



सीएमपीडीआई
cmpdi

A Mini Ratna Company

**ENVIRONMENTAL IMPACT ASSESSMENT
&
ENVIRONMENTAL MANAGEMENT PLAN**

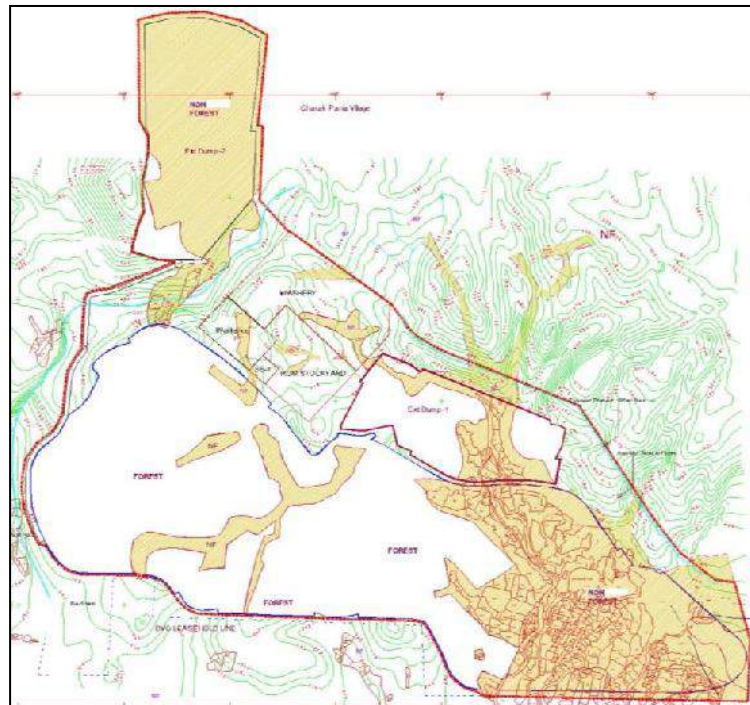
(As per EIA Notification, 2006)

FOR

**Karo OCP Exp. (15 MTPA) and
Karo Washery (7 MTPA)**

(B & K Area)

Mine Lease Area- 552.84 Ha



**Central COALFIELD LIMITED
(A Subsidiary of Coal India Limited)**

November, 2018

**Central Mine Planning and Design Institute Limited
Gondwana Place, Kanke Road, Ranchi**

(Format of first inside page for EIA reports mentioning the names of the experts involved)

Declaration by Experts contributing to the EIA of Karo Expansion OCP & Coal Washery

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

EIA Coordinator:

Name: DP Singh, Chief Manager (Environment), CMPDI (RI-III)

Signature & Date: *DP Singh*

Period of involvement: June 2015 till date

Contact information: 08987789103

Functional Area Experts:

S. No.	Functional Areas	Name of the expert/s	Involvement (Period & Task**)	Signature & Date
1	AP*	Pushkar	June 2015 till date	<i>Pushkar</i>
2	WP*	Vinita Arora	-do-	<i>Vinita</i>
3	SHW*	VK Pandey	-do-	<i>VK Pandey</i>
4	SE*	RM Bhoite /H. S. Sharma	-do-	<i>H. S. Sharma</i>
5	EB*	Prof S.K. Maiti	-do-	<i>S.K. Maiti</i>
6	HG*	Prabhu Prasad	-do-	<i>Prabhu Prasad</i>
7	GEO	R. P. Singh	-do-	<i>R. P. Singh</i>
8	SC*	Prof Anshumali/ Prof S.K. Maiti	-do-	<i>S.K. Maiti</i>
9	AQ*	PC Jha	-do-	<i>PC Jha</i>
10	NV*	Abhijit Sinha	-do-	<i>Abhijit Sinha</i>
11	LU*	Tilak Mandal	-do-	<i>Tilak Mandal</i>
12	RH*	Vivek Singh	-do-	<i>Vivek Singh</i>

*See overleaf for the details

**Please attach additional sheet if required

Declaration by the Head of the Accredited Consultant Organization/ authorized person

I, Dr. Anindya Sinha, hereby, confirm that the above mentioned experts prepared the EIA of Karo Expansion OCP & Coal Washery. I also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

Signature:

Name: Dr. Anindya Sinha

Designation: Regional Director

Name of the EIA Consultant Organization: CMPDI, RI-III, Gondwana Place, Kanke Road, Ranchi-834008.

NABET Certificate No. & Issue Date: NABET/EIA/01/12/002 Dated 31.01.2012

Manoj Kumar
- 21/11/18
(Manoj Kumar)

क्षेत्रीय निदेशक
Regional Director
को.सं-3, सी.एम.पी.डी.आर. रांची-834008
RI-3. C.M.P.D.I.R. Ranchi

Basic Information**karo Expansion OCP (15 MTY) and Integrated Washery (7MTY)**

I. PROJECT DETAILS		
1	Name of the Project	Karo Expansion OCP (15 MTY) & Integrated Karo Washery (7 MTY)
2	Name of the Company, Address, Tele No & E-mail	Darbhangra House ,Central Coalfields Limited PO : Ranchi Distt. : Ranchi (Jharkhand) Telephone : + 91-651-2360184 E-mail: envccl@yahoo.com
3	Latitude and Longitude of the Project	Latitude : 23 ⁰ 47' 02" N to 23 ⁰ 48' 38" N Longitude: 85 ⁰ 57' 27" E to 85 ⁰ 58'38" E
4	If a joint venture, the names & Addresses of the JV Partners including their share	NA
5	Details of Coal linkage	It is proposed to transport coal from mine to Kargali washery and railway siding which is at a distance of 6.5 km through covered conveyor belt system
6	Whether the project is in the Critically Polluted Area (CPA)	No
7	Cost of the Project	1626.92 for Karo Expansion OCP & 269.88 for Karo Washery
8	Employment generated/ to be generated	Total direct employment to be generated against land acquisition is 133. Out of which 113 PAPs have already been provided with direct employment.
9	Benefits of the project	<ul style="list-style-type: none"> • Improvements in physical infrastructure • Improvements in social infrastructure and quality of life of people • Increase in employment potential • Contribution to the exchequer • Prevention of illegal mining • Post-mining enhancement of green cover and eco-restoration
10	Whether new or Expansion Project. If expansion: (i) fromMT toMT (ii) What is the % of expansion	Expansion
11	If for expansion, whether the application is under 7(ii) of the EIA Notification, 2006	No

12	If expansion, please indicate the number and date of the Certified Compliance Report of Regional Officer of MoEF.	Yes. Site inspection by RO MoEFCC has been carried out on 15.09.2018 and report submitted vide letter no: 103-477/ROR-2015/2658 dt 2.11.2018.
13	No. and Date of the ToR/and revised ToR , if any, letter issued by the MoEF (if this is a case for EC)	TOR under violation was granted by EAC (Violation), MoEFCC on 17.07.2018 vide letter no F.No. 23-69/2018-IA(II)
14	No. and Date of the EC and the revised EC letter issued by the MoEF (if this is a case for reconsideration. If so, what specific reconsideration(s) being sought by the proponent)	Karo OCP was granted environmental clearance for 1.50 MTPA capacity vide letter number J-11015/544/2009-IA.II(M) dated 24.12.2014.
15	If the Project was considered in EAC, Pl. gives dates of the meeting(s).	Tor under violation was granted by EAC (Violation), MoEFCC on 17.07.2018. Further the project was considered for EC in 12 th EAC (Violation) meeting held on 28.08.2018.
16	Type of Mine (Opencast/ Underground/ Mixed)	Opencast & Integrated Coal Washery
17	Capacity of the mine applied for	15 MTY for Karo Expansion OCP & 7 MTY for Integrated Karo Washery
18	ML Area (i) As per approved mine plan	552.84 Ha
19	Date of approval of mine plan, mine closure plan, status & date	Mining Plan and Mine closure plan of Karo Expansion OCP (11/15 MTPA) and Integrated Washery (7 MTPA) was approved by CCL Board on 10.06.2016
20	Date of Board's Approval	10.06.2016 of Karo Expansion OCP (11/15 MTPA).
21	Date of Ground water clearance	Application for NoC was submitted to CGWA for ground water withdrawal vide letter no 21-4/314/JH/MIN/2018 on 29.10.2018. Copy enclosed as Annexure VI.
22	Date of mine closure approval	10.06.2016
23	Any river/ Nallaha flowing near/ adjacent to the proposed mine. If yes, please give details.	Karo nala and Gati nala – flowing within the boundary

II. TECHNICAL DETAILS

24	Geological Reserve	
i	Total Geological Reserve	----
ii	Mineable Reserve	105.17 MT
iii	Extractable Reserve	105.17 MT
iv	Percent (%) of extraction	100%

v	Range of ground water level	-----
vi	Total estimated water requirement	(i) Potable Water Demand : 490 m ³ /day (ii) Industrial Water Demand : 3970 m ³ /day (2380 for coal mines +1590 m ³ /day for Washery)

25	Details of Seams:	Seam VI/VII combined, VIII, VI/VII/VIII Combined, IX, X and XI		
i	No. of Seams	6 seams		
ii	Thickness of Seams to be worked on	Seam / Parting	Quarry -I Thickness Range	Quarry -II Thickness Range
		Bermo	12.27	
		Parting	13.64	
		Local	0.44-0.76	
		Parting	4.55-5.51	
		XI	0.91--2.51	0.98 -3.14
		Parting	22.75-33.86	19.85-24.44
		X	10.57 -12.85	10.33-14.80
		Parting	0.91-11.21	1.64 -22.0
		IX	3.11 -4.77	2.56 -5.38
		Parting	0.38 -4.34	0.62 15.86
		VI/VII /VIII	24.12-36.25	
		VIII		12.65 -20.85
		Parting		0.84 -6.15
		VII /VI		9.40 -18.51
iii	Grade of Coal	W-IV, II		
iv	Stripping ratio	0.86		
v	Category of gaseousness	Not Applicable		
vi	Average gradient	6 ⁰ -8 ⁰ for Quarry I & 8 ⁰ -10 ⁰ for Quarry II		
vii	Maximum Thickness of seams	36.25		
26	Method of mining	Surface Miner in coal and Shovel-Dumper combination in OB.		

27	Life of mine	12 Years for Karo OCP and 15 Years for Karo Washery
28	Whether ambient air quality seasonal data has been documented. If so, from which season to which season and whether the results are within the prescribed limits.	Yes. Seasonal ambient air quality data has been documented for the post monsoon period 2015 (17/10/2015 – 16/01/2016). Further, as desired by EAC(Violation), baseline revalidation has been done for one month during the period (16.09.2018 – 15.10.2018).
29	Whether the certificate of compliance of earlier EC from MOEF Regional Office has been obtained, if the proposal is for expansion.	Yes. Site inspection by RO MoEFCC has been carried out on 15.09.2018 and report submitted vide letter no: 103-477/ROR-2015/2658 dt 2.11.2018.
30	Details of O.B	
i	External OB dumps	1 for Quarry I & 1 for Quarry II
ii	No of OB dumps	2 for Quarry I & 2 for Quarry II
iii	Area	38 Ha for Quarry I & 57.24 Ha for Quarry II
iv	Height	340 m for Quarry I & 395 m for Quarry II
v	Quantity (in M Cm.)	10.68 Mcum for Quarry I & 23.45 Mcum for Quarry II
vi	Year of back filling	
31	Details of Internal Dumps:	
i	Number of Internal dumps	2 (1 for Quarry I & 1 for Quarry II)
ii	Area	72.28 Ha for Quarry I & 88.25 Ha for Quarry II
iii	Height	280 m for Quarry I & 310 m for Quarry II
iv	Quantity	19.37 Mcum for Quarry I & 36.88 Mcum for Quarry II
32	Details of final Mine Voids	
i	Area	135.21 Ha
ii	Depth	125 m for Quarry – I & 110 m for Quarry - II
33	Details of Quarry	Not Applicable
i	Total quarry area	295.75 Ha
ii	Backfilled quarry area of Ha. shall be reclaimed with plantation	160.54 Ha
iii	A void of ha. at a depth of m which is proposed to be converted into a water body	135.21 Ha
34	Details of Land usage	Land Use During Mining

LAND USE DETAILS

SI no	Particulars of land (Area Ha)	Forest	Non-Forest	Total
1	Quarry	185.07	110.68	295.75
2	External OB dump-1	24.73	13.27	38.00
	External OB dump-2	5.00	52.24	57.24
3	Infrastructures	36.77	8.31	45.08
4	Road, Top soil dump, nala diversion, green	52.53	32.72	85.25
5	Res. colony*	0.00	5.00	5.00
6	Conveyer to Kargali Washery/ siding *	7.50	19.02	26.52
Total Land Required		311.60	241.24	552.84

i

Pre-mining

Data as per Satellite Imagery			
Classes		Core Zone	
Level-I	Level-II	Area (Km ²)	% of Total
Forest Land	Dense Forest	0.66	11.96
	Open Forest	1.02	18.48
	Total Forest Land	1.68	30.43
	Scrubs	1.19	21.56
Plantation Area	Social Forestry	0.16	2.90
	Plantation on OB	0.11	1.99
	Plantation on Backfill	0.12	2.17
	Total Plantation Area	0.39	7.07
Agriculture Land	Crop land	0.00	0.00
	Fallow Land	0.58	10.51
	Total Agriculture Land	0.58	10.51
Waste Land	Waste Land	0.64	11.59
	Sand Body	0.00	0.00
	Fly Ash Pond	0.00	0.00
	Barren Rocky Land	0.00	0.00
	Total Waste Land	0.46	8.33
Mining Area	Coal Quarry	0.38	6.88

ii

Post- mining

	Barren OB Dump	0.29	5.25
	Back Fill	0.14	2.54
	Coal Dump	0.08	1.45
	Water Filled Qry	0.03	0.54
	Total Mining Area	0.92	16.67
Settlements	Urban Settlements	0.19	3.44
	Rural Settlements	0.06	1.09
	Industrial Settlements	0.03	0.54
	Total Settlement Area	0.28	5.07
Water Body	River/ Ponds	0.02	0.36
	Total Area	5.52	100.00

		LAND USE DURING MINING		POST MINING LAND USE	
S N		Landuse during mining	Total Area (Ha)	Post-mining land use	Total Area (Ha)
1	Quarry	295.75		Plantation on backfilled area	160.54
				Void Filled with Water	135.21
2	External OB dump-1	38		plantation on External OB Dump	95.24
	External OB dump-2	57.24			
3	Infrastructures	45.08		CCL use	45.08
4	Road, nala diversion, green	85.25		Road in public use	4.4
				Nallah	3.3

		<table border="1"> <tr> <td></td> <td>belt/vacant land & safety zone</td> <td></td> <td>Green belt (10 to 30 m wide)</td> <td>24.2</td> </tr> <tr> <td></td> <td></td> <td></td> <td>Undisturbed</td> <td>53.35</td> </tr> <tr> <td>5</td> <td>Residential colony*</td> <td>5</td> <td>Public use</td> <td>5</td> </tr> <tr> <td>6</td> <td>Conveyer to Kargali washery*</td> <td>26.52</td> <td>CCL use</td> <td>26.52</td> </tr> <tr> <td colspan="2">Total Land Required</td> <td>552.84</td> <td></td> <td>552.84</td> </tr> </table>		belt/vacant land & safety zone		Green belt (10 to 30 m wide)	24.2				Undisturbed	53.35	5	Residential colony*	5	Public use	5	6	Conveyer to Kargali washery*	26.52	CCL use	26.52	Total Land Required		552.84		552.84
	belt/vacant land & safety zone		Green belt (10 to 30 m wide)	24.2																							
			Undisturbed	53.35																							
5	Residential colony*	5	Public use	5																							
6	Conveyer to Kargali washery*	26.52	CCL use	26.52																							
Total Land Required		552.84		552.84																							
iii	Core area	Total 552.84 Ha (Non-forest land- 241.24 Ha. Forest land- 311.6 Ha)																									
	<u>Details of Forest Issues</u>																										
i	Total Forest area involved (in ha.) for mining	311.6 Ha forest land involved																									
ii	Status of Forest Clearance	<ul style="list-style-type: none"> • FC granted for 77.43 ha forest land diverted vide letter number: F.No.8-22/2003- FC Dated 31st March 2004. • FC Stage I granted for 226.67 ha forest land on 24.12.2018. • Stage I for diversion of 7.50 Ha. of land for Conveyer to Kargali Washery/ siding is under process. <p><i>(Copy of Forest Clearances issued are enclosed as Annexure X.)</i></p>																									
iii	Is there any National park, Eco-sensitive zones, within 10 km. radius? If so, give the details	No																									
iv	If the project is within 10 Km of radius of the wild life sanctuary, whether the Wild Life Management	No																									

	Plan has been prepared and approved. If so, pl. give the status, date of approval with the budgetary provision.	
v	Extent of Forest land in the project (including safety zone and all types of Forest land) (in ha.)	311.60 Ha forest land involved
vi	Total Forest Land for which Stage-I FC is available (give area in ha.), provide breakup of this area in following format:	

Area (in ha)	Stage-1 FC issued vide letter no. & date
77.43 Ha	FC granted: F.No.8-22/2003-FC Dated 31st March 2004.
226.67 Ha	F.No: 8-25/2009-FC Dt 24.12.2018.

vii	Balance Forest land for which Stage-I FC is not available (give area in ha.)	7.50 Ha
viii	Details of wild life issues involved, if any. If so, whether WL management plan has been prepared, pl. indicate the status.	No Wild life issues involved.
35	Cost of the Project:	
i	Total Capital Cost:	Rs. 1626.92 Crs for Karo Expansion OCP & Rs. 269.88 Crs for Karo Washery
ii	Cost of production:	
iii	Sale Price:	
iv	CSR Cost:	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 ton of Coal Production of previous year whichever is higher.
v	R&R Cost:	Rs. 1274.40 lakhs
vi	No of PAFs:	360 PAFs would be rehabilitated in initial stage of mine operation to achieve targeted production.
vii	Environmental Management Cost	Rs. 17958.59 lakhs
36	Details of transportation of Coal	Raw coal by conveyor, Washed coal & Reject also by covered belt Conveyor.
i	In pit:	Covered conveyor
ii	Surface to siding:	Covered conveyors to the Kargali Washery Railway siding
iii	Siding to loading	Covered conveyor
37	Details of reclamation:	
a	Toal Afforestation plan shall be implemented covering of mining. This will include:	
i	Reclaimed external OB dump (in ha):	95.24 Ha
ii	Internal dump (in ha),	160.54 Ha
iii	Green belt (in ha)	24.2 Ha
iv	Density of tree plantation (in no. of plants)	2500 per ha
v	Void (in ha.) at a depth of (in m) which is proposed to be converted into water body	135.21 Ha
vi	Others in ha. (such as excavation area along ML boundary, along roads and infrastructure,	137.65 Ha

	embankment area and in township located outside the lease etc.)	
III. LEGAL ISSUES		
38	Pl. Give details, if the proposal is under any investigation	No
39	Any court cases pending. If so, please provide a list with details as annexure	No
40	Any violation cases pending. If so, please provide a list with details as annexure	No
41	Give details of actual production vis-à-vis sanctioned capacity since the inception of mine in following format:	Enclosed in Table 2.2 of EIA/EMP Report.
IV. PUBLIC HEARING ISSUES		
42	Date and Place of Public Hearing	05.01.2016, Karo
43	Issue raised during Public Hearing and assurance given along with the financial provisions and action plan, if any, by the project proponent. (Please attach as an annexure in tabular form)	Enclosed in Section 7.1 of EIA/EMP Report and as Annexure VII
V. Consultant:		
44	Name of the consultant who prepared the EIA/EMP report	By Central Mine Planning and Design Institute Ltd. (CMPDIL), Ranchi as per TOR issued and observations made by EAC in its 12th meeting held on 28.08.2018.
45	Whether the consultant has been accredited by the QCI and NABL and whether it is accredited with Quality Council of India(QCI)/ National Accreditation Board of Education and Training (NABET) as per the MOEF OM dated 2 nd December, 2009.	Yes. Accreditation Certificate no: NABET/EIA/1720/RA 0092 Dt.28.05.2018
VI. IMG of Ministry of Coal:		
46	Whether the project was considered by the IMG of Ministry of Coal for any irregularities. If so the no. and date of the show cause notice and the response of the MoC.	Not Applicable

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EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

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IV.	Copy of Mining plan Approval
V.	Copy of QCI Accreditation
VI.	Copy of Application made to CGWA for obtaining NOC for ground water withdrawal
VII.	Document of Public Hearing
VIII.	Latest Certified Compliance Report from the regional office of MoEF&CC
IX.	Copy of MoU with other accredited laboratory
X.	Copy of Stage I Forest Clearance
XI.	Baseline Heath Status
XII.	Copy of CTO and CTE for Karo OCP
XIII.	Copy of Environmental Statement of Karo OCP
XIV.	Copy of Earlier Environmental Clearance

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Compliance of The Observation Made By EAC (Violation) Committee

Para No.	Observation made by EAC	Details at	
		Particulars	Page No./Sec
i	Submission of basic information for EC as per proforma relevant to the coal sector	The basic information for EC as per proforma relevant to the coal sector has been enclosed at the beginning of this report.	
ii	Latest certified compliance report from the regional office of MoEF&CC.	Enclosed as Annexure-VIII	
iii	Declaration from QCI/NABET consultant in EIA report.	Annexure- V	
iv	Indexing of all the chapters in EIA/EMP report.	All the chapters in the EIA/EMP report are indexed as per the generic EIA/ EMP guidelines.	
v	Copy of MoU with other accredited laboratory for carrying out base line studies.	Annexure-IX	
vi	Validation of base line data with one-month monitoring as data submitted in the EIA is two years old.	Section 3.3 to 3.5	Section 3.3 to 3.5
vii	Hydrological studies as per GEC 2015 guidelines to be prepared and submitted.	Section 3.7: Hydrogeological Features	Section 3.7: Hydrogeological Features
viii	NOC from CGWA for ground water withdrawal.	Annexure VI: Copy of Application made to CGWA for obtaining NOC for Ground water withdrawal	
ix	Revised water balance needs to be prepared and submitted.	Section 4.3.1 and Plate XII	Section 4.3.1 and Plate XII
x	Integrated impact assessment of mine and coal washeries on environmental attributes.	4.2.1 & 4.2.2 Air Quality Impact Assessment 4.3.4 Water Quality	4.2.1 & 4.2.2 Air Quality Impact Assessment 4.3.4 Water Quality
xi	Copies of stage- I Forest Clearance.	Annexure X	
xii	Revised land use plan to be submitted.	4.5.1 Landuse pattern and Plate IV: Landuse During Mining	4.5.1 Landuse pattern and Plate IV: Landuse During Mining

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Para No.	Observation made by EAC	Details at	
		Particulars	Page No./Sec
xiii	Base line health status of villagers within 5 km of lease area.	Section 3.9.12 Health Impact Status of villagers	Section 3.9.12 Health Impact Status of villagers
xiv	Stage wise mining plans to be incorporated in EIA/EMP report.	Plate XIII A,B & C	
xv	Provision of STP for residential colonies.	4.3.6 : Disposal of Waste water and treatment technology	4.3.6 : Disposal of Waste water and treatment technology
xvi	The colony construction shall comply National Building code, MSW RULES-2016,EC BC-2016,and other MOEF guidelines related to green belt, solar energy, rain water harvesting, etc.	All the constructional activities that will be carried out will comply with the National Building code.	
xvii	Alternative technology available for coal washing and justification for selecting the present technology and also to submit proposal for reduction of tailings leading to size reduction of ponds and consequent leachate control measures to be detailed in the EIA/EMP.	Section 2.10.5	32-36
xviii	submit proposal for reduction of tailings leading to size reduction of ponds and consequent leachate control measures to be detailed in the EIA/EMP	Section 2.10.5	32-36
xix	Year wise green belt plan to be prepared with cost and type of species.	Section 4.5.3 D Post Mining Land Use plan	129-131
xx	Preparation of damage assessment and remediation plan as chapter 13 in the EIA report as per notification dated 14/03/2017.	Prepared as a separate chapter XIII in EIA EMP	223-226
xxi	Details of R&R to be incorporated in the EIA/EMP report.	Section 4.9 Rehabilitation and Resettlement	138-139
xxii	Certificate of Ground water clearance from CGWA for mining operations and also permission from concerned authority for utilization water from Gati Nala Check dam for washeries.	Annexure VI	
xxiii	Fund allocation for Corporate Environment Responsibility (CER) shall be made as per Ministry's O.M. No. 22-65/2017-IA.III dated 1st May, 2018 for various activities therein. The details of fund allocation and activities for CER shall be incorporated in EIA/EMP report.	Section 10.3.8	193-196
xxiv	Revised EIA/EMP to be prepared and submitted by incorporating all the above points and also as per the generic structure of EIA notification,2006.	The EIA/EMP has been revised as per the observations made by EAC in its meeting held on 28.08.2018 and as per the Appendix III of EIA notification 2006.	
xxv	Copy of approved mining plan	Annexure IV	

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Para No.	Observation made by EAC	Details at	
		Particulars	Page No./Sec
xxvi	Filled in Form-2 along with above information.	Annexure II	

Compliance Of Terms Of Reference (ToR)

ToR Para no	Prescribed TOR	Details at
1	Undertaking EIA and Preparation of Environment Management Plan along with Public hearing	The EIA&EMP has been prepared considering the impact and management. Base line data for three months (17/10/2015 – 16/01/2016) and validation of baseline data with one month Monitoring (16.09.2018-15.10.2018) has been provided in Chapter – III. Public Hearing was conducted on 05.01.2016. The details of Public hearing has been provided in Sec 7.1 and enclosed as Annexure VII.
2	Project proponent shall be required to submit a bank guarantee equivalent to the amount of remediation plan& natural and community resource augmentation plan	Remediation plan& natural and community resource augmentation plan has been prepared and is being submitted as a separate chapter 13 in EIA/EMP.
3	The PP shall be liable to pay the compensation against the illegal mining	The matter is sub-judice and necessary action will be taken after the final judgment in respect of coal mines.
4	The PP shall submit an undertaking by way of an affidavit to comply with all statutory requirement and judgement of Hon'ble SC	The undertaking has already been submitted to EAC vide letter no:HOD(Env)/2018/443 Dt 16.07.2018, the copy attached as Annexure III.
5	State Govt./SPCB shall take action	The matter lies with State Govt., Jharkhand.

TOR Para No.	Prescribed TOR	Details at	
		Particulars	Page No.

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

TOR Para No.	Prescribed TOR	Details at	
		Particulars	Page No.
i	Project description, its important and the benefits.	Chapter 2 Project Description	20
		Chapter 8 Project Benefits	170
ii	Project site details (location, toposheet of the study area of 10 km, coordinates, google map, layout map, land use, geological features and geo-hydrological status of the study area, drainage).	1.3 Location, Communication Of The Project And Its Physiography	17
iii	Land use as per the approved master plan of the area, permission/ approvals required from the land owning agencies, development authorities, local body, water supply & sewerage board, etc	4.5 Land Environment	127
iv	Land acquisition status, R&R details	4.5 Land Environment	127
		4.9 Resettlement and rehabilitation	139
v	Forest and wildlife and eco-sensitive zones, if any in the study area of 10 km – clearances required under the Forest (conservation) Act, 1980, the Wildlife (Protection) Act, 1972 and/or the Environment (Protection) Act, 1986.	3.8 Biological Environment	68
vi	Baseline environment study for ambient air (PM10, PM2.5, SO2, NOX & CO) water (both surface and ground, noise and soil for one season (except monsoon) as per MoEF&CC/CPCB guidelines at 6-8 locations in the study area of 10 km.	3.3 Air Environment	41
		3.4 Water Environment	44
		3.5 Noise Environment	49
		3.6 Soil Quality	51
vii	Details on flora and fauna and socio-economic aspects in the study area.	3.8 Biological Environment	68
		3.9 Socio-Economic Profile	77
viii	Likely impact of the project on the environmental parameters (ambient air,	Chapter-4 Anticipated	

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

TOR Para No.	Prescribed TOR	Details at	
		Particulars	Page No.
	surface and ground water, land, flora and fauna and socio-economic, etc).	Environmental Impacts And Mitigation Measures	93-139
ix	Source of water for different identified purposes with the permission required from the concerned authorities, both for surface water and the ground water (by CGWA) as the case may be, rain water harvesting, etc.	4.3.1 Water Requirement Annexure Vi: Copy Of Application Made To Cgwa For Obtaining Noc For Ground Water Withdrawal	104-110
x	Waste water management (treatment, reuse and disposal) for the project and also the study area.	4.3.6 Disposal Of Mine Water	110-112
xi	Assessment of ecological damage with respect to air, water, land and other environmental attributes. The collection and analysis of data shall be done by an environmental laboratory duly notified under the Environment (Protection) Act, 1986, or an environmental laboratory accredited by NABL, or a laboratory of a Council of Scientific and Industrial Research (CSIR) institution working in the field of environment.	Chapter-3 Description of Environment Chapter-4 Anticipated Environmental Impacts And Mitigation Measures	38-92 93-139
xii	Preparation of EMP comprising remediation plan and natural and community resource augmentation plan corresponding to the ecological damage assessed and economic benefits derived due to violation.	Chapter 13 Remediation Plan And Natural & Community Resource Augmentation Plan (NCRAP)	213-217
xiii	The remediation plan and the natural and community resource augmentation plan to be prepared as an independent chapter in the EIA report by the accredited consultants.	Chapter 13 Remediation Plan And Natural & Community Resource Augmentation Plan (NCRAP)	213-217
xiv	Other scope of work as contends in the standard TOR notified by the Ministry for opencast coal mining.	Chapter 7 Additional Studies	152

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

TOR Para No.	Prescribed TOR	Details at	
		Particulars	Page No.

The following general points should be noted

Sl. No.	Particulars	Reply with Reference
i	All documents should be properly indexed, page numbered.	Yes
ii	Period/ date of data collection should be clearly indicated.	Yes
iii	Authenticated English translation of all material provided in Regional languages.	Yes
iv	After the preparation of the draft EIA-EMP Report as per the aforesaid TOR, the proponent shall get the Public Hearing conducted as prescribed in the EIA Notification 2006 and take necessary action for obtaining environmental clearance under the provisions of the EIA Notification 2006.	Yes
v	The letter/application for EC should quote the MOEF file No. and also attach a copy of the letter prescribing the TOR.	Yes
vi	The copy of the letter received from the Ministry on the TOR prescribed for the project should be attached as an annexure to the final EIA-EMP Report.	Yes
vii	The final EIA-EMP report submitted to the Ministry must incorporate the issues in TOR and that raised in Public Hearing. The index of the final EIA-EMP report, must indicate the specific chapter and page no. of the EIA-EMP Report where the specific TOR prescribed by Ministry and the issue raised in the P.H. have been incorporated. Mining Questionnaire (posted on MOEF website) with all sections duly filled in shall also be submitted at the time of applying for EC.	Yes
viii	General Instructions for the preparation and presentation before the EAC of TOR/EC projects of Coal Sector should be incorporated/ followed.	Yes

Chapter 1

Introduction

1.0 Purpose of the report

Considering the gap in demand and supply of coking and non-coking coal, CCL entrusted CMPDI to explore the possibility of augmentation of production of Karo OCP located in B&K Coalfields. The PR of Karo OCP was approved by CIL Board for a rated capacity of 3.5 MTY in August, 2006 with an initial capital of 96.53 Crs. Keeping in view of huge demand of coking and non-coking coal it became necessary to produce maximum possible coal production from this mine within minimum mine life. So a fresh exercise has been done and mine has been redesigned to produce 15.0 MTY of coal at capacity with yearly advance rate of 100-110 m.

The matter was examined and was found that geo mining parameters of two blocks are such that coal exploitation will be carried out separately in two different quarries (Quarry I and Quarry II) with independent mine entries. However, inclusion of coal reserves of both the blocks within the proposed Karo Expansion Project Report has been considered in this proposal for the following reasons:

- a) Gainful utilization of common infrastructures like Workshop, Substation, CHP and Washery.
- b) Common application for various Government Clearances like public hearing, EMP clearances and land acquisition.
- c) Similar coal quality parameters of both the blocks facilitating the common coal crushing and washing arrangement.
- d) Better economy of scale leading to improvement of financial parameters of Karo Expansion Project Report (EPR).

Purpose of this report is to suggest among others mitigative measures required to minimize the environmental impacts of mining and washery operations of Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA), B&K Area, Central Coalfields Limited.

This report also envisages the study of ecological damage caused due to excess production in the years 2014-15 & 2015-16 and suggesting suitable Remediation Plan and Natural and Community Resource Augmentation Plan (NCRAP) as prescribed in Terms of Reference enclosed as Annexure I.

1.1 Identification of Project and Project Proponent

The project falls in Bokaro & Kargali Area of Central Coalfields Limited, a subsidiary of Coal India Limited. This Project Report has been prepared on the basis of two geological reports, one is "Geological Report of Karo Eastern Block", prepared during '86-87' by RI-III, CMPDI and the other is "Geological Report on Coal Exploration, Kaveri (Karo II) Block", prepared by MEC in '94. Previously two opencast mines were planned in the above two geological blocks separately in the name of Karo-I OCP (1.5 MT) at Karo Eastern Block and Kaveri OCP (2.0 MT) at Kaveri (Karo II) Block. The advance Action Proposals for Karo-I & Kaveri OCP's was sanctioned for Rs 4.92 Crs. In Sept. '89 and Rs 5 Crs in April '91 respectively.

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Opencast Operation

Presently opencast operations are being carried out in the minetake area of proposed Karo EPR (Quarry-I) known as Karo OCP. The present proposal envisages opencast mining upto seam VI/VII combined in Karo block (Quarry –II) and seam VI/VII/VIII combined in Kaveri (Quarry I) block.

1.2 Brief Description of the Project

Karo Expansion OCP (15 MTPA capacity) & Integrated non-coking coal Karo Washery (7 MTPA), B&K Area, Central Coalfields Limited is proposed within an area of 552.84 Ha.

This includes 31.52 Ha land falling outside core zone required for colony & clean coal conveyor layout (5 & 26.52 Ha respectively).

The project is situated in the north-eastern part of East Bokaro coalfield and covered on Survey of India Topo-sheet no- 73E/13 (1:50000 RF).

Karo OCP was granted environmental clearance for 1.50 MTPA capacity vide letter number J-11015/544/2009-IA.II(M) dated 24.12.2014.

Presently opencast operations are being carried out in the minetake area of proposed Karo Expansion OCP and known as Karo OCP. A pit top washery has been proposed for washing of non-coking coal @ 7 MTPA. **Washed non-coking coal will be fed through belt conveyors to nearby Kargali siding for rail dispatch through RLS.** Kargali siding about 5 km away. The balance of products of Karo non-coking coal washery is given below.

Product	Size (mm)	Wt%	Ash%	Qty. (MTPA)
Washed coal	(-) 50	75.4	33.5	5.3
Low quality fuel	50-13	24.6	62.4	1.7
Total	(-) 50	100.0	40.6	7.0

The total project life is 15 years including washery development period.

1.3 Location, Communication Of The Project And Its Physiography

1.3.1 Location (Plate-IA & IB)

Karo Expansion Project is situated in the northeastern part of East Bokaro coalfield. This project lies to the north of Bokaro Colliery and Bermo Quarry of DVC, to the west of Amlo Project and to the east of Konar Project. The mine is a part of B&K area of CCL. It is bounded between the latitude 23^o47'02" & 23^o48'38" and longitude 85^o57'27" & 85^o58'38".

1.3.2 Connectivity:

The East Bokaro coalfields lies on the Gomoh-Barkakana-Dehri-On-Sone loop line of Eastern Railway. Bermo Railway Station is on this line is located at a distance of about 5 km to the south of Kaveri (Karo-II) Block (**Plate II**). The East West running Gomia-jarangdih-Phusro-Jaina More Road, which meets the Bishnugarh-Petarwar Road connects the coalfield with Hazaribagh, Dhanbad and Ranchi. The block is also connected to Bokaro Thermal Power Station in the west and Phusro in the south east by metaled road. The nearest township Phusro is situated at a distance of about 7 kms. Phusro is connected to the GT Road by Phusro Dumri Road.

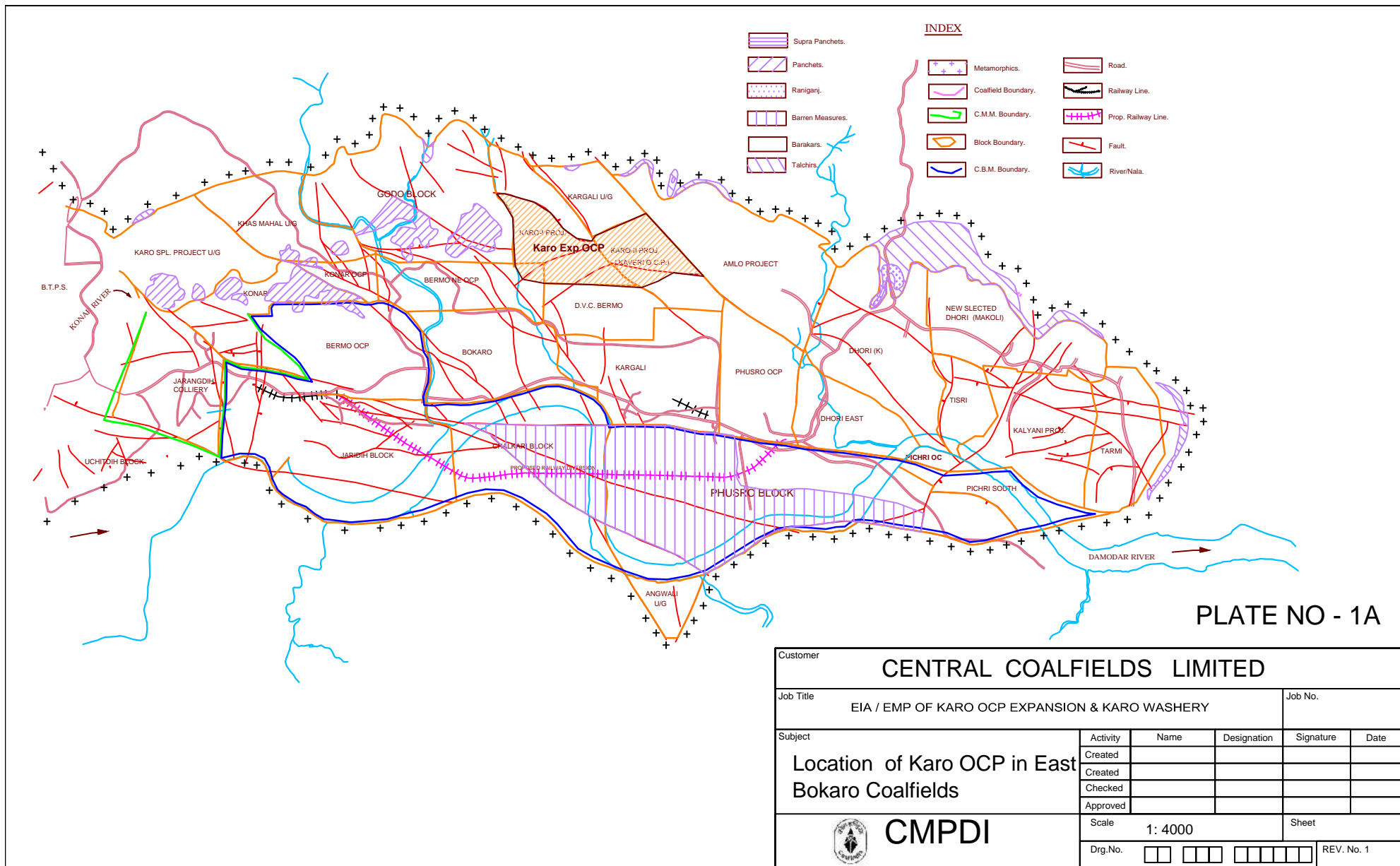

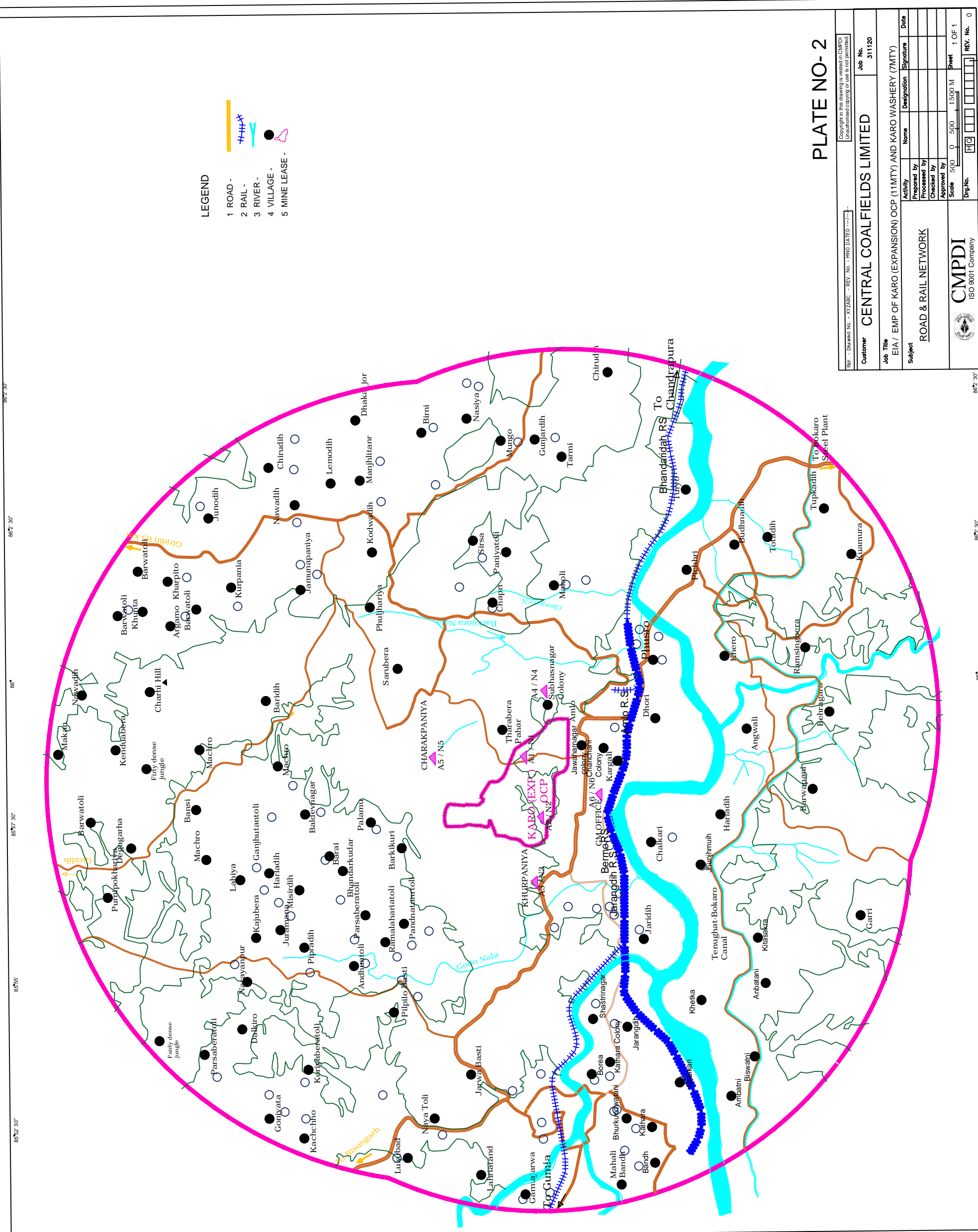


PLATE NO - 1A

Customer CENTRAL COALFIELDS LIMITED					
Job Title EIA / EMP OF KARO OCP EXPANSION & KARO WASHERY				Job No.	
Subject Location of Karo OCP in East Bokaro Coalfields	Activity	Name	Designation	Signature	Date
	Created				
	Checked				
	Approved				
 CMPDI	Scale 1: 4000			Sheet	
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85°52' 30" 85°57' 30" 86° 86°2' 30"

85°52' 30" 85°57' 30" 86° 86°2' 30"

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

The nearest airport is Ranchi. However, there is a small airstrip located near Sawang Colliery. This belongs to Indian Explosives Limited and is located at a distance of about 15 kms from Kaveri (Karo-II) Block.

1.3.3 Physiography & Drainage (Plate –III-A & Plate – III-B)

The entire topography of the block is rugged and pronounced with hills and valleys. The ground elevation varies from a maximum of 335 mtrs in the north to a minimum of 237 mtrs in the south of the block. The general slope is towards south.

The drainage of the block is controlled by two nalas viz. Karo nala (HFL 244 mtr) and Gati Nala (245 mtr to the west of Quarry –II) flowing towards south. These nalas ultimately flow into the Damodar river near Bokaro-Kargali Colliery. The block also has few ponds in the south eastern part.

1.4 Nature and Size

The details of units with proposed capacity and washery is given below-

Table 1.1 Nature and Size of Project

Karo Expansion OCP (11MTY) & Karo Washery (7 MTY)			
Name of Mine	Production capacity (MTPA)	Area (Ha)	Life (years)
Karo OCP Expansion	15	552.84	12
Karo Washery	7.00		15

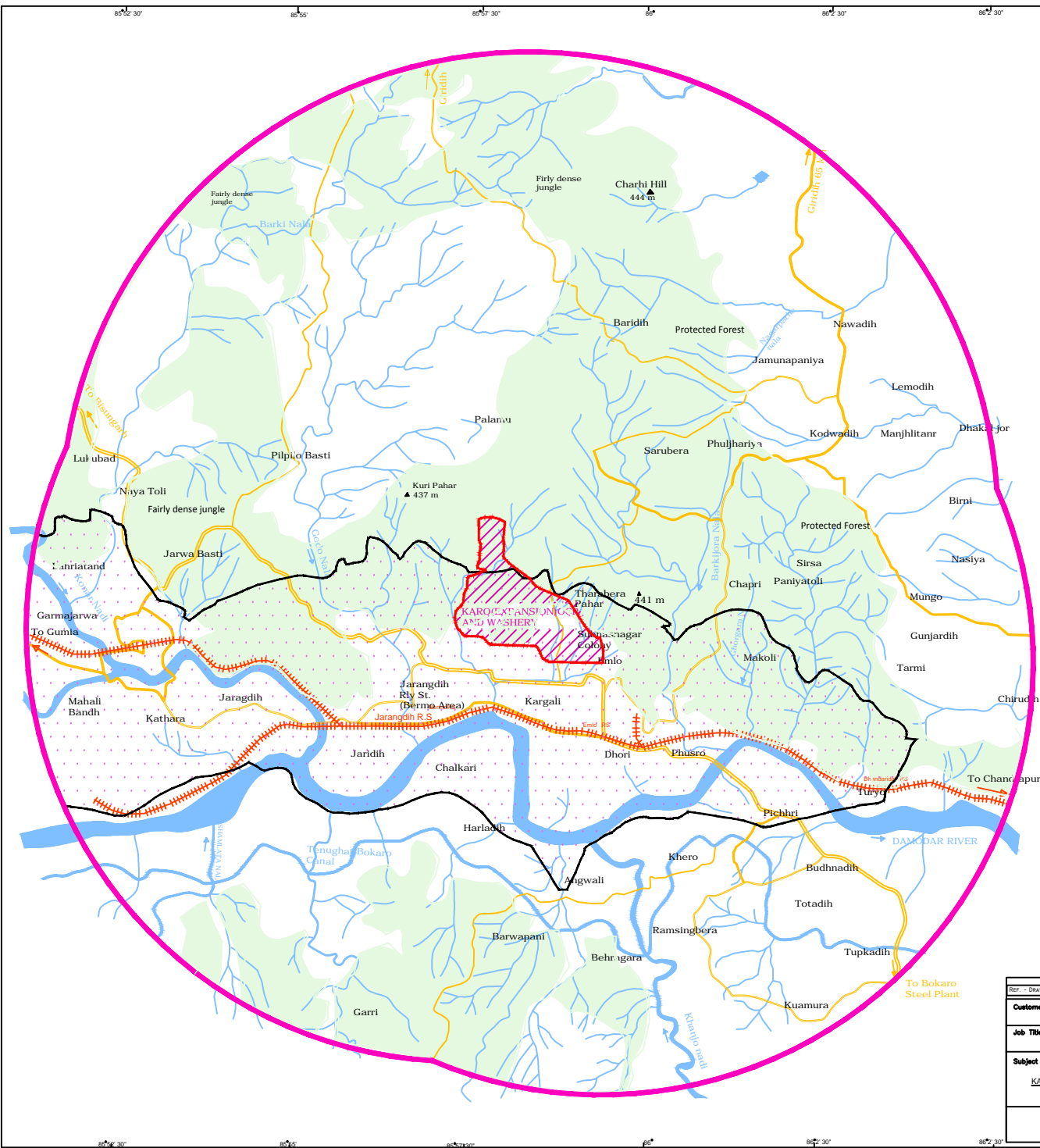
1.5 Source and Type of Data

This report has been formulated using various data from the following sources:

Table 1.2 Source and Type of data

Sl.No.	Type of Data	Sources
1	Project report, Geological report, Prefeasibility report of Washery, EMP report, Mining and economic parameters and other miscellaneous data	CMPDIL and CCL.
2	Baseline data generation in respect of air, water, noise and soil.	Ecomen Laboratories Pvt. Ltd., Lucknow. Further, validation of baseline data for one month by CMPDI as per prescribed ToR.
3.	Land use/ cover mapping of core & buffer zone	As per State Govt. record, data supplied by the concerned CCL area office & through Remote Sensing data, CMPDI
4.	Flora and fauna	Survey Report prepared by the VRDS CONSULTANTS, CHENNAI

DRAINAGE MAP OF KARO (EXPANSION) OCP AND WASHERY



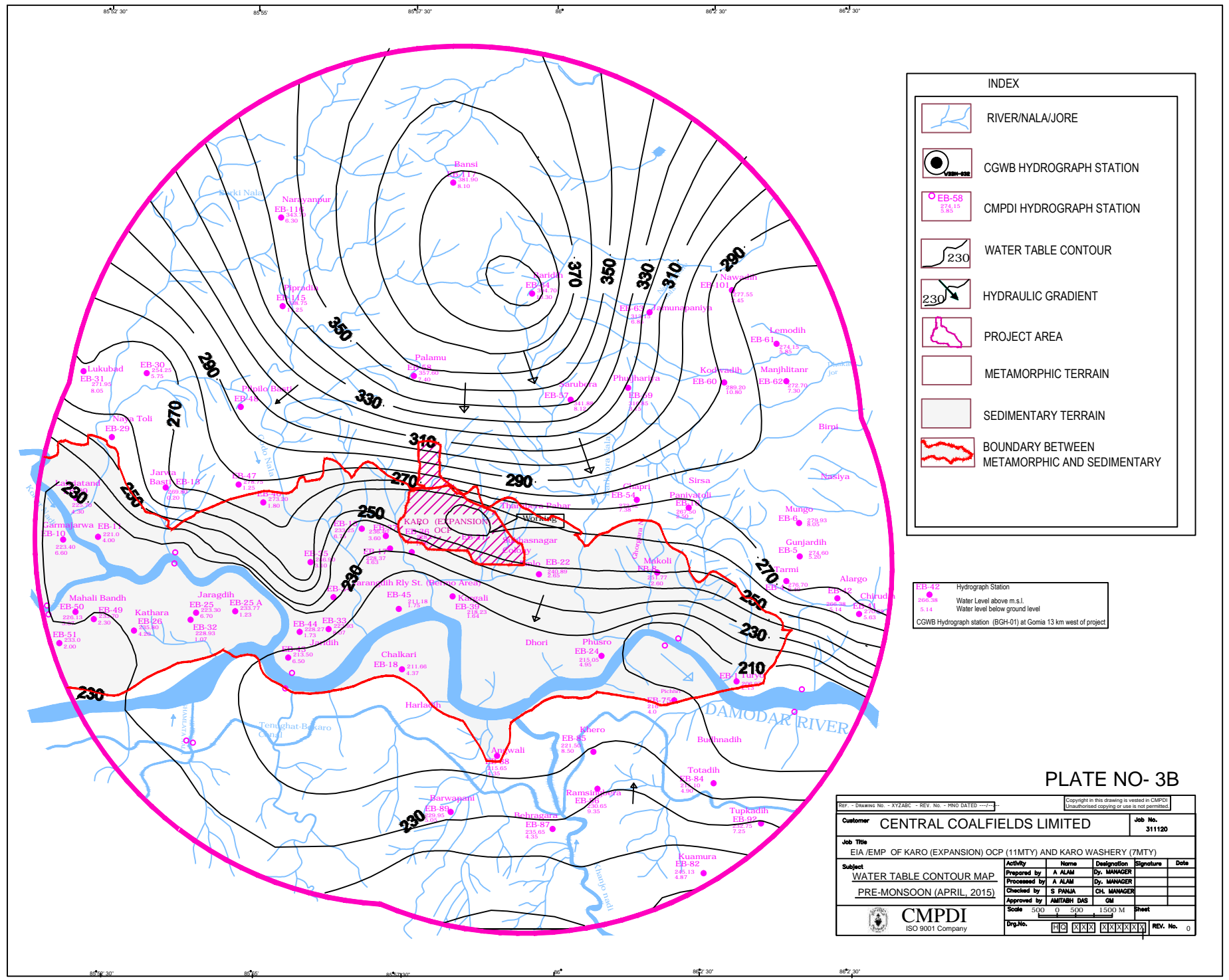
INDEX

	RIVER/NALA/JORE
	PROJECT AREA
	METAMORPHIC TERRAIN
	SEDIMENTARY TERRAIN
	BOUNDARY BETWEEN METAMORPHIC AND SEDIMENTARY
	FOREST/ JUNGLE/ PLANTATION










PLATE NO- IV

REF. - DRAWING No. - XYZABC - REV. No. - MNO DATED ---/---/---		Copyright in this drawing is vested in CMPDI <small>Unauthorized copying or reuse is not permitted.</small>			
Customer	CENTRAL COALFIELDS LIMITED	Job No.	311120		
Job Title	HYDROGEOLOGICAL STUDIES FOR EMP				
Subject	DRAINAGE MAP KARO (EXPANSION) OCP AND WASHERY EAST BOKARO COALFIELD	Activity	Name	Designation	Signature
		Prepared by	A ALAM	DY. MANAGER	
		Processed by	A ALAM	DY. MANAGER	
		Checked by	S PANJA	CH. MANAGER	
		Approved by	AMTABIH DAS	GM	
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CMPDI ISO 9001 Company					

WATER TABLE CONTOUR MAP OF KARO (EXPANSION) OCP AND WASHERY



INDEX

	RIVER/NALA/JORE
	CGWB HYDROGRAPH STATION
	CMPDI HYDROGRAPH STATION
	WATER TABLE CONTOUR
	HYDRAULIC GRADIENT
	PROJECT AREA
	METAMORPHIC TERRAIN
	SEDIMENTARY TERRAIN
	BOUNDARY BETWEEN METAMORPHIC AND SEDIMENTARY

EB-42 Hydrograph Station
 ● Water Level above m.s.l.
 ○ Water level below ground level
 CGWB Hydrograph station (BGH-01) at Gomia 13 km west of project

PLATE NO- 3B

REF. - Drawing No. - XYZABC - REV. No. - RND DATED - / /		Copyright in this drawing is vested in CMPDI. Unauthorised copying or use is not permitted.	
Customer		CENTRAL COALFIELDS LIMITED	
Job Title		Job No.	
EIA/EMP. OF KARO (EXPANSION) OCP (11MTY) AND KARO WASHERY (7MTY)		311120	
Subject	Activity	Name	Designation
	WATER TABLE CONTOUR MAP	A ALAM	Dy. MANAGER
	PRE-MONSOON (APRIL, 2015)	S PANJA	CH. MANAGER
		AMITABH DAS	GM
Scale		Sheet	
500 0 500 1500 M			
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03 03 03 03 03 03		0	

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

5.	Socio-economic study	Census data 2011 & House hold survey carried by VRDS CONSULTANTS, CHENNAI
6.	Surface hydrology and hydrogeology	CMPDIL(HQ), Ranchi
7.	Remediation Plan and Natural and Community Resource Augmentation Plan (NCRAP)	CMPDIL, Ranchi

1.7 Scope of the Study

The application for environmental clearance was submitted to MoEF for preparation of EIA/EMP & NCRAP for Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA), B&K Area, Central Coalfields Limited. Presentation on ToR for preparation of EIA & EMP for the same was made to MoEF and ToR was issued vide letter no F.No: 23-69/2018-IA(III) Dt. 17.07.2018. Based on this ToR, EIA/EMP was prepared and submitted to MoEF. The presentation before the EAC was held on 28.08.2018 and the committee has made some observations in its Minutes of Meeting. **This report also envisages the observations made by EAC during the presentation made on 28.08.2018.**

This EIA/EMP of Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA) has been prepared as per EIA notification, 2006 and conditions prescribed as per the Terms of Reference (ToR) granted by MoEFCC.

Chapter 2

Project Description

2.1 General

Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA), B&K Area, Central Coalfields Limited is proposed within an area of 552.84 Ha.

This includes 31.52 Ha land falling outside core zone required for colony & clean coal conveyor layout (5 & 26.52 Ha respectively).

The project is situated in the north-eastern part of East Bokaro coalfield in Bokaro district and covered on Survey of India Toposheet no- 73E/13 (1:50000 RF) between 23° 47' 02" to 23° 48' 38"N latitude 85° 57' 27" to 85° 58' 38"E longitude.

Presently opencast operations are being carried out in the minetake area of proposed Karo Expansion OCP and known as Karo OCP. A pit top washery has been proposed for washing of non-coking coal at 7 MTPA. Washed non-coking coal will be fed through belt conveyors to nearby Kargali siding for rail dispatch through RLS. Kargali siding about 5 km away.

2.2 Description of the Project

2.2.1 Type of the project

Karo Expansion OCP (15 MTPA) was planned as an expansion of existing mine. This expansion has been planned on the basis of two geological reports, namely, Karo Eastern Block, & Kaveri (Karo II) Block.

Presently opencast operations are being carried out in the minetake area of proposed Karo Expansion OCP.

A pit top washery has been proposed for washing of non-coking coal @ 7 MTPA. Washed non-coking coal will be fed through belt conveyors to nearby Kargali siding for rail dispatch through RLS. Kargali siding is about 5 km away. The balance of products of Karo non-coking coal washery is given below in **Table 2.1**.

Table 2.1 Balance of Product

Product	Size (mm)	Wt%	Ash%	Qty. (MTPA)
Washed coal	(-) 50	75.4	33.5	5.3
Low quality fuel	50-13	24.6	62.4	1.7
Total	(-) 50	100.0	40.6	7.0

Coking coal produced from the mine at 4 MTPA will be fed through belt conveyors to nearby Kargali washery / siding for washing or rail dispatch to consumers through a separate RLS at Kargali siding.

About 1.7 MTPA of low quality fuel generated in Karo washery will be stored adjacent to washery & despatched for power generation to the proposed FBC power plant.

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

2.2.2 Need for the project

Considering the gap in demand and supply of coking and non-coking coal, CCL entrusted CMPDI to explore the possibility of augmentation of production of Karo OCP located in B&K Area, CCL. The PR of Karo OCP was approved by CIL Board for a rated capacity of 3.5 MTY in August, 2006 with an initial capital of 96.53 Crs. Keeping in view of huge demand of coking and non-coking it became necessary to produce maximum possible coal production from this mine within minimum mine life. So a fresh exercise has been done and mine has been redesigned to produce 15.0 MTY with yearly advance rate of 100-110 m. The approval is enclosed as Annexure IV.

However, inclusion of coal reserves of both the blocks within the proposed Karo Expansion Project Report has been considered in this proposal for the following reasons:

- a) Gainful utilization of common infrastructures like Workshop, Substation, CHP and Washery.
- b) Common application for various Government Clearances like public hearing, EMP clearances and land acquisition.
- c) Similar coal quality parameters of both the blocks facilitating the common coal crushing and washing arrangement.
- d) Better economy of scale leading to improvement of financial parameters of Karo Expansion Project Report (EPR).

2.3 Location Details

2.3.1 General Location

Karo OCP is situated in the north-eastern part of East Bokaro coalfield. This project lies to the north of Bokaro Colliery and Bermo Quarry of DVC, to the west of Amlo project, to the east of Konar Project.

2.3.2 Specific Location

The location of the mine on the Toposheet scale 1:50000 is attached and it is a part of B&K Area of CCL. The block is bounded between the latitude $23^{\circ}47'02''$ and $23^{\circ}48'38''$ and longitudes $85^{\circ}57'27''$ and $85^{\circ}58'38''$.

2.3.3 Project Boundary & Project Site Layout

Quarry I:-

The boundaries of the proposed quarry as shown in the Final Stage Quarry Plan have been fixed in the following manner:

Northern Boundary

The northern floor boundary has been fixed along the incrop of Seam-VI/VII/VIII combined. The present extent of mining has also been considered while defining this boundary.

Western Boundary

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

The western floor boundary lies along faults F_3 , which is the common floor boundary with Quarry-II.

Southern Boundary

The southern surface boundary has been fixed at a distance of about 7.5m from the DVC lease line. In DVC leasehold, there is a quarry, which belongs to DVC. The surface barrier between the proposed Karo expansion OCP and DVC quarry is 30m. There are residential colonies of this company, like Subhas Nagar, Jawahar Nagar located partly within Karo OCP leasehold boundary.

Eastern Boundary

The eastern floor boundary has been fixed along the fault F_{1b} that acts as the common floor boundary of this quarry with Amlo (Dhori West) OCP in the east of Quarry-I. Amlo has already worked upto the upthrow side of the fault and the area is free from any OB Dump.

Quarry II:-

The boundaries of the proposed quarry as shown in the Final Stage Quarry Plan have been fixed in the following manner:

Northern Boundary

This boundary has been fixed along the incrop zone of Seam-VI/VII combined.

Western Boundary

Western quarry surface edge has been restricted leaving a minimum distance of 60m from Gati Nala flowing north to south and meeting Damodar River to the south.

Southern Boundary

The surface boundary in the south-western direction has been restricted at a distance of about 30 m from the DVC leasehold line and 60m from Baid Karo village.

Eastern Boundary

The eastern floor boundary has been fixed along fault F_3 . This partly forms a common boundary with Quarry-I.

2.4 Size and Magnitude of operation

2.4.1 Previous five year Production

Table 2.2 - Previous Five Years production

Year	Production (MTPA)
2013-14	0.77
2014-15	1.63
2015-16	1.94
2016-17	1.50
2017-18	1.50

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

2.4.2 Summarised Calendar Programme

Table 2.3 Summarized Calendar Programme of Excavation-Quarry I & Quarry II

YEARS	SUMMARISED CALENDAR PROGRAMME		
	COAL in (MT)	OB in M.cum	Stripping Ratio (Cum/Te)
1	3.00	2.46	0.82
2	6.00	4.92	0.82
3	11.00	9.24	0.84
4	11.00	10.01	0.91
5	15.00	13.20	0.88
6	11.00	9.68	0.88
7	11.00	9.41	0.86
8	9.00	7.29	0.81
9	9.00	7.20	0.80
10	8.56	7.19	0.84
11	6.00	5.52	0.92
12	4.62	4.25	0.92
TOTAL	105.18	90.38	0.86

2.4.3 Target Output

Karo OCP has been planned for a capacity of 15.0 MTY. The target production will be achieved in 5th year of quarry operation.

2.4.4 Mine Life

The total life of the project including Karo Washery is 15 years. The break-up is as under:

- Construction period: Nil for mine & 3 years for washery.
- Production build-up period: 4 years
- Production period with target output: 1 year
- Tapering period: 07 years
- Total period : 12 Years for Karo OCP and 15 Years for karo Washery.

2.4.5 Future Expansion Potential

DVC Bermo leasehold line is at a distance of 30 m from Karo OCP Quarry surface boundary. Bermo Quarry in Bermo Seam is operative within DVC Bermo leasehold. Karo OCP may be advanced in dip direction after lease/mutual agreement from DVC thereby increasing the mineable reserve and life of Karo OCP.

2.5 Physiography, Drainage and Communication (Plate No. IIIA & IIIB)

2.5.1 Physiography

The entire topography of the block is rugged and pronounced with hills and valleys. The ground elevation varies from a maximum of 335m in north to a minimum of 236m in the south of the block. The general slope is towards south.

2.5.2 Drainage

The drainage of the block is controlled by two nalas namely Karo nala (HFL 244 m) and Gati nala (HFL 245 m to the west of Quarry-II) flowing towards south. These nalas ultimately flow into the Damodar River near Bokaro-Kargali Colliery. The block also has few ponds in the south-eastern part.

2.5.3 Communication (Plate No. II)

The East Bokaro Coalfield lies on the Gomoh-Barkakana-Dehri-on-Sone loop line of Eastern Railway. Bermo railway station on this line is located at a distance of about 5 Km to the south of Kaveri (Karo-II) Block.

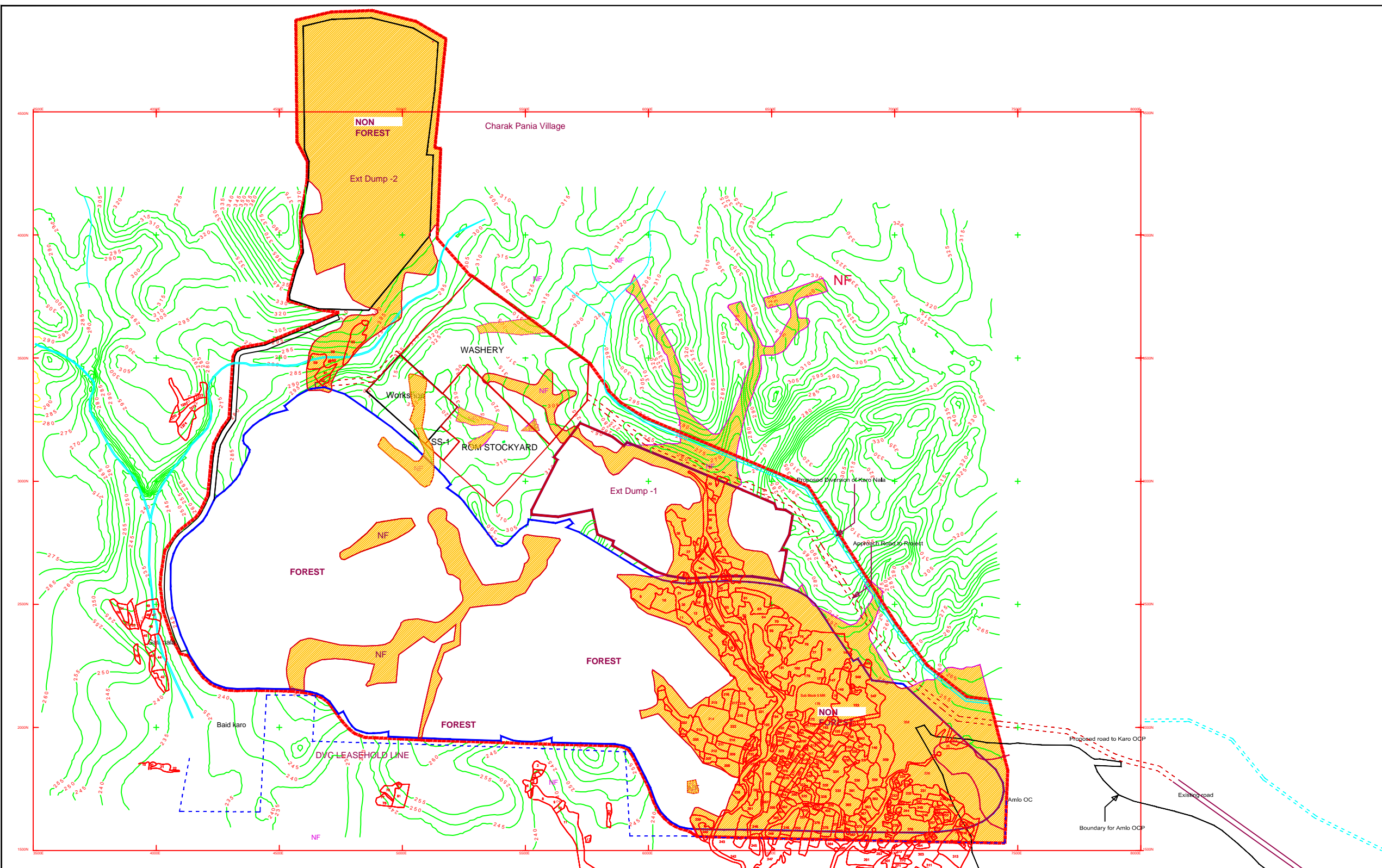
The east-west running Gomia-Jarangdih-Phusro-Jaina More Road, which meets the Bishnugarh-Petarwar Road and Dhanbad-Ramgarh Road, connects the coalfield with Hazaribagh, Dhanbad and Ranchi. This road is located to the south of the Kaveri (Karo-II) Block. The block is also connected to Bokaro Thermal Power Station in the west and Phusro in the southeast by metal road. The nearest township Phusro, is situated at a distance of about 7 Km. Phusro is connected to the G.T. road by Phusro Dumri road.

The nearest airport is Ranchi. However, there is a small air-strip located near Sawang Colliery. This belongs to Indian Explosives Ltd. and is located at a distance of about 15 Kms. from Kaveri (Karo-II) Block.

2.6 Land use

The area of proposed project is 552.84 Ha, out of which 295.75 is proposed for excavation, overburden area is proposed over 95.24 Ha, infrastructure & washery etc will be spread over 54.25 Ha. Balance land will be undisturbed/ safety zone, green belt, road, nala diversion etc.

Out of total area of 552.84 Ha, 31.52 Ha land falling outside core zone is required for colony & coal conveyor layout to Kargali washery & Kargali siding. Refer Plate IV for land use during mining of karo OCP and integrated washery.



Legend

SI No.	Particulars	Symbol
01	Non Forest (NF)	[Orange hatched symbol]
02	Forest	[Green hatched symbol]
03	Under Ground Workings	[Red hatched symbol]
04	Nails	[Red cross symbol]
05	Surface Contour	[Green line symbol]
06	Project Boundary	[Red line symbol]

Reference Drawings

SI No.	Particulars	Ref. Number
01	Geological Plan of Karo Eastern Block, East Bihari CF	R-18(02)2476
02	Working Plan of Karo Seam Quarry (K to VI) as on 20/10/03	Colliery Plan
03	Floor Contour & Isoclone Plan of Seam-VI, Karo Eastern Block	R-18(02)2442

PLATE NO - 4A

CENTRAL COALFIELDS LIMITED

BA (SMP) OF KARO OCP EXPANSION (11 MTP) & KARO WASHERY (7 MTP)

Land Use Plan Along With Contour

CMPDI

Scale: 1:4000

DATE: [] [] []

BY: [] [] []

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Table 2.4 Proposed Land Use during Mining

SN	Particulars of land	Forest (Area in Ha)	Non- forest (Area in Ha)	Total (area in Ha)
1.	Quarry	185.07	110.68	295.75
2.	External OB dump-1	24.73	13.27	38.00
3.	External OB dump-2	5.00	52.24	57.24
4.	Infrastructures	36.77	8.31	45.08
5.	Road, nala diversion, top Soil Dump, green belt/vacant land & Safety	52.53	32.72	85.25
6.	Res. colony*	0.00	5.00	5.00
7.	Conveyer to Kargali Washery/ siding *	7.50	19.02	26.52
	Total Land Required	311.6	241.24	552.84

*31.52 Ha of land (Residential Colony and Conveyor to Kargali Washery) is outside the core zone.

The land usage of the project will be as follows:

Forest land- 311.60 Ha including 7.50 Ha in conveyor layout outside core zone.

- FC granted for 77.43 ha forest land in core zone diverted vide letter number: F.No.8-22/2003- FC Dated 31st March 2004.
- FC applied for 226.67 ha forest land in core zone on 9.03.2006. Proposal recommended by MoEF&CC for stage-I clearance in FAC meeting held on 25.01.2018.
- Stage I for diversion of 7.50 Ha. of land for Conveyer belt from Karo OC to Kargali Washery/ siding is under process.

2.7 Geology

Karo EPR (Quarry-I&II) has been planned in Karo Eastern block, which is located in the Central part of the East Bokaro Coalfield. The block is bounded between the latitude 23°47'02" and 23°48'38" and longitudes 85°57'27" and 85°58'38". The preliminary "Geological report on the quarriable potentialities of the thick seams of Karo group in the Eastern sector, Karo block" was prepared by NDCD in early sixties. The report outlined the need for drilling additional boreholes for outcrop proving, precise delineation of faults, additional quality data including the washability data in respect of thick Karo group of seams. Accordingly CMPDI drilled additional 16 boreholes mostly in the western part and prepared a comprehensive report "A Geological Report on Karo Eastern block, East Bokaro Coalfield, Bihar" in March 1987. Based on the above report the block was divided into Karo -I located in the western part and Karo-II in the eastern part. Both the blocks are separated by fault F3. Karo-II block was designated as Kaveri. The Kaveri block was further explored by the MECL during the period April 1989 to November 1989 for additional data required for structural proving, delineation of faults and incrop in the eastern part. Based on the exploration details MECL submitted the Geological report entitled "Geological report on coal exploration Kaveri (Karo-II) Block, East Bokaro Coalfield" in March 1994.

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Quarry-I and Quarry-II of Karo OCP forms two contiguous opencast blocks with similarity in lay, dispositions of seams and broad similarity in quality. An integrated opencast has been envisaged to form Karo Expansion OCP with a rated capacity of 11 MTY. The quarry envisaged in the eastern part in the Kaveri block has been designated as Quarry-1, and quarry planned in the Karo-I block has been designated as Quarry-II. Both the quarries are separated by each other by the fault F3. Refer Plate VA for geological Plan of Karo Expansion OCP and plate VB for combined cross section of seams

The Karo Eastern block is located in the central part of East Bokaro Coalfield and lies on the northern limb of main synclinal basin of the field. The block under consideration is occupied by the rocks of Talchir, Karharbari & Barakar formations of lower Gondwana, apart from soil and alluvium of the recent era.

The Metamorphic is exposed along the northern part of the block. Talchirs are exposed in patches in the northern part, The Karharbari formations overlying Talchirs contains 4 coal seams from Karo-I to Karo-IV. The Barakars contain Karo group of seams from Karo-V to Karo-XI. The seams VI and above are thick and are potential for opencast mining. Seams VI, VII, VIII occur as composite seam in Quarry-I where as in Quarry -II Karo group of seams from seam V to seam XI are well preserved and the seam VI and VII occur as composite seam and seam VIII occurs as a separate seam.

2.7.1 Strike

The general trend of the strike is East-West in both Kaveri as well as Karo-I area. However, minor swings in the strike have been observed in some area.

2.7.2 Dip

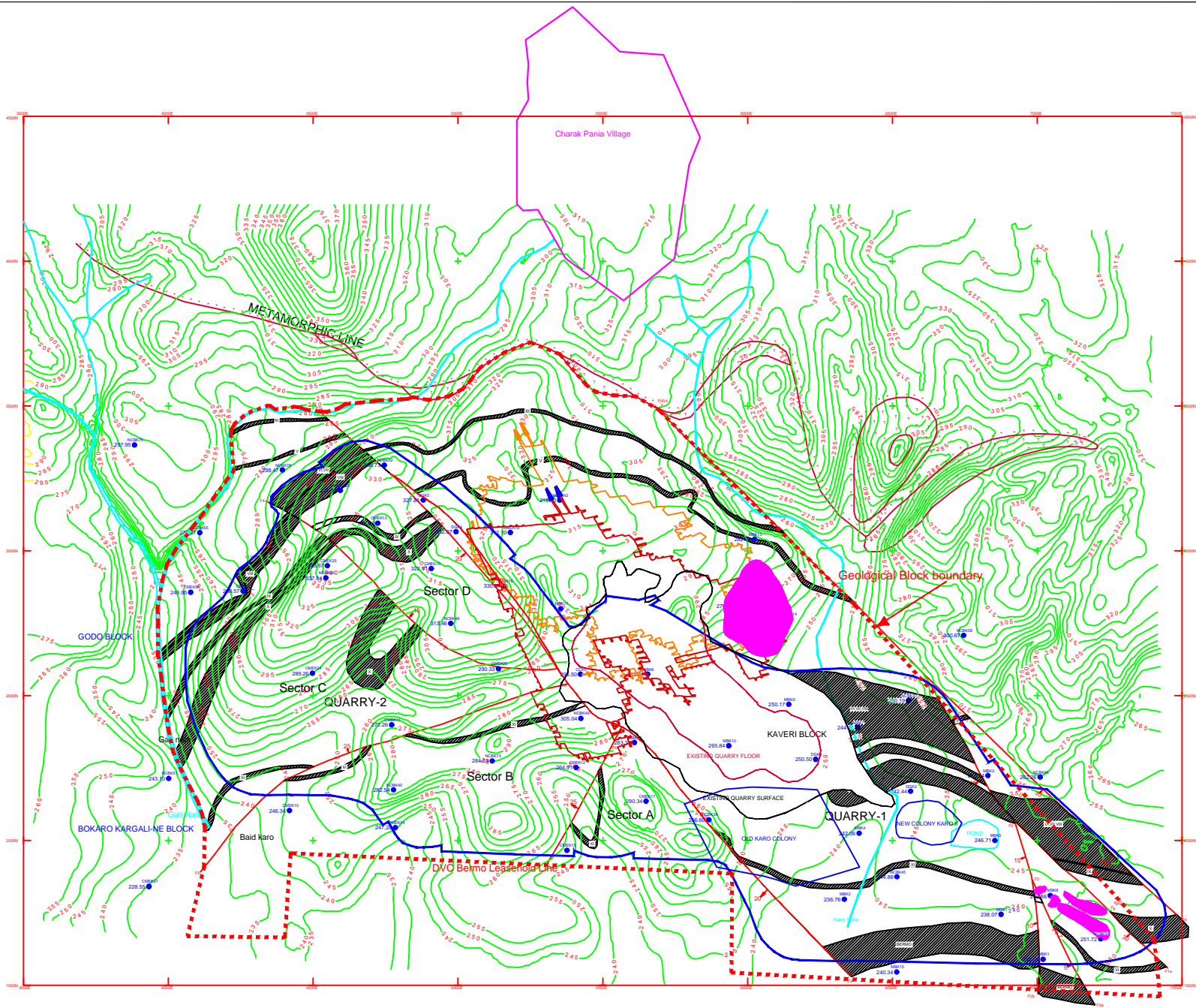
The dip of the formation is 8° to 10° due south.

