

ମହାନଦୀ କୋଲଫିଲ୍ଡସ୍ ଲିମିଟେଡ୍
महानदी कोलफील्ड्स लिमिटेड
Mahanadi Coalfields Limited
(A subsidiary of Coal India Limited)

Office of the project officer
Kaniha OCP

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MCL

Ref. No: MCL/PO/KOCP/2025-26/1537

Date: 13.11.2025

To,

The Additional Principal Chief Conservator of Forest
Eastern Region Office,
Ministry of Env't. & Forest
A/3, Chandrasekharapur,
Behind Rail Vihar & adjacent to Wildlife Range Office
Bhubaneswar-751023

Sub:- Six Monthly Progress Report on implementation of Environmental Clearance conditions stipulated by MoEF&CC in respect of Kaniha OCP (14 MTY), MCL.

Ref:- EC granted vide letter No.J-11015/134/2007-1A-II[M]pt dtd.17.07.2017 by MOEF&CC

Dear Sir,

Enclosed please find here with the six monthly progress report on implementation of EC Conditions in respect of Kaniha OCP, Kaniha Area, MCL for the period 1st April 2025 to 30th September 2025 along with all annexures.

This is submitted for your kind information.

Encl:- As above

Yours faithfully,


Project Officer
Kaniha OCP, MCL

Copy to:-

1. The General Manager, Kaniha Area
2. The General Manager (Env't.), MCL, HQ, Burla
3. The Staff Officer (E & F), Kaniha Area
4. The Project Env't. Officer, Kaniha OCP
5. Office/Guard file

SIX MONTHLY PROGRESS REPORT ON THE IMPLEMENTATION OF ENVIRONMENTAL CLEARANCE CONDITIONS IMPOSED BY MOEF (GOI), NEW DELHI IN RESPECT OF KANIHA OCP, KANIHA AREA, MCL.

Status of period ending	30.09.2025
Name of the project	Kaniha OCP
No. & Date of MOEF clearance letter :	i) No.J-11015/42/2001-IA.II[M] dtd. 12.04.2002 for 3.5 MTY ii) No.J-11015/134/2007-IA.II[M]dtd. 31.10.2007 (For Expansion Project 10 MTY) iii) No.J-11015/134/2007-IA-II[M]pt dtd. 17.07.2017 (For Expansion Project 14 MTY)
Project approval	i) Approved by Department of Coal, Ministry of Energy, Govt. of India Vide No. 43011/2[B]/2002-CPAM dtd .19.01.2005 for 3.5MTY ii) Approved by MCL Board of Directors on 22.12.2007 vide letter no. MCL/HQ / CP &P/08 dt.11.01.2008 (For 10 MTY Kaniha OC expansion Project)
Present status of the project	
Mining operation	The Mining operation in the project has been started w.e.f. 24.11.2010
Total OB removed during1 st April 2025 to 30 th September 2025.	2489480.82 Cu.M
Total coal raised during1 st April 2025 to 30 th September 2025.	4656383.54 Te
Cost of project	96.18Cr. for 3.5MTY, 457.77 Cr. For 10MTY
Actual date of commencement	24.11.2010
Conditions given by MOEF while granting Environmental Clearance.	Status of implementation of the Conditions.
Specific Conditions	
(i) The maximum production from the mine at any given time shall not exceed the limit as prescribed in the EC.	The production of the mine shall be 14 MTY (maximum) as per condition of EC.

(ii) The validity of the EC is for the life of the Mine or as specified in the EIA Notification, 2006, whichever is earlier.	Agreed.
(iii) The proposed time bound action plan shall be implemented in letter and spirit and reported to the Regional Office at Bhubaneswar by September, 2017. The same shall be subsequently reviewed by the EAC.	The proposed time-bound action plan is being implemented. The report of time bound action plan is enclosed as Annexure 1.
(iv) Consent to Establish under the Water Act, 1974 and the Air Act, 1981 shall be obtained from the State Pollution Control Board prior to setting up the required infrastructure for the proposed incremental capacity expansion of 4 MTPA.	Consent to Establish obtained from the State Pollution Control Board, Odisha vide letter no.16493 on dtd. 26.12.2017 for the proposed incremental capacity expansion of 4 MTPA.
(v) Transportation of coal from face to Coal Handling Plant and silos shall be carried out through conveyor belts, and then to the TPP by rail.	Presently transportation of coal from face to siding is being carried out through tippers and then to TPP by rail. However, a work order for execution of the work-CHP with RLS through belt conveyor & surge bin has been issued to MEKON on 30th April 2021. Work has already started on 08th June 2021 and is likely to be completed by 31st March 2026.
(vi) Mitigative measures to be undertaken to control dust and other fugitive emissions all along the roads by providing sufficient numbers of water sprinklers.	Two numbers of mobile tankers of 12 KL capacity and three nos of fog canon of 12KL capacity are in operation during all three shifts to control dust and other fugitive emissions all along the Haul road, CT roads etc. In, 01 no. of truck mounted fog canon/atomizer is also in operation for dust suppression at CT road, peripheral roads including village roads etc.
(vii) Continuous monitoring of occupational safety and other health hazards, and the corrective actions need to be ensured.	Continuous monitoring of occupational safety and other health hazards is being carried out continuously by IME/PME as per provision of Mines Rule, 1955. Corrective actions are being taken as and when required through referral hospitals. For the period 2025-26 (1st April 2025 to 30th September 2025, the total number of persons who have undergone IME is Nil & PME is 86 nos.
(viii) Controlled blasting techniques should be adopted to control ground	Controlled blasting in OB is being carried out as per terms & conditions of permission granted by

vibration and fly rocks.	DGMS. For soft OB, 02 no. of Rippers are used which eliminates drilling and blasting operations partially.								
(ix) More locations (4-5 nos) to be identified in downwind areas in the buffer zone for ambient air quality monitoring in consultation with the State Pollution Control Board. One of such key locations at Patharmunda, shall be provided with continuous air quality monitoring station.	Four more monitoring locations have been identified at four different locations i.e. at village Jarada, at village Chhelia, at village Jamania and at village Jaipur in consultation with Regional Officer, SPCB, Angul in downwind areas for ambient air quality monitoring. Regular ambient air quality monitoring is being conducted in these newly located stations along with the existing ones i.e. a total of 08 locations. One Continuous Ambient Air Quality Monitoring System has been installed and commissioned at Patharmunda during November 2021.								
(x) Interlocking water spraying arrangement with surface miner cutting picks may be explored for introduction to help prevent generation of dust at source itself.	In all surface miners, there is provision of in-built water spraying arrangements through its cutting drum up to edge of the picks, which inject water during operations and reduces the generation of dust in source itself.								
(xi) Contribution of Project through its CSR initiative may be quantified in parameters pertaining to Human Development Indices (HDI).	The study of "Measuring Human Development Index and quality of life index of seven villages around Kaniha OCP" conducted through ECO CONSULTANT SERVICES, LUCKNOW vide Work Order no. MCL/GM(KA)/SO(C)/2023-24/69 dtd. 22.05.2023. The copy of the report is enclosed as Annexure 2.								
(xii) A progressive afforestation plan shall be implemented covering an area of 384.94 ha at the end of mining, Green Belt over an area of 68.80 ha. Density of tree plantation is about 2500 trees/ ha. Massive plantation shall be carried out in open spaces in and around the mine and a 3-tier avenue plantation along the main approach roads to the mine.	It has been planned for afforestation about more than 384.94 Ha in different locations at the end of mining as specified in the permission. This will be done in phased manner as per availability of land. However, project has planted saplings in various years, list of which is tabulated below. <table><tr><td>Year of Plantation</td><td>Location</td><td>No. of seedlings planted</td><td>Types of species planted</td></tr><tr><td>2025-26</td><td>Chhelia, Banbaspur & Kansamunda Village</td><td>42000</td><td>Neem, Sisso, Karanja, Jamu, Panasa, Amla, Jackfruit, Papaya, Lemon, Mango</td></tr></table>	Year of Plantation	Location	No. of seedlings planted	Types of species planted	2025-26	Chhelia, Banbaspur & Kansamunda Village	42000	Neem, Sisso, Karanja, Jamu, Panasa, Amla, Jackfruit, Papaya, Lemon, Mango
Year of Plantation	Location	No. of seedlings planted	Types of species planted						
2025-26	Chhelia, Banbaspur & Kansamunda Village	42000	Neem, Sisso, Karanja, Jamu, Panasa, Amla, Jackfruit, Papaya, Lemon, Mango						

