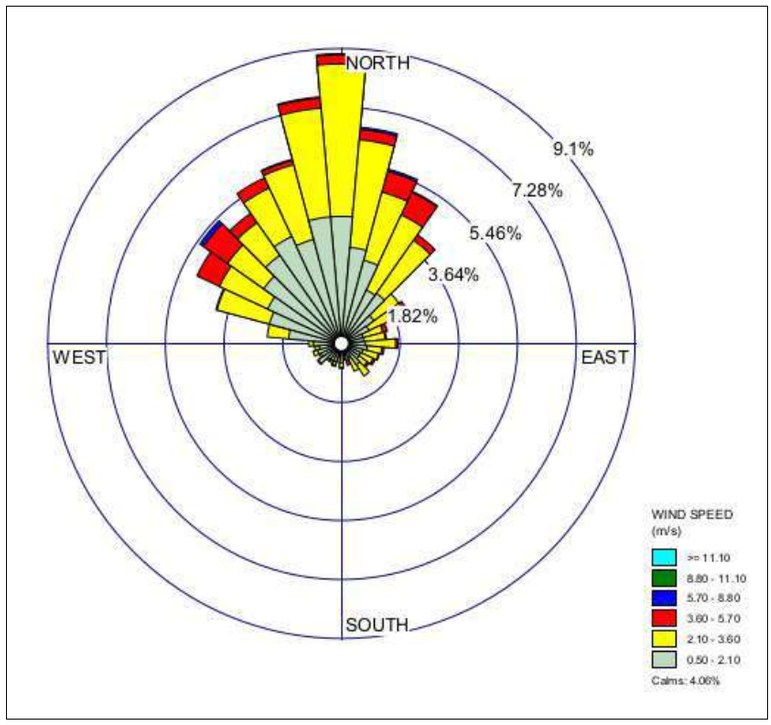


Figure 5.3: Windrose of the study area during November-December 2019 (wind direction blowing towards the centre)

5.2. Dispersion of Particulate matter

Spatial profiles of maximum ground-level concentrations of 24-hour average values of PM_{10} and $PM_{2.5}$ were simulated using the AERMOD Gaussian plume model. The emission rates of particulate matter from multiple source types including the point, line, and area were derived from the field monitoring of the emission inventory. Point sources mainly include the emissions from the industries situated in the study area that mainly use coke/coal as the fuel. The line sources include the emissions from the vehicular exhaust. Emission inventory of traffic pollution was carried out in the study area by noting down the vehicular activity. The vehicular activity of different vehicular types such as trucks, light motor vehicles, three-wheeled vehicles, motorbikes, etc. was multiplied by the corresponding emission factors for the estimation of gaseous pollution. The summation of emissions from all vehicle types adds to the overall line sources contributing to the pollution load in the study area. The area sources include emissions from the open cast mining emissions (including all the activities in the mine premises) and domestic burning (including emissions from crematoria, bakeries, open eat-outs, restaurants, chulha burning from the slum, etc.).

The emissions in grams per second were calculated from the emission inventory survey, for the line and point sources. Whereas, the emission rates in $g/s/m^2$ were calculated for the area sources including mining. These emission rates from each source type have been computed in the study area and fed into the AERMOD model domain for the simulation of spatial average concentrations of PM_{10} and $PM_{2.5}$. In the present study, the maximum GLC (ground level concentrations, in $\mu g/m^3$) was simulated at several receptor grid locations in AERMOD domains. The AERMOD model was run during the sampling period in May 2019 and November 2019, representing the pre-monsoon and post-monsoon seasons, respectively.

Analysis of WRF model simulated wind speed and direction data shows that the wind is

predominantly flowing from south-east direction to north-west direction, followed by the reversal in the direction, during the monitoring in summer, representing pre-monsoon conditions (Figure 5.5). The wind speeds during the monitoring period in summer month varied between 0.5 and 8.8m/s. During the monitoring period in winter (post-monsoon), the wind predominantly flowed from the north-east to south-west direction having wind speeds in the range of 0.5 to 3.6m/s (Figure 5.5).

The wind blowing from different directions in the study area determines the direction of pollution dispersion. The Gaussian plume equation used in the AERMOD model estimates the diffusion and advection of the pollutants concerning the emission rates and meteorology (wind speed, direction and atmospheric stability categories). The model simulated maximum ground level concentration of the particulate matter (PM_{10} and $PM_{2.5}$) in the study area covering the JCF is shown through the isopleths. The isopleths (contours connecting the regions with the same ground level concentration in the context of the present study) of maximum GLC of PM_{10} and $PM_{2.5}$ were observed to form a pattern according to the predominant wind directions flowing in different monitoring seasons. It is observed that the line sources in the study area have contributed the maximum to the surface GLC of PM_{10}, following the open cast mines. The AERMOD model simulated the value of GLC of PM_{10} due to line sources, open cast mines, and all sources are 927, 286, and 978µg/m^3, respectively, for the summer season. The $PM_{2.5}$ maximum GLC contributed by the line sources, open cast mines, and all sources included are 809, 143, and 835µg/m^3, respectively. It is evident from the result that the line sources are significantly contributing to the overall particulate pollution in the study area during summer.

The analysis of the PM_{10} and its maximum GLC simulated by the AERMOD model for the winter season also follows a similar pattern as of summer. The contribution of line sources, open cast mines, and all sources included are 1565, 597, and 1679µg/m^3, respectively. The $PM_{2.5}$ maximum GLCs during the winter are 1004, 299, 1167µg/m^3 as contributed by line, open cast mines, and all sources including, respectively. Based on the emission inventory and the prevailing meteorological conditions during the winter season have in general contributed to the higher particulate matter than that of the summer season.

Pockets of maximum concentrations of PM_{10} (200-1000 µg/m^3 and above) are observed in the vicinity to roads nearer to the open cast mines south of Dhanbad City during the winter (Figure 5.5). The localities of the high concentrations of PM_{10} are Sabji Patti road and Sudamdih mine area, which is reflected in the figure. The area covering the Dhanbad city and the mines situated in the southwest have PM_{10} concentrations in the range of 200-900µg/m^3. The fringes of the JCF have recorded the PM_{10} concentrations in the range of 100-250µg/m^3. In contrast, the PM_{10} concentrations for the summer season have significantly lower and the majority of the study area have PM_{10} < 100µg/m^3, however, the area extending from south of Dhanbad City and Sudamdih mine have relatively high PM_{10} concentration in the range of 100-500µg/m^3. Baghmara and Sonardih mine area in the west of Dhanbad City have also been observed to have high GLC of PM_{10} in the range of 100-500µg/m^3.

A similar pattern of the spatial distribution of $PM_{2.5}$ is reflected as of PM_{10}. As the underlying meteorological conditions are the same for both the PM_{10} and $PM_{2.5}$ simulations the

spatial pattern is nearly similar. High concentrations of $PM_{2.5}$ (100-500µg/m^3) are observed in the southwest direction of Dhanbad City (Figure 5.6). The maximum GLC of PM_{10} is found to be higher than $PM_{2.5}$ during both the monitoring seasons, and higher concentrations are observed during the winter season. The prevailing winter meteorology in the region has lower wind speeds and mixing heights, which poses an unfavorable situation for the dispersion of particulate matter, hence containing a high chance of accumulation of airborne pollutants. The significant contribution of particulate matter from the line sources is observed in the study area, followed by the area sources (from open cast mining, domestic burning, bakeries, open eat-outs, and restaurants)**.** The locations of the highly polluted can be interpreted from the images shown in Figures 5.6 (a) and 5.6 (b) for devising realistic and grass-root level mitigation strategies.

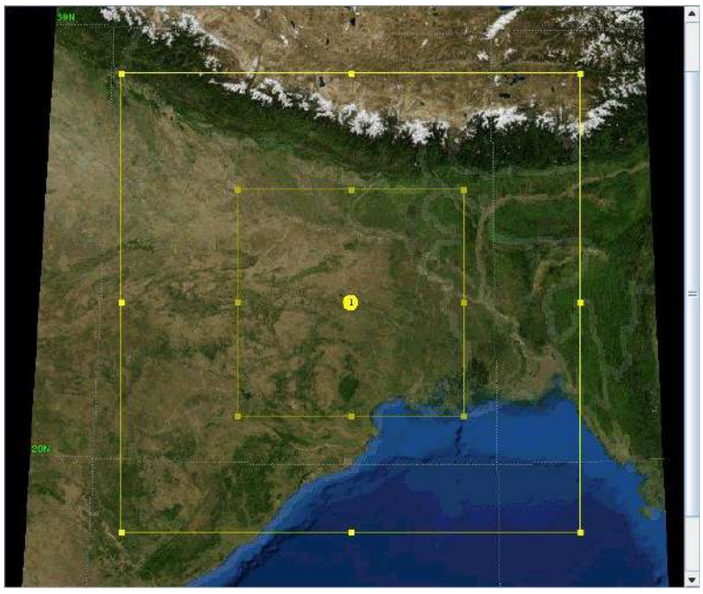


Figure 5.4: AERMOD grid covering the Jharia Coal Fields (JCF). The line, area, and point sources covered in the study are indicated in red color. The UTM coordinates of the left bottom point are x=406111 and y=2603492, and the coordinates of the right top point are x=456248 and y=2653417.

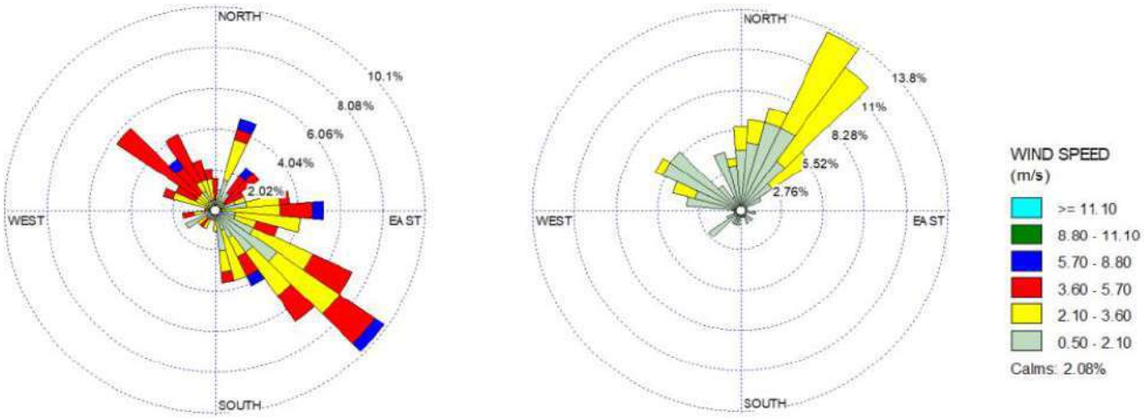
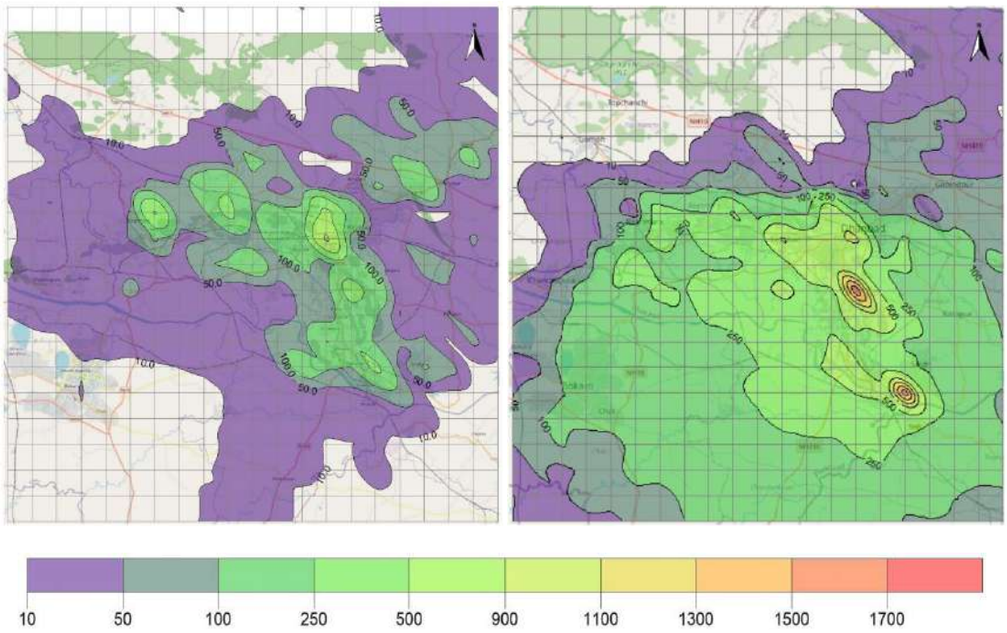
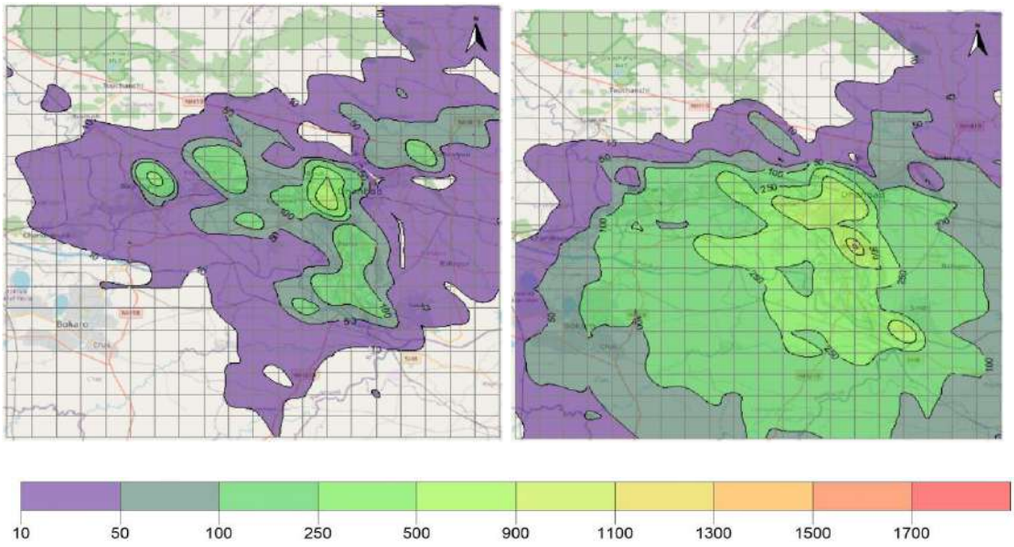


Figure 5.5: Windrose diagram for the summer (left) and winter seasons (right) at Jharia Coal Fields during the sampling period. Wind direction is flowing towards the centre.



(a)



(b)

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

5.3 Validation of the model

Comparison between the model simulated period average PM and the measured PM concentrations was made to determine the overall efficiency of the dispersion model. In the present study, the model validation metrics viz. mean bias (MB), normalized mean bias (NMB), mean gross error (MGE), normalized mean gross error (NMGE), and Pearson's correlation (r) were calculated for PM_{10} and $PM_{2.5}$ separately including data of both seasons. At some of the monitoring locations like Mines Rescue, Katras, Patherdih, Harina, Lodhna, and Lohapatti the discrepancies between the modeled and observed data were found to be high, for both summer and winter seasons. At remaining locations for both seasons, the results indicate an acceptable/fair degree of model performance in simulating the particulate dispersion. Results show that the correlation coefficient between the measured and modeled PM_{10} is 0.6, which is

fair enough in environmental open systems, similarly, for $PM_{2.5}$ the correlation value is around 0.7 (Table 5.1).

Table 5.1 Performance Stimulation Metric

Model metric	PM_{10}	$PM_{2.5}$
MB	-19.46	20.67
NMB	-0.11	0.24
NMGE	0.32	0.37
Correlation Coefficient	0.6	0.7

The NMB values are observed to be lower for PM_{10} (-0.11) than $PM_{2.5}$ (0.24), which indicates the slight negative bias in PM_{10} simulations (under-prediction of the concentrations) and positive bias in $PM_{2.5}$ (over-prediction of the concentrations). Whereas, the NMGE for both PM_{10} and $PM_{2.5}$ are 0.32 and 0.37, respectively, which indicates the variation in the model simulations deviate around 30% from the mean values on average (which is a result due to some extreme values in the simulations). However, this discrepancy could be minimized if long-term simulations are carried out, which is highly computationally intensive. Nevertheless, the model performance metrics in terms of correlation and normalized mean gross error infer that the model could capture the spatial profile of the particulate matter distribution to a good extent.

Chapter 6 Recommendation

6.1. Mine industries

1. The project proponent might consider installing conveyor systems for transporting the coal from the coal handling plant to the railway siding or to the nearest thermal power plant (if feasible).
2. A sufficient number of plants should be planted around the mine pit to arrest the movement of particulate matter or dust into the surrounding areas.
3. Scientific studies might be necessary to design a green belt with an optimized dimension of plot size and direction as per the prevailing meteorology. Similar studies are required to design a wind barrier for optimized benefits.
4. Adequate dust control measures should be in place, like mechanized sweeping, water sprinkling or mist spraying systems on the haul roads and at loading sites. Long-range misting or fogging canons are also should be in place.
5. Dust suppression measures at all operations of mining should be ensured.
6. Ensuring the complete coverage of the trucks and railway wagons that carry coal with a tarpaulin sheet is necessary.
7. In the long-run mobilization of closed trucks to carry the coal is preferable.
8. The coal transport roads should not be left with open curb sides. End to end covering up of curb side is essential to avoid the re-suspension of coal due to the truck movement.

6.2. Area Sources

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

1. Construction and demolition of buildings in the urban area give high local dust contribution resulting health problems. These practices need to follow compliance guidelines to reduce emissions.
2. Road and pavement should be well constructed to suppress road dust. The standard specifications and code of practice for road construction should be followed and implemented as per the Indian Road Congress (IRC) guidelines or international standard guidelines.
3. Strategically placed green cover in urban and semi-urban areas can help to improve local air quality.
4. Manage agricultural residues, including strict enforcement of bans on open burning
5. Strictly enforce bans on the open burning of household waste.
6. Use clean fuels – electricity, natural gas, liquefied petroleum gas (LPG) in cities, and LPG and advanced biomass cooking and heating stoves in rural areas; substitution of coal by briquettes
7. Use incentives to improve the energy efficiency of household appliances, buildings, lighting, heating and cooling; encourage roof-top solar installations
8. Promote the use of electric vehicles

9. Encourage centralized waste collection with source separation and treatment, including gas utilization.
10. There is a substantial population that also uses available coal. These houses could be given a combination of improved chulla or free/subsidised power for cooking purposes.
11. Hotels and dhabas need to be educated and compulsorily asked to use LPG for its cooking purposes.
12. The trash and MSW burning is very common. Some of the places contain a mix of plastics and thermocol. The combustion of these materials is very harmful to human health.
13. Coal depot pollution is due to open storage and unregulated buying, selling and transportation. These coal depots are responsible for nearby air pollution peaks. However, the contribution of the same need to be assessed.

6.3. Line Source

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

1. Vehicle inspection and maintenance: Enforce mandatory checks and repairs for vehicles.
2. Improved public transport: Encourage a shift from private passenger vehicles to public transport.
3. Set up a mechanism of Inspection and Maintenance programme for all vehicles in the district through RTO with automated system assessment.
4. The Inspection & Maintenance (I & M) centre shall also test all vehicles for their inbuilt emission tests.
5. All commercial vehicles should be phased out after 8 years of age or subjected to two years extension after rigorous I&M tests
6. All private vehicles should be subjected to proper assessment and fitness tests through I&M centres.
7. All autos and buses shall also be subjected to I&M tests
8. Dhanbad city does not have a designated place for truck parking and maintenance related activities. A separate designated place should be allocated to prevent illegal parking and repair shops on the roads and kerbside.
9. Dhanbad city does not have a designated place for Auto-rikshaw. A separate designated place should provide to prevent traffic congestion and control vehicle emission.
10. Major haul trucks with heavy loads should not pass through the main city. The plan being made should be implemented in the next 1-1.5 years.
11. Overloading is a common phenomenon in the region resulting in poor road quality. This can be avoided through online checking when vehicles leave industries with a guarantee that the vehicle is not carrying more material than its designated loads.

6.4. Others

- There is a need to explore various options for controlling air pollutants to tackle increased emissions in future.
- The local authority should stress sustainable and affordable public transport keeping clean air goals in mind.
- Frequent (time to time) arrangement of campaign/awareness programmes for lawmakers, stakeholders, health professionals, academicians to brainstorm about the future scenario and importance of clean air.
- Strategic installation of continuous air quality monitoring systems at various locations of urban, semi-urban and rural areas to check the existing air quality and information dissemination to the general public.

Annexure -1

[A] Cumulative receptor sample of PM_{10} for source profiling with fitting parameters

Source contribution estimate	**Source profiles**	**Std Error**	**R-square**	**Chi-square**
82.7% mass	Unpaved road	0.056	0.96	2.41
	Coal combustion	0.643		
	Light Duty vehicle	1.60		
	Heavy Diesel vehicle	2.19		
	Residential combustion	5.59		
	Iron and steel industry	7.16		
	Agriculture soil dust	0.212		
	Solid waste	1.37		

[B] Cumulative receptor sample of $PM_{2.5}$ for source profiling with fitting parameters

Source contribution estimate	**Source profiles**	**Std Error**	**R-square**	**Chi-square**
88.1% mass	Residential combustion	3.34	0.98	2.44
	Coal combustion	0.094		
	Light Duty vehicle	0.30		
	Heavy Diesel vehicle	1.91		
	Agriculture soil dust	0.10		
	Flyash	0.51		

WATER HARVESTING & ARTIFICIAL RECHARGE

Coal mining is the major industrial activity in the area. Ground water pumping is an integral part of mine management for safe and efficient coal extraction. Pumping from both underground and opencast mines may affect groundwater table near the mine area. In coal mining area the impact is observed to be mostly limited to 500 m from the mine boundary. Mining activity also creates high permeability aquifer zones during backfilling activities in opencast mines and depillaring/caving activities in underground mines. Besides this, groundwater utilization is mainly for domestic and irrigation use in the study area.

To minimize the impact of mining on ground water system, the project/mine authority has been adopting all possible measure to increase the ground water recharge potential.

The stage of ground water development in the buffer zone (10 km from the periphery of the core zone) of Cluster-X mines comes to about 40.15%. As per the data collected from the Central Ground Water Board, Ranchi, the stage of ground water development in the Jharia Block in which Cluster-X project and its buffer zone located is 53.62% in year 2004 and 105.63% in year 2008-09. CGWB observation well located at Jharia does not show any declining trend. The area falls within the “Critical” to “Overexploited category but both pre monsoon and post monsoon ground water level do not show any significant long term declining trend. Rather the pre-monsoon water level shows a rising trend. Again, core zone of cluster X is located in the discharge area near Damodar River. Therefore artificial recharge can be done in the buffer zone of the Cluster-X.

Artificial recharge has to be done to check the lowering of water level in the study area using rainwater harvesting and surplus mine water.

Groundwater inflow (11825 m^3/day) and mine influence area (maximum 500 m from the mine edge) have been estimated and the groundwater monitoring would be undertaken as corrective measure to avoid adverse effects. The mine discharge after passing through sedimentation tank is being discharged onto local jore / nala with check dams at suitable locations so that the groundwater gets additional recharge by the return flow.