2.7.3 Faults

As many as six faults of different magnitudes have been interpreted in Karo-I & Kaveri blocks. The details of these faults have been summarised below.

Table 2.5 Details of faults

Fault No	Trend	Dip Direction	Throw (M)	Remarks
Kaveri block				
F 1 - F 1	NW-SE	South Westerly	80	Located in the eastern boundary. It splits in to F1a & F1 b
F1 a - F 1a	NW-SE	South Westerly	35	
F 1 b - F1 b	NW-SE	South Westerly	45	
F 2 - F 2	NW-SE	South Westerly	10	Located in the eastern boundary. It splits in to F2a &F2 b
F 2 a - F2 a	NW-SE	South Westerly	0-10	
F 2 b - F 2 b	NW-SE	South Westerly	0-10	



Notes

Sl No.	Particulars
01	All values are in meters.
02	Geological Map of Kaveri Block (MECR/NC/Do. No. 66/94) has been considered for
03	Geological Map of Kaveri Eastern Block RI-3/G/4549 has been considered for

Legend

Sl No.	Particulars	Symbol
01	Coal seams outcrop	
02	Bore holes	
03	Sand stone	
04	Rock	
05	Surface Contours	
06	Boreholes Drilled by MECL	
07	Boreholes Drilled by CMPDIL	
08	Boreholes Drilled by ICL	
09	Tachy Formations	
10	Quarry boundary	

Reference Drawings

Sl No.	Particulars	Ref. Number
01	Geological Plan of Kaveri Eastern Block, Coal Blocks CP	RI-3/G/4549
02	Working Plan of Kaveri Eastern Block Quarry (A to V) as on 31/03/05	Geology Plan
03	MECL Geological Plan	MECL/RI-3/G/4549

PLATE NO - 6A

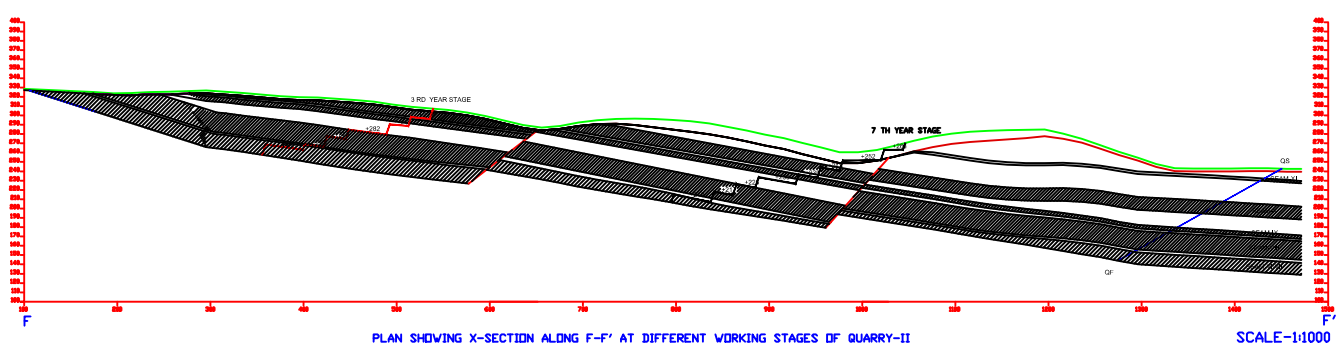
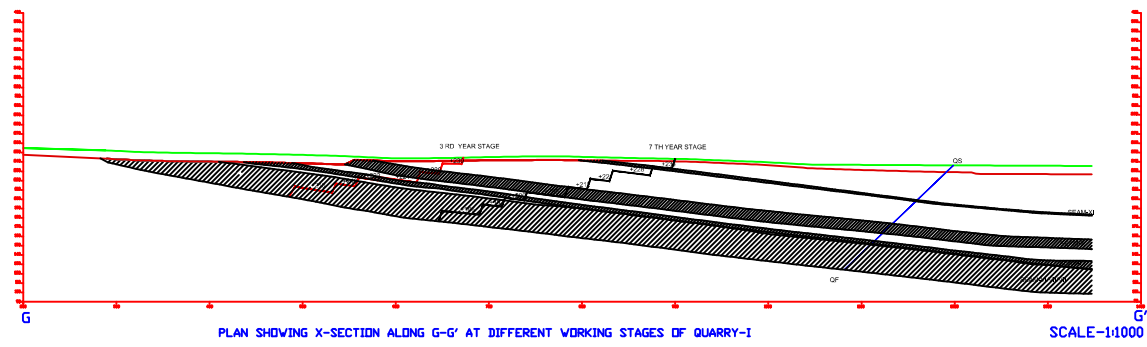
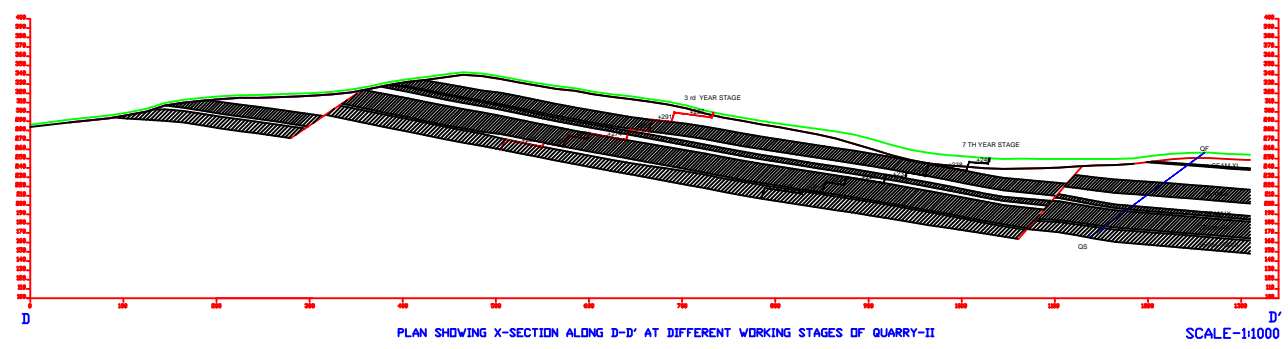
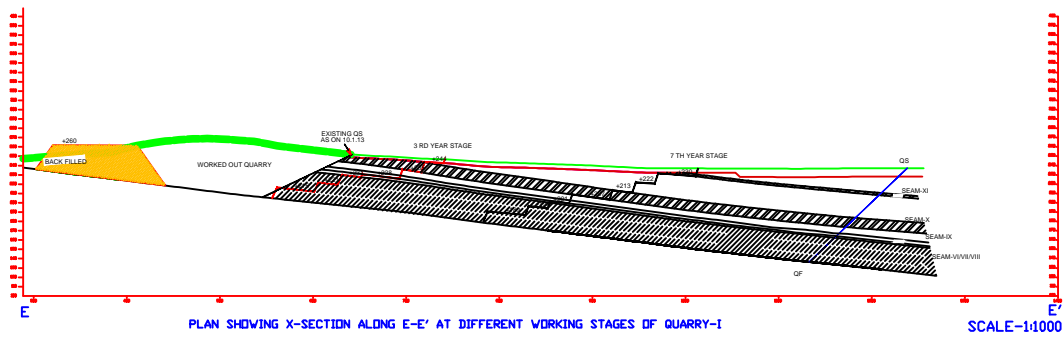
CENTRAL COALFIELDS LIMITED
 (A UNIT OF I.C.P. OF KARGO, I.C.P. OF KARGO, I.C.P. OF KARGO & KARGO WASHERY (MPT))

Geological Plan of Kaveri Eastern Block & Kaveri Block

CMPDI RI-III
A MEMBER COMPANY

Scale: 1:5000

Sheet No. 1 of 1



Legend

Sl No.	Particulars	Symbol
01	SURFACE	
02	ALLUVIUM	
03	FAULT	
04	MINING SYSTEM	
05	COAL DEAMS	
06	QUARRY END	

PLATE NO - 6B

CENTRAL COALFIELDS LIMITED			
EIA / EMP OF KARO OCP EXPANSION (11 MTP) & KARO WASHERY			
Sl No.	Particulars	Scale	Date
01	Prepared		
02	Checked		
03	Approved		
X-SECTIONS AT DIFFERENT STAGES OF QUARRY I & II			
CMPDI, RI-III		A MAHARAJA COMPANY	
Scale: 1:1000		Date: 11/01/2020	

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Fault No	Trend	Dip Direction	Throw (M)	Remarks
F 3 - F 3	NW-SE	South Westerly		Forms the western boundary of the Kaveri block .It splits in to F3a & F3 b
F 3 a - F3 a	NW-SE	South Westerly	20	
F 3b - F 3 b	NW-SE	South Westerly	50	
Karo - I Block				
F 4 - F 4 (FII) 3	NW-SE	Easterly	15-20	Located in the western part of the Kaveri block and abuts against the fault F3
F 5 - F 5 (FI) 1	NW-SE	South Westerly	10-20	
F 6- F 6	NW-SE	South Westerly	20	

*The fault nomenclature in the bracket is as per CMPDI Geological Report March 1987.

2.7.4 Sequence of Coal Seam and Parting

The sequence of coal seams and partings as established in Quarry-I (Kaveri block) and Quarry-II (Karo-I blocks) are summarised below:

Table 2.6 Sequence of Coal Seams and Parting in Quarry-I and Quarry-II

Seam / Parting	Quarry -I		Quarry -II	
	Thickness Range	No of BH Intersection	Thickness Range	No of BH Intersection
Bermo	12.27	1		1
Parting	13.64			
Local	0.44-0.76	1		
Parting	4.55-5.51			
XI	0.91--2.51	6	0.98 -3.14	4
Parting	22.75-33.86		19.85-24.44	
X	10.57 -12.85	11	10.33-14.80	11
Parting	0.91-11.21		1.64 -22.0	
IX	3.11 -4.77	12	2.56 -5.38	10
Parting	0.38 -4.34		0.62 15.86	
VI/VII /VIII	24.12-36.25	13		
VIII			12.65 -20.85	12
Parting			0.84 -6.15	
VII /VI			9.40 -18.51	10
Parting	27.56 36.19		27.58 -40.53	
V	1.11 -3.58	15	0.27 -3.88	10
Parting	9.40 -15.82		11.63 -20.91	
IV	0.11 -0.77	15	0.16-0.76	4
Parting	1.35-7.63		1.50 -7.53	
III	1.0 -3.76	14	0.74 -2.84	10

Note - Bermo seam in Quarry I lies in the dip side batter of quarry and hence not considered.

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

2.7.5 Seam Description

The exploration in the Kaveri block revealed presence of seams from Bermo to Seam-III in Quarry-I and from seam XI to seam III in Quarry-II in Karo-I block. Seam XI to seam VI are thick and have quarriable potentialities in the Kaveri and Karo-I Blocks. The quarry envisaged in the Kaveri area has been designated as Quarry-I and quarry planned in the Karo-I Block has been designated as Quarry-II in the Karo Expansion Opencast Project. The details of individual coal seams in Quarry-I and Quarry-II have been summarised below.

2.7.6 Mineable Reserve

Table 2.7 Mineable Reserve

Sl. No.	Seam Name	Mineable Reserve (MT)		
		Quarry-I	Quarry-II	Total
1	Seam-VI/VII Combined		15.07	15.07
2	Seam-VIII		24.09	24.09
3	Seam-VI/VII/VIII Combined	28.41		28.41
4	Seam-IX	3.26	6.29	9.55
5	Seam-X	8.76	16.55	25.31
6	Seam-XI	1.62	1.12	2.74
Total		42.06	63.12	105.17

2.8 Quality of Reserves

Table 2.8 Summarised details of Quality in Quarry-I

Parameters				
Proximate-analysis				
SEAMS	XI	X	IX	VI/VII/VIII
BH analysis	6	9	9	11
Ex-Band				
Moisture %	0.9 -2.3	0.5-2.9	0.7-1.0	0.7--1.0
Ash %	23.5 28.40	23.2-27.4	21.8-26.7	22.1-26.7
Vm %	18.5-20.5	17.4-24.5	19.0-20.4	18.7-19.7
		20.8-31.1	23.2-24.7	
In-Band				
Moisture %	0.9-1.1	0.6-2.8	0.6-1.0	0.6-0.7
Ash %	31.7-36.10	30.7-37.9	21.8-29.9	36.6-47.8
Vm %	17.7-18.7	16.4-19.8	19.0-20.4	15.8-16.3

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Uvm %-	23.6-24.4	20.7-25.96	23.26-24.6	
UHV				1771-3183
Grade	WG-IV-UG	WG-IV-UG	WG-II WG-IV	F -G
Coking Properties				
CI	13 -16	13- 17	15	12-16
CT	E -F	E-F	F	D/E -E

Table 2.9 Summarised details of Quality in Quarry–II

Parameters					
Proximate-analysis					
SEAMS	XI	X	IX	VIII	VI/VII
Ex-Band					
BH analysis	4	6	6	7	7
Moisture %	0.4 -1.0	0.4 -1.2	0.6 -1.2	0.2-0.9	0.6 0.7
Ash %	23.9 -29.0	24.6 -27.4	24.0 -26.1	24.6 -27.4	24.2 -26.6
V M %	18.9 -22.6	19.0 -23.2	19.4 -21.3	17.0 -21.3	18.8 -19.9
In-Band					
Moisture %	0.5 -0.7	0.6- 1.2	0.5 -1.0	0.9	0.5 -0.8
Ash %	30.2 -33.9	26.1 -34.0	24.4 -32.9	39.3 -43.6	35.18- 44.2
Vm %	20.4 -20.8	18.4 -20.3		36.0-39.6	24.5
CV	5870 -6155	5895 -6115		5970 - 6240	5845 -6305
Uvm %-	23.7 -29.0	22.5 -28.9	23.8 -26.8	21.4 -26.1	18.1 -26.7
UHV(K Cal /kg)				2814 -3546	2731 -3976
Grade	WG-IV	WG-III WG-IV	WG -III WG-IV	E - F	E - F
Ultimate Analysis					
C%	89.3 -89.8	88.4-90.5	89.1 -90.5	80.4 -90.1	87.8 -91.5
H%	4.8 -5.1	4.6 -5.0	0.4 -0.5	4.6 -5.0	4.5 -4.8
N%	-				
S%		0.5	0.4 -0.5	0.5	
O% (by diff.)	3.4	2.1	3.3 -3.6	2.9	
Coking Properties					
CI	13 -20	15 -17	15-18	13 -18	11 -22
CT	E -E-F	F	E-G/G1	D/E -F	C/D-F
Co2%	0.04 -0.25	0.65- 1.01			0.62 -1.86

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P %		0.49-0.187	0.38 -0.45		
Cv K Cal /Kg	8620-8660				

2.9 Types of Mining

2.9.1 Quarry I

The method of mining adopted to extract coal and OB in Quarry- I is inclined slicing with **Surface Miner in coal and Shovel-Dumper combination in OB**. This method has been proposed considering the following Geo mining conditions of the quarry.

- Moderately steep (6-8 degrees) gradient of seams.
- Multiple seams.
- Sufficient strike length.
- Variable thickness of OB/Partings.

Quarry- I OCP is a working mine, it has advanced in dip side by approximately 800m from incrop of Seam-VI/VII/VIII. The strike is not opened to its full extent due to the existing Karo nala, which needs to be diverted, so that planned strike length could be opened in first year of quarry operation. Until, the Karo nala is diverted, the mine cannot reach its rated capacity.

2.9.2 Quarry II

The mining and geological conditions of the mine are as follows: -

Multiple seams to be worked

- Gradient of 8-10 deg of the coal seams.
- Variable thickness of OB/Partings.

Considering the above mining and geological conditions the method of mining adopted to extract coal and OB in Quarry II is inclined **slicing with Surface Miner in coal and Shovel-Dumper combination in OB**.

It is also proposed to respond to improvements in technology and equipments, which would result in, improved profitability and productivity parameters taking into account of safety and environmental parameters.

Considering the geo-mining conditions surface miner in coal and shovel-dumper combination in OB with drilling and blasting has been proposed for mining for both the quarries. Other technologies like Dragline, Bucket Wheel Excavator, are ruled out for this quarry.

2.10 Infrastructure

2.10.1 Buildings

a. Residential buildings

Karo Open cast project is a running mine and there is a residential colony exists. The manpower provision for this project is 873. Thus, number of quarters required at 55%

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housing satisfaction shall be 481. 637 M.Qs. are already constructed there, so provision for construction of only 25 B type, 34 C type & 14 D type quarters has been made. The township is proposed to be constructed at the suitable site near existing colony. Provision of 5.0 Ha land for construction of township at proposed location has been made. Permanent type of quarters has been proposed.

b. Service buildings

It is proposed to provide facilities for medical, educational, recreational & shopping facilities for Karo Open Cast Project. Provision has been made in this report for construction of Project office, site office; Excavation Workshop, E&M workshop, Store, substation, magazine, first aid center, canteen, rest shelter, and various other Community buildings.

2.10.2 Roads & Culverts

a) Colony road

The length of roads inside the township has been estimated as 0.50 km.

b) Haul road

The length of haul road has been estimated as 3.0 km.

c) Approach road to the project

Provision has been made for construction of 4.5 km. approach road to project.

d) Approach road to colony

The length of approach road to the proposed Colony has been estimated as 0.5 km. for all the variants.

2.10.3 Water supply and Sewerage

Water demand

The potable & industrial water requirement for the project has been assessed as follows:

- (i) Potable Water Demand : 490 m³/day
- (ii) Industrial Water Demand : 3970 m³/day (2380 for coal mines +1590 m³/day for Washery)

Source of water

Source of water for potable and industrial use will be mine water.

2.10.4 Workshop & store

Karo OCP is an existing mine, the existing workshop is old. So, a separate new unit workshop has been proposed.

Maintenance Facilities

This unit workshop is envisaged to cater the need of daily maintenance, scheduled maintenance, lubrication, routine inspection, minor/medium repair and replacement of parts/sub-assemblies of HEMM such as- Dumpers, Dozers, Shovels, and Drills etc.

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Minor repair of assemblies and sub-assemblies of pumps, Electrical, etc. deployed in the project will also be performed in this workshop. Planning of this unit workshop and project store has been done based on a routine maintenance and repair programme to achieve the high level equipment availability, reliability and longer life.

Maintenance and repair load of this unit workshop has been assessed on the basis of annual operating time, life of the equipment / assemblies/ sub-assemblies etc.

Space requirement for maintenance & repair activities, parking facilities of HEMM, washing of equipment, requirement of open and covered space/sheds etc. have also been worked out based on the number & size of HEMM to be deployed in this mine.

Scope of work

This Unit workshop will have two parts- Excavation and E&M workshop. Apart from this, Project store and other common facilities like- canteen, fuelling station, washing station, security post, fire fighting etc. have been provided.

Any major overhaul of equipment and manufacturing of spares on large scale are beyond the scope of this workshop. These works will be carried out in nearby Regional workshop or Central workshop, Barkakana.

Excavation workshop

This part of unit workshop will have the facilities for attending to the scheduled maintenance, daily maintenance, washing, minor/medium repair or replacement of parts/ sub-assemblies of face and transport equipment such as dumpers, shovels, drills, dozers, cranes, grader and other miscellaneous equipment used for mining operation.

Maintenance and minor repair of Face equipment e.g. shovels & drills will be carried out at the site.

E& M workshop

Considering the nature of repair and maintenance of E&M equipment, which is different from that of the HEMM, a separate E&M workshop has been provided.

This part of the workshop will have the facilities for scheduled maintenance, day-to-day maintenance and minor repair by parts / units.

2.10.5 Karo Washery

Raw coal produced from Karo OCP will be supplied to the proposed washery. The seam wise reserves and year wise production from Karo OCP are given hereafter in Table- 2.8. From this table we can illustrate that the raw coal can be supplied to the proposed washery to the tune of 7.0 Mty for 7 years only. For rest of the washery life, raw coal of similar characteristics shall be supplied from neighbouring mines of B&K area.

Table 2.10 Raw Coal Linkage to Karo Washery

Year ↓	Karo OCP			Total
	Quarry 1	Quarry 2		
	Seam VI/VII/VIII C	Seam VIII	Seam VI/VII	
	Production (Mt)			
1	1.12	0.59	0.40	2.11
2	2.24	1.19	0.81	4.24
3	3.46	2.35	1.58	7.39

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4	3.17	2.21	1.38	6.76
5	3.17	2.21	1.38	6.76
6	3.27	2.21	1.38	6.86
7	3.41	2.21	1.38	7.00
8	3.41	2.21	1.38	7.00
9	3.41	2.36	1.43	7.20
10	1.75	2.36	1.43	5.54
11	0.00	2.36	1.43	3.79
12	0.00	1.82	1.10	2.92
Total	28.41	24.08	15.08	67.57

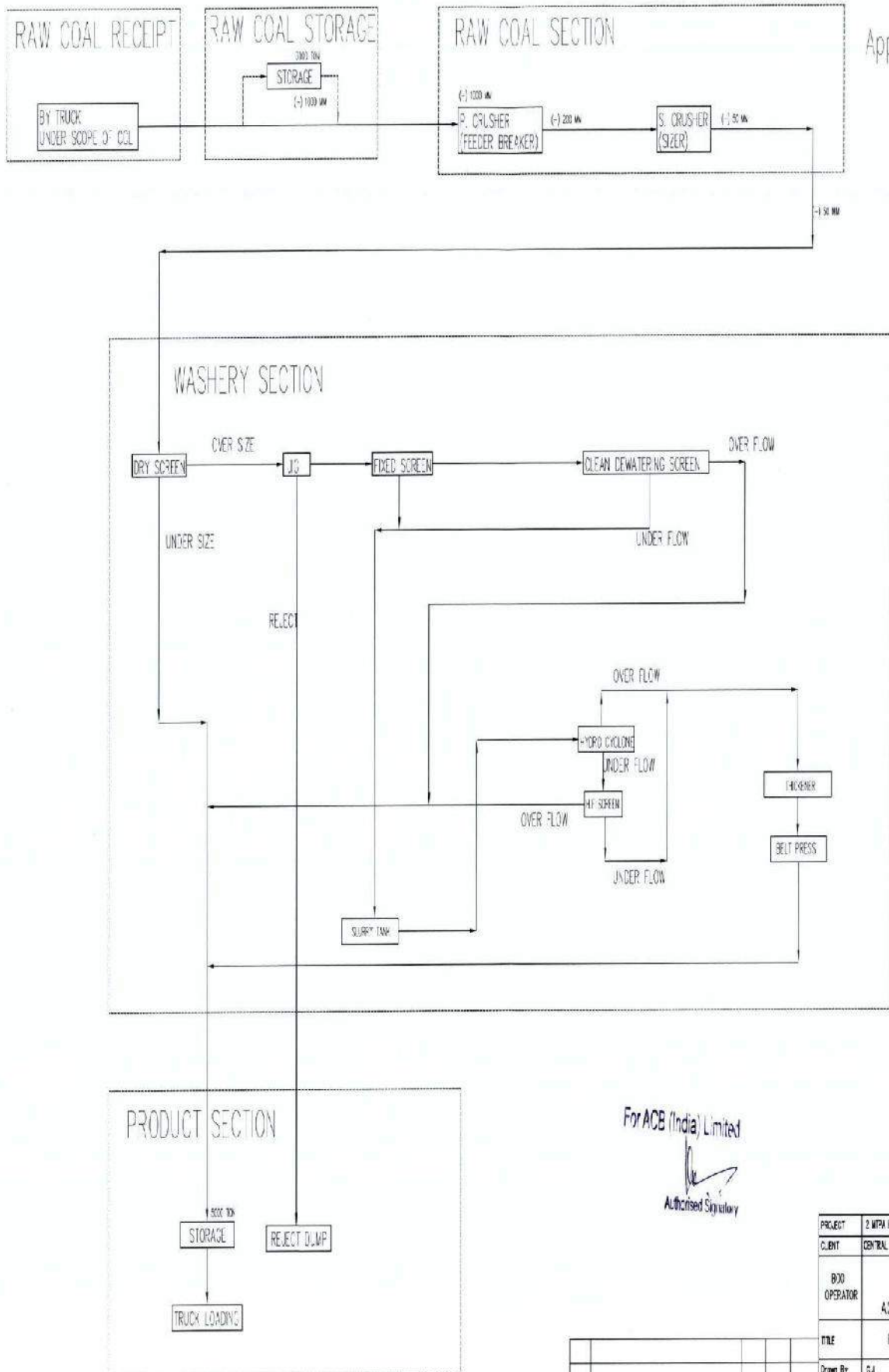
- The seams of linked mines of Karo OCP (VI/VII, VI/VII/VII and VIII) are not exposed. In view of this, the test results generated for Konar washery have been considered for preparation of this pre-feasibility report. It is prudent to mention here that the samples tested for Kargali Washery were collected from seams VI/VII and VIII of Khasmahal OCP. As such, the Balance of Products predicted are broad and indicative only.
- A process flow sheet for achieving washed coal at 33.5% has been finalised based on the available washability test results of Khasmahal OCP. The final process will be selected after generation of washability and other tests of representative RoM samples from the linked mines of Karo Washery.
- The salient features of process flow for achieving the targeted ash of 34.0% for thermal power station is briefly mentioned hereafter and flow sheet of Coal Washery is shown in Table 2.11.
- Receiving raw coal of (-) 100 mm from Karo OCP through covered belt conveyors.
- Storing of raw coal (-100 mm) in 11000 t ground storage.
- Reclamation of raw coal from ground storage and conveying the same to screen-cum-crusher house.
- Screening at 50 mm to obtain two size fractions i.e. 100-50mm & (-) 50 mm.
- Crushing of 100-50 mm coal down to 50 mm and mixing it with natural -50 mm coal.
- Conveying of entire -50 mm fraction to washery building.
- Screening of (-) 50 mm coal at 13 mm on vibrating screens to produce two size fractions i.e. 50-13 mm & -13 mm.
- Deshaling of 50-13 mm fraction in two products electronically controlled improved type jigs to produce deshaled coal (float) and rejects (sinks).
- Dewatering of deshaled coal obtained from jigs in double deck dewatering screens followed by dewatering of 25-13 mm fraction in basket type centrifuge.
- Conveying underflow of dewatering screens, centrifuge etc. in radial thickener for thickening.
- Dewatering of thickened slurry i.e. underflow of thickener in belt filter press and mixing of dewatered slurry with the product.
- Conveying of washed coal (i.e. deshaled coal 50-13 mm obtained from jigs, untreated -13 mm raw coal fraction and dewatered fines from belt filter press) from washery building to covered washed coal storage of 18000 t capacity.
- Dewatering of rejects produced from jigs in bucket elevators.

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- Conveying of dewatered rejects by covered belt conveyor to Temporary Reject Storage Site.
- Reclamation of washed coal from covered storage and conveying to Kargali Washery Railway Siding. Washed coal will be loaded into Railway wagons through Rapid Loading System (3600/ 5500 tph) for onward dispatch to consumers.
- Provisioning of slurry pond(s) for emergency bleeding of thickener.
- Due to the proposed dewatering stream, belt filter press and thickener, the use of water will be optimized.
- Provision of rainwater harvesting of roof top water.

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

Table 2.11 Flow-Sheet Of Karo Non-Coking Coal Washery



Appendix-2

For ACB (India) Limited
 Authorized Signatory

PROJECT	2 MTPA KARO COAL WASHERY
CLIENT	CENTRAL COALFIELDS LIMITED
BDO OPERATOR	ACB (INDIA) LIMITED
TITLE	FLOW DIAGRAM
Drawn By	G.J.
CHKD	

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

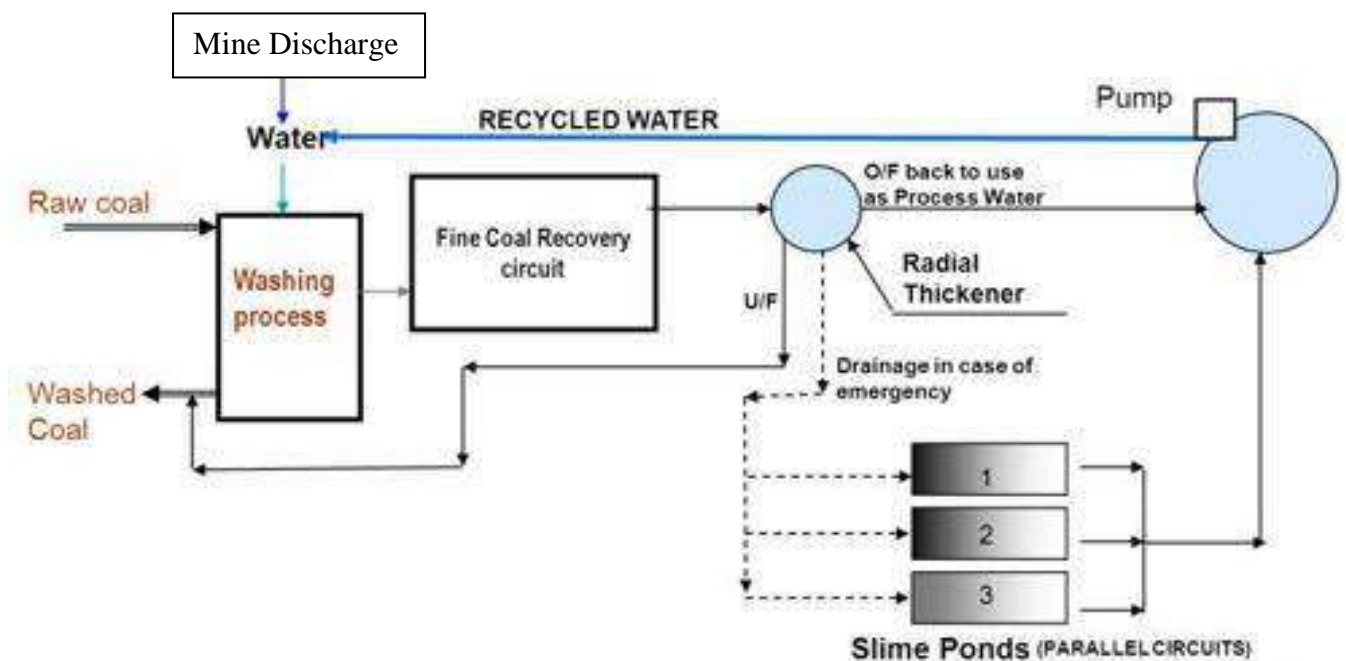
2.10.6 Infrastructure facilities:

During construction period, water shall be supplied from incline nos. III & V of Karo UG, which is closed and water logged since 2005. Total accumulated water in the above inclines is about 61 million gallon. By putting borehole from surface to the dip most points i.e. quarry floor of both the U/G dip side workings water can be provided through submersible pumps. The distance of seam-III & seam-V are 980 mtr and 1240 mtr respectively.

The quantity of water required for operation & maintenance of the proposed washery is about 1590 m³/day. The requirement of water during operation of proposed washery will be cater by using excess mine water. The alternative source of water supply to this washery can be made from abandoned mine void of Bokaro opencast mine (sector-2). The process of the proposed washery is based on **closed water circuit system**. All the water fed into the system will be collected after use and re-circulated after treatment in various units and no effluent will be allowed to escape into the natural drainage system..

Water requirement and Water Balance

The Washery is based on zero discharge system. Typical arrangement of Recirculation system in Karo washery resulting in a Zero discharge is shown below in **Fig. 2.2**



TYPICAL ARRANGEMENT OF RECIRCULATION SYSTEM IN KARO WASHERY

Power

Requirement of power depends on the throughput capacity and the process selected. The tentative requirement of power is about 7.5 MVA for operation & maintenance of the proposed washery.

EIA/EMP of Karo Expansion OCP (15 MTPA) & Integrated Washery (7.0 MTPA)

It is envisaged that the power at 33 kV level will be made available through an overhead transmission line (OHTL) from proposed sub-station of Karo OCP located at a distance of about 0.5 km from the washery site.

During construction period, power shall be supplied from the Excavation workshop of Karo OCP, which is at a distance of 0.5 km (approx.) through overhead line.

Railway siding for loading & dispatch of saleable products

Washed coal from the washed coal covered storage will be reclaimed and conveyed through set of covered belt conveyors to the Kargali Washery Railway siding. The tentative distance from the proposed washery site to the Railway siding is about 6.5 km. Washed coal will be loaded into Railway wagons through Rapid Loading System (3600/ 5500 tph) for onward transportation to consumers.

2.11 Disposal of Washery Rejects

Based on the technology selected, the likely average quantity of rejects to be produced from the washery has been estimated at about 1.7 Mty. A temporary reject storage site situated at the proposed washery, is identified for temporary storage of rejects. **Rejects produced from the washery shall be transported by covered belt conveyor to this storage site by the BOM Operator.** The rejects from this site shall be supplied to the proposed FBC based power plant near Konar Washery site by CCL.

Chapter 3

Description of Environment

3.1 General

In order to have comprehensive understanding of present environmental situation in proposed project area, a detailed study of micro meteorology, ambient air quality, water, noise, soil, socio-economy, flora-fauna and land use pattern have been done.

Study area, as framed in TOR by MOEF, is 10 km radius from the periphery of the project. All the base line data have been studied and assessed within this definition of study area. The references of studies and data collected for baseline data generation are as given below. The copy of QCI accreditation of the labs and copy of MoU are enclosed as Annexure V and Annexure IX.

Table 3.1 References of baseline data

Study	Based on References to
Socioeconomic profile	2011 census data
Social Profile	-Do-
Economic Profile	-Do-
Workforce Pattern	-Do-
Basic and Civic Amenities	-Do-
Household (HH) Survey	VRDS, Chennai
Land Use pattern	
Core zone	As per State Govt. record
Buffer Zone / Study area	Satellite Imagery Data
Meteorological trends	Indian Meteorological Department of the nearby area
Temperature trends	IMD Hazaribag
Rainfall trends	IMD Hazaribag
Micro-meteorological data	ECOMEN, Lucknow.
Wind temperature, speed and direction	-Do-
Relative Humidity	-Do-
Cloud Cover	-Do-
Rainfall	-Do-

Sl. No.	Study	Based on References to
5.00	Baseline data	Ecomen, Lucknow & CMPDI (One month Data, 16.09.18-15.10.18)
5.01	Air Quality	-Do-
5.02	Water Quality	-Do-
5.03	Noise Level	-Do-
5.04	Soil Quality	Ecomen, Lucknow
6.00	Forest, Flora and Fauna	VRDS Chennai
6.01	Forest	-Do-
6.02	Flora	-Do-
6.03	Fauna	-Do-
7.00	Hydrogeological	CMPDIL
8.00	Land degradation	CCL and CMPDIL
9.00	Solid Waste	CCL and CMPDIL
10.00	Hazard assessment	CCL and CMPDIL
10.01	Ground vibration	CCL and CMPDIL

3.2 Micro-meteorological Study

As a part of micro-meteorological study, micrometeorological and microclimatic parameters were recorded by installing an auto weather monitoring station within the core zone. Data wind speed, wind direction, ambient temperature, relative humidity, barometric pressure, cloud cover, sky appearance and rainfall on hourly basis during the study period (17/10/2015 – 16/01/2016).

3.2.1 Rationale behind Sampling

The transport and diffusion of the pollutants in the atmosphere is governed by meteorological factors. Factors like wind velocity; wind direction and atmospheric stability are known as primary/basic meteorological parameters since the dispersion and diffusion of pollutants depend mainly on these factors. Factors like ambient temperature, humidity, rainfall, atmospheric pressure etc, are known as secondary meteorological parameters as these factors control the dispersion of the pollutants indirectly by affecting the primary factors. Thus, to assess the air pollution impact it becomes essential to collect the above-mentioned meteorological parameters in the project area.

Parameters monitored, period and frequency of monitoring is given as in **Table-3.2**

Parameters Monitored

Parameters to be monitored	Period & Frequency of monitoring
Temperature	Hourly intervals continuously for 90 days in a season.
Wind Direction	--Do--
Wind Velocity	--Do--

Photographs Showing Baseline Data Collection



Meterological Station at karo



AAQ Monitoring at Work Shop Location of Karo OCP



Mine water Sampling @ Karo OCP



Soil Sampling in Agricultural Land (Pilipilo Narayan Pur)



Soil Sampling at OB Dump Area in Konar OCP



Water Sampling Surface Water Konar River



Noise Monitoring in Subhash Nagar Location

Calm condition	--Do--
Relative Humidity	--Do--

3.2.2 Methodology of Sampling

Wind velocity and wind direction were recorded using Cup Anemometer and Wind vane respectively. Ambient temperature was noted by Wet and Dry bulb thermometer. Relative humidity was measured by hygrometer. An aneroid barometer was used for measuring atmospheric pressure and self-recording rain gauge was used for rainfall data collection. Cloud cover data has been collected by visual inspection.

3.2.3 Data Collection and Analysis

Meteorological data collected at meteorological station representing the study area during the study period (17/10/2015 – 16/01/2016). Wind rose diagram has been shown in the **Plate no.VI**.

The following is the summary of the analysis of the Micro - meteorological data collected:

Table 3.2 Seasonal Wind Distribution

Season: Post-monsoon 2015 (17/10/2015 – 16/01/2016)

Karo Wind Rose(Frequency Distribution)								
	Directions / Wind Classes (m/s)	0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
1	348.75 - 11.25	22	0	0	0	0	0	22
2	11.25 - 33.75	31	0	0	0	0	0	31
3	33.75 - 56.25	34	0	0	0	0	0	34
4	56.25 - 78.75	5	0	0	0	0	0	5
5	78.75 - 101.25	42	0	0	0	0	0	42
6	101.25 - 123.75	52	0	0	0	0	0	52
7	123.75 - 146.25	38	0	0	0	0	0	38
8	146.25 - 168.75	61	0	0	0	0	0	61
9	168.75 - 191.25	132	0	0	0	0	0	132
10	191.25 - 213.75	72	0	0	0	0	0	72
11	213.75 - 236.25	16	0	0	0	0	0	16
12	236.25 - 258.75	7	0	0	0	0	0	7
13	258.75 - 281.25	10	0	0	0	0	0	10
14	281.25 - 303.75	75	0	0	0	0	0	75
15	303.75 - 326.25	170	0	0	0	0	0	170
16	326.25 - 348.75	45	0	0	0	0	0	45
	Sub-Total	812	0	0	0	0	0	812
	Calms							1394
	Missing/Incomplete							0
	Total							2206

3.3 Air Environment

To evaluate the baseline environmental status with respect to ambient air quality, baseline data at six locations in core and buffer zone of Karo OCP & Karo washery was assessed for the post monsoon period of 2015. Further, as per the Terms of Reference obtained in respect of Karo Expansion OCP and Integrated washery, validation of baseline environmental status has been done by monitoring ambient air quality at **8 stations** in core and buffer zone of Karo OCP & washery. The following criteria were taken into account during selection of the sampling locations for collection of representative samples:

- Topography of the area.
- Human settlements within the study area.
- Prevailing meteorological conditions in the region.
- Representation of the area.
- Safety, accessibility and non-interference with general routine of the people residing in the sampling location.

3.3.1 Methodology

The techniques used for measurement of pollutants may be summarized as under:

Measurement Techniques

Sl. No	Parameters	Code of Practice	Sampler	Instruments used for Analysis
01	PM ₁₀	IS: 5182 (Part-IV)	RDS Sampler with Cyclone Separator	Balance, Desiccator
02	PM _{2.5}	-	Fine Dust Sampler	Balance, Desiccator
03	SO ₂	IS: 5182 (Part-V)	RDS Sampler	Spectrophotometer
04	NO _x	IS: 5182 (Part-V)	RDS Sampler	Spectrophotometer

3.3.2 Sampling Locations, Parameters and Frequency of Sampling

Location of Air Monitoring stations have been shown In **Plate No. – VII A**. The air monitoring list is as given below –

Table 3.3 Sampling Location for Air Quality Monitoring

SI. No.	Location Name	Location Code	Direction (from Site)	Distance (Km)
1.	Workshop	A1	NE	0.70
2.	Baidyakaro	A2	SW	1.5
3.	Subhash nagar	A3	SE	0.50
4.	Charakpaniya	A4	N	0.30
5.	Khurpaniya colony	A5	W	1.50
6.	GM office*	A6	S	1.90
7	Amlu Basti	A7	SE	0.30
8	Kali Mandir	A8	NW	1.20

- A6- GM office falls within the Mining/ industrial area.

Air quality monitoring stations have been selected considering the predominant wind direction and areas having greater exposure to air pollution. Stations A1 & A2 fall within the core zone of the project and Station A6 falls in the core zone of adjacent project i.e., Kargali OCP and remaining stations fall within the buffer zone of project area.

Monitored Parameters and Frequency of Sampling

Sl. No.	Parameters	Sampling Frequency
01	PM ₁₀	2days/week (on 24 hourly basis)
02	PM _{2.5}	2days/week (on 24 hourly basis)
03	Sulphur dioxide (SO ₂)	2days/week (on 24 hourly basis)
04	Oxides of Nitrogen (NO _x)	2days/week (on 24 hourly basis)

3.3.3 Observations

Ambient air quality was monitored at 6 locations (A1 to A6) during the period (17/10/2015 – 16/01/2016) and validation of air quality data was done through one month data generated at 8 locations (A1 to A8) during the period 16.09.2018 – 15.10.2018 within study area.

The summary of air quality monitoring data during the period (17/10/2015 – 16/01/2016) for 6 locations is as given below.

Table 3.4 Maximum and Minimum value of Ambient Air Results

Period: (17/10/2015 – 16/01/2016)

Sl. No.	Parameter Locations	PM _{2.5} (µg/m ³)		PM ₁₀ (µg/m ³)		SO ₂ (µg/m ³)		NO _x (µg/m ³)	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1.	WORKSHOP(A- 1)	81.10	54.80	166.10	145.70	28.60	20.30	36.60	24.40
2.	BAIDYA KARO (A-2)	68.60	55.90	144.30	128.90	22.30	13.30	50.70	16.10
3.	SUBHASH NAGAR (A- 3)	43.10	35.20	70.30	60.00	21.40	13.30	52.00	17.70
4.	CHARAKPANIYA (A- 4)	48.20	39.00	73.00	61.30	19.70	8.80	53.00	18.10
5.	KHURPANIA COLONY (A-5)	52.00	41.30	78.20	68.20	12.75	9.00	50.10	23.60
6.	GM OFFICE (A-6)*	60.00	50.20	82.50	70.10	11.25	7.79	38.70	23.30

- A6- GM office falls under core zone of Kargali OCP.

Table 3.5 Analysis of Heavy Metals in PM₁₀ Samples*Unit: µg/m³*

Location Code	As	Co	Hg	Se	Cr	Cu	Mn	Ni	Pb	Zn
A1	BDL	BDL	BDL	BDL	BDL	0.04	0.14	0.15	0.15	1.60
A2	BDL	BDL	BDL	BDL	BDL	0.07	0.13	0.12	0.16	1.55
A3	BDL	BDL	BDL	BDL	BDL	0.03	0.12	0.14	0.12	1.30
A4	BDL	BDL	BDL	BDL	BDL	0.02	0.16	0.15	0.10	1.46
A5	BDL	BDL	BDL	BDL	BDL	0.04	0.14	0.14	0.11	1.32
A6	BDL	BDL	BDL	BDL	BDL	0.03	0.12	0.16	0.10	1.61
Detection Limit (ppm)	0.008	0.01	0.001	0.01	0.04	-	-	-	-	-

Table 3.6 Analysis of free SiO₂ in PM₁₀ Samples

Location Code	Date of Monitoring	
	09.11.15	21.12.15
A1	1.20	1.00
A2	1.14	1.18
A3	1.22	1.10
A4	1.15	0.97
A5	0.90	0.95
A6	1.21	0.85

From the baseline air quality data, it can be observed that all values of criteria pollutants monitored are well within the limits. Further analysis particulate matter for heavy metals and SiO₂ also do not show any significant pollution levels in core and buffer zone.

As desired by the EAC, validation of baseline air quality data has been done for one month (16.09.2018 – 15.10.2018) over 8 stations within core and buffer zone.

Maximum and Minimum value of Ambient Air Results

Period: (16.09.2018 – 15/10/2018)

Sl. No.	Parameter Locations	PM _{2.5} (µg/m ³)		PM ₁₀ (µg/m ³)		SO ₂ (µg/m ³)		NO _x (µg/m ³)	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1.	WORKSHOP (A- 1)	76	55	172	149	<25	<25	<6	<6

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2.	BAIDYA KARO BASTI (A- 2)	67	52	148	128	<25	<25	<6	<6
3.	SUBHASH NAGAR (A- 3)	43	36	77	64	<25	<25	<6	<6
4.	CHARAKPANIYA (A- 4)	50	34	80	65	<25	<25	<6	<6
5.	KHURPANIA COLONY (A- 5)	44	34	77	63	<25	<25	<6	<6
6.	GM OFFICE* (A- 6)	70	51	160	70	<25	<25	<6	<6
7	AMLO BASTI (A-7)	62	52	86	71	<25	<25	<6	<6
8	KALI MANDIR (A-8)	50	42	85	75	<25	<25	<6	<6

- A6- Station situated near mining/ industrial activity.

From the seasonal base line data and the validation data, it can be observed that that all values of criteria pollutants monitored are within the limits and there is no significant change in the baseline environmental status of core and buffer zone.

3.4 Water Environment

The monitoring of water quality has been conducted by collecting water samples from ground water, surface water and mine water discharge / workshop discharge (if any) for the proposed project. The various purposes of the water environment monitoring are as follows:

- To assess the water quality characteristics for critical parameters;
- To evaluate the impacts on agricultural productivity, habitat conditions, creational resources and aesthetics in the vicinity ; and
- To facilitate predication of impact on water quality by project activities.

3.4.1 Methodology

Grab sampling method was adopted for collection of ground water sample from hand-pump, waste water and surface water samples from different sources of water bodies.

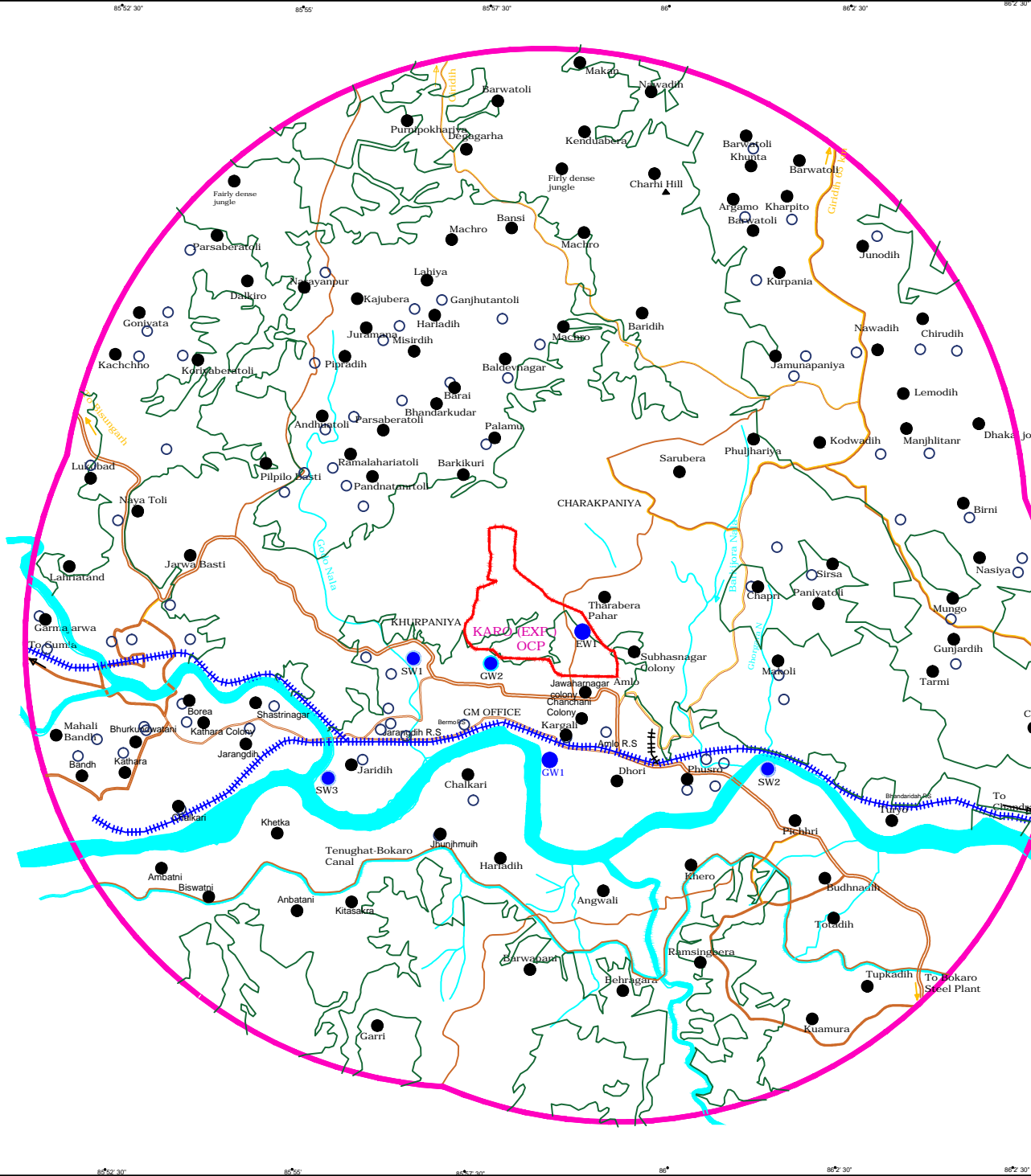
Three nos. of samples for ground water, five nos. of surface water and four numbers of waste water were collected as representative samples to assess water quality of the area during study period. These samples were analyzed as per "Standard Method for the Examination of Water & Waste Water" published by American Public Health Association (APHA: 21st Edition, 2005).

3.4.2 Sampling Locations

Sampling location of water monitoring stations is given below and shown in **Plate VII B:**

Table 3.7 Location of water Quality Sampling Stations

S.No	Source	Location
01	Ground Water	1- Bhutia Tand, Hand Pump-GW₁



- GROUND WATER LOCATION** ●
- HAND PUMP IN BHUTIA TAND - GW1
 - HAND PUMP IN BAIDYA KARO BASTI - GW2
- SURFACE WATER LOCATION** ●
- GODDO NALA - SW1
 - DAMODAR RIVER - SW2
 - KONAR RIVER - SW3
- EFFLUENT WATER LOCATION** ●
- KARO OCP DISCHARGE - EW1

PLATE NO- 8B

REF. - Drawn No. - XYZABC - REV. No. - PNO DATED ---/---/---		Copyright in this drawing is vested in CMPDI Unauthorized copying or use is not permitted.	
Customer CENTRAL COALFIELDS LIMITED			Job No. 311120
Job Title EIA / EMP OF KARO (EXPANSION) OCP (11MTY) AND KARO WASHERY (7MTY)			
Subject	Activity	Name	Designation
LOCATION MAP OF WATER MONITORING STATION	Prepared by		
	Processed by		
	Checked by		
Approved by			
Scale 500 9 500 1500 M		Sheet 1 OF 1	
CMPDI ISO 9001 Company		REV. No. 0	

		2- Bore Well of Baidya Karo Basti - GW₂
02	Surface Water	1- Godda Nala- SW₁ (U/S) 2- Damodar River - SW₂(D/S) 3- Konar River- SW₃(U/S)
03	Effluent Water:	1. Lagoon Discharge K1 2. Lagoon Discharge K2

3.4.3 Ground Water Quality

The ground water quality was monitored at two locations Bhutia Tand, Hand Pump (GW1) and Bore Well of Baidya Karo Basti (GW2) during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one month (16.09.2018 – 15/10/2018) ground water quality data has been generated by CMPDI at the same locations for comparison and validation of baseline data.

Table 3.8 Ground water Quality

Period :(17/10/2015 – 16/01/2016)

Location Code	pH	TDS (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	Nitrate (mg/l)	Iron (mg/l)	Total Coliform (MPN/100ml)
GW-1	7.44	389	26	0.91	8.81	0.14	Absent
GW-2	6.94	394	28	0.89	10.10	0.16	Absent
IS: 10500:1991 (Reaff:2012)	6.5-8.5	500	250	1.00	45.00	0.3	Absent

Table 3.9 Ground water Quality- Validation

Period: (16.09.2018 – 15/10/2018)

SN	Parameter	Sampling Stations		Detection Limit	IS:10500 Standards	Standard / Test Method
		GW-1	GW-2			
1	Boron (as B), mg/l, Max	<0.20	<0.20	0.20	0.5	APHA, 22 nd Edition ,Carminc
2	Cadmium (as Cd), mg/l, Max	<0.0005	<0.0005	0.0005	0.003	APHA, 22 nd Edition, AAS-GTA
3	Calcium (as Ca), mg/l, Max	60.8	43.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	70	16	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.10	1.26	0.02	1.0	APHA, 22 nd Edition , SPADNS
7	Free Residual	<0.02	<0.02	0.02	0.2	APHA, 22 nd Edition, DPD

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	Chlorine, mg/l, Min					
8	Iron (as Fe), mg/l, Max	<0.06	0.14	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	0.005	0.01	APHA, 22 nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.05	0.12	0.02	0.1	IS-3025/59:2006,AAS-Flame
11	Nickel (as Ni), mg/l, Max	0.01	<0.01	0.01	0.02	IS-3025/54:2003, AAS-Flame
12	Nitrate (as NO ₃), mg/l, Max	3.56	1.49	0.5	45	APHA, 22 nd Edition, UV-Spectrophotometric
13	Odour	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
14	pH value	7.32	7.98	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
15	Phenolic compounds (as C ₆ H ₅ OH), mg/l, Max	<0.001	<0.001	0.001	0.001	APHA, 22 nd Edition, 4-Amino Autipyrine
16	Selenium (as Se), mg/l, Max	<0.002	0.003	0.002	0.01	APHA, 22 nd Edition, AAS-GTA
17	Sulphate (as SO ₄) mg/l, Max	58	17	2.00	200	APHA, 22 nd Edition. Turbidity
18	Total Alkalinity (CaCO ₃), mg/l, Max	162	140	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Dissolved Solids, mg/l, Max	380	218	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
21	Total Hardness (CaCO ₃), mg/l, Max	189	160	4.00	200	IS-3025/21:1983, R-2002, EDTA
22	Turbidity, NTU, Max	1	6	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
23	Zinc (as Zn), mg/l, Max	0.56	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

The ground water quality during baseline study is presented in Table 3.12 and the validation of data is presented in Table 3.13. From the validation data it can be observed that all the parameters including pH, TDS etc are within limits and represent the natural ground water quality pattern of that area.

3.4.4 Surface Water Quality Data

The surface water quality was monitored at three locations Godda Nalla (SW1) (U/S), Damodar River (SW2) (D/S) and Konar River (SW3) (U/S) during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one month (16.09.2018 – 15/10/2018) surface water quality has been generated by CMPDI at the same locations for comparison study and validation of baseline data.

Table 3.10 Surface Water Quality

Period: (17/10/2015 – 16/01/2016)

Location Code	pH	TDS (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	Nitrate (mg/l)	Iron (mg/l)	Total Coliform (MPN/100ml)
SW-1 (U/S)	7.41	452	50.0	0.38	8.00	0.06	160
SW-2 (D/S)	7.46	400	42.5	0.43	8.48	0.14	180
SW-3 (U/S)	7.31	410	48.0	0.48	5.86	0.098	120

Table 3.11 Surface Water Quality- Validation

Period: (16.09.2018 – 15/10/2018)

Sl. No	Parameter	Sampling Stations				Detection Limit	BIS Standard & Method
		SW1	SW2	SW3			
1	Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002		0.002	IS 3025/37:1988 R : 2003, AAS-VGA
2	BOD (3 days 27°C), mg/l, Max	2.4	2.4	6.2		2.00	IS 3025 /44: 1993, R : 2003 3 day incubation at 27°C
3	Cadmium(as Cd), mg/l, Max	<0.0005	<0.0005	<0.0005		0.0005	APHA, 22 nd Edition AAS-GTA
4	Chlorides (as Cl), mg/l, Max	14	14	14		2.00	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03		0.03	IS 3025 /42 : 1992 R : 2009, AAS-Flame
6	Disolved Oxygen, min.	6.3	6.3	6.2		0.10	IS 3025/38:1989, R : 2003, Winkler Azide
7	Fluoride (as F) mg/l, Max	0.91	0.66	0.17		0.02	APHA, 22 nd Edition SPADNS
8	Hexavalent Chromium, mg/l, Max	<0.01	<0.01	<0.01		0.01	APHA, 22 nd Edition, 1,5 - Diphenylcarbohydrazide
9	Iron (as Fe), mg/l, Max	<0.06	0.30	1.53		0.06	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
10	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005		0.005	APHA, 22 nd Edition AAS-GTA
11	Nitrate (as NO ₃), mg/l, Max	5.39	2.47	<0.50		0.50	APHA, 22 nd Edition, UV-Spectrophotometric
12	pH value	7.24	7.96	7.54		0.2	IS-3025/11:1983, R-1996, Electrometric

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13	Phenolic compounds (as C ₆ H ₅ OH), mg/l, Max	<0.00 1	<0.001	<0.001		0.001	APHA, 22 nd Edition 4-Amino Antipyrine
14	Selenium (as Se), mg/l, Max	<0.00 2	0.003	0.003		0.002	APHA, 22 nd Edition AAS-GTA
15	Sulphate (as SO ₄) mg/l, Max	25	45	08		2.00	APHA, 22 nd Edition Turbidity
16	Total Dissolved Solids, mg/l, Max	168	164	104		25.00	IS 3025 /16:1984 R : 2006, Gravimetric
17	Total Suspended Solids, mg/l, Max	10	28	72		10.00	IS 3025 /17:1984, R :1996, Gravimetric
18	Zinc (as Zn), mg/l, Max	0.02	0.01	0.02		0.01	IS 3025 /49 : 1994, R : 2009, AAS-Flame

The surface water quality data shows that there is no significant adverse impact of mining operations on the surrounding surface water bodies like River Bokaro, River Damodar and Goddo Nala.

3.4.5 Effluent Water Quality

The effluent water quality was monitored at two locations Lagoon Discharge (KW1) and lagoon discharge (KW2) during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one month (16.09.2018 – 15/10/2018) effluent water quality data has been generated by CMPDI at the same locations for comparison and validation of baseline data.

Table 3.12 Effluent Water Quality

Period: (17/10/2015 – 16/01/2016)

Location Code	pH	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	Chloride (mg/l)	O & G(mg/l)	Ammonical Nitrogen as NH ₃ -N (mg/l)
EW-1	7.46	10.1	3.0	8.0	40.0	BDL	0.22
GSR 422(E) Std.	5.5-9.0	100	30	250	2.0	10.0	50.0

Table 3.13 Effluent Water Quality- Validation

Period: (16.09.2018 – 15/10/2018)

Sl.No.	Parameter	Sampling Stations			Detection Limit	MOEF -SCH-VI STANDARDS Class 'A'	BIS Standard & Method
		1	2	3			
1	Ammonical Nitrogen, mg/l, Max	0.14	0.15		0.02	50.0	IS 3025/34:1988, R : 2009, Nessler's
2	Arsenic (as As), mg/l, Max	<0.002	<0.002		0.002	0.2	IS 3025/37:1988 R : 2003, AAS-VGA
3	B.O.D (3 days 27°C), mg/l, Max	6.0	6.0		2.00	30.0	IS 3025 /44:1993,R:2003 3 day incubation at 27°C
4	Cadmium(as Cd), mg/l, Max	<0.0005	<0.0005		0.0005	2.0	APHA, 22 nd Edition, AAS-GTA
5	COD, mg/l, Max	20	24		4.00	250.0	APHA, 22 nd Edition, Closed Reflux, Titrimetric
6	Copper (as Cu), mg/l, Max	<0.03	<0.03		0.03	3.0	IS 3025/42: 1992 R : 2009, AAS-Flame

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7	Dissolved Phosphate, mg/l, Max	0.38	0.35	0.30	5.0	APHA, 22 nd Edition Molybdovanadate
8	Fluoride (as F) mg/l, Max	1.23	1.24	0.02	2.0	APHA, 22 nd Edition, SPADNS
9	Free Ammonia, mg/l, Max	<0.02	<0.02	0.02	5.0	IS:3025/34:1988, Nessler's
10	Hexavalent Chromium, mg/l, Max	<0.01	<0.01	0.01	0.1	APHA, 22 nd Edition, Diphenylcarbohydrazide
11	Iron (as Fe), mg/l, Max	<0.06	<0.06	0.06	3.0	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
12	Lead (as Pb), mg/l, Max	<0.005	<0.005	0.005	0.1	APHA, 22 nd Edition, AAS-GTA
13	Manganese(as Mn), mg/l, Max	0.02	<0.02	0.02	2.0	IS-3025/59:2006, AAS-Flame
14	Nickel (as Ni), mg/l, Max	0.01	0.02	0.01	3.0	IS-3025/54:2003, AAS-Flame
15	Nitrate Nitrogen, mg/l, Max	2.48	2.53	0.50	10.0	APHA, 22 nd Edition, UV-Spectrophotometric
16	Oil & Grease, mg/l, Max	<2.00	<2.00	2.00	10.0	IS 3025/39:1991, R : 2003, Partition Gravimetric
17	pH value	7.81	7.21	0.2	5.5 to 9.0	IS-3025/11:1983, R-1996, Electrometric
18	Phenolic compounds (as C ₆ H ₅ OH),mg/l, Max	<0.001	<0.001	0.001	1.0	APHA, 22 nd Edition 4-Amino Antipyrine
19	Selenium (as Se), mg/l, Max	0.005	0.005	0.002	0.05	APHA, 22 nd Edition, AAS-GTA
20	Sulphide (as SO ₃), mg/l, Max	<0.005	<0.005	0.005	2.0	APHA, 22 nd Edition Methylene Blue
21	Temperature (°C)	28	28	Shall not exceed 5° C above the receiving temp.		IS-3025/09:1984, Thermometric
22	Total Chromium (as Cr), mg/l, Max	0.22	0.26	0.04	2.0	IS-3025/52:2003, AAS-Flame
23	Total Kjeldahl Nitrogen, mg/l, Max	<1.00	<1.00	1.00	100.0	IS:3025/34:1988, Nessler's
24	Total Residual Chlorine, mg/l, Max	<0.02	<0.02	0.02	1.0	APHA, 22 nd Edition, DPD
25	Total Suspended Solids, mg/l, Max	32	34	10.00	100.0	IS 3025/17:1984, R :1996, Gravimetric
26	Zinc (as Zn), mg/l, Max	0.01	0.02	0.01	5.0	IS 3025 /49 : 1994, R : 2009, AAS-Flame

The effluent water quality data shows that there is no significant change in the baseline environmental status of project area.

3.5 Noise Environment

3.5.1 Rationale behind ambient noise quality monitoring

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. Noise monitoring locations have been identified based on the activities in the inhabited and mining areas.

The ambient noise quality monitoring stations were set up at six locations, two locations in core zone and four locations in buffer zone area during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one-month (16.09.2018 – 15/10/2018) noise quality has been generated by CMPDI at the same locations for comparison and validation of baseline data.

Locations were selected for noise quality monitoring in study area with consent of customer. Ambient noise monitoring was done for 24 hours, twice a month during study period. Details of the selected locations are as follows:

3.5.2 Sampling Locations

Details of sampling location and location map is shown in **Plate No. VII A**

List of noise monitoring stations-

- i. Workshop-N₁
- ii. Baidya Karo Basti-N₂
- iii. Shubhash Nagar Colony-N₃
- iv. Charakpaniya-N₄
- v. Khurpaniya Colony-N₅
- vi. GM office-N₆
- vii. Amlo Basti- N₇
- viii. Kali Mandir Gandhi Nagar- N₈

Table 3.14 Day & Night Time Noise Level Data

Period: (17/10/2015 – 16/01/2016)

Date	Noise Level in dB (A)		LOCATIONS CODE					
			N ₁	N ₂	N ₃	N ₄	N ₅	N ₆
19.10.2015	L _{eq}	Day	61.8	54.8	63.6	61.3	52.3	51.6
		Night	54.0	44.6	56.4	53.9	43.1	42.6
10.11.2015	L _{eq}	Day	60.5	54.8	63.9	60.2	53.6	51.9
		Night	53.9	44.8	56.9	52.6	44.2	45.6
25.11.2015	L _{eq}	Day	61.3	54.5	62.6	59.3	52.6	50.3
		Night	53.2	44.3	53.6	49.3	43.5	43.2
10.12.2015	L _{eq}	Day	60.5	54.6	61.2	57.8	52.6	50.3
		Night	53.9	44.5	51.3	46.2	43.5	43.6
25.12.2015	L _{eq}	Day	63.6	53.9	58.5	56.3	52.5	50.1
		Night	54.6	45.0	51.0	43.0	44.2	43.9
09.01.2016	L _{eq}	Day	63.0	54.2	57.0	56.2	51.8	50.0
		Night	54.3	44.9	48.1	44.2	42.8	43.7

Table 3.15 Noise data – Validation

Period: (16.09.2018 – 15/10/2018)

Station Name	Date of Sampling	Noise Level
Workshop	18/09/2018	53.7
Baidya Karo Basti	18/09/2018	51.6
Subhash Nagar	18/09/2018	52.2
Churpaniya	18/09/2018	51.3
Khurpaniya Colony	20/09/2018	53.8
G.M.Office	20/09/2018	51.1
Amlo Basti	20/09/2018	52.7
Kali Mandir Gandhi Nagar	20/09/2018	51.1

From the above observations, it may be concluded that the Noise levels are in good compliance with the National Ambient Air Quality Standards (NAAQS) for Industrial and Residential areas.

3.6 Soil Quality

Three sampling locations were fixed to represent the entire area and samples were collected on seasonal basis from each location from three depths viz. 0-30, 30-60, 60-90cm.

3.6.1 Methodology

Soil samples were collected by digging at the appropriate location from depths 0-30, 30-60 and 60-90cm with the help of a spade and a 'Khurpi' and processed in Lab. The processed samples were analyzed for the different parameters according to the standard methods as described under Jackson, M.L., 'Soil Chemical Analysis', Indian Council of Agricultural Research, New Delhi, 'Hand Book of Agriculture', IS:2720 (Part IV), 1975 and IS:2720, Part (V), 1970 ; Methods of Soil Analysis, Part I & II, Black, CA et.al. American society of Agronomy, Inc. USA, 1965.

3.6.2 Rationale Behind Sampling

The main aim of the soil testing is to assess the soil quality of the area for assessment of impact of developmental activities on soil and production potential, selection of suitable species of plants for green belt and afforestation as an anti pollution measures.

3.6.3 Sampling Locations

Details of sampling location are shown on location map is shown in **Plate no. VII C**

3.6.4 Observations

The detailed observation made for soil quality during the study period is below -

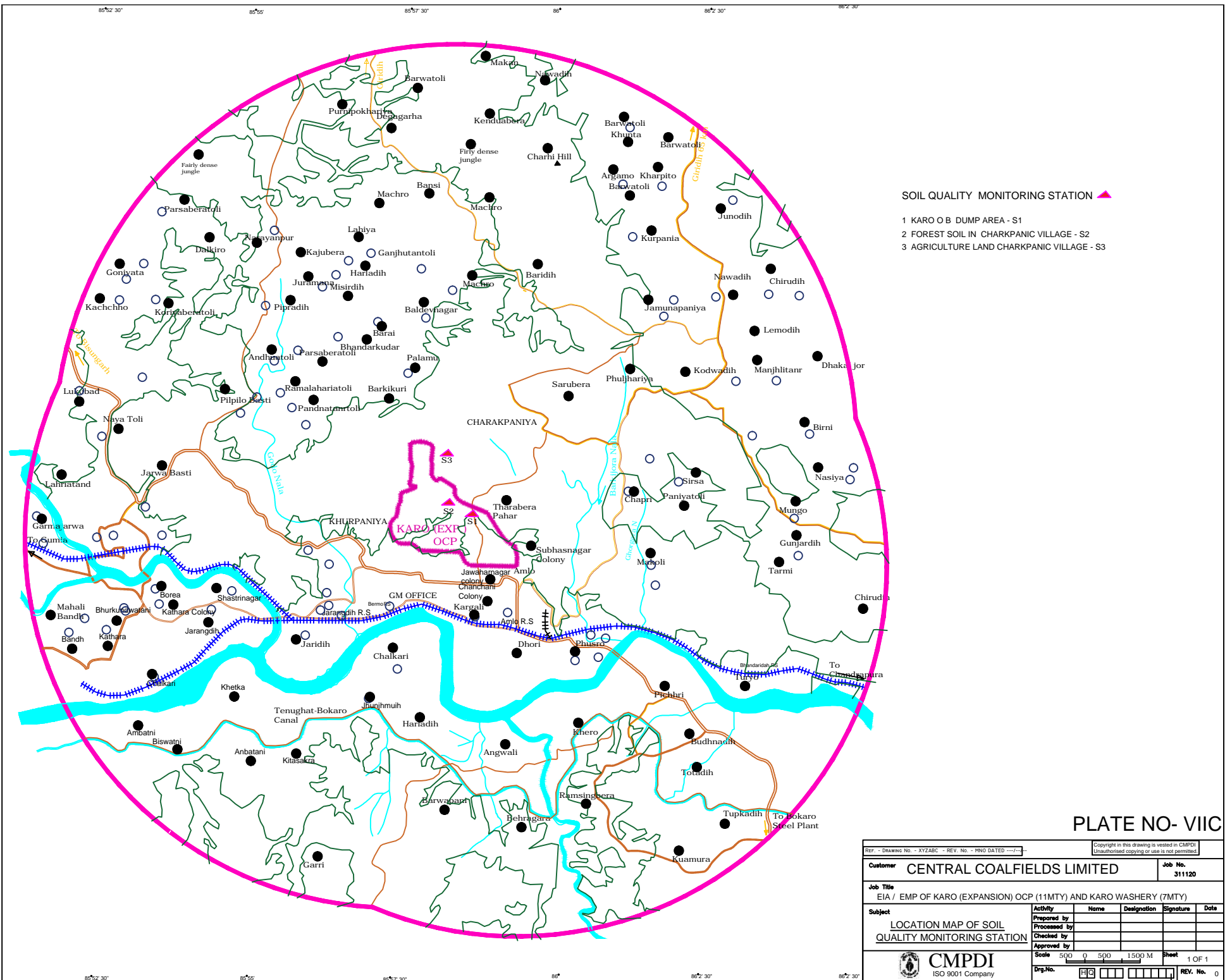
Location: Karo OB Dump Area (S-1)

Date of Sample Collection: 05.11.2015

Period of Analysis: 10.11.2015 to 20.11.2015

Table 3.16 Soil Analysis Results (S-1)

SI. No.	PARAMETERS	Results		
		30 cm	60 cm	90 cm
1	pH	7.36	7.52	7.61
2	Elec.Conductivity(μ mhos/cm)	1.48	2.00	1.48
3	Nitrogen Av.(kg/ha)	196.00	201.00	208.60
4	Phosphorous Av.(mg P ₂ O ₅ (kg/ha)	14.61	16.21	16.10
5	Potassium Av.(kg/ha)	171.00	188.60	188.98
6	SAR (meq/l)	7.51	7.56	7.38
7	WHC (%)	9.14	9.24	9.21



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Sl. No.	PARAMETERS	Results		
		30 cm	60 cm	90 cm
8	Organic Carbon (%)	1.08	0.92	1.10
9	Specific Gravity (%)	1.31	1.48	1.36
10	Field capacity (%)	10.41	10.31	11.10
11	Wilting Coefficient	0.70	0.76	0.72
12	Grain Size Distribution			
a)	Textural Class	Clay	Clay	Sandy Clay
b)	Sand (%)	18	14	16
c)	Silt (%)	33	37	39
d)	Clay (%)	52	51	46
13	Cation Exchange Capacity (meq/100g)	4.80	4.56	3.98

Table 3.17 Soil Analysis Results (S-2)

Location: Charkpania Village, Forest Land (S-2)

Date of Sample Collection: 05.11.2015

Period of Analysis: 10.11.2015 to 20.11.2015

Sl. No.	PARAMETERS	Results		
		30 cm	60 cm	90 cm
1	pH	7.28	7.40	7.48
2	Elec. Conductivity (μ mhos/cm)	1.21	1.38	1.31
3	Nitrogen Av. (kg/ha)	188.00	194.60	200.12
4	Phosphorous Av. (mg P2O5 (kg/ha)	17.10	14.87	15.96
5	Potassium Av. (kg/ha)	172.50	181.30	182.40
6	SAR (meq/l)	7.98	7.29	7.48
7	WHC (%)	7.96	8.31	8.98
8	Organic Carbon (%)	0.91	0.86	0.89
9	Specific Gravity (%)	0.92	0.98	0.91
10	Field capacity (%)	8.14	8.82	9.43
11	Wilting Coefficient	0.59	0.58	3.72
12	Grain Size Distribution			
a)	Textural Class	Clay	Clay	Sandy Clay
b)	Sand (%)	14	16	13
c)	Silt (%)	36	31	39
d)	Clay (%)	50	53	48
13	Cation Exchange Capacity (meq/100g)	4.98	4.89	4.10

Table 3.18 Soil Analysis Results (S-3)

Location: Charkpania Village, Agriculture Land (S-3)

Date of Sample Collection: 05.11.2015

Period of Analysis: 10.11.2015 to 20.11.2015

SI. No.	PARAMETERS	Results		
		30 cm	60 cm	90 cm
1	pH	7.28	7.40	7.48
2	Elec.Conductivity (μ mhos/cm)	1.21	1.38	1.31
3	Nitrogen Av.(kg/ha)	188.00	194.60	200.12
4	Phosphorous Av.(mg P ₂ O ₅ (kg/ha)	17.10	14.87	15.96
5	Potassium Av.(kg/ha)	172.50	181.30	182.40
6	SAR (meq/l)	7.98	7.29	7.48
7	WHC (%)	7.96	8.31	8.98
8	Organic Carbon (%)	0.91	0.86	0.89
9	Specific Gravity (%)	0.92	0.98	0.91
10	Field capacity (%)	8.14	8.82	9.43
11	Wilting Coefficient	0.59	0.58	3.72
12	Grain Size Distribution			
a)	Textural Class	Clay	Clay	Sandy Clay
b)	Sand (%)	14	16	13
c)	Silt (%)	36	31	39
d)	Clay (%)	50	53	48
13	Cation Exchange Capacity (meq/100g)	4.98	4.89	4.10

3.7 Hydrogeological Features

3.7.1 Methodology

The hydrogeological assessment of karo Expansion OCP and Integrated washery has been done using GEC-1997. Report of the Groundwater Resource Estimation Committee regarding changes in methodology to estimate Groundwater Resource calculation was published by Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delhi on May'2017. The methodology is named as GEC-2015 which will be implemented and followed by CGWB and other organizations related to groundwater assessment as needed. As discussion held with CGWB officials, at present GEC-1997 methodology is being followed

and new methodology is under adaptation and required some time to be implemented. Groundwater Resource Estimation of any area requires huge database and a time frame of at least one hydrogeological cycle (12 months) and after calculation it should be verified with field conditions. It is a continuous process and adaptation of new norms required time depending upon volume of study area.

However, to adopt the GEC-2015 norms specially in coal mining areas a training has been requested at CGWB, Raipur (RGNGWTRI, CGWB training institute) so that Hydrogeologist from CMPDI can implement GEC-2015 norms as soon as possible into their respective coalfields. It is requested to the committee that hydrogeological assessment using GEC-1997 norms may please be accepted. Moreover, latest groundwater resource estimation of Taluks/Blocks/Districts provided by CGWB is still as per GEC-1997 norms.

3.7.2 Drainage Pattern

The Damodar River rises in the Palamau hills of Chhota Nagpur at an elevation of about 610 m above Mean Sea Level (MSL). The area drained by the Damodar River at its mouth is about 22, 015 sq. km and the river is about 592 km in length. The drainage in the entire East-Bokaro Coalfields and the adjoining areas is controlled by the Damodar river and Konar river (Tributary of Damodar river) running from west to east in the buffer zone. The northern part of the buffer zone is drained by Godo Nala, Barkijora Nala and Barki Nala, all are 4th order streams. Godo Nala and Barkijora Nala are the tributaries of Damodar River whereas Barki Nala is the tributary of Konar Nadi (5th order stream) in the buffer zone. Khanjo Nala is flowing towards north in the southern part of buffer zone and join Damodar River.

Damodar River flows from west to east and the run-off from within the coalfields and also adjoining areas during monsoon, drains into this river through seasonal nalas flowing in southerly direction. The drainage map of the buffer zone was prepared on topographic map of scale 1:50 000 (**Plate: III A**). The drainage pattern of the area is dendritic in nature. A dendritic drainage pattern is the most common form and looks like the branching pattern of tree roots. The subsurface geology has a similar resistance to weathering so there is no apparent control over the direction the tributaries take. There are a number of ponds and tanks in the area. Damodar River, a 6th order stream in the study area (Buffer zone) is the master drainage of the area.