	2024-25	Near Coal Stock	8000	Neem, Sisso, Karanja, Jamu, Panasa, Amla
	2022-23	Kaniha	7000	Neem, Jamu, Srisa, Kadamba
	2021-22	Near Kansamunda site Office	3200	Neem, Sisso, Karanja, Jamu, Panasa
	2021-22	Near Gundurinali	3200	Amla, Kartha, Tentuli, Patuli, Sirisha
	2020-21	Near Project Office	200	Mango, Guava, Pome granate, Sapota, Lemon
	2019-20	NA	Nil	NA
	2018-19	NA	Nil	NA
	2017-18	Near Railway Siding	150	Mango, Neem, Kadamba, Chakunda
	2017-18	Medicinal garden near ETP	100	Ashoka, Basanga, Aswagandha, Aloe vera, Kanchan, Kamini,
	2016-17	Along both side of CT Road	2400	Boula, Kadamba, Chakunda, Mango etc.
	2016-17	Revenue Inspector office, Bada Gunduri & Badagunduri field	3750	Radhachuda, Krushnachuda, Kadamba, Chakunda etc.
	2016-17	In front of Project Office in Van Mahostav Programme	100	Kaju, Mango, Guava, Jamun etc.
	2014-15	Near railway siding	1300	Sisso, Kadamba, Boula
	2014-15	Inside Project Office	124	Guava, Mango, Jamun
(xiii) There will be one external dump during Phase-I having an area of 172.0 Ha (around 59.17 Mcum during phase-I) with height of 85 meter above the surface level, this will be later re-handled. Remaining quantity of Till date (30th September 2025) there is only one external OB dump, which is on coal bearing area. No new OB dump has been created. The present height, area and volume of OB dump is 90.00m (Max), 103.34 Ha. & 56.01 Million Cum respectively. Till date 34.92 Ha of area has been de-coaled, backfilling has already been started in				

overburden will be internally backfilled having an area of 196 ha in phase-I.	the area of 30.69 Ha but most of these areas are yet to achieve ground level
(xiv). The mine will be continued for phase-II operation after stage II forest clearance of there mining area so mine will be ultimately closed only after phase II operation. The final mine void would be in 339.00 Ha with maximum depth up to 80 m out of the total quarry area of 1188.00 Ha. The void of 339.0 ha with depth of 80 m (max) & 20 m (min) to be converted into a water body. Remaining quarry area of 849 Ha should be backfilled. Out of 849.0 ha, 298.60 ha will be afforested and the remaining 550.40 ha will be used for agriculture purpose (conceptual) during mine closure period.	No operation has been started in Phase-II till yet. All the parameters as per the terms and conditions of EC shall be complied.
(xv) The maximum slope of the dump shall not exceed 28 degrees. Monitoring and management of reclaimed dump sites shall continue till the vegetation becomes self-sustaining and compliance status shall be submitted to Regional Office on yearly basis.	Slope of the existing dump is maintained at 28 degrees to avoid steepness and to reduce erosion of particles. Grasses have come out naturally and the dumps are stabilized. Leguminous plants planted in Top Soil Dump in 2015-16. In the year, 2017 additional 50 kilograms of Dhaincha seeds has been broadcasted over the topsoil dump before onset of monsoon to conserve the nutrients and moisture. During the year 2025-26, before the onset of monsoon, 20 kilograms of Grass seeds has been broadcasted over the topsoil dump to conserve the nutrients and moisture. Seedlings have come out in these broadcasted areas. As the external OB dump is going to be re-handled in near future, no plantation afresh is proposed now. Compliance status is being submitted regularly.
B. General Conditions.	
(a) Mining	
(i) No change in mining technology and scope of work shall be made without prior approval of the Ministry of Environment, Forest and Climate	No change has been made in the mining technology and scope working till yet. No change in calendar plan has been made so far. The details of production for the last 10 years are given below

Change. No change in the calendar plan including excavation, quantum of coal and waste should be made.

and the production is within the sanctioned capacity of 14.0 MTPA.

Year	Coal Production (Million tones)	OB (Mm3)
2011-12	0.337	1.57
2012-13	0.682	0.583
2013-14	4.525	0.131
2014-15	6.99	1.334
2015-16	9.837	4.085
2016-17	8.709	3.95
2017-18	8.33	2.737
2018-19	6.61	2.99
2019-20	7.53	3.65
2020-21	7.94	3.85
2021-22	10.09	7.30
2022-23	12.15	7.41
2023-24	11.81	7.32
2024-25	10.85	6.58
2025-26 (till Sep'2025)	4.66	2.52

(ii) Mining shall be carried out as per the approved mining plan, and also abiding by the relevant laws related to coal mining and the circulars issued by Directorate General Mines Safety (DGMS). An approved progressive Mine Closure Plan shall strictly be complied with and submitted.

Mining Plan and Mine Closure Plan for Kaniha OCP Expansion from 10 MTY to 14 MTY (Revision-2) was approved by Ministry of Coal on dtd. 08th February, 2017 vide letter no. 34012/(04)/2011-CPAM. Mining is carried out as per the approved mining plan. All the laws & regulations related to coal mining with circulars issued by DGMS from time to time is being abided. The provisions of approved mine closure plan is being abided.

(b). Land Reclamation

(i) Digital processing of the entire lease area using remote sensing technique shall be carried out regularly once in three years and report submitted to Ministry of Environment, Forest and Climate Change its Regional Office.

Satellite imagery based land use pattern monitoring is being carried out regularly and is available in the MCL website www.mcl.gov.in

The same in respect of Kaniha OCP is being submitted to ERO, MoEF, Bhubaneswar along with Six Monthly EC Compliance Report.

Data obtained from the satellite image of Kaniha OCP for the year 2015, 2018, 2021 & 2023 is presented in

	tabular format. <table><tr><td>Land Use (Ha)/Year</td><td>2015</td><td>2018</td><td>2021</td><td>2023</td></tr><tr><td>Settlement</td><td>16.80</td><td>16.24</td><td>31.00</td><td>30.00</td></tr><tr><td>Vegetation Cover</td><td>50.20</td><td>57.08</td><td>80.00</td><td>74.00</td></tr><tr><td>Mining area</td><td>87.49</td><td>169.80</td><td>209.00</td><td>279.00</td></tr><tr><td>Plantation</td><td>10.53</td><td>10.53</td><td>7.00</td><td>9.00</td></tr><tr><td>Waste land</td><td>142.81</td><td>125.72</td><td>100.00</td><td>90.00</td></tr><tr><td>Water Bodies</td><td>6.6</td><td>8.19</td><td>7.00</td><td>7.00</td></tr></table> There is an increase in Plantation cover in the year 2023 as compared to the year 2021 because of undertaking different plantation activities in the mine lease area. Decrease in vegetation cover in the year 2023 as compared to the year 2021 is mainly due to clearing of shrubs for undertaking different developmental activities like construction of Rapid Loading System for transportation of coal, development of Concrete Coal Transportation Road for movement of tippers. The detailed report on information on of satellite Imagery on land use patterns changes for the year 2023 is enclosed as Annexure-3.	Land Use (Ha)/Year	2015	2018	2021	2023	Settlement	16.80	16.24	31.00	30.00	Vegetation Cover	50.20	57.08	80.00	74.00	Mining area	87.49	169.80	209.00	279.00	Plantation	10.53	10.53	7.00	9.00	Waste land	142.81	125.72	100.00	90.00	Water Bodies	6.6	8.19	7.00	7.00
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(ii) Final mine void depth should not be more than 40 m. The void area should be converted into water body. The remaining area should be back filled up to the ground level and covered with thick top soil. The land after mining should be restored for agriculture or forestry purpose.	As per approved mine closure plan, final mine void depth shall be kept maximum 40m which shall act as water reservoir Maximum excavated area shall be backfilled up to original ground level and restored for agriculture and forestry.																																			
(iii) The top soil, if any, shall temporarily be stored at earmarked site(s) only and it should not be kept unutilized for long. The topsoil shall be used for land reclamation and plantation. The overburden dumps should be vegetated with suitable native species to prevent erosion and surface run off. The entire excavated area shall be backfilled and afforested in line with the approved Mine Closure Plan. Monitoring and management of rehabilitated areas should continue until the vegetation	Top soil has been excavated and stacked in earmarked site maintaining proper slope to be used for reclamation and development of green belt in future. Plantation of leguminous plants for soil conservation and nutrients has been done. At present there is only one external OB dump, which spreads in an area of 105.54 Ha (as on date). Due to constraint in land, presently the OB is being dumped over coal bearing area, which will be re-handled in future as soon as de-coaled area created for backfilling. Moreover the present dump yard is on active stage, so no plantation is being carried out over the dump yard. However some portion of the present dump is stabilized due to growth of natural vegetation.																																			