The impact on ground water level will be minimized by artificial recharge by spreading of pumped out water, creation and filling of ponds with mine water and construction of rainwater harvesting structure.

Rain Water harvesting is a deliberate collection and storage of rain water that runs off on natural and man-made catchment area. The amount of water harvested depends on the frequency and intensity of the rain fall and characteristics of the catchment to allow the precipitate to infiltrate through the sub-soil and percolate down to recharge aquifers.

It is therefore proposed that during mining operation the rain water within the mining area will be accumulated in earthen water pool developed on the surface which will not only be helpful in re-charging the ground water of the area but will fulfil the non-drinking water demand of nearby inhabitants also.
Necessary check dams (Figure No-2) have been/will be made in the nala for recharging ground water aquifer. Roof-top rainwater harvesting (Figure No-3) will be taken up in the project area using the administrative buildings if required. Rainwater harvesting and artificial recharge will also take place through abandoned dug-wells and final voids of old mines for increasing ground water potential and check water level lowering.

Check dams / Nala bunds – Runoff conservation structures like check dams, nala bunds are constructed over the stream / nala bed thereby increasing the contact period of rainwater with the underlying formation. It is commonly

constructed across small streams with gentle slope and there is no submergence beyond stream course. The site selected should have sufficient thickness of permeable bed / weathered formation to facilitate recharge within short span of time. A check dams in Kari jore near Dhansar Colliery (western part) and another one at Nagri jore near Jogta/Nischitpur OC is provided to facilitate groundwater recharge.

Figure No-2: Check Dams / Nala bunds.

Rooftop Runoff Recharge –

- **Recharge through existing Dug/Tube well –** In areas where shallow aquifers have dried up and existing Dug/Tube wells are tapping deeper aquifer, rooftop rainwater harvesting through existing wells can be adopted to recharge the aquifers.
- **Filter Pit –** If the roof area is more, to accommodate excess rainwater a filter pit may be constructed. The shape and size of the filter pit is depending upon available runoff.

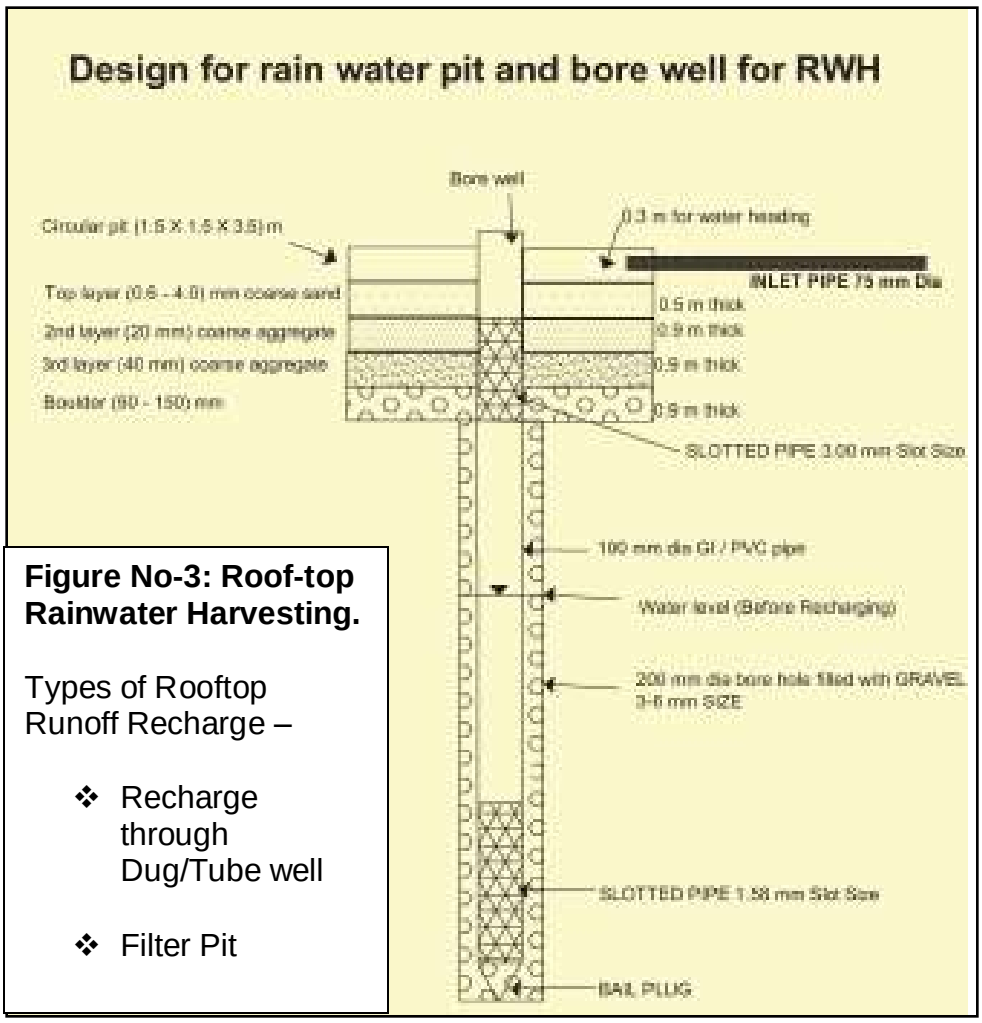


Figure No-3: Roof-top Rainwater Harvesting.

Types of Rooftop Runoff Recharge –

- Recharge through Dug/Tube well
- Filter Pit

Recharge Pit – The abandoned underground mine workings can be used as recharge pit which can act as artificial recharge structure to augment the recharge of deeper aquifers. It behaves as huge ground water reservoirs and contains groundwater runoff (i.e. planned recharge). After mine closure, voids of opencast and underground workings will be waterlogged. This will help in maintaining the water table in the surrounding areas and may become a source of water supply to the community. Out of 115.15 Ha of abandoned quarry in the core zone of Cluster-X, 46.15 Ha has already been backfilled. Remaining area of 69.00 Ha will be act as water body to recharge the groundwater.

Recharge through Dug well – Existing dug wells may also be used as recharge wells, as and when source water become available. In areas where

considerable de-saturation of aquifers have already taken place due to over-exploitation of groundwater resources resulting in the drying up of dug wells and lowering of piezometric head in bore/tube wells. Existing groundwater abstraction structures can be used as cost-effective mechanism for artificial recharge of the phreatic or deeper aquifer zones. Dug well has been made near or within the small streams / nala / jore to augment the groundwater recharge. Water is percolating from flowing stream into groundwater systems through dug wells.

Water harvesting through Settling tank and Percolation tank -These is an artificially created surface water body, submerging in its reservoir a highly permeable land so that surface runoff is made to percolate and recharge the ground water storage. Percolation tank should be located on highly fractured and weathered rock with lateral continuity. The size of the tank should be governed by the percolation capacity of strata in the tank bed.

The surplus mine water will be given to the local people for irrigation. Utilization of mine water for irrigation use will also enhance the ground water recharge potential through artificial recharge in the area.

The pond, tanks, stop dams etc constructed in the rehabilitated and affected villages also augment the groundwater recharge.

Efforts are being made to construct more recharge structures at suitable sites in the nearby villages in consultation with Central Ground Water Board.
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).

cmpdi
A Mini Ratna Company

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

पत्रांक: आर.आई.-2/पर्यावरण/एम-30/ 1967-69

दिनांक: 02.08.2016 03.

सेवा में,
विभागाध्यक्ष (पर्यावरण)
बी. सी. सी. एल.
कोयला भवन
धनबाद

(Stamp: ...पर्यावरण... 633(M) 03/08/16)

विषय: Study of Installation of Rail-cum-Conveyor System in BCCL for transportation of coal.

संदर्भ: पत्र संख्या:
1. सी.एम.पी.डी.आई./पर्यावरण /2016/663, दिनंक: 14.07.2016,
2. BCCL/Dy.GM (Env)/F-EMP/16/1314-15 (M), Dated: 23.06.2016,
3. आर.आई.- 2/पर्यावरन / एम-30/1150, दिनांक : 20.06.2015.
4. E-17719

महोदय,

In reference to your letter no. BCCL/Dy.GM (Env)/F-EMP/16/1314-15 (M), Dated: 23.06.2016, to GM (Env), CMPDI-HQ, it has already been indicated in letter no.आर.आई.-2/पर्यावरन / एम-30/1150, दिनांक : 20.06.2015 that study for installation of Rail-cum-Conveyor System in BCCL for transportation of coal can be started only after the liquidation of coal mine fire, rehabilitation of 595 unstable sites, road realignment and relocation of railway sidings of BCCL and final report of RITES in regard to realignment of railway lines.

This is for your kind information.

भवदीय

(वि.कु. सिन्हा) [signed] /8/16
क्षेत्रीय निदेशक

Sri Amaltassa Act Mgr (Env) for record. 3/8/16 4.8.16.

प्रतिलिपि:
1. महाप्रबंधक (पर्यावरण) सी.एम.पी.डी.आई (मुख्यालय), राँची
2. विभागाध्यक्ष (खनन), आर.आई- II, धनबाद

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

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.

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

CLUSTER X GROUP OF MINES

Bhowrah North (UG),Bhowrah North (OC),Bhowrah South (UG), 3 Pit OCP,Chandan OCP(Bhowrah),Patherdih (UG),Chandan OCP (Patherdih),Sudamdih Incline (UG),Sudamdih Shaft (UG),Amlabad (UG) Closed,Sudamdih Coal Washery(Within the lease hold of Sudamdih Shaft Mine)

Normative Production : 1.762 MTPA
Peak Production : 2.289MTPA
Lease Hold Area : 2057.47Ha

Bharat Coking Coal Limited

(July,2019)

Prepared by

Environment Division
Central Mine Planning & Design Institute Limited
CMPDI (HQ)
Gondwana Place
Kanke Road, Ranchi-834008

CONTENTS

CHAPTER NO.	TITLE	PAGE No.
I	INTRODUCTION	1-6
II	FUGITIVE DUST GENERATION DUE TO MOVEMENT OF COAL	7-16

Chapter – I

Introduction

1.1 Genesis:

MOEF provided Environmental Clearance to the various mines of the Cluster J-11015/380/2010-IA.II (M) Dated 06.02.2013 As per the Environmental Clearance Conditions given by the Ministry of Environment & Forest "A study should be initiated to analyse extent of reduction in pollution load every year by reducing road transport of coal". Therefore the present study has been carried out to quantify the pollution load due to coal transportation.

1.2 Methodology:

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

1.3 General Information about the Cluster:

1.3.1 Brief Description:

Cluster X mines of BCCL consists of six mines, Bhowrah North (Mixed UG and OC), Bhowrah South (Mixed UG and OC that are 3 Pit OCP Chandan OCP), Patherdih (Mixed UG and OC that is Chandan OCP), Sudamdih Incline (UG), Sudamdih Shaft (UG) are operating mines and one closed Amlabad (UG) mine . There is also one existing Sudamdih coal washery. This cluster is located in the Eastern part of the Jharia coalfield. These mines are taken over by BCCL from private mine owners after nationalization through Coal Mines Nationalization Act, 1972-73.BCCL is the proponent of the cluster and it is under the administrative control of Coal India Limited.

1.3.2 Nature and Size of the Cluster:

(Mixed UG and OC), Bhowrah South (Mixed UG and OC that are 3 Pit OCP Chandan OCP), Patherdih (Mixed UG and OC that is Chandan OCP), Sudamdih Incline (UG), Sudamdih Shaft (UG) are operating mines . There is one closed Amlabad (UG) mine. There is also one existing Sudamdih coal washery. The cluster falls in Eastern Jharia Area of Jharia Coalfield part of the Bharat Coking Coal Limited in the Dhanbad District of Jharkhand state. BCCL is the proponent of the cluster and it is under the administrative control of Coal India Limited. Coal India Limited is a Public Sector Undertaking of Government of India and functioning under the Ministry of Coal, Govt. of India.

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

Table 1.1: Details of the Mines of Cluster –X

Sl No	Name of Mines	Production Capacity (MTY)		Lease Hold Area (Ha)
		Normative	Peak	
1	Bhowrah North (UG)	0.11	0.143	208.83
2	Bhowrah North (OC)	0.42	0.546	
3	Bhowrah South (UG)	0.29	0.377	571.58
4	3 Pit OCP	0.235	0.305	
5	Chandan OCP(Bhowrah)	0.158	0.205	
6	Patherdih (UG)	0.054	0.070	244.34
7	Chandan OCP (Patherdih)	0.22	0.286	
8	Sudamdih Incline (UG)	0.09	0.117	254.27
9	Sudamdih Shaft (UG)	0.185	0.240	391.50
10	Amlabad (UG) Closed	0	0	386.95
	Total	1.762	2.289	2057.47
11	Sudamdih Coal Washery (Within the lease hold of Sudamdih Shaft Mine)	1.6	2.08	18

1.3.3 Impact of Fire Control on Ambient Air Quality:

Due to unscientific mining prior to nationalization there are unstable sites identified in the BCCL. Out of 595 unstable sites identified in the Master Plan, 15 sites consisting of 2187 no. of houses/families are affected. The affected families will be rehabilitated in adjacent non coal bearing area at a cost of Rs. 11199.89 lakhs

1.3.4 Impact of Resettlement on Ambient Air Quality:

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

1.4 Meteorological Data

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

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

The analysis of wind pattern during the season showed that the predominant wind directions were from North-West & West followed by North-East having frequencies 15.71%, 11.45% & 4.67% respectively. The receptors located in the Downwind directions i.e. SE and East from the dust generating sources are likely

to be affected. The dispersion of air borne dust during calm period (45% of time) will be very poor and buildup of pollutant concentration during this period will occur.

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

Table 1.2: SEASONAL WIND DISTRIBUTION

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

Wind Direction	Wind Velocity (m/s) & Duration (%)				
	< 0.5	0.6 -1.5	1.6 -3.5	>3.5	Total
N		1.61	0.78	0.00	2.38
NNE		0.83	0.37	0.00	1.19
NE		3.17	1.47	0.05	4.67
ENE		0.41	0.14	0.00	0.55
E		1.10	0.69	0.00	1.79
ESE		0.50	0.37	0.00	0.87
SE		1.28	0.41	0.05	1.74
SSE		0.64	0.18	0.00	0.82
S		0.41	0.09	0.00	0.50
SSW		0.28	0.05	0.00	0.32
SW		2.29	0.60	0.00	2.88
WSW		1.06	0.41	0.00	1.47
W		8.99	2.48	0.00	11.45
WNW		1.24	1.01	0.00	2.24
NW		11.47	4.22	0.05	15.71
NNW		2.11	3.59	0.00	5.7

Wind Direction	Wind Velocity (m/s) & Duration (%)				
	< 0.5	0.6 -1.5	1.6 -3.5	>3.5	Total
CALM	44.97	-	-	-	44.97
Total	44.97	37.32	17.56	0.15	100

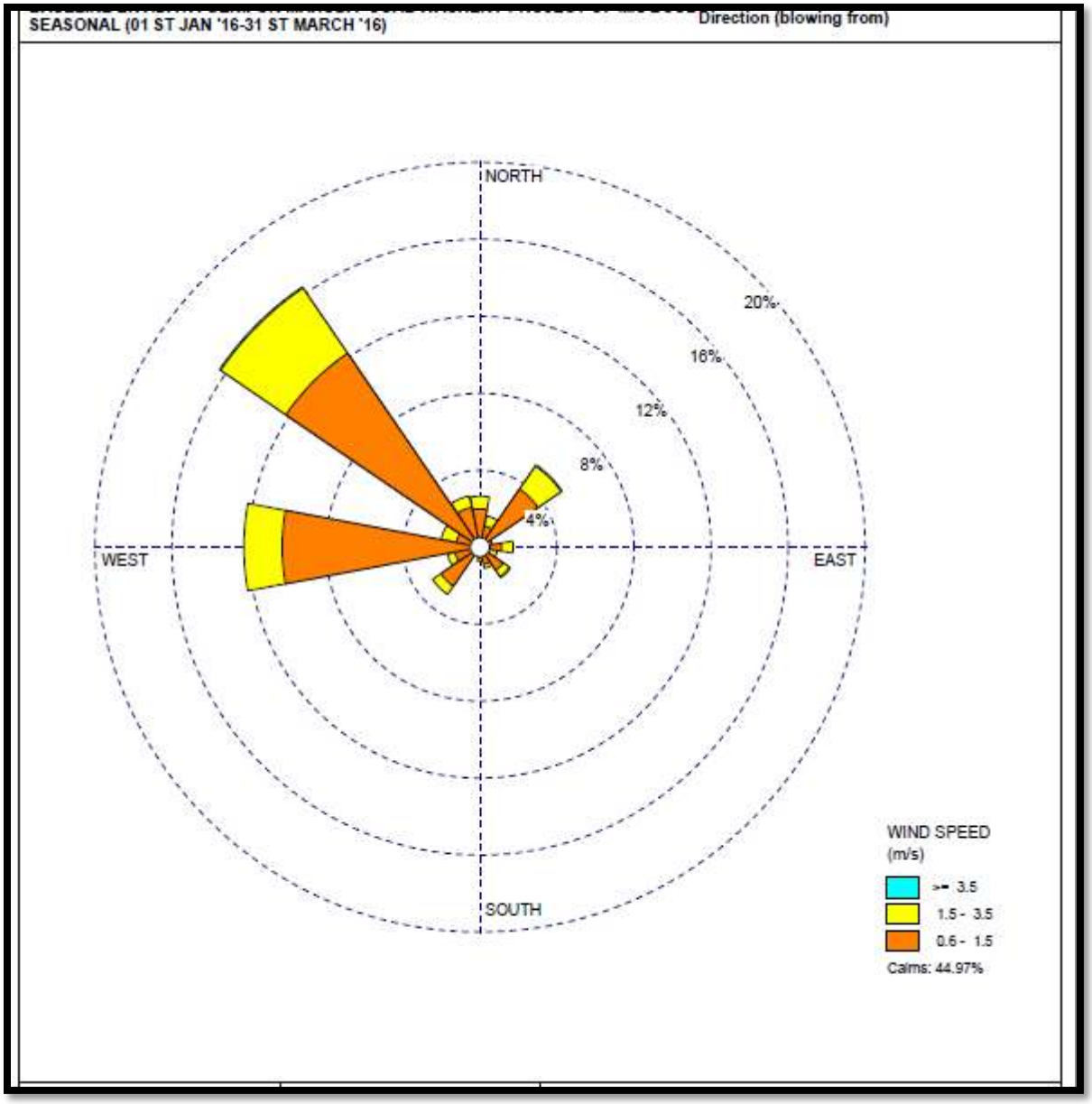


Figure No.-1.1 Wind Rose diagram for the period 1St Jan to 31St March 2016

Chapter – II

Fugitive Dust Generation Due To Movement of Coal

2.1 Introduction

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

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

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

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

2.2 Movement of Coal

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

2.2.1 Cluster X Dust Generation (Kg/day):

Table: 2.1 Dust Generation (Kg/day)

Dust generated per day (Kg/Day)										
Name of the Mine	**Year**	**Location**	**Distance from Face to Siding (Km)**	**Coal Transferred (Te)**	**Daily Coal Production (Te/Day)**	**Capacity of the Dumper**	**Vehicle Kilometer Travelled**	**Emission Rate for PM 10 (kg/VKT)**	**Pollution Load * Dust Generated Per Day (Kg/day)**	**Dust generated Kg/per tonne**
Bhowra South	13-14	Sudmadih washery	6	11888.66	36.00	14	30.86	0.53	16.354	
	13-14	Other Consumers	20	28226.29	86.00	14	245.71	0.53	130.229	
	13-14	workshop	0.5	120	0.00	14	0.00	0.53	0.000	
		Total for 13-14			**122.00**				**146.583**	1.20
	14-15	Sudmadih washery	6	3495.82	11.00	14	9.43	0.53	4.997	
	14-15	Munidih washery	20	2014.34	6.00	14	17.14	0.53	9.086	
	14-15	workshop	0.5	120	0.00	14	0.00	0.53	0.000	
	14-15	Other Consumers	20	26230.52	79.00	14	225.71	0.53	119.629	
		Total for 14-15			**96.00**				**133.711**	1.39
	15-16	Sudmadih washery	6	4232.18	13.00	14	11.14	0.53	5.906	
	15-16	Other Consumers	20	24238.9	73.00	14	208.57	0.53	110.543	

Dust generated per day (Kg/Day)										
Name of the Mine	**Year**	**Location**	**Distance from Face to Siding (Km)**	**Coal Transferred (Te)**	**Daily Coal Production (Te/Day)**	**Capacity of the Dumper**	**Vehicle Kilometer Travelled**	**Emission Rate for PM 10 (kg/VKT)**	**Pollution Load * Dust Generated Per Day (Kg/day)**	**Dust generated Kg/per tonne**
	15-16	workshop	0.5	120	0.00	14	0.00	0.53	0.000	
		Total for 15-16			**86.00**				**116.449**	1.35
Bhowra (North) u/g mines	13-14	Sudmadih washery	6	4232.18	13.00	14	11.14	0.53	5.906	
	13-14	Other Consumers	20	24238.9	73.00	14	208.57	0.53	110.543	
	13-14	workshop	0.5	120	0.00	14	0.00	0.53	0.000	
		Total for 13-14			**13.00**				**116.449**	8.96
	14-15	Sudmadih washery	6	2366.92	7.00	14	6.00	0.53	3.180	
	14-15	Munidih washery	20	1398.73	4.00	14	11.43	0.53	6.057	
	14-15	workshop	0.5	120	0.00	14	0.00	0.53	0.000	
	14-15	Other Consumers	20	26219.77	79.00	14	225.71	0.53	119.629	
		Total for 14-15			**90.00**				**128.866**	1.43
	15-16	Sudmadih washery	6	3092.46	9.00	14	7.71	0.53	4.089	
	15-16	workshop	0.5	120	0.00	14	0.00	0.53	0.000	
	15-16	Other Consumers	20	21299.27	65.00	14	185.71	0.53	98.429	
		Total for 15-16			**74.00**				**102.517**	1.39
Sudamdih incline (ASP)	13-14	Sudmadih washery	3	14806.94	45.00	14	19.29	0.53	10.221	
	13-	workshop	0.5	29	0.00	14	0.00	0.53	0.000	

Dust generated per day (Kg/Day)										
Name of the Mine	**Year**	**Location**	**Distance from Face to Siding (Km)**	**Coal Transferred (Te)**	**Daily Coal Production (Te/Day)**	**Capacity of the Dumper**	**Vehicle Kilometer Travelled**	**Emission Rate for PM 10 (kg/VKT)**	**Pollution Load * Dust Generated Per Day (Kg/day)**	**Dust generated Kg/per tonne**
	14									
		Total for 13-14			**45.00**				10.221	0.23
	14-15	Sudmadih washery	3	27204.78	82.00	14.00	35.14	0.53	18.626	
	14-15	Munidih washery	20	412.66	1.00	20.00	2.00	0.53	1.060	
	14-15	MPL	20	7862.26	24.00	14.00	68.57	0.53	36.343	
		Total for 14-15			**106.00**				56.029	0.53
	15-16	Sudmadih washery	3	14263.52	43.00	15.00	17.20	0.53	9.116	
		Total for 15-16			**43.00**				**9.116**	0.21
Patherdih u/g (ASP)	13-14	Sudmadih washery	3	14090.58	43.00	14.00	18.43	0.53	9.767	
	13-14	workshop	4	120	0.00	14.00	0.00	0.53	0.000	
		Total for 13-14			**43.00**				**9.767**	0.23
	14-15	Sudmadih washery	3	5128.19	16.00	14.00	6.86	0.53	3.634	
	14-15	workshop	4	20	0.00	14.00	0.00	0.53	0.000	
	14-15	Other Consumers	20	3442.17	10.00	14.00	28.57	0.53	15.143	
		Total for 14-15			**26.00**				**18.777**	0.72
COCP Patherdih (ASP)	13-14	Sudmadih washery	3	27899.58	85.00	14.00	36.43	0.53	19.307	
	13-14	MPL	20	88044.23	267.00	14.00	762.86	0.53	404.314	
	13-	By Rail (Durgapur	1	1535.81	5.00	14.00	0.71	0.53	0.379	

Dust generated per day (Kg/Day)										
Name of the Mine	**Year**	**Location**	**Distance from Face to Siding (Km)**	**Coal Transferred (Te)**	**Daily Coal Production (Te/Day)**	**Capacity of the Dumper**	**Vehicle Kilometer Travelled**	**Emission Rate for PM 10 (kg/VKT)**	**Pollution Load * Dust Generated Per Day (Kg/day)**	**Dust generated Kg/per tonne**
	14	steel plant)								
		Total for 13-14			**90.00**				**424.000**	4.71
	14-15	Sudmadih washery	3	11459.74	35.00	14.00	15.00	0.53	7.950	
	14-15	W-III washery	3	24128.06	73.00	14.00	31.29	0.53	16.581	
	14-15	Other Consumers	20	15074	46.00	14.00	131.43	0.53	69.657	
		Total for 14-15			**81.00**				**94.189**	1.16
	15-16	Sudmadih washery	3	50234.35	152.00	14.00	65.14	0.53	34.526	
		Total for 15-16			**152.00**				**34.526**	0.23

* In terms of PM 10 expressed as kg/day, ** Average distance has been considered .## Emission rate for PM_{10} has been taken from the S&T work (funded by MoC) carried out by CMPDI during 2002-2007.