Mining/Project area: The area under Karo (Expansion) OCP mining area is drained by two seasonal nalas (3rd order) namely Gati Nala and Karo Nala flowing towards south and acts as path-ways to the surface run-off from the mine area to Damodar River. All these nalas have general slopes towards south. At present working in Quarry-I is limited due to presence of Karo Nala. To enhance the production it is proposed to divert the Karo Nala and expand the mine strike completely thereby facilitating HEMM deployment. At present the mine is near vertical in the east side near Karo Nala. The Gati Nala flowing alongside the western boundary of the Quarry-II. The boundary of Quarry-II is limited to 60 m distance from the Gati Nala. The HFL of Gati Nala and Karo Nala have been recorded as 245m and 244 m respectively. It is proposed to make protective embankment for Quarry-II by filling of OB dump along Gati Nala. The height of protective embankment has been proposed to not less than 250 m. The watershed map has been attached as **Plate III B**.

3.7.3 Aquifer Description

The permeable formations i.e. sand and sandstone within Gondwanas behave as aquifer. The coal seams and shales developed act as impermeable beds i.e. aquiclude. The Karo OCP block is covered by recent soil and alluvium. Below the alluvium/soil cover thick Barakar and Karharbari formations including coal seams have been developed. Based on the sub-surface geological data generated from the exploratory boreholes and existing mines, the disposition of aquifers has been worked out up to the bottommost seam i.e. Seam-III. The aquifer description is given below.

Table 3.19 Aquifer Description in Karo Block

Hydrogeological Unit	Formation	Thickness in meters
Unconfined aquifer	Alluvium, sandy soil and weathered sandstone of Gondwanas. Fine to Medium grained sandstone, shale, siltstone etc.	25.00 m
Aquiclude	Bermo Seam (<i>Not proposed to work</i>)	12.27
Semi-confined aquifer	Medium grained sandstone, carbonaceous shale	13.64
Aquiclude	Local seam (<i>Not proposed to work</i>)	0.44-0.76
Semi-confined aquifer	Fine grained sandstone	28.00 to 33.00
Aquiclude	Seam XI (<i>Proposed to work</i>)	0.91 to 3.14
Semi-confined aquifer	Medium grained sandstone, carbonaceous shale, and sandy shale.	3.00 to 16.00
Aquiclude	Seam-X (<i>Proposed to work</i>)	10.57 to 14.80
Semi-confined aquifer	Medium grained sandstone, carbonaceous shale, and sandy shale.	5.00 to 38.00
Aquiclude	Seam-IX (<i>Proposed to work</i>)	2.56 to 5.38
Semi-confined	Fine sandstone, sandy shale, carbonaceous	0.38 to

Hydrogeological Unit	Formation	Thickness in meters
aquifer	shale,	15.86
Aquiclude	Seam-VI/VII/VIII or Seam-VIII (<i>Proposed to work</i>)	12.65 to 36.25
Semi-confined aquifer	Sandy shale, carbonaceous shale,	0.84 to 6.15
Aquiclude	Seam-VII/VI (<i>Proposed to work in Quarry-II</i>)	9.40 to 18.51
Semi-confined aquifer	Medium grained sandstone, carbonaceous shale, and sandy shale.	27.56 to 40.53
Aquiclude	Seam-V	0.27 to 3.88
Semi-confined aquifer	Medium to coarse grained sandstone, sandy shale and alternating shale and fine grained sandstone	9.40 to 20.91
Aquiclude	Seam-IV	0.11 to 0.77
Semi-confined aquifer	Medium grained sandstone and sandy shale.	1.35 to 7.63
Aquiclude	Seam-III	1.0 to 3.76

3.7.4 Type of Aquifers

1. Unconfined aquifer
2. Semi-confined aquifers

UNCONFINED AQUIFER

In the core zone, soil / alluvium and weathered sandstone together with sandstone and siltstone of Barakar Formation lying above the top most seam constitute the material for top unconfined aquifer. The permeable formations mainly composed of sandstone behave as

aquifer units. The coal seam and shales developed in the area act as impermeable beds i.e. aquiclude. The average thickness of the unconfined aquifer above top most coal seams is 25 m.

While in the buffer zone, the alluvium, weathered sandstone of Gondwanas and weathered metamorphic rocks including granite gneiss, hornblende gneiss, schists, amphibolites and pegmatites etc constitutes this aquifer. The thickness of the unconfined aquifer varies from 1.00 m to 12.00 m in the area covered by metamorphic rocks. An area of 350.27 sq. km (77.8% of total area) out of total area of 450.45 sq. km (Buffer zone) is covered by metamorphic rocks in the buffer zone. Only 100.18 sq. km of area is covered by Gondwana group of rocks in Buffer zone.

In general, soil/alluvium possess moderate to high porosity and infiltration factor. Thus, the ground water potential is generally moderate to high in soil/alluvium while it is poor in hard, compact sandstone. In the unconfined aquifer, ground water moves laterally through the inter-granular spaces in the sandstone. Generally the water table in the unconfined aquifer is conforming to the local topography. But water table contour does not follow the local topography in the active mining area due to impact of mine pumping on ground water.

This aquifer becomes the source of drinking water tapped in dug wells and Hand pump tube-wells in the area. Ground water occurs in this aquifer under water table conditions.

SEMI-CONFINED AQUIFERS

The deep-seated sandstone partings between coal seams 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 lower aquifers are divided into multi aquifer system due to presence of persistent impervious thick coal seams.

In these lower aquifers the ground water movement is restricted mainly through joints and fractures (i.e. secondary porosity). With the presence of intercalated shale and carbonaceous shale beds and reduction in permeability with depth, the lower aquifers are poor in potential.

A total nine number of semi-confined aquifers are up to the floor of the bottommost seam of the proposed Karo Expansion mining area as shown **Table No-3.20**. The individual average thickness of these aquifers varies from 0.38 m to 40.00 m. The top and bottom of this aquifer is marked by impervious bed of shale or coal seams. The recharge to this aquifer takes place due to infiltration of direct rainfall in the outcrop zones/areas of these partings and interconnections formed by faults, fractures, etc. between top unconfined aquifer and itself.

The aquifer units present above the bottommost mineable coal seams are major source of inflow into the proposed opencast mining. With the siltation and compaction, the seepage from mine floor may be considered as negligible.

77.80 % of the buffer zone is covered by metamorphic rocks. These rocks may be categorized as compact rocks as they do not have any primary porosity. Secondary porosity in these rocks may have been created due to tectonic activity and weathering activity. The faulted, sheared, jointed and weathered zone store and transmit water in these formation. The recharge to this aquifer take place through interconnection formed by fault, fracture etc from top unconfined aquifer.

3.7.5 Ground Water Level

To collect the representative groundwater levels in the study area, CMPDI has established a monitoring network with 3 nos. of dug wells (Hydrograph stations) in the core zone in the area of 5.52 sq. km and 65 nos. of dug- wells (Hydrograph stations) in the entire buffer zone of 450.45 sq. km. (10 km radius from the periphery of Karo Expansion mine area. Water level monitoring in these hydrograph stations has been done in pre-monsoon as well as in post monsoon and data for Core zone and Buffer zone. The pre-monsoon and post-monsoon water level of core zone and buffer zone with average value are given in table given below.

Table 3.20 Water level of Hydrograph stations in Core and Buffer Zone

Period	Core Zone								
	Pre-monsoon(April/May)			Post-Monsoon(Nov/Dec)			Fluctuation		
	From	To	Average	From	To	Average	From	To	Average
2011	2.78	6.42	4.79	1.19	2.48	1.90	0.75	3.98	2.89
2012	2.44	5.52	3.80	1.34	2.65	2.06	1.10	2.87	1.74
2013	3.40	6.80	5.18	2.25	2.80	2.59	1.15	4.00	2.58
2014	2.7	5.24	3.97	1.74	7.05	3.67	0.47	3.50	1.98
2015	1.76	3.60	2.68						
2016	4.25	8.55	6.51	1.65	3.50	2.29	2.60	5.05	4.21
2017	2.79	7.50	5.34	1.29	3.30	2.24	1.5	3.6	2.25
2018	2.04	2.95	2.49						
Period	Buffer Zone								
	Pre-monsoon (April/May)			Post-Monsoon(Nov/Dec)			Fluctuation		
	From	To	Average	From	To	Average	From	To	Average
2011	0.90	9.95	5.26	0.25	6.80	2.98	0.07	5.25	2.28
2012	1.02	11.95	5.85	0.80	8.90	3.55	0.05	5.40	2.28
2013	1.40	11.50	5.61	0.50	7.55	3.21	0.15	6.50	2.42
2014	1.25	10.50	4.94	0.90	9.05	3.92	0.10	5.90	1.00
2015	0.20	10.80	4.88	1.15	10.20	4.40	0.0	3.67	0.92
2016	1.05	11.95	5.74	0.0	10.90	4.31	0.0	4.0	1.90
2017	0.0	12.60	5.44	0.05	10.35	4.13	0.05	7.10	2.03
2018	0.70	11.85	5.58						
Note: Water level in meter below ground level									

The average pre-monsoon water level in the core zone is 4.34 m during the period between 2011 and 2018 whereas the average water level in post-monsoon condition goes to 2.45 below ground level during the period between 2011 and 2017.

In the buffer zone, the average pre-monsoon water level is 5.41 m during the period between 2011 and 2018 whereas the average water level in post-monsoon condition goes to 3.78 m below ground level during the period between 2011 and 2017.

The average fluctuation of water level is 2.60 m in core zone and 1.83 m in buffer zone during the period between 2011 and 2017.

The average fluctuation decreases over the time in both core and buffer zone. The above situation may happen in case of decrease in rainfall recharge causing the post monsoon water level goes down over the time period. Whereas decrease in the draft over the time period may cause the pre- monsoon water level rises.

The location of these hydrograph stations are marked on pre-monsoon water table contour map of April'2015 (**Plate No-III B**) The annual fluctuation of water table in the core zone and buffer zone are also given in above.

The pre-monsoon water table map of April'2015 (**Plate No-III B**) of the core zone and buffer zone of the study area have been prepared. The water table slopes towards Damodar River and maintain a gentle slope. The water table contour maps clearly indicate that the water levels follow the topographic trend of the area with a gradient of about 6.20×10^{-3} . It is generally 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. The recharge zone is in the northern higher plains (RL>400 m) and the discharge area is Damodar River located in the south of the project area (RL<200 m).

Recharge Area: - Water table contour map prepared for April, 2015 indicates that the recharge zone is the northern higher plains. The recharge is mainly from rainfall to the unconfined aquifer. Semi-confined aquifers get recharged from precipitation on the outcrop region and leakage from unconfined aquifer.

Discharge Area: Water table contour map for April, 2015 indicates that the discharge area is the low lying flat terrain, nalas and Damodar River located in the south of the project. Karo (Expansion) open cast mine also acts as local discharge zone for the aquifer.

Interrelationship of aquifer and surface water: water level contour map indicates that the perennial jores/nala in the area is being fed by ground water (effluent stream).

3.7.6 Historical Ground Water Level

The nearest permanent observation well of CGWB well (BGH-01) situated in Gomia at a distance of 13.0 km west of proposed Karo (Expansion) OCP for the water level trend analysis purposes. The pre-monsoon and post monsoon historical groundwater levels for the last few years (1998 to 2017) recorded by CGWB at Gomia Station has been given below in Table No-3.21.

Table 3.21 Water Level data from Permanent Observation Well of CGWB at Gomia Station.

Permanent observation well of CGWB at Gomia (BGH-01) at a distance of 13.00 km west of Proposed Karo (Expansion) OCP			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Annual Fluctuation (m)
1998	5.59	4.07	1.52
1999	9.25	4.27	4.98
2000	9.02	2.43	6.59
2001	8.46	2.18	6.28
2002	6.40	-	-

Permanent observation well of CGWB at Gomia (BGH-01) at a distance of 13.00 km west of Proposed Karo (Expansion) OCP			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Annual Fluctuation (m)
2003	6.18	-	-
2004	6.80	2.30	4.50
2005	6.00	4.80	1.20
2006	10.20	2.27	7.93
2007	10.25	3.75	6.50
2008	10.41	2.90	7.51
2009	11.30	1.46	9.84
2011	10.60	3.80	6.80
2012	10.60	3.11	7.49
2013	11.54	3.84	7.70
2014	7.1	3.23	3.87
2015	4.6	3.55	1.05
2016	4.81	2.72	2.09
2017	8.0		
Average	8.26	3.16	5.36

*Water levels are from ground level in meter.

The ground water level data of the permanent observation well of CGWB (BGH-01) at Gomia shows that the pre-monsoon water level goes down over the mentioned time period. This may happen due to increasing draft which causes the water level goes down in the area. The post monsoon water level depends on the rainfall recharge. As this well is located in non-mining area, the depletion of water table is due to overexploitation by the local people.

The pre-monsoon and post monsoon historical groundwater levels for the last few years were recorded by CMPDI at the nearest permanent hydrograph stations like at Turyo Basti (Well No.: EB-01), Kargali (Well No.: EB-38) and Pahadi Dhouda (Well No.: EB-36). Water level of well no. EB-36 (core zone) and well nos. EB-01 and EB-38 (buffer zone) of the project area, were collected and are given below in Table No-7, Table No-8 and Table No-9 respectively.

Table 3.22 Water Level data from Permanent Observation Well at Turyo Basti (CMPDI)

Permanent observation well of CMPDI at Turyo Basti (EB-01) at a distance of 6.00 km south-east of Proposed Karo (Expansion) OCP			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Annual Fluctuation (m)
2002	3.37	1.60	1.77
2003	4.02	-	-
2004	-	1.68	-

Permanent observation well of CMPDI at Turyo Basti (EB-01) at a distance of 6.00 km south-east of Proposed Karo (Expansion) OCP			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Annual Fluctuation (m)
2005	-	1.12	-
2009	-	2.13	-
2010	6.10	1.30	4.80
2011	4.50	1.75	2.75
2012	4.20	1.70	2.50
2013	3.05	1.30	2.96
2014	4.10	1.40	2.70
2015	2.13	2.10	0.03
2016	2.65	-	
2017	2.5	1.6	0.90
2018	2.25	-	
Average	3.53	1.60	2.30
*Water levels are from ground level in meter.			

The ground water level data of the permanent observation well of CMPDI (EB-01) at Turyo Basti shows that the pre-monsoon water level varies from 2.13 m (2015) to 6.10 m (2010) with an average of 3.53 m below ground level. The post monsoon water levels vary from 1.12 m (2005) to 2.13 m (2009) with an average 1.60 m below ground level. There is no major changes in post-monsoon water level over the period of time which depends on rainfall recharge. Annual water level fluctuation varies from 0.03 m (2015) to 4.80 m (2010) with an average of 2.30 m. it does not show any depletion or declining of water level in pre-monsoon and post-monsoon period.

Table 3.23 Water Level data from Permanent Observation Well at Kargali (CMPDI)

Permanent observation well of CMPDI at Kargali (EB-38) at a distance of 1.00 km south of Proposed Karo (Expansion) OCP			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Annual Fluctuation (m)
2002	-	3.52	-
2003	6.08	-	-
2004	6.32	5.98	0.34
2005	-	-	-
2009	-	2.50	-
2010	5.60	5.55	0.05
2011	5.90	5.37	0.53
2012	6.08	4.15	1.93
2013	6.00	2.60	3.40

Permanent observation well of CMPDI at Kargali (EB-38) at a distance of 1.00 km south of Proposed Karo (Expansion) OCP			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Annual Fluctuation (m)
2014	4.05	2.20	1.85
2015	3.25	-	
2016	3.35		
2017	6	3.15	2.85
2018	3.9		
Average	5.13	3.89	1.56
*Water levels are from ground level in meter.			

The ground water level data of the permanent observation well of CMPDI (EB-38) at Kargali shows that the pre-monsoon water level varies from 3.25 m (2015) to 6.32 m (2004) with an average of 5.13 m below ground level. The post monsoon water levels vary from 2.20 m (2014) to 5.98 m (2004) with an average 3.89 m below ground level. The pre-monsoon water level in Kargali Area shows the water level rises over the period of time between 2002 and 2018. Annual water level fluctuation varies from 0.05 m (2010) to 3.40 m (2013) with an average of 1.56 m. The well at Kargali does not show any depletion or declining of water level both in pre-monsoon and post-monsoon period.

Table 3.24 Water Level data from Permanent Observation Well at Pahadi Dhouda (CMPDI)

Permanent observation well of CMPDI at Pahadi Dhouda (EB-36) situated within the core zone of Proposed Karo (Expansion) OCP			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Annual Fluctuation (m)
2010	4.09	1.27	2.82
2011	5.17	1.19	3.98
2012	2.44	1.34	1.10
2013	5.34	2.74	2.60
2014	5.24	1.74	3.50
2015	1.76	-	-
2016	6.74	1.74	5.0
2017	2.79	1.29	1.50
2018	2.04	-	-
Average	3.95	1.67	2.92
*Water levels are from ground level in meter.			

The ground water level data of the permanent observation well of CMPDI (EB-36) at Pahadi Dhouda shows that the pre-monsoon water level varies from 1.76 m (2015) to 6.74 m (2016) with an average of 3.95 m below ground level. The post monsoon water levels vary from 1.19 m (2011) to 2.74 m (2013) with an average 1.67 m below ground level. The pre-

monsoon water level in Pahadi Dhouda Area shows the water level rises over the period of time between 2010 and 2015. Annual water level fluctuation varies from 1.10 m (2012) to 3.98 m (2011) with an average of 2.92 m. The well at Pahadi Dhouda does not show any depletion or declining of water level both in pre-monsoon and post-monsoon period. The locations of these wells are shown in **Plate No- VII**.

3.7.7 Water Level Trend

Hydrograph for the permanent observation well of Central Ground Water Board, located in Gomia (BGH-01) at a distance of 13.0 km west of proposed Karo OCP just outside of the buffer zone of the project is prepared and presented in **Plate No – VIII** to assess the water level trends in pre-monsoon and post-monsoon seasons during the period from 1998 to 2017. The pre-monsoon water level shows declining trend. This may happen due to increasing draft which causes the water level goes down in the area. The post-monsoon water level shows inclining trend which mainly depends on the rainfall recharge in the area.

Hydrographs for the three CMPDI observation wells located in core zone (EB-36) and buffer zone (EB-01 and EB-38) are prepared and presented in **Plate No-VIII** to assess the water level trends in pre-monsoon and post-monsoon seasons during the period from 2002 and 2018.

Both pre and post-monsoon water level trend of dug-well EB-01 and dug-well EB-38 shows inclining trend and does not show any depletion or declining of water level both in pre-monsoon and post-monsoon period. The dug-well at Pahadi Dhouda (EB-36) shows inclining trend of pre-monsoon water level which concluded that there is no effect of mining on water level in core zone of the project area while mining is being done in the Quarry-I section.

3.7.8 Groundwater Resources in the Area

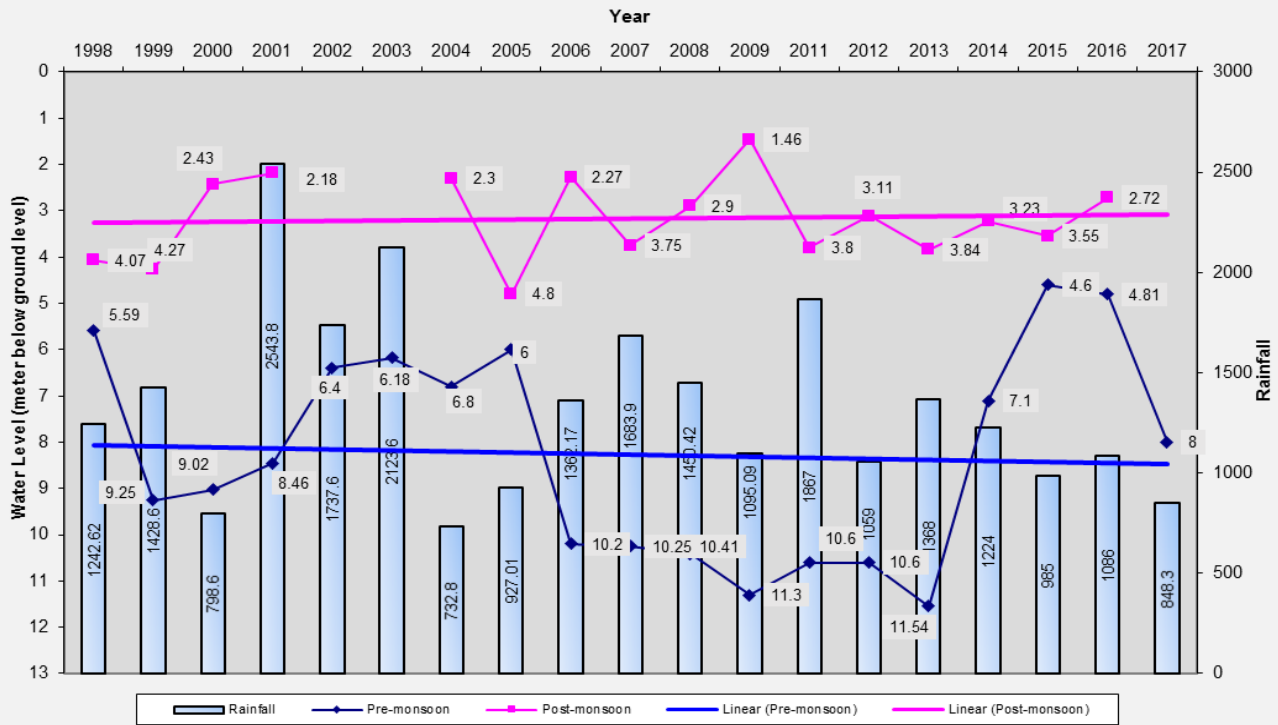
Groundwater Recharge Rainfall is the main source of groundwater recharge. The study area receives an average annual rainfall of 1259 mm (out of which 1040 mm during monsoon season and 219 mm during non-monsoon season). Additionally, groundwater is also being recharged from other sources such as from mine discharge, irrigation, reservoirs/ponds etc. An area of 10 km radius from the periphery of core zone of Karo Expansion OCP is considered as buffer zone. Out of the total area of 450.45 sq. km of buffer zone, 100.18 sq. km is covered by sedimentary rock and 350.27 sq. km covered by metamorphic rock. The area covered by seasonal nala/river (7.21 sq. km) is not considered for area of recharge during recharge estimation. Therefore 95.18 sq. km (100.18-5.00 sq. km) area covered by sedimentary terrain and 348.06 sq.km (350.27-2.21 sq.km) covered by metamorphic terrain is considered for recharge estimation.

As recommended in GEC Report 1997, a rainfall infiltration factor of 13% was considered for sedimentary rocks and 8% was considered for metamorphic rocks in the study area for computation of rainfall recharge by Rainfall Infiltration Factor Method, given below.

Table 3.25 Rainfall Recharge in Buffer Zone by Rainfall Infiltration Method

Description of items	Quantity
1. Area	Sedimentary – 95.18sq. km Metamorphic – 348.06 sq. km
2. Normal Rainfall during a. Monsoon season in mm (June to Oct)	1040 mm

**Pre- and Post-monsoon Water Level Trends of Hydrograph Station:
Gomia, Well No: BGH-01, Dist: Bokaro, Jharkhand
(Permanent Observation Well of CGWB, 13.0 km west of Karo (Expansion) OCP)**



**Pre- and Post-monsoon Water Level Trends of Hydrograph Station:
Toryo Basti, Well No: EB-01, Dist: Bokaro, Jharkhand
(Permanent Observation Well of CMPDI, 6.0 km south-east of Karo (Expansion) OCP)**

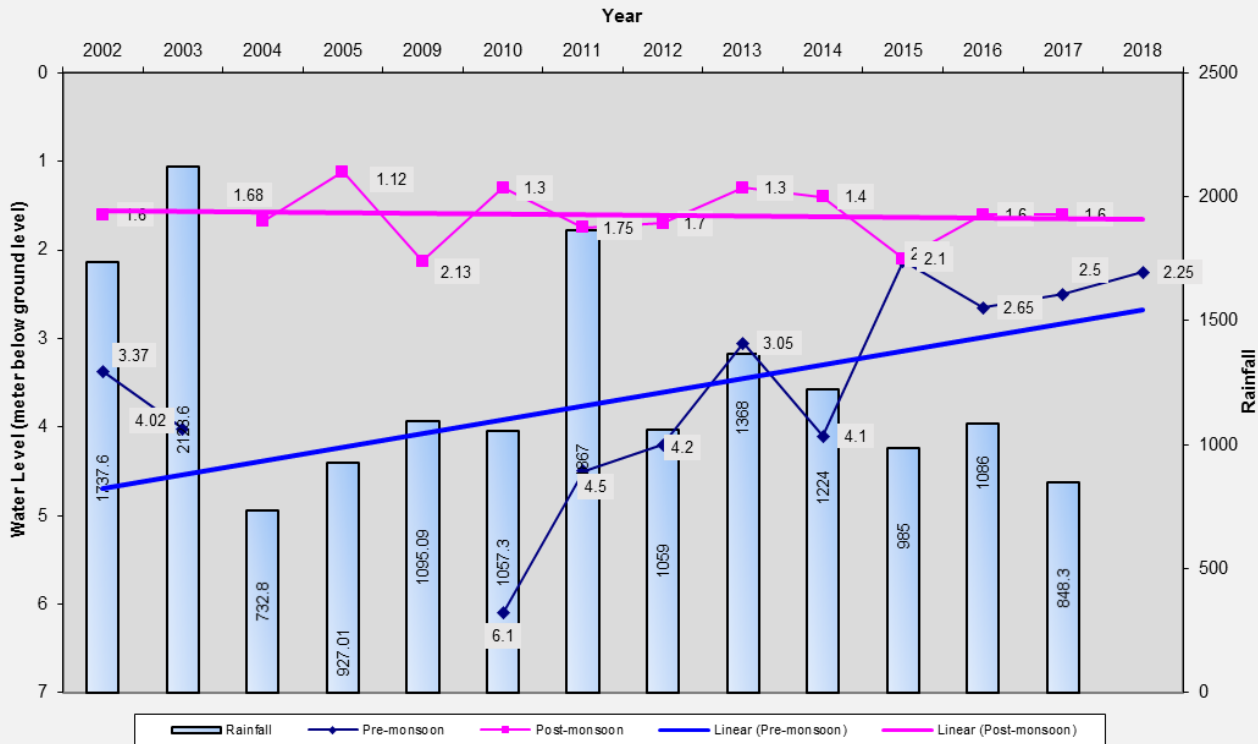


PLATE NO - VIIIA

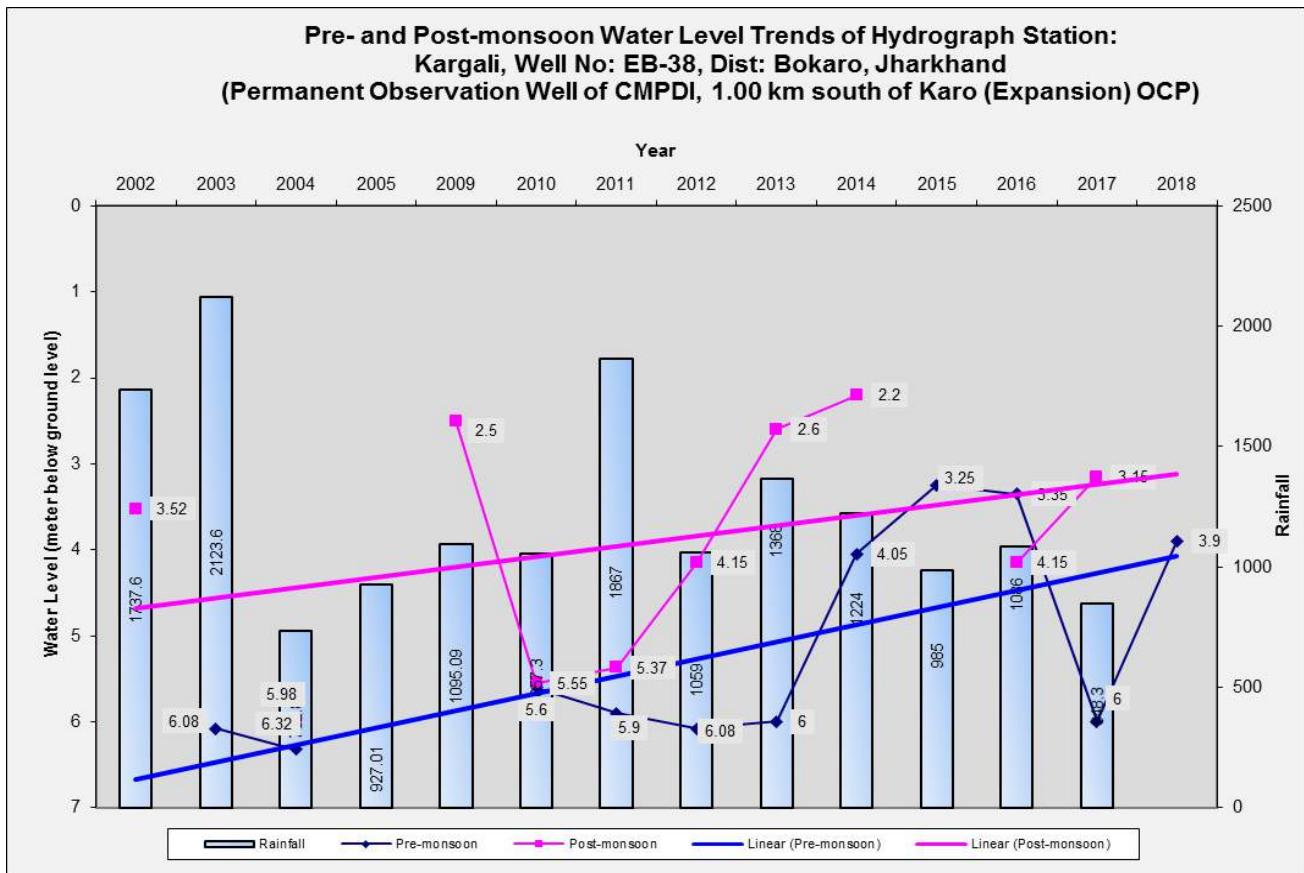
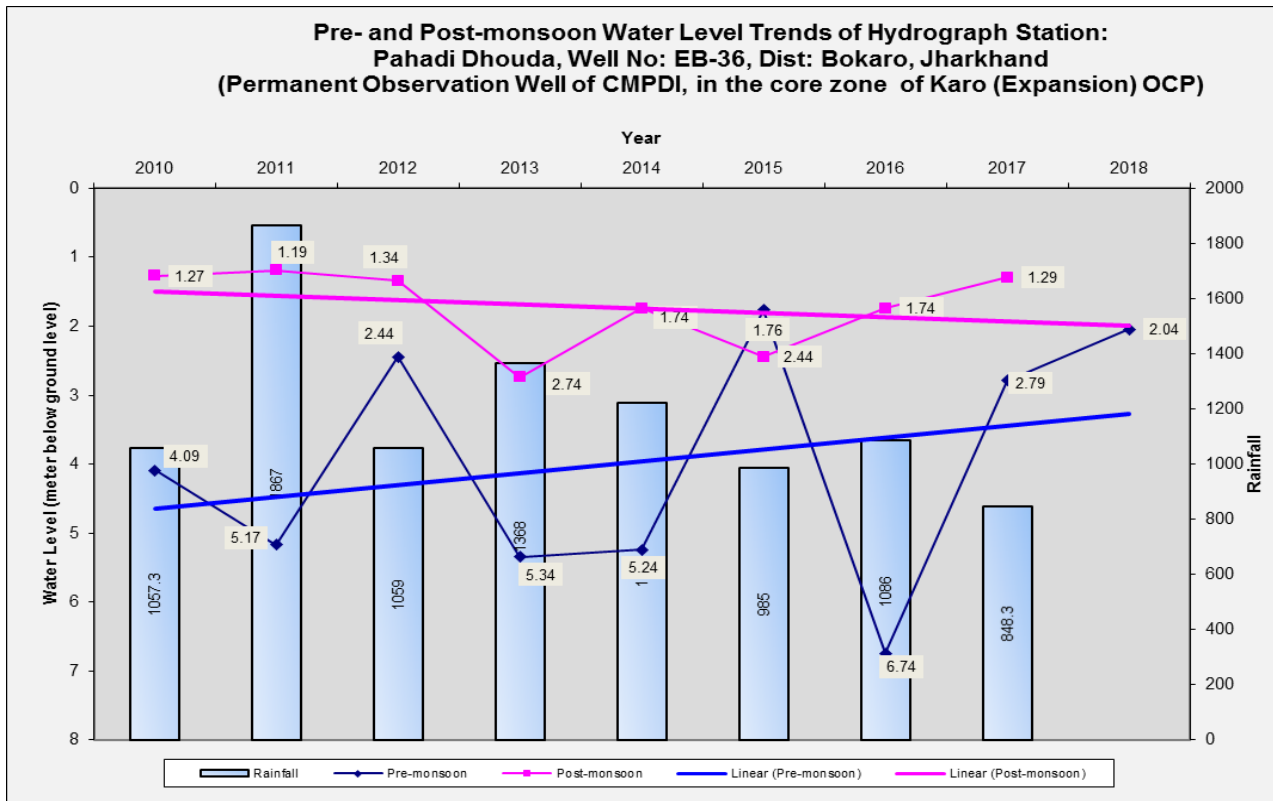


PLATE NO - VIIIB

b. Non-monsoon seWLFason in mm (Nov to May)	219 mm
c. Non-monsoon season rainfall as a percentage of normal annual rainfall (Yes if > 10%, No if < 10%)	Yes, it is 21.0%. Therefore Recharge during non-monsoon is to be considered.
3. Rainfall infiltration factor	Sedimentary – 13% Metamorphic – 8%
4. Rainfall recharge in Buffer zone by rainfall infiltration factor method	i) Sedimentary – 12.87 ii) Metamorphic – 28.96
a. Monsoon season (MCUM)	a. Monsoon Recharge- 41.83
b. Non-monsoon season(MCUM)	i) Sedimentary – 2.71 ii) Metamorphic – 6.10
	b. Non-monsoon recharge -8.81
Gross Rainfall Recharge [(4a) + (4b)]	50.64 MCUM

As recommended in GEC Report 1997, a specific yield value 0.04 was considered for sedimentary rocks and 0.03 was considered for metamorphic rocks for computation of rainfall recharge during monsoon season by Water table Fluctuation Method, given below.

Table 3.26 Rainfall Recharge in Buffer Zone by Water Level Fluctuation Method during monsoon season

Description of items	Quantity
1. Area	Sedimentary – 95.18 sq. km Metamorphic – 348.06 sq. km
2. Water table Fluctuation	Sedimentary – 1.75 m Metamorphic – 2.47 m
3. Specific Yield	Sedimentary – 0.04 Metamorphic – 0.03
4. Change in groundwater storage	Sedimentary – 6.66 MCUM Metamorphic – 25.79 MCUM Total: 32.45 MCUM
5. Gross groundwater Draft for 'All Uses' during monsoon season (From Table No.-17)	8.39 MCUM
6. Recharge from 'Other Sources' during monsoon season. Return flow from Excess mine water i.e. 20% of 1.74 MCUM during monsoon season {Table No-17}	0.35
7. Gross Rainfall Recharge [(4) + (5) – (6)]	40.49 MCUM

As recommended in GEC Report 1997, the rainfall recharge during monsoon season is estimated after comparing results from Water table Fluctuation Method and Rainfall Infiltration Factor Method, given below:

Table 3.27 Rainfall Recharge during monsoon season in Buffer Zone

Description of items	Quantity
1. Rainfall Recharge during monsoon season in Buffer Zone a. By Water Table Fluctuation Method (from Table No-11)	40.49 MCUM
b. By Rainfall Infiltration Factor Method [from Table No-10 (4a)]	41.83 MCUM
2. Difference between (1a) and (1b) expressed as a percentage of (1b), 'PD' $\frac{\{(1a) - (1b)\}}{(1b)} * 100$	-3.2 %
3. Rainfall Recharge in the Buffer Zone during monsoon season after considering the 'PD' [= (1a) if 'PD' is between -20 and +20% i.e. 40.49 = 0.8 * (1b) if 'PD' is less than -20% = 1.20 * (1b) if 'PD' is greater than +20%]	40.49 MCUM

3.7.9 Net Groundwater Availability

The Net annual ground water availability of 48.19 million cubic meters have been estimated for the study area (buffer zone).

Table 3.28 Net Groundwater Availability in Buffer Zone

Description of items	Quantity
1. Rainfall Recharge in Buffer Zone a. During Monsoon season (from Table No - 12) b. During Non-monsoon season {from Table No – 10 (4.b)} c. Annual [(1a) + (1b)]	40.49 MCUM 8.81 MCUM 49.30 MCUM
2. Recharge from 'Other Sources' a. During Monsoon season Return flow from Excess mine water [20% as seepage factor] b. During Non-monsoon season Return flow from Irrigation [25 % of Irrigation Draft] Return flow from Excess mine water [20% as a seepage factor] c. Annual [(2a) + (2b)]	0.35 MCUM 0.59 MCUM 0.49 MCUM 1.43 MCUM
3. Total Annual Groundwater Recharge [(1c) + (2c)]	50.73 MCUM
4. Unaccounted annual natural discharge a. [0.05 * (3)] if rainfall recharge during monsoon season computed by 'Water table Fluctuation Method' b. [0.10 * (3)] if rainfall recharge during monsoon season computed by 'Rainfall Infiltration factor Method'	2.54 MCUM
5. Net Annual Groundwater Availability in Buffer Zone [(3) – (4)]	48.19MCUM

3.7.10 Groundwater Draft

The groundwater withdrawal is generally for irrigation, domestic and industrial requirement and is quantified as under.

The irrigation draft (145 m³/Ha/Annum) for 16311 Ha of agricultural land of the buffer zone of Karo Expansion OCP has been considered and was estimated as 2.365 million cubic meters per annum. The total draft for irrigation is considered during non-monsoon season only. Land use pattern of buffer zone is given below.

Table 3.29 Land use pattern

Serial No.	Particulars	Buffer Zone	
		Qty in Ha	%
1	Agricultural Land	16311	36.21
2	Waste Land	3744	8.31
3	Forest	11451	25.42
4	Scrubs	9116	20.24
5	Plantation	1033	2.29
6	River/Pond	721	1.60
7	Built up area / settlement	1259	2.79
8	Mining Area	1410	3.13
Total		45045	100

A domestic consumption rate of 70 lpd for 347298 population of buffer zone is considered (8.87 MCum/annum). The consumption by the cattle population was projected as 10% of domestic use (0.89 MCum/annum). Thus, the water consumption for domestic use of buffer zone including cattle consumption is projected as 9.76 M.Cum/annum.

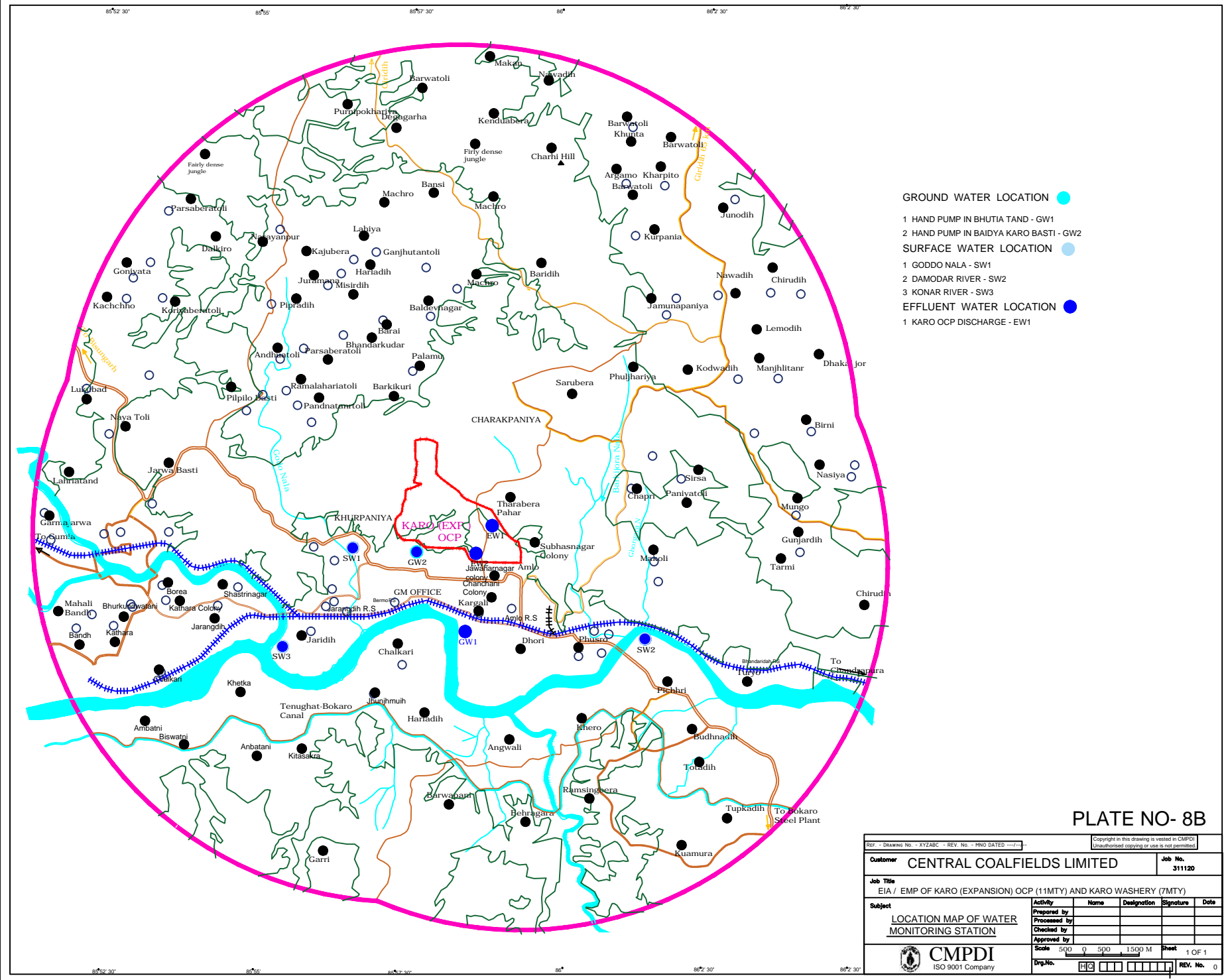
Table 3.30 Population Data in Buffer Zone

Particulars	Buffer Zone	Population draft of buffer zone
No of Villages	76	347298 @70 LPD=8.87 McuM/annum + cattle – 0.89 McuM/annum = 9.76 Mcum/annum
Number of House-hold	64835	
Total Population	347298	

Groundwater extraction is being done by the existing mines of CCL in the buffer zone of this mine shown in **Plate No-IX**. An estimate has been made on the water pumped out from the existing mines in the buffer zone of Karo Expansion OCP and washery, and it comes to 10.36 MCUM (million cubic meters) per annum. After the domestic and industrial (6.20 MCUM) consumption of the mines, the net excess annual mine discharge in the buffer zone is 3.34 MCUM. The excess mine discharge is being supplied to the peripheral villages for domestic and irrigation and also being used for artificial recharge to the ground water system. The average mine inflow from the aquifers being pumped out to the surface from the existing mines in the buffer zone of project is shown in given below.

Table 3.31 Mine Inflow in the Existing Mines in the Buffer Zone

Name of the Mine (East Bokaro Coalfield)	Av Mine pumping (m ³ /day)	Domestic and Industrial consumption from mine water (m ³ /day)	Excess mine water (m ³ /day)



- GROUND WATER LOCATION** ●
- HAND PUMP IN BHUTIA TAND - GW1
 - HAND PUMP IN BAIDYA KARO BASTI - GW2
- SURFACE WATER LOCATION** ●
- GODDO NALA - SW1
 - DAMODAR RIVER - SW2
 - KONAR RIVER - SW3
- EFFLUENT WATER LOCATION** ●
- KARO OCP DISCHARGE - EW1

PLATE NO- 8B

REF. : Drawn No. - XYZABC - REV. No. - PNO DATED ---/---/---		Copyright in this drawing is vested in CMPDI Unauthorized copying or use is not permitted.	
Customer CENTRAL COALFIELDS LIMITED		Job No. 311120	
Job Title EIA / EMP OF KARO (EXPANSION) OCP (11MTY) AND KARO WASHERY (7MTY)			
Subject	Activity	Name	Designation
LOCATION MAP OF WATER MONITORING STATION	Prepared by		
	Processed by		
	Checked by		
Approved by			
Scale 500 9 500 1500 M		Sheet 1 OF 1	
CMPDI ISO 9001 Company		REV. No. 0	

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

Name of the Mine (East Bokaro Coalfield)	Av Mine pumping (m ³ /day)	Domestic and Industrial consumption from mine water (m ³ /day)	Excess mine water (m ³ /day)
Selected Dhori GoM	1315	2849 (1534 m ³ /day surface water + 1315 m ³ /day mine water)	0
Pichri OCP	1917	1452	465
Dhori GoM	5890	1561	4329
Amlo OCP	1013	410	603
Kargali Proj.	410	328	82
Bokaro OCP	12051	958	247
Bermo OCP	712	712 (+ 27 m ³ /day from other sources)	0
Govindapur PH-II OCP	958	547	411
Kathara Project	3013	300	2713
Jarangdih UG and OCP	5506	4849	657
Khasmahal Proj.	301	246	55
Swang OCP and UGP	6164	4301	1863
Total (m³/day)	28404	16979	11425
Total (MCUM/annum)	10.36	6.20	4.17
20% return flow to the Ground Water System (MCUM/annum)			0.83
Net Discharge to the Surface/local pond/Tank/peripheral villages (MCUM/annum)			3.34

The annual domestic draft is 9.76 MCUM in buffer zone (Table No-15). Out of which 4.07 MCUM draft in monsoon season (June to Oct) and 5.69 MCUM draft in non-monsoon season (November to May) are considered.

The annual domestic and industrial draft of mines is 6.20 MCUM in buffer zone (Table No-16). Out of which 2.58 MCUM draft in monsoon season (June to Oct) and 3.62 MCUM draft in non-monsoon season (November to May) are considered.

Out of 4.17 MCUM of excess mine water, 1.74 MCUM of water in monsoon season and 2.43 MCUM in non-monsoon season are being used for artificial recharges and supplying to the peripheral villages for domestic and irrigation purposes.

3.8 Biological Environment

3.8.1 Scope of the study:

The study includes the listing of existing flora and fauna in the study area (10 km radius) by technical experts. Preparation of list of flora and fauna duly authenticated separately for the core and buffer zone. A statement clearly specifying whether the study area forms a part of the migratory corridor of any endangered fauna. If the study area has endangered flora and fauna, or if the area is occasionally visited or used as a habitat by Schedule – I fauna, or if the project falls within 15 km of an ecologically sensitive area, or used as migratory corridor then a comprehensive conservation plan has to be prepared.

3.8.2 Methodology of the Study

An ecological survey was conducted during October-December 2015 to generate baseline data on flora and fauna of the project.

The study has covered the following aspects:

S. No.	Floral Component	S. No.	Faunal Elements
1.	Agricultural crops	1.	Listing of Faunal elements
2.	Commercial crops	2.	Endangered Species / Endemic Species
3.	Plantations/Agro-forestry	3.	Wildlife Schedules
4.	Natural Vegetation/Forest type	4.	Migratory Species
5.	Grassland Vegetation	5.	Migratory corridors or Paths
6.	Endangered/ Endemic species	6.	Breeding & Spawning Grounds
7.	Aquatic flora	7.	Aquatic fauna

Identification of vegetation in relation to natural forest flora and croplands is conducted through reconnaissance field surveys and insight observations of core and buffer zone areas. The plant species identification is done based on the morphological characteristics and reproductive materials i.e. flowers, fruits and seeds. Land use pattern in relation to agriculture practices and crop varieties are identified through physical verification of farm lands. Secondary data gathered from local villagers and revenue officials.

The faunal elements (animal species) of core and buffer zone are identified by direct sightings or indirect evidences. The authenticity of faunal elements occurrence is confirmed by interaction with the local forest department / people. Avifauna (bird's species) identification is done with pictorial descriptions of published literature. Information pertaining to existence of any migratory corridors and paths are obtained with local inhabitants. The status of each faunal element is determined and wildlife schedule category is ascertained as per the IUCN-Red Data Book (RDB) and Indian wildlife (Protection) Act, 1972.

3.8.3 Status of Flora- Core Zone:

A. Terrestrial Flora

Terrestrial and Aquatic flora of the project areas is classified in to:

- Agriculture crops cultivated (cereals, pulses and vegetables) during rainy season (Kharif) and post rainy months of winter season (Rabi);
- Crops of commercial importance;
- Plantations and Agro-forestry species and
- Natural vegetation of Forest type include endemic species, endangered category, Ethno botanical and Aquatic flora.

B. Agricultural crops

To a certain extent most of the agriculture activity is confined to Southwest monsoon period of July to October. The vegetable are cultivated in backyards and farmlands during post-rainy months. A list of agriculture crops of the core and buffer zone are presented below:

Table 3.32: List of Agricultural crops in Core Zone

Crop variety	Family Name	Botanical Name	Trade Name
Cereals	Poaceae	<i>Zea mays</i>	Maize (Makka)
		<i>Oryza sativa</i>	Dhan (Paddy)
Pulses	Fabaceae	<i>Cajanus cajan</i>	Arhar

C. Commercial crops:

Besides traditional varieties, a few crops of commercial importance are cultivated during post rainy months of winter period from November to February. The list of commercial crops is presented below in table.

Table 3.33: List of Commercial Crops in Core Zone:

Crop variety	Family Name	Botanical Name	Trade Name
Vegetables	Solanaceae	<i>Solanum melongena</i>	Brinjal
	Cucurbitaceae	<i>Momordica charantia</i>	Karela
	Cucurbitaceae	<i>Luffa acutangula</i>	Jhinga
	Cucurbitaceae	<i>Benincasa hispida</i>	Kohra
	Malvaceae	Hibiscus esculentus	Bhindi (Lady Finger)
Oil Yielding	Brassicaceae	<i>Brassica compestris</i>	Mustard
Spices	Liliaceae	<i>Alium sativum</i>	Lashum (Garlic)
Fruits	Anacardiaceae	<i>Mangifera indica</i>	Aam (Mango)
	Myrtaceae	<i>Psidium guajava</i>	Amrud (Guava)
	Moraceae	<i>Artocarpus heterophyllus</i>	Jackfruit (Kathal)
	Rhamnaceae	<i>Ziziphus mauritiana</i>	Ber (Jujube)
	Caricaceae	<i>Carica papaya</i>	Papita

D. Plantations / Agro forestry species:

The plantations developed in vacant lands consist of Agro forestry species. The agro forestry species of core and buffer zone have been presented below.

Table 3.34: List of Plantations/Agro Forestry Species in Core Zone:

Family Name	Botanical Name	Trade Name
Moraceae	<i>Artocarpus integrifolia</i>	Kathal
Papilionaceae	<i>Butea frondosa</i>	Palas
Caesalpiniaceae	<i>Cassia fistula</i>	Amaltas
Fabaceae	<i>Dalbergia sisso</i>	Shisham
Caesalpiniaceae	<i>Delonix regia</i>	Gulmohor
Fabaceae	<i>Dalbergia sisso-</i>	Shesam
Meliaceae	<i>Azadirachta indica</i>	Neem
Mimosaceae	<i>Acacia nilotica</i>	Subabul
	<i>Dendrocalamus strictus</i>	Bamboo

E. Natural Vegetation/ Forest Type:

Natural vegetation/Forest type of the project area is characterized by Northern tropical dry mixed deciduous forest comprises three layer strata:

- (i) Upper layer of trees and lianas;
- (ii) Middle strata of woody shrubs and creepers and
- (iii) Lower strata of ground occupancy of grasses and sedges.

(i) Upper layer – Tree flora

Table 3.35: list of Natural Vegetation in Core Zone:

Family Name	Botanical Name	Trade Name
Fabaceae	<i>Dalbergia sissoo</i>	Sisam
Graminae	<i>Bambusa arundinacea</i>	Katang bamboo
Meliaceae	<i>Azadirachta indica</i>	Neem
Mimosaceae	<i>Acacia Arabica</i>	Babul
Moraceae	<i>Ficus religiosa</i>	Peepal tree
Verbenaceae	<i>Toctona grandis</i>	Sagwan

(ii) Middle layer – Shrubs and Climbers

Table 3.36: list of Natural Vegetation in Core Zone:

Family Name	Botanical Name	Trade Name
Apocynaceae	<i>Calotropis gigantea</i>	Crown flower
Euphorbiaceae	<i>Ricinus communis</i>	Arandi
Verbenaceae	<i>Lantana camara</i>	Wild sage
	<i>Zizyphus oenoplia</i>	Indian Jujuba

(iii) Ground layer – Herbs & Shrubs

Table 3.37: list of Natural Vegetation in Core Zone:

Family Name	Botanical Name	Trade Name
Amaranthaceae	<i>Celosia argentea</i>	Kukada
	<i>Achyranthus aspera</i>	Aradhi
Caesalpiniaceae	<i>Cassia occidentalis</i>	Amaltas
Asteraceae	<i>Tridax procumbens</i>	Kamarmodi
	<i>Parthenium hysterophorus</i>	Gajar gawat
Euphorbiaceae	<i>Ephorbia hirta</i>	Dhudhi
Fabaceae	<i>Tephrosia purpurea</i>	Divali
Lamiaceae	<i>Ocimum sanctum</i>	Tulsi
	<i>O.basilicum</i>	Rantulsi
Malvaceae	<i>Sida acuta</i>	-
Solanaceae	<i>Datura metal</i>	Kala dhotra
Zygophyllaceae	<i>Tribulus terrestris</i>	Gokhru

F. Grass Lands:

No prominent grass land ecosystem has been found in the Core and Buffer zone of the project. However, the grass lands were mixed with natural vegetation in low lands and cultivable waste lands are now being utilized as grazing grounds to the livestock species.

Table 3.38: List of Grasses and Sedges:

Family Name	Botanical Name	Trade Name
Cyperaceae	<i>Cypera rotundus</i>	Blade grass
	<i>Kylinga tenuifolia</i>	-
Poaceae	<i>Cynodon dactylon</i>	Durva/Doob
	<i>Apluda mutica</i>	Phulkia
	<i>Dactyloctenium aegyptium</i>	-
	<i>Digitaria ternata</i>	-
	<i>Eragrostiella bifaria</i>	-

No endangered flora is recorded from Core or Buffer zone of the project area.

G. Aquatic Flora:

The aquatic flora adjacent to rivers, streams, rivulets in village ditches and small ponds of core zone are presented below

Table 3.39: List of Aquatic flora in Core Zone:

Family Name	Botanical Name	Trade Name
Convolvulaceae	<i>Ipomoea aquatica</i>	Water spinach

3.8.4 Status of Flora- Buffer Zone:

Table 3.40: List of Agricultural crops in Buffer Zone:

Crop variety	Family Name	Botanical Name	Trade Name
Cereals	Poaceae	<i>Oryza sativa</i>	Paddy (Dhan)
	Poaceae	<i>Zea mays</i>	Maize (Makka)
Pulses	Fabaceae	<i>Cajanus cajan</i>	Arhar (Pigeon pea)

	Fabaceae	<i>Vigna mungo</i>	Urad (Black gram)
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Table 3.41: List of Commercial crops in Buffer Zone:

Crop variety	Family Name	Botanical Name	Trade Name
Vegetables	Solanaceae	<i>Lycopersicon lycopersicum</i>	Tomato
	Malvaceae	<i>Abelmoschus esculentus</i>	Bhendi
	Cucurbiataceae	<i>Coccinia indica</i>	Kundru
		<i>Cucurbita pepo</i>	Kaddu
		<i>Momordica charantia</i>	Karela
	Solanaceae	<i>Capsicum annum</i>	Mirchi
		<i>Solanum melongena</i>	Brinjal
Oil Yielding	Brassicaceae	<i>Brassica compestris</i>	Mustard
Spices		<i>Capsicum</i>	Mirch
		<i>Coriandrum sativum</i>	Dhania
Fruits	Myrtaceae	<i>Psidium gujava</i>	Guava
	Musaceae	<i>Musa paradisiaca</i>	Banana
	Caricaceae	<i>Carica papaya</i>	Papaya

Table 3.42: List of Plantation/Agro Forestry Species in Buffer Zone:

Family Name	Botanical Name	Trade Name
Anacardiaceae	<i>Mangifera indica</i>	Mango
Annonaceae	<i>Annona squamosa</i>	Sitaphal
Euphorbiaceae	<i>Phyllanthus emblica</i>	Awla
Fabaceae	<i>Dalbergia sissoo</i>	Shesam
	<i>Pongamia pinnata</i>	Karanj
Poaceae	<i>Bambusa arundinacea</i>	Bamboo
Musaceae	<i>Musa paradisiaca</i>	Kela
Moraceae	<i>Artocarpus heterophylla</i>	Jack fruit
	<i>Ficus religiosa</i>	Anjir
Moringaceae	<i>Moringa oleifera</i>	Munga
Myrtaceae	<i>Eucalyptus globulus</i>	Nilgiri
	<i>Psidium guava</i>	Guava
Verbenaceae	<i>Tectona grandis</i>	Sagwan

Table 3.43: list of Natural Vegetation in Buffer Zone:**(a) Upper layer – Tree flora**

Family Name	Botanical Name	Trade Name
Anacardiaceae	<i>Mangifera indica</i>	Aam/Mango
Annonaceae	<i>Annona squamosa</i>	Sitaphal
Caesalpinaceae	<i>Bauhinia racemosa</i>	Apta
	<i>Cassia fistula</i>	Bahawa
	<i>Delonix regia</i>	Gulmohar
Combretaceae	<i>Terminalia chebula</i>	Harhar
Sapotaceae	<i>Madhuca longifolia</i>	Mohua tree

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Simaroubaceae	<i>Ailanthus excelsa</i>	Maharukh
Euphorbiaceae	<i>Phyllanthus emblica</i>	Awla
Fabaceae	<i>Butea monosperma</i>	Palas
	<i>Dalbergia sissoo</i>	Sisam
	<i>Pongamia pinnata</i>	Karanj
Poaceae	<i>Bambusa arundinacea</i>	Katang bamboo
Meliaceae	<i>Azadirachta indica</i>	Neem
	<i>Melia azedarach</i>	Bakneem
Mimosaceae	<i>Acacia auriculiformis</i>	Babul
	<i>Albizzia lebeck</i>	Sirish
Moraceae	<i>Ficus benghalensis</i>	Vad
	<i>F. religiosa</i>	Pipal
Myrtaceae	<i>Aegle marmelos</i>	Bel
	<i>Syzygium cumini</i>	Jamun
Palmae	<i>Borassus flabellifer</i>	Sindhi
Rhamnaceae	<i>Zizyphus jujube</i>	Ber
Verbenaceae	<i>Tectona grandis</i>	Sagwan
Ebenaceae	<i>Coromandel Ebony</i>	Kend
Apocynaceae	<i>Holarrhena antidysentrica</i>	Koraiya
Moraceae	<i>Artocarpus heterophyllus</i>	Kathal
Dipterocarpaceae	<i>Shorea robusta</i>	Sakua
Meliaceae	<i>Azadirachta indica</i>	Neem

(b) Ground layer – Shrubs & Herbs

Family Name	Botanical Name	Trade Name
Combretaceae	<i>Calycopteris gigantia</i>	Gilibuli
Cuscutaceae	<i>Ipomoea aquatica</i>	Ganesh vel
	<i>Ipomoea quamoclit</i>	Boota
Euphorbiaceae	<i>Phyllanthus reticulatus</i>	Pitundi
Menispermaceae	<i>Cocculus hirsutus</i>	Vasan vel
Verbenaceae	<i>Lantana camara</i>	Raimunia
	<i>Vitex negundo</i>	Nirgundi
Amaranthaceae	<i>Achyranthus aspera</i>	Chirchitta
	<i>Amaranthus spinosus</i>	Kate chawli
Caesalpinaceae	<i>Cassia tora</i>	Kan kuti
Asteraceae	<i>Tridax procumbens</i>	Kamarmodi
	<i>Parthenium hysterophorus</i>	Gajar gawat
Capparidaceae	<i>Cleome viscosa</i>	Pivili tilwan
Convolvulaceae	<i>Evolvulus alsinoides</i>	-
Euphorbiaceae	<i>Euphorbia hirta</i>	Dhudhi
Fabaceae	<i>Tephrosia purpurea</i>	-
Lamiaceae	<i>Hyptis suaveolens</i>	-
	<i>Ocimum sanctum</i>	Tulsi
Malvaceae	<i>Hibiscus lobatus</i>	-
	<i>Sida acuta</i>	-
Nyctaginaceae	<i>Boerhaavia diffusa</i>	-

Poaceae	<i>Andropogon pumilus</i>	Diwartan
Rubiaceae	<i>Borreria articularis</i>	-
Solanaceae	<i>Datura metal</i>	Kala dhotra
Zygophyllaceae	<i>Tribulus terrestris</i>	Goakru

Table 3.44: List of Grasses and Sedges in Buffer Zone:

Family Name	Botanical Name	Trade Name
Amaranthaceae	<i>Achyranthus aspera</i>	Chirchitta
	<i>Amaranthus spinosus</i>	Kate chawli
Cyperaceae	<i>Kyllinga tenuifolia</i>	-
	<i>Scleria annularis</i>	-
Poaceae	<i>Apluda mutica</i>	Banjura grass
	<i>Aristida hystrix</i>	-
	<i>Chloris barbata</i>	-
	<i>Cymbopogon martini</i>	Tikhadi
	<i>Dactyloctenium aegyptium</i>	Crow foot grass
	<i>Digitaria ternate</i>	-
	<i>Eragrostiella bifaria</i>	-
	<i>Eragrostis ciliaris</i>	-
	<i>Panicum tripheron</i>	-
	<i>Sacharrum spontanium</i>	Kansh
Periplocaceae	<i>Hemidesmus indicus</i>	Sugandhipala
Papaveraceae	<i>Argemon maximum</i>	Kateh

During survey it is observed that endangered flora is not present within the study area.

Table 3.45: List of Aquatic Plants in Buffer Zone:

Family Name	Botanical Name	Trade Name
Convolvulaceae	<i>Ipomoea aquatic</i>	Water spinach
Menyanthaceae	<i>Nymphoides indica</i>	Floating leaf
Nelumbonaceae	<i>Nelumbo nucifera</i>	Lotus
Typhaceae	<i>Typha angustata</i>	Bull rush

3.8.5 Fauna- Core Zone

Among the faunal groups avifauna of terrestrial inhabitants of passerine category birds are conspicuous in forest patches, grass lands to Agro-ecosystems of crop lands and plantations. However, no big game animals have been found from the core and buffer zone of the project. The domesticated animals like **Goat (*Capra aegagrus*); Buffalo (*Bubalus bubalis*); Cow (*Bos primigenius*); and Dog (*Canis lupus familiaris*)** were found in farm lands and villages.

The aquatic habitats consist of Damodar river, streams; rivulets, ponds; ditches and water logged areas were represented by fin-fish (fishes), shell-fish (mollusk) and prawns

(crustaceans) of seasonal varieties. The check lists of faunal elements of core and buffer zone have been presented in Table below.

Table 3.46: list of Terrestrial Fauna in Core Zone:

(a) Mammals

Zoological Name	Common Name	Status in wildlife (Protection) Act	ICUN RDB
<i>Rousettus leschenaulti</i>	Indian Fulvous - Bat	Schedule-V, Section 3	LC
<i>Mus booduga</i>	Indian Field Mouse	Schedule-V, Section, 5	LC
<i>Mus rattus rattus</i>	Common House Rat	Schedule-V, Section, 6	LC
<i>Bandicoota bengalensis</i>	Bandicoot Rat	Schedule-V, Section, 6	LC
<i>Herpestes edwardsi</i>	Indian Grey mongoose	Schedule-IV, Section, 6A	LC

(b) Birds

Zoological Name	Common Name	Status in wildlife (Protection) Act	ICUN RDB
<i>Bubulcus ibis</i>	Cattle egret	Schedule-IV, Section,11	LC
<i>Ardeola grayii</i>	Indian pond heron	Schedule-IV, Section,11	LC
<i>Milvus migrans</i>	Black kite	Schedule-IV, Section,11	LC
<i>Streptopelia chinensis</i>	Spotted dove	Schedule-IV, Section,11	LC
<i>Alcedo atthis</i>	Small blue kingfisher	Schedule-IV, Section,11	LC
<i>Halcyon smyrensis</i>	White-breasted kingfisher	Schedule-IV, Section,11	LC
<i>Merops orientalis</i>	Small bee-eater	Schedule-IV, Section,11	LC
<i>Acridotheres tristis</i>	Common myna	Schedule-IV, Section,11	LC
<i>Pycnonotus cafer</i>	Red-vented bulbul	Schedule-IV, Section,11	LC
<i>Coracias benghalensis</i>	Indian roller	Schedule-IV, Section,11	LC
<i>Turdoides caudatus</i>	Common babbler	Schedule-IV, Section,11	LC
<i>Centropus sinensis</i>	Crow pheasant	Schedule-IV, Section,11	LC
<i>Dicrurus adsimilis</i>	Black drongo	Schedule-IV, Section,11	LC
<i>Carvus splendens</i>	House crow	Schedule-V, Section,1	LC
<i>Colombia livia</i>	Kabutar	Schedule-IV,Section ,11	LC

During survey, it was observed that endangered , endemic and migratory species were not found in the core zone.

3.8.6 Fauna- Buffer Zone:

Table 3.47: List of Terrestrial Fauna in Buffer Zone:

(a) Mammals

Zoological Name	Common Name	Status in Wildlife (Protection) Act	ICUN RDB
<i>Herpestes edwardsi</i>	Indian Grey Mongoose	Schedule-IV, Section 6A	LC
<i>Lepus nigricollis</i>	Black napped Hare	Schedule-IV, Section 3A	LC
<i>Rousettus leschenaulti</i>	Indian Fulvous Fruit- Bat	Schedule-V, Section 3	LC
<i>Mus booduga</i>	Indian Field Mouse	Schedule-V, Section 5	LC
<i>Mus rattus rattus</i>	Common House Rat	Schedule-V, Section 6	LC
<i>Bandicota bengalensis</i>	Bandicoot Rat	Schedule-V, Section 6	LC

<i>Hystrix indica</i>	Indian porcupine	Schedule-IV, Section 5	LC
<i>Canis aureus</i>	Common Jackal	Schedule-II, Section 1	LC
<i>Sus Scrofa</i>	Wild Pig	Schedule-III	LC

(b) Birds

Zoological Name	Common Name	Status in Wildlife (Protection) Act	ICUN RDB
<i>Egretta alba</i>	Larger egret	Schedule-IV, Section,11	LC
<i>Bubulcus ibis</i>	Cattle egret	Schedule-IV, Section,11	LC
<i>Ardeola grayii</i>	Indian pond heron	Schedule-IV, Section,11	LC
<i>Milvus migrans</i>	Black kite	Schedule-IV, Section,11	LC
<i>Haliastur Indus</i>	Brahminy kite	Schedule-IV, Section,11	LC
<i>Streptopelia chinensis</i>	Spotted dove	Schedule-IV, Section,11	LC
<i>Alcedo atthis</i>	Small blue kingfisher	Schedule-IV, Section,11	LC
<i>Halcyon smyrensis</i>	White-breasted kingfisher	Schedule-IV, Section,11	LC
<i>Merops orientalis</i>	Small bee-eater	Schedule-IV, Section,11	LC
<i>Dinopium benghalensis</i>	Common wood pecker	Schedule-IV, Section,11	LC
<i>Acridotheres tristis</i>	Common myna	Schedule-IV, Section,11	LC
<i>Upupa epops</i>	Common hoopoe	Schedule-IV, Section,11	LC
<i>Sturnus contra</i>	Asian pied starling	Schedule-IV, Section,11	LC
<i>Dendrocitta vagabond</i>	Indian tree pie	Schedule-IV, Section,11	LC
<i>Venellus indicus</i>	Red-wattled lapwing	Schedule-IV, Section,11	LC
<i>Chardrius dubius</i>	Little ringed flover	Schedule-IV, Section,11	LC
<i>Psittakula krameri</i>	Rose ringed parakeet	Schedule-IV, Section,11	LC
<i>Pycnonotus cafer</i>	Red-vented bulbul	Schedule-IV, Section,11	LC
<i>Coracias benghalensis</i>	Indian roller	Schedule-IV, Section,11	LC
<i>Turdoides caudatus</i>	Common babbler	Schedule-IV, Section,11	LC
<i>Centropus sinensis</i>	Crow pheasant	Schedule-IV, Section,11	LC
<i>Dicrurus adsimilis</i>	Black drango	Schedule-IV, Section,11	LC
<i>Carvus macrorhynchos</i>	Jungle crow	Schedule-IV, Section,1	LC
<i>Passer domesticus</i>	House sparrow	Schedule-IV, Section,11	LC
<i>Ploceus philippinus</i>	Baya weaver	Schedule-IV, Section,11	LC
<i>Carvus splendens</i>	House crow	Schedule-V, Section,1	LC

(c) Reptiles

Zoological Name	Common Name	Status in Wildlife (Protection) Act	ICUN RDB
<i>Calotes versicolor</i>	Garden lizard	Schedule-IV, Section,12	LC
<i>Enhydris enhydris</i>	Smooth water snake	Schedule-IV, Section,12	LC
<i>Natrix piscator</i>	Olive keel back snake	Schedule-IV, Section,12	LC
<i>Bungarus caeruleus</i>	Krait	Schedule-IV, Section,12	LC

(d) Amphibians

Zoological Name	Common Name	Status in Wildlife (Protection) Act	ICUN RDB
<i>Bufo melanostictus</i>	Common toad	Schedule-IV, section,13	LC

<i>Euphlyctis hexadactyla</i>	Common frog	Schedule-IV, section,13	LC
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(e) Butter flies

Zoological Name	Common Name	Status in Wildlife (Protection) Act	ICUN RDB
<i>Danaus genutia</i>	Striped tiger	Schedule-IV, Section,18	LC
<i>Antheria mylita</i>	Moth	Schedule-IV, Section,18	LC

During survey, it is observed that endangered, endemic and migratory species are not present in the core zone. Also, migratory corridors are not present in the study area.

Table 3.48:..List of Aquatic Fauna in Buffer Zone:

(a) Fishes

Zoological Name	Common Name	Status in Wildlife (Protection) Act
<i>Channa punctatus</i>	Spotted murrel	Not Applicable
<i>Clarias batrachus</i>	Magur	Not Applicable
<i>Mugil cephalous</i>	Mullet	Not Applicable
<i>Labeo rohita</i>	Rohu	Not Applicable
<i>Labeo gonious</i>	Minor carp	Not Applicable
<i>Catla catla</i>	Catla	Not Applicable

(b) Crustaceans:

Zoological Name	Common Name	Status in Wildlife (Protection) Act
<i>Macrobrachium rosenbergi</i>	Freshwater Prawn	Not Applicable
<i>Macrobrachium malcolmsoni</i>	Small Prawn	Not Applicable

(c) Mollusc:

Zoological Name	Common Name	Status in Wildlife (Protection) Act
<i>Planaxis sulcatus</i>	Ground snail	Not Applicable
<i>Littorina sp.</i>	Common snail	Not Applicable

3.9 Socio-Economic Profile

Socio-economic study including demographic, economic, workforce, civic amenities and basic & civic amenities in the study area is based on 2011 census data and Household's survey carried out by VRDS, Chennai in Oct- Nov., 2015.

3.9.1 Methodology Of Sampling

The study of Socio-economic environment is an integral part of Environmental Impact Assessment (EIA). The study includes the Social profile, Economic, Infrastructure facilities, Occurrence of historical / Archaeological sites and presence of important features of the

area (Core zone and Buffer zone 10 Km radius from mine lease area). All this information is collected from the census of 2011 and reported in this report.

In order to validate the census data, house hold survey of 250 households was made by floating questionnaire to the residence and local people of different villages and village head (Sarpanch / Police Patil) etc. Sample size varies as per need, time and convenience. Occupational health status of the above for the different age group and sex was also collected.

- Village boundary maps as per Census 2011 have been used to collect data; same has been attached for your reference.
- Identify District and Sub-district of Study area from Map provided by CMPDIL.
- Mark 8 corner villages from 8 directions (N, NE, E, SE, S, SW, W, NW) on the sub-district maps.
- Mark a border connecting the above 8 points

Report villages within the boundary.

3.9.2 DEMOGRAPHIC Profile of the study area

The study area comprises **76** villages, with a total population of **347298** persons.

A) AVERAGE HOUSEHOLD SIZE

Details of number of households and total population is covered in Table 3.40. Average household size lies between 4 and 6 persons per family, in the study area.

$$\text{Avg_HH_Size} = (\text{Total Population}) / (\text{No of Households})$$

Below is the summary of the same.

Table 3.49: Summary Avg - HH size

No of Households	Total Population	Avg_HH_Size (Persons)
64835	347298	5

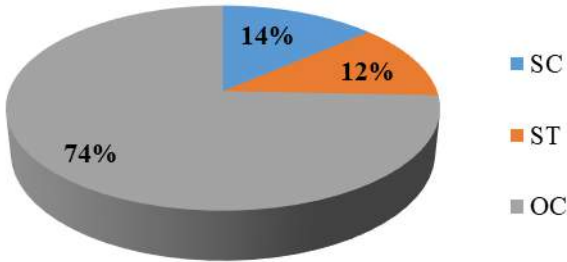
B) POPULATION CASTE WISE BREAKUP

The data has been given for individual caste, as per the notified list of SCs and STs in Table 3.41.

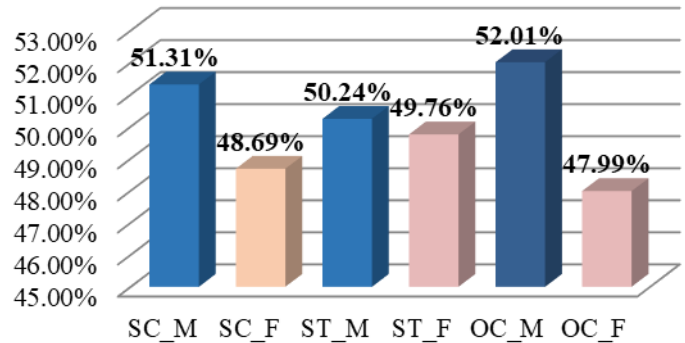
Below is the summary of the same data, in tabular and figurative form.

Table 3.50: Summary Caste distribution

Caste Wise Distribution



M/F Caste Wise



	POPULATION			SC			ST			OC		
	POP	M	F	POP	M	F	POP	M	F	POP	M	F
TO	34729	1795	16773	47299	24271	23028	41801	21002	20799	25819	13429	12390
T		66	2									
%	8	51.7	48.3	13.6	51.3	48.6	12.0	50.2	49.7	74.3	52.0	47.99
		0%	0%	2%	1%	9%	4%	4%	6%	4%	1%	%

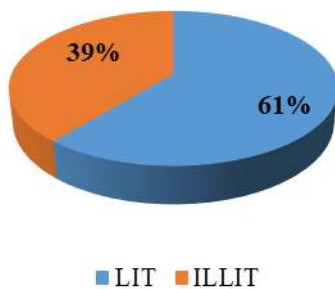
Fig-3.1: Caste distribution

Fig- 3.2: M/ F Caste wise comparison

C) LITERACY WISE BREAKUP

The data for literates and illiterates of each village is given in *Table 3.42*. Below is the summary of the same data, in tabular and figurative form.

Literacy wise distribution



M/F comparison literacy

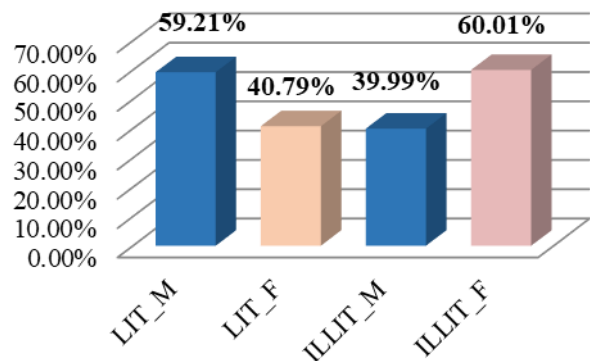


Fig-3.3: Literacy distribution

Fig-3.4: M / F Literacy comparison

Table 3.51: Summary Literacy Status

	LITERATES			ILLITERATES		
	POP	M	F	POP	M	F
TOT	211676	125336	86340	135622	54230	81392
%	60.95%	59.21%	40.79%	39.05%	39.99%	60.01%

D) SEX RATIO

Sex ratio is an indicator of social status. In places where women have a better social status, there the difference between the numbers of male and female is less, the ratio is found to be close to 1:1.

Below is the summary of the same data in tabular form, representing number of female every 1000 male.

$$\text{Sex ratio} = (\text{Number of females} \times 1000) / (\text{Number of males})$$

Table 3.52: Summary sex ratio

TOTAL	SC	ST	OC
934	949	990	923

The ideal sex ratio is 1:1. From the above table, it can be observed that in study area, the number of female per 1000 male is less than required.

3.9.3 ECONOMIC Profile of the study area

The census classifies workers into two groups, namely, 'Main workers' and 'Marginal workers'. Main Workers are those who have worked for the major part of the reference period, i.e. 6 months or more. Marginal Workers are those who have not worked for the major part of the reference period i.e. less than 6 months.

The main/marginal workers are classified on the basis of Industrial category of workers in following four categories:

- Cultivators
- Agricultural Laborers
- Household Industry Workers
- Other Workers

The worker class profile is covered in Table 3.44. Below is the summary of the same data, in tabular and figurative form.