becomes self-sustaining. Compliance status shall be submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office on six monthly basis.	Compliance in this regard is submitted along with six monthly EC conditions compliance.
(iv) Greenbelt shall be developed all along the mine lease area in a phased manner. The width of the green belt along forest area should not be less than 7.5 m, and the total area covered by 3 tier green belt shall not be less than 100 ha. A 3-tier green belt comprising of a mix of native species shall be developed all along the major approach roads.	Green belt of length 1.5 RKM has been developed along the major approach road to Project Office, Site Office and along the service road of Kaniha OCP. During the year 2025-26 an area of 11.25 Ha has been planted inside the mine lease. The phase-I mining does not involve any non diverted forest land, and all the forest land present in the project will only be worked as a part of Phase-II mining after 11 years and it will be ensured for development of green belt of 7.5m all around the forest area.
(c). Emissions, Effluents and Waste Disposal	
(i) Transportation of coal by road should be carried out by covered trucks only. Effective measures such as regular water sprinkling shall be carried out in critical areas prone to air pollution and having high levels of PM ₁₀ and PM _{2.5} such as haul road, loading and unloading point and transfer points. Fugitive dust emissions from all the sources shall be controlled regularly. It shall be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central/State Pollution Control Board in this regard	It is ensured that all the trucks are covered by tarpulin during transportation of coal by road. Two numbers of mobile tankers of 12 KL capacity and three nos of fog canon of 12KL capacity have been deployed in haul roads, and other transportation roads to arrest the dust before it gets air borne. In siding areas, 14 nos of fixed water sprinklers with 30m throw capacity and 360° rotation are installed by covering entire length of siding to suppress the dust. Sprinklers remain operational in all the three shifts during loading and unloading. Three numbers of fixed type fog canons are in operation at railway siding. One no of Mobile Fog canon is also in operation at Railway sidings, CT and other peripheral/village roads for suppression of fugitive dust.
(ii) Vehicular emissions shall be kept under control and regularly monitored. Project should obtain 'PUC' certificate for all the vehicles from authorized pollution testing centers.	All the vehicles deployed in the mine on contractual basis. It is being ensured that all the vehicles possess valid PUC.
(iii) Adequate ambient air quality	Air quality monitoring is being done in the core and

monitoring stations shall be established in the core zone as well as in the buffer zone for monitoring of pollutants, namely PM₁₀, PM_{2.5}, SO₂ and NO_x. Location of the stations shall be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets in consultation with the State Pollution Control Board. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr, etc carried out at least once in six months.	buffer zone by CMPDIL, Bhubaneswar at eight different locations in 2025-26 after consultation with Regional Officer, SPCB. For the year 2025-26 monitoring is being done at eight different locations viz, Old site Office, North of Mine, New Time Office, Near Project Office, Near Jatra Padia, Jarada, Near External OB dump Jamania, South of proposed quarry limit of KOCP, South west of mine which are present in upwind and downwind direction. Monitoring of heavy metals such as Hg, As, Ni, Cd, Cr etc. is also carried out once in six months.
(iv) Crusher/feeder and breaker material transfer points should invariably be provided with dust suppression system. Belt-conveyors should be fully covered to avoid air borne dust. Drills shall be wet operated or fitted with dust extractors.	No CHP exist, as the mine is producing sized coal by surface miner. However, for dust suppression at loading points like railway siding auto sprinkler arrangements has been provided. In other part of the mine dust suppression is being done by two number of mobile tankers of 12 KL capacity and three nos of fog canon of 12KL capacity. No drilling is required in coal benches. Drilling operation in hard OB strata is done and is equipped with dust guard to arrest the air borne dust around the source of generation. Now in Z-South Quarry, OB is also removed through ripper, which rules out the process like drilling & blasting and hence reduces vibration & fly rocks.
(v) The project proponent shall not alter the major channels around the site. Appropriate embankment should be provided along the side of the river/nallah flowing near or adjacent to the mine. The embankment constructed along the river/nallah boundary should be of suitable dimensions and critical patches should be strengthened by stone pitching on the river front side and stabilised with plantation so as to withstand the peak water flow and prevent mine inundation.	There is no alteration of major channels around the site. Presently the quarry edge is situated at a distance of 5 KM away from bank of river Brahmani with the mine being at about 10m higher altitude and about 3 KM from the Tikira Nadi and 2.5 Km from Bhalutunguri Nadi with the mine being at about 8m higher in altitude. The embankment as stipulated in the permission shall be required when the quarry edge will reach nearer to river/nallah boundary.

(vi) Rainwater harvesting shall be implemented for conservation and augmentation of ground water resources in the area in consultation with Central Ground Water Board.	For augmentation of groundwater resource, rainwater-harvesting system has been provided at Coal Sampling lab & Project office of Kaniha OCP, where the rainwater is captured from the roof catchments and water is channelized to rain water harvesting system for ground water recharge.
(vii) Catch drains and siltation ponds of appropriate size shall be constructed around the mine working, coal heaps and OB dumps to prevent run off of water and flow of sediments directly into the river and other water bodies. The water so collected should be utilized for watering the mine area, roads, green belt development etc. The drains shall be regularly desilted particularly after monsoon and maintained properly. Sump capacity should provide adequate retention period to allow proper settling of silt material. Dimension of the retaining wall to be constructed at the toe of the dumps and OB benches within the mine to check run-off and siltation should be based on the rainfall data.	Siltation ponds of sizes (68.00 M X 28.00 M X 2.00 M) & (98.00 M X 28.00 M X 2.70 M) as pre sedimentation pond I & II and two other sedimentation ponds of capacity (135 M x 95 M x 4.5 M) and (115 M x 88 M x 2.0 M) as clear water pond has been constructed to accommodate the surface runoff within the mine lease. Construction of catch drains for free flow of water leading from the source to siltation pond has also been completed. The water collected in the siltation pond is being used for water spraying the mine area, roads, sidings and development of greenbelt. The catch drains are being regularly de-silted and are being maintained regularly. Garland drains of adequate size and proper gradient is made along the toe of OB dump as well as quarry edge to ensure free flow of monsoon water. Adequate sump capacity has been prepared considering fifty percent safety margin and retention period to allow proper settling of silt material. The sump capacity is also being monitored on regular basis before onset of monsoon every year.
(viii) Industrial waste water (CHP, workshop and waste water from the mine) should be properly collected and treated so as to conform to the standards prescribed under the Environment (Protection) Act, 1986 and the Rules made there under, and as amended from time to time. Oil and grease trap should be installed before discharge of workshop effluents.	There is no CHP present inside the mine lease of the project. There is no departmental HEMM in the mine and no wastewater from workshop is allowed to be discharged to outside. But now construction of ETP equipped with O&G trap has already been completed near the work shop area for the contractors engaged in coal and OB production inside the mine lease area.
d. Noise & Vibration Control	
(i) Adequate measures shall be taken for control of noise levels	Adequate measures are being taken for control of noise level. Noise level is monitored at three places viz., near

below 85 dBA in the work environment. Workers engage in blasting and drilling operations, operation of HEMM, etc shall be provided with ear plugs/muffs.	Jarada village, Patharmunda village and at Site office. As per the noise level monitoring data, the noise level during day time and during night time is within the limits. All the workers engaged in blasting, drilling and HEMM operations are being provided with earmuffs.
(ii) Controlled blasting techniques should be practiced with use of delay detonators to mitigate ground vibrations and fly rocks.	Recently blast free mining using rippers has been introduced in Z-South Quarry (part of mine). Controlled blasting in OB is being carried out by using electronic delayed detonators to mitigate ground vibration and fly rocks.
e. Occupational Health & Safety	
(i) Besides carrying out regular periodic health check-up of their workers, 20% of the workers identified from workforce engaged in active mining operations shall be subjected to health check-up for occupational diseases and hearing impairment, if any, through an specialized agency /institution within the District/State and the results reported to this Ministry and to DGMS.	As per permission of the Mines Rule, 1955 Initial Medical Examination (IME) & Periodical Medical Examination (PME) are being carried out at the regional Hospital MCL, Talcher for the employees of Kaniha OCP, Kaniha Area as per target assigned. During the year 2025-26 (from 1 st April 2025 to 30 th September 2025) the total number of persons who have undergone IME is Nil & PME is 86 nos.
(ii) Personnel working in dusty areas should wear protective respiratory devices and they should also be provided with adequate training and information on safety and health aspects. Supervisory staff shall be held responsible for ensuring compulsory wearing of dust mask.	The employees working in dusty areas have been provided with PPEs like dust mask. Regular training and information on safety and health aspects are provided in vocational training center, pit safety meeting, and safety fortnight celebrations etc. 221 nos. of dust masks and 99 nos. of earmuffs were provided during the period from 1 st April 2025 to 30 th September 2025.
(iii) In case of outsourcing of work through MDO, the project proponent shall ensure the strict enforcement of the above conditions.	Not applicable