2.3 Optimum Coal Transportation scheme in the Present Scenario:

Phase – I (for 10 + 05 Years)

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

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

Phase – II (after 15 Years):

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

During 2015-16, the combined daily coal production of the Cluster was 355 tones resulting in 263 kg of daily fugitive dust generation. The dust (PM-10) generation rate at present is 0.10 kg/te.

As a result of replacement of existing road transportation of coal by Conveyor to railway siding will result in reduction of fugitive dust generation to the extent of 5131 kg/day for daily coal production of 6936 tonnes (2.289 MTY) during Phase –II.

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

Cluster	Production Capacity (MTY)	Proposed Transport Infrastructure in Phase – II
X	2.289	**Coal transport by Conveyor to Railway Siding**
	6936 tonnes /Day	

2.5 Conclusion:

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

Phase – I :(2013-14 to 2028 -29) :

1. During Phase – I, business as usual(BAU) scenario will prevail and the existing road cum rail transport network system will be used for coal dispatch to the consumers. During 2015-16, the combined daily coal production of the Cluster was 355 tones resulting in 263 kg of daily fugitive dust generation. The dust (PM-10) generation rate at present is 0.10 kg/te.
2. The generation of fugitive dust due to transportation of coal by road can be further reduced by enforcing covering of loaded trucks, periodical removal of loose materials lying on the road surface and black topping of coal transportation roads.
3. Avenue plantation, effective wetting of the road surface and proper maintenance of roads will further result in mitigation of the impact of road generated dust on ambient air quality.
4. Better road condition, by the use of Mechanical Sweeper or vacuum cleaner dust generation may be minimized.

Phase – II :(From 2029-30 Onwards):

As a result of replacement of existing road transportation of coal by Conveyor to railway siding will result in reduction of fugitive dust generation to the extent of 5131 kg/day for daily coal production of 6936 tonnes (2.289 MTY) during Phase –II.

1. During Phase –II, dust load will further reduce due to quenching of mine fire and domestic coal consumption after resettlement of general population dwelling within the command area of cluster, as a result of implementation of Jharia Action Plan. It will result in significant improvement in ambient air quality.

2. **Coal Production Vs. Dust Generation due to Road Transportation is presented below:**

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

Year	Coal Production (Te/day)	Dust Generation(Kg/Day)
2015-16 (By Road transportation)	355	263
2029-30 (Considering peak production and all the coal transported through Road)	6936	5131
2029-30(By Conveyor Transportation)	6936	0

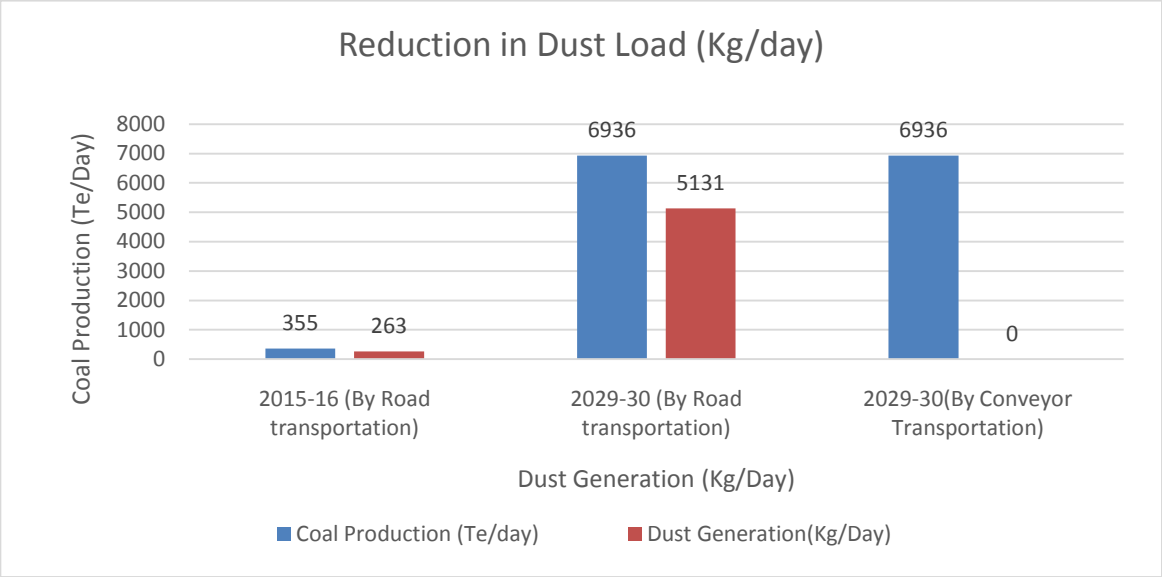


Figure 2.1: Presentation of reduction in dust generation due to replacement of Road transportation by Conveyor system.

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

*****

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

ANNEXURE –

CSR BUDGET & EXPENDITURE

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 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: (in 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 promotion of sanitation and making available safe drinking water	1.17	

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**	

CSR BUDGET AND EXPENDITURE for FY 2017-18

Sl No	Particulars	Expenditure incurred (in Rs. Lakh)
1	Various health camps & allied activities (Project JYOTI)	2.20
2	Swachh Vidyalaya Abhiyan (toilets bill)	165.60
3	Construction of toilets at SSLNT Mahila Mahavidyalayaand at Bhatinda Pootki	14.30
4	Swachhta Pakhwada activities	0.30
5	Construction of PCC Road in Topchanchi Blocks	4.40
6	Deepening /renovation of ponds in Tundi and East Tundi	11.90
7	Handloom weaving training project	6.00
8	Construction of Community Hall at Johar Asthan, Hirapur,Dhanbad (bill)	0.40
9	BCCL Ke LAAL/BCCL Ki LAADLI	35.40
10	Others (including liability)	33.50
11	**Total**	**273.9**

CSR WORKS AND EXPENDITURE FOR 2018-19

Sl No	CSR Projects identified	Sector	Amt. spent (Rs. lakhs)
Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agroforestry, conservation of natural resources and maintaining quality of soil, air and water including contribution to the Clean Ganga Fund set-up by the Central Government for rejuvination of river Ganga (04 nos. of pond projects)			
1	Deepening/renovation including construction of steps/ghats for pond at Belardih ,East tundi	Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agroforestry, conservation of natural resources and maintaining quality of soil, air and water including contribution to the Clean Ganga Fund set-up by the Central Government for rejuvination of river Ganga	4.22
2	Deepening/renovation including construction of steps/ghats at Aam Bandh Sindurpur (Khairabani) village under Sindurpur Panchayat in Baliapur Block	Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agroforestry, conservation of natural resources and maintaining quality of soil, air and water including contribution to the Clean Ganga Fund set-up by the Central Government for rejuvination of river Ganga	6.06
3	Deepening/renovation including construction of steps/ghats at Aam Bandh at Dardaha village under Dolabhar Panchayat in Baliapur Block	Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agroforestry, conservation of natural resources and maintaining quality of soil, air and water including contribution to the Clean Ganga Fund set-up by the Central Government for rejuvination of river Ganga	7.09
4	Deepening/Renovation including Construction of steps/ghat for Khas Bandh Pond at Latani under East Tundi by BCCL	Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agroforestry, conservation of natural resources and maintaining quality of soil, air and water including contribution to the Clean Ganga Fund set-up by the Central Government for rejuvination of river Ganga	0.60
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 (Medical camps & Swachhta Pakhwada under sanitation)			
5	Medical camps held under CSR	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	1.68

6	Swachhta Marathon (run for cleanliness) to promote awareness about Swachhta under Swachhta Pakhwada (held under under Ministry instructions)	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	2.21
7	Arrangements for Swachhta Pakhwada (held under under Ministry instructions)	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	0.18
8	05 shows of Nukkad Natak held towards promotion of cleanliness under Swachhta pakhwada (held under under Ministry instructions)	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	0.50
Promoting education,including special education & employment enhancing vocation skills especially among children,women,elderly,and the differently abled & livelihood enhancement projects (03 nos. of projects)			
9	BCCL Le LAAL/BCCL Ki LAALDI	Promoting education,including special education & employment enhancing vocation skills especially among children,women,elderly,and the differently abled & livelihood enhancement projects	26.12
10	Skill development: Providing 100 nos. of sewing machines for training towards empowering SGH women through Jharkhand State Livelihood Promotion Society	Promoting education,including special education & employment enhancing vocation skills especially among children,women,elderly,and the differently abled & livelihood enhancement projects	5.00
11	Training Scheme for preparing "Trainees" for Mining Sirdars	Promoting education,including special education & employment enhancing vocation skills especially among children,women,elderly,and the differently abled & livelihood enhancement projects	16.03
Rural development projects (02 nos. of projects)			
12	Construction of bamboo huts with thatched roof in Barwa village under Green Haat Project	Rural development projects	2.05
13	Construction of Community Centre at Jiramuri village, Ratanpura panchayat under Govindpur Block, Dhanbad	Rural development projects	16.18

Others (Monthly expenditure incurred towards HR expenses of NCSR Hub TISS as per its MoU)			
14	Payment to NCSR Hub TISS Mumbai towards human resource expenses	Others	2.29
Liability			
15	NCSR Hub, TISS Liability for impact assessment study	Rural development projects	3.94
16	BCCL Ke LAAL/BCCL Ki Laadli liability	Promoting education, including special education & employment enhancing vocation skills especially among children, women, elderly, and the differently abled & livelihood enhancement projects	23.44
17	Others including liabilities of CSR works (Swachhta Pakhwada, installation of hand pumps, Various construction works at RBB High School, Rajganj etc.)	Sanitation, safe drinking water, promoting education	25.09
Total			**142.69**

CSR BUDGET AND EXPENDITURE FOR FY 2019-20

Sl No	CSR Projects identified	Sector	Amt. Spent (₹ lakhs)
1	Deepening/renovation including construction of steps/ghats for ponds at Tundi, East Tundi & Baliapur	Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agroforestry, **conservation of natural resources** and maintaining quality of soil, air and water including contribution to the Clean Ganga Fund set-up by the Central Government for rejuvination of river Ganga	9.53
2	Installation of hand pumps at different locations in Dhanbad district through Dept. of drinking water and Sanitation, Dhanbad via depository mode	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**	18.02
3	Medical camps under Block II Area	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	0.42
4	Green Haat project at Barwa village, Govindpur block (under Swachhta Pakhwada)	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	0.81
5	Sanction of the amount to Municipal Commissioner, Dhanbad for procurement of fogging machine and sprayer for Dhanbad Municipal Corporation towards tackling COVID-19, under CSR initiatives of BCCL	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	10
6	Works in Pehla Kadam School- a School for the underprivilaged located at Jagjeevan Nagar	Promoting education, **including special education** & employment enhancing vocation skills especially among children, women, elderly,and the differently abled & livelihood enhancement projects	7.21

7	Works in RBB School, Rajganj	Promoting education,including **special education** & employment enhancing vocation skills especially among children,women,elderly,and the differently abled & livelihood enhancement projects	84.39
8	BCCL Ke LAAL/BCCL Ki Laadli	**Promoting education**, including special education & employment enhancing vocation skills especially among children, women, elderly, and the differently abled & livelihood enhancement projects	4.73
9	Development of smart classes in different high Schools, higher secondary Schools and other Schools in Dhanbad District for a total of 129 schools through District administration via depository mode	**Promoting education**, including special education & employment enhancing vocation skills especially among children, women, elderly, and the differently abled & livelihood enhancement projects	193.5
10	Mining Sirdars training to SC/ST candidates (preference to PAPs)	Promoting education,including special education & employment enhancing **vocation skills** especially among children,women,elderly,and the differently abled & **livelihood enhancement projects**	8.93
11	Construction of PCC road at Topchanchi Block	Rural development projects	2.12
12	Construction of Marriage Hall at Ratanpur Village, Ratanpur Panchayat, Govindpur Block	Rural development projects	33.63
13	Construction of Community Center at Jiramuri Village ,Ratanpur Panchayat, Govindpur Block	Rural development projects	1.25
14	Depository mode transfer to D.C. Dhanbad towards preparatory efforts to tackle COVID-19 situation in Dhanbad", under CSR initiatives of BCCL	Disaster Management	200
15	Depository mode transfer to Chief Minister's Relief Fund, Jharkhand	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	50

16	Miscellaneous: Yoga Diwas, Handloom handing over expense, final bill settlement of constructed marriage mandap	Others	0.12
17	Liability reversed	Others	(23.4)
Total			**601.22**

CSR Works & Expenditure FY 2020-21*

(CSR Budget - ₹ 5.54 Crore)

Sl No	CSR Projects identified	District and State of Project		Amt. spent (₹ lakhs)		Direct or through agency
		District	State	Direct Exp	Overheads	
A	**Promoting education,including special education & employment enhancing vocation skills especially among children,women,elderly,and the differently abled & livelihood enhancement projects**					
1	Works in RBB School, Rajganj	Dhanbad	Jharkhand	27.57	--	Direct
B	**Rural Development Works**					
1	Construction of marriage hall at Ratanpur panchayat, Govindpur Block	Dhanbad	Jharkhand	3.73	--	Direct
2	Other Civil Works	Dhanbad	Jharkhand	1.69	--	Direct
C	**COVID-19 related initiatives**					
1	Procurement of bleaching powder	Dhanbad	Jharkhand	6.4	--	Direct
2	Procurement of face masks	Dhanbad	Jharkhand	0.16	--	Direct
3	Financial assistance to D.C. Dhanbad to combat COVID-19 situation in Dhanbad	Dhanbad	Jharkhand	200	--	Depository mode of work execution through Dhanbad district administration
	Total			**239.55**	--	

**** Figures unaudited for the FY 2020-21***

Modified CSR Annual Action Plan for FY 2021-22 - BCCL

Sl. No.	CSR Projects/Programmes	Item from the list of the activities in schedule VII of the act	Estimated Budget (₹ in Lakhs)*	Manner of execution	Implementation Schedule	Monitoring and reporting mechanism	Details of need and impact assessment **, if any
COVID related proposals							
1	Assistance to Dhanbad District Administration	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water. Disaster Management, including relief, rehabilitation and reconstruction activities.	100.00	BCCL	FY 2021-22	By BCCL	NA
2	Assistance to Jharkhand State Administration	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water. Disaster Management, including relief, rehabilitation and reconstruction activities.	25.00	BCCL	FY 2021-22	By BCCL	NA
3	Masks & hand sanitizers	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water. Disaster Management, including relief, rehabilitation and reconstruction activities.	0.72	BCCL	FY 2021-22	By BCCL	NA
4	Fooding & other miscellaneous heads	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water. Disaster Management, including relief, rehabilitation and reconstruction activities.	36.45	BCCL	FY 2021-22	By BCCL	NA
5	Boarding and lodging of frontline health workers	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water. Disaster Management, including relief, rehabilitation and reconstruction activities.	22.62	BCCL	FY 2021-22	By BCCL	NA

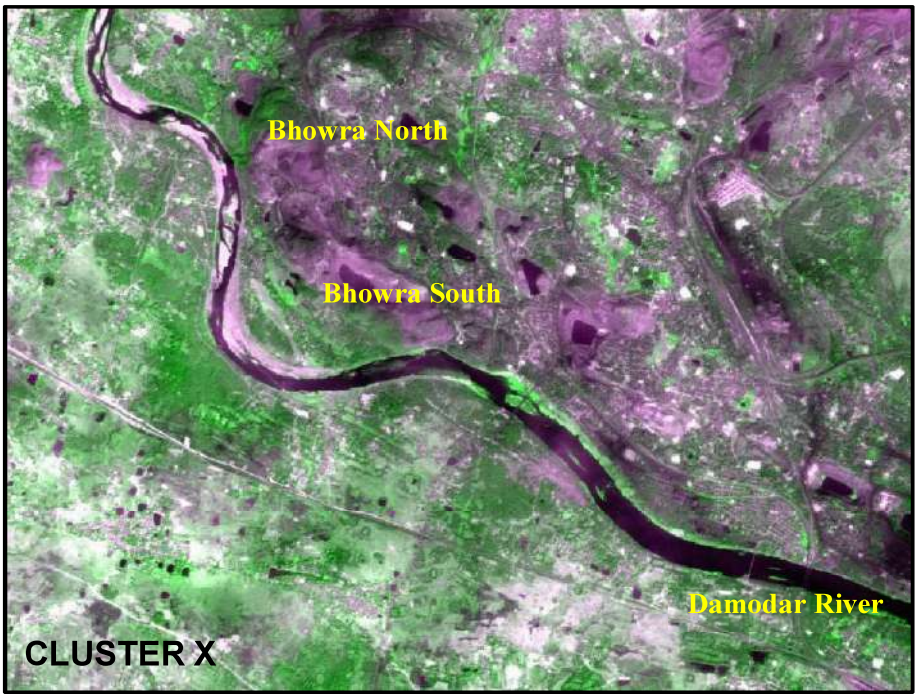
6	Sanitization of temporary quarantine centres	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water. Disaster Management, including relief, rehabilitation and reconstruction activities.	2.15	BCCL	FY 2021-22	By BCCL	NA
Non-COVID related proposals							
7	Training of PAPs at CIPET	Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently abled and livelihood enhancement projects.	28.00	BCCL	FY 2021-22 & FY 2022-23	By BCCL	NA
8	Development of Aanganwadis	Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently abled and livelihood enhancement projects.	263.50	BCCL	FY 2021-2022 to FY 2023-2024	By BCCL	NA
9	Swachh Vidyalaya Abhiyan Survey	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water.	6.96	BCCL	FY 2021-22	By BCCL	NA
10	Distribution of blankets	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water.	3.58	BCCL	FY 2021-22	By BCCL	NA
11	Mining sirdarship training for SC/ST candidates. Project closed in FY 2021-22 on submission of bills.	Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently abled and livelihood enhancement projects.	3.26	BCCL	FY 2021-22	By BCCL	NA
12	COVID quarantine centre. Project closed in FY 2021-22 on submission of bills.	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water.	3.80	BCCL	FY 2021-22	By BCCL	NA
13	Public toilet at Dhanbad	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water.	3.15	BCCL	FY 2021-22	By BCCL	NA

14	Gymnasium at Ambedkar Academy, Dhanbad. Project closed in FY 2021-22 on submission of bills.	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water.	2.35	BCCL	FY 2021-22	By BCCL	NA
15	Reversal of Financial Liability of FY 2020-21 for Medical Camps under CSR	Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation including contribution to the Swachh Bharat Kosh set-up by the Central Government for the promotion of sanitation and making available safe drinking water.	-8.52	BCCL	FY 2021-22	By BCCL	NA
	Total		**493.02**				**-**

Note * - Modalities of utilisation of fund- Project wise funds shall be utilised as per project wise budget within the Delegation of Power as per rules of the Company

Note ** - As per the Companies (Corporate Social Responsibility Policy) Amendment Rules, 2021, (a) Every company having average CSR obligation of ten crore rupees or more in pursuance of subsection (5) of section 135 of the Act, in the three immediately preceding financial years, shall undertake impact assessment, through an independent agency, of their CSR projects having outlays of one crore rupees or more, and which have been completed not less than one year before undertaking the impact study.

Land Reclamation/ Restoration Monitoring of Five Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data of the Year 2021



Submitted to

Bharat Coking Coal Limited

cmpdi
A Mini-Ratna Company

Land Reclamation/ Restoration Monitoring of Five Clusters of (Opencast + Underground) Coal Mines of Bharat Coking Coal Limited based on Satellite Data of the Year 2021

March - 2022

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

CONTENTS

Executive Summary iii

1 Background 1
2 Objective 2
3 Methodology 2
4 Land Reclamation Status in Bharat Coking Coal Ltd. 6

List of Tables

Table -1 Cluster wise Land Reclamation Status iv
Table -2 Area Statistics of Land Use Classes in Clusters 9

List of Figures

Figure-1 Cluster wise Land Reclamation Status-2021 (BCCL) v
Figure-2 Methodology of Land Reclamation Monitoring 3
Figure-3 Bar-chart of Land Reclamation Status of Cluster I 15
Figure-4 Bar-chart of Land Reclamation Status of Cluster IV 15
Figure-5 Bar-chart of Land Reclamation Status of Cluster VII 16
Figure-6 Bar-chart of Land Reclamation Status of Cluster X 16
Figure-7 Bar-chart of Land Reclamation Status of Cluster XI 17

List of Plates

Plate -1: Land Use Map of Cluster I 10
Plate -2: Land Use Map of Cluster IV 11
Plate -3: Land Use Map of Cluster VII 12
Plate -4: Land Use Map of Cluster X 13
Plate -5: Land Use Map of Cluster XI 14

List of Photographs

Photo-1: Social Forestry Plantation in Cluster XI 17
Photo-2: Ecological Restoration Site in Cluster I 18
Photo-3: Plantation on OB Dump in Cluster I 18
Photo-4: Plantation on OB Dump in Cluster IV 19
Photo-5: Parasnath Udyaan in Cluster IV 19
Photo-6: Road side Plantation in Cluster VII 20
Photo-7: Plantation on OB Dump in Cluster X 20

Executive Summary

1. Project — Land reclamation/ restoration monitoring of five clusters of (Opencast + Underground) coal mines of Bharat Coking Coal Ltd. (BCCL) based on satellite data on every three-year basis.