Table 3.53: Summary Worker classification

	WORKERS			NON_WORKERS		
	TOT	M	F	TOT	M	F
TOT	110058	83909	26149	237240	95657	141583
%	31.69%	76.24%	23.76%	68.31%	40.32%	59.68%

	MAIN WORKERS			MARGINAL WORKERS		
	TOT	M	F	TOT	M	F
TOT	63380	54927	8453	46678	28982	17696
%		86.66%	13.34%		62.09%	37.91%

	MAIN_CL		MAIN_AL		MAIN_HH		MAIN_OT	
	M	F	M	F	M	F	M	F
TOT	5429	1478	2387	835	1013	394	46098	5746
%	78.60%	21.40%	74.08%	25.92%	72.00%	28.00%	88.92%	11.08%

	MARG_CL		MARG_AL		MARG_HH		MARG_OT	
	M	F	M	F	M	F	M	F
TOT	5743	5388	7022	7201	532	832	15685	4275
%	51.59%	48.41%	49.37%	50.63%	39.00%	61.00%	78.58%	21.42%

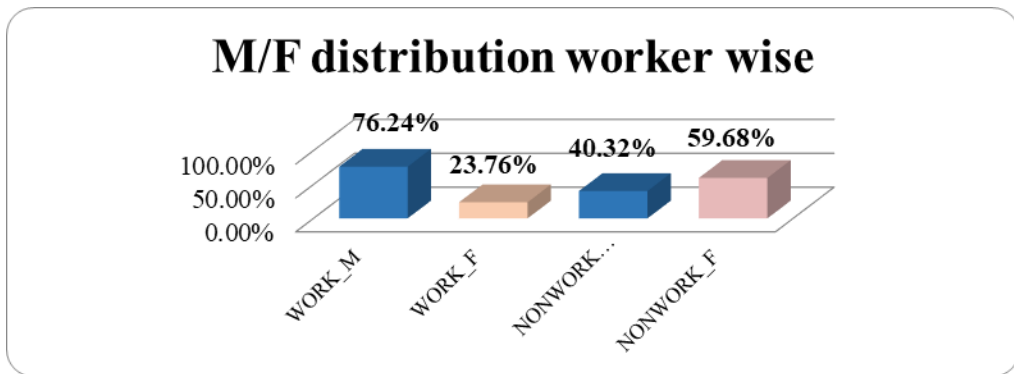


Fig.3.5 Male/Female worker comparison

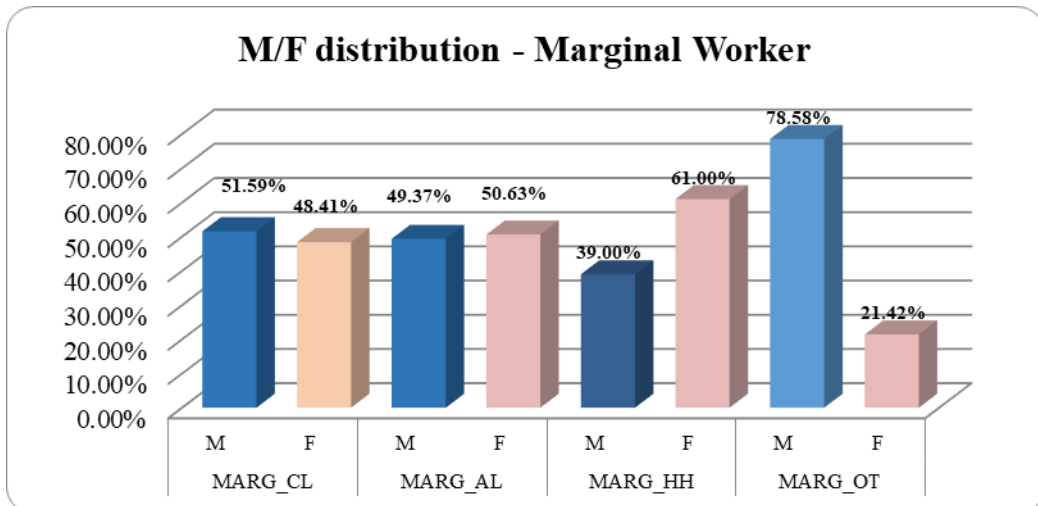


Fig-3.6a: Marginal worker distribution

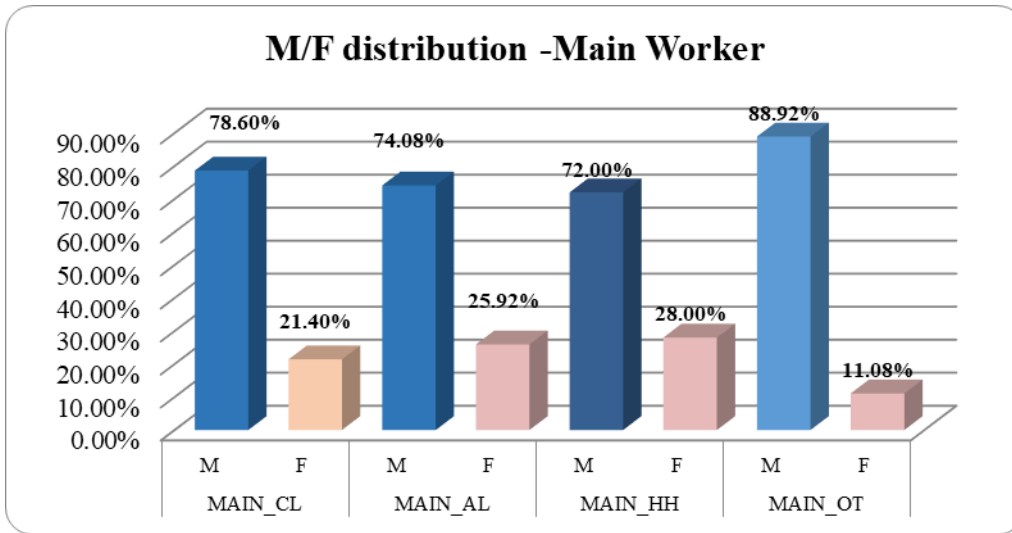


Fig-3.6b: Main worker distribution

The number of female workers is less than half the number of male workers. Interestingly, among agricultural marginal workers, Females out the number of males. In urban areas, majority of Female workers are engaged in households industry and other work.

3.9.4 INFRASTRUCTURE Profile of the study area

Basic and civic amenities pattern of the villages in study area is covered below:

A) LAND USE DISTRIBUTION

Land use and land management practices have a major impact on natural resources, including water, soil, nutrients, plants and animals. Land use information can be used to develop solutions for Natural Resource Management. The land use percentage of study area given is covered in Table 3.45.

Table 3.54: Summary Land – use distribution

FOREST AREA	IRR_CULT	UNIRR_CULT	WASTE	NA_CULT
35.96%	36.18%	6.33%	18.55%	2.99%

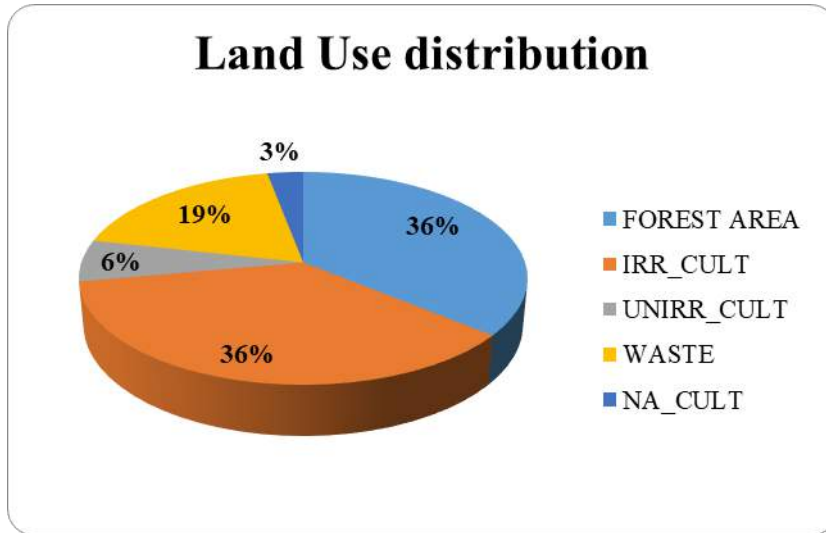


Fig-3.7: Land use comparison

From above we can observe that % of Non- irrigated Land is much higher than irrigated land. Also, % of barren land is negligible. The study area soil conditions are favourable for forestation.

3.9.5 EDUCATION INSTITUTE STATUS

The educational institute availability in study area is given in Table 3.46. Below is the summary for the same.

Table 3.55: Education availability

	Pre-Primary School (Nursery/LKG/UKG)		Primary School		Middle School		Secondary School		Senior Secondary School	
	Govt	Private	Govt	Private	Govt	Private	Govt	Private	Govt	Private
A	0	14	67	8	43	6	10	4	1	2
NA	69	55	2	61	26	63	59	65	68	67

Table 3.56 Education availability if not within the village

	Pre-Primary School (Nursery/LKG/UKG)	Primary School	Middle School	Secondary School	Senior Secondary School
< 5 kms	21	2	20	22	18
5 - 10 Kms	20	0	6	27	27
> 10 Kms	14	0	0	8	21

From above, it can be observed that primary/middle school education is available in most villages. Secondary/Senior-secondary education is available within 10 kms range for most villages.

3.9.6 Power supply availability

The power supply availability for various purposes in study area, is given in Table 3.47. Below is the summary for the same.

Table 3.57: Power supply availability

	Power Supply - Domestic Use	Power Supply -Agriculture Use	Power Supply - Commercial use	Power Supply -All Uses
A	51	11	8	10
NA	18	58	61	59

Power supply for domestic/agricultural purposes is available in more than 95% villages, but, is not available for commercial purpose in ~50 % of the villages in study area. This indicates fewer tendencies towards industrial development.

3.9.7 MEDICAL CENTER SERVICES & AMENITIES

A greater component of medical effort is devoted to improving the quality of life, or more accurately, to prevent or to minimize the poor quality of life associated with chronic disease: to the relief of pain, disfigurement, and disability.

The medical center services & amenities availability for various purposes in study area is given in Table 3.48. Below is the summary for the same.

Table 3.58: Health amenities availability within village

	Comm unity Health Centre	Primary Health Centre	Primary Health Sub Centre	Materni ty And Child Welfare Centre	TB Cli nic	Hosp ital Allop athic	Hospital Alternative Medicine	Dispen sary	Veterinary Hospital
A	0	6	12	3	0	3	1	4	1
NA	69	63	57	66	69	66	68	65	68

Table 3.59: Health amenities availability if not within the village

	Community Health Centre	Primary Health Centre	Primary Health Sub Centre	Maternity And Child Welfare Centre	TB Clinic	Hospital Allopathic	Hospital Alternative Medicine	Dispensary	Veterinary Hospital
< 5 kms	13	15	49	11	4	10	9	11	13
5 - 10 Kms	22	21	8	22	12	27	31	24	22
> 10 Kms	34	27	0	33	53	29	28	30	33

As in most villages, cattle still play a major role as a source of income, the availability of veterinary hospitals becomes crucial. Veterinary hospitals are accessible within the range of 10 kms for most villages. Maternity/TB clinics are also present within the range of 10 kms.

3.9.8 COMMUNICATION SERVICES & AMENITIES

A decisive role can be played by communication in promoting human development in today's new climate of social change. The communication services availability for various purposes in study area is given in Table 3.50. Below is the summary for the same.

Table 3.60: Communication amenities availability within village

	Post Office	Sub Post Office	Post And Telegraph Office	Telephone (landlines)	Public Call Office /Mobile (PCO)	Mobile Phone Coverage	Internet Cafes / Common Service Centre (CSC)
A	16	14	1	11	23	41	3
NA	53	55	68	58	46	28	66

Table 3.61: Communication amenities availability if not within village

	Post Office	Sub Post Office	Post And Telegraph Office	Telephone (landlines)	Public Call Office /Mobile (PCO)	Mobile Phone Coverage	Internet Cafes / Common Service Centre (CSC)
< 5 Kms	16	30	7	12	8	6	9
5 - 10 Kms	17	19	17	20	21	22	25
> 10 Kms	20	6	44	26	17	0	32

3.9.9 TRANSPORT SERVICES

Without effective transportation, regions are largely isolated from each other. Effective, affordable transportation also plays a role in letting people move to new areas

The transport services availability in study area is given in table 3.52. Below is the summary for the same.

Table 3.62: Transport amenities availability within village

	Private Bus	Public Bus	Railway Station
A	1	13	1
NA	68	56	68

Table 3.63: Transport amenities availability if not available within village

	Private Bus	Public Bus	Railway Station
< 5 kms	7	7	8
5 - 10 Kms	20	21	27
> 10 Kms	41	28	33

The availability of bus services for communication looks better than railway services.

3.9.10 WATER SUPPLY

Uses of water includes agricultural, industrial, household, recreational and environmental activities. Providing better water supply can significantly improve the quality of life and is a source of socio-economic development. Some diseases in poor or developing countries are related to insufficient or unsafe water, together with local factors as climate, density of population, local practices etc.

3.9.11 HOUSEHOLD SURVEY

250 Households of 5 villages with a population of 1166 were surveyed for below data.

Table 3.64- Household Average Size breakup/Annual income of the surveyed villages

Household Average Size				
Village Name	No_HH_Surveyed	TOT_P	Avg_HH_Size (Persons)	Avg. Annual Income
Baidkaro	60	290	4.83	0.30 (BPL)
Subhasnagar Colony	55	260	4.72	7.75
Jawaharnagar Colony	50	235	4.68	8.10
Chanchal Colony	55	249	4.52	7.50
Gandhinagar Colony	30	132	4.40	6.50
TOTAL	250	1166	4.63	6.47

Table 3.65: Land/housing Details of surveyed villages

Land / Housing detail					
Name of village(s) - Core zone/ 500 m	Number of Families			Type of House	
	Land (only)	Homestead (only)	Both	Kuccha	Pucca
Baldkaro	-	60	-	45	15
Subhasnagar Colony	-	55	-	0	55
Jawaharnagar Colony	-	50	-	0	50
Chanchal Colony	-	55	-	0	55
Gandhinagar Colony	-	30	-	0	30

Table 3.66: Education infrastructure of the surveyed villages

Education Infrastructure(0-5 kms)					
Village Name	Pre-primary school	Primary School	Middle School	Secondary School	Senior Secondary School
Baldkaro	Available	Available	Available	Available	Available
Subhasnagar Colony	Available	Available	Available	Available	Available
Jawaharnagar Colony	Available	Available	Available	Available	Available
Chanchal Colony	Available	Available	Available	Available	Available
Gandhinagar Colony	Available	Available	Available	Available	Available

Table 3.67: Basic Infrastructure of the surveyed villages

Basic Infrastructure Amenities(0-5 kms)					
Village Name	Power-Supply	Hospital availability	Post Office	Bus service	Railway Station
Baldkaro	Available	Available	Available	Available	Available
Subhasnagar Colony	Available	Available	Available	Available	Available
Jawaharnagar Colony	Available	Available	Available	Available	Available
Chanchal Colony	Available	Available	Available	Available	Available
Gandhinagar Colony	Available	Available	Available	Available	Available

Table 3.68: Overall habitat condition of surveyed villages

Criteria	YES	NO	CANNOT SAY
Health is Good	-	-	Can't Say
Major disease found	Yes	-	-
Dog menace	Yes	-	-
Mosquito problem	Yes	-	-

Pig problem	Yes	-	-
Water contamination	Yes	-	-
Solid Waste Accumulation	Yes	-	-
Air pollution/Foul Smell	Yes	-	-
Dust Problem	Yes	-	-
Noise Problem	Yes	-	-
Alcoholism	Yes	-	-

- People in the Baidkaro region have income below poverty line
- Water supply within core zone villages provided by CCL
- Electricity within core zone villages is provided by CCL
- Basic amenities are available within the distance of 10 Km.
- Infrastructure for primary education is available within 10 km.
- Medical amenities is available within the range of 10 kms
- Most houses in core zone are pucca houses except Baidkaro in core zone
- The villages are connected with Electric lines but power is intermittently supplied as in all rural areas of the state particularly in summer season.
- The fuel for cooking purpose is L.P.G, kerosene, Coal or Firewood.
- Most of the villages are connected with fair (tar/mud) roads with state transport facilities. Motor cycles, Cycles are used for traveling purposes. Tractors, Trucks are used for carrying materials.

During survey, it is observed that, people are very conservative about informing their income. The maximum expenses are on food and clothing.

3.9.12 OCCUPATIONAL HEALTH SURVEY

Under the Occupational Health and Safety Act, occupational illness is defined as a condition that results from exposure in a workplace to a physical, chemical or biological agent to the extent that the normal physiological mechanisms are affected and the health of the worker is impaired.

It is observed that Asthma, Hypertension and Chest disorder (TB), Paralytic attack, Cataract, Conductive Hearing Problem (CHB), Coronary Artery disease (CAD) and Dislipidimia (Cholesterol) are common in people of old age group (> 40 years). Malaria, Jaundice, Dysentery/Diarrhoea and Skin diseases are common in all age groups. Baseline health status is also enclosed as Annexure XI.

Table 3.69: 5km radius health checkup report from financial year 2016-17 to 2017-18

2016-17					
SN	Village Name	Date of Camp	Type of Camp (Age Group)	No. of Beneficiaries	Major findings (Disease)
01.	BRL DAV Public School Bhandaridah	11.04.2016 to 13.04.2016	6 Yrs to 17 Yrs.	157	Health Checkup
02	Village Health Checkup Camp Jarwa	08.06.2016	25 Yrs to 60 Yrs	17	Hypertension, diabetes, fever, Cough/Cold Copd, Bronchitis,

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

	Basti				Toothache, Cervical Pain, Pain abdomen, Gastritis, LBA, Generalized weakness etc.,
03	Bermo Basti	15.06.2016	-do-	40	-do-
04	Jarwa Basti	13.07.2016	-do-	18	-do-
05	Bermo Basti	20.07.2016	-do-	42	-do-
06	Amlo Basti	03.08.2016	-do-	64	-do-
07	Barki Kuris school	06.08.2016	-do-	54	-do-
08	Jarwa Basti	10.08.2016	-do-	36	-do-
09	Bermo basti	17.08.2016	-do-	21	-do-
10	Amlo Basti	07.09.2016	-do-	38	-do-
11	Bermo Basti	21.09.2016	-do-	35	-do-
12	Charakpania (Barkikuri)	05.10.2016	-do-	49	-do-
13	Kurakpania Basti	19.10.2016	-do-	51	-do-
14	Charakpania (barkikuri)	02.11.2016	-do-	69	-do-
15	Barwa Bera	09.11.2016	-do-	33	-do-
16	Kurakpania Basti	16.11.2016	-do-	52	-do-
17	Charakpania (Barkikuri)	07.12.2016	-do-	37	-do-
18	Barwa Bera	14.12.2016	-do-	56	-do-
19	Kurakpania Basti	21.12.2016	-do-	27	-do-
20	Charakpania (Barkikuri)	04.01.2017	-do-	29	-do-
21	Barwa Bera	14.12.2017	-do-	41	-do-
22	Barwa Bera	08.02.2017	-do-	22	-do-
23	Kurakpania Basti	15.02.2017	-do-	33	-do-
24	Charakpania (Barkikuri)	01.03.2017	-do-	36	-do-
25	BarwaBera	08.03.2017	-do-	22	-do-
26	Kurakpania Basti	15.03.2017	-do-	02	-do-
27	Eye Camp (IOL) R.H., Kargali	17.12.2016 18.12.2017	40 to 70 Yrs	56	Eye
28	-do-	06.01.2017 to 07.01.2017	-do-	44	Eye
29	Eye Camp R.H., Kargali	19.03.2017	-do-	17	Eye
30	General Surgery (Hydrocele & Hernia)	26.03.2017 & 06.04.2017	-do-	29	Hydrocele & Hernia.

2017-18

SN	Village Name	Date of Camp	Type of Camp (Age Group)	No. of Beneficiaries	Major findings (Disease)
01	Village Health Checkup Camp Jaridih Bazar	20.05.2017	25 Yrs to 60 Yrs	112	Hypertension, diabetes, fever, Cough/Cold Copd, Bronchitis, Toothache, Cervical Pain, Pain abdomen, Gastritis, LBA, Generalized weakness etc.,
02	Barwa Bera	11.10.2017	-do-	23	-do-
03	Charakpania (Barkikuri)	12.10.2017	-do-	27	-do-
04	Charakpania (Barkikuri)	08.11.2017	-do-	20	-do-
05	Gandhinagar Giridih	29.11.2017	-do-	48	-do-
06	Charakpania (Barkikuri)	06.12.2017	-do-	22	-do-
07	Charakpania (Barkikuri)	07.02.2018	-do-	31	-do-
08	Jaridih Bazar Gujarati School	10.02.2018	-do-	142	-do-
09	Barwa Bera	14.02.2018	-do-	13	-do-
10	Kurakpania Basti	21.02.2018	-do-	21	-do-
11	Charakpania (Barkikuri)	23.02.2018	-do-	34	-do-
12	Charakpania (Barkikuri)	07.03.2018	-do-	31	-do-
13	Barwa Bera	14.03.2018	-do-	31	-do-
14	Kurakpania Basti	21.03.2018	-do-	30	-do-

3.9.13 PUBLIC AWARENESS AND OPINION ABOUT THE PROJECT

Most of the respondents are aware about the project. 85% respondents have favourable opinion, 10 % have unfavourable opinion and 5 % have not given any opinion.

The respondents were asked to opine about the project. They expect increase in job opportunities, improvement in educational, transport, medical, housing, sanitation facilities.

3.9.14 PROJECT BENEFITS

The implementation of the project will improve the socio-economic status of the joining areas and will help to meet the energy demand of the nation. Project will lead to development of ancillary industries and an overall economic growth of nearby towns to supplement the population of the area.

The project is likely to give a boost to the economy of the area and providing primary and secondary employment to local people. There will be improvement in infrastructure facilities like drinking water, medical, educational, schools etc. There will be overall gain with respect to improvement in social and economic aspect. This will lead to the overall development of the society.

3.10 Land Environment

3.10.1 Land use pattern of Core Zone

The proposed land use pattern of the core zone during mining is given in table below.

Table 3.70 Land Use during Mining

SN	Particulars of land (Area Ha)	Forest	Non- Forest	Total
1	Quarry	185.07	110.68	295.75
2	External OB dump-1	24.73	13.27	38.00
	External OB dump-2	5.00	52.24	57.24
3	Infrastructures	36.77	8.31	45.08
4	Road, nala diversion, green belt/vacant land	52.53	32.72	85.25
5	Res. colony*	0.00	5.00	5.00
6	Conveyer to Kargali Washery/siding *	7.50	19.02	26.52
Total Land Required		311.6	241.24	552.84

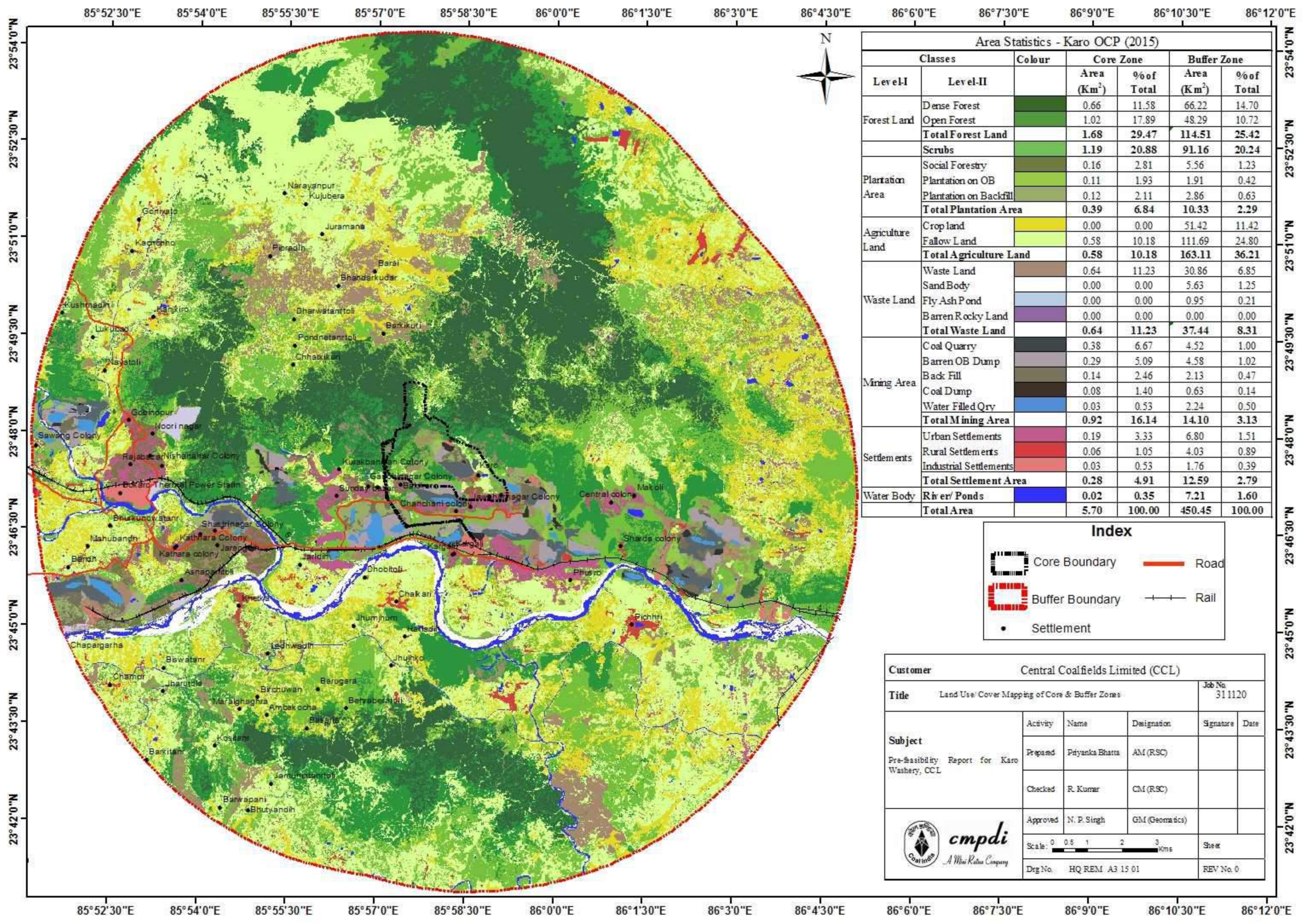
* 31.52 Ha of residential colony and conveyor belt fall outside core zone.

3.10.2 Land use pattern of Core and Buffer Zone

The land use pattern of the core & buffer zone based on satellite imagery data is given in **Table 3.61** and shown in plate X.

Table 3.71 Satellite Imagery of Core and Buffer Zone

Classes		Core Zone		Buffer Zone	
Level-I	Level-II	Area (Km ²)	% of Total	Area (Km ²)	% of Total
Forest Land	Dense Forest	0.66	11.96	66.22	14.70
	Open Forest	1.02	18.48	48.29	10.72



Area Statistics - Karo OCP (2015)

Level-I	Level-II	Colour	Core Zone		Buffer Zone	
			Area (Km ²)	% of Total	Area (Km ²)	% of Total
Forest Land	Dense Forest		0.66	11.58	66.22	14.70
	Open Forest		1.02	17.89	48.29	10.72
	Total Forest Land		1.68	29.47	114.51	25.42
Plantation Area	Scrubs		1.19	20.88	91.16	20.24
	Social Forestry		0.16	2.81	5.56	1.23
	Plantation on OB		0.11	1.93	1.91	0.42
Agriculture Land	Plantation on Backfill		0.12	2.11	2.86	0.63
	Total Plantation Area		0.39	6.84	10.33	2.29
	Crop land		0.00	0.00	51.42	11.42
Waste Land	Fallow Land		0.58	10.18	111.69	24.80
	Total Agriculture Land		0.58	10.18	163.11	36.21
	Waste Land		0.64	11.23	30.86	6.85
Mining Area	Sand Body		0.00	0.00	5.63	1.25
	Fly Ash Pond		0.00	0.00	0.95	0.21
	Barren Rocky Land		0.00	0.00	0.00	0.00
	Total Waste Land		0.64	11.23	37.44	8.31
	Coal Quarry		0.38	6.67	4.52	1.00
	Barren OB Dump		0.29	5.09	4.58	1.02
Settlements	Back Fill		0.14	2.46	2.13	0.47
	Coal Dump		0.08	1.40	0.63	0.14
	Water Filled Qry		0.03	0.53	2.24	0.50
	Total Mining Area		0.92	16.14	14.10	3.13
	Urban Settlements		0.19	3.33	6.80	1.51
Water Body	Rural Settlements		0.06	1.05	4.03	0.89
	Industrial Settlements		0.03	0.53	1.76	0.39
	Total Settlement Area		0.28	4.91	12.59	2.79
Total Area			5.70	100.00	450.45	100.00

Index

- Core Boundary
- Buffer Boundary
- Road
- Rail
- Settlement

Customer		Central Coalfields Limited (CCL)			
Title		Land Use/ Cover Mapping of Core & Buffer Zones		Job No. 311120	
Subject Pre-feasibility Report for Karo Washery, CCL	Activity	Name	Designation	Signature	Date
	Prepared	Priyanka Bhatta	AM (RSC)		
	Checked	R. Kumar	CM (RSC)		
		Approved	N. P. Singh	GM (Geomatics)	
Scale: 0 0.5 1 2 3 Kms		Drg No. HQ REM A3 15 01		REV No. 0	

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Classes		Core Zone		Buffer Zone	
Level-I	Level-II	Area (Km ²)	% of Total	Area (Km ²)	% of Total
	Total Forest Land	1.68	30.43	114.51	25.42
	Scrubs	1.19	21.56	91.16	20.24
Plantation Area	Social Forestry	0.16	2.90	5.56	1.23
	Plantation on OB	0.11	1.99	1.91	0.42
	Plantation on Backfill	0.12	2.17	2.86	0.63
	Total Plantation Area	0.39	7.07	10.33	2.29
Agriculture Land	Crop land	0.00	0.00	51.42	11.42
	Fallow Land	0.58	10.51	111.69	24.80
	Total Agriculture Land	0.58	10.51	163.11	36.21
Waste Land	Waste Land	0.64	11.59	30.86	6.85
	Sand Body	0.00	0.00	5.63	1.25
	Fly Ash Pond	0.00	0.00	0.95	0.21
	Barren Rocky Land	0.00	0.00	0.00	0.00
	Total Waste Land	0.46	8.33	37.44	8.31
Mining Area	Coal Quarry	0.38	6.88	4.52	1.00
	Barren OB Dump	0.29	5.25	4.58	1.02
	Back Fill	0.14	2.54	2.13	0.47
	Coal Dump	0.08	1.45	0.63	0.14
	Water Filled Qry	0.03	0.54	2.24	0.50
	Total Mining Area	0.92	16.67	14.10	3.13
Settlements	Urban Settlements	0.19	3.44	6.80	1.51
	Rural Settlements	0.06	1.09	4.03	0.89
	Industrial Settlements	0.03	0.54	1.76	0.39
	Total Settlement Area	0.28	5.07	12.59	2.79
Water Body	River/ Ponds	0.02	0.36	7.21	1.60
	Total Area	5.52	100.00	450.45	100.00

Chapter 4

Anticipated Environmental Impacts and Mitigation Measures

4.1 General

The impacts (both beneficial and adverse) of mining and its allied activities of the project have been assessed and presented in respect of air, water, noise, blasting vibration, socio-economic profile, flora & fauna, land resource, traffic movement and visual/aesthetic aspect in this chapter.

The control measures to mitigate various environmental impacts are also highlighted in this chapter for carrying out mining operation in an environmentally compatible manner. Further, all provisions of Coal Mines Regulations and Directives shall be followed in this project.

4.2 Air Environment

The impact assessment has been carried out dealing with the following points:

- (i) Inventory of air pollution emission sources
- (ii) Impact assessment (short-term and long-term besides direct/indirect and residual)

Suitable air pollution control measures are being taken to contain the air pollution for maintaining the ambient air quality within the stipulated standards besides making the mining operation eco-friendly in this project. All provisions of Coal Mines Regulations and Directives are followed.

4.2.1 Air Pollution Impact Assessment

To assess the impact, the project life is divided into following time frames:

- Operation phase (long term).
- Post-operational phase (short term).

The activities associated with these time frames and having impact on the ambient air quality along with the pollutants are enumerated in the following sections.

Operational phase: During this phase activities for mining of coal, its handling and transport are taken up. Such activities are detailed below:

Table 4.1 Sources of Air Pollution within Project Area

S No.	Source of Pollution	Pollutant
I.	Drilling & blasting	Dust
II.	Handling, loading & unloading of coal	Dust and noxious gases
III.	Ground coal stock formation	Dust from wind erosion

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IV.	OB Dumps	Dust from wind erosion till the development of green cover
V.	Movement of vehicles	Dust and noxious fumes
VI.	Coal (RoM) handling	Dust
VII.	Loading and unloading of Wagons/conveyors	Dust
VIII.	Coal crushing- Primary and Secondary	Dust
IX.	Coal Screening	Dust
X.	Coal Sizing	Dust
XI.	Reject transportation and handling,	Dust
XII.	Washed coal handling	Dust
XIII.	Reject storage	Dust
XIV.	Movement of vehicles	Dust and noxious fumes

Post-operational phase: During this stage of the project, the activities related to the closure of mine are to be carried out. Preparation of final mine closure plan shall be carried out five years before the closure of the mine. The activities having impact on the ambient air quality during this phase are enumerated below:

(i)	Movement of HEMMs for physical reclamation of degraded land.	Dust and obnoxious fumes
(ii)	Movement of vehicles for shifting and salvaging operation of equipment.	Dust and obnoxious fumes
(iii)	Movement of vehicles for clearing of coal and other materials.	Dust and obnoxious gases

The mining and its related activities create ambient air pollution. The impact of mining on ambient air quality is highlighted in the following paragraphs.

4.2.2 Air quality modelling

Air Quality Impact Prediction

Estimation for increase in PM10 at the eight Ambient Air Quality Stations, chosen for the purpose of baseline AAQ data generation, has been done with the help of the FDM model. The contribution from proposed mining activity (to achieve the peak production level of 15 MTPA) has been assessed for the two scenarios of operation i.e. with control measures and without control measures (business as usual). The model was run to predict the incremental PM concentrations for the two scenarios over and above the baseline concentrations found at the eight AAQ stations.

Identification of sources of Particulate Matter and Gaseous pollutants

The main sources of air pollution with regard to Karo Expansion OCP and Washery for the purpose of estimation of increase in RPM and PM_{2.5} were identified as-

- 1) Drilling in Coal benches.
- 2) Drilling in OB benches.
- 3) Blasting in Coal benches.
- 4) Blasting in OB benches.
- 5) Truck loading of coal & OB.
- 6) Coal transportation through conveyor belt to Kargali washery
- 7) Emissions from primary and secondary crusher of Washery.
- 8) OB transportation.
- 9) Wind erosion at active OB dumps

Receptors

The baseline Ambient Air Quality Stations (2 in Core Zone and 6 in the Buffer Zone), chosen for the purpose of baseline data generation by CMPDI Ranchi, have been treated as receptors for estimation of increase in PM and gaseous pollutants.

Meteorological Input

Micrometeorological and microclimatic parameters were recorded by Ecomen Pvt. Ltd.. for the post monsoon period, hourly reading of wind velocity, wind direction, temperature, relative humidity, cloud cover and rainfall data were recorded. The model was run on 24 hours input meteorological file based on the average of the readings taken which represents typical meteorological condition found during the study period.

Emission Factors

A S&T study titled, "Development of emission factors for various mining machineries & operations in opencast coal mines (EE-27)" was carried out by CMPDI (HQ) during 2002 to 2008. During this study, emission factors for Suspended Particulate Matter (PM ≤ 100 µm) were developed for Drilling, Loading of coal and OB by Shovel, Unloading of OB, Transportation on haul roads and Coal sizing. The emission factors data for PM -10 and PM - 2.5 have been estimated on the basis of particle size distribution study. SPM Emission Factors & control factors for Various Mining Operations have been given below:

Table 4.2 Emission Factors Considered for AQIP

Sl. No	Activity	Uncontrolled Emission Factor				Control Factor (as given in EET)	Reference of E.F.
		Unit	PM – 2.5	PM -10	TSP		
1	Top soil removal by scrapper	kg/t	0.00058	0.0052	0.029	50 % control when soil is naturally or artificially wet.	AP 42 , USEPA(1998)
2	Drilling in Coal Bench	kg/hole	0.04	0.22	0.83	90 % for fabric	*Coal S&T Project

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						filter. 70 % for water sprays.	
3	Drilling in OB Bench	kg/hole	0.11	0.56	2.18	90 % with fabric filter 70 % for water sprays	*Coal S&T Project
4	OB Loading	kg/t	1.5×10^{-05}	1.4×10^{-04}	7.7×10^{-04}	None	*Coal S&T Project
5	OB Unloading	kg/t	6.0×10^{-05}	5.0×10^{-04}	3.0×10^{-03}	None	*Coal S&T Project
6	Coal Loading	kg/t	2.1×10^{-04}	1.5×10^{-03}	7.1×10^{-03}	None	*Coal S&T Project
7	Coal Unloading	kg/t	1.4×10^{-04}	1.23×10^{-03}	7.1×10^{-03}	None	*Coal S&T Project
8	Coal / OB transportation on unpaved haul road	kg/VKT	0.076 Vehicle km traveled (VKT) = (No. of trips) x (distance traveled)	0.53	2.56	50% for water sprinkling	*Coal S&T Project
9	Coal Sizing						
	(a) Primary Crusher	kg/t	0.008	0.056	0.28	Control factor = 99 % for enclosure with dust extraction system	*Coal S&T Project
	(b) Secondary Crusher	kg/t	0.02	0.13	0.64	Control factor = 99 % for enclosure with dust extraction system	*Coal S&T Project
10	Blasting OB / Coal	kg/ blast	$0.03 \times \text{E.F.}$ for TSP*	$0.18 \times \text{E.F.}$ for TSP*	$344(\text{A})^{0.8} /$ $(\text{M})^{1.9}(\text{D})^{1.8}$	None	AP 42 , USEPA(1998)
11	Dozing OB**	kg/hr	$0.11 \times \text{E.F.}$ for TSP	$0.29 \times \text{E.F.}$ for TSP	$2.6 (\text{S})^{1.2}$ $/(\text{M})^{1.3}$	None	AP 42 , USEPA(1998)
12	Dozing Coal#	kg/hr	$0.11 \times \text{E.F.}$ for TSP	$0.29 \times \text{E.F.}$ for TSP	$35.6 (\text{S})^{1.2}$ $/(\text{M})^{1.4}$	None	AP 42 , USEPA(1998)
13	Wind erosion from OB dumps, coal	kg/ha/hr	0.008 (exclude contribution	0.09 (exclude contribution	0.4	50 % for water sprays	AP 42 , USEPA(1998)

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	mine pits and coal stockyard		of calm period)	of calm period)		
14	Pit retention		0 %		50 % for PM -10	Emission Estimation Technique for Mining, version 2.3 , EPA Australia
15	Unloading point of conveyor belt	Kg/t			0.029	USEPA 1998

*The average values for Silt(S) and Moisture (M) content in coal and OB were observed as S = 12 %, M = 7 % , For OB, S = 5 % & M = 4 % respectively during an coal S&T Study for "Development of emission factors for various mining machineries & operations in an opencast coal mines"(EE-27).

**For Dozing OB, TSP = = 2.96 kg/hr for S = 5 %, M = 4 %,

#For Dozing Coal, TSP = = 46.06 kg/hr for S = 12 %, M = 7 %,

D – depth of drill hole, A – incremental area for blasting

Activity	Unit	Uncontrolled Emission Factor for PM10	Control Factor	Reference of E.F.
Coal cutting & loading by Surface Miner	kg/t	$(0.0022*d^{0.7})/(1.6*M^{0.3})$	None	Australian emission factor
Conveyor loading/unloading point	kg/t	$((0.35*0.0016*(U/2.2)^{1.3})/((M/2)^{1.4})$	99%	Enclosure & Fabric filter

d- Drop height for surface miner in meter

U- Avg. wind speed (m/s)

M- Moisture content (%)

Present & Predicted Concentrations of PM10 & PM2.5 For 15.0 MTPA Normative Coal Production at Karo OCP

Table 4.3 Input Data for AQIP

proposed annual coal production (MTPA)	15.00
Coal production during FY 2017-18 (MTPA)	1.50
Annual Peak incremental coal production (MTPA)	13.50
Stripping Ratio	0.86
Annual Peak incremental OB generation (Mcum/yr)	11.61
No. of operation days per annum	330.00
Specific gravity of coal (Tonne/m3)	1.60
Density of OB (t/m3)	2.40
Quantity of coal for Conveyor transport up to Kargali washery (MTPA)	15.00

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

Drill hole to hole distance (m)	Length	Width	Depth (D)	No. of drill holes
Coal Bench	3.5	3.5	10	210
OB Bench	3.5	3.5	10	280

Capacity of Dumper for OB (Tonne)	100
Avg. distance travelled per trip for OB dumping (km)	1.80
Active OB dump Area (Ha)	116.14
Capacity of Dumper for coal (Tonne)	100.00
Avg. distance travelled per trip for coal (km)	2.00
Moisture content for OB (M), (%)	4
Moisture content for coal (M), (%)	7.00
No. of conveyor unloading points within mine	2.00
No. of conveyor unloading points from Karo washery to Kargali washery	5.00
Drop height (d) for Surface miner (m)	1
Avg. wind speed (m/s)	1

Sources of Emission	
Area of Mine (including external OB dump) (Ha)	390.99
Area of washery (Ha)	18
Area of ROM Stock yard	13.44
Length of conveyor from Karo washery to Kargali washery (km)	6.50
Length of conveyor belt within mine (km)	1.5

Assumptions	
Quantity of Topsoil (TPD) = 10% of Quantity of OB (TPD)	
Maximum not reclaimed OB dump Area at a time = Total OB Dump Area/3	

Particulars	Formula used	Calculated Value
Total Daily incremental coal production (TPD)	Annual Peak incremental coal production (MTPA) x No. of operation days per annum	40303.03
Daily incremental OB generation (m3/d)	Annual Peak incremental OB generation (Mcum/yr) x No. of operation days per annum	34660.61
Volume of coal (m3/d)	Daily incremental coal production (TPD) / Specific gravity of coal (Tonne/m3)	25189.39
Quantity of OB (TPD)	Daily incremental OB generation (m3/d) x Density of OB (t/m3)	83185.45
Quantity of Topsoil (TPD)	10% of Quantity of OB (TPD)	8318.55
Daily incremental coal production for conveyor transport (TPD)	Annual Peak incremental coal production for conveyor transport (MTPA) x No. of operation days per annum	33333.33
Daily incremental coal production for direct dispatch (TPD)	Annual Peak incremental coal production for direct dispatch (MTPA) x No. of operation days per annum	6969.70

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

OB Removal		
Area of OB benches being blasted in a day (A), (m ²)	Daily incremental OB generation (m ³ /d) / Depth of OB bench (m)	3466.06
No. of trips for transportation of OB per day	Daily incremental OB generation (m ³ /d) / Capacity of Dumper for OB (Tonne)	832
Total vehicle km traveled for OB (VKT)	No. of trips for transportation of OB per day x Avg distance traveled per trip for OB dumping (km)	1497.34

	Incremental Emissions (SPM) generation from various activities	
SN	Activity	Incremental Emission Generation (Kg/day) without control measures
1	Top Soil Removal	Quantity of Topsoil (TPD) x Emission Factor for Topsoil Removal (kg/t)
2	OB Removal	
a	Drilling	No. of drill holes for OB per day x Emission Factor for drilling in OB
b	Blasting	$0.18 \times 344 (\text{Area})^{0.8} / (\text{Moisture})^{1.9} (\text{Depth})^{1.8}$
c	Dumper loading by shovel	Quantity of OB (TPD) x Emission Factor for OB loading (kg/t)
d	Transportation of OB	Total vehicle km traveled for OB (VKT) x Emission Factor for OB transportation (kg/VKT)
e	Unloading of OB	Quantity of OB (TPD) x Emission Factor for OB unloading (kg/t)
f	Wind erosion of OB	Maximum not reclaimed OB dump Area at a time (ha) x Emission Factor for Wind erosion of OB (kg/ha/hr) x 24
3	Coal Extraction (By Surface Miner)	
a	Coal cutting & loading by Surface Miner	Quantity of coal (TPD) x Emission Factor for surface miner (kg/t)
b	Unloading of coal at receiving point	Quantity of coal (TPD) x Emission Factor for coal unloading (kg/t)
c	Coal transportation by conveyor within mine	Quantity of coal (TPD) x Emission Factor for conveyor unloading point (kg/t) x No. of unloading points
	Incremental Emission factor for mine (gm/m²/s)	Incremental Emission generation from mine (kg/day) x 1000 / (Area of mine (Ha) x 10000x24x60x60)
4	Direct coal dispatch from ROM stockyard	
a	Unloading of Coal by conveyor	Quantity of coal for direct dispatch (TPD) x Emission Factor for coal loading (kg/t)
b	Loading of Coal by shovel	Quantity of coal for direct dispatch (TPD) x Emission Factor for coal loading (kg/t)

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

	Incremental Emission factor for ROM stockyard (gm/m²/s)	Incremental Emission generation from ROM stockyard (kg/day) x 1000 / (Area of ROM stockyard (Ha) x 10000x24x60x60)
5	CHP (Enclosed with dust extraction system)	
a	Primary Crusher	Quantity of coal (TPD) x Emission Factor for Primary crusher (kg/t)
b	Secondary Crusher	Quantity of coal (TPD) x Emission Factor for Secondary crusher (kg/t)
c	Loading of Coal Rejects	Quantity of coal rejects (TPD) x Emission Factor for coal loading (kg/t)
	Incremental Emission factor for CHP (gm/m²/s)	Incremental Emission generation from CHP (kg/day) x 1000 / (Area of CHP (Ha) x 10000x24x60x60)
6	Conveyor belt from Karo Washery to Kargali siding	
a	Conveyor unloading points	Quantity for conveyor transport (TPD) x Emission Factor for conveyor unloading point (kg/t) x No. of unloading points
	Incremental Emission factor for conveyor belt from Karo Washery to Kargali siding (gm/m/s)	Incremental Emission generation from conveyor belt (kg/day) x 1000 / (Length of conveyor (km) x 1000x24x60x60)
	Incremental Emission Generation without control measures (Kg/day) = Incremental Emission Generation without control measures (Kg/day) x Control Factor (%)	

Table 4.4 Quantification of Emissions

Emissions (SPM) generated from various activities				
SN	Activity	Emission (Kg/day)		
		without control measures	with control measures	
1	Top Soil Removal	43.26	21.63	
	Sub-total (1)	43.26	21.63	
2	OB Removal			
a	Drilling	305.20	91.56	50% Pit retention
b	Blasting	132.89	132.89	50% Pit retention
c	Dumper loading by shovel	32.03	32.03	50% Pit retention
d	Transportation of OB	1916.59	958.30	50% Pit retention
e	Unloading of OB	249.56	249.56	
f	Wind erosion of OB	1114.91	557.46	
	Sub-total (2)	3751.17	2021.78	
3	Coal Extraction (By Surface Miner)			

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

a	Coal cutting & loading by Surface Miner	15.46	15.46	50% Pit retention
b	Unloading of coal at receiving point	24.79	24.79	50% Pit retention
c	Coal transportation by conveyor within mine	1.40	0.01	50% Pit retention
	Sub-total (3)	41.64	40.26	
	Total (1+2+3)	3836.07	2083.67	
	Incremental Emission factor for mine (gm/m²/s)	1.13555E-05	6.16806E-06	
4	Direct coal dispatch from ROM stockyard			
a	Unloading of Coal by conveyor	0.24	0.00	
b	Loading of Coal	10.45	10.45	
	Total	10.70	10.46	
	Incremental Emission factor for ROM stockyard (gm/m²/s)	9.21186E-07	9.00519E-07	
5	Crushers at Washery			
a	Primary Crusher	14.04	14.04	
b	Secondary Crusher	32.60	32.60	
c	Loading of Coal Rejects	7.83	7.83	
5	Conveyor belt from Karo Washery to Konar washery			
a	Conveyor unloading points	5.80	0.06	
	Incremental Emission factor for conveyor belt from Karo Washery to Konar washery (gm/m/s)	1.065E-05	1.065E-07	

Control measures given:

- 1) Making Topsoil wet during removal.
- 2) Water sprays for drilling in OB bench & coal bench.
- 3) Water sprinkling of haul road.
- 4) Enclosure for conveyor belts.
- 5) Enclosure with dust extraction system at Primary & secondary Crusher.

Table 4.5 Predicted Concentrations of PM₁₀

Zone Category	24 Hours average PM ₁₀ concentration ($\mu\text{g}/\text{m}^3$)					
	Incremental Concentration without control measures (BAU)	Incremental Concentration with control measures	Background/ Baseline concentration	Total predicted concentration without control measures (BAU)	Total predicted concentration with control measures	Permissible limit
A1	107.81	58.55	160	267.81	218.55	300
A2	172.69	93.71	135.25	307.94	228.96	
A3	73.4	28	69	142.4	97	100
A4	35.49	13	71.88	107.37	84.88	100
A5	50	16	69.5	119.5	85.5	100
A6	40	4.37	97.5	137.5	101.87	300
A7	72	16	74	146	90	100
A8	18	5.8	79.25	97.25	85.05	100

Observation

On the basis of the above prediction, it is found that there will be significant increase in PM₁₀ in A1, A2, A3, A4, A5 and A7 stations but only marginal impact on A6 & A8 stations. Stations A1, A2 fall within core zone of Karo OCP and A6 fall within core zone of Kargali OC.

However, the predicted level of increase in PM₁₀ is likely to remain below the limits prescribed by NAAQS both for industrial and residential locations.

To reduce the ambient air quality impact further, a thick green belt plantation shall be done all along the project boundary. The Isopleth of PM₁₀ without control measures (Business As Usual) and with control measures is shown in enclosed Plate- XI A, XI B respectively.

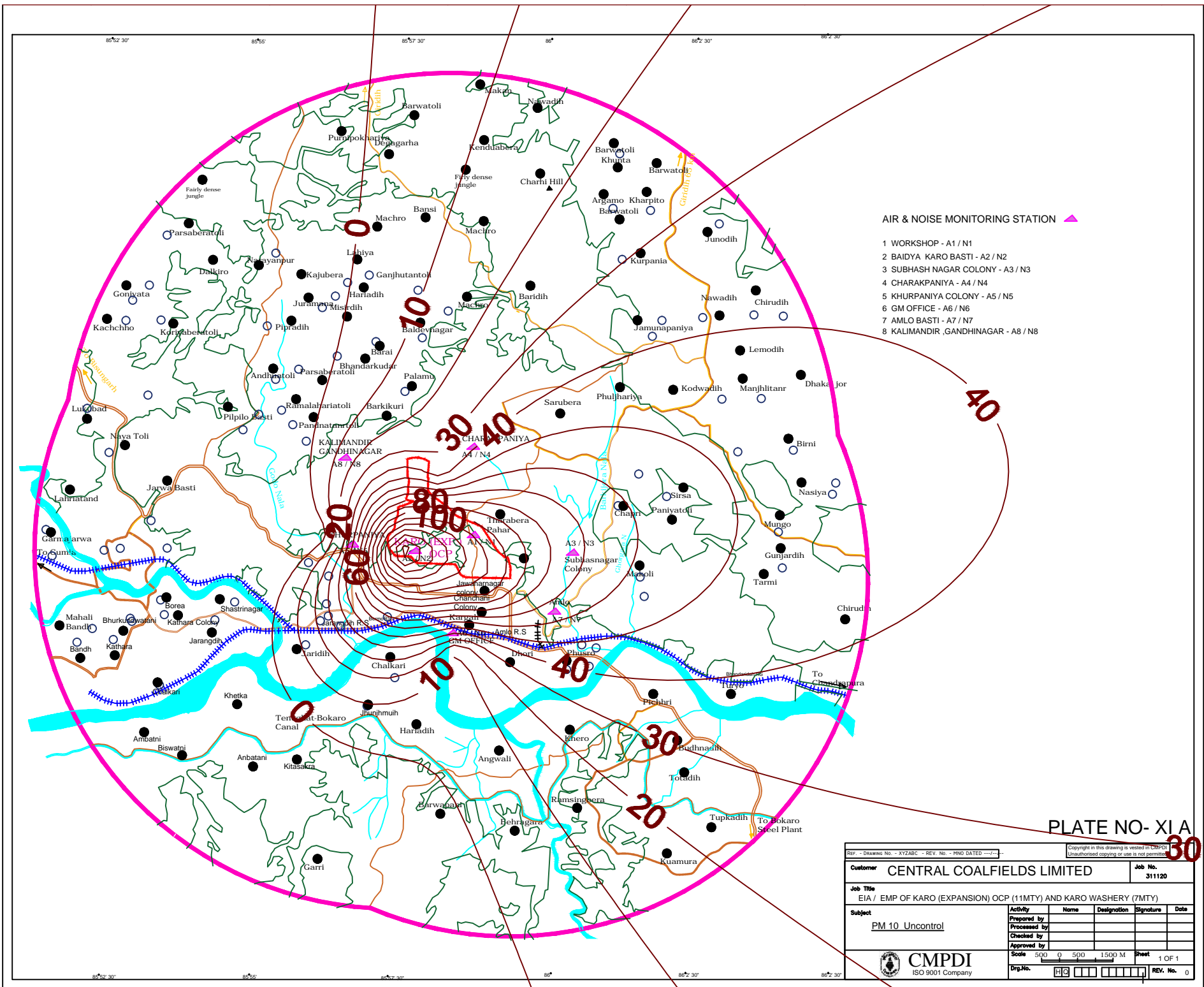
Conclusion

The model was run for the worst case scenario of peak coal production level of 15 MTPA. The likelihood of peak coal production being reached is quite less. In view of this, the actual future AAQ is likely to be better than the predicted level.

4.2.3 Air Pollution Control Measures

Appropriate mitigative measures shall be taken to contain the predicted level within prescribed level. These measures (both preventive and suppressive) are enumerated below:

✿ **Loading and transport**



AIR & NOISE MONITORING STATION ▲

- 1 WORKSHOP - A1 / N1
- 2 BAIDYA KARO BASTI - A2 / N2
- 3 SUBHASH NAGAR COLONY - A3 / N3
- 4 CHARAKPANIYA - A4 / N4
- 5 KHURPANIYA COLONY - A5 / N5
- 6 GM OFFICE - A6 / N6
- 7 AMLO BASTI - A7 / N7
- 8 KALIMANDIR ,GANDHINAGAR - A8 / N8

PLATE NO- XI A

Customer: **CENTRAL COALFIELDS LIMITED** Job No. **311120**

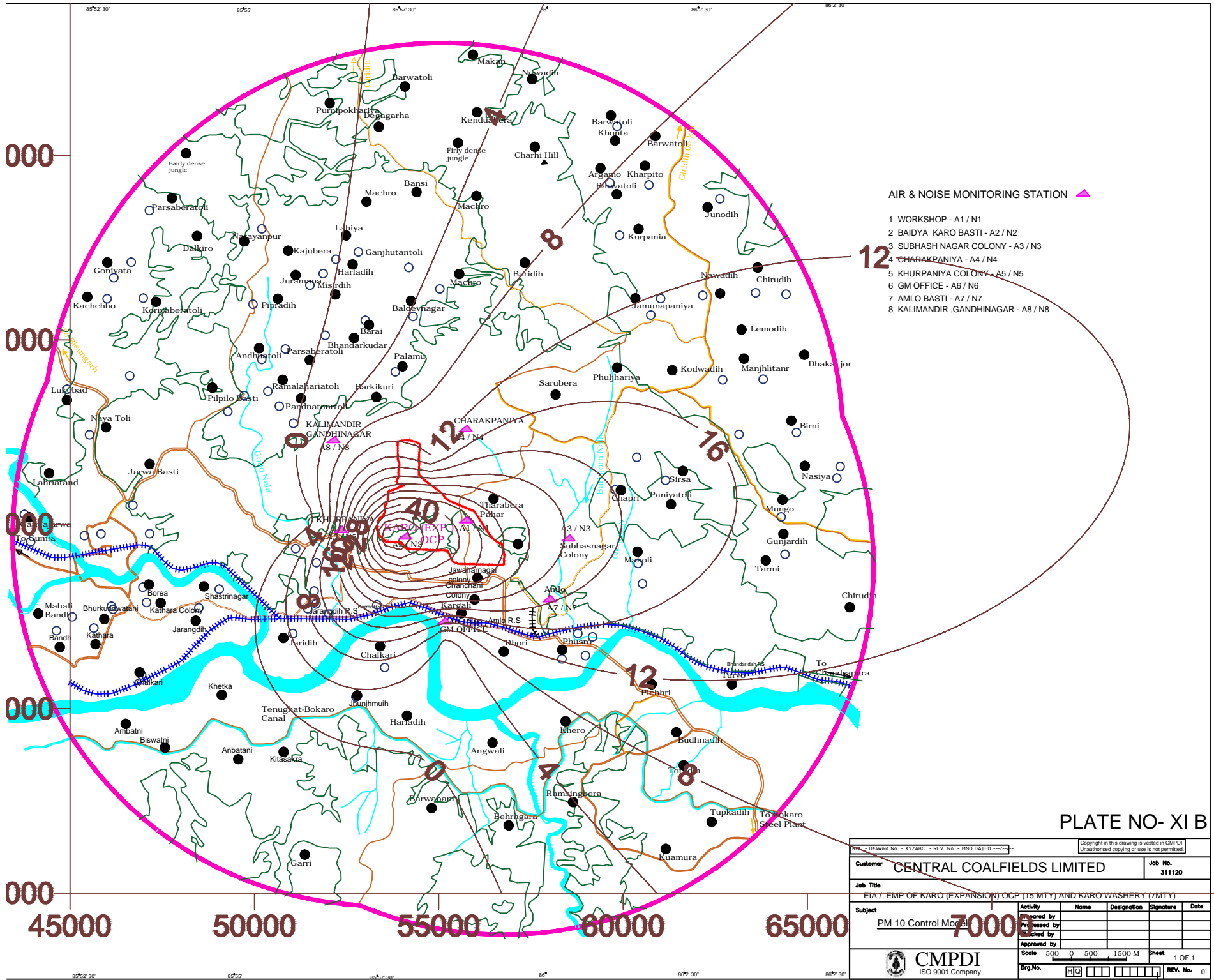
Job Title: **EIA / EMP OF KARO (EXPANSION) OCP (11MTY) AND KARO WASHERY (7MTY)**

Subject: **PM 10 Uncontrol**

Activity	Name	Designation	Signature	Date
Prepared by				
Processed by				
Checked by				
Approved by				

Scale: 500 0 500 1500 M Sheet 1 OF 1

Org.No. **CMPDI** ISO 9001 Company REV. No. 0



- AIR & NOISE MONITORING STATION** ▲
- 1 WORKSHOP - A1 / N1
 - 2 BAIDYA KARO BASTI - A2 / N2
 - 3 SUBHASH NAGAR COLONY - A3 / N3
 - 4 CHARAKPANIYA - A4 / N4
 - 5 KHURPANIYA COLONY - A5 / N5
 - 6 GM OFFICE - A6 / N6
 - 7 AMLO BASTI - A7 / N7
 - 8 KALIMANDIR, GANDHINAGAR - A8 / N8

PLATE NO- XI B

Rev. - DRAWING No. - XYZABC - REV. No. - MNO DATED - / /		Copyright in this drawing is vested in CMPDI. Unauthorised copying or use is not permitted.	
Customer CENTRAL COALFIELDS LIMITED		Job No. 311120	
Job Title EIA / EMP OF KARO (EXPANSION) OCP (15 MT/Y) AND KARO WASHERY (7MT/Y)			
Subject PM 10 Control Model		Activity	
Prepared by		Name	
Checked by		Designation	
Approved by		Signature	
Scale 500 0 500 1500 M		Sheet 1 OF 1	
CMPDI ISO 9001 Company		Drg.No. 10 11 12 13 14 15 16 17 18 19 20	

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

The following measures will be taken:

- Suppression of coal dust during coal handling by fixed sprinklers. Minimization of the height of coal-fall at transfer points to reduce the dust generation.
- Coal transportation is proposed through closed conveyor belt.

S No.	Products	Starting Point	Transportation by	Distance (Approx.)	Destination point
1.	Raw Coal	Mine Site	Covered conveyor	6.5km	Washery
2.	Washed Coal	Washery Premises	covered conveyors to the Kargali Washery Railway siding	6.5 km	Rapid Loading System (3600/5500 tph)
3.	Coal Reject	Washery Premises	Covered conveyor	200 m	Temporary Reject Storage Site

- Greenbelts around industrial sites, service building area besides avenue plantation along roads.
- Regular water spraying at haul roads and transfer points. For this purpose, fixed water sprinklers and movable sprinklers will be installed.

⊗ **Fires at coalfaces, coal stockyards**

(a) At coal faces

To prevent and control such fires, the following measures will be taken:

- Exposures of coal benches for long time will be avoided.
- Provision of adequate fire-fighting arrangements including storage of sufficient quantity of water at all critical points.
- Regular supervision.

(b) At coal stockyards

- Limiting the amount of stock by giving close attention to marketing besides following the "first-in and first-out" sequence.
- Attention to the following while stacking of coal:
 - Proper dimensions of stack (height to be limited to not more than 8m).
 - Dozing/compaction to make the stock semi-consolidated.
 - Regular and strict supervision of stacks.
 - Provision of fire-fighting arrangement with supply of adequate quantity of water at sufficient pressure.

⊗ **Mitigation Measures at Washery and crushing units**

Sl. No.	Identified Source of Fugitive Emission	Planned Mitigation
1	Receiving Hopper	Enclosure and Sprinkling
2	Surge Hopper	Enclosure and Sprinkling

3	Crushing / Dry Screening	Dust Extraction System / Sprinkling
4	Coal Stock Yard	Sprinkling
5	Washing (Wet Process)	Coal washing is wet process, hence does not generate fugitive emission
6	Washed Coal Stock	
7	Rejects Stock	
8	Belt Conveyors	Covered Conveyor, green belt

- Dust suppression within the washery shall be done by sprinkling of water.
- Monitoring the condition of transfer chutes and skirt boards and replacing/repairing shall be done on regular basis during the normal inspection by the concerned persons along with the sectional heads.
- Water spraying for dust suppression at temporary storage site for reject shall be done regularly.
- Road inside the plant shall be paved to minimize the dust due to vehicle movement.
- To minimize the generation of fugitive dust in conveyance of washery products following arrangements have been made:
- Green belt area of 1.45 Ha in and around the washery site including around the conveyor, vacant places shall be developed to control dust emission.
- Efforts for good housekeeping will minimize dust nuisance within the plant premises.
- The crushers/pulverizers of the coal washeries shall be provided with enclosures fitted with suitable air pollution control measures.
- Water spray arrangements shall be provided at all strategic coal transfer points, enclosures for conveyors etc.

4.3 Water Environment

4.3.1 Water Requirement

Karo (Expansion) OCP consists of one running quarry and one proposed quarry with proposed washery of capacity 7.0 MTY. The present proposal envisages the expansion of Karo OCP to cater the demand of coal. The peak mine inflow of both the quarries has been estimated. The estimated peak mine inflow of quarry-I and quarry-II is 2400 m³/day and 2300 m³/day. The estimated peak mine inflow may be achieved at the end of the quarry operation. The peak domestic and industrial water supplies of Karo Expansion OCP are 490 m³/day and 3970 m³/day respectively. After domestic and industrial uses, excess mine water discharge will be used for artificial recharge. At present domestic/drinking water supply in the area is being done through IWSP (Integrated Water Supply Projects) under which the Damodar River water is being filtered through Kargali Filter Plant (Figure-1) to supply domestic water to Project Area and nearby area such as Kargali Bazar, Gandhi Nagar, Jawahar Nagar, Subhas Nagar, Kurukpania Village, Bermo Colony, Ghutia Tand Village, Ram Nagar Colony etc. Artificial recharge pond have been made near New Karo colony covering an area of 1600 sq m. At the proposed stage of mining excess mine water will be supplied to pond. This may help to recharge the ground water in the project area.



Figure-1: Water Filter Plant at B&K Area, CCL.

The peak mine discharge 4700 m³/day (1.715 MCUM/annum) will be source for 'All Uses' in the Core zone of Karo Expansion OCP. Out of which 0.69 MCUM discharge during monsoon and 1.025 MCUM discharge during non-monsoon season are considered. Karo washery has been proposed in the mine leasehold area to wash coal from Karo OCP with annual capacity of 7.0 MTY. During construction period, water shall be supplied from incline nos. III & V of Karo UG, which is closed and water logged since 2005. Total accumulated water in the above inclines is about 61 million gallon. The quantity of water required for operation & maintenance of the proposed washery is about 1590 m³/day. The requirement of water during operation of proposed washery will be cater by using excess mine water. The alternative source of water supply to this washery can be made from abandoned mine void of Bokaro opencast mine (sector-2). The process of the proposed washery is based on **closed water circuit system**. All the water fed into the system will be collected after use and re-circulated after treatment in various units and no effluent will be allowed to escape into the natural drainage system. Provision of roof-top rain water harvesting has been envisaged for recharging the ground water or by collecting the water into the constructed/developed water bodies for use in the washery.

Mines require water for both domestic and industrial (Workshop, dust suppression in CHP, Haul Road watering, firefighting, greenbelt development and use in Washery) uses. The peak industrial water demand of Karo Expansion OCP and its washery has been projected as 3970 m³/ day. The total domestic water demand is projected as 490 m³/ day. Only excess mine water of 240 m³/ day will be supplied to pond or tank for artificial recharge.

The details of present water supply and peak water demand for Karo Expansion OCP and washery are given below.

Table 4.6 Domestic and Industrial supply of Karo Expansion OCP

Purpose	Present water Supply of Existing Karo OCP (m ³ /day)	Peak Water Demand of Karo Expansion OCP (m ³ /day)

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

INDUSTRIAL		
HEMM Washing	230	230
CHP/Industrial	50	330
Workshop	10	100
Fire Service	100	650
Dust suppressing	140	1000
Land Reclamation &	70	70
Washery	NA	1590
Total	600	3970
DOMESTIC (Township)		
Housing	400	405
Service Building	40	40
Process & Loss	40	45
Total	480	490

Mine pumping water from Karo Expansion OCP will be the source of water to meet the entire domestic and industrial requirement of the mine. The present and future (Peak) utilization of mine pumping are given in Table below.

Table 4.7 Mine Discharge and its Utilization

Mine	Peak Mine Discharge (m ³ /day)	Domestic water Supply	Industrial Water Supply	Water Supply to Peripheral villages	Artificial Recharge
m ³ /day					
Existing Karo OCP	750	IWSP Supply in the area	600	Nil	150
Karo Expansion OCP	4700 (i.e. 1.71 MCUM/annum, out of which 0.68 MCUM in Monsoon & 1.03 MCUM in Non-monsoon period)	490	3970 (2380 for coal mines +1590 m ³ /day for Washery)	Nil	240

*** Year-wise mine inflow given in Mine Discharge Chapter**

The surplus mine water, after the meeting of domestic and industrial requirement, will be used for artificial recharge. The usage diagram of Karo Expansion OCP has been provided as **Plate- No-XII**.

4.3.2 GROUND WATER BALANCE OF CORE ZONE

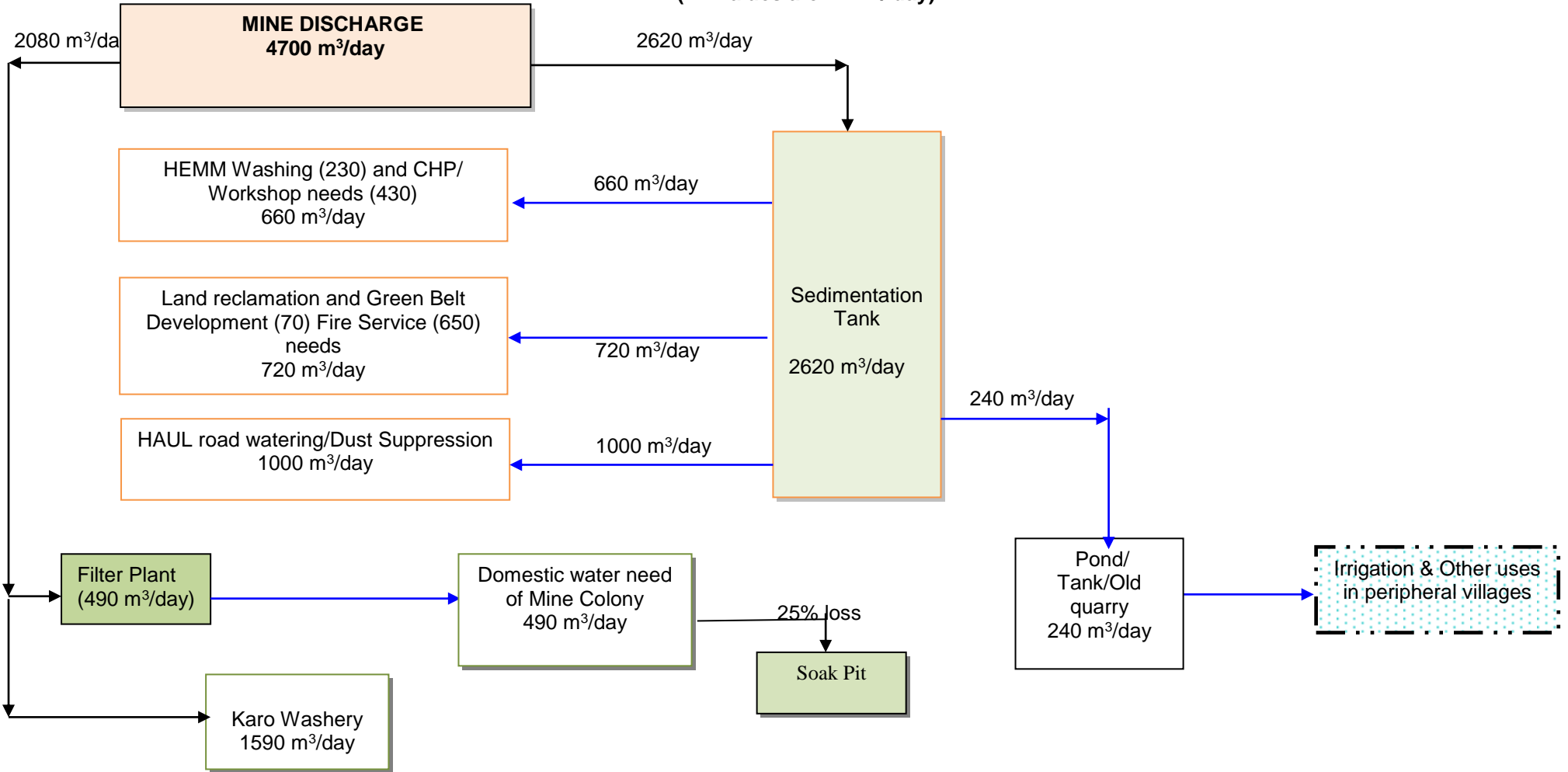
The annual groundwater recharge (as recommended in GEC'97), total draft and groundwater balance of the Core zone of Karo Expansion OCP is given below. The extraction of groundwater in the core zone by mine pumping will be 1.71 Mm³ per annum which is more than the annual recharge of 1.573 Mm³ per annum. This quantum (0.143 Mm³) of over extraction will be met through the surrounding strata (buffer zone) as the water bearing geological strata should not be viewed in isolation.

Table 4.8 Annual Ground Water Balance of Core Zone

Description of items	Quantity
Rainfall Infiltration factor Method	
1. Area (Sedimentary rocks)	5.52 sq.km
2. Normal Rainfall during	
a. Monsoon season in mm	1040 mm
b. Non-monsoon season in mm	219 mm
c. Non-monsoon season rainfall as a percentage of normal annual rainfall	21.0 %
3. Rainfall infiltration factor	13 %
4. Rainfall recharge in Core zone by rainfall infiltration factor method	
a. Monsoon season	a. 0.78 MCUM
b. Non-monsoon season	b. 0.16 MCUM
Gross Rainfall Recharge	0.94 MCUM
Water Table Fluctuation Method (Monsoon recharge)	
5. Area	5.52sq.km
6. Water table Fluctuation	1.98 m
7. Specific Yield	0.04
8. Change in groundwater storage	0.458 MCUM
9. Gross groundwater Draft for 'All Uses' during monsoon season Mine discharge(from Table No-19)	0.68 MCUM
10. Recharge from 'Other Sources' during monsoon season	Nil
11. Gross Rainfall Recharge [(8) + (9) - (10)]	1.138 MCUM
Rainfall Recharge Calculation during Monsoon season	
12. Rainfall Recharge during monsoon season in Core Zone	
a. By Water Table Fluctuation Method	1.138 MCUM
b. By Rainfall Infiltration Factor Method	0.94 MCUM
13. Difference between (12a) and (12b) expressed as a percentage of (12b), 'PD' $\left[\frac{\{(12a) - (12b)\}}{(12b)} * 100 \right]$	21%
14. Rainfall Recharge during monsoon season after considering 'PD' $\left[\begin{aligned} &= (12a) \text{ if 'PD' is between } -20 \text{ and } +20\% \\ &= 0.8 * (12b) \text{ if 'PD' is less than } -20\% \\ &= 1.20 * (12b) \text{ if 'PD' is greater than } +20\% \end{aligned} \right]$	1.138 MCUM
Net Annual Groundwater Availability	
15. Rainfall Recharge in Core Zone	
a. During Monsoon season (14)	1.138 MCUM
b. During Non-monsoon season (4b)	0.16 MCUM
c. Annual (a + b)	1.298 MCUM
16. Recharge from 'Other Sources'	
a. During Monsoon season	
b. During Non-monsoon season	
c. Annual (a + b) 20% 4700 m ³ /day mine discharge as return flow to GW system	0.34 MCUM
17. Total Annual Groundwater Recharge (15 + 16)	1.638 MCUM
18. Unaccounted annual natural discharge	
a. [0.05 * (17)] if rainfall recharge during monsoon season computed by 'Water	0.065 MCUM

WATER USAGE DIAGRAM OF KARO EXPANSION OCP AND KARO WASHERY, CCL

(All Values are in m³ / day)



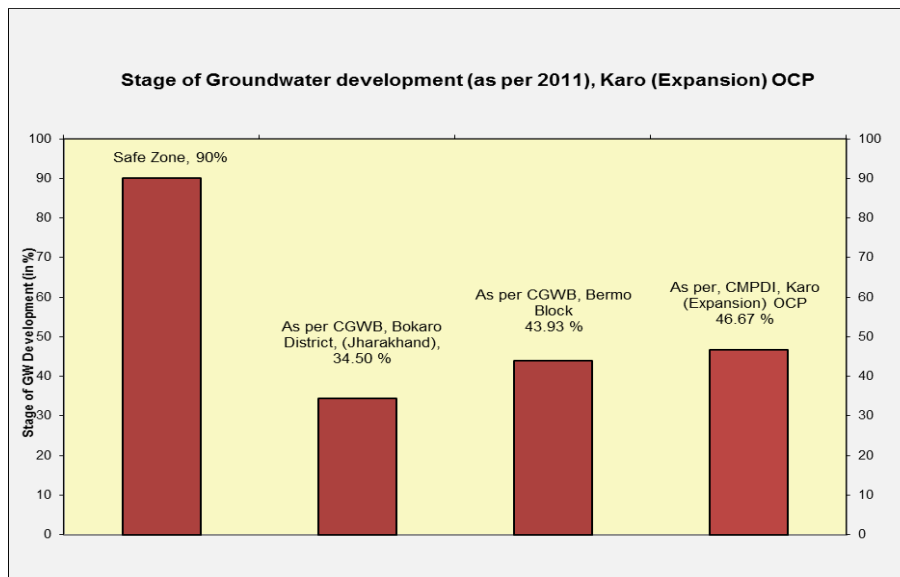
EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

table Fluctuation Method' b. [0.10 * (17)] if rainfall recharge during monsoon season computed by 'Rainfall Infiltration factor Method'	
19. Net Annual Groundwater Availability in Core Zone (17 – 18)	1.573 MCUM
20. Total Groundwater Draft for 'All Uses' (4700m ³ /day mine discharge from Table No-19)	1.71 MCUM
21. Annual Groundwater balance (19-20)	-0.143 MCUM

4.3.3 Stage of Ground Water Development

Coal mining is the major industrial development activity visible in the area. Besides this, ground water utilisation is mainly for domestic and irrigation use. The present stage of ground water development of the Buffer Zone comes to about 46.67 %. The stage of ground water development in the Karo Expansion OCP area and its buffer zone is classified as "Safe" category.

As per the assessment done by from Central Ground Water Board, Ranchi in 2011, the stage of ground water development in Bermo Block of Bokaro District is 43.93%. Karo Expansion OCP and its buffer zone are located in Bermo Block of Bokaro District of Jharkhand and falls within the "Safe" category. The stage of groundwater development is 34.50% in Bokaro district.



4.3.4 Water Quality

With no processing activity involved, the mine water will be free from any contamination. In both underground and opencast mining, except for suspended solids, the mine water is free from any serious pollutants. As the water will be discharged only after passing through the ETP, the discharge water will be clean and fit for consumption.

As part of Environment Management plan (EMP) preparation, the drinking water/ground water, Surface water and mine water of project area have been analysed. Drinking water / ground water sample (GW-1 and GW-2), Surface water (SW-1, SW-2 and SW-3) and mine

water discharge samples (EW-1) were analysed. The sample locations are shown in **Plate No. VIIB**

Location of the collected sample have been marked on the Plate-VII B. Surface water sample have been collected and analysed from both Damodar and Konar River. Ground water sample was collected from different location in the core zone of Karo (Expansion) OCP to assess water quality in aquifers and drinking water quality. The water quality at all the locations is found to be well within the prescribed norms of IS: 10,500 – 1991.