f. Biodiversity																					
(i) The project proponent shall take all precautionary measures during mining operation for conservation and protection of endangered fauna, if any, spotted in the study area. Action plan for conservation of flora and fauna shall be prepared and implemented in consultation with the State Forest and Wildlife Department. A copy of action plan shall be submitted to the Ministry of Environment, Forest and Climate Change and its Regional Office.	The project authority is taking all precautionary measures during mining operation for conservation and protection of endangered fauna. If any wild life spotted, a wild life management plan will be prepared aiming at the providing safe passage to the existing wild animals in the lease area to the nearby forest areas. Along with the safe passage of animals an afforestation programme will also be taken up by user agency for restoration of habitats of wild animals in consultation with the State Forest and Wildlife Department.																				
g. Implementation of Action Plan as per Public Hearing and CSR Activities																					
(i) Implementation of Action Plan on the issues raised during the Public Hearing shall be ensured. The Project Proponent shall complete all the tasks as per the Action Plan submitted with budgetary provisions during the Public Hearing. Land oustees should be compensated as per the norms laid out R&R Policy of the Company or the National R&R Policy or R&R Policy of the State Government, whichever is higher.	The issues raised by the public during public consultation have been addressed on priority. The detail of compliance of issues raised during public hearing has already been submitted. Rehabilitation & Resettlement is being done as per the R & R Policy of Govt. of Odisha, 2006. The R & R details are as under: a. PAFs : 2360 b. Employment given till date: 1764 c. Cash Compensation Provided: 56 d. Annuity Given: 08 e. Resettlement Provided: 1629																				
(ii) The Board of every company shall ensure that the company spends, in every financial year, at least two per cent of the average net profits of the company made during the three immediately preceding financial years, in pursuance of its Corporate Social Responsibility Policy under Section 135 of the Companies Act, 2013, for the socio economic development of the neighborhood.	It is being complied with. The CSR expenditure incurred during last five years is given below: <table border="1"> <thead> <tr> <th>Year</th><th>CSR Expenditure (in Lakhs)</th></tr> </thead> <tbody> <tr><td>2016-17</td><td>77.21</td></tr> <tr><td>2017-18</td><td>68.23</td></tr> <tr><td>2018-19</td><td>45.14</td></tr> <tr><td>2019-20</td><td>36.29</td></tr> <tr><td>2020-21</td><td>92.69</td></tr> <tr><td>2021-22</td><td>140.59</td></tr> <tr><td>2022-23</td><td>99.30</td></tr> <tr><td>2023-24</td><td>174.36</td></tr> <tr><td>2024-25</td><td>187.88</td></tr> </tbody> </table>	Year	CSR Expenditure (in Lakhs)	2016-17	77.21	2017-18	68.23	2018-19	45.14	2019-20	36.29	2020-21	92.69	2021-22	140.59	2022-23	99.30	2023-24	174.36	2024-25	187.88
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2023-24	174.36																				
2024-25	187.88																				

h. Corporate Social Responsibility

(i) The Company should have a well laid down Environment Policy approved by the Board of Directors.	The company has a well laid down environment policy, approved by Board of Directors, where MCL is committed to protect the environment through prevention, mitigation of pollution, proper disposal and recycling of wastes, conservation of bio-diversity and bringing awareness among all its stakeholders for continual improvement in environmental performances by following the best practices.																												
(ii) To have proper checks and balances, the Company should have a well laid down system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large.	The non compliances/violations of conditions mentioned in EC are brought to the notice of Project proponent at the project level and General Manager at Area level by Project Environment Officer and Area Environment Officer. These non-compliances are then communicated to General Manager (E&F), MCL HQ to take up these matters in Board for resolving the hindrances in the way of requisite compliances as per the environmental statutes.																												
(iii) A separate environmental management cell with suitable qualified personnel should be set-up under the control of a Senior Executive, who will report directly to the Head of the Organization.	There is one Project Nodal Environmental officer at Kaniha OCP under project officer. There is one Deputy Manager in environment cadre posted at area level under Area Environment Officer who is reporting to Area General Manager, Kaniha Area for all environmental issues. Above all, there is Environment Department at MCL, HQ headed by General Manager (Environment) who Reports to Director (Technical), MCL.																												
(iv) The funds earmarked for environmental protection measures should not be diverted for other purpose. Year wise expenditure should be reported to the Ministry and its Regional Office.	The fund is not being diverted to other purpose/activities. Sufficient funds have been allocated for implementation of environmental safeguard measures. The expenditure details for the last 10 years are as follows: <table><tr><th>Year</th><th>Expenditure</th></tr><tr><td>2012-13</td><td>Rs.43.70 lakh</td></tr><tr><td>2013-14</td><td>Rs.51.10 lakh</td></tr><tr><td>2014-15</td><td>Rs 44.76 lakh</td></tr><tr><td>2015-16</td><td>Rs 157.95 lakh</td></tr><tr><td>2016-17</td><td>Rs.217.34 lakh</td></tr><tr><td>2017-18</td><td>Rs.220.81 lakh</td></tr><tr><td>2018-19</td><td>Rs. 211.98 lakh</td></tr><tr><td>2019-20</td><td>Rs. 297.87 lakh</td></tr><tr><td>2020-21</td><td>Rs. 262.35 lakh</td></tr><tr><td>2021-22</td><td>Rs. 264.18 lakh</td></tr><tr><td>2022-23</td><td>Rs. 353.96 lakh</td></tr><tr><td>2023-24</td><td>Rs. 422.98 lakh</td></tr><tr><td>2024-25</td><td>Rs. 518.95 Lakh</td></tr></table>	Year	Expenditure	2012-13	Rs.43.70 lakh	2013-14	Rs.51.10 lakh	2014-15	Rs 44.76 lakh	2015-16	Rs 157.95 lakh	2016-17	Rs.217.34 lakh	2017-18	Rs.220.81 lakh	2018-19	Rs. 211.98 lakh	2019-20	Rs. 297.87 lakh	2020-21	Rs. 262.35 lakh	2021-22	Rs. 264.18 lakh	2022-23	Rs. 353.96 lakh	2023-24	Rs. 422.98 lakh	2024-25	Rs. 518.95 Lakh
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(i) Statutory Obligations	
(i) Environmental clearance is granted subject to final outcome of Hon'ble Supreme Court of India, Hon'ble High Court, NGT and any other Court of Law, if any, as may be applicable to the project.	Being complied with.
(ii) This Environmental Clearance is subject to obtaining requisite NBWL Clearance from the Standing Committee of National Board for Wildlife, if any, as applicable to the project.	At present no significant wildlife present in the mine lease area of the project. If any wildlife reported, NBWL Clearance from the Standing Committee of National Board for Wildlife will be taken.
(iii) The project proponent shall obtain Consent to Establish and Consent to Operate from the concerned State Pollution Control Board prior to increase in capacity of washery and effectively implement all the conditions stipulated therein.	There is no washery attached to this mine.
(iv) Project Proponent shall obtain the necessary prior permission from the Central Ground Water Authority (CGWA) for drawl of water (surface and ground water).	No Objection Certificate (NOC) in respect of Kaniha OCP, MCL has been obtained from CGWA for ground water abstraction vide letter no. CGWA/NOC/MIN/REN/1/2025/11362 and is valid from 11.11.2023 to 10.11.2025. Application for renewal of NOC also submitted in time.
j. Monitoring of Project	
(i) Regular monitoring of ground water level and quality shall be carried out in and around the mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring shall be carried out four times in a year pre monsoon (April-May), monsoon (August), post-monsoon (November) and winter (January) and the data thus collected may be sent regularly to Ministry of Environment, Forest and Climate Change and its	The ground water level and quality is being monitored on regular basis by CMPDIL. Water level is monitored in three nos. of well & three nos. of Piezometer (already installed) at inside the premises of Chellia Prathamika School, Outside Golagharsahipr athamika school, Bijigol and inside the premises of Kansamunda Uchhavidyala on quarterly basis. The Comprehensive Hydrogeological Report and Ground Water Modelling Report prepared for Kaniha OCP in Oct 2025 is enclosed as annexure-4.