2. Objective — Objective of land reclamation/ restoration monitoring is to assess the area of backfilled, plantation, social forestry, active mining area, water bodies, distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.

3. Salient Findings

- Out of 5 Clusters of mines viz. I, IV, VII, X and XI considered for land reclamation monitoring during the year 2021-22; cluster XI group of mines is added during the year 2021-22. These clusters consist of mainly opencast mines.

- Out of the total mine leasehold area of 9411.54 Ha. of the 05 clusters considered for monitoring during the year 2021-22; total excavated area is 1218.18 Ha. out of which 61.92 Ha. area (5.08%) has been planted on backfill (Biological Reclamation) and 712.90 Ha. area (58.52%) is under backfilling (Technical Reclamation) and 443.36 Ha. area (36.40%) is under active mining. Cluster wise details of land reclamation of the above Clusters is given in Table-1.

- Total area under plantation (green cover) covers an area of 968.94 Ha. which is 10.30% of total leasehold area.

- This report and the findings will be considered as basis for further monitoring and reclamation related activities.

Table 1

Land Reclamation Status in five Clusters (Underground + Opencast Mines) of BCCL based on Satellite Data of the Year 2021

(Area in Hectare)

Sl. No.	Cluster No.	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leasehold)		Total Area under Reclamation	
						Biological Reclamation		Other Plantations											
				Area under Backfilling		Plantation on Excavated / Backfilled Area		Plantation on External OB Dumps		Social Forestry, Avanue Plantation Etc.									
1	*2*	*3*		*4*		*5*		*6*		*7*		*8*		*9 (=4+5+8)*		*10 (=5+6+7)*		*11(=4+5)*	
		2018	2021	2018	2021	2018	2021	2018	2021	2018	2021	2018	2021	2018	2021	2018	2021	2018	2021
1	Cluster I	575.00	575.00	10.11	11.10	7.29	7.29	47.99	45.21	25.53	25.53	28.39	27.61	45.79	46.00	80.81	78.03	17.40	18.39
				22.08%	24.13%	15.92%	15.85%					62.00%	60.02%			14.05%	13.57%	38.00%	39.98%
2	Cluster IV	1123.79	1123.79	147.22	176.03	0.00	0.00	27.11	27.11	165.09	165.09	166.67	152.29	313.89	328.32	192.20	192.20	147.22	176.03
				46.90%	53.62%	0.00%	0.00%					53.10%	46.38%			17.10%	17.10%	46.90%	53.62%
3	Cluster VII	2127.70	2127.70	351.54	351.68	37.47	25.47	15.52	11.43	238.67	238.67	122.23	183.42	511.24	560.57	291.66	275.57	389.01	377.15
				68.76%	62.74%	7.33%	4.54%					23.91%	32.72%			13.71%	12.95%	76.09%	67.28%
4	Cluster X	2057.47	2057.47	116.28	143.64	29.16	29.16	66.09	66.09	140.75	140.75	59.41	45.71	204.85	218.51	236.00	236.00	145.44	172.80
				56.76%	65.74%	14.23%	13.34%					29.00%	20.92%			11.47%	11.47%	71.00%	79.08%
5	Cluster XI	-	3527.58	-	30.45	-	0.00	-	0.00	-	187.14	-	34.33	-	64.78	-	187.14	-	30.45
					47.01%		0.00%						52.99%				5.31%		47.01%
	TOTAL	**5883.96**	**9411.54**	**625.15**	**712.90**	**73.92**	**61.92**	**156.71**	**149.84**	**570.04**	**757.18**	**376.70**	**443.36**	**1075.77**	**1218.18**	**800.67**	**968.94**	**699.07**	**774.82**
				58.11%	**58.52%**	**6.87%**	**5.08%**					**35.02%**	**36.40%**			**13.61%**	**10.30%**	**64.98%**	**63.60%**

(% is calculated with respect to Excavated Area as applicable)

Note: In reference of the above Table, different parameters are classified as follows: (Cluster XI started from current year)

1. Area under Biological Reclamation includes Areas under Plantation done on Backfilled Area Only.

2. Area under Technical Reclamation includes Area under Barren Backfilling only.

3. Area under Active Mining Includes Coal Quarry, Advance Quarry Site and Quarry filled with water etc., if any.

4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in the above Table.

5. (%) calculated in the above Table is in respect to Total Excavated Area except for "Total Area under Plantation" where % is in terms of "Leasehold Area".

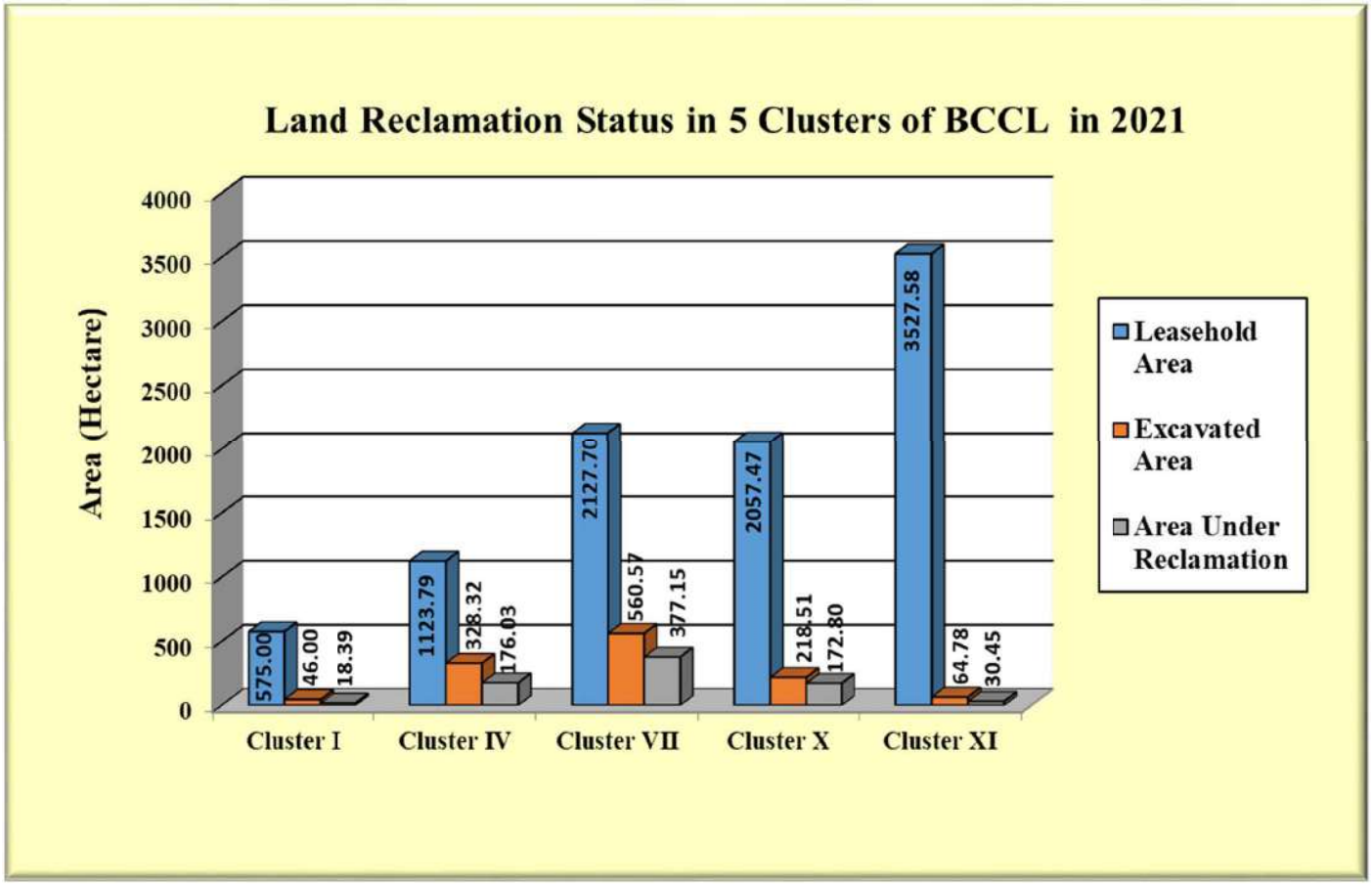


Fig. 1: Cluster wise Land Reclamation Status in five Clusters - 2021 (BCCL)

4. Land Reclamation Status in Bharat Coking Coal Ltd.

4.1 Following 5 clusters of mines comprising both underground and opencast projects of Bharat Coking Coal Ltd. have been taken up for land reclamation monitoring during the year 2021-22:

- **Cluster I** (Damoda OCP)
- **Cluster IV** (Salanpur Colliery, Amalgamated Keshalpur West Mudidih Colliery, Amalgamated Gaslitand Katras Choitudih Colliery)
- **Cluster VII** (Kusunda OCP, Kustore OCP, Alkusa OCP, Dhansar OCP, Industry, Ena OCP, Rajapur OCP, Amalgamated East Bhuggatdih Simlabahal Colliery)
- **Cluster X** (Bhowra North Colliery, Bhowra South Colliery, Patherdih Colliery, Sudamdih Shaft, Sudamdih INC, Amlabad Colliery)
- **Cluster XI** (Gopalichuck, Pootkee, Kendwadih)

4.2 Cluster wise Land Reclamation status of above mentioned clusters in BCCL is given in Table 1 and also shown graphically in Fig 1. Area statistics of different land use classes present in the mine leasehold of the above clusters for the year 2021 are shown in Table 2. Land use maps derived from the satellite data are shown in Plate 1 - 5. Different land use classes based on satellite data are depicted in bar charts in Fig. 3 - 7.

4.3 Study reveals that out of total mine leasehold area of 9411.54 Ha. of the 5 clusters of mines (Underground + Opencast) of BCCL mentioned above taken for this study in 2021-22, total excavated area is 1218.18 Ha. out of which 61.92 Ha. (5.08%) has been planted (*Biologically Reclaimed*), 712.90 Ha. (58.52%) is under backfilling (*Technically Reclaimed*) and balance 443.36 Ha. (36.40%) is under active mining.

4.4 Land reclamation monitoring for cluster XI of BCCL is taken up for the first time in the year 2021-22. Hence comparison of this cluster in year 2021 has not been made with respect to year 2018. The data thus generated in the year 2021 will be considered as base data for comparison of land reclamation of this cluster of mines at the interval of every three years.

4.5 Study indicates that overall all the projects of BCCL considered for this study in the year 2021-22 indicate increase or static trend in Technical reclamation (area under backfill) with respect to the year 2018.

4.6 After analyzing the satellite data of the year 2018 vs 2021, it reveals that area under total plantation (Green cover) carried out on backfilled area, OB dumps as well as under social forestry in all the clusters of BCCL has increased from 800.67 Ha. (13.61%) to 968.94 Ha. (10.30%) in span of last three years. This significant increase of 168.27 Ha. area under total plantation (Green Cover) in the leasehold boundary during three years is due to addition of cluster-XI.

4.7 On comparing the status of land reclamation for the year 2021 with respect to the year 2018 in all cluster of mines of BCCL considered for land reclamation in the year 2021-22, it is evident from the analysis that area under total land reclamation has increased from 699.07 Ha. (Yr 2018) to 774.82 Ha. (Yr 2021). This increase of 75.75 Ha. area under total land reclamation in the period of three years is the result of sincere effort made by BCCL towards land reclamation.

4.8 In Cluster VII, it is seen that area under plantation on backfill (Biological Reclamation) has decreased from 37.47 Ha. in the year 2018 to 25.47 Ha. in the year 2021. This decrease of 12 Ha. area in Biological reclamation is due to rehandling of backfill and also there is effect of mine fire in this

cluster. Hence total area under plantation on backfill has decreased from 73.92 Ha. (Yr 2018) to 61.92 Ha. (Yr 2021).

4.9 Out of the 5 Clusters in BCCL considered for satellite data based land reclamation monitoring in 2021, Cluster X tops with 79.08% reclamation followed by Cluster VII with 67.28%, Cluster IV with 53.62%, Cluster XI with 47.01% and Cluster I with 39.98%.

4.10 The area under total plantation (Green Cover) is maximum in Cluster IV (17.10%) followed by Cluster I with (13.57%), Cluster VII with (12.95%), Cluster X with (11.47%) and Cluster XI with (5.31%).

4.11 This study will again will be carried out after an interval of three years to assess the land reclamation status in the above projects.

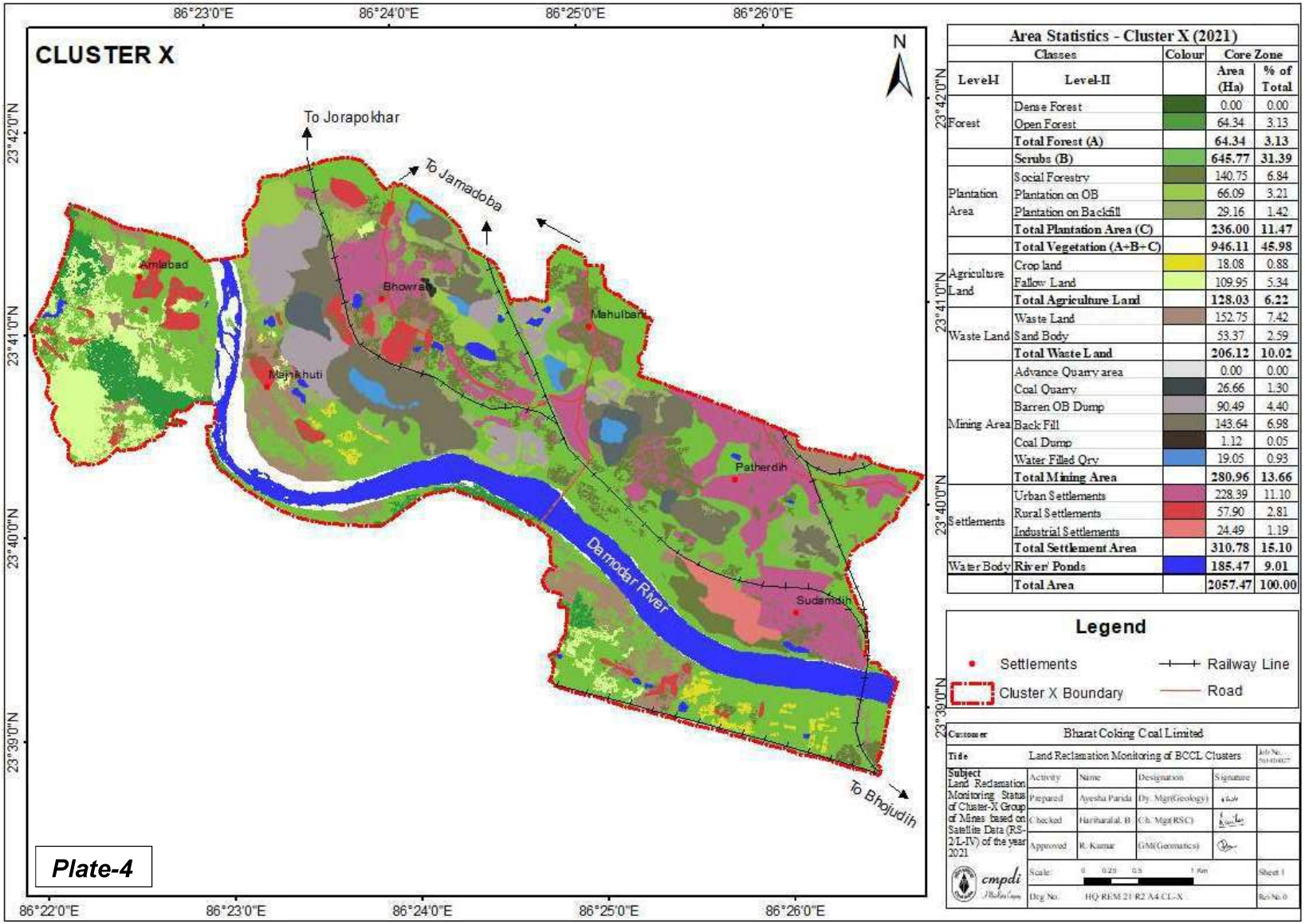
Table 2

Cluster wise Area Statistics of Land Use/ Cover classes in five Clusters of (OC+UG) mines of BCCL based on Satellite Data of the year 2021

Status of Land Reclamation in 5 Clusters of (UG+OC) mines of Bharat Coking Coal Ltd. based on Satellite data of the Year 2021

(Area in Hectare)

		CLUSTER I		CLUSTER IV		CLUSTER VII		CLUSTER X		CLUSTER XI		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest	0.00	0.00	0.00	0.00	0.00	0.00	64.34	3.13	0.00	0.00	64.34	0.68
	Total Forest (A)	0.00	0.00	0.00	0.00	0.00	0.00	64.34	3.13	0.00	0.00	64.34	0.68
SCRUBS	**Scrubs (B)**	230.09	40.02	172.78	15.37	572.72	26.92	645.77	31.39	1177.06	33.37	2798.42	29.73
PLANTATION	Social Forestry/Avenue Plantation	25.53	4.44	165.09	14.69	238.67	11.22	140.75	6.84	187.14	5.31	757.18	8.05
	Plantation on OB Dump	45.21	7.86	27.11	2.41	11.43	0.54	66.09	3.21	0.00	0.00	149.84	1.59
	Plantation on Backfill (Biological Reclamation)	7.29	1.27	0.00	0.00	25.47	1.20	29.16	1.42	0.00	0.00	61.92	0.66
	Total Plantation (C)	78.03	13.57	192.20	17.10	275.57	12.95	236.00	11.47	187.14	5.31	968.94	10.30
	Total Vegetation (A+B+C)	**308.12**	**53.59**	**364.98**	**32.48**	**848.29**	**39.87**	**946.11**	**45.98**	**1364.20**	**38.67**	**3831.70**	**40.71**
	Coal Dump	1.99	0.35	1.94	0.17	8.92	0.42	1.12	0.05	0.73	0.02	14.70	0.16
ACTIVE MINING	Coal Quarry	11.14	1.94	145.67	12.96	177.97	8.36	26.66	1.30	31.66	0.90	393.10	4.18
	Advance Quarry Site	1.73	0.30	0.00	0.00	0.00	0.00	0.00	0.00	2.67	0.08	4.40	0.05
	Quarry Filled With Water	14.74	2.56	6.62	0.59	5.45	0.26	19.05	0.93	0.00	0.00	45.86	0.49
	Total Area under *Active Mining*	**27.61**	**4.80**	**152.29**	**13.55**	**183.42**	**8.62**	**45.71**	**2.22**	**34.33**	**0.97**	**443.36**	**4.71**
	Barren OB Dump	21.18	3.68	110.42	9.83	53.57	2.52	90.49	4.40	22.66	0.64	298.32	3.17
RECLAIMED	Area Under Backfilling (Technical Reclamation)	11.10	1.93	176.03	15.66	351.68	16.53	143.64	6.98	30.45	0.86	712.90	7.57
	Total Area under Mine Operation	**61.88**	**10.76**	**440.68**	**39.21**	**597.59**	**28.09**	**280.96**	**13.66**	**88.17**	**2.50**	**1469.28**	**15.61**
WASTELAND	Waste Lands	65.94	11.47	82.19	7.31	182.23	8.56	152.75	7.42	708.59	20.09	1191.70	12.66
	Fly Ash Pond / Sand Body	15.55	2.70	0.00	0.00	0.00	0.00	53.37	2.59	15.83	0.45	84.75	0.90
	Total Wasteland	**81.49**	**14.17**	**82.19**	**7.31**	**182.23**	**8.56**	**206.12**	**10.02**	**724.42**	**20.54**	**1276.45**	**13.56**
WATERBODIES	Reservoir, Nallah, Ponds	15.38	2.67	12.13	1.08	20.60	0.97	185.47	9.01	63.67	1.80	297.25	3.16
	Total Waterbodies	**15.38**	**2.67**	**12.13**	**1.08**	**20.60**	**0.97**	**185.47**	**9.01**	**63.67**	**1.80**	**297.25**	**3.16**
AGRICULTURE	Crop Lands	3.42	0.59	3.45	0.31	38.23	1.80	18.08	0.88	81.78	2.32	144.96	1.54
	Fallow Lands	80.92	14.07	37.02	3.29	20.12	0.95	109.95	5.34	822.67	23.32	1070.68	11.38
	Total Agriculture	**84.34**	**14.67**	**40.47**	**3.60**	**58.35**	**2.74**	**128.03**	**6.22**	**904.45**	**25.64**	**1215.64**	**12.92**
SETTLEMENTS	Urban Settlement	7.17	1.25	166.29	14.80	390.66	18.36	228.39	11.10	336.58	9.54	1129.09	12.00
	Rural Settlement	14.04	2.44	16.81	1.50	9.41	0.44	57.90	2.81	14.68	0.42	112.84	1.20
	Industrial Settlement	2.58	0.45	0.24	0.02	20.57	0.97	24.49	1.19	31.41	0.89	79.29	0.84
	Total Settlements	**23.79**	**4.14**	**183.34**	**16.31**	**420.64**	**19.77**	**310.78**	**15.10**	**382.67**	**10.85**	**1321.22**	**14.04**
	Grand Total	**575.00**	**100.00**	**1123.79**	**100.00**	**2127.70**	**100.00**	**2057.47**	**100.00**	**3527.58**	**100.00**	**9411.54**	**100.00**



Area Statistics - Cluster X (2021)

Classes		Colour	Core Zone	
Level-I	Level-II		Area (Ha)	% of Total
Forest	Dense Forest		0.00	0.00
	Open Forest		64.34	3.13
	Total Forest (A)		**64.34**	**3.13**
	Scrubs (B)		**645.77**	**31.39**
Plantation Area	Social Forestry		140.75	6.84
	Plantation on OB		66.09	3.21
	Plantation on Backfill		29.16	1.42
	Total Plantation Area (C)		**236.00**	**11.47**
	Total Vegetation (A+B+C)		**946.11**	**45.98**
Agriculture Land	Crop land		18.08	0.88
	Fallow Land		109.95	5.34
	Total Agriculture Land		**128.03**	**6.22**
Waste Land	Waste Land		152.75	7.42
	Sand Body		53.37	2.59
	Total Waste Land		**206.12**	**10.02**
Mining Area	Advance Quarry area		0.00	0.00
	Coal Quarry		26.66	1.30
	Barren OB Dump		90.49	4.40
	Back Fill		143.64	6.98
	Coal Dump		1.12	0.05
	Water Filled Qry		19.05	0.93
	Total Mining Area		**280.96**	**13.66**
Settlements	Urban Settlements		228.39	11.10
	Rural Settlements		57.90	2.81
	Industrial Settlements		24.49	1.19
	Total Settlement Area		**310.78**	**15.10**
Water Body	**River/ Ponds**		**185.47**	**9.01**
	Total Area		**2057.47**	**100.00**

Legend

Settlements — Railway Line

Cluster X Boundary — Road

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of BCCL Clusters				Job No. 561410027
Subject: Land Reclamation Monitoring Status of Cluster-X Group of Mines based on Satellite Data (RS-2/L-IV) of the year 2021	Activity	Name	Designation	Signature	
	Prepared	Ayesha Parida	Dy. Mgr(Geology)		
	Checked	Hariharalal. B	C/h. Mgr(RSC)		
	Approved	R. Kumar	GM(Geomatics)		
cmpdi	Scale:	0 0.25 0.5 1 Km			Sheet 1
	Drg No.	HQ/REM/21/R2/A4/CL-X			Rev No. 0