Analyses of mine water discharge from Karo OC (EW-1) indicate that all parameters are within the permissible limit (MoEF Scheduled – VI Standard). Therefore, mine pumping water is not contaminating any surface water bodies or groundwater system.

4.3.5 Mine Drainage

The entire mine area is covered by alluvium and soil. The semi-consolidated Gondwana are stratified formations underlying the alluvium/soil. The permeable beds (mainly sandstone) act as individual hydrogeological units and develop multi-aquifer system due to presence of persistence of impermeable shale beds/ coal seams. As such under these circumstances, the horizontal permeability (Kh) is usually many folds higher than the vertical permeability (Kv). Thereby, the ground water flow velocity along the bedding plane is higher than across the plane.

The opencast mine acts as a large diameter well/sink. Mine water inflow is contributed mainly from the saturated formations lying above the bottom most mineable coal seam. Thus, the mine inflow is directly proportional to the exposed mine area (aquifer exposed) and mine depth. In the initial stage the mine inflow is in proportion to the rate of mine expansion. The unconfined aquifer lying above the topmost coal seam, contributes the maximum inflow. With the presence of impermeable formation such as shale, coal seams etc, the inflow from lower aquifer units will be proportionally small. In due course, the inflow reduces and gets stabilized in time due to partial de-saturation of the aquifer.

With the spatial variation in the aquifer parameters, the inflow will increase in places with higher transmissivity. So also in the reclaimed area, due to high porosity and recharge, will also contribute inflow in the later stage.

With increase in depth of incision, the semi-confined aquifer would also be exposed /punctured thereby the total system would be converted into water table condition near to the active mine face and a cone of depression would be formed by the gravity drainage from different aquifer zones.

In the Karo Expansion OCP block, the permeable formations lying above the bottommost workable coal seam are mainly composed of sandstone with occasional intercalation of shale and siltstone.

Based on the famous Darcy's law i.e. $Q=KIA$, the groundwater inflow from different mine faces were predicted. As the water table will have a higher gradient near the high wall face, a hydraulic gradient (I) of 0.02 was considered for the aquifer. The present and peak mine flow of existing and proposed OCP has been estimated as shown below.

Table 4.9 Present and Peak Mine Inflow of Karo OCP

Stages	Quarry (Karo Expansion)	Aquifer	Permeability (K) m/d	Hydraulic gradient	Mine inflow (m ³ /day)

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

	OCP)				
Present	Quarry-I	Unconfined	1) Loose OB Dump B- 2.0 2) Formation Aquifer-0.18 to 0.38	0.02	750
	Quarry-II	Semi-Confined			Nil
Peak	Quarry-I	Unconfined			2400
	Quarry-II	Semi-Confined			2300

The projected calculation (750 m³/day) of the present mines as shown in Table-22 is more or less tally with the actual observed in the mine during the sump test carried out in October, 2015. Therefore, the present inflow of Karo OCP is 750 m³/day. So Inflow in first year (present Inflow) is 750 m³/day.

The permeable formations lying above the bottommost workable coal seam of Karo Expansion OCP will contribute to mine inflow. The overburden dumped internally and top formation aquifer is the main source of groundwater with permeability of 2.0 m/day to 0.38 m/day respectively. The prediction of year-wise mine inflow of Karo Expansion OCP has been shown in table given below:

Table 4.10 Predicted Year-Wise Mine Inflow of Karo Expansion OCP

Year	Quarry-I		Quarry-II		Total Inflow (m ³ /day)
	Depth (m)	Mine Inflow (Estimated) (m ³ /day)	Depth (m)	Mine Inflow (Estimated) (m ³ /day)	
1 st		750		300	1050
2 nd		800		400	1200
3 rd	60	1200	50	600	1800
4 th		1250		800	2050
5 th		1390		1100	2490
6 th		1500		1200	2700
7 th	80	1580	60	1670	3250
8 th		1600		1700	3300
9 th		1700		1850	3550
10 th		1950		2000	3950
11 th		2200		2100	4300
12 th	125	2400	110	2300	4700

4.3.6 DISPOSAL OF MINE WATER

To meet the safety of the mine and create good working conditions, it is necessary to discharge the mine water collection onto surface. To collect the mine water, sumps are provided at deep-most part of the opencast mines. The saturated parting thickness among the coal seams ranges from is 0.38 m to 40 m for semi-confined aquifer and 25 m average thickness of unconfined aquifer. The maximum ground water inflow will be 4700 m³/day. Rainwater of the catchments area of the mine will also be accumulated to the sump during

rainy season. Some intermediate sumps are also proposed. These sumps also behave as primary settling tanks for the mine water. Thereby, the suspended solids, the major contaminant added to the mine water inflow, would settle and clean water will be discharged onto surface.

The peak mine discharge 4700 m³/day (1.71 MCUM/annum) will be source for 'All Uses' in the Core zone of Karo Expansion OCP. Out of which 0.68 MCUM discharge during monsoon and 1.03 MCUM discharge during non-monsoon season are considered. Mines require water for both domestic and industrial (Workshop, dust suppression in CHP, Haul Road watering, firefighting, greenbelt development and use in washery. The peak industrial water demand of Karo Expansion OCP and its washery is projected as 3970 m³/ day. The total domestic water demand is projected as 490 m³/ day. Only excess mine water of 240 m³/day will be used for artificial recharge. Pond for Artificial recharge have been made near New Karo colony. Both rainwater and mine water (240 m³/day) will be used to recharge the ground water system through these recharge pond.

Waste water disposal and treatment technology

Discharge from various sources (m³/day)

- | | | |
|-------|--|------------------------------|
| (i) | Manufacturing- | Nil |
| (ii) | Residential & related - | 370 m³/day |
| (iii) | Social (horticulture/environment/maintenance)/any other use- | Nil |

100 m³/day for workshop and 230 m³/day for HEMM washing= 330 m³/day

40% will be lost i.e. 130 m³/day during the operation and

200 m³/day (60%) will be reused. Zero discharge.

1590 m³/day for proposed Washery will be reused and recirculated.

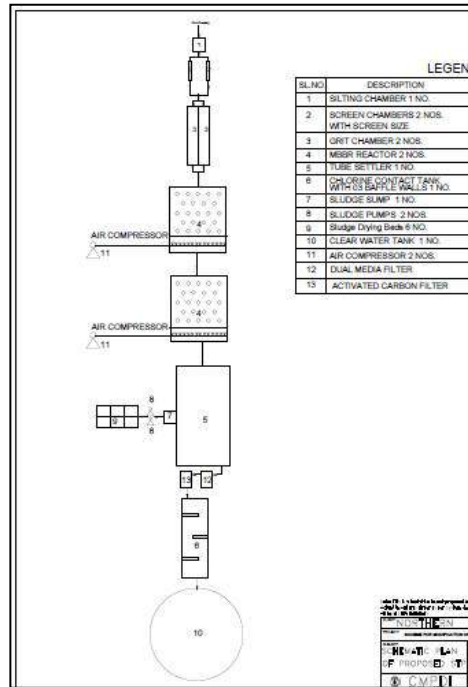
- (iv) Mine Discharge -

Recycled/Reused (No discharge into Surface water bodies) **Nil**

Mine Discharge-4700 m³/day. Total mine water will be used & re-circulated (after domestic and industrial use excess mine water of 240 m³/day will be used for artificial recharge via pond/tank after treatment through filter plant/settling tank. No mine water will be discharge into the natural drainage.

Treatment Technology

1. **Mine water Discharge** → settling tanks→ Reuse.
1. **Industrial Water** →Oil & Grease trap →Sedimentation tank→ Reuse
2. **Domestic use**→ Sewage Treatment Plant. Provision has already been made in the approved Project report for construction of Domestic Sewage Treatment Plant at the colony



4.3.7 IMPACT OF MINING ON WATER REGIME

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

- Impact on topography
- Impact on surface water and quality
- Impact on groundwater and quality

4.3.8 Impact on Topography

A local change in ground topography has already been taken place around Karo OCP due to mining operation such as open pit, embankment, dumps of overburden and coal, etc. As a result, there would be marginal change in the drainage and surface run-off.

Karo Expansion OCP will further be responsible for changing the topography of the area. Within the core zone area, cracks and loosening of soils would be resulted due to mining and associated activities such as drilling, blasting, etc thereby physical/textural changes would occur in soil/formation. This mine induced process increases the rate of infiltration and recharge. On the other hand, soil is more susceptible for changes due to erosion, leaching phenomena/ process, etc. Further the fine dust particles of coal and overburden may adversely affect the porosity of soils.

Total 90.42 Million m³ of overburden (OB) will be generated from Karo OCP during the entire mine life. Out of which 56.26 Million m³ will be dumped internally (back-filled) and rest (34.13 Million m³) will be dumped externally covering an area of 267.61 Ha. Quarry-I and Quarry-II will be totally filled up with overburden with average height of 25 m and 40 m respectively from the surface. No re-handling of OB dump is required here as the total OB

dumped is on non-coal bearing area and de-coaled area. The height of external OB dump near quarry-I and quarry-II area will be 70 m and 75 m respectively. Both the quarries will be completely filled-up with overburden. Final R.L. of both the external and internal dumps will be varies from 280m to 395 m.

The top-soil enriched with good soil and manure will be spread back on the back-filled quarry with proper treatment and plantation done over the backfilled area. Both the back-filled area (internal dump) and external dump of the opencast patches/mine will be biologically reclaimed with the help of experts.

The back-filled may be a good media for high groundwater recharge due to high permeability. It may be appropriate to highlight the fact that temporary groundwater loss/deficit created during active mining stage would be compensated by these different means in the post mining stage so that the initial groundwater levels are regained to normalcy at the earliest for utility of the area.

Afforestation and Plantation:

The OC mine will be back filled to the maximum extent till the end of operation. Biological reclamation of both external and internal OB dump will be carried out during the life of the mine. It is to be ensured that in the final land use plan, all forest land acquired for the project is afforested and land should be suitable for vegetation.

The OB dump will be used to fill up the voids and merged to surrounding landscape and can be further developed to restore them for agricultural use. The original land profile can be maintained for post mining land use which can be restored for agricultural use.

In addition to the reclamation of mining area, plantation is being done around industrial sites, service building area and residential colony along with avenue plantation along roads. Even the remaining areas, which are amenable for plantation, shall be planted with appropriate species of plants.

Besides above, the Danga land and other areas suitable for plantation shall also be brought under green cover.

Thus, in this way the final land use plan would be made acceptable by bringing the same as far as possible matching with the pre-mining conditions.

4.3.9 Impact on Surface Water and Its Quality

As mentioned earlier, there would be change in the ground topography, infiltration capacity or rate of soil formation/erosion and sediment load in Jore /Nalas due to mining operation resulting in some local change in drainage pattern and surface run-off in core zone of this opencast mine. It is established that infiltration zone would serve as good media for high groundwater recharge and reduces the surface run-off considerably in the core zone. In view of this, the mine has to handle more water in the monsoon period besides the additional contribution from the surface run-off of the catchments area.

At present Quarry-I is being worked in mine leasehold area. Karo Nala and Gati Nala are two main seasonal nala in the area. To enhance the production it is proposed to divert the Karo Nala to open the full extent of the mine strike for facilitating HEMM deployment. The Gati Nala flowing alongside the western boundary of the Quarry-II. The boundary of Gati Nala is limited to 60 m distance from the Gati Nala. The HFL of Gati Nala and Karo Nala has been

recorded as 245m and 244 m respectively. It is proposed to make protective embankment for Quarry-II by filling of OB dump along Gati Nala.

Damodar River flows at a distance of 1.70 km from the southern boundary of Project area. Special care is to be taken up (Garland drains around OC and Toe-wall around Overburden) to minimize the impact of mining on watershed.

Mine water is to be collected and passed through sedimentation tank/pond to arrest the silt. This treated mine water will be utilised for industrial and domestic requirement of the mines and colonies of the mine area and rest of the excess mine water after treatment discharged into local tanks/mine voids to recharge the groundwater system.

The surface run-off from the dumps of overburden material and coal and mine water discharge/effluent are laden with suspended particles of coal and other associated materials. This water is collected and passed through sedimentation tank/pond. The surface run-off from the mine area will be free from suspended particles and its mixing may not induce any change in the surface water quality. The surface water quality in the area will be monitored in regular interval.

Water pollution may be caused from effluent coming out from the industrial area due to washing of mining equipment, workshop, Washery and firefighting. The total industrial effluent will be treated first in grease & oil trap and then in sedimentation ponds to get the suspended particles settled. Water thus regained will be re-circulated for its use for industrial purpose. It would be a closed water circuit and there will not be any industrial effluent discharge from the mine. The proposed Karo washery in the mine area will also work on closed water circuit system. All the effluent water will be re-circulated for its use.

No acid mine drainage has been reported in the area. This is proven by pH of the mine water. Normally, the coal mining activity does not induce any unwanted chemical or elements into the groundwater affecting the water chemistry except for total suspended solids (TSS); no serious pollutant has been observed in the mine water discharge. The analytical results of mine pumping water from existing Karo mine area are well within the MOEF standards (MoEF Scheduled – VI Standard) .

4.3.10 Karo Nala Diversion

As discussed earlier, the diversion of karo nala has been proposed. The details of karo nala diversion is as given below.

Parameters considered for Nala Diversion

- Diversion channel will be located within the allotted mining boundary
- Probable peak flood to be assessed carefully using different approaches with particular emphasis on cross check of results of empirical approaches by method using actual observed daily peak rainfall in order to avoid any possibility of inundation of mining area under consideration
- Coal seams proposed to be exploited should not be affected. Alignment of diversion channel to be carefully decided considering contours so as to keep the quantity of earth work and depth of cutting to the minimum as possible.
- Gradient of diversion channel to be kept such that the velocity is within permissible limits for the maximum design flood
- Bed width and side slopes to be designed considering stability of section and peak design flood carrying capacity for the adopted bed gradient.

- A Check dam has been proposed near the end of the strengthened existing nallah which eventually merges with the lower part of karoo nallah to reduce and control velocity of the run-off water through designed channel.
- As the catchment area of The lower part of the karoo nallah does not increase due to mining activities, its present section will remain adequate for carrying the surface run-off.

Catchment Area of Karo Nallah

Catchment area plan of Karo Nallah has been drawn on toposheet showing course of Karo Nallah, and other topographical features. Two sections for nallah have been proposed as given hereunder. The variation in sections has been made keeping in view the presence of hillock in the proposed route which necessitates larger excavation. The presence of rock in the hillocks shall allow steeper side slope. The calculated catchment areas are as follows:

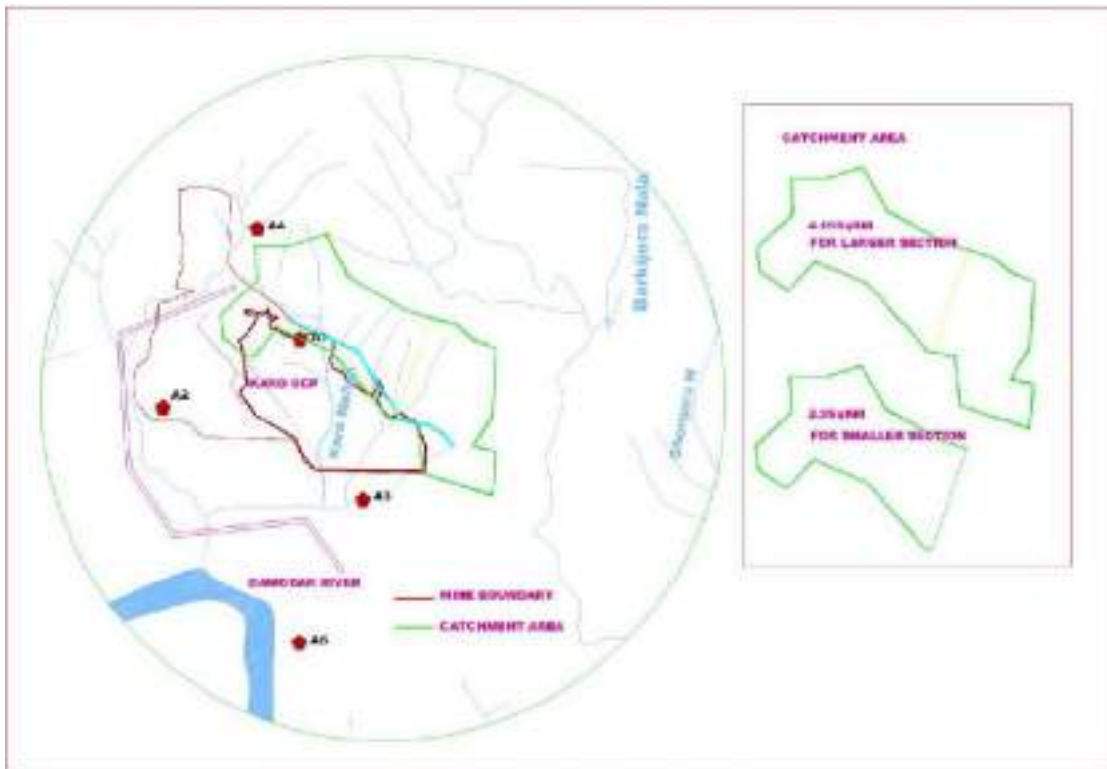


Figure 3 showing catchment area of Karo Nallah

Computation of peak design flood and design of hydraulic section

Design flood being the most critical parameter for design of diversion channel to avoid any possibility of inundation of proposed mining area, its assessment has been made by different approaches :

FOR Nalla generally running through mild sloping plains:

Computation of peak design flood

1. Dicken's Formula

Peak Discharge Q = C * A^{3/4}

Dicken's Coefficient C = 21

Taking average of zonal value of Dicken's coefficient

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

(C) for Central India region which lies between 14 & 28

Catchment Area for the particular section	A	4.37	SQ. KM
Adding 5% extra catchment for uncertainty	Q	63.45	CUMECS

2. Rational Method

Peak Discharge	Q	$=(1/36)*K*Pc*A$	
RUN-OFF COEFF. K	K	0.6	
Taken max. value of K for wooden land and forested areas			
Max Rainfall in a day over last 12 years on 30.05.2013		245	MM
As data for last 25 years are not available, max. daily rainfall has been escalated as per previous trend by			
		50%	
Assuming 6 hours duration of max. daily rainfall			
Critical Rainfall Intensity (cm/hr)	Pc	6.125	
Catchment Area (Ha)	A	436.8	
	Q	44.59	CUMECS
Design Discharge	Q	63.45	CUMECS

Hydraulic Design of Diversion Channel Section

Design Discharge	Q	63.45	CUMECS
Level at Start of Diversion		280	M
Level at End of Diversion		250	M
Level difference		30	M
Total length of diverted Nallah		2600	M
Diverted Nallah Slope		0.012	V:H
Adopting Bed Grade of diversion channel	S	0.01	1 IN 86.667
Adopting Bed width of diversion channel	B	4.00	
Side Slopes		1.50	1.50 H:1V
Full Supply depth	D	2.00	M
Ratio B/D		2	OK

Free board as per (IS 4745 - 1968), (IS 7112 - 1973) for canal carrying a discharge of more than 10 m³/sec.

Freeboard		0.75	M
Width of water surface at FSD	T	10.00	M
Length of each inclined side of channel below FSD		5.41	M
Wetted Perimeter of channel	P	14.82	M
Cross section area of channel at FSD	A	14.00	SQM
Hydraulic mean radius	R	0.94	M

Concrete bottom float finished sides as
Cement rubble masonry plastered, n (0.016
- 0.020)

Coefficient of rugosity (Manning's "n")	n	0.02	
Velocity of flow	V	5.17	M/S

Maximum permissible velocity for Concrete
lined channel V 6.0 (m / s)

			OK, less than max. permissible
Discharge	Q	72.40	CUMECS
			OK, more than design discharge

FOR part of the nallah through HillocksError! Not a valid link.

Alignment of diversion channel and preparation of general lay-out plan of diversion scheme

Alignment of diversion channel has been suitably adjusted / fitted considering the topography of the area based on contour plan so as to keep the quantity of earth work and depth of cutting to the minimum. Lay-out plan for diversion scheme of Karo Nallah showing diversion channel alignment and tentative location of Check Dam superimposed on contour map is shown below:

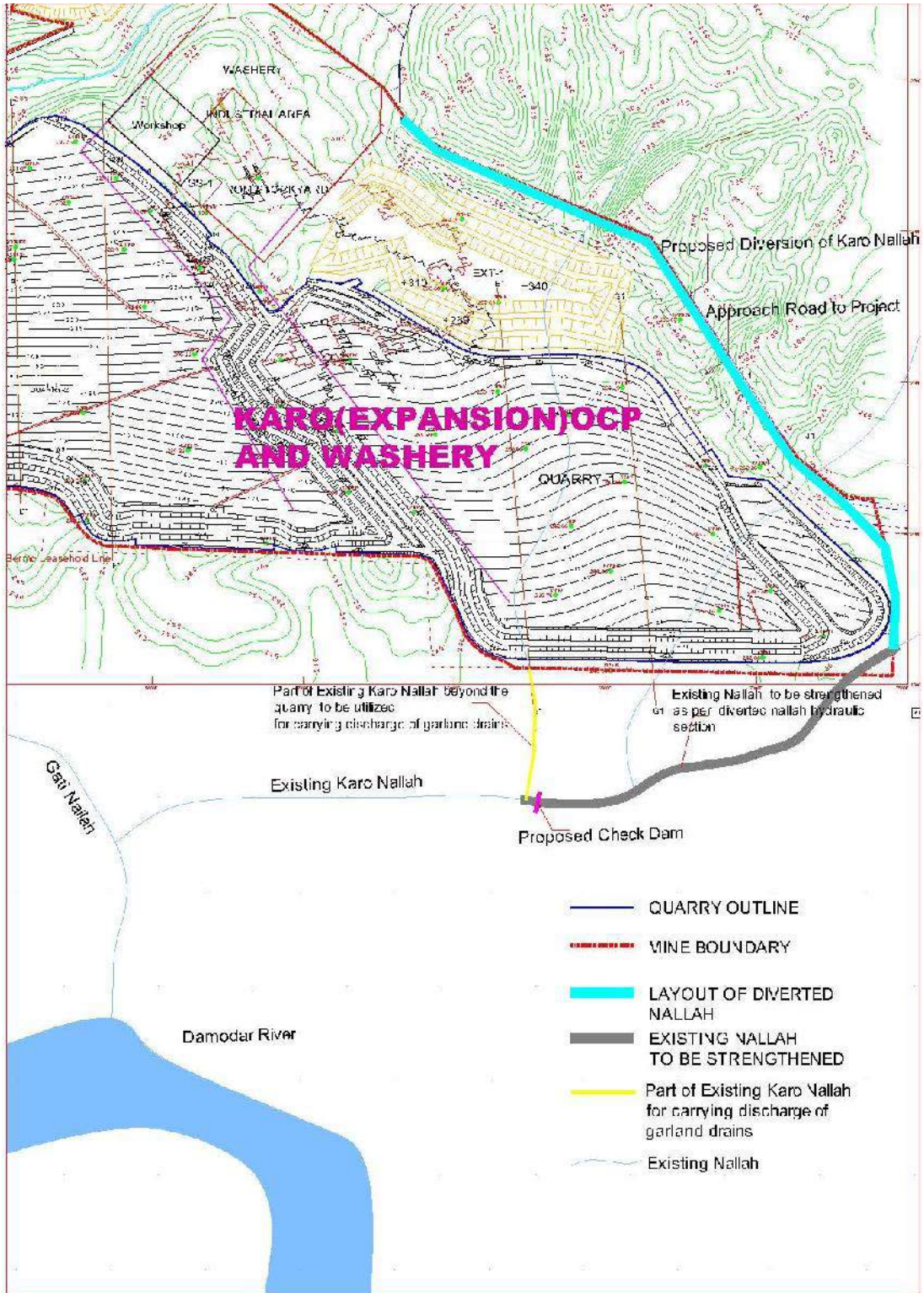
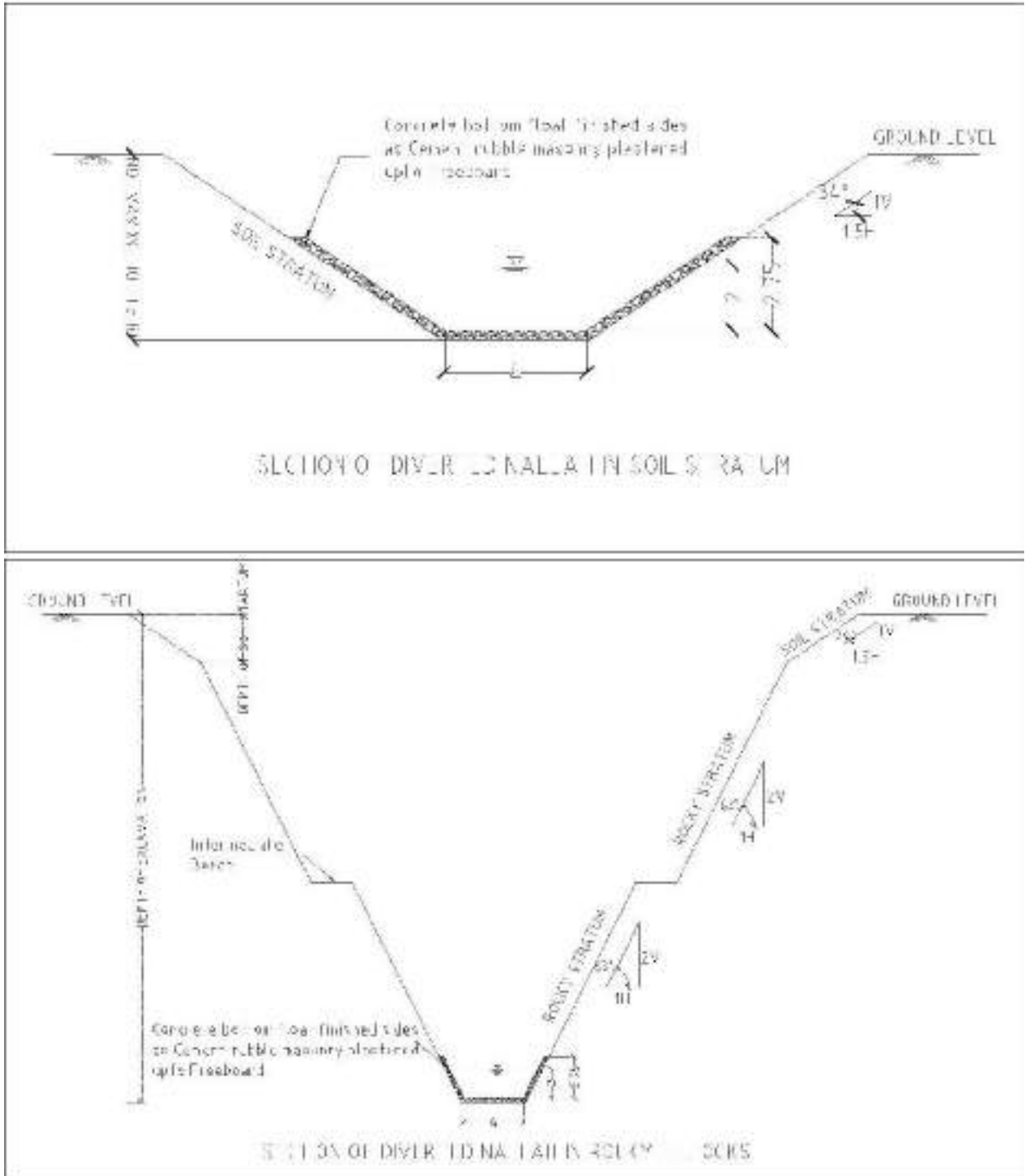


Figure 4 showing layout of diverted nallah and existing nallah to be strengthened

Hydraulic design of channel section

Gradient of diversion channel has been adopted as 1 in 87 as per the contour and in order to keep the velocity of flow within permissible limits for the maximum design flood. Bed width of 4 m have been selected with a view to optimize the earth work as well as keep the Full supply depth within desired limit of 2.0 m with a freeboard of 0.75m.



Check Dam along diversion channel

A check dam is proposed to regulate the velocity of flow of diverted nallah before it meets the existing nallah. The location of the proposed check dam is given in Figure 4. The rubble masonry check dam will be of adequate height to build a reservoir in the upstream. The river bed and the side slopes shall be adequately protected. Provision of PCC pavers in staggered orientation in the downstream side shall facilitate in reducing velocity and eddies.

4.3.11 IMPACT ON GROUNDWATER SYSTEM

Mining is associated with groundwater problems, particularly when it is below water table. The impact of mining on groundwater is mainly dependent on parameters of mines and aquifers, groundwater recharge-discharge processes etc. In opencast mining, the unconfined aquifer and the semi-confined aquifers are get affected due to` continuous gravity drainage and conventional sump pumping for efficient and safe working.

Impact on aquifer due to mine pumping: There is an impact of mining activity on aquifer due to mine inflow and subsequently mine pumping in any opencast project.

In opencast mine, the different aquifers overlying the workable coal seam would be contributing ground water to the mine by gravity drainage since they are punctured at the mine. The anticipated peak groundwater inflow of Karo Expansion OCP is about 4700 m³/day. As such due to this pumping /gravity drainage, cone of depression would be formed. The shape and extent of the cone would depend mainly on hydraulic conductivity and specific yield of the aquifers, mine depth, area etc. Generally steep drawdown cone would be formed in low potential aquifers thereby the area of influence is small distance and reverse is established in respect of aquifers with high hydraulic conductivity. The individual permeable beds develop individual drawdown cones and the impact is usually limited to few hundred meters.

The Radius of Mine Influence area has been estimated for Karo Expansion OCP by using Sichardt's formula ($R=C \times (h-h_w) \times \sqrt{k}$). Based on the aquifer and mine parameters the maximum radius of mine influence of Karo Expansion Project, considering average hydraulic conductivity value of 0.38 m/day at final mine depth of 125 m is 320 m from the mine periphery and will have a maximum drawdown of 25 m.

However the present mine flow of Existing Karo OCP is 750 m³/day (Table No.19). The average pre-monsoon water level in the core zone rises up to 2.11 m during the period between 2011 to 2015 whereas the average water level in post-monsoon condition goes down during the period between 2011 to 2015 (Table No-4). Inclining trend of pre-monsoon water levels shows decrease in ground draft/discharge over the period of time. It indicates that there is very less impact on water level noticed in the core zone at present due to mine pumping. The aquifers are getting recharged by artificial recharge and re-circulated mine discharged water.

It may be appropriate to mention here that the presence of prominent boundaries/water bodies, faults and also inter-fingering of sandstone and shale beds may restrict the propagation of drawdown cone.

With the variation in aquifer/mine geometry, multi-aquifer system, return flow from mine discharge, abundant recharge, the zone of disturbance will be reduced. Thus, the propagation of drawdown cone will be limited to a small distance for a temporary period. Mine induced effect will be noticed near the mine in the down-dip side and becomes milder/insignificant thereafter. However the effect is limited or negligible in the up-dip side of the incrop zone due to shallow mine depth of the area. Only unconfined aquifer is going to be affected for mining activity to the immediate vicinity of the mine area as the semi-confined aquifer below is continuously recharged from above unconfined aquifer. Therefore the drawdown is restricted only within the unconfined aquifer.

The ground water chemistry indicates that the ground water in the area is potable and does not contain any toxic elements. The opencast mining activity in the area does not induce any unwanted chemical or elements into the ground water affecting the water chemistry.

The analytical results of ground water from the Karo (Expansion) OCP are well within the IS: 10500 standards of drinking water.

WATER HARVESTING & ARTIFICIAL RECHARGE

Coal mining is the major industrial activity in the area. Ground water pumping is an integral part of coal mining. 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 Karo Expansion OCP comes to about 46.67%. As per the data collected from the Central Ground Water Board, Ranchi, the stage of ground water development in the Bermo Block is 43.93% in which Karo Expansion OCP and most of its buffer zone located and the region falls within the "Safe" category. Application for obtaininn NOC from CGWA is enclosed as Annexure VI.

Both water level trends of CMPDI observation wells of EB-1, EB-36 and EB-38 (Plate no. VIII A & B), located in core zone and buffer zone of Karo Expansion OCP, do not show any declining trend.

Water level Areas having shallow water levels / rising water level trends are not considered for inclusion in artificial recharge plan (Manual on Artificial recharge of Ground water, CGWB, 2007)

The artificial recharge by water conservation structures in the outside mine influence areas will check water level lowering. But within the mine influence area it may not be a viable solution because of the reason that recharged water would drain into the mine at a faster rate due to the steep hydraulic gradients resulted in the mining activity. Again, it may also lead to mine inundation. However, artificial recharge will be taken up for improving the quality of ground water.

Peak mine Discharge (4700 m³/day) and mine influence area (maximum 320 m from the mine edge) have been estimated and the groundwater monitoring would be undertaken as corrective measure to avoid adverse effects. After meeting the both industrial and domestic demand of Karo Expansion OCP, the surplus mine water of 240 m³/day will be utilized for artificial recharge to the ground water system using tank and ponds created at near New Karo colony (Fig-2).

The impact on ground water level is being 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 catchments area. The amount of water harvested depends on the frequency and intensity of the rainfall and characteristics of the catchments to allow the precipitate to infiltrate through the sub-soil and percolate down to recharge aquifers.

In the monsoon season the garland drain channels the surface run-off from the mine area without any contamination and is accumulated in earthen water pool developed in the peripheral villages 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.

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.

The recharge to semi-confined aquifers takes place due to infiltration of direct rainfall in the outcrop zones/areas of these partings and interconnections formed by faults, fractures, etc. between top unconfined aquifer and themselves. The semi-confined aquifer is confining in nature in down dip-side whereas the same aquifer is in unconfined condition in the incrop side within the mining area of Karo (Expansion) OCP (Geological Plan- Plate-V and Geological Cross section-Plate-VI).

After mine closure, void of opencast mine 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.

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 (5th to 12th June).



Figure: 2 Rainwater Harvesting through Pond at New Karo Colony

4.3.12 CONSERVATION MEASURES

- The mine discharge will be effectively utilize to meet the mine's domestic and industrial needs. Almost, the entire industrial and domestic water demand of the Karo Expansion OCP will be met from treated mine water.
- To increase the source availability, Hand pumps and in some places piped water supply will be provided nearby villages.
- No excess mine water is being discharged to nala/river. All the mine seepage water collected at the sump is being utilised for industrial and water harvesting purposes.

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

- The proposed washery will work on closed water circuit system. So no effluent will be generated.
- At the proposed stage, mine water will be treated through filter plant and supply for the domestic purposes.
- Supply of domestic water to nearby area such as Kargali Bazar, Gandhi Nagar, Jawahar Nagar, Subhas Nagar, Kurukpania Village, Bermo Colony, Ghutia Tand Village, Ram Nagar Colony etc.
- Rainwater harvesting and artificial recharge to the groundwater system is being done through pond located near New Karo colony.
- Garland drain around the mine has been constructed in order to prevent the entry of surface run off inside the mine to avoid the contamination of rainwater.
- The catch drains has been constructed around the foot of the OB dumps in order to collect surface run off water from the dumps and convey them to the settling ponds.
- Regular plantation is being taken up during the life of the mine to create green barrier. The plant species will be selected in consultation with State Forest Department.

4.3.13 FUTURE STRATEGY

- To assess the impact on local water levels, in time and space coordinates, a monitoring network in the zone of influence will be established and the water levels will be monitored quarterly.
- To create the water resources and to increase groundwater recharge in the nearby villages, under community development, tanks/ponds will be constructed or strengthened. Desiltation/deepening of existing ponds in the local villages would enhance the water availability in the nearby villages.
- Action will be taken to meet the shortage of drinking water in peripheral villages, if any.
- 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 ground water recharge.
- 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. 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 (5th to 12th June).
- Rain water along with surplus mine pumping water will be discharge into surface reservoirs/tank/pond/mine voids after passing through the settling tank. Necessary earthen check dams will be made in the nala for recharging ground water aquifer.
- Roof Top rainwater harvesting structure will be constructed in the administrative building of the projects/mines.

- Utilization of treated mine water discharge by both industry and local people in the mine influence area.
- Monitoring of water quality of mine water discharge, local River/nala and domestic water source (dug well/Hand pump wells) will be continued under routine monitoring (February, May, August & November).
- During course of operation, area received considerable impact, suitable control and remedial measures would be adopted by the mine authorities.
- After cessation of mining, with plenty rainfall and abundant ground water recharge, the water levels will recoup and attain normalcy. Thus, the impact of mining on groundwater system may be considered as a temporary phenomenon. The abandoned mine void also behave as water pool and improve the resources availability in the area.
- The water-logged final void of the mine can be utilized for pisciculture.
- Any other measures recommended by the regulatory agencies.

4.4 Noise Environment

4.4.1 The sources of noise

The major sources of noise will be:

- Drilling operation
- Blasting for overburden
- Operation of HEMMs like shovels, dumpers, dozers, graders, front-end loaders, etc
- Operation of equipment in washery, workshop, etc.

The noise associated with mining activities may be classified into three types

- Continuous
- Intermittent
- Impulse

The workmen associated with the operation of HEMMs, etc. will experience a noise level above stipulated 90 dB (A) [DGMS Circular, No.18 (Tech.) of 1975] for more than 4-4.5 hours per shift. Unless suitable mitigatory measures are taken, high noise pollution will have impact on the workmen. It is worthwhile to mention that intermittent and impulse noises are considered to be less dangerous than continuous noise due to the short exposure duration except under the situation when the level exceeds 115 dB (A).

4.4.2 Impact of noise nuisance & blasting

The ambient noise level of the project will be monitored regularly. Noise levels are likely to remain within the limits of the prescribed standard. So the noise produced from this project will not have auditory, non-auditory, masking effects, etc. as suitable mitigation measures shall be taken in the project.

Controlled blasting technique will be adopted in the project. So, there will be no adverse effects on life, property and ambient noise.

4.4.3 Acceptable noise levels and peak particle velocity

Assessment of impact of noise nuisance of a workplace can be achieved by comparing the level with TLV prescribed by the DGMS. There are also standards relating exposure time with noise levels from the International Standard Organization (ISO) and American Conference of Governmental Industrial Hygienists (ACGIH). These standards may also be used to assess the impact of noise in workplaces.

4.4.4 Noise pollution control measures

The following measures shall be taken :

- Proper designing of plant & machinery by providing in-built mechanisms like silencers, mufflers and enclosures for noise generating parts and shock absorbing pads at the foundation of vibrating equipment.
- Routine maintenance of equipment.
- Rational deployment of noise generating plant and machinery.
- Greenbelts around the quarry, infrastructure sites and service building area besides avenue plantation on both sides of the roads
- To maintain noise level at night time within the limit for the inhabited localities situated at a very close proximity.
- HEMMs with sound proof cabins.
- Personal protective devices to all the persons working in high noise areas.
- Regular monitoring of noise levels at various points.

4.4.5 Blasting vibration control measures for safe blasting

Due attention will be given to the following factors:

- All provisions of Coal Mines Regulations will be followed.
- Quantity of explosive
- The quantity of explosive will be decided as per condition imposed by DGMS.
- Stemming material
- Stemming material to be used is sand. However, the drill cuttings and chips of triangular shape can be used as an effective stemming material with proper packing.
- Delay system
- Use of millisecond delay detonators that are initiated by shock tube initiation system, between rows and between holes in the same row.
- Blasting time

- Blasting will be done in day time during the shift change over period as per requirement. However, the frequency of blasting will depend upon the availability of land (tenancy in particular), DGMS permission for use of explosive, meteorological condition, geo-mining condition and method of mining.
- Warning
 - Before blasting is done, warning sound shall be given and placards/flags will be displayed so that people can move to safe places.

4.4.6 Vibration control

- Proper conformation to measures for safe blasting as mentioned above, to avoid damage to any structure or annoyance to the people in the adjoining areas.
- Proper design factor will be taken while constructing various structures for stability against vibration.
- A safe blasting zone will be kept around the periphery of the quarry. This zone is kept free from village habitation and community infrastructure and thus impact of vibration after blasting on the surface structures is avoided.
- Controlled blasting will be done near built-up areas and surface features, as and when required.

4.5 Land Environment

4.5.1 Present Land Use Pattern

The land use pattern of the core zone based on satellite imagery data is given below.

Table 4.11 present Land Use as per Satellite Imagery

Classes		Core Zone	
Level-I	Level-II	Area (Km ²)	% of Total
Forest Land	Dense Forest	0.66	11.96
	Open Forest	1.02	18.48
	Total Forest Land	1.68	30.43
	Scrubs	1.19	21.56
Plantation Area	Social Forestry	0.16	2.90
	Plantation on OB	0.11	1.99
	Plantation on Backfill	0.12	2.17
	Total Plantation Area	0.39	7.07
Agriculture Land	Crop land	0.00	0.00
	Fallow Land	0.58	10.51
	Total Agriculture Land	0.58	10.51
Waste Land	Waste Land	0.64	11.59
	Sand Body	0.00	0.00
	Fly Ash Pond	0.00	0.00
	Barren Rocky Land	0.00	0.00
	Total Waste Land	0.46	8.33

Classes		Core Zone	
Level-I	Level-II	Area (Km ²)	% of Total
Mining Area	Coal Quarry	0.38	6.88
	Barren OB Dump	0.29	5.25
	Back Fill	0.14	2.54
	Coal Dump	0.08	1.45
	Water Filled Qry	0.03	0.54
	Total Mining Area	0.92	16.67
Settlements	Urban Settlements	0.19	3.44
	Rural Settlements	0.06	1.09
	Industrial Settlements	0.03	0.54
	Total Settlement Area	0.28	5.07
Water Body	River/ Ponds	0.02	0.36
Total Area		5.52	100.00

4.5.2 Land Use during Mining

Table 4.12 present Land Use as per Satellite Imagery

SI no	Particulars of land (Area Ha)	Forest	Non- Forest	Total
1	Quarry	185.07	110.68	295.75
2	External OB dump-1	24.73	13.27	38.00
	External OB dump-2	5.00	52.24	57.24
3	Infrastructures	36.77	8.31	45.08
4	Road, Top soil dump, nala diversion, green belt/vacant land	52.53	32.72	85.25
5	Res. colony*	0.00	5.00	5.00
6	Conveyer to Kargali Washery/ siding *	7.50	19.02	26.52
Total Land Required		311.60	241.24	552.84

* 31.52 Ha of residential colony and conveyer belt falls outside core zone

Status of Acquisition

- FC granted for 77.43 ha forest land diverted vide letter number: F.No.8-22/2003- FC Dated 31st March 2004.
- FC applied for 226.67 ha forest land on 9.03.2006. Proposal recommended by MoEF&CC for stage-I clearance in FAC meeting held on 25.01.2018.
- Stage I for diversion of 7.50 Ha. of land for Conveyer to Kargali Washery/ siding is under process.
- Total Non-Forest land of 241.24 Ha has already been acquired.
- Copy of Forest Clearances issued are enclosed as Annexure X.

4.5.3 Land Reclamation

Stages of Land Reclamation

This is carried out in two distinct phases:

- Physical/technical reclamation.
- Biological reclamation.

a) Physical / technical reclamation

During the process, the geometrical shape of the internal dumps is altered to make it amenable to effective biological reclamation and also to provide safety and stability.

Backfilling & reshaping of internal dumps

The OC quarry will be backfilled with overburden. The backfilling will be carried out in a phased manner. Once the backfilling has reached a certain predetermined reduced level, the plots will be levelled, graded and cleared of large stone pieces lying on the surface. The slope of the ground will be made very gentle as far as possible (preferably less than 2%). The graded and levelled area will be divided into small sectors and small check bunds will be constructed to retain moisture and humus in the soil. The outer slope of each bench will be kept at the natural angle of repose of the spoil material and at overall slope angle of 28° considering all benches.

The drainage arrangements for precipitation run-off are as follows :

- During working stage, the run-off will be collected from internal dump by foot drain for diverting to sump on mine floor for pumping.
- In the post-mining period, the drainage pattern of the reclaimed area will be such that the run-off will be diverted to final void of the quarry.

Topsoil management

Topsoil from unbroken excavation areas will be scraped for progressive and concurrent utilization during physical/technical reclamation of backfilled area, thus obviating the necessity of large storage area of topsoil separately.

b) Biological reclamation

For successful biological reclamation of the reclaimed area, preference will be given to endemic species and mixed culture. The species will be selected carefully from the following groups for quick reclamation :

- Nitrogen fixing tree species for fuel wood, timber and fodder
- Fruit bearing tree species
- Tree species with dense foliage for shade
- Grass species.

c) Dumping Strategy

The dumping strategy has been formulated with due consideration of the following aspect:

- Minimal use of the land for external dumping.
- Rationalization of the lead distance for hauling.
- Stability of the dump both internal and external, which ultimately leads to the safety of the person working in the mine.

Based on the above criteria the following dumping strategy has been adopted.

DUMPING ARRANGEMENT

SPOIL DUMP

The project report envisages two dumping options.

Quarry-I

- External Dump I: Area – 38 Ha, Highest dump level- +340m and Capacity- 10.68 Mcum.
- Internal Dump: Area – 72.28 Ha, Highest dump level- +280m and Capacity- 19.37 Mcum.

Quarry-II

- External Dump II: Area – 57.24 Ha, Highest dump level- +395m and Capacity- 23.45 Mcum.
- Internal Dump: Area – 88.25 Ha, Highest dump level- +310m and Capacity- 36.88 Mcum

YEARWISE EXTERNAL & INTERNAL DUMPING

The stage wise volume of external and internal dumping is given in the following table:

Quarry-I

Table 4.13 Dump Management Plan of Quarry-I

Particulars	Solid Volume (Mcum)		Total (Mcum)
	External (Mcum)	Internal (Mcum)	
From 1 st to 3 rd year of Quarry Operation	5.46	1.84	7.3
From 4 th to 7 th year of Quarry Operation	5.22	9.32	14.54
From 8 th to 10 th year of Quarry Operation	Nil	8.21	8.21
Total	10.68	19.37	30.05

Quarry-II

Table 4.14 Dump Management Plan of Quarry-II

Particulars	Solid Volume (Mcum)		Total (Mcum)
	External (Mcum)	Internal (Mcum)	
From 1 st to 3 rd year of Quarry Operation	8.91	0.33	9.24
From 4 th to 7 th year of Quarry Operation	14.54	10.02	24.56
From 8 th to 12 th year of Quarry Operation	Nil	26.53	26.53
Total	23.45	36.88	60.33

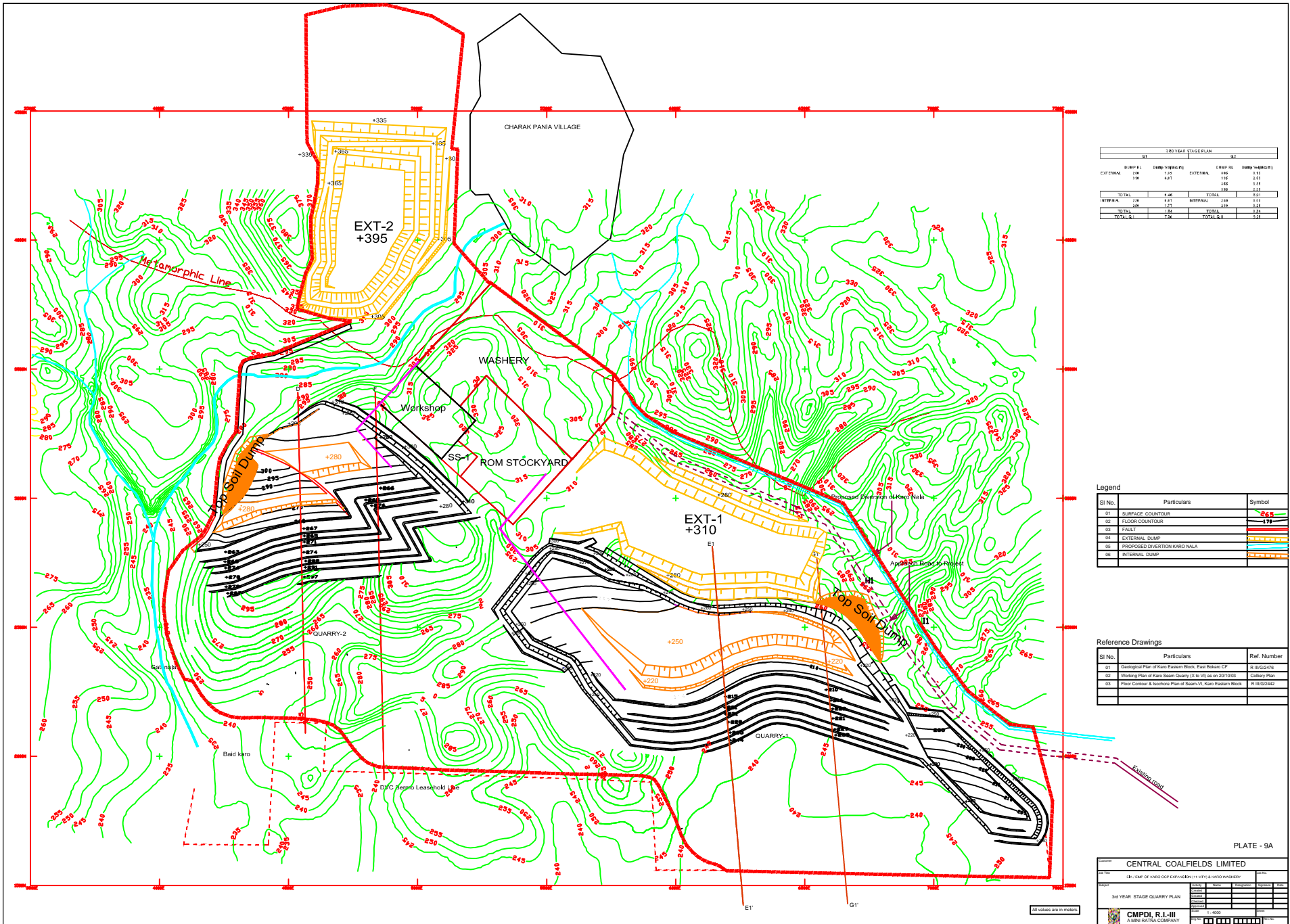
Refer Plate XIII A , XIII B , XIII C for Stage wise dump Plans

D) Post Mining Land Use Plan

Table 4.15 Post Mining Land Use within Core zone

SN	LAND USE DURING MINING		POST MINING LAND USE	
	Landuse during mining	Total Area (Ha)	Post-mining land use	Total Area (Ha)
1	Quarry	295.75	Plantation on backfilled area	160.54
			Void Filled with Water	135.21
2	External OB dump-1	38	plantation on External OB Dump	95.24
	External OB dump-2	57.24		
3	Infrastructures	45.08	CCL use	45.08
4	Road, nala diversion, green belt/vacant land & safety zone	85.25	Road in public use	4.4
			Nallah	3.3
			Green belt (10 to 30 m wide)	24.2
			Undisturbed	53.35
5	Residential colony*	5	Public use	5
6	Conveyer to Kargali washery*	26.52	CCL use	26.52
Total Land Required		552.84		552.84

As per proposed post mining land use plan given above, the total proposed plantation within the project boundary is 287.98 Ha (Including plantation on backfilled area, avenue Plantation, external OB dump and green belt). The stage wise plantation plan along with the expenditure is as given below. Refer Plate XIII A, XIII B , XIII C for Stage wise dump Plans



3RD YEAR STAGE PLAN				
Q1		Q2		
BLIMP RL	DUMP VOLUME (M ³)	DUMP RL	DUMP VOLUME (M ³)	
EXTERNAL	236	EXTERNAL	186	422
INTL	641	INTL	152	793
			146	939
TOTAL	877	TOTAL	338	1215
INTERNAL	236	INTERNAL	249	485
TOTAL	877	TOTAL	587	1464
TOTAL Q1	236	TOTAL Q2	351	587

SI No.	Particulars	Symbol
01	SURFACE CONTOUR	265
02	FLOOR CONTOUR	179
03	RAIL	
04	EXTERNAL DUMP	
05	PROPOSED DIVERSION KARD NALA	
06	INTERNAL DUMP	

SI No.	Particulars	Ref. Number
01	Geological Plan of Kani Eastern Block, East Block CF	II/SG2476
02	Working Plan of Kani Steam Quarry (X to Y) as on 20/10/03	Colliery Plan
03	Flow Control & Isolation Plan of Kani Eastern Block	II/SG2442

PLATE - 9A

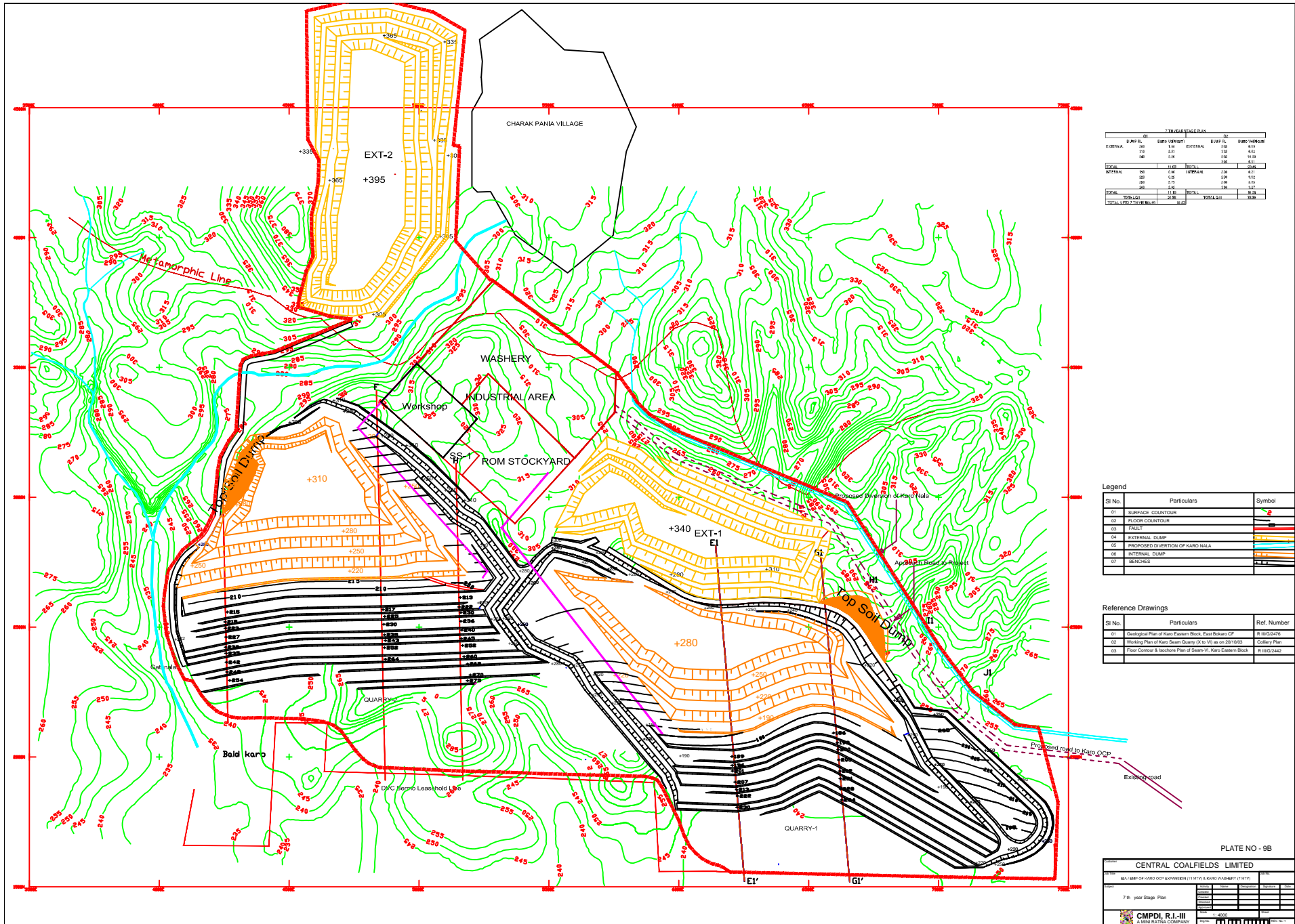
CENTRAL COALFIELDS LIMITED

(A COMPANY OF KANI COAL CORPORATION) (A PUBLIC SECTOR UNDERTAKING)

3RD YEAR STAGE QUARRY PLAN

Scale	1:4000
Author	CMPDI, R.L-III
Checked	
Approved	

All values are in meters



TOTAL QUANTITY			
SI	DESCRIPTION	QUANTITY	UNIT
01	Surface Counter	1.00	Sq. M
02	Floor Counter	1.00	Sq. M
03	Washery	1.00	Sq. M
04	Industrial Area	1.00	Sq. M
05	ROM Stockyard	1.00	Sq. M
06	Quarry-1	1.00	Sq. M
07	Top Soil Dump	1.00	Sq. M
TOTAL		7.00	Sq. M

Legend

SI No.	Particulars	Symbol
01	SURFACE COUNTER	—
02	FLOOR COUNTER	—
03	WASHERY	—
04	INDUSTRIAL AREA	—
05	EXTERNAL DUMP	—
06	INTERNAL DUMP	—
07	ROADS	—

Reference Drawings

SI No.	Particulars	Ref. Number
01	Geological Plan of Karo Eastern Block, East Bokaro CP	R/11022476
02	Working Plan of Karo Seam Quarry (X to V) as on 20/10/03	Colliery Plan
03	Floor Contour & Leachhold Plan of Seam VI, Karo Eastern Block	R/11022442

PLATE NO - 9B

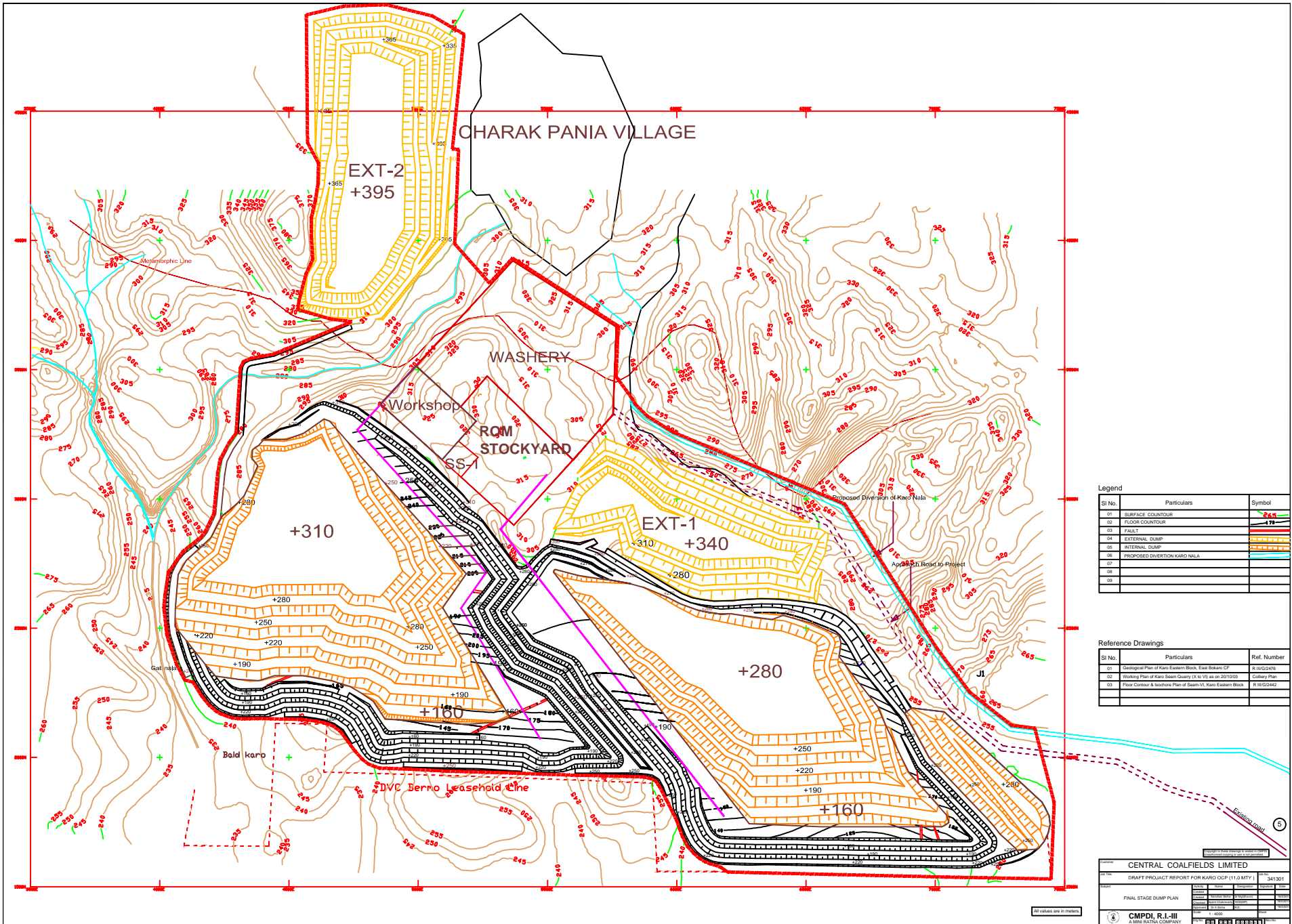
CENTRAL COALFIELDS LIMITED

(A MINERALS COMPANY OF THE STATE OF BIHAR)

7th year Stage Plan

Scale	1:4000
Author	CMPDI, R.I.-III
Checked	
Approved	

A MINERALS COMPANY



Legend

Sl No.	Particulars	Symbol
01	SURFACE CONTOUR	245
02	FLOOR CONTOUR	179
03	FALLI	
04	EXTERNAL DUMP	
05	INTERNAL DUMP	
06	PROPOSED DIVERSION KARO NALLA	
07		
08		
09		

Reference Drawings

Sl No.	Particulars	Ref. Number
01	Geological Plan of Karo Eastern Block, East Block CF	II/IG2476
02	Dumping Plan of Karo Seam Quarry (X to Y) as on 20/10/03	Colliery Plan
03	Flow Control & Isobars Plan of Seam 'H', Karo Eastern Block	II/IG2442

CENTRAL COALFIELDS LIMITED

DRAFT PROJECT REPORT FOR KARO ODP (11.0 MTP)

341301

FINAL STAGE DUMP PLAN

Scale	1:4000
Author	
Checked	
Approved	

CMPDI, R.L-III
A MINI RATNA COMPANY

All values are in meters

Table 4.16 Stage wise Plantation Plan

Year	Green Belt			Avenue Plantation			reclamation of OB Dump			Total		
	Area (Ha)	No. of trees	Estimated Cost of Plantation (Rs.)	Area (Km)	No. of trees	Estimated Cost of Plantation (Rs.)	Area (Ha)	No. of trees	Cost of Plantation (Rs.)	Area (Ha)	No. of trees	Cost of Plantation (Rs.)
1 st Year-5 th year	16	40000	3585280	5	12500	25402406	12.62	31550	2827889.6	33.62	84050	31815576
6 th year – 10 th year	8.2	20500	1837456	2	5000	10160963	105.1	262750	23550808	115.3	288250	35549227
11 th year – 15 th year	0	0	0	1	2500	5080481	138.06	345150	30936484.8	139.06	347650	36016966
Total	24.2	125000	5422736	8	20000	40643850	255.78	792500	57315182.4	287.98	937500	103381768

The list of the species recommended for afforestation on the overburden and other vacant areas is as given below:

Botanical Name	Local /Trade Name	Mitigation value
<i>Acacia ariculiformis</i>	Babool	Dust pollution
<i>Albizia lebeck</i>	Sirish	Dust pollution
<i>Madhuca latifolia</i>	Mahua Tree	Dust pollution
<i>Aegle marmelos</i>	Bael tree	Dust pollution
<i>Syzygium cumini</i>	Amrud	Dust pollution
<i>Cassia fistula</i>	Golden shower	Dust pollution
<i>Ailanthus excelsa</i>	Maharukha	Dust pollution
<i>Butea monosperma</i>	Flame of the Forest	Dust pollution
<i>Dalbergia sisoo</i>	Indian Rose wood	Dust pollution
<i>Dendrocalamus strictus</i>	Hard bamboo	Wind barrier
<i>Bambusa aurundinacea</i>	Hallow bamboo	Wind barrier
<i>Ficus benghalensis</i>	Banayan Tree	Soil erosion
<i>Ficus religiosa</i>	Peepal Tree	Soil erosion
<i>Azadirachta indica</i>	Neem tree	Soil erosion
<i>Melia azaderach</i>	Bakneem	Soil erosion
<i>Terminalia arjuna</i>	Arjun	Soil erosion
<i>Terminalia tomentosa</i>	Saj	Noise barrier
<i>Ailanthus excelsa</i>	Mahurkha	Noise barrier
<i>Tectona grandis</i>	Teak wood	Noise barrier

4.5.4 Top Soil Management

In mining plan, it has been proposed to excavate about 0.80 Mcum top soil separately. This top soil shall be preserved properly and used for biological reclamation of the external & internal OB dump and other degenerated land for vegetation within the mining area. It is a

major environment protection programme. Soil management in opencast mine is necessary to re-establish the stability & productivity of lands disturbed due to mining activity.

Average Depth of Topsoil = 0.30 m

Area of Topsoil to be excavated = 290 Ha = 2950000 m²

Volume of Topsoil to be excavated = 0.80 M.cum

4.6 Solid Waste Management

4.6.1 Hazardous Waste Management

Source of Hazardous Waste:

As per Schedule-I of Hazardous Waste (Management, Handling & Transboundary) Rules, 2008, the list of processes generating hazardous wastes in the mine operation of karo OCP & Washery is identified as under:

Sl. No. of Notification	Description
5.1	Used / spent oil
34.3	Chemical sludge from waste water treatment
34.4	Oil and grease skimming residues

Quantum of Hazardous Waste

The specification of used oil suitable for reprocessing/recycling as per Schedule-V of Hazardous Waste (Management, Handling & Trans-boundary) Rules, 2008 is as under:

Sl. No.	Parameter	Permissible Limits
1	Polychlorinated biphenyls (PCBs)	< 2 ppm
2	Lead	100 ppm
3	Arsenic	5 ppm
4	Cadmium + Chromium + Nickel	500 ppm
5	Poly-aromatic hydrocarbons (PAH)	6%

The quality of the used oil generally confirms to the prescribed standards in the mining operations and arrangement may be made with the approved recycler for reprocessing/recycling.

Table 4.17 Calculation for Sludge Generation

No. of HEMM & other vehicles	103
Frequency of washing	Once in 4 days
No. of washing per day	25.75
Water required for washing of per vehicle (m3)	7.2
Effluent generation from washing of vehicles per day (m3)	187.2
Water requirement for workshop floor washing per day (Litres/m2)	4
Workshop area (m2)	23000

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

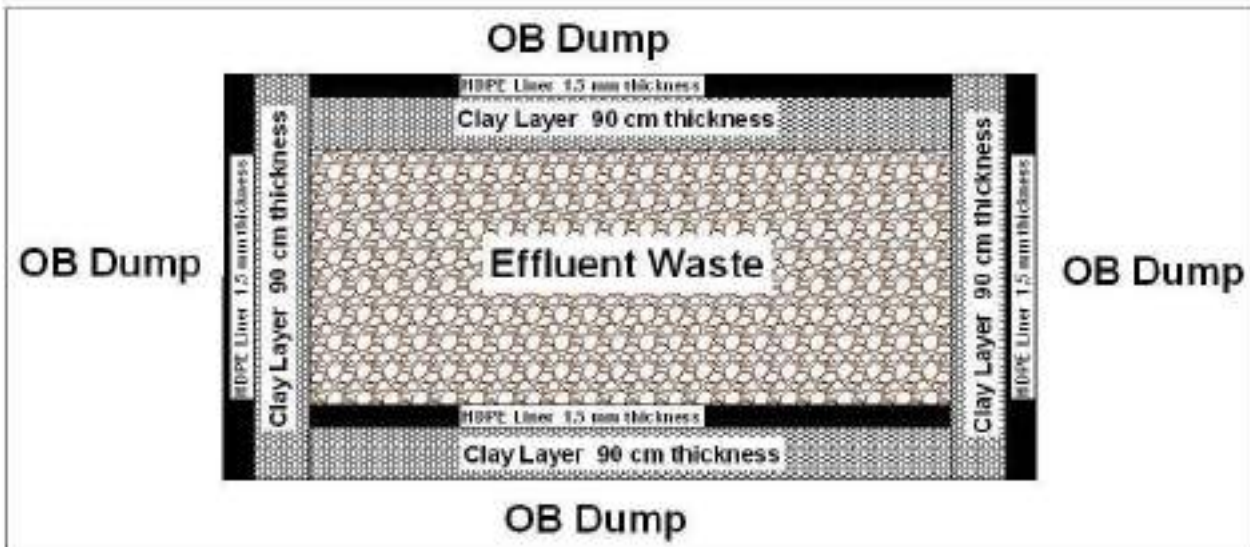
Water requirement for workshop floor washing per day (m3)	92
Total effluent generation from workshop (m3)	279.2
Effluent quality	
Suspended solids (mg/litre)	3000
Standard for Suspended solids (mg/litre)	100
Desired concentration of Suspended Solids (mg/litre)	60
Effluent Sludge to be removed (mg/litre))	2940
Effluent Sludge to be removed (kg/m3)	2.94
Total effluent sludge generation (kg)	820.85
Oil & grease sludge generation due to skimming	
Oil & grease concentration (mg/litre)	50.00
Standard for oil & grease (mg/litre)	10.00
Oil & grease to be removed (mg/litre)	40.00
Oil & grease to be removed (kg/m3)	0.04
Total oil & grease sludge generation per day (kg)	11.17

Note: Assumptions are made as per CMPDI Norms.

Necessary authorization may be obtained from Jharkhand State Pollution Control Board for recycling of the hazardous waste as per Hazardous Waste (Management, Handling & Transboundary) Rules, 2008.

The sludge generated from the effluent treatment plant will be disposed of in a land fill site centrally located for the area to cater to all the projects of the area. This will be decided in consultation with General Manager, Staff Officer (P&P), and other officials of CCL HQ and CMPDI, RI-III. The cross-section of the land fill site is provided in the scheme. Due to lesser quantity of the sludge and pollution potential being less, we may go in for single tier of the cross section.

Schematic arrangement showing Land Fill Site is given below:



Disposal of Batteries and Bio-medical Waste

The used batteries generated to the tune of around 34 in number per year (assuming 3 years life of battery for 103 vehicles) will be disposed off through the supplier. Arrangement has already been made with the suppliers to take back the used batteries for the purpose of recycling.

In the project vicinity, there is one dispensary to look after the general nature of disease etc. of the workers. The amount of biomedical waste generated from the dispensary is meagre. Arrangement with Central Hospital may be made for disposal of the bio-medical waste. No separate arrangement is required for this purpose.

4.6.2 Municipal Solid Waste Management

Quantum of Waste Generation:

Waste generation encompasses activities in which materials are identified as no longer being of value (in their present form) and are either thrown away or gathered together for disposal. Waste generation is, at present, an activity that is not very controllable.

Calculation of Municipal Waste Generation	
Manpower	874
No. of Quarters	710
No. of persons in colony	2840
Municipal waste per person (Kg/day)	0.5
Quantum of Municipal waste (Kg/day)	1420

Table 4.18 Physical characteristics of municipal solid waste in Indian cities

Population Range (in millions)	Number of Cities Surveyed	Paper	Rubber, leather & synthetics	Glass	Metals	Total Compostable Matter	Inert
0.1-0.5	12	2.91	0.78	0.56	0.33	44.57	43.59
0.5-10.0	15	2.95	0.73	0.35	0.32	40.04	48.38
1.0-2.0	9	4.71	0.71	0.46	0.49	38.95	44.73
2.0-5.0	3	3.18	0.48	0.48	0.59	56.67	49.07
> 5	4	6.43	0.28	0.94	0.80	30.84	53.90

Note: All values are in percent, calculated on net weigh basis

Table 4.19 Chemical characteristics of municipal solid waste in Indian cities

Population Range (in millions)	Number of Cities Surveyed	Moisture (%)	Organic matter (%)	Nitrogen as total nitrogen (%)	Phosphorus as P ₂ O ₅ (%)	Potassium as K ₂ O (%)	C/N Ratio	Calorific value in kcal/kg
0.1-0.5	12	25.81	37.09	0.71	0.63	0.83	30.94	1009.89
0.5-10.0	15	19.52	25.14	0.66	0.56	0.69	21.13	900.61
1.0-2.0	9	26.98	26.89	0.64	0.82	0.72	23.68	980.06
2.0-5.0	3	21.03	25.60	0.56	0.69	0.78	22.45	907.18
> 5	4	38.72	39.07	0.56	0.52	0.52	30.11	800.70

Note: All values except moisture are on dry weight basis.

Normally the range of C/N ratio in Indian Municipal Solid Waste is 21.13 - 30.94 and the typical average value of C/N ratio is 25.66.

Waste Handling, Sorting, and Storage at the Source:

The six functional elements in the solid waste management system considered in the report is waste handling, sorting, storage, and processing at the source. Waste handling and sorting involves the activities associated with management of wastes until they are placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Sorting of waste components is an important step in the handling and storage of solid waste at the source. In addition, on-site storage is of primary importance because of public health concerns and aesthetic consideration.

Based on the source, origin and type of waste a comprehensive classification likely to be generated from various facilities in the project is given below:

- a) Domestic/Residential Waste
- b) Municipal Waste.
- c) Commercial Waste
- d) Institutional Waste
- e) Bulky Wastes
- f) Street Sweeping
- g) Construction and Demolition Wastes
- h) Industrial Wastes
- i) Hazardous Wastes
- j) Sewage Wastes

4.7 IMPACT ON FLORA AND FAUNA

4.7.1 Possible Effects

During survey it is observed that, there are no prominent vegetation patches and wildlife habitats in the core zone. The following impacts have been attributed from the mining activities.

- The mining and its related activities will altered the topography of landscape and initiate degradation in quality of environment, Ecological degradation, Loss of

biodiversity, Loss of Wildlife habitats due to overburden removed and dumped in nearby areas.

- There will be marginal or no impact on terrestrial species (plants & animals).
- There will be no impact on aquatic species and no irreparable loss to the associated fauna.
- There will be marginal impact on nearby crops / habitat due to fine dust particles of the mining activities.
- Mining activities produces dust which when air-born causes an increase in the concentration of suspended particulate matter (SPM) in the surrounding air.

4.7.2 Mitigative measures for protection of flora and Fauna

Strengthening of Water Bodies

Through community development work, the existing water sources (tanks) should be strengthened to provide water to the local community as well as fauna of the area.

Greenbelt Development:

Creation of three tier plantation with tall growing trees all along the periphery of the coal handling area, inside & outside of the premises along with roads can prevent spreading of dust pollution.

Planting of diversified fruit yielding and flowering trees of evergreen and deciduous variety could provide continuous supply of food resource as well as perching sites, nesting materials and shelter to arboreal fauna. The plant species which are useful for green barrier development to prevent dust and noise pollution, planting in the degraded mine leased areas are given in the land reclamation chapter. Refer Plate XIV A, XIV B and XIV C for stage wise plantation plan.

Reclamation of abandoned mining areas

The degraded land and OB dumps should be biologically reclaimed which will improve the green cover in the area.

Adequate numbers of vegetation should be grown on the top surface and slopes of the dumps in order to arrest the erosion of soil and it also reduces surface runoff, which helps averting siltation of natural watercourses. In order to arrest siltation from OB dump, catch drains and garland drains of adequate size should be constructed around the periphery of external OB Dumps. Also, garland drains of adequate size should be provided around the quarry edges. These drains should be regularly desilted before onset of every monsoon.

Ecological restoration Measures

Planting of diversified fruit yielding and flowering trees of evergreen and deciduous variety could provide continuous supply of food resource as well as perching sites, nesting materials and shelter to arboreal fauna.

The degraded land should be biologically reclaimed which will improve the green cover in the area. Biological reclamation of OB dumps, watershed development, etc. These activities will help in reduction of dust and noise pollution and will also supplement the shortage of water in nearby villages in future.