Regional Office, Central Ground Water Authority and Regional Director, Central Ground Water Board.	
(ii) The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest and Climate Change, its Regional Office, Central Pollution Control Board and State Pollution Control Board.	The details of implementation of the stipulated environmental safeguards is usually incorporated in six monthly progress report on the implementation of Environmental Conditions and is submitted to MoEF within the stipulated time.
(iii) The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data/information/monitoring reports.	Project has always extended its full cooperation to the officer(s) of the Regional Office, MoEF&CC by furnishing the requisite data/information/monitoring reports and the same will also be extended in future also.
(iv) The activities pertaining to development of green belt/horticulture shall be reported to concerned Regional Office of MoEF&CC on six monthly basis from the date of commencement of mining operations.	The report pertaining to development of green belt/horticulture from the date of commencement of mining operations is being furnished.
(v) For half yearly monitoring reports, the data should be monitored for the period of April to September and October to March of the financial years and submitted to the concerned authorities within 2 months of the completion of periodicity of monitoring.	Six monthly progress report on the implementation of Environmental Conditions is prepared on the basis of monitoring reports for the period of April to September and October to March of the financial years and submitted to MoEF&CC within the stipulated time.
k. Miscellaneous	
(i) A copy of clearance letter will be marked to concerned Panchayat/local NGO, if any, from whom suggestion / representation has been received while processing	A copy of the EC letter has already been marked to various panchayats namely Kamarei, Badatribida, Jarada & Kaniha.

the proposal.	
(ii) An electronic copy of the EC letter shall be marked to the concerned State Pollution Control Board, Regional Office, District Industry Sector and Collector's Office/Tehsildar Office for information in public domain within 30 days	A copy of the EC letter has already been forwarded to State pollution Control Board, Regional Office, Collector's Office, Tahsildar Office.
(iii) The EC letter shall be uploaded on the company's website. The compliance status of the stipulated EC conditions shall also be uploaded by the project authorities on their website and updated at least once every six months so as to bring the same in public domain. The monitoring data of environmental quality parameter (air, water, noise and soil) and critical pollutant such as PM ₁₀ , PM _{2.5} , SO ₂ and NO _x (ambient) and critical sectoral parameters shall also be displayed at the entrance of the project premises and mine office and in corporate office and on company's website.	EC letter and compliance status of the stipulated EC conditions is uploaded in the company's website and is available at www.mcl.gov.in A display board has been installed at Project Office of Kaniha OCP and monitoring data of environmental quality parameter (air, water and noise) and critical pollutant such as PM₁₀, PM_{2.5}, SO₂ and NO_x (ambient) are also displayed.
(iv) The project authorities should advertise at least in two local newspapers widely circulated, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at web site of the Ministry of Environment, Forest and Climate Change at www.environmentclearance.nic.in and a copy of the same should be forwarded to the Regional Office.	Advertisement of grant of EC to Kaniha OCP, MCL was published in the English news paper Indian Express on dtd.26.07.2017 and in Odiya newspaper Dharitri on dtd.26.07.2017. A copy in this regard has already been submitted to regional office vide letter no. MCL/GM/KA Env't. & Forest/2017/56 dtd. 15.09.2017.

(v) The Environmental Statement for each financial year ending 31st March in Form-V is mandated to be submitted by the PP for the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be uploaded on the Company's website along with the status of compliance of EC conditions and shall be sent to the respective Regional Offices of the MoEF&CC by e-mail.	Environmental Audit is being conducted in every financial year and its report is submitted to SPCB, Bhubaneswar. For the financial year 2024-25, the Form-V in respect of Kaniha OCP has been submitted to OSPCB vide letter no. MCL/HQ/E&F/2025/638 dated 27.09.2025. Copy of Form-V is enclosed as Annexure-5.

[Signature]
Project Officer
Kaniha OCP, MCL 13/11/25

Annexure-1

The Time-bound Action Plan for compliance of the Observations of Regional Office, MoEF & CC, Bhubaneswar is given below:

(i) Special Conditions:-

No.	Observations of Regional Office	Present status and Action plan for compliance
ii)	"The topsoil should be used for reclamation and development of green belt only and should be stacked with proper slope at earmarked site(s) only."	During the financial year 2025-26, a total of 89266.96 m ³ of top soil was generated and was stacked at the earmarked site by maintaining proper slope. The stacked topsoil will be used during reclamation of backfilled area. During the year 2025-26, before the onset of monsoon 20 kilograms of Grass seeds has been broadcasted over the topsoil dump to conserve the nutrients and moisture.
iii)	"Backfilling is yet to be started in the above mentioned de-coaled areas. PAs should simultaneously backfill the OB in the de-coaled area. It requires immediate action."	In Kaniha OCP as on 30 th September 2025, 34.91 Ha. of de-coaled area has been created and out of the above de-coaled area, 30.69 Ha. area is under backfilling.
iv)	"Implementation of Disaster management plan in progress. Detailed report on the implementation of Disaster management plan should be submitted to Regional Office on time-to-time basis."	Detailed report on the implementation of Disaster management plan has already been submitted and in future it shall be submitted on regular basis with Six Monthly Report being submitted to MoEF, RO.
v)	"As stated above, there are two active external OB dumps existing in the mines lease area. The OB dumps have not yet been reclaimed and dumping is still continuing and no plantation afresh is proposed now. Leguminous plants planted in Top Soil Dump and found that the plants were dead"	External OB Dumps are active in nature as these external dumps are going to be re-handled in near future regular plantation has not been taken up, however to conserve the nutrients and moisture, 40 kilograms of Grass seed has been broadcasted over the topsoil dump before onset of monsoon.
vii)	"The retaining wall at the toe of the all the dumps and OB benches were not yet constructed properly."	Repairing of the existing retaining wall at the toe of all the dumps has already been completed.
viii)	"However, during monitoring it has been observed that the crushing of the coal by surface miner requires adequate and high efficient measures for dust suppression."	Surface miners are Eco-friendly mining machine as it totally eliminates drilling, blasting & CHP operations. The cutting drum and picks mounted on it are located below the body of the machine and rubber flaps are provided so that cutting of coal takes place in almost enclosed environment. Further, water sprinkling nozzles have been provided to suppress the dust generated during cutting operations which are interlocked with the movement of the drum. Thus, the system is full proof, robust & efficient and it is further ensured that water tanks provided on the surface miner are filled up regularly and there is no cutting operation without simultaneous sprinkling of water

ix)	"Water spraying is being done in regular basis by mobile tanker to suppress dust in haul road. However, during monitoring it has been observed that frequent clearing of dust precipitated on the sides of the road and drainage line should be carried out. Fixed and mist type of water sprinkling system should be installed on main and haul roads. Frequency of water sprinkling by mobile water tank should be increased for suppression of dust at haul roads. All approach roads (existing and proposed) should be metal topped."	through the nozzles mounted near the cutting drum. Two numbers of mobile tankers of 12 KL capacity and three nos of fog canon of 12KL capacity are deployed for dust suppression during all three shifts. Along with the above-mentioned measures one more truck mounted fog canon / atomizer has been commissioned since 17 th Aug 2020 for suppression of fugitive dust. Three nos of fixed type fog canon have also been installed and commissioned in the railway siding. Clearing of road side dust is taken up on regular basis. Now frequency of cleaning has also been increased further to keep the dust level within the permissible limit. Concreting has been done on all permanent approach and coal transportation roads. All permanent roads have already been metal topped.
xix)	"However, during the monitoring it has been observed that the raw influent generated from railway siding and transportation road is being stored in the sedimentation pond and the overflow from the pond being channelized to the ETP. The channels are also not properly concreted to avoid soil contamination. It is required to redesign the ETP by an expert for appropriate treatment of leachate coming from the railway siding and other sources of wastewater."	In order to ensure appropriate treatment of the effluent generated from newly constructed contractor's workshop, construction of ETP equipped with O & G trap has also been completed. Moreover, there is no departmental HEMM in the mine and no wastewater from workshop is allowed to be discharged to outside.
xxi)	"It has been observed that the vegetation cover and plantation land were decreased from 102.38 ha to 50.20 ha and 10.88 ha to 10.53 ha respectively."	The reduction in vegetation cover is due to clearing of shrubs for mining & infrastructure. To increase plantation, cover an area of 11.25 Ha. has been planted during the year 2025-26.
xxiii)	"The prepared report on the R&R activities for the 8 villages and their implementation should be submitted to the Regional Office on time to time basis".	Present Status Report on the R&R activities was explained to the RO and further updated status report is presented in Table 1, 2 & 3.

(ii) General Conditions.