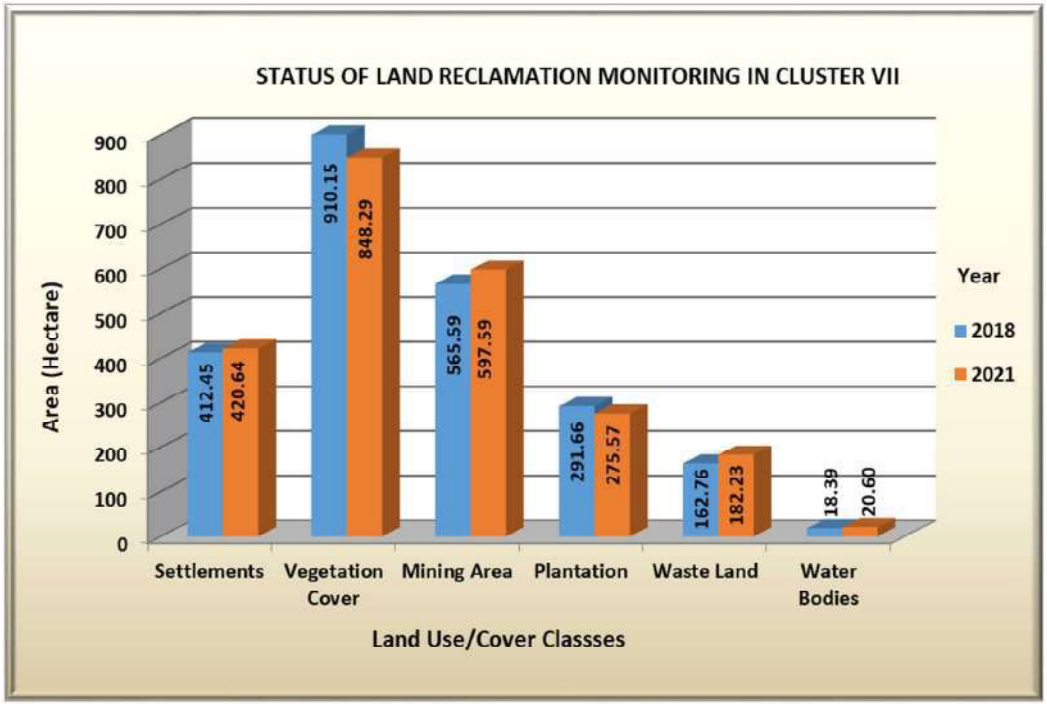


Fig. 5: Land Reclamation Status of Cluster VII

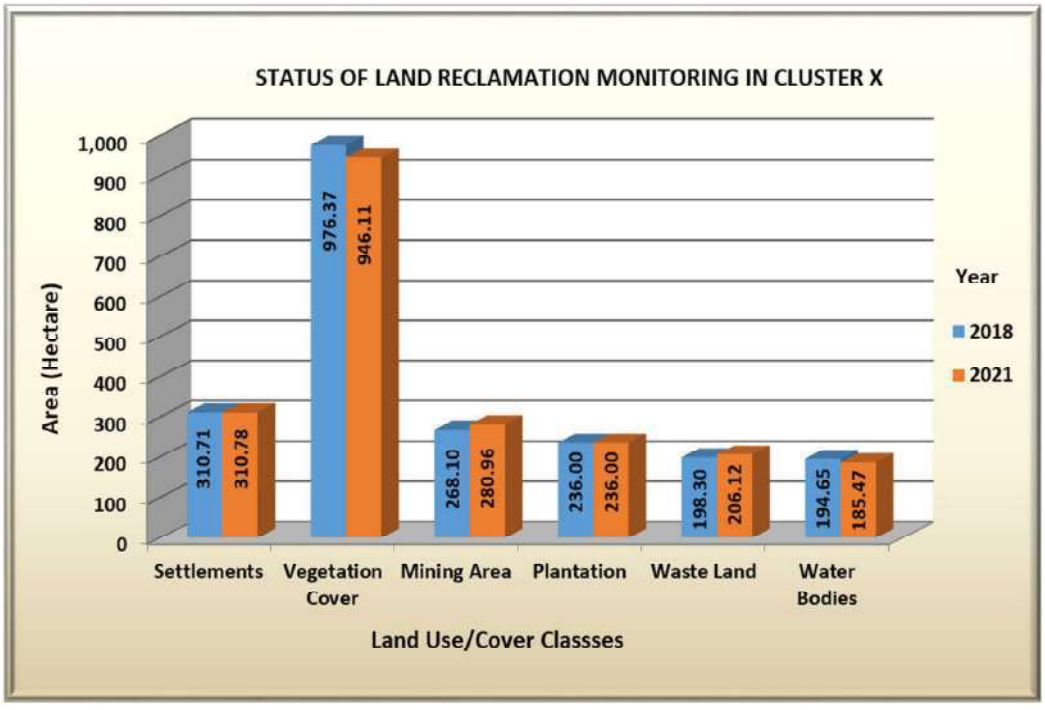


Fig. 6: Land Reclamation Status of Cluster X

Photo 6: Road side Plantation in Cluster VII

Photo 7: Plantation on OB Dump in Cluster X

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.

BHARAT COKING COAL LIMITED

MINING PLAN AND MINE CLOSURE PLAN

FOR

AMALGAMATED SUDAMDIH PATHERDIH MINE

(UPTO {-} 60m RL HORIZON)

(EASTERN JHARIA AREA)

SEPTEMBER – 2018

CENTRAL MINE PLANNING & DESIGN INSTITUTE LTD.
REGIONAL INSTITUTE NO.-II
DHANBAD

CHAPTER - XII

PROGRESSIVE AND FINAL MINE CLOSURE PLAN

12.0 MINE CLOSURE PLANNING

12.1 OBJECTIVES OF CLOSURE PLANNING

Mine closure planning has to be carried out at the starting of the mine and needs periodic reviewing and revision during its life cycle to cope with the geo-technical constraints, safety and economic risks, social and environmental challenges. Various other objectives are as follows:

- To allow a productive and sustainable after-use of the site which is acceptable to the mine owner and the regulatory authority;
- To protect public health and safety;
- To alleviate or eliminate environmental damage and thereby encourage environmental sustainability;
- To minimize adverse socio-economic impacts.

12.2 DIFFERENT ASPECTS OF MINE CLOSURE PLANNING

The mine closure planning broadly involves the following aspects:

(a) Technical aspects;

The following technical aspects would be reviewed in the final mine closure planning. Details can be worked in closure plans envisaged to be prepared.

Safety hazards including management of fire and subsidence: In the mine closure plan, action will be taken to cover all the safety aspects including management of fire & subsidence and mine inundation.

Management of Pit Slopes: During operation of the mine, overall slope will be maintained at an angle not exceeding 22^0-28^0. Vegetation cover will also be provided along the slopes to arrest any failure.

As regards stability of back-filled dumps, the final level of reclaimed backfill will be matched with the levels of surrounding areas leaving a final residual void which will serve as a lagoon which may be utilised as water reservoir for the locality.

During operation, the external and internal OB dump will be developed with 30 m berm width and maximum height of 90m in case of external OB dump and the overall dump slope shall not exceed 22 to 28 degrees. The waste dumps will be provided with toe wall and garland drains. The dump will be technically reclaimed and vegetation will be grown after spreading the top soil. The above measures will prevent slope failure and improve the aesthetic value.

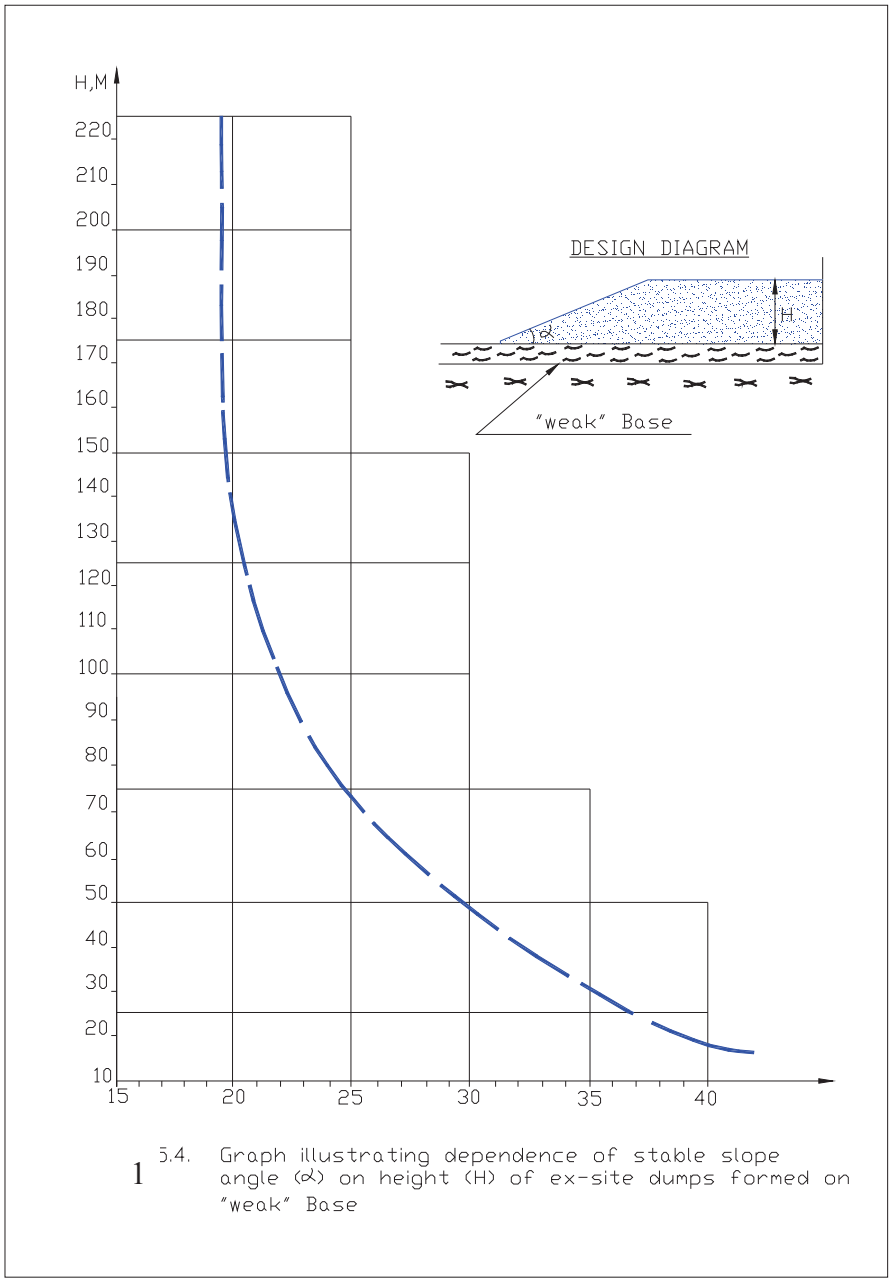


Fig. 5.4. Graph illustrating dependence of stable slope angle (α) on height (H) of ex-site dumps formed on "weak" Base

Backfilling will be started in the OCP and the final level of reclaimed backfill will be matched with the levels of surrounding areas leaving a final residual void which will also serve as a lagoon which may be utilised as water reservoir for the locality. Most of the back filled area shall be afforested by selecting proper plant species in consultation with State Forest Department. A part of the back filled area would also be developed for agricultural purpose with the help of the concerned State Authority.

- **Management of hydrology and hydro-geology**: In the mine closure plan, the surface flow pattern of precipitation and mine water would be clearly developed and water channel suitably laid down so that it does not disturb the general hydrology of the area.

  Mining operation may reduce the water table of the area. To recharge the water table, it is proposed that the mine water during operation will be discharged into surface water settling tank over flow of settled water from the tank will be used for water sprinkling, plantation, domestic purpose, etc. Therefore, the excess over flow water will be discharged into the nearby river. After closure of the mine vegetation will be grown on the entire vacant area.

- **Details of decommissioning of the infrastructures:** The decommissioning of the various infrastructures developed for the mine like office complex, roads, pipelines and transmission line etc. shall be planned in details so that the land occupied by these infrastructures are released. However, before such decommissioning, the possibility of re-use of these infrastructures for the neighboring mines shall be explored.

i) **Closure of entry to the open-cast mine:** After closure of the mining activities, all the entries to the mine will be effectively sealed off to avoid any accident and to prevent access to any unauthorized person. The area that is not reclaimed shall be properly fenced/ sealed to prevent any

unauthorized entry into the area. However, the guidelines / instructions from DGMS, if any, will be followed.

(b) Environmental aspects

This would include the following:

- **Management of final voids**: In the mine closure plan, voids due to mining are to be dealt and the final land use plan will include filling of the voids for land reclamation where possible and for hydro reclamation where feasible.

- **Reclamation of forests/vegetation:** It is to be ensured that in the final land use plan, all vacant land acquired for the project is afforested

- **Channelisation of available water:** If the mine is having sufficient water and if on closure, the mine water flows into the surface water courses, channelising this water for surrounding community for their irrigational/domestic uses may be taken up. This can be planned by providing structures involving one time costing

- **Management of Recharge Areas**: The pre-mining and post mining scenario on the hydrogeological recharge system would be included in the closure plan.

- **Acceptable Surface and Ground Water Flows**: In the final closure plan of the mine, wherever the mine water is likely to flow out to surface and meet the surface water sources; the quality of water from such mines would be assessed and flow pattern designed in the final plan.

(c) Social aspects;

The social aspects of land use planning relating to mine closure would include the following:

- **Re-deployment of Workforce:** The company employees will be gainfully engaged in the neighboring projects after cessation of mining activities.

- **Management of Community Facilities:** In view of the short life of the project no new community facility will be created. However, the existing facilities of adjoining areas will be strengthened.

(d) **Financial aspects**.

Mine Closure activities would be a constant exercise for the mine which would begin with the commencement of mining operations and continue till post closure. The mine closure activities would naturally entail certain expenditures, which will have to be borne by the mine operator. There are two types of Closure, namely, Progressive Mine Closure (Concurrent) and Final Mine Closure. This would cover the activities which are being executed along with normal mining operation and would continue to be executed in course of execution of the project.

The Final Mine closure cost has to deal with the following:

- Cost of closure activities.
- Cost towards organization for executing the closure activities.
- Cost of the post project monitoring.
- Creation of a corpus fund for the final mine closure.

(e) Maintenance of records pertaining to Progressive Mine Closure

The Mine management shall maintain following 2 Nos. of Progressive mine closure plans for every 5 year period:

A Progressive mine closure plan for surface activities

This plan shall be maintained at a scale of 1: 4000 showing the entire progressive mine closure activities (surface) carried out on yearly basis. The plan shall be updated on annual basis and shall be signed by appropriate authorities from the Project and the Area. After every annual renewal, the plan shall be placed before HOD (Env.) of the Company for scrutiny and approval.

Execution of progressive mine closure activities and 5 yearly monitoring

Besides the above plan, a progressive mine closure register shall also be maintained by the mine management. This register shall carry details of the progressive mine closure activities to be carried out on yearly basis. The details to be maintained in the said register shall cover inter alia the name of the activity, place, period of execution, executing agency, expenditure incurred, proof of the expenditure incurred, final status of the area where activity was executed, plan on which such activity has been shown etc.

The entries into the said register shall be signed by the appropriate authorities from the mine and the area. At the end of each year the said register (along with two plans) shall be placed before HoD (Env)/GM(Env.) of the company for scrutiny and approval.

After observing the necessary administrative/financial formalities, the mine authorities shall execute the identified progressive mine closure activities, whenever and wherever required. The executed activities shall be shown on the above said plans and recorded in the said registers.

The executed progressive mine closure activities shall be monitored on 5- yearly basis by 3rd party (ISM, CMPDI, NEERI etc.).

The 5 yearly return from escrow fund would be equal to expenditure incurred on progressive mine closure activities during last 5 years or 80 % of total deposited amount in the escrow account (including interest) whichever is less. The said return would be subject to above said monitoring of progressive MCP by a third party (ISM/CMPDI/NEERI etc.).

As the 5 yearly return from escrow fund is linked with the expenditure incurred on progressive mine closure activities during last 5 years, it is very important that progressive mine closure records, plans, expenditure details along with proof are properly maintained.

At this juncture it is important to note that some of the progressive mine closure activities, enumerated in the preceding paragraphs, are legal obligations specified in Project reports, EMP, permissions obtained from statutory bodies such as CPCB, SPCB, DGMS etc. The Project authorities are bound to comply with these obligations.

12.3 MINE CLOSURE OBLIGATIONS

There is need to define the liabilities, responsibilities and authorities of the mine management, other regulatory bodies, Central and State Governments after mine closure. Some obligations relating to the Mine Management Companies are as follows :

(a) **Health & Safety:** Regulation Nos. 6, 61, 106, 112 of Coal Mines Regulations, 2007 and its related DGMS Circulars;

(b) **Environment :** Water (Prevention & Control of Pollution) Act, 1974; Air (Prevention & Control of Pollution) Act, 1981;

Environmental (Protection) Act, 1986 and Environmental Protection (Amendment) Rule, 2000;

DGMS Directives on Noise & Ground Vibration;

(c) **Forest :**

Forest (Conservation) Act, 1980.

(d) **Rehabilitation :**

CIL's policy, however, applicable for land oustees only.

(e) Decommissioning/asset disposal, etc**.**

12.4 IMPACT ASSESSMENT REMEDIAL MEASURES

Environmental Impact on Landscape, Water Source, air and noise pollution during mine life has been discussed earlier. It is imperative that the environmental monitoring may be continued for 3 years after closure of mines in order to assess corrective measures to be implemented to sustain pre-mining ecosystem and environment in the core and buffer zone (to the extent possible).

12.5 STAKEHOLDERS INVOLVEMENT

Various stakeholders effected due to mine closure need to be identified and they may be as follows :

The Company	:	Employees, Management & Stakeholders
The Community	:	Local business and service providers, landholders, neighbours and nearby residents, local Government and NGOs and Community Groups.
The State	:	The State Government. The Central Government and concerned Government Agencies.

There is need of regular consultations between the stakeholders to evolve the needs of the stakeholders and their involvement in the process.

12.6 CLOSURE ACTION PLAN

Closure planning is a whole-of-life exercise that begins at the start of a mine and continues till post-closure. The dynamic nature of closure planning requires regular and critical review to reflect changing circumstances as a result of any operational change, new regulation, and new technology and remain flexible enough to cope with unexpected events.

The following steps have to be undertaken in relation to Mine Closure Planning:

Prior to the surface demolition/restoration a surface audit should be undertaken on all surface structures, spoil heaps, lagoons, etc. to assess whether there are any hazardous materials that could cause problems; viz. explosives, chemicals, etc. A list of surface assets should be prepared and made available to potential purchasers, prospective purchasers could be invited and asked to submit sealed bids, this could ensure that the sale of assets give better financial gain.

In order to identify potential impact, necessary hydro-geological studies into post-mining ground water recharge have to be done.

Work force on roll of BCCL may be re-deployed for gainful utilization in the same or other mines of BCCL.

As a detailed component of the Closure Plan, a Decommissioning Plan is to be developed towards the final stages preferably 5 years prior to tentative closure of the mine. Once established, it may be updated annually.

12.7 PROTECTIVE MEASURES TO BE TAKEN

Protective measures must include the following :

- The protection of mine Entries , building and other structure on the project site against access by unauthorized persons;
- The maintenance of all mechanical, hydraulic and waste management system;
- The continuation of all monitoring programmes;
- The control of all contaminated effluents;
- The securing of all petroleum products, chemicals and waste;
- The rendering of all tailings, dams and piles of earth, rock and waste resulting from work done on the project site in a stable and safe condition.

12.8 CLOSURE COSTS

As per MOC guidelines, a corpus escrow account @ Rs.1.0 lakhs (August, 2009 Price Level) per Ha (for UG) and @ Rs. 6.0 lakhs (for OC) of the project area shall be opened with the coal controller organization to meet the expenses of final mine closure. The current Guidelines read as:

"It has been estimated that typically closure cost for an opencast mine will come around Rs. 6.00 lakh per Hectare of the project area and it would be Rs. 1.00 lakh per Hectare for underground mine project area at current price levels (August, 2009) and these rates will stand modified based on Wholesale Price Index as notified by Government of India from time to time".

It is difficult to conclusively predict the mining parameters on a long term basis owing to rapidly changing mining technology, developments in the field of

clean coal technologies and R&D activities in development of alternative energy sources.

As per the latest Guidelines issued by the MoC, GoI(dt. 07.01.2013) the *"annual closure cost is to be computed considering the total project area at the above mentioned rates and dividing the same by the entire life of the mine in years for new projects and balance life of mine in years for operating/existing mines."*

Jharia Coalfield is characterized by occurrence of a number of working coal horizons, giving a leverage of extended working life of the mines. Some more seams can come in the lap of workable horizons due to improvement in mining technology in times to come. The underground mines in leasehold of JCF are generally small capacity mines, giving a false impression of very long lives due to small level of current production level. There may be a strategy in future to amalgamate the mines for higher production level to attain the economics of scale. The existing OC Mines working at shallow depth may be worked at a greater depth, In such a situation, the life of the mine arrived at with current level of production for the balance reserve may not be workable in the long run. **In such a situation, it is envisaged that a revised mine closure plan should be prepared as per relevant guidelines and submitted for approval of the competent authority.**

The Mine Closure Plan for Sudamdih Incline Mines and Patherdih Group of Mines was prepared in October, 2013 and was approved by BCCL Board in 301st Board meeting held on 30.10.2013. As per the approved Mine Closure Plan, the closure cost was estimated at approximately Rs.396.316 lakhs for Sudamdih Incline Mine and Rs. 831.155 lakhs for Patherdih Group of Mines under the conditions envisaged in the aforesaid closure plan. The amount already deposited in the escrow account (Account no. 00150100008872 and 00150100008871 at Bank of Baroda, Dhanbad Branch) in the name of Sudamdih Incline Mines and Patherdih Group of Mines is Rs. 403.46 Lakhs upto 31.03.2018.

The earlier mine closure plan was prepared considering Sudamdih Incline Mine and Patherdih Group of Mines as mixed mine i.e. running of both underground & opencast operation. However now it has been decided by BCCL management to discontinue underground mining operation and to extract coal only by opencast mining operation in the Amalgamated Sudamdih Patherdih Colliery. Therefore, given the changes in mining parameters of the mine since the preparation of approved Mine Closure Plan, a new Mine Closure Plan is required for this mine. Accordingly this mining plan and mine closure plan is prepared considering only opencast operation at Amalgamated Sudamdih Patherdih Colliery. However a new escrow account may be opened in the name of Amalgamated Sudamdih Patherdih Colliery and the existing two accounts may be discontinued as per the policy decision of BCCL.

In ASP Colliery, the leasehold area after boundary adjustment is 505.85 Ha, as per the plan supplied by the colliery authority, out of which 284.83 Ha is not considered workable area at present, due to Damodar river (52.23 Ha), coal barriers, DGMS restrictions, non-coal bearing area (Barren Area), Railway acquired land and surface built-up. The remaining area of 221.02 Ha is considered as project area, out of which 135.0 Ha area is considered for opencast mining in the near future and 85.39 for OB dump/Phase-II mining. Thus, 221.02 Ha area is considered for calculation of closure cost as per opencast norms.