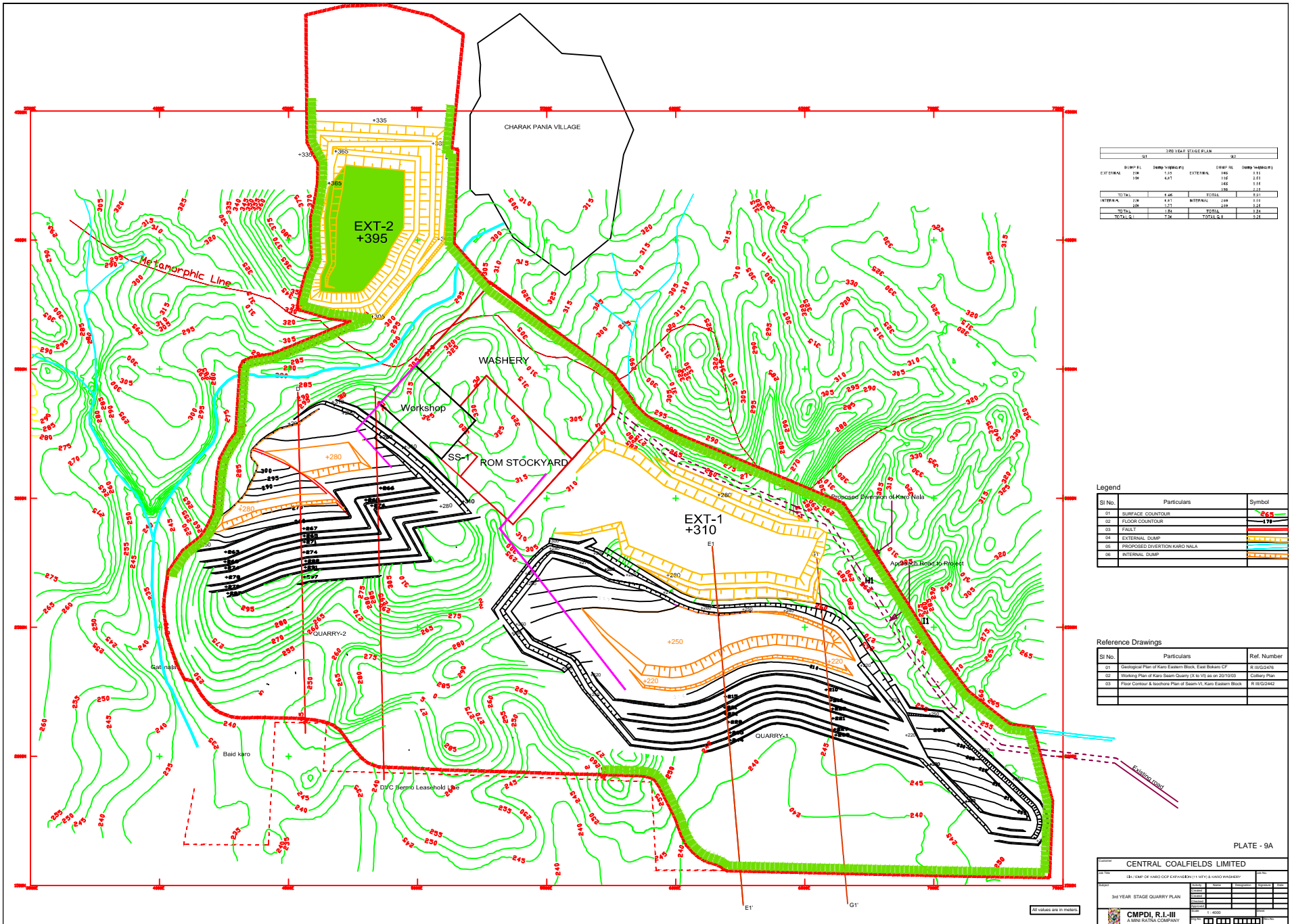


PLATE - 9A

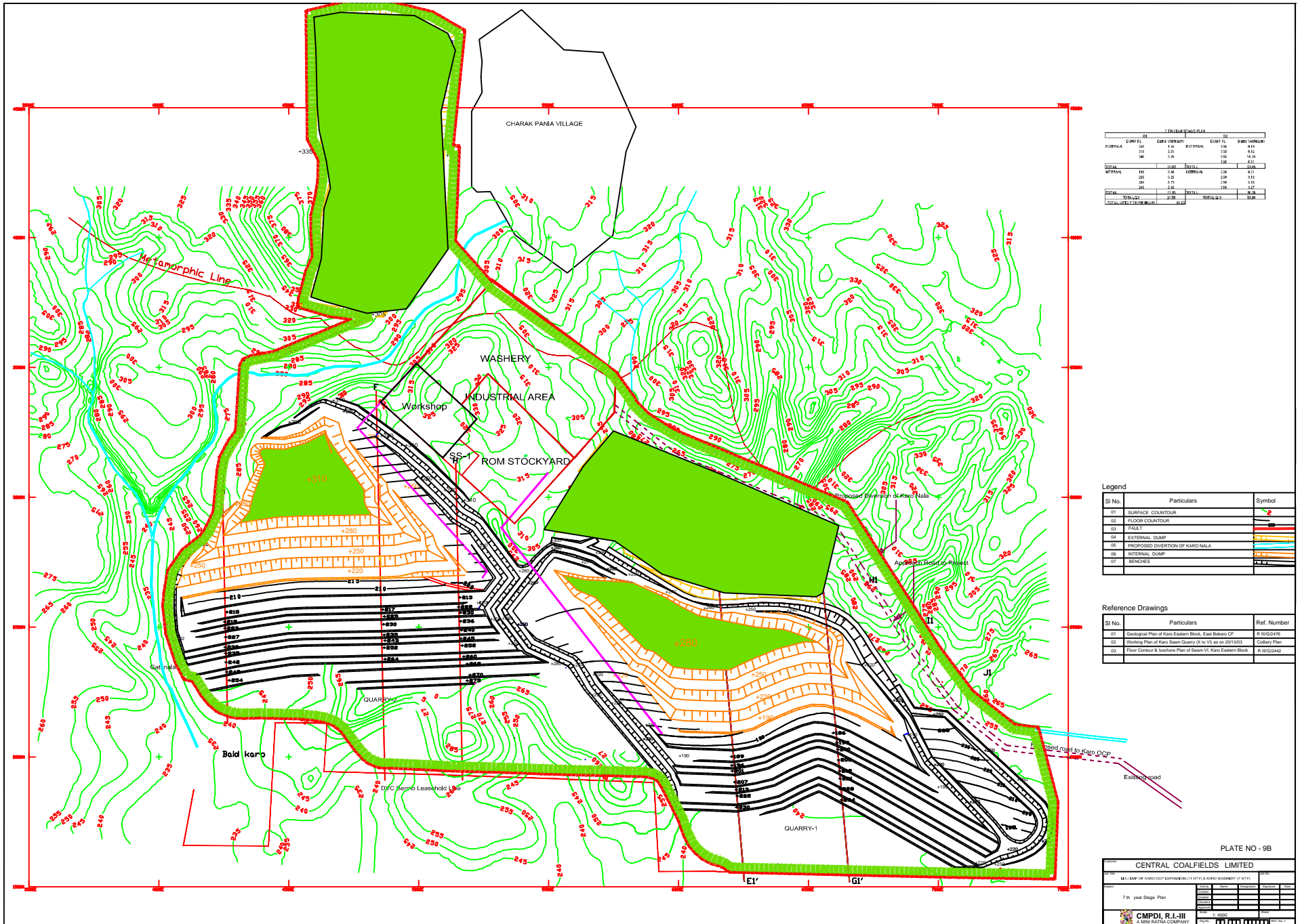
CENTRAL COALFIELDS LIMITED

3RD YEAR STAGE QUARRY PLAN

Scale: 1:4000

CMPDI, R.L-III
A MINI RATTNA COMPANY

All values are in meters



Sl. No.	Particulars	Area (Ha)	Volume (M ³)
01	DUMP FL	20	1.50
02	FLOOR COUNTER	115	2.10
03	FACE	40	1.20
04	EXTERNAL DUMP	10	0.30
05	INTERNAL DUMP	20	0.60
06	BENCHES	10	0.30
TOTAL		215	6.00

Sl. No.	Particulars	Symbol
01	SURFACE COUNTER	—
02	FLOOR COUNTER	—
03	FACE	—
04	EXTERNAL DUMP	—
05	INTERNAL DUMP	—
06	BENCHES	—

Sl. No.	Particulars	Ref. Number
01	Geological Plan of Karo Eastern Block, East Block CP	R II/G2476
02	Working Plan of Karo Seam Quarry (K to VI) as on 2010/03	Colliery Plan
03	Plan Contour & Isopleth Plan of Seam-VI, Karo Eastern Block	R II/G2442

PLATE NO - 9B

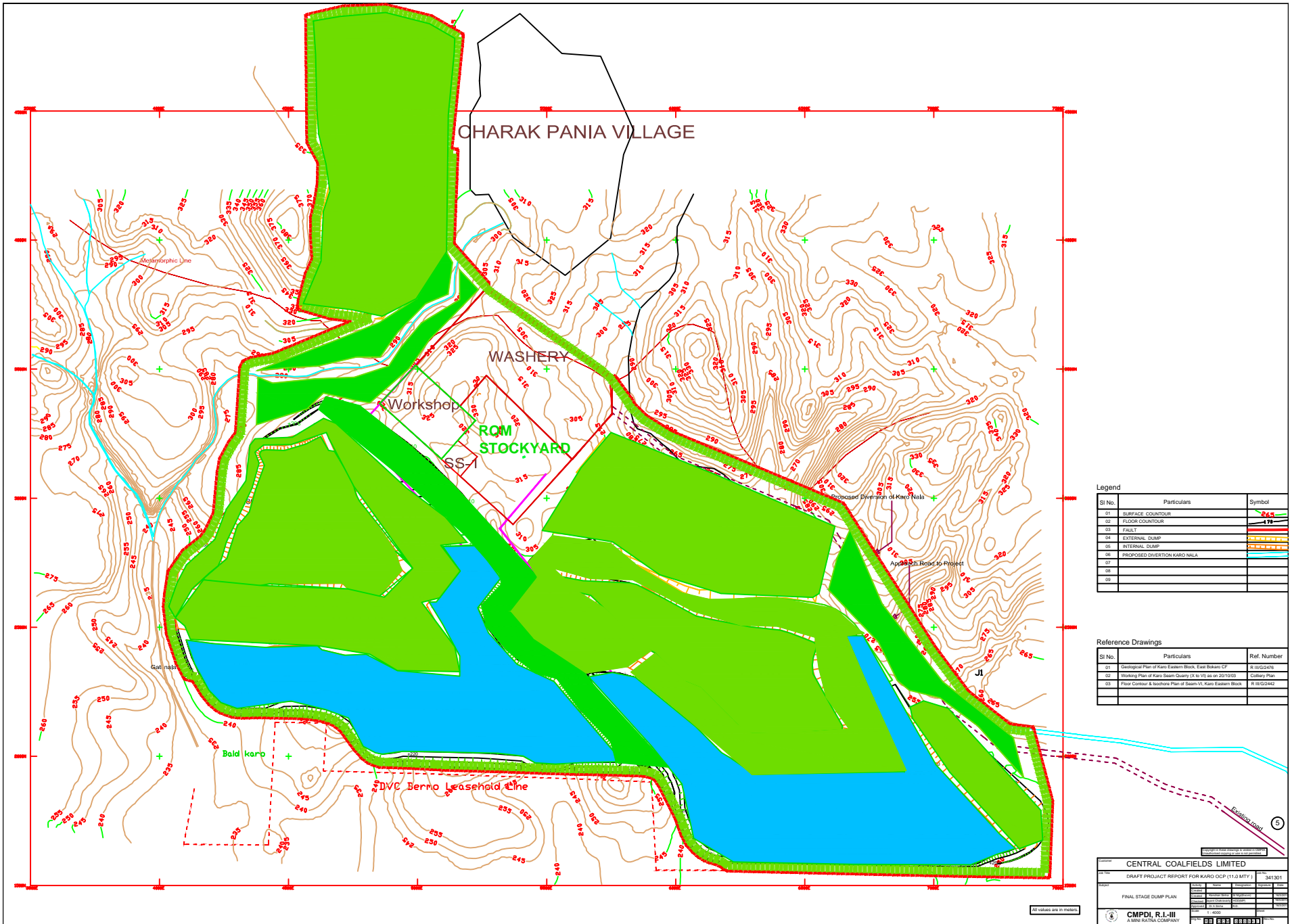
CENTRAL COALFIELDS LIMITED

7th year Stage Plan

CMPDI, R.I.-III
A MINI RATNA COMPANY

Scale: 1:4000

DATE: 10/01/2011



Legend

Sl No.	Particulars	Symbol
01	SURFACE CONTOUR	265
02	FLOOR CONTOUR	479
03	WALL	
04	EXTERNAL DUMP	
05	INTERNAL DUMP	
06	PROPOSED DIVERSION KARO NALLA	
07		
08		
09		

Reference Drawings

Sl No.	Particulars	Ref. Number
01	Geological Plan of Karo Eastern Block, East Block CF	IIUG2476
02	Working Plan of Karo Seam Quarry (X to Y) as on 20/10/03	Colliery Plan
03	Floor Contour & Isobars Plan of Seam 'H', Karo Eastern Block	IIUG2442

CENTRAL COALFIELDS LIMITED

DRAFT PROJECT REPORT FOR KARO ODP (11.0 MTPA) 341301

FINAL STAGE DUMP PLAN

DATE	20/10/2003	SCALE	1:4000
DRAWN BY		CHECKED BY	
APPROVED BY		DATE	

CMPDI, R.L-III
A MINI RATNA COMPANY

All values are in meters

4.8 Socio-Economic Impact

Table 4.20 Socio-economic impact

Sl. No.	Parameters	Impact
1	Population Growth & In-migration	Population growth in the project area as well as in the buffer zone is already accelerated owing to immigration of people from outside resulting in increased job and income opportunities.
2	Human Settlement & Resettlement / Rehabilitation	The incoming population to the project is already moved in search of jobs. In view of that the existing civic amenities such as water supply, power supply etc. is in improvement with the ongoing of the project.
3	Transport & Communication	Due to increase industrial activities and population growth in the area, the existing transport and communication system have already improved with a view to catering to increased traffic volume and frequency.
4	Income & Employment	Coal mining project forms the basic sector of employment. With increase in income opportunities and employment potentialities in this sector as the mining activities increase, the other economic sectors starts gaining in momentum. New avenues of employment in the sectors such as construction, trade & commerce and service is also getting on the move resulting in shooting up demand of workers and others.
5	Civic amenities & community Development	Due to the infrastructural facilities created and the consequent migrational happenings in the project area and nearby, socio-cultural interaction has resulted amongst population consisting of people from different areas. With added educational, medical and communication facilities developed in the areas, the standard of living has improved. With ongoing of mining activities additional facilities for local population by way of better communication, postal services, educational facilities, advanced medical services etc. are on in the area.
6.	Educational facilities & Literacy Drive	A number of educational institutes are already existing in the buffer zone. This has attracted nearby villages to avail such facilities which in turn has increased literacy level in the area.
7	Economic growth	The mining activities have accelerated the economic transformation and urbanisation in the region with the creation of new employment opportunities. This has boosted or will boost the economic growth of the region.
8	Growth of Financial Revenues-State & Central	State Government is benefited through financial revenues in crores of rupees by way of royalty, sales tax etc. from the direct and indirect operations in the project area. Central exchequer is also getting financial revenues by way of Income tax, Central Sales Tax etc.
9.	Social growth	There is a marked change in social status of the area with opening of the project.

4.9 Resettlement and rehabilitation

Karo Basti is located within Quarry I. It has been estimated that about 360 project affected families (PAF) will be affected with advancement of this mine. These PAF'S would be rehabilitated in initial stage of mine operation to achieve targeted production.

4.9.1 DETAIL OF HOMESTEAD SHIFTING

Table 4.21 Detail of Homestead Shifting

SN	Name of the Village	No. of families	Number of families with year of shifting				Compensation (Rs. Lakh)
			2019-20	2020-21	2021-22	2022-23	
1	Amlo Village	243	60	60	60	63	860.22
	Amlo Basti	189	47	47	47	48	669.06
	Muslim Tola	54	13	13	13	15	191.16
2	Karo Village	117	29	29	29	30	414.18
	Karo Basti	59	15	15	15	14	208.86
	Karo Purana Colony	58	14	14	14	16	205.32
Total		360	89	89	89	93	1274.40

- Proposed rehabilitation site is situated near Hindustan Bridge, south of Hathia Pathar & Damodar river. Area of site is 51.53 Acre, at a distance of about 8-9 km from project.

4.9.2 DETAIL OF EMPLOYMENT TO LAND LOSERS

Table 4.22 Detail of employment to land losers

SN	Name of Village	No. of families	Estimated employment to land
1	Amlo Village	243	89 jobs to land losers
	Amlo Basti	189	
	Muslim Tola	54	
2	Karo Village	117	43 jobs to land losers
	Karo Basti	59	
	Karo Purana Colony	58	
Total		360	133 against 264.74 Acre

NOTE: Till date, 113 land losers have already been provided employment against tenancy land apart from cash compensation of Rs 58.85 Lakh.

R&R Policy of CIL

Compensation For Land
One Employment per 2 acres to land losers (plots can be clubbed together) Or monetary compensation @ Rs.5.0 Lakh per acre subject to a minimum of Rs.0.50 Lakh.
The compensation can be paid in form of annuity also on monthly, quarterly, annually etc upto 60 years of age or life of project, whichever is earlier.
Note: A person receiving employment forgoes all claims to monetary compensation and a person receiving monetary compensation forgoes all claims to employment.

Compensation For Homestead
Compensation for homestead building as per standard valuation method under LA Act subject to a minimum of Rs. 2 Lakh per household
Payment of Rs 3.0 Lakh in lieu of alternate housing site, assistance in designing & shifting, compensation for construction cattle shed and working shed etc.
Subsistence allowance to each affected family @ 25 days Minimum Agricultural Wages per month for one year.
Compensation For Sharecroppers, Land lessees, Tenants, Day labourers, Landless tribals etc. @ Rs. 5 lakh per household in lieu of livelihood loss.
Affected landless tribal families will be provided one time financial assistance equivalent to 500 days MAWs as a compensation for loss of customary rights.
Assistance to PAPs to take up non-farm self employment through petty contracts or formation of co-operatives.
Contractors will be persuaded to give jobs to eligible PAPs on preferential basis.

Chapter 5

Analysis of Alternative

(TECHNOLOGY AND SITES)

5.1 Introduction

The scoping exercise results in need for consideration of alternative technologies on account of predicted environmental impact. Alternatives have been considered for

- Selection of site for the project
- Selection of appropriate Technology for coal mining & Coal Washing

5.2 Selection of site and method of Mining

Mineral deposits are site specific and therefore, selection of a mine site has limited alternatives. However, the activities relating to mine development and exploitation have many alternatives in terms of choice of mining method, drilling and blasting methodologies, location of waste dumps etc.

5.2.1 Method of mining in Karo OCP

Quarry I

The method of mining adopted to extract coal and OB in Quarry- I is inclined slicing with Surface Miner in coal and Shovel-Dumper combination in OB. This method has been proposed considering the following Geo mining conditions of the quarry.

- i) Moderately steep (6-8 degrees) gradient of seams.
- ii) Multiple seams.
- iii) Sufficient strike length.
- iv) Variable thickness of OB/Partings.

Quarry- I OCP is a working mine, it has advanced in dip side by approximately 800m from incrop of Seam-VI/VII/VIII.

Quarry II

The mining and geological conditions of the mine are as follows: -

- (a) Multiple seams to be worked
- (b) Gradient of 8-10 deg of the coal seams.

(c) Variable thickness of OB/Partings.

Considering the above mining and geological conditions the method of mining adopted to extract coal and OB in Quarry II is inclined slicing with Surface Miner in coal and Shovel-Dumper combination in OB.

It is also proposed to respond to improvements in technology and equipments, which would result in, improved profitability and productivity parameters taking into account of safety and environmental parameters.

5.2.2 Choice of Technology

Considering the geo-mining conditions **surface miner in coal and shovel-dumper combination in OB with drilling and blasting has been proposed for mining for both the quarries.** Other technologies like Dragline, Bucket Wheel Excavator, are ruled out for this quarry.

SURFACE MINER

The equipment selection process is the most critical part of the project planning. The following selection criteria have been considered for selecting the size and type of the equipment:

- The strike length of the mine
- Annual rate of advance/deepening
- Total volume of overburden and coal to be handled annually
- The individual thickness of coal seam and partings
- The geo-mining condition of the mine.
- The type of mining system to be used like Inclined Slicing or Horizontal Slicing.
- The intuitive economics of the mine
- Presence of geological disturbances like faults, intrusions etc.

Based on the above selection criteria and keeping in view of the Geological and Mining parameters of Karo OC, surface miner is most suitable one in the area under consideration. The proposed opencast mine has therefore, been designed to be operated by surface miner.

COAL WINING

Coal will be mined by surface miner SM 4200 in conjunction with F.E. loader (10 cum) and 100T rear dumpers. Dozer with ripper attachment is provided for mixed benches working

and selective mining to avoid grade slippage. This attachment will also be useful in handling faulted area operation and temporary sump formation.

OVERBURDEN REMOVAL

OB / partings are envisaged to be removed by 10-12 cum Electric Hydraulic Shovel with 100 T Rear Dumpers. OB will be transported through batters on the side flanks of both the quarries to internal dump horizon. Each horizon of internal dump is linked to the same horizon of batter roads in both the quarries. This design eliminates the lift of loaded dumper and reduces the lead considerably.

5.3 Selection of Site for Washery

Basic considerations in deciding the location of plant site are listed below in order of its significance.

- Nearness to sources of main raw materials.
- Availability of sufficient stretch of land with relatively flat terrain.
- Availability of necessary infrastructure such as transportation, communication, roads, water, etc.
- Convenient rail and road links.
- Availability of skilled and unskilled manpower.

The site considered for the proposed washery is in the close proximity to the source of raw coal. The infrastructure and auxiliary facilities are adequately present for the proposed activity.

5.4 Selection of Appropriate Technology

The process consists of deshaling of 50-13 mm coal in jig and direct mixing of -13 mm raw coal with deshaled coal to obtain washed coal and rejection of 50-13 mm sinks fraction from jig. The salient features of process are briefly described below:

- Receiving raw coal of (-) 100 mm from Karo OCP through covered belt conveyors.
- Storing of raw coal (-100 mm) in 11000 t ground storage.
- Reclamation of raw coal from ground storage and conveying the same to screen-cum-crusher house.
- Screening at 50 mm to obtain two size fractions i.e. 100-50mm & (-) 50 mm.
- Crushing of 100-50 mm coal down to 50 mm and mixing it with natural -50 mm coal.
- Conveying of entire -50 mm fraction to washery building.
- Screening of (-) 50 mm coal at 13 mm on vibrating screens to produce two size fractions i.e. 50-13 mm & -13 mm.

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- Deshaling of 50-13 mm fraction in two product electronically controlled improved type jigs to produce deshaled coal (float) and rejects (sinks).
- Dewatering of deshaled coal obtained from jigs in double deck dewatering screens followed by dewatering of 25-13 mm fraction in basket type centrifuge.
- Conveying underflow of dewatering screens, centrifuge etc. in radial thickener for thickening.
- Dewatering of thickened slurry i.e. underflow of thickener in belt filter press and mixing of dewatered slurry with the product.
- Conveying of washed coal (i.e. deshaled coal 50-13 mm obtained from jigs, untreated -13 mm raw coal fraction and dewatered fines from belt filter press) from washery building to covered storage of 18000 t capacity.
- Dewatering of rejects produced from jigs in bucket elevators.
- Conveying of dewatered rejects by covered belt conveyor to Temporary Reject Storage Site.
- Reclamation of washed coal from covered storage and conveying to Kargali Washery Railway Siding. Washed coal will be loaded into Railway wagons through Rapid Loading System (3600/ 5500 tph) for onward dispatch to consumers.

The process of the proposed washery is based on closed water circuit system. All the water fed into the system will be collected after use and re-circulated after treatment in various units and no effluent will be allowed to escape into the natural drainage system. Provision of rain water harvesting of roof top water has been envisaged by recharging the same to ground and/or by collecting the same into the constructed/developed water bodies for use in the washery.

Chapter 6

Environmental Monitoring Programme

6.1 Technical aspects of monitoring the effectiveness of Mitigation Measures

Following aspects of monitoring the effectiveness of mitigation measures will be taken into account:

Table 6.1 Technical Aspects of Monitoring

Sl. No.	Technical aspects of monitoring the effectiveness of mitigation measures
1.00	Generation of environmental data bank
1.01	Measurement methodology
1.02	Frequency
1.03	Location
1.04	Data analysis
1.05	Reporting
1.06	Schedules
1.07	Emergency procedures
1.08	Detailed budget
1.09	Procurement schedules
2.00	Evolving micro environmental management plan for the project in collaboration with other agencies and consultants.
3.00	Monitoring project implementation along with environmental Control measures.
4.00	Co-ordinate with other project activities to ensure timely Implementation of the project.
5.00	Co-ordination with Ministry of Environment & Forest, Central / State Pollution Control Board for prevention and control of water and air pollution.

6.2 Generation of environmental data bank

With a view to generating environmental data following aspects shall be planned or programmed well in advance for proper environmental monitoring:

6.2.1 Measurement methodology

Measurement methodology shall be followed as per guidelines of MoEF and CPCB, New Delhi.

Air Quality:

The Suspended Particulate Matter. (SPM), Respirable, Particulate Matter RPM (PM10 & PM2.5), Heavy metals, Sulphur dioxide (SO₂) and Oxides of Nitrogen (NO_x) concentration in downwind direction considering predominant wind direction, at a distance of 500 metres from the following dust generating sources shall be measured in the manner indicated below:

Table 6.2: Measurement Techniques

Sl. No	Parameters	Code of Practice	Sampler	Instruments used for Analysis
1.	SPM	IS: 5182 (Part-IV)	RDS Sampler with Cyclone Separator	Balance, Desiccator
2.	PM ₁₀	IS: 5182 (Part-IV)	RDS Sampler with Cyclone Separator	Balance, Desiccator
3.	PM _{2.5}	-	Fine Dust Sampler	Balance, Desiccator
4..	SO ₂	IS: 5182 (Part-V)	RDS Sampler	Spectrophotometer
5..	NO _x	IS: 5182 (Part-V)	RDS Sampler	Spectrophotometer

In addition to the general laboratory and analytical facilities, the following sampling and analytical equipments shall be used.

Table 6.3 Sampling and Analytical Equipments

Sl. No	Name of the Equipment
1	High Volume air samplers.
2	Multi gas air samplers.
3	Wind recorder
4	Aneroid Barometer.
5	Wet & Dry Bulb Thermometer
6	Hygrometer

7	Rain Gauge
8	Dust Fall Jar & Stand with bird Guard.
9	Spectrophotometer.

Water Quality:

Three litres of representative water samples will be collected in plastic container and transported to laboratory for physico-chemical analysis. For determination of BOD and bacteriological analysis, 250 ml pre-sterilized bottles will be used and care will be taken to maintain cool temperature by keeping the bottles in ice boxes during transportation to the laboratory for analysis. Physico-chemical and bacteriological parameters for drinking water samples will be compared with IS: 10500 standard and mine discharge water samples will be compared with MoEF Schedule-VI standard. The methodology of analysis for drinking water and mine water samples are given below.

Table 6.4 Methodology of analysis for drinking water and industrial effluent

Parameters	Method of analysis	Detection Limit
Colour	Photometric	1
Odour	Physically	-
pH	Electro-metric	0.01
Taste	Physically	-
Turbidity	Photometric	0.1
Total Residual free chlorine	Volumetric (Titration)	0.04
Total Hardness	Volumetric (Titration)	0.5
Chlorides	Volumetric (Titration)	0.25
Dissolved solids	Gravimetric	0.1
Calcium	Volumetric (Titration)	0.02
Sulphate	Nephelometric	1
Arsenic	As-Kit	0.01
Mercury	AAS	0.001
Lead	AAS	0.05
Cadmium	AAS	0.01
Hexavalent Chromium	Photometric	0.01
Copper	AAS	0.02
Zinc	AAS	0.02
Selenium	Photometric	0.01

Parameters	Method of analysis	Detection Limit
Fluoride	Photometric	0.01
Phenolic Compounds	Extraction/Photometric	0.001
Manganese	AAS	0.05
Iron	AAS	0.05
Nitrate	Photometric	0.01
Alkalinity	Titration	0.5
Boron	Photometric	0.01
Most Probable Numbers (MPN)	Multiple tube fermentation technique	1
Dissolved Phosphate	Photometric	0.01
Free Ammonia	Photometric	0.02
Nickel	AAS	0.1
Sulphide	Photometric	0.01
Total Chromium	AAS	0.1
Total Kjeldahn Nitrogen (TKN)	Photometric	0.02

In addition to the general laboratory and analytical facilities, the following sampling and analytical equipment shall be used.

Noise Level:

Guidelines prescribed by the Director General, Mines & safety (DGMS) shall be complied with. The noise level meter capable of measuring equivalent sound pressure level shall be used for noise level measurement.

6.2.2 Frequency

A monitoring frequency for Air, Water, and Noise levels will be as per Standards of MoEF (Vide GSR 742 (E) dated 25..9.2000):

Table 6.5: Monitoring Frequency

Sl. No.	Particulars	Monitoring frequency
1.00	Ambient Air	Every fortnight.
2.00	Water	
2.01	Effluent and surface water	pH, Chemical Oxygen Demand, Total Suspended Solid, Oil & Grease at every fortnight and all parameters once in a

		year.
2.02	Drinking water	As per IS: 10500 once in a month.
3.00	Noise	Day and Night at every fortnight.

6.2.3 Location

Location of the monitoring station shall be selected in view of the site condition and site configuration of the project keeping the guidelines of MoEF and CPCB, New Delhi in to consideration

6.2.4 Data analysis

Data generated shall be planned to analysis keeping the guidelines of MoEF and CPCB, New Delhi in to consideration.

6.2.5 Reporting

Regular and periodic recording of the monitoring shall be planned. Monitoring data thus generated the reports will be submitted to SPCB by end of the following month.

6.2.6 Schedules

A comprehensive monitoring program is suggested underneath. Environmental attributes should be monitored. Location and frequency of monitoring as recommended in the consent conditions of CPCB has been considered in recommending the schedule.

A monitoring schedule for Air, Water, and Noise levels will be as per Standards of MOEF (Vide GSR 742 (E) dated 25.9.2000):

Table 6.6 Monitoring Schedule

Particulars	Parameters	Schedule
Ambient Air	SPM, RPM(PM ₁₀ & PM _{2.5}) SO ₂ , NO _x	At every fortnight.
Water		
Effluent & surface water	pH, Chemical Oxygen Demand, Total Suspended Solid, Oil & Grease	At every fortnight
Drinking water	All parameters	Quarterly
Noise	L _{eq} (dB)	Day and night at every fortnight
Plantation	Growth and survival/mortality rates of the plantations	Till the end of 3 years. Once trees attain desired growth, no further monitoring will be

		required.
Land Reclamation and Plantation	Delineation of the quantum of overburden to be excavated, backfilled, and the plantation schedules etc. Interaction with different Government Departments like Department of Agriculture, West Bengal State forest department, Forest Research Institute would give additional technical guidelines. Guidelines from State and Central Ministry of Environment and Forest will be obtained for effective implementation of EMP.	On regular scheduled planned action plan.
Health	Health of the workers and staff associated with the mining operations and other connected industrial activities for identifying occupational diseases etc.	Regular / Periodic health check-up and initiating remedial measures against diseases, and mobile health ambulance for health monitoring for periodic health check up of the industrial workers.

6.3 Emergency procedures

The term 'major accident' means an unexpected and sudden occurrence of event from abnormal developments in course of one's industrial activity leading to a serious danger to public or environment, whether immediate or delayed, inside or outside the installation involving one or more hazardous substances.

Keeping in view the three basic principles i.e. prevention, preparedness(both pro-active and reactive) and mitigation of effect through rescue, recovery, relief and rehabilitation, a comprehensive blue print of disaster management plan(DMP)is to be prepared for Karo Expansion OCP (11/15 MTPA normative/peak capacity & integrated non-coking coal Karo Washery (7 MTPA) B&K Area, Central Coalfields Limited incorporating the following:

- Identification and assessment of risks
- Recommendation of measures to prevent damage to life and property against such risks.

The emergency procedures have been discussed in Chapter VII

6.4 Detailed Budget

Financial Provision

SN	Particulars	Amount (Rs Lakh)
Pollution Control		
I.	Anti-pollution measures in mine & Industrial area	1142.28
II.	Anti-pollution measures in township	89.55
III.	Rain water harvesting scheme	20.00
Sub Total (1)		1251.83
Other Measures		
IV.	Cost of rehabilitation	1274.40
V.	Cost of compensatory afforestation	3477.83
VI.	Cost of restoration	10325.13
VII.	Others	129.85
VIII.	Compensation for non-forest land	1499.55
Sub Total (2)		16706.76
Grand Total (1+2)		17958.59

6.5 Evolving micro environmental management plan

The responsibility for implementing environmental management plan would rest with the project officer of the project, who would be properly assisted by a team of qualified and trained personnel. The organisation for environmental management in B & K area office will carry out the task and responsibility connected therewith.

The Co-ordinated Organisations are expected to safeguard the following aspects of environmental control.

Co-ordinated Organisation

Sl. No.	Particulars	Co-ordinated Organisation
1.	Compensation to land losers	General Manager, B&K Area , CCL
		Land Survey and Revenue Deptt. CCL(HQ)
		Representative from State Govt.
2.	Pollution Control Measures	General Manager, B&K Area , CCL
		Project Officer / Environmental cell, B&K Area , CCL
		Environmental Cell, CCL HQ
3.	Plantation/Green Belt Development	General Manager, B&K Area , CCL
		Project Officer/ Environmental cell, B&K Area , CCL
		Environmental Cell, CCL HQ

6.6 Monitoring project implementation along with environmental control measures

For effective implementation and mid-term corrective measures (if required) monitoring and control monitoring implementation is essential. For this purpose a time bound monitoring implementation plan for environmental management has been prepared.

The scope of environmental management includes plantation, surface drainage, industrial water treatment plant, air, water and noise pollution checks etc. For air, water and noise pollution control measures, samples will be collected and tested for all four seasons at strategic places representing all the categories of areas as indicated by CPCB, CMPDIL. The implementation authority should be guided and advised as per the feedback data from these tests. CMPDI may be consulted as and when necessary

6.7 Co-ordinate with other project activities to ensure timely implementation of the project

Organisations stated herein before shall co-ordinate with other departments / sub-departments responsible for carrying out other pertinent activities of the project so that implementation activities of the project do not interfere with each other and all the activities necessary for the project go along smoothly and without impediments for timely completion of the project.

6.8 Co-ordination with Ministry of Environment & Forest, Central / State Pollution Control Board for prevention and control of water and air pollution

The above mentioned organization will have regular and timely co-ordination with Ministry of Environment & Forest, Central / State Pollution Control Board for securing consent under prevention and control of water and air pollution acts so that the project is not hampered.

Chapter 7

Additional Studies

7.1 Public Consultation

The details of Public Hearing in respect of Karo Expansion OC (15 MTPA) and Integrated washery (07 MTPA) conducted on 05.01.2016 is as given below. The detailed report is enclosed as Annexure VII.

Table 7.1 Details of Public Hearing

A	Date of Advertisement	05.12.2015
B	Newspapers in which the advertisement appeared	Prabhat Khabar
C	Date of public hearing (DD/MM/YYYY)	05.01.2016
D	Public Hearing Panel chaired by & members present	Jugnu Minj, ADM Bokaro
		Kamalkanth Pathak, Junior Engineer, JSPCB
		Rajeev kumar Sinha, Junior Engineer, JSPCB
		Mithilesh Jha, Assistant Scientist, Ranchi, JSPCB
E	No. of people attended the public hearing meeting and number of people from the lease area.	171, About 50
F	Summary/details of public hearing in tabular form	

Table 7.2 Summary/ details of public hearing in tabular form.

SN	Name & Address	Issues raised by the Public	Response/Commitment of Project Proponents
1	Sri Bannu Mahto, Village - Baidkaro	Proposed karo washery falls under Palmu panchayat. Land verification work is pending. He requested for the quick verification work. He requested arrangement of drinking water, road, electricity etc.	Verification work is going on. Assurance for pure drinking water, road, electricity etc has been given.
2	Sri Hari Mahto, Panchayat representative, village - Palmu	The implementation of the provisions of the public hearing report should be properly done. Arrangement for drinking water, education, medical etc. for the villager should be done. Employment to local people should be given.	Provision made in the technical presentation should be taken care of. Arrangement for medical facility is being done in the hospital of CCL under CSR schemes. Arrangement for drinking water will be strengthen.

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3	Sri Ranjit Mahto, Village – Karo Basti	Repair work of the road of Karo should be done. Employment of the local people in the outsourced company should be increased.	Repair of the damaged road will be done. Outsource company has employed the local youth according to the requirement and the qualification of the youth. For more employment interaction with the outsource company will be done.
4	Sri Jhari lal Hasda, Village - Karo	The basic facility should be provided for the villagers of the Charakpaniya, Kuri, Palmu, Karo, Baidkaro etc.	Development work in the surrounding villages is being done with CSR & CD fund. The company is committed for providing basic facilities.
5	Sri Ashok Kumar, Ward member, No-6, Subhash nagar	The Project affected villagers should be give benefit. Top soil should be preserved. Preserved soil should be spread over reclaimed land after extraction of coal and the same land should be return to the villagers. Participation of the public representatives should be insured in the CSR meeting.	Identity card of the project affected villagers is being prepared for the villager who have not been given employment.
6	Sri Basant Rai Mukhiya, Village – Palmu	Development work should be done in the tribal dominated villages Barkikuri & Chotkikuri adjacent to the Project. Coal loading should be done manually and the villagers should be given priority in it. Technical education and training arrangement should be done for the youth.	Facilities for the villagers, adjacent to the Project, are being provided. Technical education and training arrangement has been done for the youth at CCL level.
7	Sri Ram charan turi Village – Amlo Basti	In village, land owner and landless people lives. Landless people depends on selling of leaves and datum from the jungle. Land owner should get employment.	All type of landowner and local unemployed people are given opportunity for job as per qualification.
8	Sri Pratap Singh, village - Karo	Many villagers are deprived of employment and other facilities due to late verification of gairmajuwa land. Verification work should be done fast. Few land are such that more than one claimant of ownership of land. Identification of right claimant of land will be done. Separate road for coal transportation from Karo Project should be constructed.	About 90 % of verification work of land owner is completed. Verification of GMK land is going on. Due to more than one claimant on few land created difficulty in identification of right claimant. It is carefully examined so that right owner of the land is identified.

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9	Sri Sanjay Bhokatha, ward member, No -4, Karo Basti	Basic facilities should be provided in ST dominated villages Bandukbera.	Development work nearby villages are being done by CCL through CSR and CD fund.
10	Srimati Chinta Devi, member of District Parisad, Kurpaniya	The land owner whose land was acquired do not move here and there. Total development of rural area should be done.	The land owner whose land is verified, they are being provided all facilities as per company provision. Overall development of rural area will be kept in mind.
11	Srimati Archana Singh, ward member, Kargali Bazar	All the works should be done as per given in public hearing document. Arrangement for cleaning, drinking water etc. should be done and representative of people shall be invited in the CSR meeting.	Commitment made during public hearing will be done in toto regarding pollution control.
12	Sri Prem kumar Mahto, Upperghat, Palmu	Focus should be given on providing drinking water, transport facilities and to reduce noise and air pollution. New pond should be constructed for use of irrigation and livestock. Old existing pond should be revive and check dam should be constructed. Review of the work performed under CSR fund should be done.	Development works viz. construction of pond and their revival, construction of wells and check dam are done under CSR fund in rural areas.
13	Sri Ganesh Mahto, Charakpaniya Basti	In absence of land record, one faces difficulty in the issue of residential and caste certificate. Issue of certificates for displaced persons is required for availing benefits.	Arrangement is being made for the issue of certificates for those displaced persons who have not been provided employment.
14	Sri Rameswar Mahto, Ward member, BaidKaro	Rural road should be connected to main road by metalling the rural road. Rabies injection should be made available in the dispensary.	All rural roads are being connected to main road. CCL in co-ordination with State Govt.
15	Sri Iswar Mahto, Baidkaro	Basic facilities should be provided to the villagers.	Basic facilities are being provided to the villagers.
16	Sri Isar Mahto, Karo Basti	Water of Karo Pond has becomes completely polluted. There is scarcity of drinking water for which arrangement should be done and verification of GM land should be done.	Arrangement for the drinking water has been made through pipe lines. Efforts are being made for expediting the work of verification of land.

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17	Sri Ram kisun Mahto, Village – barki Kuri	The name of Karo washery should be Barkikuri washery because the proposed washery will be commissioned on the land of Barkikuri. Electricity is available in the half of the village which should be extended to whole village. The paper of the land is submitted to B & K area since 2007. Verification should be done.	The name of any Project or Washery are recommended by DGMS, Proposed washery are recommended in the name of Karo washery.
18	Sri Jugal Kishore Mahto, Bermo Basti	The employment or compensation are not provided on the land acquired earlier. At present, the extension of Krishna Sudarshan central school is being done on raity land whose compensation are not paid.	All the paper related to this land may be deposited in the office. Action has been taken at the earliest.
19	Sri Amrit Mahto, Baidkaro East Panchayat	Washery should be made but 10 % ownership should be given to Rayat.	Service and compensations are provided to land loser as per land acquisition act and company rule.
20	Sri Abhay kumar sao, Ward no - 16	Implementation of the suggestions made in public hearing will ensure no grievance from anyone. Plantation should be done over reclaimed land after the mining is over.	Provisions made for pollution control measures should be adhered to. Provision for plantation over reclaimed land exists.
21	Sri Prakash kumar Mahto, Baidkaro Panchayat	What is provision of one employment against two acre land and who made this provision?	There is provision in Coal India for providing employment and compensation against two acre land.
22	Sri Jibu visvakarma, Karo Basti	Compensations are made to the land owner as the rate of 1984. Compensations should be made at present rate and the whole village should be rehabilitated altogether.	There is provision to take compensation with protest. Land owners can approach court for further justice.
23	Sri Mahendra kumar visvakarma, Subhashnagar	Standard of pollution in the project should be maintained. It should be kept in mind that the land owner gets maximum benefit.	Provisions made for control pollution should be implemented.
24	Sri Kamlesh Tiwari, Representative of Member of parliament, Subashnagar	Local people should be given preference in the employment in the proposed Coal Washery and in Project expansion so that local people may benefited along with Nation, government and the Coal company.	Arrangement for maximum employment of local people in the Company which is engaged in Construction of Coal washery and other works according to their qualifications.

7.2 Risk Management

Risk management is essential to guard against and mitigate consequences of major accidents. The term, " major accident " herein means an unexpected and sudden occurrence of an event or events from abnormal developments in course of one's industrial activity leading to a serious danger to public or environment, whether immediate or delayed; inside or outside, the installation involving one or more hazardous substances.

Keeping in view the three basic principles i.e. prevention, preparedness (both pro-active and reactive) and mitigation of the effect through rescue, recovery, relief and rehabilitation; a comprehensive blue print of the Risk Management Plan (RMP) has been prepared for Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA) incorporating the following:

1. Identification and assessment of risks
2. Recommendation of measures to prevent damage to life and property against such risks.

7.3 Safety Aspect Of Workmen & HEMM

Special precaution should be taken while deploying workers in the mine. Before employing any labour to the mine proper vocation training should be imparted and recommendations of VIIIth Safety Conference should be strictly followed. Some of the major aspects are as follows:-

A. FOR PERSONS

- I. No persons shall be deployed unless he is trained at VTC
- II. Records in Form-B Form-D shall be maintained.
- III. Records of Vocational training Certificate and driving license of operators shall be kept by competent authority and shall be made readily available for inspection by management.
- IV. No person shall be employed unless person holds VTC. A record of it shall be maintained.
- V. Adequate supervision shall be maintained by qualified competent persons only.

B. FOR MACHINERIES AS RECCOMENDED BY DGMS CIR. (TECH.) -1 OF 1999:

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- I. All the machineries to be deployed in mines should be checked before deployment by competent authority.
- II. A proper record of repair and maintenance along with inspection done by competent authority and defect pointed out shall be maintained and signed by authorized person.
- III. All the equipment shall be provided with audiovisual alarms, proper light for use at night and period.
- IV. When natural light is not sufficient an audio-visual alarms for reversing on trucks shall be provided.
- V. Machine manufacturers should be asked to give risk analysis details in respective machines deployed
- VI. Suitable type of the fire extinguishers shall be provided in every machine.

C. GENERAL

- I. No person/vehicle shall be deployed at any place other than authorized place.
- II. All workers should obey lawful instruction of mine management.
- III. Risk Management Plan of tipper/pay loader shall be made and implemented.
- IV. All drivers shall obey systematic traffics rules prepared by management
- V. Before deploying workers they must be trained and briefed about safety aspects in opencast mine. However during course of execution of the work, if any accident occurs whether major or minor, the matter shall have to be immediately informed to mine management i.e. Colliery Manager/Agent/GM of the Area so that notices of accidents in an accordance with (Reg.9 of CMR 1957) and Section 23 of The Mines Act 1952 may be given and other necessary steps may be taken in accordance with the Mines Act 1952.
- VI. Mine authority shall operate transport system in such a way so as to minimize pollution in the mine.

7.3.1 Slope failure in Mine Pit

The exposed ends of the coal seams and OB will be left with a safe slope to avoid slope failure and collapse of benches. Similarly, at the end of mining operations safe terminal pit slope will be provided to avoid failure.

All the working benches will be under the direct supervision of project level officials and all the necessary precautions will be taken to make the workings safe.

The pit design parameters enumerated in Table-7.3 have been adopted.

Table 7.3 Pit Design Parameters

Sl. No.	Particulars	Unit	Value
1.00	For Coal seams		
1.01	Bench Height(max)	m	15
1.02	Width	m	10 - 15
1.03	Slope	°	60 ⁰
2.00	For OB strata		
2.01	Maximum bench height	m	15
2.02	Working bench height	m	30
2.03	Non-working bench height	m	35
2.04	Bench slope	°	70 ⁰
3.00	OB dump		
3.01	Usual height of spoil dump bunch	m	30
3.02	Width of the active dump bench	m	60
3.03	Slope	°	37 ⁰

Dumping will be done either external or internal. It is suggested to level the dump and grade it properly to avoid water accumulation. The dump will be formed in tiers not exceeding 30m heights each. The slope will be equivalent to the angle of repose i.e. 35-37⁰.

7.3.2 Blasting

For proper blasting and minimising the adverse side effects due to blasting viz noise ground vibration back-breaks, air blast, fly rocks etc. precautions given as in Table-7.2 have been suggested to avoid dangerous situation:

Table 7.4 Precautions suggested

Sl. No.	Precautions suggested
1	The optimal blast design parameters will be implemented.
2	A safety zone of 100m beyond the quarry limit is envisaged and controlled blasting will be done keeping this aspect in mind
3	The blasting will be done at a fixed time as far as possible.
4	All necessary precautions will be taken while blasting.
5	Regular monitoring of vibration will be carried out and necessary precautions will be taken while blasting.
6	Before blasting is done, warning siren will be activated so that people can move over to safe places.
7	Arrangements will be made to alert the people working for sudden inrush of water by accidental development of fracture connecting the working place to the water

	bodies/aquifer.
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7.3.3 Explosive Handling

Adherence to relevant statutory safety provisions as stipulated by DGMS, Chief Controller of Explosives and others will be made.

7.3.4 Mine inundation

The mine pit will receive water from three sources namely, direct precipitation over excavated area, surface run-off from the surrounding area and seepage from the strata. During the heavy rainstorms, there may be a situation when the mine may get flooded due to ingress of water from the higher ground through natural drainage. This may cause loss of human life, equipment etc. To guard against this eventuality, the following steps given as in Table-7.3 will be taken.

Table 7.5 Precautionary measures

Sl. No.	Precautionary measures
1	Provision of garland drain around the mine to prevent ingress of precipitation, run off & keeping the same.
2	Provision of sufficient number of pumps to pump out mine water during the critical rainfall period.
3	Precaution against danger from local stream.

7.3.5 Fire

Accidental fires are the causes of large-scale loss of property and life. Keeping this in view, adequate fire fighting arrangement has been made. Adequate numbers of fire extinguishers have been provided for store and other service buildings. While calculating total water demand for the project, provision for fire fighting has also been made.

To prevent and control the fires at coal faces and coal stockyards, the measures suggested with respect to fires in Chapter-IV will be adopted. In case of dispersion of hot ashes and dust following water gas explosion, venting of hot steam after rains or siding of burning material during shovelling operation, the workers will be informed in advance so that they can run for cover below nearest earth moving machinery such as dumpers, shovels, dozers, etc. or inside the cabins of these machinery. Regular mock rehearsal for taking shelter in emergency situation will be done.

7.3.6 Precautions to be taken during mining operation due to existing UG workings and probable break out of fire:

- a. Quarry shall be worked by Heavy Earth Moving Machinery only. No manual operation in the quarry will be done.
- b. Exposed coal faces (including UG galleries) shall be kept covered with fine grained incombustible OB material to prevent breathing of air and control fire
- c. Overburden containing carbonaceous material shall not be dumped within 30m of the exposed side of the coal benches. Hot overburden shall be quenched and cooled at dump sites.
- d. Except for the purpose of inspection and support work no person shall be allowed in the underground mine beneath and within 200 m of the opencast excavation. The person visiting UG will take all safety precautions for safe working.
- e. Blasting in fire area**
 - I. No explosive other than slurry and emulsion explosive shall be used.
 - II. Blasting shall be done with detonating fuse down the hole. Fresh drill holes should be tightly plugged at the mouth.
 - III. Temperature inside the hole shall be measured by Bi-Metallic thermocouple heat sensor (before filling with water) and if the temperature exceeds 80°C in any hole the hole will not be charged.
 - IV. All blast holes shall be kept filled with water. When any hole is traversed by cracks or fissures the hole shall not be charged unless it is lined with an asbestos pipe and the hole filled with water. In addition, bentonite should be used for sealing any cracks at the bottom of the hole.
 - V. Detonating fuse shall not be laid on hot ground without taking suitable precautions.
 - VI. Charging and firing of holes in any one round shall be expeditiously completed and in any case within 2 hours.
 - VII. Effective muffling of hot shot holes with old wire rope screens shall be done for prevention of flying hot fragments.
 - VIII. No blasting shall be done in crushed or broken ground.
 - IX. No person shall be employed within 150m when blasting the heated material.

- X. The spacing of hole in the coal/OB benches lying immediately above the galleries shall be so adjusted that the holes do not lie immediately above the galleries in order to ensure that blast holes do not directly fire into the underground working.
- XI. No person including a shot firer shall take shelter within 100m of the quarry opening. Such shelter shall be of an approved design.

7.3.7 PROTECTION OF EQUIPMENT DEPLOYED AT BOTTOM HORIZONS FROM FLOODING

During the heavy monsoon period, the mining operation in the lower-most bench may have to be stopped. Therefore, it is proposed to drown the lower-most bench, which would work as a sump. The water will be pumped out and discharged into the nearby nala/River.

For ensuring safety of the equipment while working out bottom horizons with no access to surface profile, the following measures should be taken:

- (a) Drivage of initial trenches if any and coal cutting on bottom benches should be done during the dry period of the year.
- (b) Ramps should be made for quick shifting of equipment from bottom horizons, liable to be flooded during monsoon period, to the top horizons.

7.3.8 SAFETY MEASURES FOR WORKING OVER DEVELOPED COAL SEAMS

- (a) For deployment and movement of HEMM minimum solid parting of 3m must be ensured over developed workings which should be mined by Hydraulic Backhoe as far as possible.
- (b) Accurate survey plan of development workings must be prepared for safe operation of the HEMM.
- (c) Precautions laid down by DGMS (Tech. 3/1980 & 4/1983) to prevent coal dust explosion and subsequent fire in underground due to blow through shots shall be adhered to.

7.3.9 PREVENTION OF ELECTRIC SHOCKS

During mining operations, all the statutory provisions of the Indian Electricity Rules 1956, and Indian Standards for installation and maintenance of electrical equipment etc. should be observed.

- (a) For protection from electric shocks to persons, all electrical equipment with voltage up to 1000V should be provided with Earth Leakage Relay, which will automatically disconnect electrical circuits.
- (b) Closed mobile substations and switchgears should be mechanically interlocked which exclude the possibility of opening the door when oil switch and air circuit breakers are in operation.
- (c) All metal parts of electrical equipment should be properly earthed to avoid failure of insulation.
- (d) All H.T lines and cables located within the blasting zones should be disconnected during charging & blasting operations.

7.3.10 DUST SUPPRESSION & DILUTION OF EXHAUST FUMES

The following measures should be adopted for dust suppression at all quarry working places, dumps, haul roads, CHP and near other auxiliary mining operations.

- (a) Spraying with water on all working faces & haul roads, by special spraying machines or water-sprinkler.
- (b) While drilling holes, it is necessary to use dust extraction devices.
- (c) Installation of local dust suppression and air conditioning devices in cabins of excavators and drilling rigs may be considered.
- (d) Leveling of spoil dump surface.
- (e) Separate dust suppression arrangement should be provided for CHP.

To prevent collection of harmful mixtures in the atmosphere, from the different sections of quarry workings, it is recommended:-

To spread out the sources of dust formation and omission of harmful gases throughout the working area of the quarry.

- (a) Drilling & blasting operations should be timed for periods of maximum wind activity during the day.
- (b) Dumpers may be provided with purifiers for exhaust gases.

7.3.11 MEASURES TO BE TAKEN FOR FIRE FIGHTING & FIRE PREVENTION

In addition to statutory provisions, the measures for firefighting and prevention of fires are as follows:

- (a) Organization of special cell for systematic observations to examine and prevent fire.
- (b) Removal of spillage of coal on benches and cleaning of coal horizons to prevent cases of coal heating.
- (c) Storage of lubricants and cotton waste in enclosed fireproof containers in working places.
- (d) Provision of fire extinguishers

7.3.12 Road Accidents

Sufficient arrangements for illumination of road including haul roads will be undertaken. Properly planned and designed road crossing will be implemented to prevent vehicular accidents. Further haul roads have been planned in such a way that the HEMM traffic will be away from the passenger traffic. These are likely to prevent road accidents. All the dumpers are fitted with sound warning while reversing, thereby preventing accident.

7.3.13 Medical Preparedness

For guarding against accidental hazards the following measures tabulated in Table-7.4 will be taken:

Table 7.6 Mitigation Measures.

Sl. No.	Preventive Measures against accidental hazards
1	Emergency Ambulance Service will be kept ready on a 24 hour basis.
2	Doctor and paramedical staff will be made ready during emergency.
3	First Aid Medical facilities will be provided at work place.

The existing and nearby mine has already been provided with a dispensary with qualified doctors in addition to a first aid centre. These will meet the medical emergencies arising out of the accidents.

7.3.14 Other Miscellaneous Measures

- Proper illumination in the quarry, OB dump area, workshop and other workplaces besides roads will be undertaken as mentioned above.
- Efficient communication system to allow communication link amongst various work centres to help in avoiding accidents and handling of emergencies.
- Fire alarm and fire fighting system will be provided at project site.

The adoption of preventive measures as enumerated above will ensure that the operation of this project will be safe as well as environment friendly.

7.4 Natural Resource Conservation

Conservation of coal enjoins maximum recovery of in-situ reserves of coal and its proper utilization. Coal deposits in Karo OC mine block seams upto Seam-VI/VII/VIII combined are potential seams for opencast mining, both qualitatively and quantitatively. These aspects are taken into account during mine planning and operation in ensuring maximum recovery. Opencast mining using Surface Miner is one of the very important technologies of coal production of thick or even thin seams from shallow depth.

Suitable measures should be taken to minimize coal loss during mining operations. Selective mining of in-seam dirt band has been proposed. It is proposed not to dump any spoil material over coal bearing area, amenable for mining, at present or even at a future date.

7.5 Social Impact Assessment, R & R Action plan

7.5.1 Social Impact Assessment

Main ingredients of Social impact

Detailed assessment with respect to social impact has been given as in Chapter –IV herein before. However, main ingredients thereto are paraphrased below in Table-7.5.

Following social impacts are expatiated below:

Table 7.7 Social Impacts

Sl.No.	Main ingredients of Social impact
1	Population Growth & In-migration
2	Human Settlement & Resettlement / Rehabilitation
3	Transport & Communication
4	Income & Employment
5	Civic Amenities& Community Development
6	Educational facilities & Literacy Drive
7	Economic growth
8	Growth of Financial Revenues- State & Central
9	Social status growth

Secondary Employment opportunities

There will be spontaneous economic stimulus in the area with the commencement of opencast patch. Some traders and private enterprises will grow in the area with this economic growth. Besides, the State exchequer will derive financial revenues through levy of royalty, sales tax etc. and Central Government will also be benefited by way of Central Sales Tax, Income Tax, Cesses etc.

Educational Facilities

There are several educational institutions of various standards managed by public and private sectors/bodies in the area due to CCL.

Medical Facilities

There are nos. of maternity & child welfare centers and community health workers managed by the State Govt. taking care of the population in the study area. CCL provides the facility of dispensaries at project level and hospitals at Area level and a central hospital exists at company headquarter.

Immunization facilities are also available at every colliery hospital and dispensary. The family planning Camps are held regularly at the hospitals/dispensaries.

Every worker is periodically checked up once in every five years and proper record of their health profile including X-ray and laboratory tests are kept. The importance of such periodical medical examination is to detect and prevent occupational diseases like Pneumoconiosis and Tuberculosis etc.

The mining activities expose workers to some injuries and health hazards. Incidents of occupational disease and injuries and health hazards as recorded in the hospital for employees in B & K area are almost negligible.

Preventive measures

The CCL authorities have adopted the following measures to prevent occupational diseases and health hazards.

- Pre-employment, pre-placement and periodic medical examination of the employees.
- Regular monitoring of working environment and implementation of safety and control measures, to prevent hazards.
- Use of protective equipments, clothing, helmets, Gas mask, shoes, etc.
- Periodical medical examination of every worker is done once in five years to detect preventable and curable diseases at an early stage.
- Cases suspected having Pneumoconiosis are examined by a Special Board constituted by the Chief Medical Officer. Established cases are suitably compensated and their job is changed if required.

7.6 Socio-economic Control Measures

7.6.1 Corporate Social Responsibility (CSR)

CIL's CSR policy is framed after incorporating the features of the Companies Act 2013 and as per notification issued by Ministry of Corporate Affairs, Govt. of India on 27.02.2014 as well as DPEs guidelines and broadly covers the following: -

- Welfare measures for the community at large, so as to ensure the poorer section of the Society derived the maximum benefits.
- Contribution to the society at large by way of social and cultural development, imparting education, training and social awareness especially with regard to the economically backward class for their development and generation of income to avoid any liability of employment.
- Protection and safeguard of environment and maintaining ecological balance.

OBJECTIVE

The main objective of CSR policy is to lay down guidelines for the coal companies to make CSR a key business process for sustainable development for the Society. It aims at supplementing the role of the Govt. in enhancing welfare measures of the society based on the immediate and long term social and environmental consequences of their activities. CIL will act as a good Corporate Citizen, subscribing to the principles of Global Compact for implementation.

AREAS TO BE COVERED

The poor and needy Section of the Society living in different parts of India would normally be covered. The CSR Programme will also cover the existing components of Special Corporate Plan (SCP) and Tribal Sub Plan (TSP) for development of the SC and ST population besides development components for the entire population.

In respect of Subsidiary Companies of CIL, for carrying out CSR activities, 80% of the budgeted amount should be spent within the radius of 25 Km of the Project Site/Mines/Area HQ/Company HQ and 20% of the budget would be spent within the State/States in which the subsidiary companies are operating.

In respect of CIL (HQ), CSR should be broadly executed on All India basis including the areas under Subsidiary Companies.

CIL (HQ) being a Holding Company shall also execute CSR activities for supporting the subsidiaries.

In case CSR budget of any subsidiary company is exhausted, the concerned CMD of that company may refer the particular CSR activity/ project/programme to CIL which are considered to be emergent/important by the concerned CMD.

ALLOCATION OF FUND

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

SCOPE

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

- Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation and making available safe drinking water.
- Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently abled and livelihood enhancement projects;
- Promoting gender equality, empowering women, setting up homes and hostels for women and orphans, setting up old age homes, day care centres and such other facilities for senior citizens and measures for reducing inequalities faced by socially and economically backward groups;
- 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;
- 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;
- Measures for the benefit of armed forces veterans, war widows and their dependents
- Training to promote rural sports, nationally recognized sports, Paralympics sports and Olympic sports;
- 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;
- Contributions or funds provided to technology incubators located within academic institutions which are approved by the Central Government;
- Rural development projects etc.

Implementation:

- The investment in CSR should be project based and for every project time framed periodic mile stones should be finalized at the outset.
- Project activities identified under CSR are to be implemented by Specialized Agencies. Specialized Agencies could be made to work singly or in tandem with other agencies. Specialized agencies would include:
 - Community based organization whether formal or informal.
 - Elected local bodies such as Panchayats
 - Voluntary Agencies (NGOs)
 - Institutes/Academic Organizations
 - Trusts, Mission etc.
 - Self-help groups

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- Government, Semi --Government and autonomous Organizations.
- Standing Conference of Public Enterprises (SCOPE)
- Mahila Mondals/Samitis and the like
- Contracted agencies for civil works
- Professional Consultancy Organization etc.

Activities related to Sustainable Development will form a significant element of the total initiatives of CSR. Such activities should come under the 3 UN Global Compact Principles pertaining to the Environment Business are asked to

- Support a precautionary approach to environmental challenges
- Undertake initiatives to promote greater environmental responsibility and
- Encourage the development and diffusion of environmentally friendly technologies.

UPKEEP AND MAINTENANCE OF ASSETS CREATED:

Maintenance of Assets created under CSR would be the Responsibility of the concerned State Government, local representative of the Society and concerned Non-Government Organization (NGO) through which the CSR activities are implemented and an undertaking/consent would also be taken.

7.7 Action Plan for CSR

Normative Capacity of the Karo OCP is 11.00 MT. The fund for the CSR should be allocated based on 2% of the average net profit of the Company for the three immediate preceding financial years or Rs. 2.00 per Tonne of Coal Production of previous year whichever is higher. An amount to the tune of Rs. **22000000.00/-** per annum will be used for the CSR works per year.

Table 7.8 Proposed Expenditure Towards CSR

Sl. No	HEAD OF WORKS	CSR expenditure to be done per year in Rs.				
		2018-19	2019-20	2020-21	2021-22	2022-23
1	Education facilities including grant of schools, providing education kits, running of schools etc.	5940000	5940000	5940000	5940000	5940000
2	Water Supply and rain water harvesting works, wells, ponds, hand pumps and tube wells	4840000	4840000	4840000	4840000	4840000
3	Health Care and vaccination, awareness camp, mobile medical camp, Immunisation, medicine etc.	3300000	3300000	3300000	3300000	3300000
4	Environment Protection i.e plantation etc.	1320000	1320000	1320000	1320000	1320000

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5	Social Empowerment like Community centre, Literacy drive, shopping complex.	1540000	1540000	1540000	1540000	1540000
6	Infrastructure Development like road, bridge, repairing of school, drains, electric line etc.	3080000	3080000	3080000	3080000	3080000
7	Sports Culture like village stadium village stadium, grant to village sports body, organizing sports meet	440000	440000	440000	440000	440000
8	Grant to NGO for community development	660000	660000	660000	660000	660000
9	Miscellaneous welfare for adopted villages	880000	880000	880000	880000	880000
	TOTAL	22000000.00	22000000.00	22000000.00	22000000.00	22000000.00

Chapter 8

Project Benefits

8.1 Introduction

The setting up of mines has already brought changes in the living standards and quality of life of people in and around the mines by providing direct and indirect employment opportunities and through various welfare measures undertaken by CCL. Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA), B&K Area, Central Coalfields Limited will continue to enhance the socio-economic activities in the adjoining areas. This will result in following benefits:

- Improvements in physical infrastructure
- Improvements in social infrastructure and quality of life of people
- Increase in employment potential
- Contribution to the exchequer
- Prevention of illegal mining
- Post-mining enhancement of green cover and eco-restoration

The project benefits are summarized here under:

8.2 Improvements In Physical Infrastructure & Community Development

The existing mines have improved and will continue to improve the physical infrastructure of the adjoining areas. This would include the following:

- Improved road communication due to Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA)
- Strengthening of existing community facilities through the Community Development Program of CCL.
- Greater availability of good quality power grade coal will result in enhanced power generation to meet the energy demand of the society.
- Pumping of mine water may augment the water availability after due treatment
- Gainful post-mining land utilization of mine lease area.
- Creation of community assets (infrastructure) like provision for drinking water, construction of school buildings, check dams, village roads / linked roads & culverts, dispensary & health centres, community centres, market place *etc.*

- Skill development & capacity building like vocational training, income generation programs, and entrepreneurship development program.
- Literacy program, adult education, assist formation of Village Working Group (VWG), Mahila Mandali *etc.*
- Awareness program and community activities, like health camps, medical aides, family welfare camps, AIDS awareness program, immunization camp, sports & cultural activities, plantation *etc.*

The above list is illustrative and not exhaustive. The activities will be village specific depending on the need assessed for the people. As far as possible, efforts will be made to co-ordinate with similar developmental programs that are taken up by the central or state Govt. in the areas of Coal India Limited. All activities under the CSR program should be environment friendly and socially acceptable to the local people.

8.3 Improvements In Social Infrastructure And Quality Of Life Of People

There would be some obvious changes in various environmental parameters due to mining activity, increased economic activities, creation of new employment opportunities, infra-structural development, better educational and health facilities. Following are the specific impacts.

a. Socio-economic

Overall there will be positive impact in socio-economic area due to increased economic activities, creation of new employment opportunities, infra-structural development and better educational and health facilities. The impact in the Core Zone and Buffer Zone is due to the following-

I. Population Dynamics

Due to direct and indirect employment potential, there is scope of migration of people into project area and in the peripheral regions, from nearby areas Mining activities, acceleration of the economic activities and urbanisation along with creation of new employment opportunities and bussiness may change the population dynamics of the area.

II. Standard of Living

The people will come in contact with migrated people. This may encourage higher aspirations among the people of the area. Accelerated economic activities and urbanization may increase quality of life and standard of living.

b. Water Supply

I. Potable Drinking with Deep bore-well & water Service Reservoir

Bore-well including submersible pump, GI connections up to Water Service Reservoir (RCC Overhead tanks for domestic as well as industrial purpose), Ground Water Service Reservoir, Clear Water Pumps, Pump house are provided in the

project. These are improved benefits in the line of safe drinking water facility in the project.

II. Planned water supply distribution system

For water distribution system in the project, 80 -100 mm water supply pipe lines (External water supply system) are provided in the project for facilitating improved benefits of safe drinking water to the people of the project and its vicinity.

c. Health Care facilities

CCL will undertake awareness program and community activities, like health camps, medical aides, family welfare camps, AIDS awareness program, immunization camp *etc.*

Immunization facilities are also available at every colliery hospital and dispensary. The family planning Camps are held regularly at the hospitals/dispensaries.

Every worker is periodically checked up once in every five years and proper record of their health profile including X-ray and laboratory tests is kept.

8.4 Employment Potential

There is a possibility of creation of direct and indirect employment opportunities due to working of Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA). Overall this will have positive impact on socio-economic profile of the area. CCL will also undertake skill development & capacity building programs like vocational training, income generation and entrepreneurship development.

8.5 Other Tangible Benefits

Continuing and augmentation of coal production from Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA) of CCL will help to bridge the gap of demand and supply of superior power grade coal in India. To meet the growing demand of coal, especially in power sector, sponge iron sector and brick and other small-scale sectors, the production of coal from the mines is of utmost importance. The project will also contribute to the exchequer of State and Central Government.

8.6 Enhancement of Green Cover.

8.6.1 Roadside plantation

Plantation along both the edges of the roads are planted in the project. This will enhance ecological condition of the area apart from scenic greenery. A green belt of adequate width on either sides of the haul road would be raised and the existing vegetation protected.

8.6.2 Biological reclamation on dumps

Biological Reclamation of internal dump and external dump, and green belt development in other vacant areas will improve the ecological balance of the area.

Plantation in the project area of Karo Expansion OCP (15 MTPA) & integrated non-coking coal Karo Washery (7 MTPA) is proposed around roads, railway sidings, external dumps and barren land etc. Plantation will be also done around washery premises in 20 m width. This effort by project authorities will help in enhancement of green cover in Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA) and eco-restoration of degraded land. The local varieties of plant species will be used for enhancement of green cover and eco-restoration.

8.7 Other Benefits:

To Power Plants using Washed Coal:

- Increased generation efficiency, mainly due to the energy loss as inert material passes through the combustion process.
- Increased plant availability.
- Reduced investment cost.
- Reduced operation & maintenance cost due to less wear and reduced cost for fuel and ash handling.
- Energy conservation in the transportation sector and lower transportation costs.
- Less impurities and improved coal quality.
- Reduced load in the air pollution control system.
- Reduction in the amount of solid waste that has to be disposed off
- Reduction in the generation of fly ash quantity at the user point by using washed coal in place of coal
- Revenue contribution to government/local bodies and local area development activities

8.8 Corporate Social Responsibility

The Mines of Coal India and its subsidiaries are located in different parts of the country spread in 8 States, and relatively in isolated areas with little contact to the outside society. Mining of coal has profound impact on the people living in and around the areas where the mines are established. The obvious impact of the introduction of any production activity in such areas change the traditional lifestyle of the original inhabitants and indigenous

communities and also change the socio-economic profile of the area. Hence, the primary beneficiaries of CSR should be land oustees, PAP and those staying within the radius of 25 Kms of the Project. Poor and needy section of the society living in different parts of India should be second beneficiaries.

CIL's CSR policy is framed after incorporating the features of the Companies Act 2013 and as per notification issued by Ministry of Corporate Affairs, Govt. of India on 27.02.2014 as well as DPEs guidelines and broadly covers the following: -

- Welfare measures for the community at large, so as to ensure the poorer section of the Society derived the maximum benefits.
- Contribution to the society at large by way of social and cultural development, imparting education, training and social awareness specially with regard to the economically backward class for their development and generation of income to avoid any liability of employment.
- Protection and safeguard of environment and maintaining ecological balance.

8.8.1 Scope of CSR:

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

- a. Eradicating hunger, poverty and malnutrition, promoting preventive health care and sanitation and making available safe drinking water.
- b. Promoting education, including special education and employment enhancing vocation skills especially among children, women, elderly, and differently abled and livelihood enhancement projects;
- c. Promoting gender equality, empowering women, setting up homes and hostels for women and orphans, setting up old age homes, day care centres and such other facilities for senior citizens and measures for reducing inequalities faced by socially and economically backward groups;
- d. 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;
- e. 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;
- f. Measures for the benefit of armed forces veterans, war widows and their dependents
- g. Training to promote rural sports, nationally recognized sports, Paralympics sports and Olympic sports;

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- h. 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;
- i. Contributions or funds provided to technology incubators located within academic institutions which are approved by the Central Government;
- j. Rural development projects

8.8.2 Source of fund

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

8.8.3 Upkeep and maintenance of assets created

Responsibility of the concerned State Govt and the local representative of the Society before any capital investment is made, an undertaking would be taken from the representatives of the local community that they would be responsible for the maintenance of the assets.

Table 8.1: Expenditure towards CSR

Sectorial Year-wise CSR Expenditure (Rs Lakh) of B&K Area, CCL								
SN	Sector	2013-14	2014-15	2015-16	2016-17	2016-17 Addl.	2017-18	Total
1	Drinking water	16.63	28.59	9.61	22.55	84.20	114.00	275.58
2	Education	40.30	48.59	8.76	0.00	0.00	17.00	114.65
3	Infrastructure	105.98	108.01	32.50	0.00	0.00	0.00	246.49
4	Sanitation	3.47	0.00	3.25	40.43	0.00	19.00	66.15
5	Sports	5.20	5.21	1.82	0.00	0.00	0.00	12.23
6	Environment	0.00	12.01	76.21	9.69	0.00	17.00	114.91
7	Medical	0.00	8.94	4.19	22.40	0.00	0.00	35.53
8	Skill Development	0.00	0.00	3.89	15.15	21.50	1.50	42.04
9	Miscellaneous	0.00	12.95	16.80	0.00	0.00	20.30	50.05
Total		171.58	224.3	157.03	110.26	105.66	188.80	957.63

8.8.4 Some of the Photographs of CSR work done by B & K area, CCL is give below:



Fig. 8.3



Fig. 8.4

Chapter 9

Environmental Cost Benefit Analysis

MOEF while issuing TOR has not specifically indicated for carrying out "Cost Benefit analysis" hence, the same has not been carried out.

Chapter 10

Environment Management Plan

10.1 General

The implementation and monitoring of pollution control measures and for overall environmental management, environmental cell at the area and corporate level will take all necessary care. It will look after the following aspects of environmental management.

- * Generation of environmental data bank.
- * Evolving micro environmental management plan for the project in collaboration with other agencies and consultants.
- * Monitoring project implementation along with environmental control measures.
- * Co-ordinate with other project activities to ensure timely implementation of the project.
- * Co-ordination with Ministry of Environment & Forest, Central/State Pollution Control Board for prevention and control of water and air pollution.

This organisation will be responsible for:

- * Implementation of environmental control and protection measures and
- * Monitoring of the implementation system.

10.2 Implementing Organisation

The responsibility for implementing environmental management plan would rest with the project officer of the project, who would be properly assisted by team of qualified and trained personnel. Organisation for environmental management in B & K area office will carry out the task and responsibility connected therewith.

The Co-ordinated Organisations are expected to safeguard the following aspects of environmental control.

10.2.1 Compensation to land losers

- * General Manager, B & K Area
- * Project Officers, of Karo OCP.
- * Land Survey and Revenue Deptt. CCL(HQ)
- * Representative from State Govt

10.2.2 Pollution Control Measures

- * General Manager, B & K Area
- * Project Officer/Environmental Cell, Karo OCP
- * Environmental Cell, CCL HQ

10.2.3 Plantation/Green Belt Development

- * General Manager, B & K Area
- * Project Officer/Environmental Cell, Karo OCP
- * Environmental Cell, CCL(HQ)

10.2.4 Land Restoration

- * General Manager, B & K Area
- * Project Officer/Environmental Cell, Karo OCP
- * Environmental Cell, CCL(HQ)

An organisation chart showing the hierarchical levels for environmental control is give in **Figure – 10.1.**

10.3 Environment Management Plan :

10.3.1 Rehabilitation & Resettlement plan

Karo Basti is located within Quarry I. It has been estimated that about 360 project affected families (PAF) will be affected with advancement of this mine. These PAF'S would be rehabilitated in initial stage of mine operation to achieve targeted production.

DETAIL OF HOMESTEAD SHIFTING

Table 10.1 detail of homestead shifting

SN	Name of the Village	No. of families	Number of families with year of shifting				Compensation (Rs. Lakh)
			2019-20	2020-21	2021-22	2022-23	
1	Amlo Village	243	60	60	60	63	860.22
	Amlo Basti	189	47	47	47	48	669.06
	Muslim Tola	54	13	13	13	15	191.16
2	Karo Village	117	29	29	29	30	414.18

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Karo Basti	59	15	15	15	14	208.86
Karo Purana Colony	58	14	14	14	16	205.32
Total	360	89	89	89	93	1274.40

NOTE:

- Proposed rehabilitation site is situated near Hindustan Bridge, south of Hathia Pathar & Damodar river. Area of site is 51.53 Acre, at a distance of about 8-9 km from project.

DETAIL OF EMPLOYMENT TO LAND LOSERS

Table 10.2 Detail of employment to land losers

SN	Name of Village	No. of families	Estimated employment to land losers
1	Amlo Village	243	89 jobs to land losers
	Amlo Basti	189	
	Muslim Tola	54	
2	Karo Village	117	43 jobs to land losers
	Karo Basti	59	
	Karo Purana Colony	58	
Total		360	133

NOTE: Till date, 113 land losers have already been provided employment against tenancy land apart from cash compensation of Rs 58.85 Lakh.

10.3.2 Pollution Control Measures

Control measures for air pollution:

Appropriate mitigative measures shall be taken to contain the predicted level within prescribed level. These measures (both preventive and suppressive) are enumerated below:

⊛ **Loading and transport**

- Suppression of coal dust during coal handling by fixed sprinklers. Minimization of the height of coal-fall at transfer points to reduce the dust generation.
- Coal transportation is proposed through closed conveyor belt.

S No.	Products	Starting Point	Transportation by	Distance (Approx.)	Destination point
1.	Raw Coal	Mine Site	Covered conveyor	6.5km	Washery

2.	Washed Coal	Washery Premises	covered conveyors to the Kargali Washery Railway siding	6.5 km	Rapid Loading System (3600/5500 tph)
3.	Coal Reject	Washery Premises	Covered conveyor	200 m	Temporary Reject Storage Site

- Greenbelts around industrial sites, service building area besides avenue plantation along roads.
- Regular water spraying at haul roads and transfer points. For this purpose, fixed water sprinklers and movable sprinklers will be installed.

⊗ **Fires at coalfaces, coal stockyards**

(c) At coal faces

To prevent and control such fires, the following measures will be taken:

- Exposures of coal benches for long time will be avoided.
- Provision of adequate fire-fighting arrangements including storage of sufficient quantity of water at all critical points.
- Regular supervision.

(d) At coal stockyards

- Limiting the amount of stock by giving close attention to marketing besides following the "first-in and first-out" sequence.
- Attention to the following while stacking of coal:
 - Proper dimensions of stack (height to be limited to not more than 8m).
 - Dozing/compaction to make the stock semi-consolidated.
 - Regular and strict supervision of stacks.
 - Provision of fire-fighting arrangement with supply of adequate quantity of water at sufficient pressure.

⊗ **Mitigation Measures at Washery and crushing units**

Sl. No.	Identified Source of Fugitive Emission	Planned Mitigation
1	Receiving Hopper	Enclosure and Sprinkling
2	Surge Hopper	Enclosure and Sprinkling
3	Crushing / Dry Screening	Dust Extraction System / Sprinkling
4	Coal Stock Yard	Sprinkling
5	Washing (Wet Process)	Coal washing is wet process, hence does not generate fugitive emission
6	Washed Coal Stock	
7	Rejects Stock	
8	Belt Conveyors	Covered Conveyor, green belt

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- Dust suppression within the washery shall be done by sprinkling of water.
- Monitoring the condition of transfer chutes and skirt boards and replacing/repairing shall be done on regular basis during the normal inspection by the concerned persons along with the sectional heads.
- Water spraying for dust suppression at temporary storage site for reject shall be done regularly.
- Road inside the plant shall be paved to minimize the dust due to vehicle movement.
- To minimize the generation of fugitive dust in conveyance of washery products following arrangements have been made:
- Green belt area of 1.45 Ha in and around the washery site including around the conveyor, vacant places shall be developed to control dust emission.
- Efforts for good housekeeping will minimize dust nuisance within the plant premises.
- The crushers/pulverizers of the coal washeries shall be provided with enclosures fitted with suitable air pollution control measures.
- Water spray arrangements shall be provided at all strategic coal transfer points, enclosures for conveyors etc.