No.	Observations of the Regional Office	Present status and Action plan for compliance

iii), iv), v)	"The SPM and PM_{2.5} were exceeding the limits and the necessary action should be taken to bring the concentration within the limits". "PAs should take adequate measures to control the fugitive dust emissions at all these points".	Following additional steps have been taken: • 01 no. of mobile fog canon have been deployed since 17th Aug 2020 for effective dust suppression • 03 nos. of fixed type fog canon also commissioned in railway siding to prevent fugitive dust emission. • Strict supervision to ensure effective dust suppression SPM, PM10 & PM2.5 values are within the prescribed standards. Air quality data for the month of 1st April 2025 to 30th September 2025 is enclosed as annexure-6. Further Additional measures proposed: The work order for execution of the work, CHP with RLS through belt conveyor & surge bin has been issued to MEKON on 30th April 2021. Work has already started on 08th June 2021 and is likely to be completed by 31st March 2026. These steps shall significantly reduce the dust concentration.
vi)	"During the monitoring, it has been observed that the workers were not wearing any ear plug/muff which operating when operating HEMM. All the workers engaged in noisy atmosphere like blasting, drilling and HEMM operations should be provided with earmuffs".	All the workers engaged in noisy atmospheres like blasting, drilling and HEMM operations has already been provided with earmuffs. Training programme is being organized to sensitize the work force for using personal protective equipment.
vii)	"Oil and grease trap was not installed for discharge of workshop effluents where the workshop activities were taken up at the top of the top soil dump".	The unauthorized temporary shed for maintenance of the private tippers has already been removed from the topsoil dump, hence presently no such measure is required.
x)	"However, during monitoring, it has been observed that many of the workers working in the core zone area were not wearing any dust mask".	All the workers engaged in dusty areas are provided with the dust mask. Training programme is being organized to sensitize the work force to use personal protective equipment.
xii)	"However, it is required to submit the item wise break-up for the expenditure incurred for implementation of environmental safeguard".	Item wise break-up for the expenditure incurred for implementation of environmental safeguard is enclosed as annexure -5.

Table 1: Status of Compensation for Land & Structure:

Name of Project	Name of Village	Tenancy land acquired (Ac.)	Amount Sanction (in Rs.)	Amount Paid	Deposited in Tribunal	Amount Balance
Kaniha OCP (Phase-I)	Jamania	13.14	7981342.46	7938937.04	40542.82	1862.60
	Adaitaprasad	55.82	17586388.03	16706400.23	805425.40	74562.40
	Jarada	463.15	264424327.46	262769562.38	0	1654765.08
	Kansamunda	129.56	106683612.90	602125.39	99824881.43	6256606.08
	Jaipur	9.33	5840711.52	282789.09	4506608.45	1051313.98
	Telisingha	282.92	224638682.65	218997427.81	580939.57	5060315.27
	Kaniha	13.21	7687532.00	6883324.99	801639.93	2567.08
	Patharmunda	94.93	111472982.72	101945264.17	2134147.66	7393570.89
	Total	1062.06	746315579.7	616125831.10	108694185.26	21495563.38
Kaniha OCP (Phase-II)	Jamania	66.450	151806230.50	142956536.31	0.00	8849694.19
	Chhelia	253.690	747092860.71	683425535.29	0.00	63667325.42
	Jarada	125.890	576734625.08	14194583.61	0.00	562540041.47
	Kansamunda	56.850	299597273.75	255637846.31	17834444.11	26124983.33
	Gundurinali	17.910	93106769.75	84265289.11	0.00	8841480.64
	Telisingha	100.200	492149660.81	170289582.03	0.00	321860078.78
	Kaniha	51.45	250351355.57	224533983.56	0.00	25817372.01
	Patharmunda	189.030	1184280495.50	938928859.68	65335580.70	180016055.12
	Total	861.470	3795119271.67	2514232215.90	32271209.91	1197717030.96

Gopalji OCP	Adaitaprasad	41.99	212971537.91	162050467.40	0	50921070.51
	Kansamunda	537.94	2406559860.33	1561013779.88	25458.41	845520622.04
	Kaniha	37.410	187360062.47	109485955.93	0	77874106.54
	Balarampur	57.980	112813194.00	90339280.73	0	22473913.27
	Total	675.32	2919704654.71	1922889483.93	25458.41	996789712.37

Table2: Status of Employment

S. No.	Name of the Village	No. of Claimants for Employment /CC/Annuity	No. of Employment/CC/Annuity Provided	No. of Cases no eligible	Balance
1	Jamania& Adaitaprasad	178	150	0	28
2	Jarada	528	503	12	25
3	Kansamunda	721	473	0	254
4	Telisingha	398	373	0	25
5	Kaniha	40	22	0	18
6	Pathamunda	230	157	0	46
7	Gundurinali	41	32	0	9
8	Chhelia	224	116	0	117
		2360	1826	12	522

Table 3: Status of Resettlement:

Village required to be resettled/ Relocated	No. of PAFs required to be resettled	Name of Resettlement Site	Area of Resettlement Site (in Acres)	Nos. of Plot available	Nos. of PAFs provided Resettlement plot	Nos. of PAFs availed cash grant in lieu of Plot	Balance Nos. of PAFs required to be Resettled
Jamania& Adaitaprasad	108	Pathamunda	0	NA	NA	108	0
Jarada	640		98.92	453	77	147	40
Kansamunda	258		0	NA	NA	179	79
Telisingha	527		0	NA	NA	493	34
Chhelia	282		0	NA	NA	172	110
Total	1815		98.92	453	77	1099	263


परियोजना अधिकारी/Project Officer
कनिहा ओसीपी/Kaniha OCP

Annexure-2

**MEASURING HUMAN DEVELOPMENT INDEX AND
QUALITY OF LIFE INDEX OF SEVEN VILLAGES
AROUND KANIHA OPENCAST COAL MINES
OF
MAHANADI COALFIELDS LIMITED,
ANGUL, ORISSA**



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Certificate No: NABET/EIA/2225/IA0102

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Introduction

Coal: Energy Reserve of India

Coal stands as India's paramount and most abundant fossil fuel, serving as the cornerstone of the nation's energy landscape. Constituting a substantial 55% of the country's energy requirements, coal has historically underpinned India's industrial prowess. Over the past four decades, India has witnessed a staggering 700% surge in commercial primary energy consumption, yet its per capita consumption, currently standing at approximately 350 kg of oil equivalent per year, remains notably lower than that of developed nations.

Fueled by a burgeoning population, a burgeoning economy, and an unwavering pursuit of enhanced living standards, India's energy demands are poised for further escalation. However, with petroleum and natural gas reserves showing limited potential, hydropower projects hampered by eco-conservation constraints, and nuclear power beset by geopolitical considerations, coal is slated to retain its central role in India's energy landscape.

Indian coal reserves present a distinctively eco-friendly energy source poised to meet domestic demands well into the next century. Spanning across 27 major coalfields, the bulk of hard coal deposits are concentrated in the eastern and south-central regions of the country. Furthermore, the southern state of Tamil Nadu boasts lignite reserves totaling approximately 36 billion tonnes, constituting a significant portion of the nation's energy wealth.

Through extensive exploration efforts, including surveys reaching depths of up to 1200 meters conducted by esteemed institutions such as the Geological Survey of India (GSI), Central Mine Planning and Design Institute (CMPDI), Singareni Collieries Company Limited (SCCL), and Mineral Exploration Corporation Limited (MECL), the cumulative estimated coal reserves as of April 1, 2022, as published in the Coal Inventory by GSI, stand at a staggering 361,411.46 million tonnes. In terms of total coal resource (in million tonnes), state of Odisha showed the biggest contribution in the India followed by Jharkhand, Chhattisgarh, West Bengal, and Madhya Pradesh. Details of State-wise and category-wise coal resource are given as under:

(Million tonnes)

State	Measured	Indicated	Inferred	Total Resource
<i>Odisha</i>	48572.58	34080.42	5451.6	88104.6
<i>Jharkhand</i>	53245.02	28259.67	5155.41	86660.1
<i>Chhattisgarh</i>	32053.42	40701.35	1436.99	74191.76
<i>West Bengal</i>	17233.88	12858.84	3778.53	33871.25
<i>Madhya Pradesh</i>	14051.66	12722.97	4142.1	30916.73
<i>Telangana</i>	11256.78	8344.35	3433.07	23034.2
<i>Maharashtra</i>	7983.64	3390.48	1846.59	13220.71
<i>Bihar</i>	309.53	4079.69	47.96	4437.18
<i>Andhra Pradesh</i>	920.96	2442.74	778.17	4141.87
<i>Uttar Pradesh</i>	884.04	177.76	0	1061.8
<i>Meghalaya</i>	89.04	16.51	470.93	576.48
<i>Assam</i>	464.78	57.21	3.02	525.01
<i>Nagaland</i>	8.76	21.83	447.72	478.31
<i>Sikkim</i>	0	58.25	42.98	101.23
<i>Arunachal Pradesh</i>	31.23	40.11	18.89	90.23
<i>Total</i>	187105.3	147252.2	27053.96	361411.5



Angul, Odisha: A leading energy contributor

Odisha has showed an increasing trend of coal reserves since 2008 starting from 66 million tonnes to nearly 85 million tonnes in 2021.