The overlapping area (where UG & OC operations have been done in different vertical levels) has been considered for calculation of closure cost as per opencast norms.

The money deposited in the Escrow Account has to deal with the following:

- Cost of closure activities.
- Cost towards organization for executing the closure activities.
- Cost of the post project monitoring.
- Creation of a corpus fund for the final mine closure

As per the above guidelines these rates will stand modified based on Whole Sale Price Index as notified by Government of India from time to time. Thus the total expenditure on this front may be calculated in following manner:

12.8.2 As per Mine Closure guidelines, the total expenditure to be incurred at the notified rate of the year (August 2009) may be calculated in following manner:

Particulars	OC Unit	Remarks
Area	221.02	Area X Notified Rate
Notified Rate (Rs.Lakh)	6	
Total Amount (in base year) (Rs. Lakh)	1326.12	

12.8.4 As per the guidelines *"these rates will stand modified based on whole Price Index as notified by Government of India from time to time".*

An escalation factor has been calculated based on WPI of June 2018 (119.1). As per the directives from Office of the Economic Adviser, WPI series has been revised. In the revised series, base year has been changed to 2011-12 from 2004-05. To account for the aforesaid change WPI linking factor has been taken as 1.561. Converting WPI of June 2018 to that of base year 2004-05, we arrive at figure of 185.9151. Escalation factor vis-a-vis WPI of August '09 (129.6) comes out to be 1.43453

Particulars	OC Unit	Remarks
Total Amount (in base year) (in Rs. Lakh)	1326.12	Total Amount (in base year) X Escalation Factor
Escalation Factor	1.43453	
Escalated Amount (in Rs. Lakh)	1902.359	

12.8.4 As per the earlier approved Mine Closure Plan the total deposited amount in Escrow Account till 31.3.2018 was Rs. 403.46 Lakhs. Out of which 104.25 lakh deposited in OC Unit and 299.21 lakh were deposited in UG unit. The

amount already accrued in the escrow account shall be adjusted against the new closure cost calculated.

Particulars	OC Unit	UG Unit	Remarks
Escalated Amount (Rs. Lakhs)	1902.359	-	
Amount already deposited in escrow account (Rs. Lakhs)	104.25	299.21	
Balance Escalated Amount (Rs. Lakhs)	1498.899		

12.8.5 To arrive at the annual cost to be deposited in each year in an escrow account, the escalated amount shall be divided by the life of the mine.

Particulars	OC Unit	Remarks
Escalated Amount	1498.899	Balance Escalated Amount / Life
Life	33	
Amount per year	45.421	

As per the guidelines, the arrived annual cost has to be escalated by 5% every year for the remaining life of the mine. The amount to be deposited every year after 5% escalation is given below:

Break-Up cost of Mine Closure of Amalgamated Sudamdih - Patherdih (ASP) Colliery Year wise

Year	OC Unit	Total
1	45.42	45.42
2	47.69	47.69
3	50.08	50.08

4	52.58	52.58
5	55.21	55.21
6	57.97	57.97
7	60.87	60.87
8	63.91	63.91
9	67.11	67.11
10	70.46	70.46
11	73.99	73.99
12	77.69	77.69
13	81.57	81.57
14	85.65	85.65
15	89.93	89.93
16	94.43	94.43
17	99.15	99.15
18	104.11	104.11
19	109.31	109.31
20	114.78	114.78
21	120.52	120.52
22	126.54	126.54
23	132.87	132.87
24	139.51	139.51
25	146.49	146.49
26	153.81	153.81
27	161.50	161.50
28	169.58	169.58
29	178.06	178.06
30	186.96	186.96
	196.31	196.31
	206.12	206.12
	216.43	216.43
TOTAL	**3636.591**	**3636.591**

The amount calculated above shall be deposited every year by BCCL in the Escrow Account in the name of Amalganated Sudamdih Patherdih Colliery.

Thus, total amount that shall be further deposited for final mine closure activities of Amalgamated Sudamdih Patherdih Colliery during the balance life of 33 years stands out to be Rs. 3636.591 lakhs as per the present status of the mine.

The amount already deposited in the escrow account will also be available for mine closure activities and should be included to arrive at the total funds available for mine closure activities.

Particulars	Amount (in Rs. lakhs) OC Unit	Amount (in Rs. lakhs) UG Unit	Total
Amount Already Deposited in Escrow Account	104.25	299.21	403.46
Amount to be Deposited in the Escrow Account in the Future	3636.591	-	3636.591
Total Amount available for Mine Closure Activities			4040.051

12.8.6 Based on the existing mine closure planning norms, the above calculated cost at current WPI of June 2018 on mine closure may be tentatively grouped under different heads as given in Tables below as per guidelines of CMPDI(HQ).

Break up Cost of Mine Closure of Amalgamated Sudamdih Patherdih Colliery

Sl. No.	Activity	Mine Closure Cost
A	**Dismantling of Structures**	
	Service Buildings	7.273
	Residential Buildings	97.097
	Industrial Structures like CHP, Workshop, field sub-station, etc.	10.910
B	**Permanent Fencing of Mine Void and other dangerous area**	
	Random Ruble masonry of height 1.2 metre including levelling up in cement concrete 1:6:12 in mud mortar	54.549

Sl. No.	Activity	Mine Closure Cost
C	**Grading of Highwall slopes**	
	Levelling and grading of highwall slopes	64.368
D	***OB Dump Reclamation**	
	Handling/Dozing of external OB Dump into mine void	3224.202
	Bio-Reclamation including soil spreading, plantation and maintenance	14.546
E	***LANDSCAPING**	
	Landscaping of the cleared land for improving its esthetic	10.910
F	***Plantation**	
	Plantation over area obtained after dismantling	18.183
	Plantation around fencing	7.273
	Plantation over the cleared external OB Dump	0.727
G	**Monitoring/Testing of parameters for three years**	
	Air Quality	8.001
	Water Quality	7.273
H	***Enterpreneuship Development(Vocational/skill development training for sustainable income of affected people**	9.455
I	***Miscellaneous and other mitigative measures**	72.732
J	**Manpower Cost for Supervision**	29.093
	TOTAL	**3636.591**

Note: *: To be covered under Progressive Mine Closure activities also.

Thus, total amount that shall be deposited for final mine closure activities of Amalgamated Sudamdih Patherdih Colliery (ASPC) mine during the period of 33 years has been estimated as 3636.591 lakhs for OC Units based on OC norms at WPI of June 2018.

Mining is to be carried out in a phased manner initiating afforestation/reclamation work in the mined out area of the first phase while commencing the mining in the second phase i.e. continuation of mining activities from one phase to other indicating the sequence of operations

depending on the geo-mining conditions of the mine. Up to 80% of the total deposited amount including interest accrued in the ESCROW account may be released after every five years in line with the periodic examination of the Closure Plan as per Clause 3.1 of the Annexure of the Guidelines. The amount released should be equal to expenditure incurred on the Progressive mine closure in past five years or 80% whichever is less. The balance amount shall be released to mine owner/leaseholder at the end of the final Mine Closure on compliance of all provisions of Closure Plan. This compliance report should be duly signed by the lessee and certify that said closure of mine complied all statutory rules, regulations, orders made by the Central or State Government, statutory organisations, court etc. and certified by the Coal Controller.

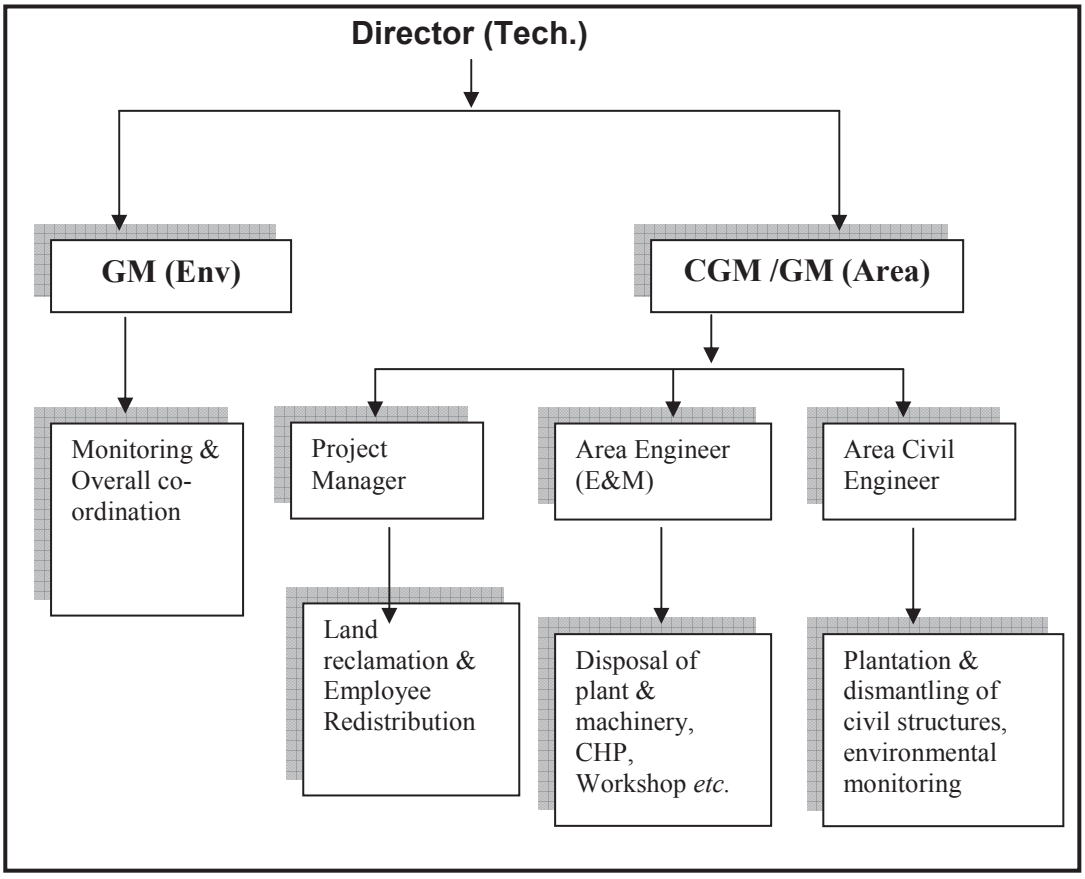
However, the additional amount beyond the escrow account, if any estimated later on, will be provided by the mine operator after estimating the final mine closure cost five years prior to mine closure (as per the mine closure guideline**.**

12.9 IMPLEMENTATION PROTOCOL

As the mine closure activities would continue even after cessation of mining activities, an organization consisting of different discipline would be formed to undertake the implementation of mine closure activities as well as monitoring of the same**.** Such activity shall continue for a period of three years after the closure of mining activity in the mine. Once the closed mine becomes stabilized in respect of safety, environmental and social aspects, the monitoring team would be withdrawn.

Mine closure activities (in opencast section as well as underground section) should be implemented as per implementation schedule given herewith.

For implementing the mine closure activities and monitoring thereof, the following organisational structure at corporate level has been proposed:



Environmental monitoring for three years after closure of mine will be carried out to evaluate the environmental quality of the area. If need be, proper mitigation measures will be taken up after evaluating the environmental quality. Before closure of the mine, Area GM will prepare survey and disposal report and the same will be submitted to DGMS for acceptance.

When the mine closure activities would take final shape and the entire area under influence is brought to an acceptable shape, BCCL would obtain a mine closure certificate from Coal Controller to the effect that the protective, reclamation and rehabilitation works in accordance with the approved mine closure plan/final mine closure plan have been carried out for surrendering the reclaimed land to the State Government concerned.

IMPLEMENTATION SCHEDULE FOR MINE CLOSURE IN AMALGAMATED SUDAMDIH PATHERDIH

(LIFE OF THE MINE: 33 YEARS)

S.N	Activity	Time Frame	YEAR					
			Operational Phase			Post Closure Phase		
			1st - 10th	11th - 20th	21th - 33th	PC1	PC2	PC3
A	**Dismantling of Structures**							
	Service Buildings	2 years						
	Residential Buildings	2 & ½ years						
	Industrial structures like CHP, Workshop, field sub-station, etc.	2 & ½ years						
B	**Permanent Fencing of mine void and other dangerous area**							
	Random rubble masonry of height 1.2 metre including leveling up in cement concrete 1:6:12 in mud mortar	2 years						
C	**Grading of highwall slopes**							
	Levelling and grading of highwall slopes	2 years						
D	**OB Dump Reclamation**							
	*Handling/Dozing of OB Dump and backfilling	Throughout the life of the mine including 3 years after cessation of mining operation						
	*Technical and Bio-reclamation including plantation and post care	Throughout the life of the mine including 3 years after cessation of mining operation						
E	**Landscaping**							
	Landscaping of the open space in the leasehold area for improving its esthetics and eco value	Throughout the life of the mine including 3 years after cessation of mining operation						
F	**Plantation**							
	Plantation over cleared area obtained after dismantling	2 years						

S.N	Activity	Time Frame	YEAR					
			Operational Phase			Post Closure Phase		
			1st - 10th	11th - 20th	21th - 33th	PC1	PC2	PC3
	*Plantation around the quarry area and in safety zone	Throughout the life of the mine including 3 years after cessation of mining operation						
	*Plantation over the OB Dump	Throughout the life of the mine						
G	**Post Closure Env Monitoring / testing of parameters for three years**							
	Air Quality	3 years						
	Water Quality	3 years						
H	***Entrepreneurship Development (Vocational/skill development training for sustainable income of affected people**	Throughout the life of the mine						
I	***Miscellaneous and other mitigative measures**	Throughout the life of the mine including 3 years after cessation of mining operation						
J	**Post Closure Manpower cost for supervision**	3 years						

NOTE: *: To be covered under Progressive Mine Closure activities also.

NOTE: The progressive mine closure will be done as per the provisions made out in the Mining Plan and as per the situation/requirement that may arise in course of execution of the Mining Plan

Item No. 351.3D

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

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

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

Background

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

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

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

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

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

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

Certified to be True Copy

B. K. Parul
Company Secretary
Bharat Coking Coal Limited
Koyla Bhawan
005

ENVIRONMENTAL POLICY STATEMENT:

Bharat Coking Coal Limited (BCCL) is committed to promote sustainable development by protecting the environment through integrated project planning & design, prevention / mitigation of pollution, conservation of natural resources, restoration of ecology & biodiversity, recycling/ proper disposal of wastes, addressing climate change and inclusive growth. It also aims to bringing awareness amongst its stakeholders for continual improvement in environmental performances following best practices.

OBJECTIVES:

Bharat Coking Coal Limited shall endeavour to:
1. Plan & design projects with due consideration to environmental concerns for Sustainable Development.
2. Conduct mining and associated operation in an environmentally responsible manner to comply with applicable laws and other requirements related to environmental aspects.
3. Prevent pollution of surrounding habitation by continuous monitoring and adopting suitable measures for environment protection.
4. Implement Environment Management Plans in all our mines /projects/Clusters effectively to mitigate pollution, conservation of natural resources and restoration of ecology & biodiversity.
5. Ensure compliance of all applicable Environmental Clearance& Forestry Clearance conditions and other statutory conditions issued by regulatory agencies.
6. Recycling of wastes on the principle of REDUCE, REUSE and RECYCLE.
7. Put special thrusts on efficient energy utilization / renewable energy as a measure to reduce carbon foot-print.
8. Strive for continual improvement in our environmental performances by setting targets, measuring progress and taking corrective action.
9. Taking measures to render productive post mining land use.
10. Implementation of activities applicable to BCCL arising out of International Conventions.
11. Create environmental awareness among the employees and the local communities through pro-active communication and training

STRATEGIES FOR IMPLEMENTATION OF ENVIRONMENTAL POLICY:

BackGround:

Bharat Coking Coal Limited subscribes to the view of Sustainable Development. Unless theenvironment can sustain all the developmental activities, any pursuit of developmentin isolation can cause irreparable damage to the ecosystem and associatedenvironmental attributes. Keeping this view in mind, Bharat Coking Coal Limited attaches toppriority towards sustainable development and approved its ‘Corporate EnvironmentalPolicy’. Based on CIL Environment Policy2012,incorporating theJharia Master Plan ,CEP of BCCL was approved by 285th BCCL board on 21.04.2012and is complimentary to theNational Environmental Policy, 2006.The Revised BCCL Policy, 2019 is the outcome of the experience gained since2012, keeping in view the modifications / amendments made time to time inenvironmental policies and additional stipulation notified by MoEF&CC (Ministry of Environment, Forest& Climate Change), and other organisations concerning mineclosure, reclamation of degraded land, environmental clearance etc. and also with theobjective of revisiting the corporate policy.The Policy has a vision of Green Mining and mission of 100% compliance of environmental statutes applicable to coal mining industry.This policy is prepared in line with that of CIL’s

policy with incorporation of prevailing local conditions.

STRATEGIES: Bharat Coking Coal Limited adopts the strategies appended below for effective implementation:

1. MINE/ PROJECT PLANNING & DESIGN FOR SUSTAINABLE DEVELOPMENT:

a) Coal being a non-renewal energy source, extraction shall be planned prudently tomeet national requirement in a planned way. The projects shall be designed on theprinciple of Sustainable Development with due consideration to environment, mine closure,safety and aspirations of the stakeholders at the planning& designstage itself with due regard to mine closure plan.

b) While preparing the Mining plan/project reports, the effort shall be to incorporatelatest mining technologies and equipment's with optimal capacity, which are moreenvironment friendly

c) All Mining Plan/ project reports will be provided with detailed provisions for ensuring environmental compliances

2. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) & ENVIRONMENT MANAGEMENT PLAN (EMP)

a. All mine planning and design shall be environmentally acceptable and operationshall be carried out in such a way as to facilitate the compliance of stipulated environmentalstandards.
b. EIA& EMP for all projects/Clusters shall be formulated as per the approved ToR (Termsof Reference) and pubic consultations for obtaining Environmental Clearance (EC) from MoEF&CC. Similarly, in the existing projects needing enhancementof production capacities with or without increase in land, change of technology,renewal of lease and change in land use etc. fresh EC is required to be sought asper norms. The projects shall be operated after obtaining Consent to Establish(CTE)/Consent to Operate (CTO) from State Pollution Control Boards (SPCB).
c. Detailed Mine Closure Plans shall be prepared for all existing and new mines as per the MoC (Ministry of Coal) guidelines.

3. COMPLIANCE OF THE STATUTORY REQUIREMENTS:

The implementation of EMP and fulfilment of all other statutory requirements like conditions of EC, FC and consents to establish & operate, including timely submission of returns to statutory bodies and various agencies, are to be ensured at all levels.

4. MEASURES TO MITIGATE POLLUTION:

a) Air Pollution:

i) Generation of dust is to be controlled at the source to the possible extent with necessary control measures during drilling, blasting, loading, unloading, CHPtransfer points etc
ii)Deployment of eco-friendly mining technologies.
iii) Dust generation is to be minimized along coal / waste transportation routes.
iv)Mechanized transportation of coal to be encouraged.
v) Green belt is to be created around the source of dust

b) Water pollution:

i) The mine water and other effluent shall be treated to ensure the discharge normsas per statute. The treated effluent shall be utilized to the extent possible with aview to achieve

maximum water conservation.
ii) Oil & grease from the effluent shall be removed by Oil & Grease Traps forproper disposal.

c) Noise / ground vibration:

i) All measures to minimize noise pollution will be taken including maintenance of HEMM, equipment and provision of PPE where required.
ii) Suitable blasting techniques shall be followed to reduce ground vibration as well as noise pollution.

d)Land reclamation:

i) Progressive and concurrent reclamation of mined out areas will be carried out as per approved EIA/EMP and Mine Closure Plan (MCP).
ii) Slopes of external dumps are the important area to be suitably graded / terraced for effective reclamation and plantation.
iii) Preservation of top soil is required for future use. Old as well as existing nonactive dumps are to be technically and biologically reclaimed.
iv) Monitoring of reclamation work of all opencast mines will be done through Satellite Surveillance. The outcome shall be put in the websites.

e) Mine closure plans:

Mine Closure Plan (MCP) shall be prepared for each mineon which Mine closure guidelines are applicable. MCP are being delineated in two phases viz. progressive and final mine closure. Appropriate funds are set aside and deposited under a special Escrow fund every year as per MoC guidelines, to be utilized for proper and final mine closure.
For mines closed prior to issuance of MoC guidelines (i.e. 27th August, 2009) suitable action to be taken as per provisions of Mines Act 1952.

f) Mine fire& subsidence

BCCL shall endeavour to reduce occurrence of mine fire and subsidence due to mining activityfor safety and conservation purpose and, shall take steps for prevention and control of coal mine fire. Monthly report shall be submitted to top management of thesubsidiary and CIL and Quarterly to company board. Action Plan for mine fire control shall be implemented. Monitoring will be done through Satellite Surveillance/other suitable technology. Rehabilitation under Master Plan will be expedited to facilitate faster liquidation of fire. During the execution of the Master Plan since 2009, changes have occurred in the fire dealing methodology, the number of affected families and the infrastructure facilities to be provided to them. However, these modifications were executed in cognizance of HPCC committee for JMP.
BCCL is committed for implementation of the GOI approved Master Plan for Dealing with Fire, Subsidence and Rehabilitation in leasehold of BCCL (Jharia Master Plan) which is also required to be dovetailed with the implementation of EC conditions of various clusters of BCCL . Necessary steps shall be taken for implementation of Jharia master plan to deal with the problem of fire and subsidence in JCF along with R&R of affected people.

g) Monitoring:

I. All receptors in and around the mining projects/clusters all be monitored regularly to assess the efficacy of the pollution control / mitigation measures within stipulated standards.
II. Effect of mining on the hydrology of the area will be monitored through measurement of water level and quality of nearby wells and bore holes provided for this purpose. Conservation of water through rainwater harvesting shall be taken up.
III. Area and Unit environmental cells shall have regular interaction with the people in and around the coal mines and other allied units on matters related to environment to take necessary and timely corrective actions.
V. Environmental initiatives and monitoring through self and third party environment audit shall be conducted for generating useful data for taking corrective actions and mitigation measures as per guidelines.

h) Other measures:

I. Special emphasis shall be given to undertake R&D related to various facets of coal mine environmental management in collaboration with Central Mine Planning and Design Institute (CMPDI) and other competent institutions.

II. Besides ensuring statutory compliance, the BCCL desires to set high standards and continual improvement.

III. Mines & establishments shall be ISO 14001certified in phased manner.

IV. CSR and R&R policies of CIL are to be incorporated by BCCL for better planning and implementation of the socio-economic issues of coal mining areas.

V. The coal mining environmental issues are complex and require multidisciplinary approach to address the same. BCCL will endeavour to enter into MoUs with expert agencies of repute to assist in environment issues and also help in capacity building of BCCL executives.

VI. BCCL conduct periodical medical examination (PME) of its work force on routine basis in compliance of the requirement mining rules and regulation,
additional test will be done as and when require.

5. PRESERVATION OF BIO-DIVERSITY:

BCCL has made the ecological restoration a flagship programme for restoration of degraded mined areas and adopting 3- tier plantation consisting of native species grasses, bushes and trees under the technical expertise of Forest research institute, Dehradun, a renowned institute in the field of forests and ecology. Ecological restoration has been widely accepted as one of the most effective means to restore the ecology and biodiversity.