Water management:

a) **Management of surface water drainage:-**

Garland drains will be made around the periphery of the quarry. These drains will be connected to the local nalla, which is not likely to be disturbed by mining operation. In the workings, heavy duty pumps will be deployed which will throw the accumulated water from the working face through settling tank into these garland drains. For treatment prior to discharge effluent will pass through Oil & Grease traps & sedimentation tanks/ ponds.

b) **Mine Water Discharge & Industrial Effluent**

The mine waste water is collected in the sedimentation pond where suspended solids get settled. The clear water after sedimentation is reused for water sprinkling, plantation etc.

c) **Domestic Effluent Treatment:-**

Domestic effluent from the colony is treated in a Sewage treatment Plant (STP).

d) **Water Conservation:-**

The waste water recycling after due treatment for the purpose mentioned above will enable conservation of water. Storage of conserved water in mine pits will be

given due emphasis to provide water round the year and quality of water will be maintained before and after storage.

e) **Control Measures Adopted against impact on ground water regime:-**

I. CONSERVATION MEASURES

- The mine discharge will be effectively utilize to meet the mine's domestic and industrial needs. The entire industrial demand including washery and domestic demand is proposed to be fulfilled from mine discharge.
- To increase the source availability, Hand pumps and in some places piped water supply will be provided nearby villages.
- No excess mine water is being discharged to nala/river. All the mine seepage water collected at the sump is being utilised for industrial and water harvesting purposes.
- The proposed washery will work on closed water circuit system. So no effluent will be generated.
- mine water will be treated through filter plant and supply for the domestic purposes.
- Supply of domestic water to nearby area such as Kargali Bazar, Gandhi Nagar, Jawahar Nagar, Subhas Nagar, Kurukpania Village, Bermo Colony, Ghutia Tand Village, Ram Nagar Colony etc.
- Rainwater harvesting and artificial recharge to the groundwater system is being done through pond located near New Karo colony.
- Garland drain around the mine has been constructed in order to prevent the entry of surface run off inside the mine to avoid the contamination of rainwater.
- The catch drains has been constructed around the foot of the OB dumps in order to collect surface run off water from the dumps and convey them to the settling ponds.
- Regular plantation is being taken up during the life of the mine to create green barrier. The plant species will be selected in consultation with State Forest Department.

II. FUTURE STRATEGY

- To assess the impact on local water levels, in time and space coordinates, a monitoring network in the zone of influence will be established and the water levels will be monitored quarterly.
- To create the water resources and to increase groundwater recharge in the nearby villages, under community development, tanks/ponds will be constructed or strengthened. Desiltation/deepening of existing ponds in the local villages would enhance the water availability in the nearby villages.
- Action will be taken to meet the shortage of drinking water in peripheral villages, if any.
- 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 ground water recharge.
- 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. Creation of awareness among workers and local peoples about Rain water harvesting and artificial recharge will be given priority.
- Rain water along with surplus mine pumping water will be discharge into surface reservoirs/tank/pond/mine voids after passing through the settling tank. Necessary earthen check dams will be made in the nala for recharging ground water aquifer.
- Roof Top rainwater harvesting structure will be constructed in the administrative building of the projects/mines.
- Utilization of treated mine water discharge by both industry and local people in the mine influence area.
- Monitoring of water quality of mine water discharge, local River/nala and domestic water source (dug well/Hand pump wells) will be continued under routine monitoring (February, May, August & November).
- During course of operation, area received considerable impact, suitable control and remedial measures would be adopted by the mine authorities.
- After cessation of mining, with plenty rainfall and abundant ground water recharge, the water levels will recoup and attain normalcy. Thus, the impact of mining on groundwater system may be considered as a temporary phenomenon. The abandoned mine void also behave as water pool and improve the resources availability in the area.
- The water-logged final void of the mine can be utilized for pisciculture.
- Any other measures recommended by the regulatory agencies.

f) **Water Quality Monitoring**

For complying the statutory provision of MOEF and Pollution Control Board, fortnightly water quality is being monitored and evaluated. Corrective measures whenever needed are taken on the basis of monitoring results.

Control measures for Noise:

The present noise levels are below the prescribed limits. If the impulsive noise levels increase due to mining operation, sufficient measures will be adopted to maintain the noise level within permissible limits at working zone.

The following measures are adopted and will be continued:

1. Planting of rows of trees with thick foliage along roads and other noise generating centres to act as acoustic barriers.
2. Isolating/enclosing the noisy machines/sources by using resilient mounting/altering structures.

3. Routine maintenance schedules for HEMM and other machineries to eliminate noise as far as possible.
4. Balanced and properly aligned conditioning of machines to reduce vibration.
5. Provision of ear muffs/ear plugs to workers subjected to noise level above recommended limits.
6. Controlled blasting.
7. Regular monitoring of noise level of project area.

Blasting Vibration Control Plan:

The following factors will be given special attention to minimise effects of blasting:

- * Charge per delay
- * Charge per round
- * Over charging will be avoided
- * Distance from the structures (Scaled distance)
- * Type of initiation & sequence of delay
- * Stemming material used will be moist.
- * Blasting time (safety aspect)

The blasting will be done at a fixed time as far as possible.

- * Warning

Before blasting is carried out, warning sound will be given so that people can move to safe place.

b) **Vibration control**

- * As mentioned above, the mitigation measures will be implemented during blasting and it is expected that vibration will not cause damage to any structure or annoyance to the people in the colony area or neighbouring villages.
- * Controlled blasting techniques will be implemented near the built up structure in the vicinity of active face.
- * A safe blasting zone has been kept around the periphery of the quarry.

10.3.3 Green Belt Development:

a) **Green Belt Around Mine:-**

In the directions where natural forest does not exist, there is need for creating green belt of adequate width will be provided as an effective dust and sight curtain in the periphery of mining area. The trees planted in the green belt area shall act as buffers and shock absorber against dusts, noise and stone flying. The trees in the green belt will be tall, wind firm, broad leaved and evergreen. The green belt plan has already been proposed in the section 4.5.3 land reclamation. Total of 24.20 Ha has been proposed for green belt development all along the project boundary.

b) **Coal Transporting road:-**

A green belt of adequate width on either side of the Coal transporting road will be raised and the existing vegetation will be protected.

c) **All other roads:-**

Along the roads plants as mentioned above will be planted.

10.3.4 Land Reclamation

Land reclamation of mined out areas is the prime need. It not only involves backfilling of overburden into the excavated voids but also includes operations required to bring the land to some productive use, i.e. agricultural, forestry or recreational purposes

i) **Systematic handling of topsoil**

For surface mining activities are required to remove topsoil or other approved plant growth materials before beginning operations, save it for a later use in a manner conducive to protecting the primary root medium from contamination and erosion, and enhance its productivity.

ii) **Topsoil removal:-**

Topsoil shall be removed before any drilling, blasting, mining, or other surface disturbance.

iii) **Topsoil storage:-**

The stock piling of topsoil will be as follows:

- a) Top soil and other materials removed shall be stock-piled only when it is impractical to promptly redistribute such materials on re-graded areas.
- b) Stock-piled materials shall be selectively placed on a stable area, not disturbed, and protected from wind and water erosion, unnecessary compaction, and contaminants, which lessen the capability of the materials to support vegetation when redistributed.

iv) **Topsoil redistribution:-**

After the final grading, the topsoil would be redistributed in a manner that achieves an approximate uniform stable thickness consistent with the post mining land uses, contours, and surface water drainage system.

v) **Technical Reclamation**

Technical reclamation will be backfilling of excavated area with overburden in a systematic manner. It depends on the depth and volume of overburden removed and equipments used for mining. Technical reclamation would involve breaking and leveling the top of OB dumps, filling of gulleys and terracing etc. The technical reclamation of backfilled dump will start from 1st year onwards. The height of external dump bench is restricted to only 10 metre. There will be two benches, one upon another. The de-coaled area after simultaneous backfilling and external dump area will be leveled by means of dozers keeping a mild slope of about 1 in 200 for surface water drainage for plantation and other recreational purposes.

vi) **Biological Reclamation**

In view of importance of vegetal cover towards environment, the technical reclamation will be strengthened by biological reclamation for conserving the environment.

vii) **Final Land use Plan**

Details of final land use of mine lease area is given here under:

LAND USE DURING MINING		POST MINING LAND USE		
SN	Landuse during mining	Total Area (Ha)	Post-mining land use	Total Area (Ha)
1	Quarry	295.75	Plantation on backfilled area	160.54
			Void Filled with Water	135.21
2	External OB dump-1	38	plantation on External OB Dump	95.24
	External OB dump-2	57.24		
3	Infrastructures	45.08	CCL use	45.08
4	Road, nala diversion, green belt/vacant land & safety zone	85.25	Road in public use	4.4
			Nallah	3.3
			Green belt (10 to 30 m wide)	24.2
			Undisturbed	53.35
5	Residential colony*	5	Public use	5
6	Conveyer to Kargali washery*	26.52	CCL use	26.52
Total Land Required		552.84		552.84

10.3.5 Mitigation measures for protection of flora and Fauna

Strengthening of Water Bodies

Through community development work, the existing water sources (tanks) should be strengthened to provide water to the local community as well as fauna of the area.

Greenbelt Development:

Creation of three tier plantation with tall growing trees all along the periphery of the coal handling area, inside & outside of the premises along with roads can prevent spreading of dust pollution.

Planting of diversified fruit yielding and flowering trees of evergreen and deciduous variety could provide continuous supply of food resource as well as perching sites, nesting materials and shelter to arboreal fauna. The plant species which are useful for green barrier development to prevent dust and noise pollution, planting in the degraded mine leased areas are as follows.

Table 10.3 Recommended plant species

Family Name	Botanical Name	Local /Trade Name	Mitigation Value
Apocynaceae	<i>Alstonia scholaris</i>	Devils Tree	Dust collection
Sapotaceae	<i>Mimusops elengi</i>	Spanish Cherry	Dust collection
	<i>Madhuca latifolia</i>	Mahua Tree	Dust Collection
Myrtaceae	<i>Aegle marmelos</i>	Bael tree	Dust collection
Caesalpinaceae	<i>Cassia fistula</i>	Golden shower	Dust collection
Cemaruhiaceae	<i>Ailanthus excelsa</i>	Maharukha	Dust collection
Fabaceae	<i>Butea monosperma</i>	Flame of the Forest	Dust collection
	<i>Dalbergia sisoo</i>	Indian Rose wood	Dust collection
Poaceae	<i>Dendrocalamus strictus</i>	Hard bamboo	Wind Breaks
	<i>Bambusa aurundinacea</i>	Hallow bamboo	Wind Breaks
Moraceae	<i>Ficus benghalensis</i>	Banayan Tree	Soil compactness
	<i>Ficus religiosa</i>	Peepal Tree	Soil compactness
Proteaceae	<i>Grevillea robusta</i>	Silver Oak	Soil Compactness
Combretaceae	<i>Terminalia arjuna</i>	Arjun	Soil Compactness
	<i>Terminalia alata</i>	Gall nut	Noise Barrier
	<i>Terminalia tomentosa</i>	Saj	Noise Barrier
Meliaceae	<i>Azadirachta indica</i>	Neem tree	Noise Barrier
Verbenaceae	<i>Tectona grandis</i>	Teak wood	Noise Barrier

10.3.6 Cost of Environmental Control Measures

Table 10.4 Financial Provision for Environmental Capital Expenditure

SN	Particulars	Amount (Rs Lakh)
Pollution Control		
•	Anti-pollution measures in mine & Industrial area	1142.28
•	Anti-pollution measures in township	89.55
•	Rain water harvesting scheme	20.00
Sub Total (1)		1251.83
Other Measures		
•	Cost of rehabilitation	1274.40
•	Cost of compensatory afforestation	3477.83
•	Cost of restoration	10325.13
•	Others	129.85
•	Compensation for non-forest land	1499.55
Sub Total (2)		16706.76
Grand Total (1+2)		17958.59

10.3.7 Mine Closure Cost Details

Mine closure cost
Table 10.5 Detail of escrow account

ESCROW ACCOUNT	
Project Area (Ha)	552.84
Escrow amount per Ha for OC project as on Aug, 2009 (in Rs Lakhs)	6
Corpus Value based on Aug, 2009 rate (in Rs. Lakhs)	3317.04
WPI as on Aug, 2009	129.6
WPI as on April, 2016	177
Current value of Corpus (in Rs. Lakh)	4530.22
Amount deposited (excluding interest) till 01.04.16 (in Rs. Lakh)	618.85
Balance Corpus for which provision is to be made as on 01.04.16 (in Rs. Lakh)	3911.37
Balance Life of mine as on 01.04.16 (in years)	12
Annual corpus (Balance corpus / Balance life, in Rs. Lakh)	325.95
Year	Amount in Lakh (Rs.)
1	325.95
2	342.25

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3	359.36
4	377.33
5	396.20
6	416.01
7	436.81
8	458.65
9	481.58
10	505.66
11	530.94
12	557.49
Total	5188.23
Total Mine closure cost (in Rs Lakhs)	5807.08

As per above an amount will be deposited every year up to the last year of mine life.

The amount calculated by the above formula shall be deposited every year by CCL in the Escrow amount opened with the Coal Controller organization in a scheduled Bank. An agreement, outlining detailed terms and conditions of operating the said Escrow Account shall be executed amongst CCL, the Coal Controller and the commercial Bank.

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).

Details of Mine Closure Cost and activities

The above escrow account will meet the cost of different activities of Mine Closure cost which is given in the table below:

Table 10.6 Progressive And Final Mine Closure Cost Distribution

SL. NO.	ACTIVITY	% OF TOTAL MINE CLOSURE COST	AMOUNT IN LAKH (RS.)	Remarks
A	Dismantling of Structures			To be included in final mine closure plan
	Service Buildings	0.20	11.61	
	Residential Buildings	2.67	155.05	
	Industrial structures like CHP, Workshop, field sub-station etc.	0.30	17.42	
B	Permanent Fencing of mine void and other dangerous area			To be included in final mine closure plan
	Random rubble masonry of height 1.2 metre including levelling up in cement concrete 1:6:12 in mud mortar	1.50	87.11	
C	Grading of highwall slopes			To be included in final mine closure plan
	Levelling and grading of highwall slopes	1.77	102.79	
D	OB Dump Reclamation			

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	Handling/ Dozing of OB Dump and back filling	88.66	5148.56	71% for progressive and 17.66% for final mine closure
	Bio-reclamation including soil spreading, plantation and post care	0.40	23.23	Equal weightage throughout the life of the mine
E	Landscaping			
	Landscaping of the open space in lease hold area for improving its esthetic	0.30	17.42	Equal weightage throughout the life of the mine
F	Plantation			
	Plantation over cleared area obtained after dismantling	0.50	29.04	To be included in final mine closure plan
	Plantation around the quarry area and in safety zone	0.20	11.61	Equal weightage throughout the life of the mine
	Plantation over the external OB Dump	0.02	1.16	Equal weightage throughout the life of the mine
G	Post Closure Env Monitoring/ testing of parameters for three years			For three years after mine closure
	Air Quality	0.22	12.78	
	Water Quality	0.20	11.61	
H	Entrepreneurship Development (Vocational/ skill development training for sustainable income of affected people	0.26	15.10	Equal weightage throughout the life of the mine
I	Miscellaneous and other mitigative measures	2.00	116.14	Equal weightage throughout the life of the mine
J	Post Closure Manpower cost for supervision	0.80	46.46	To be included in final mine closure plan
TOTAL		100.00	5807.08	

The dismantling and disposal of residential buildings, industrial structures and other infrastructures as mentioned above in the cost will be decided by the CCL authority for either re-utilization of these facilities for their neighboring mines or future mines. If the dismantling is to be opted, State Govt. may also be approached for utilization of these structures for community uses.

Time Schedule for Mine Closure

The closure of mines involves environmental, technical, social aspect and financial assurance for implementing the post closure activities as per guidelines of Ministry of Coal. The post closure implementing activities will run for three years. The following activities will be implemented as per bar chart.

10.3.8 Corporate Environmental Responsibility

Sustainable development has many important facets/components like social, economic, environmental, etc. All these components are closely interrelated and mutually re-enforcing. Therefore, the general structure of EIA document, under Appendix-III to the notification, prescribes inter-alia public consultation, social impact assessment and R&R action plan besides environment management plan (EMP).

Government of India through Ministry of Environment, Forest and Climate Change has issued an office memo vide F.No.22-65/2017-IA.III Dated: 01/05/2018 where it has issued the guidelines that the cost of Corporate Environmental Responsibility is to be in addition to the cost envisaged for the implementation of the EIA/EMP which includes the measures for the pollution control, environmental protection and conservation, R & R, wildlife and forest conservation/protection measures including the NPV and Compensatory Afforestation, required, if any, and any other activities, to be derived as part of the EIA process.

The fund allocation for Corporate Environmental Responsibility (CER) is prescribed below for different cases of projects:

SI No	Capital Investment / Additional Capital Investment (In Rs)	Greenfield Project % of Capital Investment	Brownfield Project % of Additional Capital Investment
I	II	III	IV
1.	≤100 crores	2.0 %	1.0 %
2.	>100 crores to ≤ 500 crores	1.5 %	0.75 %
3.	>500 crores to ≤ 1000 crores	1.0 %	0.50 %
4.	>From 1000 crores to ≤ 10000 crores	0.5 %	0.25 %
5.	>10000 crores	0.25 %	0.125 %

The activities proposed under CER are being worked out based on the issues raised during the public hearing, EMP and also as per the social needs identified for the project.

Karo OCP is an existing coal-mining project of CCL lying in East Bokaro Coalfield. Total cost of the project at current price level is Rs. 1626.92 Crore for Karo Expansion OCP & Rs. 269.88 Crore for Karo Washery.

As it is a case of expansion of existing mine, total additional investment is Rs. 1800.27 Crore. As per the guideline, the fund allocation for the CER is being made for Rs. 4.50 Crore.

Methodology

The activities undertaken under CER is identified based on the following inputs-

- To identify the needs of the nearby community of the project site, public hearing has been conducted on 05.01.2016 for Karo OCP that was attended by ADM Bokaro, officials of JSPCB and Central Coalfields Limited and approximately 171 people of nearby villages.
- Social Impact assessment done as part of EIA/EMP report

Table 10.7 Activities proposed under CER

SI No	Area of Focus	Frequency of Issue raised during Public Hearing	Corresponding Weightage	Final Weightage in %
1	Drinking Water	9	22.50	20
2	Infrastructure (Construction of Road, Electricity etc.)	15	37.50	40
3	Education	5	12.50	15
4	Health & Hygiene	7	17.50	15
5	Plantation (Avenue & Community Plantation)	4	10	10

As per the identified weightage in section 2, the total fund allocation made for CER is Rs. 4.50 Crore.

Table 10.8 Action plan for CER

SI No	Area of Focus	Proposed CER expenditure to be done per year in Rs. (In Lakhs)				
		Year 1	Year 2	Year 3	Year 4	Year 5
1	Drinking Water Supply and construction of wells, ponds, hand pumps and tube wells	6.0	6.0	6.0	6.0	6.0
2	Education facilities including grant of schools, providing education kits, running of schools etc.	4.5	4.5	4.5	4.5	4.5
3	Health Care and vaccination, awareness camp, mobile medical camp, Immunization, medicine etc.	4.5	4.5	4.5	4.5	4.5
4	Environment Protection i.e plantation in community area and avenue plantation	3.0	3.0	3.0	3.0	3.0
5	Infrastructure Development like road, bridge, repairing of school, drains, electric line etc.	12	12	12	12	12
Total		30.00	30.00	30.00	30.00	30.00

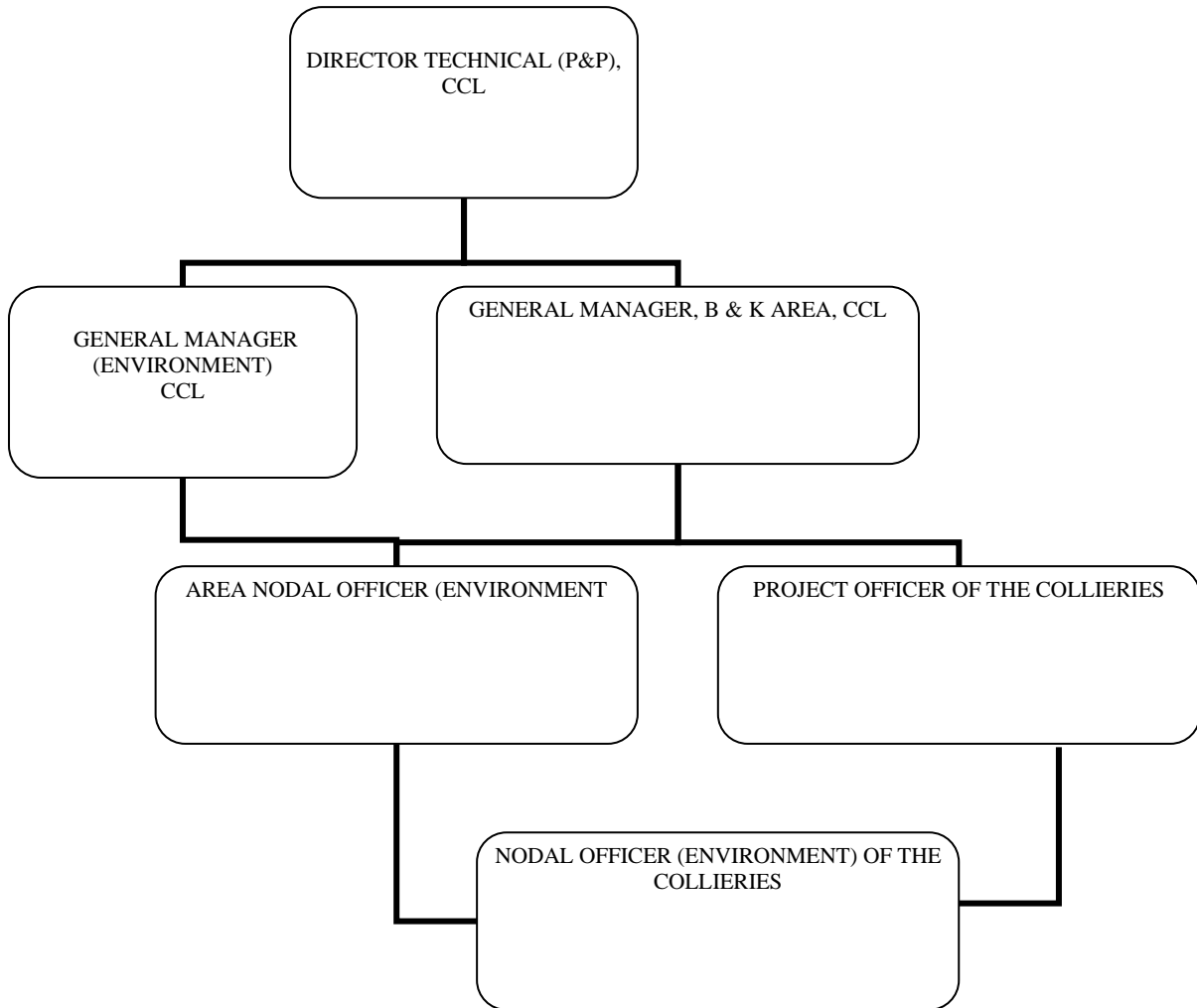
EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

SI No	Area of Focus	Proposed CER expenditure to be done per year in Rs. (In Lakhs)				
		Year 6	Year 7	Year 8	Year 9	Year 10
1	Drinking Water Supply and construction of wells, ponds, hand pumps and tube wells	6.0	6.0	6.0	6.0	6.0
2	Education facilities including grant of schools, providing education kits, running of schools etc.	4.5	4.5	4.5	4.5	4.5
3	Health Care and vaccination, awareness camp, mobile medical camp, Immunisation, medicine etc.	4.5	4.5	4.5	4.5	4.5
4	Environment Protection i.e plantation in community area and avenue plantation	3.0	3.0	3.0	3.0	3.0
5	Infrastructure Development like road, bridge, repairing of school, drains, electric line etc.	12	12	12	12	12
Total		30.00	30.00	30.00	30.00	30.00
SI No	Area of Focus	Proposed CER expenditure to be done per year in Rs. (In Lakhs)				
		Year 11	Year 12	Year 13	Year 14	Year 15
1	Drinking Water Supply and construction of wells, ponds, hand pumps and tube wells	6.0	6.0	6.0	6.0	6.0
2	Education facilities including grant of schools, providing education kits, running of schools etc.	4.5	4.5	4.5	4.5	4.5
3	Health Care and vaccination, awareness camp, mobile medical camp, Immunisation, medicine etc.	4.5	4.5	4.5	4.5	4.5
4	Environment Protection i.e plantation in community area and avenue plantation	3.0	3.0	3.0	3.0	3.0
5	Infrastructure Development like road, bridge, repairing of school, drains, electric line etc.	12	12	12	12	12
Total		30.00	30.00	30.00	30.00	30.00

Implementation

Specific activities under the area of focus for Corporate Environmental Responsibility will be identified every year for KARO OCP as per the consultation with local community and state authority. The implementation plan of the activities shall be finalized at Area level and Company level as per the CSR policy of CIL. After the approval of the scheduled activity is obtained from the CCL Board, the fund of the activities shall be allocated from the CSR budget of the company and area for the corresponding year. Activities identified under CER shall be implemented at project site and will be maintained as per the CSR guidelines of the company.

FIG. 10.1 ORGANIZATION CHART



Chapter 11

Summary and Conclusion

11.1 Introduction

The project falls in Bokaro & Kargali Area of Central Coalfields Limited, a subsidiary of Coal India Limited. The Proposed Karo EPR is located in the Bokaro district of Jharkhand and lies in the B&K area of CCL. This Project Report has been prepared on the basis of two geological reports, one is "Geological Report of Karo Eastern Block", and the other is "Geological Report on Coal Exploration, Kaveri (Karo II) Block".

11.1.1 Opencast Operation

The lay and disposition of coal seams are such that the mine capacity may be enhanced to 6.0 MTY and 5.0 MTY from Karo and Kaveri Blocks, respectively with opencast operation. The present proposal envisages opencast mining upto seam VI/VII combined in Karo block (Quarry –II) and seam VI/VII/VIII combined in Kaveri (Karo II-Quarry I) block. The equipment is proposed to be transfer to other projects after approval of Karo Expansion OCP (11MTY).

Karo Expansion OCP (15 MTPA capacity) & integrated non-coking coal Karo Washery (7 MTPA), B&K Area, Central Coalfields Limited is proposed within project area of 552.84 Ha.

The project is situated in the northeastern part of East Bokaro coalfield and covered on Survey of India Topo-sheet no- 73E/13 (1:50000 RF).

Karo Expansion OCP (15 MTPA) is planned as an expansion of existing mine. This expansion has been planned on the basis of two geological reports, namely, Karo Eastern Block, & Kaveri (Karo II) Block.

A pit top washery has been proposed for washing of non-coking coal @ 7 MTPA. Washed non-coking coal will be fed through belt conveyors to nearby Kargali siding for rail dispatch through RLS. Kargali siding is about 5 km away. The balance of products of Karo non-coking coal washery is given below.

Balance of products

Product	Size (mm)	Wt%	Ash%	Qty. (MTPA)
Washed coal	(-) 50	75.4	33.5	5.3
Low quality fuel	50-13	24.6	62.4	1.7
Total	(-) 50	100.0	40.6	7.0

The total project life including 3 years washery development period is 15 years.

11.2 Project Description

11.2.1 Method of Mining

Quarry I

The method of mining adopted to extract coal and OB in Quarry- I is inclined slicing with Surface Miner in coal and Shovel-Dumper combination in OB.

Quarry II

The mining and geological conditions of the mine are as follows: -

- Multiple seams to be worked
- Gradient of 8-10 deg of the coal seams.
- Variable thickness of OB/Partings.

Considering the above mining and geological conditions the method of mining adopted to extract coal and OB in Quarry II is inclined slicing with Surface Miner in coal and Shovel-Dumper combination in OB.

It is also proposed to respond to improvements in technology and equipments, which would result in, improved profitability and productivity parameters taking into account of safety and environmental parameters.

Considering the geo-mining conditions surface miner in coal and shovel-dumper combination in OB with drilling and blasting has been proposed for mining for both the quarries. Other technologies like Dragline, Bucket Wheel Excavator, are ruled out for this quarry.

The proposed washery shall be set up on Build, Operate & Maintain (BOM) concept. Ownership of raw coal fed to the washery & products of washery shall lie with CCL. BOM operator will be paid washing charges as per mutually agreed terms & conditions for operating & maintaining the washery till the entire contract period.

The washing of coal will lead to improvement in performance of power plant, reduction in particulate emission, reduction in load on Railway Network and reduction in handling and transportation cost of coal and solid waste.

11.3 Description of the Environment

11.3.1 Land Environment

Proposed Land Use during Mining

Sl no.	Particulars of land	Forest (area in Ha)	Non- forest (area in Ha)	Total (area in Ha)
1.	Quarry	185.07	110.68	295.75
2.	External OB dump-1	24.73	13.27	38.00
3.	External OB dump-2	5.00	52.24	57.24
4.	Infrastructures	36.77	8.31	45.08
5.	Road, nala diversion, top Soil Dump, green belt/vacant land & Safety zone	52.53	32.72	85.25
6.	Res. colony*	0.00	5.00	5.00
7.	Conveyer to Kargali Washery/ siding *	7.50	19.02	26.52
	Total Land Required	311.6	241.24	552.84

*31.52 Ha of land (residential Colony and Conveyor to Kargali Washery) is outside the core zone.

11.3.2 Micrometeorological data generation

As a part of micro-meteorological study, micrometeorological and microclimatic parameters were recorded by installing an auto weather monitoring station within the core zone. Data wind speed, wind direction, ambient temperature, relative humidity, barometric pressure, cloud cover, sky appearance and rainfall on hourly basis during the study period (17/10/2015 – 16/01/2016)

11.3.3 Ambient air quality monitoring

To evaluate the baseline environmental status with respect to ambient air quality, baseline data at six location in core and buffer zone of Karo OCP & Karo washery was assessed for the post monsoon period of 2015. Further, as per the Terms of Reference obtained in respect of karo Expansion OCP and Integrated washery, validation of baseline environmental status has been done by monitoring ambient air quality at 8 stations in core and buffer zone of Karo OCP & washery.

Maximum and Minimum value of Ambient Air Results

Period: (16.09.2018 – 15/10/2018)

Sl. No.	Parameter Locations	PM2.5(µg/m3)		PM10(µg/m3)		SO2(µg/m3)		NOx(µg/m3)	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1.	WORKSHOP (A- 1)	76	55	172	149	<25	<25	<6	<6
2.	BAIDYA KARO BASTI (A- 2)	67	52	148	128	<25	<25	<6	<6
3.	SUBHASH NAGAR (A- 3)	43	36	77	64	<25	<25	<6	<6

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

4.	CHARAKPANIYA (A- 4)	50	34	80	65	<25	<25	<6	<6
5.	KHURPANIA COLONY (A- 5)	44	34	77	63	<25	<25	<6	<6
6.	GM OFFICE* (A- 6)	70	51	160	70	<25	<25	<6	<6
7	AMLO BASTI (A-7)	62	52	86	71	<25	<25	<6	<6
8	KALI MANDIR (A-8)	50	42	85	75	<25	<25	<6	<6

- A6- Station situated near mining/ industrial activity.

From the seasonal base line data and the validation data, it can be observed that that all values of criteria pollutants monitored are within the limits and there is no significant change in the baseline environmental status of core and buffer zone.

11.3.4 Water quality monitoring

The monitoring of water quality has been conducted by collecting water samples from ground water, surface water and mine water discharge / workshop discharge (if any) for the proposed project

Sampling location of water monitoring stations is given below and shown in **Plate VII B:**

Location of water Quality Sampling Stations

S.No	Source	Location
01	Ground Water	1- Bhutia Tand, Hand Pump- GW₁ 2- Bore Well of Baidya Karo Basti - GW₂
02	Surface Water	1- Godda Nala- SW₁ (U/S) 2- Damodar River - SW₂(D/S) 3- Konar River- SW₃(U/S)
03	Effluent Water:	1- Lagoon Discharge K1 2- Lagoon Discharge K2

Ground water Quality- Validation

Period: (16.09.2018 – 15/10/2018)

Sl.No	Parameter	Sampling Stations		Detection Limit	IS:10500 Standards	Standard / Test Method
		GW-1	GW-2			
1	Boron (as B), mg/l, Max	<0.20	<0.20	0.20	0.5	APHA, 22 nd Edition ,Carmine
2	Cadmium (as Cd), mg/l, Max	<0.0005	<0.0005	0.0005	0.003	APHA, 22 nd Edition, AAS-GTA
3	Calcium (as Ca), mg/l, Max	60.8	43.2	1.60	75	IS-3025/40:1991, EDTA

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

4	Chloride (as Cl), mg/l, Max	70	16	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.10	1.26	0.02	1.0	APHA, 22 nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	0.02	0.2	APHA, 22 nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	0.14	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	0.005	0.01	APHA, 22 nd Edition, AAS-GTA
10	Manganese (as Mn), mg/l, Max	0.05	0.12	0.02	0.1	IS-3025/59:2006,AAS-Flame
11	Nickel (as Ni), mg/l, Max	0.01	<0.01	0.01	0.02	IS-3025/54:2003, AAS-Flame
12	Nitrate (as NO ₃), mg/l, Max	3.56	1.49	0.5	45	APHA, 22 nd Edition, UV-Spectrophotometric
13	Odour	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
14	pH value	7.32	7.98	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
15	Phenolic compounds (as C ₆ H ₅ OH), mg/l, Max	<0.001	<0.001	0.001	0.001	APHA, 22 nd Edition, 4-Amino Antipyrine
16	Selenium (as Se), mg/l, Max	<0.002	0.003	0.002	0.01	APHA, 22 nd Edition, AAS-GTA
17	Sulphate (as SO ₄) mg/l, Max	58	17	2.00	200	APHA, 22 nd Edition. Turbidity
18	Total Alkalinity (CaCO ₃), mg/l, Max	162	140	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Dissolved Solids, mg/l, Max	380	218	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
21	Total Hardness (CaCO ₃), mg/l, Max	189	160	4.00	200	IS-3025/21:1983, R-2002, EDTA
22	Turbidity, NTU, Max	1	6	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
23	Zinc (as Zn), mg/l, Max	0.56	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

The ground water quality during baseline study is presented in Table 3.12 and the validation of data is presented in Table 3.13. From the validation data it can be observed that all the parameters including pH, TDS etc are within limits and represent the natural ground water quality pattern of that area.

Surface Water Quality- Validation

Period: (16.09.2018 – 15/10/2018)

Sl. No	Parameter	Sampling Stations				Detection Limit	BIS Standard & Method
		SW1	SW2	SW3			
1	Arsenic (as As), mg/l,	<0.00	<0.002	<0.002		0.002	IS 3025/37:1988 R : 2003, AAS-VGA

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

	Max	2				
2	BOD (3 days 27°C), mg/l, Max	2.4	2.4	6.2	2.00	IS 3025 /44: 1993, R : 2003 3 day incubation at 27°C
3	Cadmium(as Cd), mg/l, Max	<0.0005	<0.0005	<0.0005	0.0005	APHA, 22 nd Edition AAS-GTA
4	Chlorides (as Cl), mg/l, Max	14	14	14	2.00	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	IS 3025 /42 : 1992 R : 2009, AAS-Flame
6	Disolved Oxygen, min.	6.3	6.3	6.2	0.10	IS 3025/381989, R : 2003, Winkler Azide
7	Fluoride (as F) mg/l, Max	0.91	0.66	0.17	0.02	APHA, 22 nd Edition SPADNS
8	Hexavalent Chromium, mg/l, Max	<0.01	<0.01	<0.01	0.01	APHA, 22 nd Edition, 1,5 - Diphenylcarbohydrazide
9	Iron (as Fe), mg/l, Max	<0.06	0.30	1.53	0.06	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
10	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	APHA, 22 nd Edition AAS-GTA
11	Nitrate (as NO ₃), mg/l, Max	5.39	2.47	<0.50	0.50	APHA, 22 nd Edition, UV-Spectrophotometric
12	pH value	7.24	7.96	7.54	0.2	IS-3025/11:1983, R-1996, Electrometric
13	Phenolic compounds (as C ₆ H ₅ OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	APHA, 22 nd Edition 4-Amino Antipyrine
14	Selenium (as Se), mg/l, Max	<0.002	0.003	0.003	0.002	APHA, 22 nd Edition AAS-GTA
15	Sulphate (as SO ₄) mg/l, Max	25	45	08	2.00	APHA, 22 nd Edition Turbidity
16	Total Dissolved Solids, mg/l, Max	168	164	104	25.00	IS 3025 /16:1984 R : 2006, Gravimetric
17	Total Suspended Solids, mg/l, Max	10	28	72	10.00	IS 3025 /17:1984, R :1996, Gravimetric
18	Zinc (as Zn), mg/l, Max	0.02	0.01	0.02	0.01	IS 3025 /49 : 1994, R : 2009, AAS-Flame

The surface water quality data shows that there is no significant adverse impact of mining operations on the surrounding surface water bodies like River Bokaro, River Damodar and Goddo Nala.

Effluent Water Quality- Validation

Period: (16.09.2018 – 15/10/2018)

Sl.No.	Parameter	Sampling Stations			Detection Limit	MOEF - SCH-VI STANDARD S Class 'A'	BIS Standard & Method
		1	2	3			
1	Ammonical Nitrogen, mg/l, Max	0.14	0.15		0.02	50.0	IS 3025/34:1988, R : 2009, Nessler's
2	Arsenic (as As), mg/l, Max	<0.002	<0.002		0.002	0.2	IS 3025/37:1988 R : 2003, AAS-VGA

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

3	B.O.D (3 days 27°C), mg/l, Max	6.0	6.0		2.00	30.0	IS 3025 /44:1993,R:2003 3 day incubation at 27°C
4	Cadmium(as Cd), mg/l, Max	<0.0005	<0.0005		0.0005	2.0	APHA, 22 nd Edition, AAS-GTA
5	COD, mg/l, Max	20	24		4.00	250.0	APHA, 22 nd Edition, Closed Reflux, Titrimetric
6	Copper (as Cu), mg/l, Max	<0.03	<0.03		0.03	3.0	IS 3025/42: 1992 R : 2009, AAS-Flame
7	Dissolved Phosphate, mg/l, Max	0.38	0.35		0.30	5.0	APHA, 22 nd Edition Molybdovanadate
8	Fluoride (as F) mg/l, Max	1.23	1.24		0.02	2.0	APHA, 22 nd Edition, SPADNS
9	Free Ammonia, mg/l, Max	<0.02	<0.02		0.02	5.0	IS:3025/34:1988, Nessler's
10	Hexavalent Chromium, mg/l, Max	<0.01	<0.01		0.01	0.1	APHA, 22 nd Edition, Diphenylcarbohydrazide
11	Iron (as Fe), mg/l, Max	<0.06	<0.06		0.06	3.0	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
12	Lead (as Pb), mg/l, Max	<0.005	<0.005		0.005	0.1	APHA, 22 nd Edition, AAS-GTA
13	Manganese(as Mn), mg/l, Max	0.02	<0.02		0.02	2.0	IS-3025/59:2006, AAS-Flame
14	Nickel (as Ni), mg/l, Max	0.01	0.02		0.01	3.0	IS-3025/54:2003, AAS-Flame
15	Nitrate Nitrogen, mg/l, Max	2.48	2.53		0.50	10.0	APHA, 22 nd Edition, UV-Spectrophotometric
16	Oil & Grease, mg/l, Max	<2.00	<2.00		2.00	10.0	IS 3025/39:1991, R : 2003, Partition Gravimetric
17	pH value	7.81	7.21		0.2	5.5 to 9.0	IS-3025/11:1983, R-1996, Electrometric
18	Phenolic compounds (as C ₆ H ₅ OH),mg/l, Max	<0.001	<0.001		0.001	1.0	APHA, 22 nd Edition 4-Amino Antipyrine
19	Selenium (as Se), mg/l, Max	0.005	0.005		0.002	0.05	APHA, 22 nd Edition, AAS-GTA
20	Sulphide (as SO ₃), mg/l, Max	<0.005	<0.005		0.005	2.0	APHA, 22 nd Edition Methylene Blue
21	Temperature (° C)	28	28		Shall not exceed 5° C above the receiving temp.		IS-3025/09:1984, Thermometric
22	Total Chromium (as Cr), mg/l, Max	0.22	0.26		0.04	2.0	IS-3025/52:2003, AAS-Flame
23	Total Kjeldahl Nitrogen, mg/l, Max	<1.00	<1.00		1.00	100.0	IS:3025/34:1988, Nessler's
24	Total Residual Chlorine, mg/l, Max	<0.02	<0.02		0.02	1.0	APHA, 22 nd Edition, DPD
25	Total Suspended Solids, mg/l, Max	32	34		10.00	100.0	IS 3025/17:1984, R :1996, Gravimetric
26	Zinc (as Zn), mg/l, Max	0.01	0.02		0.01	5.0	IS 3025 /49 : 1994, R : 2009, AAS-Flame

The effluent water quality data shows that there is no significant change in the baseline environmental status of project area.

11.3.5 Noise Environment

The ambient noise quality monitoring stations were set up at six locations, two locations in core zone and four locations in buffer zone area during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one month (16.09.2018 – 15/10/2018) noise quality has been generated by CMPDI at the same locations for comparison and validation of baseline data.

Sampling Locations

Details of sampling location and location map is shown in **Plate No. VII A**

List of noise monitoring stations-

- ix. Workshop-N₁
- x. Baidya Karo Basti-N₂
- xi. Shubhash Nagar Colony-N₃
- xii. Charakpaniya-N₄
- xiii. Khurpaniya Colony-N₅
- xiv. GM office-N₆
- xv. Amlo Basti- N₇
- xvi. Kali Mandir Gandhi Nagar- N₈

Noise data – Validation

Station Name	Date of Sampling	Noise Level
Workshop	18/09/2018	53.7
Baidya Karo Basti	18/09/2018	51.6
Subhash Nagar	18/09/2018	52.2
Churpaniya	18/09/2018	51.3
Khurpaniya Colony	20/09/2018	53.8
G.M.Office	20/09/2018	51.1
Amlo Basti	20/09/2018	52.7
Kali Mandir Gandhi Nagar	20/09/2018	51.1

From the above observations, it may be concluded that the Noise levels are in good compliance with the National Ambient Air Quality Standards (NAAQS) for Industrial and Residential areas.

11.3.6 Soil quality monitoring

Soil samples from three locations, one in core zone, three in buffer zone were collected at depths of 30, 60 and 100 cms and analyzed for various physico-chemical and fertility parameters.

11.3.7 Socio-Economic Survey

The sample households have been selected by multistage sampling method. There are total of 76 villages within the 10 km radius and out of that 5 villages were surveyed for the household survey.

	POPULATION			SC	ST	OC
	POP	M	F	POP	POP	POP
TOT	347298	179566	167732	47299	41801	258198
%		51.70%	48.30%	13.62%	12.04%	74.34%

11.4 Anticipated Environmental Impact

The project activities will have impact on environmental attributes. Environmental impacts on following environmental attributes have been assessed.

- Ambient Air Quality
- Ambient Noise Level
- Surface Water Quality
- Topography, water drainage and land use.
- Bio-environment including Flora & Fauna
- Socio-economic environment.
- Storage of coal and washery reject
- Impact on immediate surrounding due to construction of washery

11.4.1 Air Pollution Mitigation Measures

Appropriate mitigative measures shall be taken to contain the predicted level within prescribed level. These measures (both preventive and suppressive) are enumerated below:

✿ Loading and transport

The following measures will be taken:

- Suppression of coal dust during coal handling by fixed sprinklers. Minimization of the height of coal-fall at transfer points to reduce the dust generation.
- Coal transportation is proposed through closed conveyor belt.

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

S No.	Products	Starting Point	Transportation by	Distance (Approx.)	Destination point
1.	Raw Coal	Mine Site	Covered conveyor	6.5km	Washery
2.	Washed Coal	Washery Premises	covered conveyors to the Kargali Washery Railway siding	6.5 km	Rapid Loading System (3600/5500 tph)
3.	Coal Reject	Washery Premises	Covered conveyor	200 m	Temporary Reject Storage Site

- Greenbelts around industrial sites, service building area besides avenue plantation along roads.
- Regular water spraying at haul roads and transfer points. For this purpose, fixed water sprinklers and movable sprinklers will be installed.

☼ **Fires at coalfaces, coal stockyards**

(e) At coal faces

To prevent and control such fires, the following measures will be taken:

- Exposures of coal benches for long time will be avoided.
- Provision of adequate fire-fighting arrangements including storage of sufficient quantity of water at all critical points.
- Regular supervision.

(f) At coal stockyards

- Limiting the amount of stock by giving close attention to marketing besides following the "first-in and first-out" sequence.
- Attention to the following while stacking of coal:
 - Proper dimensions of stack (height to be limited to not more than 8m).
 - Dozing/compaction to make the stock semi-consolidated.
 - Regular and strict supervision of stacks.
 - Provision of fire-fighting arrangement with supply of adequate quantity of water at sufficient pressure.

☼ **Mitigation Measures at Washery and crushing units**

Sl. No.	Identified Source of Fugitive Emission	Planned Mitigation
1	Receiving Hopper	Enclosure and Sprinkling
2	Surge Hopper	Enclosure and Sprinkling
3	Crushing / Dry Screening	Dust Extraction System / Sprinkling
4	Coal Stock Yard	Sprinkling
5	Washing (Wet Process)	Coal washing is wet process, hence does not generate fugitive emission
6	Washed Coal Stock	
7	Rejects Stock	

8	Belt Conveyors	Covered Conveyor, green belt
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- Dust suppression within the washery shall be done by sprinkling of water.
- Monitoring the condition of transfer chutes and skirt boards and replacing/repairing shall be done on regular basis during the normal inspection by the concerned persons along with the sectional heads.
- Water spraying for dust suppression at temporary storage site for reject shall be done regularly.
- Road inside the plant shall be paved to minimize the dust due to vehicle movement.
- To minimize the generation of fugitive dust in conveyance of washery products following arrangements have been made:
- Green belt area of 1.45 Ha in and around the washery site including around the conveyor, vacant places shall be developed to control dust emission.
- Efforts for good housekeeping will minimize dust nuisance within the plant premises.
- The crushers/pulverizers of the coal washeries shall be provided with enclosures fitted with suitable air pollution control measures.
- Water spray arrangements shall be provided at all strategic coal transfer points, enclosures for conveyors etc.

11.4.2 Water Pollution Mitigation Measures

- The mine discharge will be effectively utilize to meet the mine's domestic and industrial needs. Almost, the entire industrial and domestic water demand of the Karo Expansion OCP will be met from treated mine water.
- To increase the source availability, Hand pumps and in some places piped water supply will be provided nearby villages.
- No excess mine water is being discharged to nala/river. All the mine seepage water collected at the sump is being utilised for industrial and water harvesting purposes.
- The proposed washery will work on closed water circuit system. So no effluent will be generated.
- At the proposed stage, mine water will be treated through filter plant and supply for the domestic purposes.
- Supply of domestic water to nearby area such as Kargali Bazar, Gandhi Nagar, Jawahar Nagar, Subhas Nagar, Kurukpania Village, Bermo Colony, GhutiaTand Village, Ram Nagar Colony etc.
- Rainwater harvesting and artificial recharge to the groundwater system is being done through pond located near New Karo colony.
- Garland drain around the mine has been constructed in order to prevent the entry of surface run off inside the mine to avoid the contamination of rainwater.
- The catch drains has been constructed around the foot of the OB dumps in order to collect surface run off water from the dumps and convey them to the settling ponds.

- Regular plantation is being taken up during the life of the mine to create green barrier. The plant species will be selected in consultation with State Forest Department.

11.4.3 Noise Pollution Mitigation Measures

The following measures therefore, have been envisaged to reduce the noise level to the minimum and to protect the workers from noise hazard.

- Proper designing of plant & machinery by providing in-built mechanisms like silencers, mufflers and enclosures for noise generating parts and shock absorbing pads at the foundation of vibrating equipment.
- Routine maintenance of equipment.
- Rational deployment of noise generating plant and machinery.
- Greenbelts around the quarry, infrastructure sites and service building area besides avenue plantation on both sides of the roads
- To maintain noise level at night time within the limit for the inhabited localities situated at a very close proximity.
- HEMMs with sound proof cabins.
- Personal protective devices to all the persons working in high noise areas.
- Regular monitoring of noise levels at various points.

11.4.4 Mitigation Measures for Socio-Economic Profile

The implementation of the project will improve the socio-economic status of the joining areas and will help to meet the energy demand of the nation. Project will lead to development of ancillary industries and an overall economic growth of nearby towns to supplement the population of the area.

The project is likely to give a boost to the economy of the area and providing primary and secondary employment to local people. There will be improvement in infrastructure facilities like drinking water, medical, educational, schools etc. There will be overall gain with respect to improvement in social and economical aspect. This will lead to the overall development of the society.

11.5 Analysis of Alternatives

Mineral deposits are site specific and therefore, selection of a mine site has limited alternatives. However, the activities relating to mine development and exploitation have many alternatives in terms of choice of mining method, drilling and blasting methodologies, location of waste dumps etc.

11.6 Environmental Monitoring Program

Following aspects of monitoring the effectiveness of mitigation measures will be taken into account:

Sl. No.	Technical aspects of monitoring the effectiveness of mitigation measures
1.00	Generation of environmental data bank
1.01	Measurement methodology
1.02	Frequency
1.03	Location
1.04	Data analysis
1.05	Reporting
1.06	Schedules
1.07	Emergency procedures
1.08	Detailed budget
1.09	Procurement schedules
2.00	Evolving micro environmental management plan for the project in collaboration with other agencies and consultants.
3.00	Monitoring project implementation along with environmental Control measures.
4.00	Co-ordinate with other project activities to ensure timely Implementation of the project.
5.00	Co-ordination with Ministry of Environment & Forest, Central / State Pollution Control Board for prevention and control of water and air pollution.

11.7 Additional Studies

11.7.1 Public Consultation

With a view to ascertaining the concern of local affected persons and others who have a plausible stake in environmental impacts of the project / activity a public consultation has been conducted at the project site. Detailed report is enclosed in VII chapter

11.7.2 PROJECT BENIFITS

This will result in following benefits:

- Improvements in physical infrastructure
- Improvements in social infrastructure and quality of life of people
- Increase in employment potential
- Contribution to the exchequer

- Prevention of illegal mining
- Post-mining enhancement of green cover and eco-restoration

11.7.3 Source of fund for CSR/CER-

- Normative Capacity of the Karo OCP is 15.00 MT. The fund for the CSR should be allocated based on 2% of the average net profit of the Company for the three immediate preceding financial years or Rs. 2.00 per Tonne of Coal Production of previous year whichever is higher.

11.8 Project Benefits

The setting up of mines has already brought changes in the living standards and quality of life of people in and around the mines by providing direct and indirect employment opportunities and through various welfare measures undertaken by CCL. Karo Expansion OCP (11/15 MTPA normative/peak capacity) & integrated non-coking coal Karo Washery (7 MTPA), B&K Area, Central Coalfields Limited will continue to enhance the socio-economic activities in the adjoining areas. This will result in following benefits:

- Improvements in physical infrastructure
- Improvements in social infrastructure and quality of life of people
- Increase in employment potential
- Contribution to the exchequer
- Prevention of illegal mining

Post-mining enhancement of green cover and eco-restoration

11.9 Environment Cost- Benefit Analysis

MOEF while issuing TOR has not specifically indicated for carrying out "Cost Benefit analysis" hence, the same has not been carried out.

11.10 Environment Management Plan

The activities associated with project construction and project management are likely to have minimum adverse impact on various environmental attributes including air, water, noise, soil, socio-economic profile and bio-environment. To ensure that levels of pollutants do not exceed the limits prescribed by regulatory authorities, following exercise has been taken up:

- Baseline environmental data have been generated to describe the present environmental quality in the study area.
- Likely impacts on environmental attributes due to project construction & operation have been assessed using standard method.

With above exercise, the anticipated levels of pollutants in environment have been assessed.

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Environment pollution mitigation measures have been recommended to minimize the impact & to limit them within prescribed level. These environmental mitigation measures are able to be implemental throughout the life of the project.

In addition, environmental parameters will be monitored on regular basis to ensure that level of pollution is within the prescribed level.

The project proponent (CCL) will submit several statutory reports relating to project's environment impact.

From the above, it may be seen that environmental management of the project during the full life will involve planning, design & implementation of several activities. This will require an exclusive budget and a dedicated organization.

11.10.1 Budget Estimate for Environmental Management

Capital Estimate

SN	Particulars	Amount (Rs Lakh)
Pollution Control		
•	Anti-pollution measures in mine & Industrial area	1142.28
•	Anti-pollution measures in township	89.55
•	Rain water harvesting scheme	20.00
Sub Total (1)		1251.83
Other Measures		
•	Cost of rehabilitation	1274.40
•	Cost of compensatory afforestation	3477.83
•	Cost of restoration	10325.13
•	Others	129.85
•	Compensation for non-forest land	1499.55
Sub Total (2)		16706.76
Grand Total (1+2)		17958.59

Chapter 12

Disclosure of Consultants Engaged

Table 12.1 Consultants Engaged

Generation Baseline data		
Sl. No.	Nature of Study	Name of Agency which has conducted the study
1.	EIA/EMP Report, Project Report, Pre-feasibility report of washery, Land use map based on recent imagery data, hydrogeology etc.	CMPDI, Ranchi CMPDI, a subsidiary of Coal India Ltd., is a premier consultancy organization engaged in mineral exploration, land resource management through remote sensing survey, coal petrography, mine planning, coal preparation & utilization, design of coal handling plants, environmental management of coal projects etc.
2.	Seasonal Ambient Air Quality and Micro-meteorology study, Water Quality Ambient Noise Level, Soil Quality study	Ecomen, Lucknow & CMPDI (One month Data, 16.09.18-15.10.15)
3.	Socio- Economic Study	VRDS Consultant, Chennai
4.	Flora & Fauna study	VRDS Consultant, Chennai

Chapter 13

Remediation Plan and Natural & Community Resource Augmentation Plan (NCRAP)

13.1 Brief Details of Violation

Karo OCP is an existing coal-mining project of CCL lying in East Bokaro Coalfield. The project area is coal bearing & land was acquired under CBA Act, 1957. There are number of other projects in adjoining locations and Karo OCP lies to the north of Bokaro Colliery and Bermo Quarry of DVC, to the west of Amlu Project and to the east of Konar Project. The project has existing EC capacity of 1.50 MTPA in project area of 226.33 Ha.

The production in last few years is given below.

Year	Coal (MT)	OBR (Mm ³)	Composite Excavation (Mm ³)
2014-15	1.63	0.68	1.72
2015-16	1.95	1.11	2.35
2016-17	1.50	0.77	1.73
2017-18	1.50	0.65	1.61

Note: The composite specific gravity is 1.57 Te/m³ of coal (1.55 for seams IX, X & XI and 1.64 for seam VI-VII comb) for calculation of composite excavation.

However, as per calendar program of Quarry-I submitted to EAC at the time of presentation for EC of 1.50 MTPA, the highest OB generation was 1.65 Mm³ for corresponding 1.50 MT coal production. This comes to 2.61 Mm³ composite excavation of coal+OB. This limit has never been exceeded in any of previous years in Karo OCP.

The project has run in violation in previous years on account of coal production beyond the prescribed EC capacity of 1.50 MTPA. However, the production was done as per the technology approved in the EC and coal extraction was done within the approved quarry area of 146.44 Ha permitted as per EC condition.

Further, the expansion of project from 1.50 MTPA to 11.0/15.0 MTPA along with coal washery was considered by EAC for EC on 23.06.2016 after conducting PH in January 2016.

13.2 Assessment of Ecological Damage

The objective of the present chapter is to assess the ecological damage with respect to air, water, land and other environmental attributes due to excess production.

13.2.1 Impact on Land Environment

The excess coal was produced from the same quarry area of the mine as mentioned in the approved EIA/EMP of 1.50 Mty. No land outside the project area has been broken. The post mining land use plan is enclosed below:

SN	Land use during mining	Post-mining land use	Total Area (Ha)
1	Quarry	Plantation on backfilled area	160.54
		Void Filled with Water	135.21
2	External OB dump	Plantation on External OB Dump	95.24
3	Infrastructures	CCL use	45.08
4	Road, nala diversion, green belt/vacant land & safety zone	Road in public use	4.4
		Nallah	3.3
		Green belt (10 to 30 m wide)	24.2
		Undisturbed Land	53.35
5	Residential colony	Public use	5
6	Conveyer to Kargali washery	CCL use	26.52
Total Land Required			552.84

13.2.2 Air Environment

Impact Assessment

In coal mining, the major source of air pollution is fugitive dust generated due to mining and its allied activities. To assess the impact of excess production on air environment, the Impact Prediction of particulate Matter (PM₁₀) has been done using FDM 90121 model.

The project has achieved its peak production of 1.95 MTPA in 2015-16. Therefore, 2015-16 has been considered as the worst-case scenario for the Impact Prediction.

Sources

During this phase, activities for mining of coal, its handling and transport were taken up. Such activities are detailed below:

(i)	Drilling & Blasting in coal and OB benches	Dust and noxious gases
(ii)	Handling, loading & unloading of coal	Dust and noxious gases
(iii)	Handling, loading & unloading of OB	Dust and noxious fumes
(iv)	Coal transportation to siding	Dust and noxious fumes
(v)	Crushing of coal	Dust and noxious gases
(vi)	Handling, loading and unloading of coal at railway siding	Dust and noxious gases

Receptors:

The transport of particulate matter majorly depends upon the wind direction of that area and the villages lying in the downwind wind direction of the project area will be subjected to greater impact when compared to villages lying in the up wind direction. Air quality monitoring stations have been selected considering the predominant wind direction and areas having greater exposure to air pollution. Stations A1 & A2 fall within the core zone of

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the project and Station A6 falls in the core zone of adjacent project i.e., Kargali OCP and remaining stations fall within the buffer zone of project area.

SI. No.	Location Name	Location Code	Direction (From Site)	Distance (Km)
1.	Workshop	A1	NE	0.70
2.	Baidyakaro	A2	SW	1.5
3.	Subhash nagar	A3	SE	0.50
4.	Charakpaniya	A4	N	0.30
5.	Khurpaniya colony	A5	W	1.50
6.	GM office*	A6	S	1.90

The assessment of air quality due to excess production (1.95 MTPA) including the existing control measures is as given below.

**AQIP for Particulate Matter (PM₁₀)
(Based on FDM model for 1.95 MTPA coal production).**

Zone Category	24 Hours average PM10 concentration (µg/ m ³)					
	Incremental Concentration without control measures (BAU)	Incremental Concentration with control measures	Background/ Baseline concentration	Total predicted concentration without control measures (BAU)	Total predicted concentration with control measures	Permissible limit
A1-Workshop	82.47	10.77	157.46	239.93	168.23	300
A2-Baidyakaro	0.00	0.00	137.00	137.00	137.00	
A3-Subhash Nagar	0.13	0.02	65.25	65.38	65.27	100
A4-Charakpaniya	0.00	0.00	67.10	67.10	67.10	
A5-Kurpaniya Colony	0.11	0.06	71.66	71.77	71.72	
A6-GM Office	0.35	0.06	74.40	74.75	74.46	

The summary of air quality monitoring data during the period (17/10/2015 – 16/01/2016) for 6 locations is as given below.

Maximum and Minimum value of Ambient Air Results

SI. No.	Parameter	PM _{2.5} (µg/m ³)		PM ₁₀ (µg/m ³)		SO ₂ (µg/m ³)		NO _x (µg/m ³)	
	Locations	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1.	WORKSHOP (A- 1)	81.10	54.80	166.10	145.70	28.60	20.30	36.60	24.40
2.	BAIDYA KARO (A- 2)	68.60	55.90	144.30	128.90	22.30	13.30	50.70	16.10
3.	SUBHASH NAGAR (A- 3)	43.10	35.20	70.30	60.00	21.40	13.30	52.00	17.70
4.	CHARAKPANIYA (A- 4)	48.20	39.00	73.00	61.30	19.70	8.80	53.00	18.10
5.	KHURPANIA COLONY (A-5)	52.00	41.30	78.20	68.20	12.75	9.00	50.10	23.60

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6.	GM OFFICE (A-6)	60.00	50.20	82.50	70.10	11.25	7.79	38.70	23.30
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Analysis of Heavy Metals in PM10 Samples

Unit: $\mu\text{g}/\text{m}^3$

Location Code	As	Co	Hg	Se	Cr	Cu	Mn	Ni	Pb	Zn
A1	BDL	BDL	BDL	BDL	BDL	0.04	0.14	0.15	0.15	1.60
A2	BDL	BDL	BDL	BDL	BDL	0.07	0.13	0.12	0.16	1.55
A3	BDL	BDL	BDL	BDL	BDL	0.03	0.12	0.14	0.12	1.30
A4	BDL	BDL	BDL	BDL	BDL	0.02	0.16	0.15	0.10	1.46
A5	BDL	BDL	BDL	BDL	BDL	0.04	0.14	0.14	0.11	1.32
A6	BDL	BDL	BDL	BDL	BDL	0.03	0.12	0.16	0.10	1.61
Detection Limit (ppm)	0.008	0.01	0.001	0.01	0.04	-	-	-	-	-

Analysis of free SiO₂ in PM10 Samples

Unit: $\mu\text{g}/\text{m}^3$

Location Code	Date of Monitoring	
	09.11.15	21.12.15
A1	1.20	1.00
A2	1.14	1.18
A3	1.22	1.10
A4	1.15	0.97
A5	0.90	0.95
A6	1.21	0.85

From the baseline air quality data, it can be observed that all values of criteria pollutants monitored are well within the limits. Further analysis particulate matter for heavy metals and SiO₂ also do not show any significant pollution levels in core and buffer zone. Buffer zone of the project region is a highly industrialized zone containing several mines of CCL and other industries (including powerhouses of DVC), and is difficult to quantify the impact of a single source. However, from both impact study and monitoring data, all the air quality parameters are observed to be within the permissible limits prescribed as NAAQS, 2009 by CPCB. Therefore, it can be said that there is no damage on air environment due to excess production. It can be observed from the above table that the gaseous pollutants are always within limit. However, to mitigate the air pollution and compensate the violation due to excess production the control measures are proposed in Natural and Community Resource Augmentation Plan.

Existing Control Measures

- a. Drilling and blasting:
 - To control the generation and transportation of coal dust during drilling, wet drilling and dust extraction practices have been adopted.
 - Controlled blasting is being practiced.
- b. Loading, unloading and transportation
 - The dust suppression on transportation road is being done through mobile sprinklers. 3 no. of 28 KL sprinklers and one mist type sprinkler(New Technology) has been proposed for this purpose.
 - Coal is being transported through covered tarpaulin trucks.
 - Periodic maintenance is being carried out for keeping unmetalled roads free of ruts, potholes, etc. Physical removal of dust from the roads.



Fig: Dust Suppression by 28 KL Water sprinkler



Fig: Dust Suppression at Crusher Unit

13.2.3 Impact on Water Environment

Water can be categorized in two categories:

- Ground Water
- Surface Water

Ground Water

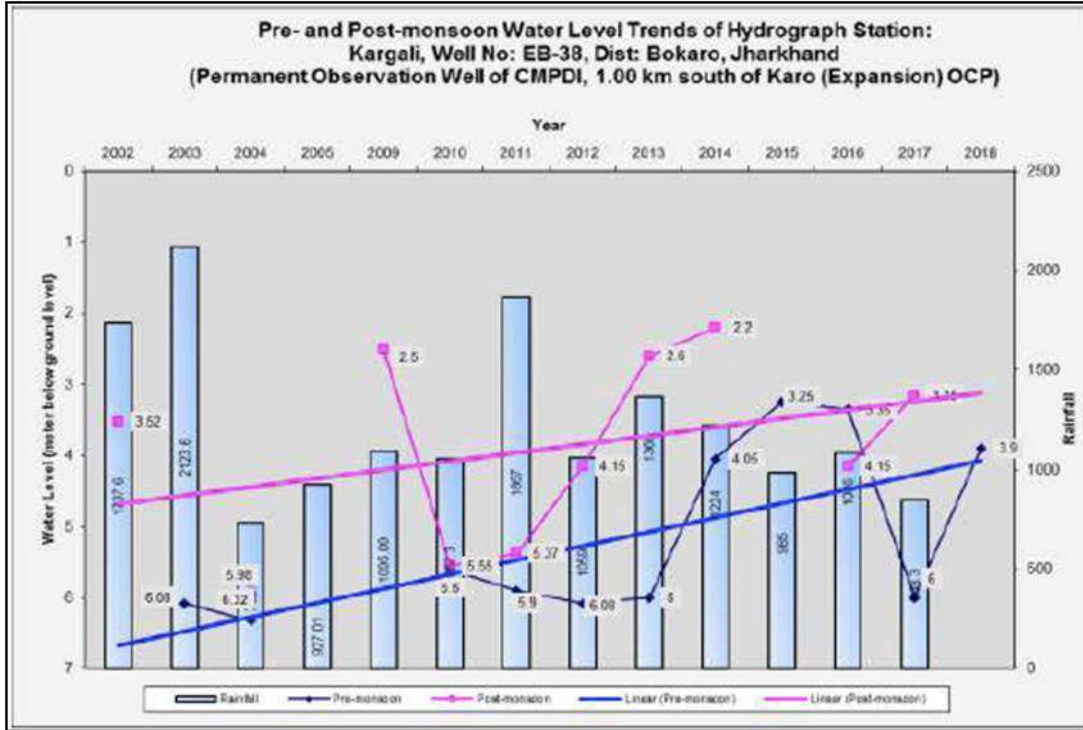
To evaluate the behaviour of long term groundwater level trends, long-term water level data from the permanent observation well of CGWB have been referred. Long term water level trends at hydrograph stations Kargali (Well No.: EB-38) and Pahadi Dhouda (Well No.: EB-36) were collected and are given below. It was estimated that the radius of influence due to project activities on ground water regime is about 320m. Hence, the impact due to excess production on ground water regime can be well understood by studying the long-term ground water pattern at this location..

Historical Ground Water Level

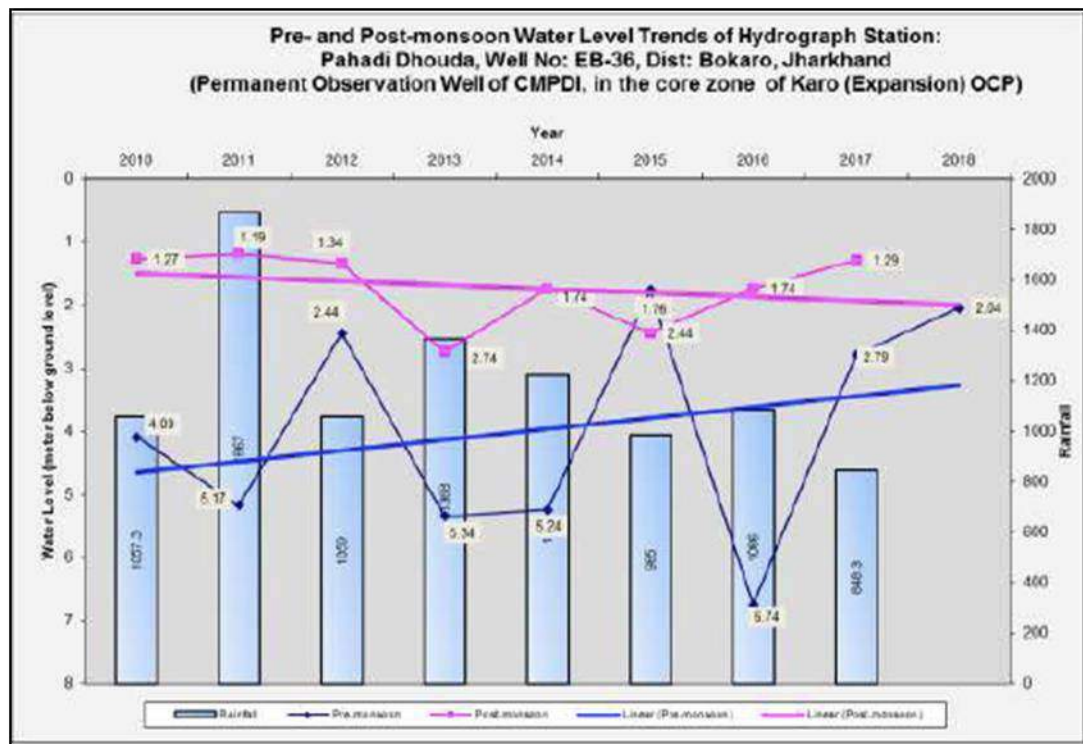
Station/ Year	Kargali (Well No.: EB-38) (Distance 1.0 km South of Proposed Karo (Exp.) OCP)		
	Pre-Monsoon (in m)	Post Monsoon (in m)	Fluctuation (in m)
2002	-	3.52	-
2003	6.08	-	-
2004	6.32	5.98	0.34
2005	-	-	-
2009	-	2.50	-
2010	5.60	5.55	0.05
2011	5.90	5.37	0.53
2012	6.08	4.15	1.93
2013	6.0	2.60	3.40
2014	4.05	2.20	1.85
2015	3.25	-	1.35
2016	4.35	3.25	1.10
2017	4.15	3.15	1.10
Average	5.41	3.98	1.43

Pahadi Dhouda (EB-36) (Situated within the core zone of Proposed Karo (Exp.) OCP)			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Fluctuation (m)
2010	4.09	1.27	2.82
2011	5.17	1.19	3.98
2012	2.44	1.34	1.10
2013	5.34	2.74	2.60
2014	5.24	1.74	3.50
2015	1.76	-	-
2016	6.74	1.74	5.0
2017	2.79	1.29	1.50
2018	2.04	-	-
Average	3.95	1.67	2.92

Pahadi Dhouda (EB-36)			
(Situated within the core zone of Proposed Karo (Exp.) OCP)			
Year	Pre-monsoon (May)	Post-Monsoon (Nov)	Fluctuation (m)
*Water levels are from ground level in meter.			



Hydrograph of Kargali (Well No: EB-38)



Hydrograph of Pahadi Dhouda (Well No: EB - 36)

Both water level trends of CMPDI observation wells of EB-36 and EB-38 (Plate no. VIII A & B), located in core zone of Karo Expansion OCP, do not show any declining trend. Overall groundwater utilisation with the increasing population and by mining has not affected the local groundwater regime and adverse impact has been observed due to excess production.

The ground water quality was monitored at two locations Bhutia Tand, Hand Pump (GW1) and Bore Well of Baidya Karo Basti (GW2) during the baseline study carried out during the period (17/10/2015 – 16/01/2016).

Further one month (16.09.2018 – 15/10/2018) ground water quality data has been generated by CMPDI at the same locations for comparison and validation of baseline data.

**Ground water Quality Monitoring
Period :(17/10/2015 – 16/01/2016)**

Location Code	pH	TDS (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	Nitrate (mg/l)	Iron (mg/l)	Total Coliform (MPN/100ml)
GW-1	7.44	389	26	0.91	8.81	0.14	Absent
GW-2	6.94	394	28	0.89	10.10	0.16	Absent
IS: 10500:1991 (Reaff:2012)	6.5-8.5	500	250	1.00	45.00	0.3	Absent

Ground water Quality- Validation

Period: (16/09/2018 – 15/10/2018)

SN	Parameter	Sampling Stations		Detection Limit	IS:10500 Standards	Standard / Test Method
		GW-1	GW-2			
1	Boron (as B), mg/l, Max	<0.20	<0.20	0.20	0.5	APHA, 22 nd Edition ,Carminc
2	Cadmium (as Cd), mg/l, Max	<0.0005	<0.0005	0.0005	0.003	APHA, 22 nd Edition, AAS-GTA
3	Calcium (as Ca), mg/l, Max	60.8	43.2	1.60	75	IS-3025/40:1991, EDTA
4	Chloride (as Cl), mg/l, Max	70	16	2.00	250	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	0.03	0.05	IS 3025/42 : 1992 R : 2009, AAS-Flame
6	Fluoride (as F) mg/l, Max	1.10	1.26	0.02	1.0	APHA, 22 nd Edition , SPADNS
7	Free Residual Chlorine, mg/l, Min	<0.02	<0.02	0.02	0.2	APHA, 22 nd Edition, DPD
8	Iron (as Fe), mg/l, Max	<0.06	0.14	0.06	0.3	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
9	Lead (as Pb), mg/l, Max	<0.005	<0.005	0.005	0.01	APHA, 22 nd Edition, AAS-GTA
10	Manganese (as Mn),	0.05	0.12	0.02	0.1	IS-3025/59:2006,AAS-Flame

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	mg/l, Max					
11	Nickel (as Ni), mg/l, Max	0.01	<0.01	0.01	0.02	IS-3025/54:2003, AAS-Flame
12	Nitrate (as NO ₃), mg/l, Max	3.56	1.49	0.5	45	APHA, 22 nd Edition, UV-Spectrophotometric
13	Odour	Agreeable	Agreeable	Qualitative	Agreeable	IS 3025 /05:1983, R-2012, Qualitative
14	pH value	7.32	7.98	0.2	6.5 to 8.5	IS-3025/11:1983, R-1996, Electrometric
15	Phenolic compounds (as C ₆ H ₅ OH), mg/l, Max	<0.001	<0.001	0.001	0.001	APHA, 22 nd Edition, 4-Amino Antipyrine
16	Selenium (as Se), mg/l, Max	<0.002	0.003	0.002	0.01	APHA, 22 nd Edition, AAS-GTA
17	Sulphate (as SO ₄) mg/l, Max	58	17	2.00	200	APHA, 22 nd Edition. Turbidity
18	Total Alkalinity (CaCO ₃), mg/l, Max	162	140	4.00	200	IS-3025/23:1986, Titration
19	Total Arsenic (as As), mg/l, Max	<0.002	<0.002	0.002	0.01	IS 3025/ 37:1988 R : 2003, AAS-VGA
20	Total Dissolved Solids, mg/l, Max	380	218	25.00	500	IS 3025 /16:1984 R : 2006, Gravimetric
21	Total Hardness (CaCO ₃), mg/l, Max	189	160	4.00	200	IS-3025/21:1983, R-2002, EDTA
22	Turbidity, NTU, Max	1	6	1.0	1	IS-3025/10:1984 R-1996, Nephelometric
23	Zinc (as Zn), mg/l, Max	0.56	0.01	0.01	5.0	IS 3025/ 49 : 1994, R : 2009, AAS-Flame

From the validation data it can be observed that all the parameters including pH, TDS etc are within limits and represent the natural ground water quality pattern of that area.

To enhance the ground water recharge, excavated mine voids within the project area have been turned into water bodies filled with excess mine discharge.



Fig: Rainwater Harvesting by Ponds near New Karo Colony



Fig: Check Dam near Godo Nallah



Fig: Piezometer Installed in Karo OCP



Fig: Garland Drain and Toe-wall

Surface Water

The study area falls under the influence of River Damodar, Godda Nala & Tisri River. No effluent water is being discharged directly into surface water bodies. Measures have been

taken to prevent the contamination of surface water bodies by the surface runoff from the OB dump and mine through construction of Toe wall and catch drains.



Fig: Toe wall along OB dump in Karo OCP



Fig: Catch Drains along OB Dump

The effluent water from workshop is being treated at ETP containing Oil and grease trap and Settling ponds, and the treated water is being reused for industrial purposes.



Fig: Oil and Grease Trap at Karo OCP

The effluent water quality was monitored at two locations Lagoon Discharge (KW1) and lagoon discharge (KW2) during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one month (16.09.2018 – 15/10/2018) effluent water quality data has been generated by CMPDI at the same locations for comparison and validation of baseline data.