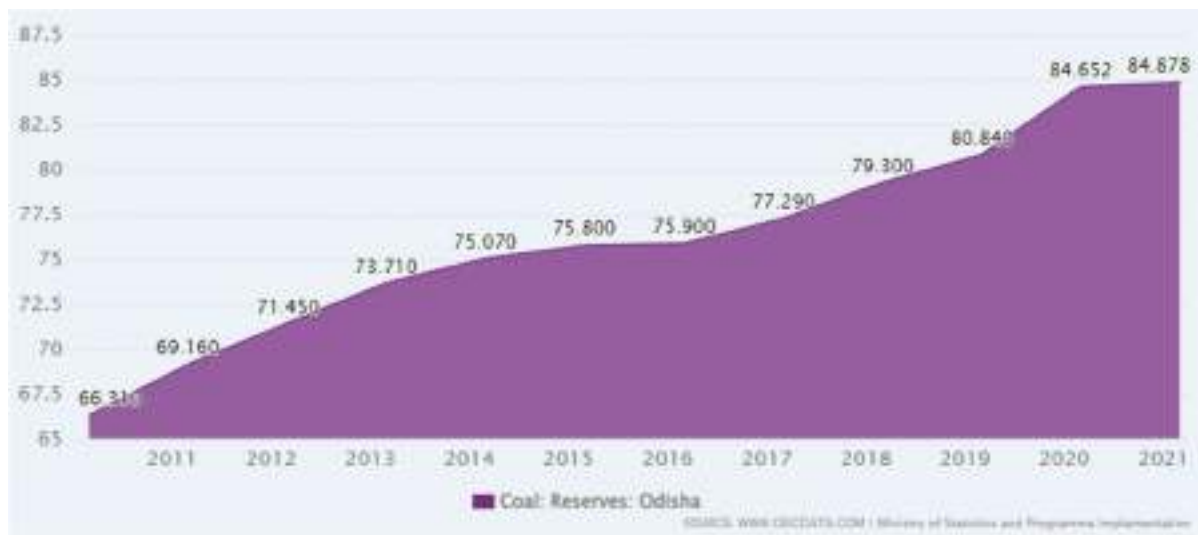


Figure 1. Increasing trend of coal reserves of Odisha since 2008. Source: www.cicdata.com

Angul occupies a significant position on Odisha's map, primarily owing to its abundant coal resources. As India's third largest coal producing district, Angul boasts nine operational mines, predominantly open cast, with only one exception. Within Odisha, the district stands as an energy surplus region, exceeding demand, thus facilitating the supply of thermal energy to neighboring southern and western states.



The district's industrial landscape is marked by the presence of four thermal power plants, alongside an integrated steel plant, a planned aluminium park, an aluminium smelter, a fertilizer plant, and various other industries directly or indirectly reliant on coal. Leveraging its strategic location and the ample availability of manpower and raw materials, Angul has emerged as a pivotal hub for industrial development.

Notable public sector undertakings (PSUs) such as NALCO, NTPC, and MCL underscore the district's economic significance, complemented by numerous private ventures in the steel and power sectors. Presently, Angul stands as one of the foremost industrially advanced districts in the state.

Forecasts suggest a remarkable expansion in coal production within Angul district, with current levels contributing to 12% of India's and 56% of the state's total production. Projections by the International Forum for Environment, Sustainability, and Technology (iFOREST) anticipate a threefold increase in coal production over the next decade.

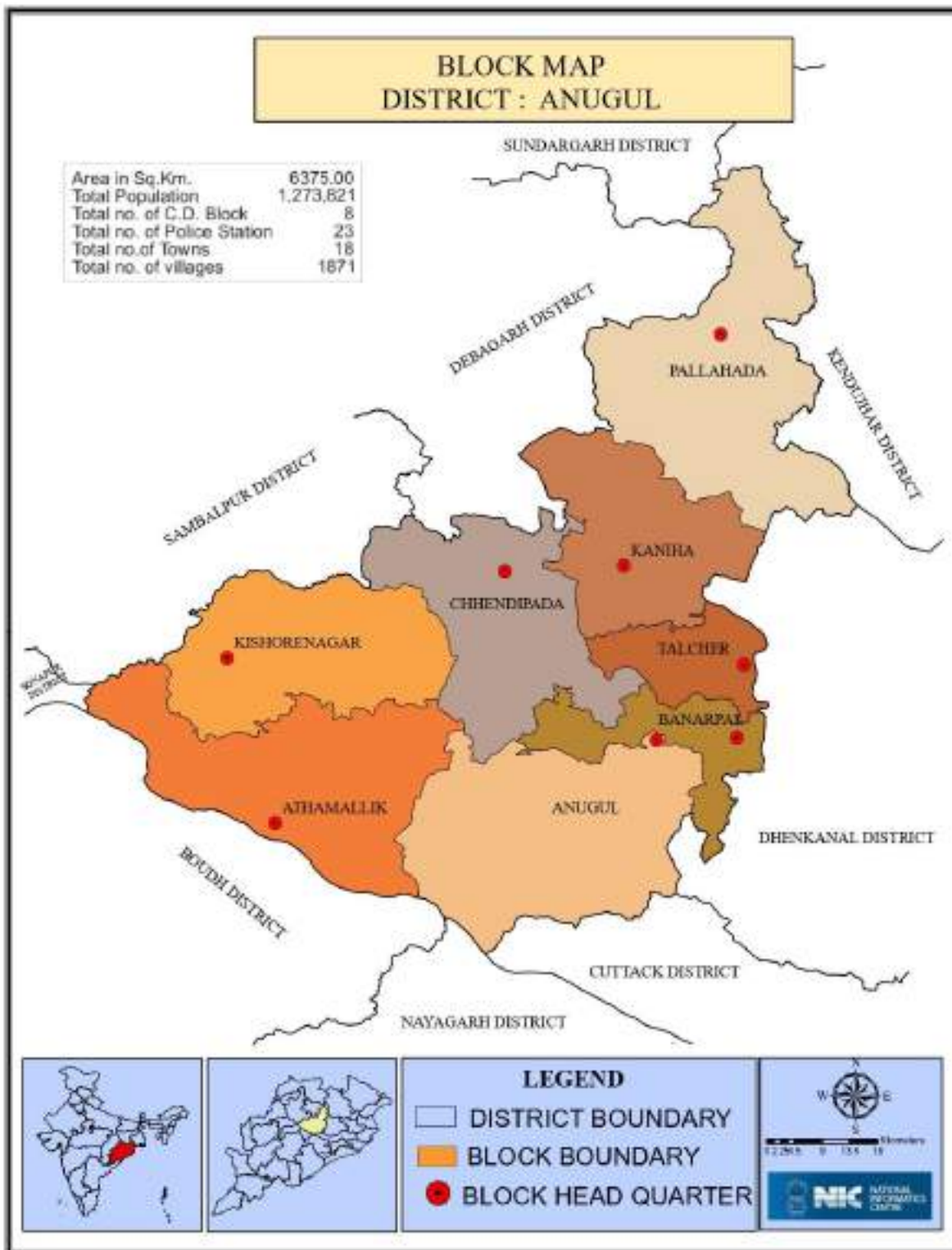
This growth trajectory aligns with Angul's status as a major power producer and a hub for steel and aluminium manufacturing. Notably, coal mining and associated industries collectively contribute approximately 61% to the district's gross domestic product (GDP).

The iFOREST report underscores the imperative for strategic interventions to steer Angul towards a sustainable, green energy-driven economic future. It advocates for measures aimed at fostering environmental sustainability while ensuring continued economic growth and prosperity in the region. Following are the companies functional in the district Angul, Odisha.