BCCL is committed towards the conservation and restoration of the natural biodiversity of the region on the degraded mined out areas and restore back to forest like areas. BCCL will strive to restore the habitats for the native fauna of the region by restoring the areas through ecological restoration.

BCCL is committed towards the wellbeing and betterment of the living standards for the local community through establishment of the eco-parks in the reclaimed mined areas in the coalfield and promoting the eco-mining tourism in the coalfield areas and exploring the new opportunities to the local communities. This will start from mine planning including technically and biologically reclamation of mined out areas in collaboration with State Forest Departments, Wild Life Divisions, NGOs, FRI Dehradun etc. working in the fields of biodiversity conservation.

6. COAL BENEFICIATION / COALWASHERIES:

a) For beneficiation of Runoff Mines (ROM) coal, washeries are being set up in a phased manner as per requirement and statutes.

b) Slurry Management System (SMS) in all washeries shall be organized to ensure collection of fines, gainful utilization of rejects viz. power generation in Fluidized Bed Combustion (FBC) plants, selling to brick manufacturers or adopting other environmental friendly disposal options as feasible.

c) The reject dumps and tailings shall be suitably handled to avoid any contamination.

d) The effluent from washeries including tailings pond shall be suitably treated and reused to minimize water consumption with zero discharge concept.

7. CONSERVATION AND CLEAN TECHNOLOGY:

a) R&D projects shall be taken up to promote clean coal technology and improve the existing technologies.

b) Energy saved is energy produced. Voluntary energy audit to be done for corrective action to reduce carbon footprint.

c) Clean Development Mechanisms will be explored for reducing emission of Green House Gases by exploration, identification, preparation of projects reports for extraction of methane from Coal Bed, Coal Mine, Abandoned Mine, Ventilation Air, UG Coal Gasification, generation and utilization of renewable energy etc.

8. AWARENESS PROGRAMME:

a) Publicity to generate awareness through exchange & communication of information, newsletters and periodicals on environment, seminars, workshops, celebration of

World Environment Day etc, at BCCL HQ, Areas & units to be undertaken. Regular training programs to be organized at various levels to inculcate awareness among employees.
b) Courses on environmental and forestry laws and Environmental Protection Measures and the Corporate Policy to be organized for project executives for improving knowledge.
c) BCCL will felicitate its workers for best practices in eco-restoration, land reclamation, conservation, compliance of statutes and innovative ways of sustaining environment.

9. WASTE MANAGEMENT:

BCCL will undertake appropriate action for safe handling, storage and disposal of solid waste and hazardous waste generated from its industrial set up and colonies as per relevant rules. The biomedical waste generated from hospitals and dispensaries will be collected and disposed in appropriate facilities created as per statutes. E-waste management and handling of various types of e-waste generatedin its operations will be done as per rule.

10. CORPORATE ENVIRONMENT RESPONSIBILITY:

Corporate Environment Responsibility (CER) is mandatory for issuing environmental clearance for all the Greenfield and Brownfield projects as per directives of MoEFCC with effect from 1st May, 2018 (O.M.No.22-65/2017- IAIII dt. 19.06.2018). Budgetary provisions should be kept for implementation of provisions of CER for all the projects which will be submitted to MoEFCC for grant of environmental clearance.

11. INCORPORATION OF VIEWS OF STAKEHOLDERS:

BCCL will critically examine and incorporate the viewpoints of various stakeholders like PAPs/PAFs, Parliamentary Committees, Standing Sub-Committees, NGOs etc.

12.IMPLEMENTATION OF POLICY:

i) Manpower: BCCL shall have environmental divisions at decision making & operational levels in its structure. The environment department shall be set up and strengthened at:
i)BCCL HQ
ii)Areas / Units / Collieries / Workshops /Washeries

ii) Roles and Responsibilities: The environmental department, set up at company HQs, Areas and Unit levels with appropriate manpower and resources, shall be responsible for implementation of policy, obtaining EC, FC, consent to establish & operate, statutes requirements and undertaking mitigation measures besides preparation of action plan every year and also to intimate the status of implementation to the management regularly.

iii) Annual Environment Budget (Revenue &Capital): The Annual Environment Budget (revenue & capital) shall be prepared based on the action plan including monitoring of various bench marks and the budget utilization. The year wise funds earmarked for environmental protection measures shall be kept in separate accounts with Environmental cost code.

REVIEW OF ENVIRONMENTAL POLICY:

In view of the present fast changing social, economic and environmental scenario, the CIL Policy shall be reviewed every 5 years to incorporate the changes in the legal, technical, environmental, economic and social inputs prevailing at that time.
Whenever, there is change in National Environmental Policy or other National / State relevant policies, Acts etc, the CILCorporate Environmental Policy would be reviewed and suitably revised. It will be followed by revision of this policy accordingly.

Place: Dhanbad **Chairman-cum-Managing Director**
Date:

No.J-11015/380/2010-IA-II(M)
Government of India
Ministry of Environment, Forest and Climate Change
IA Division

Indira ParyavaranBhawan,
Jorbagh Road, N Delhi-3
Dated: 12th June, 2019

To,

The General Manager (E&F)
M/s Bharat Coking Coal Ltd,
Koyala Bhawan,
District **Dhanbad** (Jharkhand) Email: envbccl@gmail.com

Sub: Cluster X Coal Mining Project of capacity 2.289 MTPA and Coal Washery of 2.08 MTPA of M/s Bharat Coking Coal Limited in an area of 2057.47 ha located in District Dhanbad (Jharkhand) - Amendment in Environmental Clearance - reg.

Sir,

This refers to your online proposal No. IA/JH/CMIN/8812/2010 dated 15th September, 2017 and additional information dated 9th February, 2019 on the above mentioned subject.

2. The Ministry of Environment, Forest and Climate Change has considered the proposal for amendment in environmental clearance dated 6th February, 2013 granted by the Ministry in favour of M/s Bharat Coking Coal Ltd for Cluster X Coal Mining Project (comprising six mine lease holds) of total capacity 2.289 MTPA (peak) and coal washery of 2.08 MTPA in a total area of 2057.47 ha in Jharia Coalfields, District Dhanbad (Jharkhand).

3. The amendment in said environmental clearance has been sought due to the proposed restructuring/re-appropriation of individual mines in the Cluster for implementation of the Master Plan dealing with fire and subsidence, with the revised details as under:-

S. No.	Mine	Type of Mine UG/OC	Production Capacity (MTPA)	Lease Area (ha)	Mine Life (Years)	
1	Bhowrah North	UG	0.143	208.83	>20	
	Bhowrah North	OC	0.546		6	
2	Bhowrah South	UG	0.377	571.58	30	
		OC	1.2		43	Fire dealing
3	Amalagamated Sudamdih Patherdih Mine	OC	0.709	498.61	33	Amalgamation of mines for fire dealing
4	Sudamdih Shaft	UG	0.24	391.5	30	
5	Amlabad Closed	UG	0	386.95	NA	
6	Sudamdih Coal Washery (Within lease hold of Sudamdih Shaft Mine)		2.08	18	18	
	TOTAL		**2.289**	**2057.47**		

With the proposed restructuring, combined production capacity of the Cluster would remain at 2.289 MTPA (peak) in the same total area of 2057.47 ha.

Revised Mining Plan for the changed capacities of individual mines/lease holds namely, Amalgamated Sudamdih Patherdih OCP and Bhowrah South OCP has been approved by the Board of M/s Bharat Coking Coal Ltd on 29th January, 2019.

4. The proposal was considered by the sectoral Expert Appraisal Committee in its meeting held on 24-25 April, 2019, wherein the Committee recommended the amendments proposed by the project proponent as stated in para 3 above. Based on recommendations of the EAC, Ministry of Environment, Forest and Climate Change hereby accords approval for amendment in environmental clearance dated 6th February, 2013 to effect changes in production capacities of individual mines/lease holds of Cluster X Coal Mining Project of total capacity 2.289 MTPA (peak) and Coal Washery of 2.08 MTPA in an area of 2057.47 ha.

5. All terms and conditions stipulated in the environmental clearance dated 6th February, 2013 shall remain unchanged.

SKS 12/6/2019

(S. K. Srivastava)
Scientist E

Copy to:

1. The Secretary, Ministry of Coal, Shastri Bhawan, New Delhi
2. The Additional Principal Chief Conservator of Forests, Regional office (ECZ), Ministry of Environment & Forests, Bungalow No. A-2, Shyamali Colony, Ranchi - 834002
3. The Member Secretary, Central Ground Water Authority, Ministry of Water Resources, Curzon Road Barracks, A-2, W-3 Kasturba Gandhi Marg, New Delhi
4. The Secretary, Department of Environment & Forests, Government of Jharkhand, Secretariat, Ranchi
5. The Advisor, Coal India Limited, SCOPE Minar, Core-I, 4th Floor, Vikas Marg, Laxmi Nagar, N Delhi
6. The Member Secretary, Central Pollution Control Board, CBD-cum-Office Complex, East Arjun Nagar, Delhi - 32
7. The Member Secretary, Jharkhand State Pollution Control Board, TA Building, HEC Complex, PO Dhurwa, Ranchi
8. The District Collector, Dhanbad, Government of Jharkhand
9. Monitoring File 10. Guard File 11. Record File 12. Notice Board

POLLUTION UNDER CONTROL CERTIFICATE

Vehicle Emission Test Certificate

License No: 284/2016

Sl. No:	00000127	Regis Date:	2018	Test Time:	12:14 PM
Vehicle No:	JH01AD 1547	Fuel:	DIESEL	Odometer:	NA
Make:	TATA	Engine No:	20722	Owner Name:	
Model:	TIPPER	Chassis No:	13852	Remark:	
Category:	TIPPER	Test Date:	15-3-2019		

FLUSH CYCLE

	AVERAGE		
	RPM Min	RPM Max	Oil Tmp
	0630	4250	43

DETAIL

RPM Min	RPM Max	Temp	HSU	K value
640	4250	54	20.75	0.54
610	4280	61	27.86	0.76
630	4250	62	24.62	0.66
MEAN			24.42	0.65
RESULT		PASS		

Result: Pass **Valid Up To:** 14-9-2019

This Vehicle Meets the Emission Standards Prescribed By Rule 115 (2) of Central Motor Vehicle Rule 1989.
This Certificate is Valid for Six Months Only.

Seal of Testing Centre **Test Station Code: 284/2016** **Authorized Signatory**

POLLUTION UNDER CONTROL

Lic No. 397/18 See Under Rule 252/01 JH(MVR)

TRANSPORT DEPTT. GOVT. OF JHARKHAND

Veh No. JH10AG 9659

Type of Vehicle TIPPER

TIPPER

DATE OF ISSUE 05/12/2018

VALID UPTO 03/06/2019

POLLUTION UNDER CONTROL

OUR DREAM INDIA GREEN

प्रपत्र पी.यू.सी.

झारखंड मोटर वाहन नियमावली, 2001 के नियम 252 ए(2) देखें

प्रदूषण नियंत्रण के अन्तर्गत प्रमाण-पत्र

प्रदूषण स्तर प्रमाण-पत्र

जाँच केन्द्र का नाम

कोयलांचल

वाहन प्रदूषण जाँच केन्द्र

बालाजी फ्यूल स्टेशन, धुईयाडीह, धनबाद

अनुज्ञप्ति संख्या : 397 / 18 क्रम संख्या BC-/14555

मोटर वाहन संख्या : JH10AG 9659 D.O.Regn. 11/12/2012

मेक : TML निर्गत की तिथि : 05/12/2018

मोडल : 2012 वाहन का प्रकार TIPPER

निरस्सरण स्तर को जाँच एवं निम्न पठन पाया गया

पेट्रोल / LPG वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड — गैस का नाम — वास्तविक पठन

CO :- 0.5%-4.5% — CO

HC :- 750-3000 — HC

डीजल वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड — गैस का नाम — वास्तविक पठन

H.S.U-65 — 19

फ्यूल लोड

CMVR 1989 के नियम ... के अन्तर्गत निर्धारित ... 03/06/2019

ALL INDIA VALID

प्राधिकृत हस्ताक्षर

KOYLANCHAL VAHAN PRADUSHAN JANCH KENDRA, AUTH. BY GOVT. OF JHARKHAND, KARKEND BAZAR, KUSUNDA, DHANBAD

koylanchalpuc@gmail.com

परिवहन विभाग

Sl. No: 00000127
Vehicle No: JH10R-1438
Make: TML
Model: TIPPER
Category: TIPPER

Regis Date: 2010
Fuel: DIESEL
Engine No: 20732
Chassis No: 12682
Test Date: 15-3-2019

Test Time: 12:14 PM
Odometer: NA
Owner Name:
Remark:

FLUSH CYCLE

AVERAGE		
RPM Min	RPM Max	Oil Temp
0610	4250	43

DETAIL

RPM Min	RPM Max	Temp	HSU	K value
630	4250	59	29.75	0.54
610	4250	61	27.88	0.76
630	4250	62	24.62	0.66
MEAN			27.42	0.65
RESULT		PASS		

Result: Pass **Valid Up To: 14-9-2019**

This Vehicle Meets the Emission Standards Prescribed By Rule 115 (2) of Central Motor Vehicle Rule 1989.
This Certificate is Valid for Six Months Only.

VAHAN PRADUSHAN JANCH KENDRA AUTH. BY GOVT. OF JHARKHAND KAMLEY BAZAR

Seal of Testing Centre **Test Station Code: 284/2016** **Authorized Signatory**

POLLUTION UNDER CONTROL CERTIFICATE

COMPUTERIZED EMISSION TEST CERTIFICATE

(Rule 160B(3) of MV Rules 1992)

Transport Department
Govt. Of JHARKHAND

License: 440/2015

PUCC No.	[illegible]	Make	TATA Motors Ltd.	Name	GEC PROJECT LTD
Serial No.	1171	Model	TIPPER	Address	NA
Vehicle No.	JH01AC3505	Fuel	Diesel	Date	01/02/2019
Date of Mfg.	NA	Chasis	12160	Time	02:13:25
Category	GVW	Engine	06158		

Photo of Vehicle

Sl No.	Opacity [1/m]	Opacity [%]	RPM (Max)
1	56	46.13	1209
2	0.58	46.16	1214
3	0.57	46.12	1216
4	0.6	46.14	1212
5	0.56	46.15	1218
--	--	--	--
--	--	--	--
Mean	0.58	46.136	1213.8

Grade PASS Valid Upto 31/07/2019

Certified that the vehicle's smoke emission confirms to the standards prescribed under rule 115(2) of central motors vehicle under 1989

Seal of Testing Centre

Test Station Code: 440/2015

Authorised Signatory

POLLUTION UNDER CONTROL

Lic.No. 397/18 See Under Rule 252(01) JH(MVR)

TRANSPORT DEPTT. GOVT. OF JHARKHAND

Veh No. JH22A 1658

Type of Vehicle TIPPER

TIPPER LPT

POLLUTION UNDER CONTROL

DATE OF ISSUE 03/12/2018

VALID UPTO 01/06/2019

OUR DREAM INDIA GREEN

प्रपत्र पी.यू.सी.

झारखंड मोटर यान नियमावली, 2001 के नियम 252 व (2) देखें

प्रदूषण नियंत्रण के अन्तर्गत प्रमाण-पत्र

प्रदूषण स्तर प्रमाण-पत्र

जाँच केन्द्र का नाम

कोयलांचल

वाहन प्रदूषण जाँच केन्द्र

बालाजी फ्यूल स्टेशन, गुरुगोड़, धनबाद-

अनुज्ञप्ति संख्या : 397/18		क्रम संख्या	BC-/14513
मोटर वाहन संख्या :	JH22A 1658	D.O.Reg.	29/07/2007
मेक :	TML	निर्गत की तिथि :	03/12/2018
मॉडल :	2007	वाहन के प्रकार :	TIPPER LPT 2515

निरस्तरण स्तर की जाँच एवं मिल पठन प्रपत्र —

पेट्रोल / LPG वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड	गैस का नाम	वास्तविक पठन
CO :- 0.5%-4.5% HC :- 750-9000	CO HC	

डीजल वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड	गैस का नाम	वास्तविक पठन
B.S.U-85 धुआं कोड — की एच.एस.यू.—		21

झारखण्ड सरकार

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड को पूरा करता है / नहीं करता है।

01/06/2019

ALL INDIA VALID

जाँच केन्द्र की मुहर

प्राधिकृत हस्ताक्षर

यह प्रमाण पत्र निर्गत की तिथि से छः माह तक वैध है।

KOYLANCHAL VAHAN PRADUSHAN JANCH KENDRA * KARKEND BAZAR * AUTH. BY GOVT. OF JHARKHAND

koylanchalpuc@gmail.com

POLLUTION UNDER CONTROL

Lic No. 397/18 See Under Rule 252/01 JH(MVR)

TRANSPORT DEPTT. GOVT. OF JHARKHAND

Veh No.	POLLUTION UNDER CONTROL	Type of Vehicle
JH22A 1658		TIPPER
		TIPPER LPT
DATE OF ISSUE		VALID UPTO
03/12/2018		01/06/2019

OUR DREAM — INDIA GREEN

प्रपत्र पी.यू.सी.

झारखंड मोटरयान नियमावली, 2001 के नियम 252 व 12 । देखें

प्रदूषण नियंत्रण के अन्तर्गत प्रमाण-पत्र

प्रदूषण स्तर प्रमाण-पत्र

जाँच केन्द्र का नाम

कोयलांचल

वाहन प्रदूषण जाँच केन्द्र

बालाजी फ्यूल स्टेशन, भुईफोड़, धनबाद-

अनुज्ञप्ति संख्या : 397 / 18		क्रम संख्या	BC-/14513
मोटर वाहन संख्या :	JH22A 1658	D.O.Reg.	29/07/2007
मेक :	TML	निर्गत की तिथि :	03/12/2018
मोडल :	2007	वाहन का प्रकार :	TIPPER LPT 2515

निस्सरण स्तर की जाँच एवं किया पठन द्वारा —

पेट्रोल / L.P.G. वाहन

CMVR 1989 के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड — गैस का नाम — वास्तविक पठन

CO :- 0.5%-4.5% — CO

HC :- 750-9000 — HC

डीजल वाहन

CMVR के नियम 115 (2) के अन्तर्गत निर्धारित मापदण्ड — गैस का नाम — वास्तविक पठन: 21

झारखण्ड सरकार

H.S.U-65

धुआं डीठ —

की इकाई —

CMVR नियम 115 (2) के अन्तर्गत निर्धारित नियन्त्रण मापदण्ड को पूरा करता है/नहीं करता है।

01/06/2019

ALL INDIA VALID

जाँच केन्द्र की मुहर — प्राधिकृत हस्ताक्षर

यह प्रमाण पत्र निर्गत की तिथि से छः माह तक वैध है।

KOYLANCHAL VAHAN PRADUSHAN JANCH KENDRA — AUTH. BY GOVT. OF JHARKHAND — KARKEND BAZAR

koylanchalpuc@gmail.com

Study of Occupational diseases and Hearing impairments of Coal Mines workers of BCCL directly involved in active mining operations

CMS/699(L)/11/10/19

11/10/19

GM (Environment)

REGIONAL OCCUPATIONAL HEALTH CENTRE (EASTERN), KOLKATA

&

NATIONAL INSTITUTE OF OCCUPATIONAL HEALTH, AHMEDABAD

(Indian Council of Medical research)

CONTENTS

Title	Page No.
Participating staff	03
Background	04
Introduction	05
Objectives	07
Methodology	08
Results and Discussion	
Consolidated report of both mining areas	16
Report of Kustore mining area	26
Report of Baghmara mining area	36
Conclusion and recommendations	45
References	49
Executive summary	50
Annexure	56

AIM AND OBJECTIVES

AIMS

To study the coal mining as well as coal dust related health effects in the coal mining workers.

OBJECTIVES

1. To understand health status of workers through questionnaire survey, health examination.
2. To study respiratory health in coal field mining workers.
3. To assess ventilatory functions of coal field mining workers.
4. To analyze hearing ability through audiometric evaluation.

was obtained in a quiet room. Threshold of hearing is defined as the minimum decibel level (dB) at which the subjects respond at least two times on ascending trial. The data for each subject was obtained. Pure tone threshold were obtained using descending- ascending threshold crossing technique. The data was analyzed for each ear of the subjects for all test frequencies. Hearing threshold at test frequencies was averaged for all subjects to assess hearing sensitivity.

Measurement of hearing:

Pure tone audiometry was carried out for the present investigation. In the individual experiment, subjects were briefed about the nature and purpose of the study. He was then seated in a chair, the earphones were fitted on his ears, and the door of the room was closed. They were instructed to respond by raising their fingers when they could just hear the tone lasting for 2 sec. The pulsing of the tone was set at 0.5/ sec. The intensity of the tone was raised by 5 dB until the threshold of hearing was determined at each test frequency viz 125Hz, 250Hz, 500Hz, 1KHz, 1.5KHz, 2KHz, 3KHz, 4KHz, 6KHz.and 8KHz. The actual measurement was started following a brief practice trial session. The better ear followed by the other ear was tested. The right ear was tested first in cases where both the ears were reported to be nearly equal in hearing sensitivity. It was ensured that the subject would fully cooperate. Care was taken to ensure reliable reporting of the subjects' 'just audible sound'. Misses (error of omission) and false alarms (error of commission) were avoided.

Equipment (Audiometer):

An audiometer was used as the source of pure tone audiometry. It has all the facilities of mask attenuation, frequency setting (125-8000 Hz.), decibel setting of pure tone and pulse setting. It has also a pair of earphone attachment. The audiometer is calibrated periodically as per the specification of International Standards Organization.

Questionnaire survey

Medical Examination

Pulmonary Function Test

Information- Communication

Audiometry

Haematology & Radiology Examination

CONCLUSION

- This study covered 351 subjects from Kustore sector and 140 subjects from Baghmara sector of BCCL Collieries. Mean age of the workers was 45.9 ± 8.36 years. Most of the workers were between 35-54 years age. Mean job experience was 11.72 ± 8.49 years.

- Most common symptoms complained by study subjects were musculoskeletal pain (34%). Other complaints were Cough, difficulty in breathing, chest pain, soreness of mouth etc. Headache, sleep disturbance, weakness, tremor in fingers was also experienced by some subjects.

- About 20% subjects had systolic blood pressure >140 as well as diastolic blood pressure > 90 mm of Mercury. 9% workers had only higher systolic blood pressure and 11% had only higher diastolic blood pressure.

- As far as pulmonary functional status of study subjects in concerned, about 3% subjects had restrictive type of abnormality (FVC/PFVC < 80%) and 0.6 % subjects had combined type of abnormality (FVC/PFVC <80 % and FEV1% <70%). A good number of subjects (36.5%) had FEV1% values between 70% and 80%. Mean FVC values were significantly lower among the subjects of age 45 years or above.

- So far as chest radiographic findings are concerned, 93% subjects had findings within normal limits. 3% subjects showed findings suggestive of opacities in lung and almost 1.5% had other features on chest X-ray (mostly suggestive of Koch's infection of lung). Such findings may be due to pneumoconiotic changes in lung, hence these subjects should be properly followed up and necessary medical, ethical, legal, administrative actions may be initiated as necessary.