**Effluent Water Quality
Period: (17/10/2015 – 16/01/2016)**

Location Code	pH	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	Chloride (mg/l)	O & G(mg/l)	Ammonical Nitrogen as NH ₃ -N (mg/l)
EW-1	7.46	10.1	3.0	8.0	40.0	BDL	0.22
GSR 422(E) Std.	5.5-9.0	100	30	250	2.0	10.0	50.0

**Effluent Water Quality- Validation
Period: (16.09.2018 – 15/10/2018)**

Sl.No.	Parameter	Sampling Stations			Detection Limit	MOEF -SCH-VI STANDARDS Class 'A'	BIS Standard & Method
		1	2	3			
1	Ammonical Nitrogen, mg/l, Max	0.14	0.15		0.02	50.0	IS 3025/34:1988, R : 2009, Nessler's
2	Arsenic (as As), mg/l, Max	<0.002	<0.002		0.002	0.2	IS 3025/37:1988 R : 2003, AAS-VGA
3	B.O.D (3 days 27°C), mg/l, Max	6.0	6.0		2.00	30.0	IS 3025 /44:1993,R:2003 3 day incubation at 27°C

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4	Cadmium(as Cd), mg/l, Max	<0.0005	<0.0005		0.0005	2.0	APHA, 22 nd Edition, AAS-GTA
5	COD, mg/l, Max	20	24		4.00	250.0	APHA, 22 nd Edition, Closed Reflux, Titrimetric
6	Copper (as Cu), mg/l, Max	<0.03	<0.03		0.03	3.0	IS 3025/42: 1992 R : 2009, AAS-Flame
7	Dissolved Phosphate, mg/l, Max	0.38	0.35		0.30	5.0	APHA, 22 nd Edition Molybdovanadate
8	Fluoride (as F) mg/l, Max	1.23	1.24		0.02	2.0	APHA, 22 nd Edition, SPADNS
9	Free Ammonia, mg/l, Max	<0.02	<0.02		0.02	5.0	IS:3025/34:1988, Nessler's
10	Hexavalent Chromium, mg/l, Max	<0.01	<0.01		0.01	0.1	APHA, 22 nd Edition, Diphenylcarbohydrazide
11	Iron (as Fe), mg/l, Max	<0.06	<0.06		0.06	3.0	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
12	Lead (as Pb), mg/l, Max	<0.005	<0.005		0.005	0.1	APHA, 22 nd Edition, AAS-GTA
13	Manganese(as Mn), mg/l, Max	0.02	<0.02		0.02	2.0	IS-3025/59:2006, AAS-Flame
14	Nickel (as Ni), mg/l, Max	0.01	0.02		0.01	3.0	IS-3025/54:2003, AAS-Flame
15	Nitrate Nitrogen, mg/l, Max	2.48	2.53		0.50	10.0	APHA, 22 nd Edition, UV-Spectrophotometric
16	Oil & Grease, mg/l, Max	<2.00	<2.00		2.00	10.0	IS 3025/39:1991, R : 2003, Partition Gravimetric
17	pH value	7.81	7.21		0.2	5.5 to 9.0	IS-3025/11:1983, R-1996, Electrometric
18	Phenolic compounds (as C ₆ H ₅ OH),mg/l, Max	<0.001	<0.001		0.001	1.0	APHA, 22 nd Edition 4-Amino Antipyrine
19	Selenium (as Se), mg/l, Max	0.005	0.005		0.002	0.05	APHA, 22 nd Edition, AAS-GTA
20	Sulphide (as SO ₃), mg/l, Max	<0.005	<0.005		0.005	2.0	APHA, 22 nd Edition Methylene Blue
21	Temperature (°C)	28	28		Shall not exceed 5° C above the receiving temp.		IS-3025/09:1984, Thermometric
22	Total Chromium (as Cr), mg/l, Max	0.22	0.26		0.04	2.0	IS-3025/52:2003, AAS-Flame
23	Total Kjeldahl Nitrogen, mg/l, Max	<1.00	<1.00		1.00	100.0	IS:3025/34:1988, Nessler's
24	Total Residual Chlorine, mg/l, Max	<0.02	<0.02		0.02	1.0	APHA, 22 nd Edition, DPD
25	Total Suspended Solids, mg/l, Max	32	34		10.00	100.0	IS 3025/17:1984, R :1996, Gravimetric
26	Zinc (as Zn), mg/l, Max	0.01	0.02		0.01	5.0	IS 3025 /49 : 1994, R : 2009, AAS-Flame

The effluent water quality data shows that there is no significant change in the baseline environmental status of project area.

The surface water quality was monitored at three locations Godda Nalla (SW1) (U/S), Damodar River (SW2) (D/S) and Konar River (SW3) (U/S) during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one month (16.09.2018 – 15/10/2018) surface water quality has been generated by CMPDI at the same locations for comparison study and validation of baseline data.

Surface Water Quality
Period: (17/10/2015 – 16/01/2016)

Location Code	pH	TDS (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	Nitrate (mg/l)	Iron (mg/l)	Total Coliform (MPN/100ml)
SW-1 (U/S)	7.41	452	50.0	0.38	8.00	0.06	160
SW-2 (D/S)	7.46	400	42.5	0.43	8.48	0.14	180
SW-3 (U/S)	7.31	410	48.0	0.48	5.86	0.098	120

Surface Water Quality- Validation
Period: (16.09.2018 – 15/10/2018)

Sl. No	Parameter	Sampling Stations			Detection Limit	BIS Standard & Method
		SW1	SW2	SW3		
1	Arsenic (as As), mg/l, Max	<0.002	<0.002	<0.002	0.002	IS 3025/37:1988 R : 2003, AAS-VGA

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2	BOD (3 days 27°C), mg/l, Max	2.4	2.4	6.2	2.00	IS 3025 /44: 1993, R : 2003 3 day incubation at 27°C
3	Cadmium(as Cd), mg/l, Max	<0.0005	<0.0005	<0.0005	0.0005	APHA, 22 nd Edition AAS-GTA
4	Chlorides (as Cl), mg/l, Max	14	14	14	2.00	IS-3025/32:1988, R-2007, Argentometric
5	Copper (as Cu), mg/l, Max	<0.03	<0.03	<0.03	0.03	IS 3025 /42 : 1992 R : 2009, AAS-Flame
6	Disolved Oxygen, min.	6.3	6.3	6.2	0.10	IS 3025/38:1989, R : 2003, Winkler Azide
7	Fluoride (as F) mg/l, Max	0.91	0.66	0.17	0.02	APHA, 22 nd Edition SPADNS
8	Hexavalent Chromium, mg/l, Max	<0.01	<0.01	<0.01	0.01	APHA, 22 nd Edition, 1,5 - Diphenylcarbohydrazide
9	Iron (as Fe), mg/l, Max	<0.06	0.30	1.53	0.06	IS 3025 /53 : 2003, R : 2009 , AAS-Flame
10	Lead (as Pb), mg/l, Max	<0.005	<0.005	<0.005	0.005	APHA, 22 nd Edition AAS-GTA
11	Nitrate (as NO ₃), mg/l, Max	5.39	2.47	<0.50	0.50	APHA, 22 nd Edition, UV-Spectrophotometric
12	pH value	7.24	7.96	7.54	0.2	IS-3025/11:1983, R-1996, Electrometric
13	Phenolic compounds (as C ₆ H ₅ OH), mg/l, Max	<0.001	<0.001	<0.001	0.001	APHA, 22 nd Edition 4-Amino Antipyrine
14	Selenium (as Se), mg/l, Max	<0.002	0.003	0.003	0.002	APHA, 22 nd Edition AAS-GTA
15	Sulphate (as SO ₄) mg/l, Max	25	45	08	2.00	APHA, 22 nd Edition Turbidity
16	Total Dissolved Solids, mg/l, Max	168	164	104	25.00	IS 3025 /16:1984 R : 2006, Gravimetric
17	Total Suspended Solids, mg/l, Max	10	28	72	10.00	IS 3025 /17:1984, R :1996, Gravimetric
18	Zinc (as Zn), mg/l, Max	0.02	0.01	0.02	0.01	IS 3025 /49 : 1994, R : 2009, AAS-Flame

The surface water quality data shows that there is no significant adverse impact of mining operations on the surrounding surface water bodies like River Bokaro, River Damodar and Goddo Nala.

13.2.4 Noise and Vibration

The major source of noise and vibration due to mining and its allied activities are as listed below.

- Drilling and Blasting
- Heavy Machinery
- Movement of coal transportation vehicles.

Existing Control Measures

- Controlled blasting is being practiced.

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- Blasting is being done at specific time and care is being taken that no person is present in the vicinity during the time of blasting.
- No blasting has been carried out within the 150 m of any structure nearby.
- As per the blast monitoring report, it was observed that the vibration levels are less than 5mm/sec.
- Workmen who are susceptible to heavy noise exposure have been provided with ear muffs and sound proof operator cabins.

The ambient noise quality monitoring stations were set up at six locations, two locations in core zone and four locations in buffer zone area during the baseline study carried out during the period (17/10/2015 – 16/01/2016). Further one-month (16.09.2018 – 15/10/2018) noise quality has been generated by CMPDI at the same locations for comparison and validation of baseline data.

Day & Night Time Noise Level Data
Period: (17/10/2015 – 16/01/2016)

Date	Noise Level in dB (A)		LOCATIONS CODE					
			N ₁	N ₂	N ₃	N ₄	N ₅	N ₆
19.10.2015	L _{eq}	Day	61.8	54.8	63.6	61.3	52.3	51.6
		Night	54.0	44.6	56.4	53.9	43.1	42.6
10.11.2015	L _{eq}	Day	60.5	54.8	63.9	60.2	53.6	51.9
		Night	53.9	44.8	56.9	52.6	44.2	45.6
25.11.2015	L _{eq}	Day	61.3	54.5	62.6	59.3	52.6	50.3
		Night	53.2	44.3	53.6	49.3	43.5	43.2
10.12.2015	L _{eq}	Day	60.5	54.6	61.2	57.8	52.6	50.3
		Night	53.9	44.5	51.3	46.2	43.5	43.6
25.12.2015	L _{eq}	Day	63.6	53.9	58.5	56.3	52.5	50.1
		Night	54.6	45.0	51.0	43.0	44.2	43.9
09.01.2016	L _{eq}	Day	63.0	54.2	57.0	56.2	51.8	50.0
		Night	54.3	44.9	48.1	44.2	42.8	43.7

From the above table, it can be observed that there is no significant damage due to mining activities on noise environment.

13.2.5 Impact on Flora Fauna

The excess production was excavated from the same quarry without diversion of any additional land. Therefore, due to excess production no additional forestland has got affected. The total forestland involved in Karo(Exp.) OCP is 311.60 Ha out of which Stage II FC has already been granted for 77.43 ha forest land diverted vide letter number: F.No.8-22/2003- FC Dated: 31/03/2004. For remaining, 226.67 Ha forest land Stage-I FC has been accorded on 24/12/2018 vide letter number: F.No.8-25/2009- FC.

As per the Flora Fauna study carried out QCI accredited consultant of CMPDI, the following observations are noted.

- Coal mining activity has been prevalent in this region prior to nationalization period, the flora & fauna especially in the core zone of the project is almost degraded.
- In buffer zone, the forest occurs in small sporadic patches consist of open mixed deciduous vegetation of Shorea robusta dominant tree species. The remaining area

is either barren or used as farmland for cultivation by the villagers growing both traditional and commercial crop varieties.

- It was found that there was no endangered, threatened and endemic category fauna as per the IUCN-Red Data Book (RDB), Botanical Survey of India (BSI), Indian wildlife (Protection) Act, 1972. During survey no endangered and threatened aquatic fauna have been noticed by the investigation team.

Therefore, it can be observed that there is no direct impact on flora & fauna due to excess production because no additional forest land has been broken and the forest land involved has already been diverted and NPV and compensatory afforestation cost for double of the area has already been submitted to statutory bodies.

However, due to transport and deposition of air borne particulate matter generated from the mining activity might have affected the flora and fauna in buffer zone. The pattern of incremental fugitive dust concentrations in buffer have been studied in the previous section and the mitigative measures have been suggested in the NCRAP.

13.2.6 Impact on Socio Economic Profile

- EC violation can cause damage in social context due to excess inflow of mining workers, peripheral workers like workers repairing shops, dhabas etc.
- If excess workers come into socio-economic context then it may cause further deterioration of local ecology due to limited carrying capacity of ecology.
- This may result in to falling health/ socio-economic standards of existing population as well as vulnerability of new workers.
- This in total damages local environment particularly socio-economic context.

Here we are not discussing health hazard due to excess production as the same has been discussed in other heads.

Preventive/Mitigative measures adopted

- Most of the socio-economic indicators mentioned in previous baseline study are still hold good because project boundary has not been changed and production is being done from existing quarry.
- CSR activities are carried out continuously. More emphasis of CSR are in drinking water, infrastructure, sanitation, education, skill development, social empowerment, water management, environment, sports and health.
- CSR expenditure detail is given below. It is not the complete detail but It is since organised CSR started in the area. CSR activities were being carried out prior the period given below.

Sectorial Year-wise CSR Expenditure (Rs Lakh) of B&K Area, CCL

SN	Sector	2013-14	2014-15	2015-16	2016-17	2016-17 additional	2017-18	Total
1	Drinking water	16.63	28.59	9.61	22.55	84.20	114.00	275.58
2	Education	40.30	48.59	8.76	0.00	0.00	17.00	114.65
3	Infrastructure	105.98	108.01	32.50	0.00	0.00	0.00	246.49
4	Sanitation	3.47	0.00	3.25	40.43	0.00	19.00	66.15

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5	Sports	5.20	5.21	1.82	0.00	0.00	0.00	12.23
6	Environment	0.00	12.01	76.21	9.69	0.00	17.00	114.91
7	Medical	0.00	8.94	4.19	22.40	0.00	0.00	35.53
8	Skill Development	0.00	0.00	3.89	15.15	21.50	1.50	42.04
9	Miscellaneous	0.00	12.95	16.80	0.00	0.00	20.30	50.05
Total		171.58	224.3	157.03	110.26	105.66	188.80	957.63



Fig: Computer Training (Part of Skill Development Activity) at B & K Area



Fig: Driver Training (Part of Skill Development Activity) at B & K Area



Fig: Youth Development Centre at B & K Area



Fig: Schools maintained by B & K Area under CSR

Damage Assessment

- There is no substantial damage to ecology as mentioned earlier as project area remained same and production was enhanced without significant increase in manpower. However, remedial measures taken under CSR and R&R were significant.
- Some impacts cannot be verified independently as it is an industrial complex and impact can be cumulative effect of all the industrial activities running in the periphery. Moreover, mining in the region is substantially older than any other industrial activity in the region therefore it won't be justified to ascribe any significant socio-economic change to EC violation as local population has benefitted from the mining operations.

Remedial Measures

- More resources will be dedicated to job oriented skill development activities so that people get involved in sustainable income activities. Skill courses will be according to local needs as well so that youth can have local employment.
- Another area of emphasis is education. CCL is providing coaching facility for IIT/NITs entrance exam to local school going children through its CCL ke Laal, Ladli scheme. Similar efforts can be done in reducing school drop-out rates.
- CCL is also involved in renovation of ponds. More ponds will be renovated as rural livelihood are designed around such sources of water. It helps in irrigation, fishery, drinking water for domestic animals etc.
- It will be worked in phased manner, taking up developmental activities in one panchayat at a time then next panchayat in next year, if the fund and planning permits.
- It also needs to do some pilot projects in public health like mobile health van to remote villages, hygiene and care of adolescent girls.
- It will be planned to promote community afforestation, where a village panchayat is encouraged to do afforestation in barren land and self-manage that forest.

13.2.7 Occupational Health and Safety

Due to increased pollution load and mining activities in the period of violation, health of the workmen and villagers living within the vicinity of the project may get affected.

Measures implemented

- To examine the health status of workmen who are exposed to extreme working conditions, periodic Medical Examination (PME) have been taken up. A total no of 127,294 & 135 people have undergone PME during the year 2015,2016 & 2017.
- Distribution of Safety items like Helmet, dust mask, safety goggles, earplugs etc.

Year	Dust Mask issued (Nos.)
2012-13	300
2013-14	150
2014-15	100
2015-16	522
2016-17	28
2017-18	500

- Safety inspections are being done periodically by Safety Officer of the project to check if there is any non-compliance.
- Health camps are being organized in the near by villages to check the health status and the report enclosed as annexure XI.

Impact Assessment

The PME report and Health report of nearby villages has been referred to study the impact on health and safety.

- PME report suggests that no such health impact on workmen due to pollution is identified.
- From the last 5 years health status of villagers, the major health defects identified were Bodyaches, Anaemia, Dermatties, chest infection etc. and there was no instance of occupational diseases such as pneumoconiosis.

However, to get a clear picture of the health status of villagers, more health camps will be organized in nearby villages as a part of NCRAP.

13.3 Proposed Remediation Plan and Natural and Community Resource Augmentation Plan (NCRAP)

Table 13.1 Remediation & Natural/Community Resource Augmentation Plan – Budgetary Allocation (Estimated)

SL	Environmental Attributes	Damages	Remedial Measures	Budget Estimated (Rs. In L)
1.	Air	Damage caused due to increase in fugitive dust (PM ₁₀)	Additional 01 numbers of Mist type 28 KL (new type of sprinklers)	125.00
			Proposed 1.56 km of metallised coal transport road transport	56.00

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

2	Noise	Increase in ambient Noise levels due to heavy machinery and transportation	Plantation around feeder breaker, workshop & along coal transportation road with indigenous 3 storied multi species saplings	5.00
3	Ground Water	Depletion in Water Levels due to mining, decreasing run off factor	Expenditure for garland drain of 3 Km length to channelize and store water in check dam.	40.0
			Up-gradation / strengthening of ETP	10.00
4	Surface Water	Utilization of Natural Resources (River water for construction activities contamination of surface water)	Restoration of water bodies in peripheral areas.	10.00
			Construction of Check dam/s	90.00
5	Ecology	Impacts on Plants & Trees/Biodiversity in the vicinity	Avenue plantation on external roads	5.0
			Distribution of Free saplings to peripheral villager's native plants	5.0
6	Occupational Health & Safety	Due to increased pollution load and mine activities during violation period	Health Check-up Camps in nearby Villages	45 (Rs 3 Lakh/Year)
Total Amount To Be Spent				391

Table 13.2 Proposed Action Plan for Natural and Community Resource Augmentation

Activities	Schedule for Implementation					Approximate Expenditure (Rs. In Lakh)
	Financial Year					
	1 st -3 rd	4 th -6 th	7 th - 9 th	10 th -12 th	12 th -15 th	
Additional 01 numbers of Mist type 28 KL (New type of sprinklers)	125	0	0	0	0	125
Proposed 1.56 km of metalled coal transport road transport	56	0	0	0	0	56
Plantation around feeder breaker, workshop & along coal transportation road with indigenous 3 storied multi species saplings	3	0	2	0	0	5
Expenditure for garland drain of 3 Km length to channelize and store water in check dam.	0	20	20	0	0	40
Up-gradation / strengthening of ETP	5	0	5	0	0	10
Restoration of water bodies in peripheral areas.	2	2	2	2	2	10
Construction of Check dam/s	90	0	0	0	0	90
Avenue plantation on external roads	0	5	0	0	0	5

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

Distribution of Free saplings to peripheral villager's native plants	1	1	1	1	1	5
Health Checkup Camps in Nearby Villages	9	9	9	9	9	45
TOTAL	291	37	39	12	12	391

PROFORMA FOR ENVIRONMENTAL APPRAISAL OF MINING PROJECTS (MINING SECTOR PROJECTS)

- Note 1 : All information to be given in the form of Annex/s should be properly numbered and form part of reply to this proforma.
- 2 :** Please enter ✓ in appropriate box where answer is Yes / No
- Note 3 : No abbreviation to be used - **Not available** or **Not applicable** should be clearly mentioned.
- Note 4 : **Core zone** is the mining lease area.
Buffer zone in case of ML area up to 25 ha. is to be considered as **5 km** all around the periphery of the core zone and for ML area above 25 ha. an area **10 km** all around the periphery of the core zone.
- Note 5 : Adopt **Scoping process** in carrying out EIA study.
- Note 6 : Please indicate source of data

1.0 General Information		
A	Name of the project	Karo Expansion OCP (15.00 MTPA) & Integrated Karo Non-coking Coal Washery (7 MTPA), B & K Area, Central Coalfields Limited.
	Name of the proponent	Project Officer of Karo OCP
	Mailing Address	Project Officer, Karo OCP, Bokaro & Kargali Area, Central Coalfield Limited, Block-Bermo, P.O- Sunday Bazar, District- Bokaro, Jharkhand, PIN-829127
	E-mail	pokaro047@gmail.com
	Telephone	8987784819
	Fax No.	-
B	Objective of the project	Proposed expansion of Karo OCP (15.00 MTPA capacity) & new integrated Karo non-coking coal Washery (7.00 MTPA)
C	Location of mine (s)	
	Village(s) /Tehsil/ District /State	Block-Bermo, P.O- Sunday Bazar, District- Bokaro, Jharkhand, PIN-829127
D	Does the proposal relate to	
	New mine	No
	Expansion	Yes
	Increase in ML area	Yes
	Increase in annual production	Yes
	Renewal of ML	No
	Modernisation	Yes
E	Site Information	
I	Geographical Location	
	Latitude	23 ^o 47'02" & 23 ^o 48'38"

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

	Longitude	85°57'27" & 85°58'38".
	Survey of India Topo sheet number	73 E/13
	Elevation above Mean Sea Level	237 m to 335 m above mean sea level.
	Total mining lease area (in ha.)	552.84Ha
Ii	Dominant nature of terrain	Undulating and Rolling
	Flat	No
	Undulated	Yes
	Hilly	Yes
2.	Land usage of the mining lease area (in Ha.) As per Satellite Imagery	
	Agriculture	58.00
	Forest	168.00
	Waste Land	46.84
	Surface Water Bodies	2.00
	Others (Mining, Plantation & Settlement)	278.00
	Total	552.84
3.	Indicate the seismic zone in which ML area falls. In case of zone IV & V, details of earth quakes in last 10 years.	Zone-III. No major earth quakes in last 10 years.
A	Severity (Richter Scale)	No
B	Impact i.e. Damage to	No
	Life	No
	Property	No
	Existing mine	No
4.	Break-up of mining lease area (in ha.) as per approved conceptual plan:	Pl refer table below

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

Break-up of mining lease area (in ha.) as per approved conceptual plan:

SI no.	Particulars of land	Forest (area in Ha)	Non- forest (area in Ha)	Total (area in Ha)
8.	Quarry	185.07	110.68	295.75
9.	External OB dump-1	24.73	13.27	38.00
10.	External OB dump-2	5.00	52.24	57.24
11.	Infrastructures	36.77	8.31	45.08
12.	Road, nala diversion, top Soil Dump, green belt/vacant land & Safety zone	52.53	32.72	85.25
13.	Res. colony*	0.00	5.00	5.00
14.	Conveyer to Kargali Washery/ siding *	7.50	19.02	26.52
	Total Land Required	311.6	241.24	552.84

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

5.	Township (outside mining lease)	Near the existing township	
A	Total area (in ha)	5.00 Ha proposed.	
B	No. of dwelling units	637 nos of Quarter already exists. Only 25 no B type, 34 nos. C type & 14 nos. of D type has been proposed.	
C	Distance from mine site	2 km	
6.	Distance of water bodies (in km) [* From highest flood line / high tide line]	River Bank*	Other Water bodies *
	Distance from Mining lease boundary	Damodar river - 1.5 KM	Sea / creek / lake / nalla etc.(specify) Karo nala and Gati nala – flowing within the boundary
	Ancillary facilities (CHP)		
7.	For projects falling within the Coastal Regulation Zone (CRZ)		
	Whether the mineral to be mined is of rare nature and not available outside CRZ?	No. Not applicable.	
	if yes, annex a scaled location map showing low tide line (LTL), high tide line (HTL) duly demarcated by one of the authorized agencies* [*Director, Space Application Centre, Ahmedabad: Centre for Earth Sciences Studies, Thiruvananthapuram: Institute of Remote Sensing, Anna University, Chennai: Institute of Wetland Management & Ecological Designs, Kolkata: Naval Hydrographers's Office, Dehradun: National Institute of Oceanography, Panjim, Goa: and National Institute of Ocean Technology, Chennai], boundary of mining lease area, distance of ML area from LTL and HTL CRZ boundary and CRZ classification of the project area as per the approved Coastal Zone Management Plan, and settlements, sand dunes, mangroves, forest land/patches, turtles breeding and nesting sites etc., if any, in the project area.		

8.	Indicate aerial distance from the periphery of core zone / area from the periphery of the buffer zone to the boundary of following (up to 10 km):	Aerial distance from (in km.)	
	Areas	Name	
			13.3.1 Core Zone *
			13.3.2 Buffer Zone*
1.	National Park / Sanctuary		None
2.	Biosphere Reserve / Tiger Reserve / Elephant Reserve / any other Reserve		None
3.	Forest (RF / PF / unclassified)		Project includes 311.60 Ha of forest land Patches of dense & open mixed forest in buffer zone.
4.	Habitat for migratory birds		None
5.	Corridor for animals of schedule I & II of the Wildlife (Protection) Act, 1972		None
6.	Archaeological sites * Notified * Others		None

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

7.	Defence Installation		None
8.	Industries / Thermal Power Plants		Tenughat Thermal Power Plant
9.	Other Mines		Karo Special UGP, Khasmahal OCP, Godo OCP (Proposed), Bokaro OCP, Jaridih Block (Proposed), Jarangdih OCP & UGP, Jarangdih Shaft (Proposed)
10.	Airport		Ranchi Airport 130 Km
11.	Railway Lines		Nearby railway stations are Bermo & Jarangdih RS on Gomoh-Barkakana loop line of Eastern Railway.
12.	National / State Highways		The East West running Gomoa-jarangdih-Phusro-Jaina More Road, which meets the Bishnugarh-Petarwar Raod connectes the coalfield with Hazaribagh, Dhanbad and Ranchi
[* Buffer zone in case of ML area up to 25 ha. is to be considered as 5 km all around the periphery of the core zone and for ML area above 25 ha. an area 10 km all around the periphery of the core zone].			

9.	Description of flora & fauna separately in the core and buffer zones.*	VRDS Consultant, Chennai conducted flora & fauna study during the month of November, 2015. A summarized report is given as under.

[* Consult the Wildlife (Protection) Act, 1972 as amended subsequently and list species with (1) Common name (2) Scientific name and (3) under which schedule of the Wildlife (Protection) Act the identified species fall. Get the list authenticated by an Expert in the field / credible scientific institute / University / Chief Wildlife Warden office. **Information to be based on field survey.**]

A. Flora:

Category	Core Zone	Buffer Zone
1. Agriculture crops:		
Cereals	There are no crop lands	Paddy, Wheat and Maize
Pulses	Crop lands of Paddy & Maize	Arhar /Red gram, Chick pea, Khesri (Tivra), Black gram, Green gram.
2. Commercial crops:		
Vegetables	There are no commercial crops and No cultivation	Spinach, Ash gourd, Beet root, Cauli flower, Cabbage, Chillies, Colocasia, Arbi, Coriander, Dhaniya.
Oil yielding plants	There is No cultivation of oil yielding plants	Mustard, Sunflower and Castor
Spices	There is No cultivation of Spices	Garlic
Fruits	Amba/ Mango/ Amla / Jamun/ Imli	Bel, Guava, Banana, Mango, Wood apple/ Bel, Lime, Custard apple, jack fruit, Papaya, Orange.

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

3. Plantations		
Planted by CCL	Akasmoni, Babool, Mahaneem, Kala sirus, Satwan, Cassia, Sissoo, Gulmohar, Bamboo, Eucalyptus, Peepal, Banyan tree, Subabool, Peltophorum, Karanj, Teak.	Akasmoni, Babool, Mahaneem, Kala sirus, Satwan, Cassia, Sissoo, Gulmohar, Bamboo, Eucalyptus, Peepal, Banyan tree, Subabool, Peltophorum, Karanj, Teak.
4. Natural Vegetation/Forest type		
Herbs		
Shrubs	Arakha, Dalsingha, Nagabari, Patalagaruda	Arakha, Dalsingha, Karonda, Roilei, Gudsakri, Bhui kuruma, Nagabari, Guakuli, Raktchita, Salara (Mahana), Telkor (Tilok), Patalagaruda, and Dhawai.
Trees	Babul/ Babool, Sris/ Kala sirus, Mahalimbo/ Maha Neem, Chhatiana, Neem, Ambansia, Semul/ Simili, palash, Simaro, Chakhunda, Garrari/ Karada (Padashi), Sissoo, Krisnachuda/ Gulmohur, Tendu (Kendu) Mankadkendu, banyan/ Bata/ Bad, Pipal/ Aswatha, Dhauranja, Mahuva/ Mahul, Kamalagunddi, Indian Cork tree, Jerusalem Thorn, Jungle jalebi, Karanja, Sal/ Sargi/ Surjam, Kodal, Sahada	Babul/ Babool, Sris/ Kala sirus, Mahalimbo/ Maha Neem, Chhatiana, Neem, Ambansia, Semul/ Simili, palash, Simaro, Chakhunda, Garrari/ Karada (Padashi), Sissoo, Krisnachuda/ Gulmohur, Tendu (Kendu) Mankadkendu, banyan/ Bata/ Bad, Pipal/ Aswatha, Dhauranja, Mahuva/ Mahul, Kamalagunddi, Indian Cork tree, Jerusalem Thorn, Jungle jalebi, Karanja, Sal/ Sargi/ Surjam, Kodal, Sahada
5. Grass Lands	Alloteropsis cimicina, Aristida depressa, Blepharis molluginifolia, Borreria hispida, Bulbostylis barbata, Commelina benghalensis, euphorbia hirta, Evolvulus nummularis, Oldenlandia umbellate, Phyllanthus, Simple Phyllanthus maderaspatensis, Polygala eiroptera, Polygala elongate, Rothia trifoliata	Alloteropsis cimicina, Aristida depressa, Blepharis molluginifolia, Borreria hispida, Bulbostylis barbata, Commelina benghalensis, Euphorbia hirta, Evolvulus nummularis, Oldenlandia umbellate, Phyllanthus simplex, Phyllanthus Mmaderaspatensis, Polygala eiroptera, Polygala elongate, Rothia trifoliata
6. Endangered species	None	None
7. Endemic species	None	None
8. Others	None	None

B. Fauna

Category	Core Zone	Buffer Zone
1. Total listing of Faunal Elements		
Listed Under Wildlife (protection) Act, 1972		
Terrestrial Fauna - Mammals		

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

Schedule-I	None	None
Schedule-II	None	None
Schedule-III	None	Wild Pig,
Schedule-IV	Three Striped Squirrel, Indian bush rat, Indian gray Mongoose, Indian Hare.	Three Striped Squirrel, Indian bush rat, Indian gray Mongoose, Indian Hare.
Schedule-V	Large bandicoot rat, Common Indian field mouse, home Mouse, Mouse, Bandicoot rat, Common Indian rat, Pygmy shrew, House shrew.	Large bandicoot rat, Common Indian field mouse, home Mouse, Mouse, Bandicoot rat, Common Indian rat, House shrew.
Amphibians & Reptiles		
Schedule-II	None	None
Schedule-IV	Common toad, tortoise, Indian cricket frog, Indian Bull frog, Common Indian Krait, Garden lizard, Tree Snake, Whip Snake, smooth, Water snake, Indian star tortoise, Indian wall lizard, Giant blind snake, Slender blind snake	Tortoise, Indian burrowing frog, Skipper frog, Indian cricket frog Tree Snake, Whip Snake, Indian Star Tortoise, Giant Blind Snake.
Avi fauna		
Schedule-IV	Common myna, Common Iora, Small blue kingfisher, Pond Heron, cattle Egret, Lesser pied Kingfisher, Blue rock pigeon, Indian roller, Little Green Bee Eater, Black kite (Common), White wagtail, Golden Oriole, Blossom headed Parakeet, Rose-Ringed parakeet, Red-vented bulbul, Indian robin, Spotted dove, Pied myna, Brahminy myna, Grey hornbill, Common babbler, Barn owl.	Common myna, Common Iora, Small blue kingfisher, Pond Heron, Cattle Egret, Lesser pied Kingfisher, Blue rock pigeon, Indian roller, Indian tree pie, Maratha Woodpecker, Black drango, Little egret, white- Breasted King fisher, Little Green Bee eater, black kite (Common), white wagtail, Golden Oriole, Large Cormorant, Little cormorant, Blossom headed Parakeet, Rose- Ringed Parakeet, Red-vented bulbul, Indian robin, Spotted dove, Pied myna, Brahminy myna, Grey hornbill, Common babbler, barn owl, Common hoopoe. Little Green Bee Eater, Black kite(Common), White wagtail, Golden Oriole, Blossom headed Parakeet, Rose-Ringed Parakeet, Red-vented bulbul, Indian robin, Spotted dove, Pied myna, Brahminy myna, Grey hornbill, Common babbler, Barn owl.
Schedule-V	House Crow & Vermin	House Crow & Vermin
Not listed under wildlife protection Act, 1972		
Mammals/ (Domestic Animals)	Goat, Bull, Cow, Buffalo, Cat, Dog	Goat, Bull, Cow, Buffalo, Cat, Dog

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

Birds	Parrot	Parrot
1.Invertebrates	Birni, Grasshopper, Tidda, Moth, Black Bee, Stem Borer.	Birni, Grasshopper, Tidda, Moth, Black Bee, Stem Borer.
2. Endangered species	No Endangered species	No Endangered species
3. Endemic species	No Endemic species	No Endemic species
4.Migratory species	No Migratory species	No Migratory species
5.Details of aquatic fauna if applicable	Keu, Indian Motted Eel, Katla, Daulla /Murre, Mirgal, Mangur /Cat fish, river Catfish, Singhi, Kari, Rohu, Spiny Eel, Tengna, Tilapia, Kotri, Wallago	Keu, Indian Motted Eel, Katla, Daulla /Murre, Mirgal, Mangur/ Cat fish, river Catfish, Singhi, Kari, Rohu, Bam/ Spiny Eel, Tengna, Tilapia, Kotri, Wallago

10.Details of mineral reserves (as per approved Mining Plan)

	Category	Quantity (in million 243ispa)
A	Proved	-
B	Indicated	-
C	Inferred	-
D	Mineable reserves	105.17 MT Balance

11. Major geological formation / disturbances in the mining lease area

	Category	Yes/No
A	Geological maps submitted	Yes. Refer Plate- VA
B	Geological sections submitted	Yes. Refer Plate no. – VB
C	Contour map submitted	Yes. Refer Plate- IIIB
D	Whether the presence, if any, noted of	
i	Faults	Yes
ii	Dykes	No
iii	Shear Zone	No
iv	Folds	No
v	Other weak zones	No
E	Source of data (Indicate)	Geological Report and Project Report

12.Production of mineral(s) and life of mine

	Category	Yes/No
A	Rated capacity of mine mineral wise (Tonnes / annum)	15.00 MTPA Capacity
B	Life of mine at proposed capacity (Years)	15 including washery
C	Lease period (Years)	NA
D	Date of expiry of lease (D /M /Y)	NA
E	Indicate in case of existing mines	NA
I	Date of opening of mine	2013-14 for Konar OCP
Ii	Production in the last 5 years from	Karo OCP
		2013-14 0.77

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

		2014-15	1.63
		2015-16	1.95
		2016-17	1.50
		2017-18	1.50
iii	Projected production for the next 5 years after EC	Year 1	3.00
		Year 2	6.00
		Year 3	11.00
		Year 4	11.00
		Year 5	11.00
iv	Whether mining was suspended after opening of the mine? If yes, details thereof including last production figure and reason for the same.	No	
F	Whether plans & sections provided?	Yes	

13.Type and method of mining operations

13.3.3 TYPE		13.3.4 METHOD	
Opencast	Yes	Manual	No
Underground	No	Semi-mechanised	No
Both	No	Mechanised	Yes

14.Details of ancillary operations for mineral processing

Category		
A	Existing	None
B	Additional	Karo washery (7 MTPA) proposed

Mine details

Category		
A	Opencast mine	Yes
i	Stripping ratio	0.71 for Quarry – I & 0.96 for Quarry - II
ii	Ultimate working depth (in m bgl)	125 m for Quarry – I & 110 m for Quarry - II
iii	Indicate present working depth in case of existing mine (in m bgl)	65-70
iv	Thickness of top soil (in m.)	
	Minimum	0.15
	Maximum	0.60
	Average	0.25
V	Thickness of overburden (in m.)	
	Minimum	Q 1- 2.9m, Q 2-3.2m
	Maximum	Q 1-26.6m, Q 2-12.1m
	Average	Q 1-14.75m, Q 2- 7.65m

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

vi	Mining Plan	
	Height and width of the bench in Overburden / waste.	10.0 m Height & 40 m / 20 m (Working / Non-working) Bench Width
	Height & width of the bench in ore body /coal seam	10.0 m Height & 40 m / 20 m (Working / Non-working) Bench Width
	Proposed inclination / slope of the sides of the opencast mine (separately for overburden, coal /ore and overall slope of the pit sides) both while operating the mine as well as at the time of closure of the mine.	70 ⁰ for individual coal and 37 ⁰ OB Benches during mining operation. 42 ⁰ -44 ⁰ for overall pit slope.
	Whether transverse sections across the opencast mine at the end of fifth year and at the end of the life of the mine have been submitted?	Yes, Refer Plate XIII for stage wise quarry plan
Vii	Type of blasting, if any, to be adopted.	Controlled blasting in accordance with Mines Safety act.
B	Underground mine	Not Applicable
I	Seam / Ore body Min.Depth (m)	
	Seam / Ore body Max. Depth (m)	
	Seam / Ore body Avg. thickness (m)	
	Rate of dip	
	Direction of dip in degree	
Ii	Mode of entry into the mine Shaft Adit Incline	
Iii	Details of machinery	
	On surface	
	At Face	
	For transportation	
	Others	
Iv	Method of stoping (metalliferrous mines)	
	Open	
	Filled	
	Shrinkage	
	Caving	
	Combination of above	
	Others (Specify)	
V	Extraction method	
	Caving	
	Stowing	
	Partial extraction	
Vi	Subsidence	
	Predicted max. subsidence (in m)	
	Max. value of tensile strain (in mm/m)	
	Max. slope change (in mm/m)	
	Whether identified possible subsidence area(s) superimposed on Surface Plan has been submitted	

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

	Major impacts on surface features like natural drainage pattern, houses, buildings, water bodies, roads, forest, etc.	
	Salient features of subsidence management (monitoring and control).	

16. Surface drainage pattern at mine site

A	Whether the pre-mining surface drainage plan submitted?	Yes. Refer Plate-III A.
B	Do you propose any modification / diversion in the existing natural drainage pattern at any stage? If yes, when. Provide location map indicating contours, dimensions of water body to be diverted, direction of flow of water and proposed route / changes, if any i.e. realignment of river / nallah / any other water body falling within core zone and its impact.	Yes. Diversion of Karo Nallah proposed.

17. Embankment and / or weir construction

A	Do you propose, at any stage, construction of	Yes
i	Embankment for protection against flood?	
ii	Weir for water storage for the mine?	
B	If so, provide details thereof.	An embankment is proposed on diverted Karo nala, at the point of confluence into existing nala
C	Impact of embankment on HFL and settlement around.	
D	Impact of weir on down stream users of water.	

18 Vehicular traffic density (**outside the ML area**)

Coal transportation by conveyor belt is proposed outside mine. Therefore, there will be no significant impact on vehicular traffic*.

	Category	Type of vehicles	No. of vehicles per day
a	Existing	Tipping Truck	250-300
b	After the proposed activity	Covered conveyor belt	NA
c	Whether the existing road network is adequate? If no, provide details of alternative proposal?	Yes	

18. Loading, transportation and unloading of mineral and waste rocks on surface:

A	Manual	No
B	Tubs, mine cars, etc.	No
C	Scraper, shovels, dumpers / trucks	Yes
D	Conveyors (belt, chain, etc.)	Yes
E	Others (specify).	CHP & RLS.

20. Mineral(s) transportation outside the ML area

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

S No.	Category	Qty. (in TPD)	Percentage (%)	Length (in km)
A	Road	-	-	-
B	Rail	-	-	-
C	Conveyors	45454	100%	6.5
D	Rope way	-	-	-
E	Water ways	-	-	-
F	Pipeline	-	-	-
G	Others (Specify)	-	-	-
Total		45454	100 %	-

21. Baseline Meteorological and Air Quality data

(a) Micro-meteorological data

[Continuous monitoring through autographic instrument for one full season other than monsoon]

Meteorological data collected at meteorological station representing the study area during the study period (17Oct. 2015 to 16 Jan. 2016) reveals the following status:

Meteorological data collected during the study reveal the following status:

Wind Direction: Predominant winds are from NW directions.

Wind Velocity: Wind velocity readings are ranging from <0.50 to 4.0 m/sec.

Temperature: Temperature values are ranging from 281 to 309 °K.

Relative Humidity: The average relative humidity is found to be 20.93 to 94.68 %.

Cloud Cover: Mostly clear sky is predominant during the study period.

(i) Wind rose pattern for one full season (16 points of compass i.e. N, NNE, NE, ---) based on 24-hourly data. For coastal area also furnish day time and night time data.

- Day time
- Night time
- 24 – hours period

Season: Post-monsoon 2015 (17/10/2015 – 16/01/2016)

Karo Wind Rose (Frequency Distribution)								
	Directions / Wind Classes (m/s)	0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
1	348.75 - 11.25	22	0	0	0	0	0	22
2	11.25 - 33.75	31	0	0	0	0	0	31
3	33.75 - 56.25	34	0	0	0	0	0	34
4	56.25 - 78.75	5	0	0	0	0	0	5
5	78.75 - 101.25	42	0	0	0	0	0	42
6	101.25 - 123.75	52	0	0	0	0	0	52
7	123.75 - 146.25	38	0	0	0	0	0	38
8	146.25 - 168.75	61	0	0	0	0	0	61
9	168.75 - 191.25	132	0	0	0	0	0	132
10	191.25 - 213.75	72	0	0	0	0	0	72
11	213.75 - 236.25	16	0	0	0	0	0	16

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

12	236.25 - 258.75	7	0	0	0	0	0	0	7
13	258.75 - 281.25	10	0	0	0	0	0	0	10
14	281.25 - 303.75	75	0	0	0	0	0	0	75
15	303.75 - 326.25	170	0	0	0	0	0	0	170
16	326.25 - 348.75	45	0	0	0	0	0	0	45
	Sub-Total	812	0	0	0	0	0	0	812
	Calms								1394
	Missing/Incomplete								0
	Total								2206

(ii) Site specific monitored data (17 Oct. 2015 to 16 Jan. 2016)

Month	Wind Speed (m/s)			Temperature (K)			Relative Humidity (%)			Rain Fall * (mm)			Cloud Cover** (Octas of sky)
	Mean	Max.	% of calm	Mean (Dry Bulb)	Highest	Lowest	Mean	Highest	Lowest	Total	24-hours Highest	No. of rainy days	Mean
17Oct. 2015 to 16 Jan. 2016	< 0.30	4	63.13	295	309	281	57.80	94.68	20.93				Clear

* 24-hours rainfall should be reported from 08:30 hrs. IST of previous day to 08:30 hrs. IST of the day.

* Rainy day is considered when 24 hrs. rainfall is ≥ 2.5 mm.

** Visual observations of cloud cover should be recorded four times a day at regular intervals.

(iii) Indicate name and distance of the nearest IMD meteorological station from which climatological data have been obtained for reporting in the EIA report, if any.

Micrometeorological Data was generated by M/S Ecomen Consultants, Lucknow by installing automatic weather monitoring station at the roof of a house at GM office B & K area.

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

(b) Ambient air quality data* (RPM, SPM, SO₂, and Nox)

[*Monitoring should be carried out covering one full season except monsoon – same season as in 21 (a) (i)]

[*Frequency of sampling: Sampling to be done twice a week for the entire season 24 hourly for SPM & RPM. For gaseous pollutants 24- hourly data be given irrespective of the sampling period.]

(i) Season and period for which monitoring has been carried out.

Baseline data of Karo Expansion OCP & Karo washery was assessed for the post monsoon period of 2015 at six locations in core and buffer zone. Further, as per the Terms of Reference obtained in respect of karo Expansion OCP and Integrated washery, validation of baseline environmental status has been done by monitoring ambient air quality at 8 stations in core and buffer zone of Karo OCP & washery.

(ii) No. of samples collected at each monitoring station – 24 (2 samples/week for 12 weeks)

Ambient Air Quality Results

Period: (17/10/2015 – 16/01/2016)

Name of monitoring equipment used			PM ₁₀ Resp. Dust Sampler			PM _{2.5} Fine Dust Sampler			SO ₂ Resp. Dust Sampler			NO _x Resp. Dust Sampler		
Permissible AAQ standard *														
Industrial / Coal mine, Residential, rural & other areas			100			60			80			80		
Sensitive areas			100			60			80			80		
Monitoring Location	No. of Samples Drawn	Category* (R, I, S)	Min.	Max.	98% tile	Min.	Max	98% tile	Min.	Max.	98% tile	Min.	Max.	98% tile
Workshop – (A ₁)	24	I	145.70	166.10	168.30	54.80	81.10	83.40	20.30	28.60	30.50	24.40	36.60	36.60
Baidya karo Basti – (A ₂)	24	I	128.90	144.30	144.50	55.90	68.60	68.60	13.30	22.30	23.40	16.10	50.70	52.00
Shubhash Nagar Colony – (A ₃)	24	R	60.00	70.30	70.30	35.20	43.10	43.10	13.30	21.40	21.40	17.70	52.00	52.00
Charakpaniya – (A ₄)	24	R	61.30	73.00	73.00	39.00	48.20	48.20	8.80	19.70	19.70	18.10	53.00	53.00

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

Khurpaniya Colony – (A ₅)	24	R	68.20	78.20	78.20	41.30	52.00	52.00	9.00	12.75	12.75	23.60	50.10	50.10
GM office – (A ₆)	24	R	70.10	82.50	82.50	50.20	60.00	60.00	7.79	11.25	11.25	23.30	38.70	38.70

* RPM has been compared with Coal Mines standard in Core Zone and PM_{2.5} in other than Core Zone as per NAAQS.

* SO₂ & NO_x has been compared with Coal Mines standard in Core Zone and in other than Core Zone as per NAAQS.

*R = Residential; I = Industrial; S = Sensitive

Analysis of Heavy Metals in PM₁₀ Samples

Unit: ng/m³

Location Code	As	Co	Hg	Se	Cr	Cu	Mn	Ni	Pb	Zn
A1	BDL	BDL	BDL	BDL	BDL	0.04	0.14	0.15	0.15	1.60
A2	BDL	BDL	BDL	BDL	BDL	0.07	0.13	0.12	0.16	1.55
A3	BDL	BDL	BDL	BDL	BDL	0.03	0.12	0.14	0.12	1.30
A4	BDL	BDL	BDL	BDL	BDL	0.02	0.16	0.15	0.10	1.46
A5	BDL	BDL	BDL	BDL	BDL	0.04	0.14	0.14	0.11	1.32
A6	BDL	BDL	BDL	BDL	BDL	0.03	0.12	0.16	0.10	1.61
Detection Limit (ppm)	0.008	0.01	0.001	0.01	0.04	-	-	-	-	-

BDL: Below Detection Limit of Instrument

Ambient air quality data-Validation

Period: (16.09.2018 – 15/10/2018)

Sl.No	Parameter	PM2.5(µg/m3)		PM10(µg/m3)		SO2(µg/m3)		NOx(µg/m3)	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1.	WORKSHOP(A- 1)	76	55	172	149	<25	<25	<6	<6
2.	BAIDYA KARO BASTI (A- 2)	67	52	148	128	<25	<25	<6	<6
3.	SUBHASH NAGAR (A- 3)	43	36	77	64	<25	<25	<6	<6
4.	CHARAKPANIYA(A- 4)	50	34	80	65	<25	<25	<6	<6

EIA/EMP of Karo Expansion OCP (15MTY) & Karo Washery (7 MTY)

5.	KHURPANIA COLONY (A- 5)	44	34	77	63	<25	<25	<6	<6
6.	GM OFFICE*(A- 6)	70	51	160	70	<25	<25	<6	<6
7	AMLO BASTI(A-7)	62	52	86	71	<25	<25	<6	<6
8	KALI MANDIR (A-8)	50	42	85	75	<25	<25	<6	<6

22. Stack and emission details, if any*:- **Not Applicable**

Sl. No.	Process / unit of operation (e.g. DG Set, Boiler)	Height of stack (m)	Internal top dia. (m)	Flue gas exit velocity (m/sec)	Emission rate (kg/hr)				Heat emission rate from top of stack (K.cal/hr)	Exhaust / Flue gas			
					SPM	SO ₂	NO _x	CO		Temp °C	Density	Specific Heat	Volumetric flow rate (m ³ /hr.)

23. Details of fugitive emissions during mining operations* :- Dust & Vehicular Exhaust

24. Air Quality Impact Prediction (AQIP)*

(a) Details of model(s) used for AQIP including grid size, terrain features, and input meteorological data

FDM Model, Version 90121 for 8 receptors, 2 in the core zone and 6 in the buffer zone. Hourly meteorological data generated at site by M/S Ecomen Pvt. Ltd, was used for running the model. The model was run on 24 hours input meteorological file based on the average of the readings taken which represents typical meteorological condition found during the study period.

(b) Maximum incremental GLC values of pollutants based on prediction exercise

Predicted Concentrations of PM10

Zone Category	24 Hours average PM ₁₀ concentration (µ g/ m ³)					Permissible limit
	Incremental Concentration without control measures (BAU)	Incremental Concentration with control measures	Background/ Baseline concentration	Total predicted concentration without control measures (BAU)	Total predicted concentration with control measures	
A1	107.81	58.55	160	267.81	218.55	300
A2	172.69	93.71	135.25	307.94	228.96	
A3	73.4	28	69	142.4	97	100
A4	35.49	13	71.88	107.37	84.88	100
A5	50	16	69.5	119.5	85.5	100
A6	40	4.37	97.5	137.5	101.87	300
A7	72	16	74	146	90	100
A8	18	5.8	79.25	97.25	85.05	100

[* Question Number 22, 23 & 24 need not be filled-in for mines having ML area of **25 ha. Or less.**]

[**Information on item no. 2 & 3 to be provided in cases with captive power generation of 500 KVA and above]

25. Water requirement (m³/day)

Purpose	Present water Supply of Existing Karo OCP (m ³ /day)	Peak Water Demand of Karo Expansion OCP (m ³ /day)
INDUSTRIAL		
HEMM Washing	230	230
CHP/Industrial Premises	50	330
Workshop	10	100

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Fire Service	100	650
Haul Road watering	140	1000
Land Reclamation & Plantation	70	70
Washery	Nil	1590
Total	600	3970
DOMESTIC (Township)		
Housing	400	405
Service Building	40	40
Process & Loss	40	45
Total	480	490

26. Source of water supply*

S. No.	Source	m ³ /day
1	River (name)	-
2	Ground water	-
3	Mine water (sump / pit)	4700
4	Other surface water bodies	-

[*Annex a copy of sanction letter / permission from the concerned authority (Central Ground Water Authority in case of ground water abstraction is from notified area / State Ground Water Board in case of non-notified area / State Irrigation Department for surface water pumping) for drawing water.]

27. Lean season flow in case of pumping from river / nalla (cumecs)

Not applicable

28. Ground water potential of the study area

28.1. Ground water availability

a	Range of water table (m bgl)	
i	Pre-monsoon (April/May)	
	Core Zone	1.76-8.55
	Buffer zone	0.20-12.60
ii	Post-monsoon (November)	
	Core Zone	1.19-7.05
	Buffer zone	0.05-10.90
b	Total annual replenishable recharge (million m ³ / year)	
	By ground water table fluctuation method	40.49

EIA/EMP of Karo Expansion OCP (15 MTY) & Karo Washery (7 MTPA)

	By rainfall infiltration factor method	41.83
c	Annual draft excluding estimated draft through mine discharge (million m ³ / year)	
d	Estimated draft through mine discharge (million m ³ / year)	
e	Net annual ground water availability (million m ³ / year)	
f	Stage of ground water development in % (in Bermo Block, as per CGWB)	46.67%

28 Water demand - Competing users of the water source

13	13.7.2 Us	Present Consumption (m ³ /day)		Additional proposed as per local plan (m ³ /day)		Total (m ³ /day)	
		Surface	Ground (mine water)	Surface	Ground (mine water)	Surface	Ground (mine water)
1	Domestic		480		10		490
2	Irrigation						
3	Industry		600		3370		3970
4	Mining						
5	Others (specify)						
Total			1080		3380		4460

No competing users.

29. Water quality*

(a) Annex physico -chemical analysis of water at intake point **

Water and effluent quality sampling locations

The quality of mine water samples, ground water samples and surface water sample collected from the representative spots of Karo OCP mine

Ground Water-

1- Bhutia Tand, Hand Pump-**GW₁**

2- Bore Well of Baidya Karo Basti - **GW₂**

Surface Water-

1- Godda Nala- **SW₁ US**

2- Damodar River - **SW₂ DS**

3- Konar River- **SW₃ US**

Effluent Water:

1- Lagoon Discharge- **K₁**

2- Lagoon Discharge- **K₂**

The water quality status in brief is given below. Refer to Chapter-III for detailed analysis report.

Observations

Location Code	pH	Chloride (mg/l)	Fluoride (mg/l)	Nitrate (mg/l)	Iron (mg/l)	Hardness (mg/l)
GW-1	7.32	70	1.10	3.56	<0.06	504
GW-2	7.98	16	1.26	1.49	0.14	106
Desirable Limits						
IS: 10500	6.5-8.5	250	1.00	45.00	0.30	300

GROUND WATER QUALITY STATUS

SURFACE WATER QUALITY STATUS

Location Code	pH	TDS (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	Nitrate (mg/l)	Iron (mg/l)
SW-1	7.24	168	14	0.91	5.39	<0.06
SW-2	7.96	164	14	0.66	2.47	0.30
SW-3	7.54	104	14	0.17	<0.50	1.53
IS: 2296 (Class C)	6.5-8.5	1500	600	1.50	50.00	50.00

MINE WATER QUALITY STATUS

Location Code	pH	TSS (mg/l)	BOD (mg/l)	COD (mg/l)	Cadmium (mg/l)	O & G(mg/l)	Ammonical Nitrogen (mg/l)
K-1	7.81	32	6.0	20	<0.0005	<2.0	0.14
K-2	7.21	34	6.0	24	<0.0005	<2.0	0.15
GSR 422(E) Std.	5.5-9.0	100	30	250	2.0	10.0	50.0

- (b) In case of existing mine, annex report on quality of water discharge i.e. complete physico - chemical analysis**

Yes, refer to Chapter-III for detail.

[*For non-discharging mines at least four ground water samples to be taken preferably from downstream direction of the mine in pre-monsoon and post-monsoon periods and analysed. For discharging mines six samples are to be analysed]

**All parameters as per BIS 10500. Indicate name of Methodology, Equipment used for analysis, and Detection Level (DL) for each parameter.

*** Wherever any analytical parameter is below detection level, "BDL" (Below Detection Level) should be written instead of 'NIL'.

30. Impact on ground water regime / stream / lake / springs due to mine dewatering

a	Radius of influence (in m) [To be estimated based on analysis of pumping test data and application of empirical formula]	320 m
b	Whether saline water ingress will take place? (applicable to coastal areas)	No
c	Impact on stream / lake / springs	No

[* Provide a comprehensive hydro-geological assessment report if the average mine dewatering is more than 100 m³/day and or going below water table in non-monsoon period. The report should be based on preferably latest one year pre-monsoon and post-monsoon baseline data covering information on ground water situation, aquifer characteristics, water level conditions (April – May and November), estimate of ground water resources, predicted impact of the project on ground water regime and detailed remedial / conservation measures such as artificial recharge of ground water etc. The report should be based on actual field inventory out of existing wells, at least 30 observation wells in the buffer zone with supplementary information from secondary sources (mention name). For estimation** of ground water resource (refer question no. 28 above) be designated study area of the buffer zone may be sub-divided into command and non-command areas, watershed-wise (in case of hard rock / consolidated formations) / block-wise / mandal-wise in case of alluvial / unconsolidated formations)]

[**For estimating ground water resources in the area follow the Ground Water Estimation Committee recommendations of 1997]

The comprehensive hydro-geological assessment report is given in Chapter-III & IV.

31. Waste Water Management

Mine

a	Daily average discharge (m ³ /day) from different sources	
i	Mine water discharge during	
	Lean period	240 (artificial recharge)
	Monsoon period	
ii	Workshop	297 (90% of 330) & reused
iii	Domestic (mine site) (75% of supply)	370 (75% of 490)
iv	Beneficiation / Washeries	1272 (80% of 1590) & reused
v	Coal Handling Plant	-
vi	Tailing pond	-
vii	Others (Fire service, dust suppression, green belt)	-
Total		2179

* After various uses and losses

(b) Waste water treatment plant; flow sheet for treatment process attached. Industrial ETP Proposed.

(c) **Quantity of water recycled / reused / to be recycled**

I	Percentage	46.36%
Ii	m ³ /day	2179

(d) **Point of final discharge**

Final Point	Quantity discharged (in m ³ /day)
1. Surface	-
(i) Agricultural land	-
(ii) Waste land	-
(iii) Forest land	-
(iv) Green belt	-
2. River/Nallah	-
3. Lake	-
4. Sea	-
5. Others (Old quarry/pond)	-
Total	Nil

(e) **Users of discharge water**

Users	Yes/ No
Human	Yes
Livestock	Yes
Irrigation	Yes
Industry	
Others (specify)	

(f) **Details of the river / nalla, if final effluent is / will be discharged (cumecs)**

Average flow rate	-
Lean season flow rate	-
Aquatic life	-
Analysis of river water 100 meters upstream and 100 meters downstream of discharge point submitted.	Details are given in Chapter-III.

Township

A	Waste water generation from township (m ³ /day)	370
B	Are you planning to provide sewage treatment plant?	Yes
C	Usage of treated water	Industrial use

32. Attach water balance statement in the form of a flow diagram indicating source (s), consumption (Section-wise) and output.

Refer Plate- figure no. 3.12 - Chapter-3 of EIA/EMP Report

33. Ambient noise level leq dB(A)

Unit: dB (A)

Date	Noise Level in dB (A)	LOCATIONS CODE
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EIA/EMP of Karo Expansion OCP (15 MTY) & Karo Washery (7 MTPA)

			N₁	N₂	N₃	N₄	N₅	N₆
19.10.2015	Leq	Day	61.8	54.8	63.6	61.3	52.3	51.6
		Night	54.0	44.6	56.4	53.9	43.1	42.6
10.11.2015	Leq	Day	60.5	54.8	63.9	60.2	53.6	51.9
		Night	53.9	44.8	56.9	52.6	44.2	45.6
25.11.2015	Leq	Day	61.3	54.5	62.6	59.3	52.6	50.3
		Night	53.2	44.3	53.6	49.3	43.5	43.2
10.12.2015	Leq	Day	60.5	54.6	61.2	57.8	52.6	50.3
		Night	53.9	44.5	51.3	46.2	43.5	43.6
25.12.2015	Leq	Day	63.6	53.9	58.5	56.3	52.5	50.1
		Night	54.6	45.0	51.0	43.0	44.2	43.9
09.01.2016	Leq	Day	63.0	54.2	57.0	56.2	51.8	50.0
		Night	54.3	44.9	48.1	44.2	42.8	43.7

Station Name	Date of Sampling	Noise Level
Workshop	18/09/2018	53.7
Baidya Karo Basti	18/09/2018	51.6
Subhash Nagar	18/09/2018	52.2
Churpaniya	18/09/2018	51.3
Khurpaniya Colony	20/09/2018	53.8
G.M.Office	20/09/2018	51.1

34. Solid Waste

- (a) Top soil and Solid waste quantity and quality

Name (Lump/fines/slurry/ Sludge/others)	Composition	Quantity (m³/month)	Method of disposal
Mining activity* a. Top Soil b. Over burden c. Others (specify)	Alluvium Alluvium, rock & shale -	9000 627640.00	Topsoil to be used in the biological reclamation. Out of the total 90.38 Mcum OB, 34.13 Mcum is proposed to be dumped externally and 56.26 Mcum will be dumped internally.
Effluent Treatment Plant (sludge)	Clayey sludge Oil & grease sludge	33075 kg/month 450 kg/month	Secured Landfill Recycling
Total	-	-	-

[* Annex layout plan indicating the dump sites.]

- (b)

EIA/EMP of Karo Expansion OCP (15 MTY) & Karo Washery (7 MTPA)

(i) Does waste (s) contain any hazardous/toxic substance/ radioactive materials or heavy metals?	Yes, Oil & grease.
(ii) If yes, whether details and precautionary measures provided?	Arrangement for recycling will be made with certified recyclers.

(c) Recovery and recycling possibilities.

Arrangement for recycling of oil & grease sludge will be made with certified recyclers.

(d) Possible user(s) of the solid waste. Yes, certified recyclers for oil & grease sludge.

(e)

(i) Is the solid waste suitable for backfilling?	Yes
(ii) If yes, when do you propose to start backfilling	From 3 rd year of mining

(in million m³)

Solid waste (s)	Already accumulated (A)	To be generated (B)	% of A & B to be backfilled	
			A	B
Over burden	-	90.38	-	62%
Others (specify)	-	-	-	-

Land reclamation Plan

(f)

In case waste is to be dumped on the ground, indicate	
(i) Associated environmental problems	Dust, fume and noise.
(ii) Number & type of waste dumps	2 External Dump & 2 Internal Dumps
No. of external dumps	2
Max. projected height of dumps (in m)	External Dump – 75 m AGL Internal Dump – 40 m AGL
No. of terraces and height of each stage	External Dump – 2 Internal Dump-2 Height = 30 m each
Overall slope of the dump (degree)	28 ^o
Proposed reclamation measures	160.54 Ha of quarry will be backfilled and reclaimed with plantation and remaining 135.21 Ha of quarry will be filled with water for ground water recharge.
Section of the waste dump in relation to the adjacent ground profile attached.	

	LAND USE DURING MINING		POST MINING LAND USE	
SN	Landuse during mining	Total Area (Ha)	Post-mining land use	Total Area (Ha)
1	Quarry	295.75	Plantation on backfilled area	160.54

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			Void Filled with Water	135.21
2	External OB dump-1	38	plantation on External OB Dump	95.24
	External OB dump-2	57.24		
3	Infrastructures	45.08	CCL use	45.08
4	Road, nala diversion, green belt/vacant land & safety zone	85.25	Road in public use	4.4
			Nallah	3.3
			Green belt (10 to 30 m wide)	24.2
			Undisturbed	53.35
5	Residential colony*	5	Public use	5
6	Conveyer to Kargali washery*	26.52	CCL use	26.52
Total Land Required		552.84		552.84

35. Fuel / Energy requirements*

[*To be furnished for mines having ML area more than 25 ha. or captive power generation of 500KVA and above]

(a) **Total power requirement**

(in MKWH)

S. No.	Category	Mine Site	Township	Others (specify)	Total
1	Present				
2	Proposed / additional				
Total					45.58 M kWh

(b) **Source of power**

(in MW)

S. No.	Category	SEB/Grid*	Captive power plant	DG Sets
1	Present	Karo OCP is receiving power at 11 kV from the existing 33/11 kV substation of CCL located in the area. This substation receives power at 33 kV from Bokaro Thermal Power Station of DVC	Nil	Nil
2	Proposed	Extension of the proposed 33 kV overhead line feeder from BTPS to Konar OCP to Karo , and One additional 33 kV overhead feeder will be erected from BTPS of DVC to Karo OCP.	Nil	Nil
Total			Nil	Nil

[* Annex a copy of the sanction letter from the concerned authority]

(c) Details of fuels

SN	Fuel	Daily Consumption (KL/Day)		Calorific value (Kcals/kg)	% Ash	% Sulphur
		Existing	Proposed			
1	HSD					
2	LSHS					
3	Other(Lubricant)					

36. Storage of inflammable / explosive materials

S. No.	Name	Number of Storages	Consumption (in TPD)	Maximum Quantity at any point of time
1	Fuels	1 storages		
2	Explosives	1 magazine	15.73	

37. Human Settlement

13.7.3 Population*	Core Zone	Buffer Zone
13.7.4 No. of villages	2	76
13.7.5 Number of households village-wise	Total - 360 PAFS	Total – 64835 with population -347298

[* As per 2011 census record]

38. Rehabilitation & Resettlement (R&R) Plan*

[*Provide a comprehensive rehabilitation plan, if more than 1000 people are likely to be displaced, other-wise a summary plan]

(a) Villages falling within the study area:

	Villages	
	Number	Name
Core zone	2	Amlo & Karo Village
500 m from the blasting site (s)	5	Amlo & Karo Village
Buffer zone	76	Given in Chapter-III
Township site		

(b) Details of village(s) in the core zone

S. No.	Village name	No. of Families		Average Annual Income
1	Amlo village	243		-
(a).	Amlo Basti	189		
(b)	Muslim Tola,	54		

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2	Karo village	117		
(a)	Karo Basti	59		
(b)	Karo Purana Colony	58		

[*As per actual survey]

(c) Population to be displaced and / or Land oustees

Name of village(s) falling within	Number of oustees		
	13.7.6 L	Homestead (only)	Land and Homestead (both)
<i>13.7.6.1.1 Mining Lease</i> 1. Amlo village 2. Karo village		360 PAFs	

(d)

Whether R&R package has been finalised? If yes, salient features of R&R plan for oustees.		
(i)	Site details where the people are proposed to be resettled & facilities existing / to be created.	The location for rehabilitation site has been finalised at and situated near Hindustan Bridge, South of Hathia Pathar & Damodar river. Area of site is 51.53 Acre, at a distance of about 8 -9 km from project.
(ii)	Funds earmarked for compensation package.	Rs 1274.40 Lakh
(iii)	Agency /Authority responsible for their resettlement.	CCL
(iv)	Time of commencement of resettlement of Project Affected People (PAP).	Within 1 year of EC
(v)	Period by which resettlement of PAP will be over.	5 Year after commencement

39. Lease -wise plantation details

(a)

Lease area (in ha.)		Existing Mine	New Mine
(i)	Area broken up	295.75	-
(ii)	To be broken up		
(iii)	Area not to be broken up	279.61	

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(b)

Township area (in ha)	Existing Mine	New Mine
	About 5.00 Ha outside core zone.	

(c)

Area afforested and proposed (in ha.)		Peripheral	Dumps/Quarry	Roads	Township	Others
(i)	Existing					
(ii)	Proposed	287.98 Ha including OB Dump, green belt, avenue plantation etc.				

(d)

13.7.7 No. & type of trees planted & proposed	13.7.8
13.7.9 (i) Existing	
13.7.10 When plantation was started	13.7.11 2010
13.7.12 No. of plant species planted	13.7.13
13.7.14 No. of saplings (per Ha.)	13.7.15 2500
13.7.16 Survival rate	13.7.17 70 %
13.7.18 Average height	13.7.19 3 mtrs.
13.7.20 (ii) Proposed	13.7.21 287.98 Ha

No. of plant species to be planted	Number of saplings (per ha.)
6-7	2500

40. Environmental health and safety

A	What major health and safety hazards are anticipated?	Air and water borne diseases
B	What provisions have been made/ proposed to be made to conform to health and safety requirements?	Health awareness camps in local villages
		Child health camps in local schools
		PME of mining personnel being conducted regularly.
		Audiometry examination of mining personnel exposed to high noise level
		Health awareness programs for employees
C	In case of an existing mine	Personal protective equipment provided to personnel
		Same as Para A & B
		(i) Comprehensive report on health status of the workers as under the Mines Act annexed.
		(ii) Mineralogical composition of RPM (dust)
		Free Silica
	Chromium* (Total as well as Hexavalent)	

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	Lead** [* Only for Chromite mines] [**Only for Base Metal mines]	
D	Information on radiation protection measures, if applicable.	Not Applicable

41. Environmental Management Plan

Salient features of environmental protection measures

S. No.	Environmental issues*	Already practiced, if applicable	Proposed
1	Air pollution	Water spraying, Plantation	Transportation through conveyor belt, Water spraying, Plantation, Provision of dust control in CHP & Workshop etc
2	Water pollution	Septic tank, Soak pit	Domestic sewage treatment Plant, Effluent treatment plant with oil and greese trap, Industrial sewerage treatment Plant.
3.	Water conservation	Need based Consumption and Ground water recharging	Recycling, Need based Consumption and Ground water recharging
4.	Noise pollution	Plantation, Regular Maintenance of HEMM	Plantation, Regular Maintenance of HEMM
5.	Solid waste/ Tailings	Solid waste management.	Solid waste management.
6.	Land degradation	Plantation	Plantation
7.	Erosion & Sediment	Plantation	Plantation
8.	Top soil	Preservation & Utilisation	Preservation & Utilisation
9.	Ground vibration	Controlled blasting	Controlled blasting
10.	Wildlife conservation	Plantation	Plantation
11.	Forest protection	Plantation	Plantation
12.	Others (specify)		

[*As applicable]

42. Compliance with environmental safeguards (For existing units)

A	Status of the compliance of conditions of environmental clearance issued by MoEF, if any, enclosed.	EC for Karo OCP was granted for 1.50 MTPA capacity vide letter No. J-11015/544/2009-IA.II(M) dated 24.12.2014 Compliance report of EC condition is enclosed as Annexure VIII.
B	Status of the compliance of 'Consent to Operate' issued by JSPCB, if any, enclosed.	
C	Latest 'environmental statement' enclosed.	Enclosed as Annexure XIII

EIA/EMP of Karo Expansion OCP (15 MTY) & Karo Washery (7 MTPA)

43. Scoping of EIA

Whether environmental impact assessment of the project has been carried out by following scoping process?	Yes
If yes, a copy of scoping of EIA annexed.	Yes.

44. Mine Closure

A	Have you planned mine closure?	Yes
B	Submitted a conceptual mine closure plan.	Yes
C	If yes, indicate estimated amount for implementing the same (in Rs. lakhs)	5807.08

Capital cost of the project (in Rs. Crs)

(Based on latest estimate)

1626.92 for Karo Expansion OCP & 269.88 for Karo Washery

Cost of environmental protection measures

SN	Particulars	Amount (Rs Lakh)
Pollution Control		
•	Anti-pollution measures in mine & Industrial area	1142.28
•	Anti-pollution measures in township	89.55
•	Rain water harvesting scheme	20.00
Sub Total (1)		1251.83
Other Measures		
•	Cost of rehabilitation	1274.40
•	Cost of compensatory afforestation	3477.83
•	Cost of restoration	10325.13
•	Others	129.85
•	Compensation for non-forest land	1499.55
Sub Total (2)		16706.76
Grand Total (1+2)		17958.59

47. Amount earmarked for socio-economic welfare measures for the nearby villages other than R&R plans.

2% of the average net profit of the company for the three immediate preceding financial years or Rs 2.00 per Tonne of coal production of previous year whichever is higher.

48. Public Hearing:

EIA/EMP of Karo Expansion OCP (15 MTY) & Karo Washery (7 MTPA)

A	Date of Advertisement	05.12.2015
B	Newspapers in which the advertisement appeared	Prabhat Khabar
C	Date of public hearing (DD/MM/YYYY)	05.01.2016
D	Public Hearing Panel chaired by & members present	Jugnu Minj, ADM Bokaro Kamalkanth Pathak, Junior Engineer, JSPCB Rajeev kumar Sinha, Junior Engineer, JSPCB Mithilesh Jha, Assistant Scientist, Ranchi, JSPCB
E	No. of people attended the public hearing meeting and number of people from the lease area.	171, About 50
F	Summary/details of public hearing in tabular form	

(f) Summary/ details of public hearing in tabular form.

SN	Name & Address	Issues raised by the Public	Response/Commitment of Project Proponents
1	Sri Bannu Mahto, Village - Baidkaro	Proposed karo washery falls under Palmu panchayat. Land verification work is pending. He requested for the quick verification work. Arrangement of drinking water, road, electricity etc was requested by him.	Verification work is going on. Assurance for pure drinking water, road, electricity etc was given.
2	Sri Hari Mahto, Panchayat representative, village - Palmu	The implementation of the provisions of the public hearing report should be properly done. Arrangement for drinking water, education, medical etc. for the villager should be done. Employment to local people should be given.	Provision made in the technical presentation should be taken care of. Arrangement for medical facility is being done in the hospital of CCL under CSR schemes. Arrangement for drinking water will be strengthen.
3	Sri Ranjit Mahto, Village – Karo Basti	Repair work of the road of Karo should be done. Employment of the local people in the outsourced company should be increased.	Repair of the damaged road will be done. Outsource company has employed the local youth according to the requirement and the qualification of the youth. For more employment interaction with the outsource company will be done.
4	Sri Jhari lal Hasda, Village - Karo	The basic facility should be provided for the villagers of the Charakpaniya, Kuri, Palmu, Karo, Baidkaro etc.	Development work in the surrounding villages is being done with CSR & CD fund. The company is committed for providing basic facilities.
5	Sri Ashok Kumar, Ward member, No- 6,Subhash nagar	The Project affected villagers should be give benefit. Top soil should be preserved. Preserved soil should be spread over reclaimed land after extraction of coal and the same land should be return to the villagers.	Identity card of the project affected villagers is being prepared for the villager who have not been given employment.

EIA/EMP of Karo Expansion OCP (15 MTY) & Karo Washery (7 MTPA)

		Participation of the public representatives should be insured in the CSR meeting.	
6	Sri Basant Rai Mukhiya, Village – Palmu	Development work should be done in the tribal dominated villages Barkikuri & Chotkikuri adjacent to the Project. Coal loading should be done manually and the villagers should be given priority in it. Technical education and training arrangement should be done for the youth.	Facilities for the villagers, adjacent to the Project, are being provided. Technical education and training arrangement has been done for the youth at CCL level.
7	Sri Ram charan turi Village – Amlo Basti	In village, land owner and landless people lives. Landless people depends on selling of leaves and datum from the jungle. Land owner should get employment.	All type of landowner and local unemployed people are given opportunity for job as per qualification.
8	Sri Pratap Singh, village - Karo	Many villagers are deprived of employment and other facilities due to late verification of gairmajuwa land. Verification work should be done fast. Few land are such that more than one claimant of ownership of land. Identification of right claimant of land will be done. Separate road for coal transportation from Karo Project should be constructed.	About 90 % of verification work of land owner is completed. Verification of GMK land is going on. Due to more than one claimant on few land created difficulty in identification of right claimant. It is carefully examined so that right owner of the land is identified.
9	Sri Sanjay Bhokatha, ward member, No -4, Karo Basti	Basic facilities should be provided in ST dominated villages Bandukbera.	Development work nearby villages are being done by CCL through CSR and CD fund.
10	Srimati Chinta Devi, member of District Parisad, Kurpaniya	The land owner whose land was acquired do not move here and there. Total development of rural area should be done.	The land owner whose land is verified, they are being provided all facilities as per company provision. Overall development of rural area will be kept in mind.
11	Srimati Archana Singh, ward member, Kargali Bazar	All the works should be done as per given in public hearing document. Arrangement for cleaning, drinking water etc. should be done and representative of people shall be invited in the CSR meeting.	Commitment made during public hearing will be done in toto regarding pollution control.

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12	Sri Prem kumar Mahto, Upperghat, Palmu	Focus should be given on providing drinking water, transport facilities and to reduce noise and air pollution. New pond should be constructed for use of irrigation and livestock. Old existing pond should be revive and check dam should be constructed. Review of the work performed under CSR fund should be done.	Development works viz. construction of pond and their revival, construction of wells and check dam are done under CSR fund in rural areas.
13	Sri Ganesh Mahto, Charakpaniya Basti	In absence of land record, one faces difficulty in the issue of residential and caste certificate. Issue of certificates for displaced persons is required for availing benefits.	Arrangement is being made for the issue of certificates for those displaced persons who have not been provided employment.
14	Sri Rameswar Mahto, Ward member, BaidKaro	Rural road should be connected to main road by metalling the rural road. Rabies injection should be made available in the dispensary.	All rural roads is being connected to main road. State government and CCL- -----
15	Sri Iswar Mahto, Baidkaro	Basic facilities should be provided to the villagers.	Basic facilities are being provided to the villagers.
16	Sri Isar Mahto, Karo Basti	Water of Karo Pond has becomes completely polluted. There is scarcity of drinking water for which arrangement should be done and verification of GM land should be done.	Arrangement for the drinking water has been made through pipe lines. Efforts are being made for expediting the work of verification of land.
17	Sri Ram kisun Mahto, Village – barki Kuri	The name of Karo washery should be Barkikuri washery because the proposed washery will be commissioned on the land of Barkikuri. Electricity is available in the half of the village which should be extended to whole village. The paper of the land is submitted to B & K area since 2007. Verification should be done.	The name of any Project or Washery are recommended by DGMS, Proposed washery are recommended in the name of Karo washery.
18	Sri Jugal Kishore Mahto, Bermo Basti	The employment or compensation are not provided on the land acquired earlier. At present, the extension of Krishna Sudarshan central school is being done on raity land whose compensation are not paid.	All the paper related to this land may be deposited in the office. Action has been taken at the earliest.
19	Sri Amrit Mahto, Baidkaro East Panchayat	Washery should be made but 10 % ownership should be given to Rayat.	Service and compensations are provided to land loser as per land acquisition act and company rule.

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20	Sri Abhay kumar sao, Ward no -16	Implementation of the suggestions made in public hearing will ensure no grievance from anyone. Plantation should be done over reclaimed land after the mining is over.	Provisions made for pollution control measures should be adhered to. Provision for plantation over reclaimed land exists.
21	Sri Prakash kumar Mahto, Baidkaro Panchayat	What is provision of one employment against two acre land and who made this provision?	There is provision in Coal India for providing employment and compensation against two acre land.
22	Sri Jibu visvakarma, Karo Basti	Compensations are made to the land owner as the rate of 1984. Compensations should be made at present rate and the whole village should be rehabilitated altogether.	There is provision to take compensation with protest. Land owners can approach court for further justice.
23	Sri Mahendra kumar visvakarma, Subhashnagar	Standard of pollution in the project should be maintained. It should be kept in mind that the land owner gets maximum benefit.	Provisions made for control pollution should be implemented.
24	Sri Kamlesh Tiwari, Representative of Member of parliament, Subashnagar	Local people should be given preference in the employment in the proposed Coal Washery and in Project expansion so that local people may benefited along with Nation, government and the Coal company.	Arrangement for maximum employment of local people in the Company which is engaged in Construction of Coal washery and other works according to their qualifications.

49. Whether the following approvals* (wherever applicable) have been obtained?

i	Site clearance from MoEF	Not Applicable
ii	'Consent for Establishment' from State Pollution Control Board	To be Obtained
iii	NOC from Atomic Mineral Division	Not Applicable
iv	Mining plan approval from IBM / Ministry of Coal	Approved by CCL. Enclosed as annex IV
v	In case of existing mines, mining scheme approval from IBM	Not Applicable
vi	Forestry clearance under FCA, 1980	Partly diverted Enclosed as Annex X.
vii	NOC from Chief Controller of Explosives	Obtained
viii	Commitment regarding availability / pumping of water from the concerned Authorities	Applied
ix	In case of ML area falling in notified areas of the Central Ground Water Authority, NOC from them.	Applied. Application enclosed as Annex VI

[* Annex copies of approvals and number them]

50 Was / is there any court case relating to the project or related activities?

If so, provide details of present status.

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No

Verification: The data and information given in this proforma are true to the best of my knowledge and belief.