- Haematological and biochemical findings of the subjects were mostly within normal limits. Almost 11% workers had random blood sugar level more than 140 units. As far as ophthalmological findings are concerned, 5% subjects had uncorrected vision and 9% subjects had Cataract in eyes.

- Decline in hearing ability with increasing duration of exposure was observed more at higher frequency; however, this observation is subject to adjustment for age and other probable factors.

- The subjects for this study are selected from workplaces identified by BCCL, Govt. of India, as required for the purpose of this study. The findings of this study may thus be restricted to the concerned workplaces and may not be generalisable.

RECOMMENDATION

- Prevalence of musculoskeletal pain during work in a good number of workers reflects that manual work of the work processes might be causing some discomfort for the workers. Training on proper method of manual material handling may prove useful of these workers. On the other hand regular proper exercise should be promoted among workers especially supervisory employees to get rid of ill effects of sedentary activities.

- Special emphasis should be given to protection of respiratory health, hearing ability. Periodic relevant examination (lung function test, audiometry) at regular interval is recommended.

- Industrial hygiene survey (periodic monitoring of dust and other environmental hazards) at regular interval should be undertaken including noise level monitoring in different operations.

- Some prevalent symptoms observed may be representation of nervous system effect due to exposures to toxicants. In order to exclude the possibility of exposure from occupational environment, environmental study should include assessment of exposure to metals.

- Measures like using protective appliances (e.g. PPEs), pre-placement- and periodic medical examination, for the control and prevention of relevant health hazards, are to be implemented and maintained by all the mining areas to protect the health of the workers.

EXPENDITURE MADE UNDER VARIOUS HEADS OF ENVIRONMENTAL MANAGEMENT PLAN

Major Environmental measures cost for the year 2013-14

Sl. No.	Activity (2013-14)	Cost Incurred (In Lakhs)
1	Environmental Monitoring (through HQ)	4.80
2	Gabion Plantation through DFO	20.41
3	Biological reclamation	93.98
4	EMP Preparation cost	80.00
Total Cost Incurred (Manpower cost and Diesel cost is included)		199.19

Major Environmental measures cost for the year 2014-15

Sl. No.	Activity (2014-15)	Cost Incurred (In Lakhs)
1	Environmental Monitoring (through HQ)	4.80
2	Gabion Plantation through DFO	15.11
3	Ecological Restoration	279.86
4	FRI Dehradun Monitoring Cost	0.85
5	Environment Statutory Fee	2.25
Total Cost Incurred (Manpower cost and Diesel cost is included)		302.87

Major Environmental measures cost for the year 2015-16

Sl. No.	Activity (2015-16)	Cost Incurred (In Lakhs)
1	Environmental Monitoring (through HQ)	4.80
2	Gabion Plantation through DFO	11.40
3	Ecological Restoration	308.81
4	Statutory Fee including CTO/CTE	11.25
5	FRI Dehradun Monitoring Cost	2.138
Total Cost Incurred(Manpower cost and Diesel cost is included)		338.40

Major Environmental measures cost for the year 2016-17

Sl. No.	Major Environment Activity (2016-17)	Cost Incurred (In Lakhs)
1	Environmental Monitoring (through HQ)	4.46
2	Gabion Plantation through DFO	11.16
3	FRI Dehradun Monitoring Cost	0.89
4	Ecological Restoration / Block Plantation	214.43
5	Water Sprinkling	46.20
6	Scientific study for delineation of fire (through HQ)	18.10
Total Cost Incurred (Manpower cost and Diesel cost is included)		295.24

Major Environmental Measure cost for the year 2017-18

Sl. No.	Major Environment Activity (2017-18)	Cost Incurred (In Lakhs)
1	Environmental Monitoring (through HQ)	20.55
2	Source Apportionment Study (through HQ)	141.60
3	Ecological Restoration / Block Plantation	221.53
4	FRI Dehradun Monitoring Cost	0.89
5	Water Sprinkling	34.66
Total Cost Incurred (Manpower cost and Diesel cost is included)		419.23

Major Environmental measures cost for the year 2018-19

Sl. No.	Major Environment Activity (2017-18)	Cost Incurred (In Lakhs)
1	Routine Environmental Monitoring	32.57
2	Water Quarterly Monitoring Report	3.60
3	FRI Dehradun Monitoring Cost	0.89
4	Ecological Restoration/Block Plantation	38.31
5	Water Sprinkling	31.51
6	Construction of water curtain sprinkler	1.50
7	Statutory Fee including CTO/CTE	3.80
8	Ground water Monitoring	CMPDIL (through HQ)
Total Cost Incurred (Manpower cost and Diesel cost is included)		112.18

Major Environmental measures cost for the year 2019-20

Sl. No.	Major Environment Activity (2019-20)	Cost Incurred (In Lakhs)
1	Routine Environmental Monitoring	17.99
2	Water Quarterly Monitoring Report	1.69
3	FRI Dehradun Monitoring Cost	0.85
4	Ecological Restoration/Block Plantation	45.50
5	Water Sprinkling	31.51
6	Statutory Fee including CTO/CTE	3.80
7	Mist water sprinkler (indent) through HQ	45.66
8	Ground water Monitoring	CMPDIL (through HQ)
9	Online PM10 Analyser installation (through HQ)	42.30
Total Cost Incurred (Manpower cost and Diesel cost is included)		189.30

Major Environmental measures cost for the year 2020-21

Sl. No.	Major Environment Activity (2020-21)	Cost Incurred (in Lakhs)
1.	Routine Environmental Monitoring	19.50
2.	Water Quarterly Monitoring Cost	1.69
3.	Ecological Restoration (material cost)	0.50
4.	Compensatory Plantation by DFO	13.98
5.	Block Plantation by DFO	20.42
6.	Water sprinkling (Manpower & Diesel Cost included)	30.00 (approx)
7.	Statutory Fee including CTO/CTE	3.80
8.	Ground water monitoring	CMPDIL (through HQ)
9.	Online PM10 Analyser installation (2 Nos.)	through HQ
10.	Construction of Toe Wall Bhowra South	17.34
11.	Mine Closure Cost (deposited in Escrow account)	247.51
Total Cost Incurred		354.74

Major Environmental measures Cost for the year 2021-22

Sl. No.	Major Environment Activity (2021-22)	Cost Incurred (in Lakhs)
1.	Routine Environmental Monitoring	26.70
2.	Water Quarterly Monitoring Cost	2.22
3.	Ecological Restoration (material cost)	0.50
4.	Plantation by DFO	21.50
5.	Water sprinkling (Manpower & Diesel Cost included)	30.00 (approx)
6.	Statutory Fee including CTO/CTE	3.80
7.	Ground water monitoring	CMPDIL (through HQ)
8.	Construction of Siltation pond	3.42
9.	Environmental Awareness Programme like Env Day Celebration, Amrit Mahotsav, Vriksharopan abhiyan etc	0.60
10.	Mine Closure Cost (deposited in Escrow account)	183.01
Total Cost Incurred		271.75

Mine Closure Cost Details:

S. No.	Name of Mine	Escrow account	Amount deposited in Escrow account till 31st March 2022 (in Rs. Lakh)		Total amount in Escrow Fund
			Deposited in Escrow account from 2013-14 to 2021-22	Interest incurred from 2013-14 to 2021-22	Principal & Interest upto 31.03.2022
1	Bhowra (N) Grp of Mines (UG+OC)	150100008868	532.31	238.30	770.61
2	Bhowra (S) Grp of Mines (UG+OC)	150100008830	1537.17	636.75	2173.92
3	Sudamdih Incline Mine	150100008868	93.75	59.20	152.95
4	Patherdih Grp of Mines	150100008872	389.21	153.43	542.64
5	Amalgamated Sudamdih-Paherdih Colliery (2019-20 onwards)	150100011524	116.26	4.8	121.06
6	Sudamidh Shaft Mine	150100011673	174.22	21.58	195.80
Total Eastern Jharia Area (Cluster X)			**2842.92**	**1114.06**	**3956.98**

*Note:- Amount deposited in Escrow account for implementation of progressive mine closure Activity in the mines under cluster X is 39.56 Crores from FY 2013-14 to FY 2021-22.

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– BCCL/EJA/ASP/22/ 2103 Dated: 27/09/2022

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 2021-22.**

Dear Sir,

Please find herewith the Environmental Statement duly filled in the financial year 2021-22 in respect of A.S.P. Colliery.

This is for your kind information, Sir.

Encl. - As Above

Yours faithfully

27-9-22

Project Officer
A.S.P. Colliery

Copy to:
1. Regional Officer, J.S.P.C.B, Dhanbad
2. Area Manager (Env.)E.J. Area.
3. Colliery Manager / Safety Officer, A.S.P. Colliery.
4. Office file.

"FORM – V"
(See rule 14)

Environmental statement for the financial year ending 31st March'2022

PART – A

Name and address of the owner / Occupier of the industry operation or process	: Sri Uday A. Kaole, D.T (P&P), Koyla Bhawan, Koyla Nagar, BCCL, Dhanbad.
Industry category primary (STD Code)	: Coal Mining Industry (A.S-P. Colliery)
Production capacity	: 0.709 MTPA.
Year of establishment	: 1962
Date of last environmental statement submitted.	: Dt. 23.09.2021 (Ref. No. EJA/ASP/SMD/21/2178)

PART – B

Water and Raw Material consumption:

Water Consumption	
1. Process (Dust suppression)	992 KL/ Day
2. Cooling	Nil
3. Domestic	458 KL/ Day

Name of products	**Process water consumption per unit of product point**	
	During the previous Financial year 2020-21	**During the current Financial year 2021-22**
N/A	N/A	N/A

2. Raw material consumption:

Name of Raw Material	**Name of products**	**Consumption of Raw Materials per unit of product output**	
		During the previous Financial year 2020-21	**During the current Financial year 2021-22**
Diesel	Coal	7.73 Ltrs./Ton.	5.73Ltrs./Ton.
Explosive	Coal	0.0955 KG/Ton	3.028 KG/Ton

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

Count…P/2

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	—	Total suspended solid – **39** pH – **8.04** Oil & Grease - **<2.0** COD - **40**	Within the limit Within the limit Within the limit Within the limit
b) Air	—	PM10 – **92** PM 2.5 – **47** SO_2 - **11** NOx - **21**	Within the limit Within the limit Within the limit Within the limit

PART – D

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

Hazardous waste	Total Quantity	
	During the previous Financial year 2020-21	During the current Financial year 2021-22
a) From process	Quantity of Burnt Oil -**3810 Ltrs.** Cotton waste – **1465Kg.** Oil soaked filters – **367 Nos.**	Quantity of Burnt Oil – **3993Ltrs.** Cotton waste – **1500 Kg.** Oil soaked filters – **1153Nos.**
b) From pollution control facilities	N/A	N/A

PART – E

Solid wastes

Solid wastes	Total Quantity	
	During the previous Financial year 2020-21	During the current Financial year 2021-22
a) From process	Quantity of Overburden generated –**2170162.295 M^3**	Quantity of Overburden generated – **2056041.315 M^3**
b) From Pollution control facilities	Oil & Grease trap's bottom sludge – N/A	Oil & Grease trap's bottom sludge – N/A
c) Quantity of recycled or reutilized with the unit.	Quantity of O/B used for back filling -**2170162.295 M^3**	Quantity of O/B used for back filling – **1572317.510 M^3**

Count…P/3

PART – F

Please specify the characterization (in terms of composition of quantum) of hazardous as well as solid 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 solid 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.

PART – H

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

(i) There are 04 water tankers (03 are 12000KL abd 01 is 8000KL Capacity) which sprinkle 04 trips water daily (except rainy season).
(ii) Fencing of ecological restoration site is being done.
(iii) There is no pressure filters.
(iv) Black toping of roads has not been done but water sprinkling is being done daily.
(v) Monitoring of air quality, water quality and noise levels are being done periodically.
(vi) Coal is being transported by covered trucks.

PART – I

Any other particulars for improving the quality of the environment.

Carbon sequestration studies done at H.Q. Level /source appointment study and reduction in pollution load by reducing road transport study being done at H.Q. level.

Signature : Anil 27-9-22
Name : **Anil Kumar**
Designation : **Project Officer**
Address : **A.S.P. Colliery**
Post: **Sudamdih**, Dist.: **Dhanbad**
Jharkhand - 828126

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)/2022/387 Date:- 23/06/22

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 Form – V

Dear Sir.

Environmental Statement is Form – V is being submitted to you for financial year 2021-22 in respect of Bhowra (N) U/G Mines.

Enclosures:- As above.

Yours Faithfully

23/6/22

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 2022

PART – A

(i) Name and address of the owner/occupier of the industry operation or process : Sri Sanjay Kumar Singh , 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 : 04.06.2021, (Ref. No: BCCL/EJA/BH(N)/2021/547)

PART - B

Water and River Material Consumption

Water Consumption	
Process (Dust separation)	20 M^3/day
Cooling	Nil
Domestic	120 M^3/day

Name of Products	Process water consumption per unit of product output	
	During the previous financial year	During the current financial year
COAL (coal production discontinue from 03.04.2020)	2846.66KL/T	00 KL/T

Raw Material Consumption

Name of materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial year (2020-21)	During the current financial year (2021-22)
Diesel	Coal	64 L/Te	00 L/Te
Explosive	Coal	0.00 Kg/Te	0.00 Kg/Te
Timber	Coal	S- 0.00 Nos./T; P-0.00 nos./Te	S- 0.00 Nos./T; P-0.00 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, 28.03.22)* TSS - 44 PH - 8.06 Oil & Grease - <2.0 COD - 32	Within Limit
Air	--	*(as on 28.03.21)* PM 10 – 131 PM 2.5 – 64 SO_2 - <10 NO_x - 27	----

PART – D

Hazardous Wastes

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

Hazardous Waste	Total Quantity (Kg.)	
	During the previous financial year (2020-21)	During the current financial year (2021-22)
From process	Burnt oil - 40 Litre	Burnt oil - 20 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	Nil	Nil
(b)	Pollution control facility	Nil	Nil
(c)	1.Quantity recycled or re-utilized within the unit	Nil	Nil
	2. Sold	Nil	Nil
	3. Disposed	Nil	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	: Nil
(ii)	Cost of plants	: Nil
(iii)	Plantation cost incurred	: Nil
(iv)	Backfilling cost	: Nil

PART – H

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

(i) Water sprinkling is being done in transporting road to reduce dust emission.
(ii) Proper and timely maintenance of machineries like- fan, pumps etc. is being done to control noise pollution.
(iii) Monitoring of air quality and water quality is being done periodically.
(iv) Covered coal transportation is being done.
(v) Pucca road prepared for coal transportation from 23/8 incl.
(vi) Maintenance of plants provided on both side of roads at 23/8 incl. is being maintained.

PART – I

Any other particulars for improving the quality of the environment

---

Project officer
Bhowra (N) U/G Mines

PROJECT OFFICER
BHOWRA (N) U/G MINES

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)/Env./2022/66A

Date:- 20/06/22

Sub: Flow sheet of manufacturing Process.

INPUT	***PROCESS***	***OUTPUT***	***WASTE***
1. Explosive, 2. Timber, 3. Ultra-10 and others lubricating oil like gear oil, hydraulic oil, and grease are taken from Regional Store in sealed drum/container	1. Blasting 2. Supporting 3. used in vehicles and underground machinery	COAL	Used / Burnt oil (used in underground for lubricating coal tubs and Bevel pulleys)

Manager
Bhowra (N) U/G Mines

MANAGER
BHOWRA (N) U/G MINES

Colliery Engineer,
Bhowra (N) U/G Mines

Colliery Engineer
Bhowra (N) Colliery

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

(FOR THE MONTH MARCH, 2022)

E. C. no. J-11015/380/2010-IA.II (M) dated 12th June, 2019.

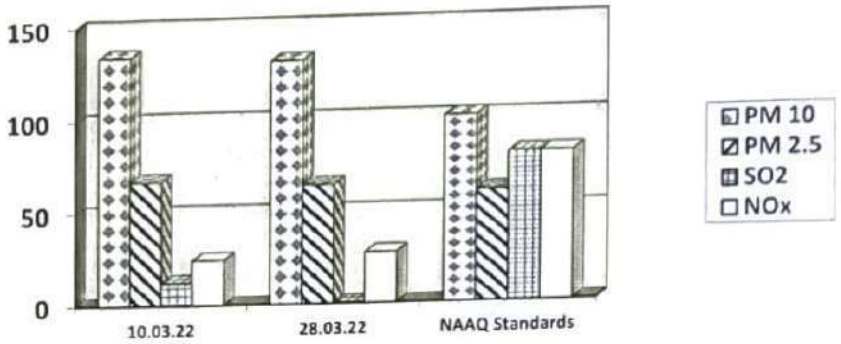
CMPDI

ISO 9001 Company
Regional Institute-II
Dhanbad, Jharkhand

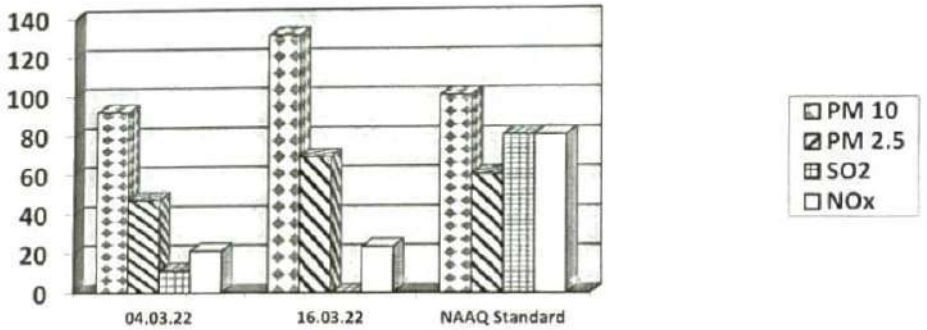
AMBIENT AIR QUALITY DATA

Cluster – X, Bharat Coking Coal limited Month: **MARCH 2022** Year: **2021-22.**

Station Name:A14-Bhowrah North		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO2	NOx
1	10.03.22	134	67	12	24
2	28.03.22	131	64	<10	27
	NAAQ Standards	100	60	80	80



StationName:A15-Sudamdih Washery		Zone: Core		Category: Industrial	
Sl. No.	Dates of sampling	PM 10	PM 2.5	SO_2	NO_x
1	04.03.22	92	47	11	21
2	16.03.22	131	69	<10	23
	NAAQ Standard	100	60	80	80



Analysed By
JNA/SA/SNA

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

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

WATER QUALITY MONITORING

3.1 Location of sampling sites

(Refer **Plate No. – II**)

i) Mine Discharge of 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 analyzed for four parameters on fortnightly basis at the Environmental Laboratory of CMPDI RI-II, Dhanbad.

3.3 Results & Interpretations

The results are given in tabular form along with the applicable standards. Results are compared with Schedule - VI, effluent prescribed by MoEF&CC. Results show that most of the parameters are within the permissible limits.

WATER QUALITY DATA

(EFFLUENT WATER- FOUR PARAMETERS)

Name of the Cluster: **Cluster -X**		Month: **MARCH 2022**	Name of the Station: **Mine Discharge of Bhowrah North**	
Sl. No.	**Parameters**	**MW10** First Fortnight	**MW10** Second Fortnight	**As per MOEF General Standards for schedule VI**
		14.03.2022	28.03.2022	
1	Total Suspended Solids	39	44	*100 (Max)*
2	pH	8.04	8.06	*5.5 - 9.0*
3	Oil & Grease	<2.0	<2.0	*10 (Max)*
4	COD	40	32	*250 (Max)*

All values are expressed in mg/lit. except pH.

Analysed By
JSA/SA/SSA

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

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

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(S)/PO/2021/ 1125 Date:- 16/09/2021

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,

Please find enclosed herewith Environmental Statement Form – V for the financial year 2020-21 in respect of Bhowra (S) Colliery.

Enclosures: - As above.

Yours Faithfully

16/9/2021

Project Officer
Bhowra South Colliery

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

भारतीय डाक
India Post

EU340520863IN IVR:69743408520638
SP BHOWRA SO (828302)
Counter No:1,17/09/2021,11:28
To:THE MEMBER SE,J S P C B
PIN:834004, Dhurwa SO
From:PROJECT OFF,BHOWRA S COLLIER
wt:20gms
Amt:41.30(Cash)Tax:6.30
<Track on www.indiapost.gov.in>
<Dial 18002666868> <Wear Masks, Stay Safe>

भारतीय डाक

(Form – V)

(See rule 14)

Environmental Statement for the financial year ending the 31st March 2020 - 21

PART – A

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

(ii) Industry category : Coal Mining Industry

(iii) Production capacity : U/G - 0.377 MT/Y
OCP – 1.2 MT/Y
(EC No:- J-11015/380/2010-1A-II(M), dt: 06/02/13) and EC amended dated 12.06.2019

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

(v) Date of last environmental Statement submitted : 14.09.2020 (Ref. No: BCCL/EJA/BH(S)/2020/997)

PART - B

Water and River Material Consumption

Water Consumption	
Process (Dust separation)	2000KLD
Cooling	Nil
Domestic	1000KLD

Name of Products	Process water consumption per unit of product output	
	During the previous financial year	During the current financial year
COAL	-	1.623 KL/T

Raw Material Consumption

Name of materials	Name of products	Consumption of raw material per Unit of output	
		During the previous financial year (2019- 20)	During the current financial year (2020-21)
Diesel	Coal	-	4.584L/Te
Explosive	Coal	4.78 Kg/ Te	4.63kg /Te
Timber	Coal	S- 0.0932 nos./Te; P- 0.0189 nos./Te *	NIL

*S – wooden sleepers, P- wooden props.

PART- C

ollution discharged to environment/unit of output (parameter as specified in the consent ssued)

Pollutants	Quantity of pollutants discharge	Concentrations of pollutants in discharge(mass/volume)	Percentage of variation from prescribed standards with reasons
Water	--	*(MW- 10 , 20.03.21)* TSS – 45 PH – 7.97 Oil & Grease - <2.0 COD - 28	Within Limit
Air	--	*(as on 22.03.21)* PM 10 – 138 PM 2.5 – 72 SO_2 – 10 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 (2019-20)	During the current financial year (2020-21)
From process	Burnt oil - 288 Litre	Burnt oil - 698 Litre
From pollution control facilities	N/A	N/A

PART – E

Solid Wastes

Solid Wastes (OB)	Total Quantity	
	During the previous financial year	During the current financial year
(a) Process	-	3993684 M3
(b) Pollution control facility	Nil	Nil
(c) Quantity recycled or re-utilized within the unit	Nil	3993684 M3 (BACKFILLED)

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): -		Backfilled in low lying area

PART – G

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

(i)	No. of plants planted	: Nil
(ii)	Cost of plants	: NA
(iii)	Plantation cost incurred	: NA
(iv)	Backfilling cost	: NA

PART – H

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

(i) Water sprinkling is being done in transporting road, coal stock yard, working faces, etc. to reduce dust emission.

(ii) Proper and timely maintenance of tipper, HEMM's, fan, pumps etc. is being done to control noise pollution.

(iii) Monitoring of air quality and water quality is being done periodically.

(iv) Covered coal transportation is being done.

(v) Pucca road prepared for coal transportation.

(vi) Maintenance of plants.

PART – I

Any other particulars for improving the quality of the environment

---

Project officer
Bhowra (S) Colliery