Public Sector			
Sl. No.	Name of the unit	Location	Production
1	Mahanadi Coal Field Ltd. (MCL)	Talcher	Coal
2	National Aluminium Company (NALCO)	Nalco Nagar, Angul	Aluminium
3	National Thermal Power Corporation (NTPC)	Kaniha	Thermal Power
4	Talcher Thermal Power Station (TTPS)	Talcher Thermal	Thermal Power
5	Heavy Water Project	Vikrampur, Talcher	Heavy Water

Private Sector			
Sl. No.	Name of the unit	Location	Production
1	Shree Metalics Ltd	Makundapur	Sponge Iron
2	Jindal Steel & Power Ltd	Nisha, Angul	Steel
3	Jindal India Thermal Power Ltd	Kaniha, Angul	Thermal Power

Kaniha: Coal Energy Spot and Mahanadi Coalfields Limited

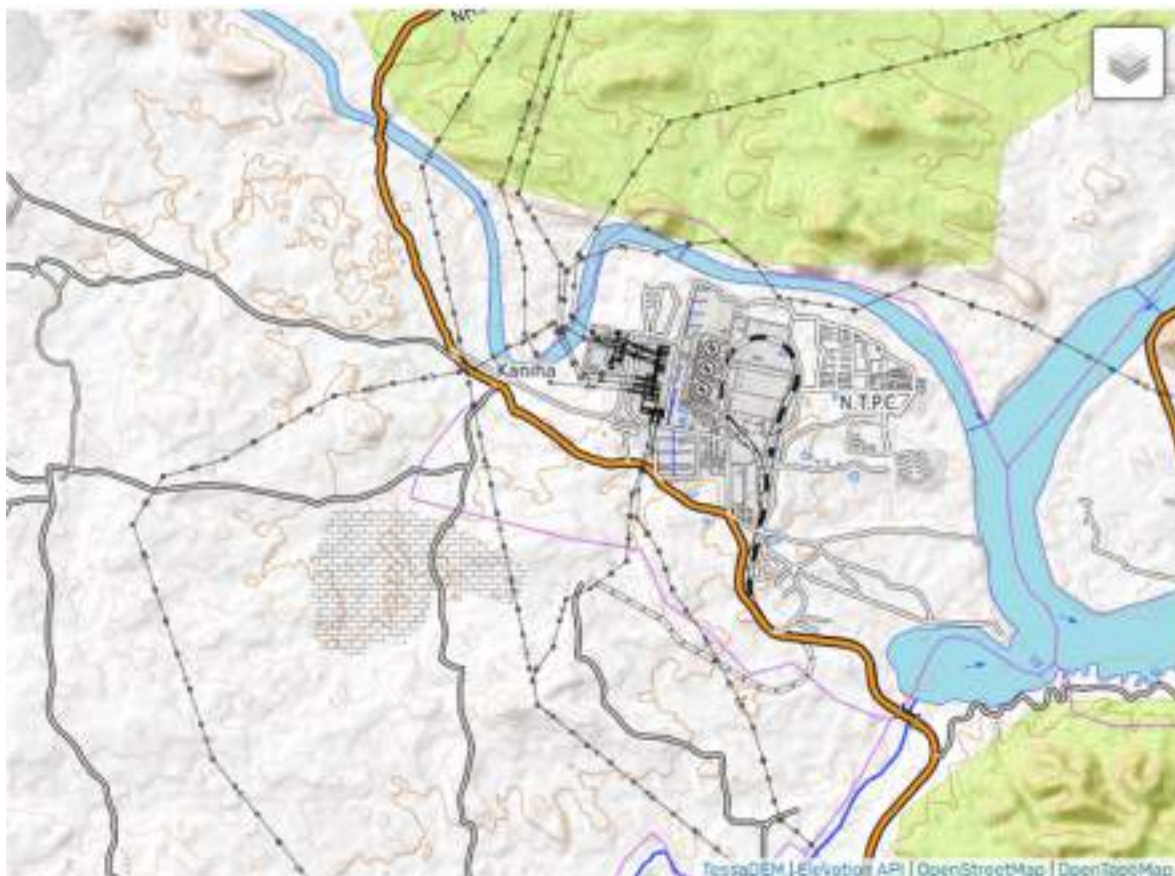


MAHANADI COALFIELDS LIMITED(MCL), a Mini Ratna Company, was incorporated in 3/4/1992 as a Public Sector Company under Ministry of Coal, Govt. of India (CIN-U10102OR1992GOI003038). Mahanadi Coalfields Limited (MCL) is one of the major coal producing companies of India. It is one of

the eight subsidiaries of Coal India Limited. MCL having its corporate office at Jagruti Vihar, Burla, Sambalpur-768020, Odisha and its coal mines located at Talcher and IB Valley in the state of Odisha.

Mahanadi Coalfields Limited (MCL) is having a total of 20 running coal mines spread over Talcher and IB coalfields in Angul, Jharsuguda and Sundargarh districts respectively in the State of Odisha, Talcher coalfields in Angul district of Odisha contains large reserve of quarriable power graded coal. This coal fields have been divided into Several Coal mining blocks, and Kaniha opencast project is one of them.

The project is in Kaniha Tehsil of Angul district. The total mineable reserve of coal of Kaniha Expansion OCP (Phase I) is 140.68 MT and the life of the project is 14 years with an average Striping ratio of 1.36 cum/t. The total land required for the instant expansion project is 718 Ha. which involves only diverted forest land, Government non-forest land & tenancy land excluding non-diverted forest land. The excavated coal from the mine is supplied to super thermal power plant, NTPC – Kaniha and is in the proximity of the Kaniha OCP. So Kaniha OCP helps NTPC, Kaniha in providing cheapest power in the country by supplying coal from the mine.



While land for coal mining area for Kaniha Opencast project (Expansion Phase-I) was acquired under CBA (A&D) Act, 1957. It is estimated that, a total of 718 Ha. of land will be utilized for the project,

which covers seven villages namely: Jamania, Adaitaprasad, Kansamunda, Jarada, Telisingha, Kaniha and Pathramunda.

Human Development Index:

The concept of human development, which emerged in the late 1980s, puts people at the centre of the development agenda and in this concept, economic growth and wealth are considered as means to development, not an end by itself.

The Human Development Reports¹ (HDR), brought out by United Nations Development Programme (UNDP), define human development as a process of enlarging people's choices. To lead a long and healthy life, to be educated and to enjoy a decent standard of living are the three most critical choices identified in the first HDR. Additional choices include political freedom, guaranteed human rights and self-respect. The human development paradigm, which puts people at the centre of its concerns, must be fully engendered. The paradigm pre-supposes the following:

- i. Equality of rights between women and men must be enshrined as a fundamental principle. Legal, economic, political or cultural barriers that prevent the exercise of equal rights should be identified and removed through comprehensive policy reforms and strong affirmative action;
- ii. Women must be regarded as agents and beneficiaries of change. Investing in women's capabilities and empowering them to exercise their choices is not only valuable in itself but is also the surest way to contribute to economic growth and overall development; and
- iii. The engendered development model, though aiming to widen choices for both women and men, should not predetermine how different cultures and different societies exercise these choices. It is important that equal opportunities to make a choice exist for both women and men.

The first Global Human Development Report was launched in 1990 by the UNDP and has been prepared annually since then. Human Development Index (HDI) as introduced by UNDP in 1990 was defined as a simple average of three Dimension Indices that measure average achievements in a country with regard to „Long and healthy life“, as measured by life expectancy at birth; „Knowledge“, as measured by the adult literacy rate and the combined primary, secondary and tertiary gross

enrolment ratio; and „A decent standard of living“, as measured by estimated earned income in Purchasing Power Parity (PPP) US\$.

In 1995, two composite measures Gender-related Development Index (GDI) and Gender Empowerment Measure (GEM) were added in the Human Development Report² to capture gender disparities and their adverse effects on social progress. The GDI considers the same variables as the HDI but focuses on inequality between women and men as well as on the average achievement of all people taken together. The GEM focuses on three additional variables- women's participation in political decision-making, their access to professional opportunities and their earning power. The GEM gives some indication of how much women are empowered in these spheres in different countries. The GDI and the GEM can capture only what is measurable and therefore do not cover other important dimensions of gender inequality, such as participation in community life and decision-making, consumption of resources within the family, dignity and personal security. These dimensions can nonetheless be powerful determinants of the relative status of women and the quality of their lives.

Following the UNDP's human development framework, the erstwhile Planning Commission released the first National Human Development Report, 2001³ in 2002 in order to compare the situation of States of India with the help of about 70 development indicators for each State. Report of the National Statistical Commission (NSC), 2001, advocated, among other things, to develop appropriate methodology for computing HDI and GDI at State level and recommended that studies be conducted using gender related data to highlight existing gender disparities.

In 2007, Ministry of Women and Child Development (MoWCD) undertook the exercise recasting of HDI, GDI and GEM for India with the support of UNDP and calculated the indices for the States/UTs adapted to the Indian datasets. A Technical Advisory Committee (TAC) was constituted for this purpose and a report titled "Gendering Human Development Indices⁴: Recasting the Gender Development Index and Gender Empowerment Measures for India" was released by MoWCD in 2009.

Human Development is a constantly evolving concept. The methods for assessing human development also need to undergo refinements in sync with the changing requirements. Indicators used in the "Knowledge" and "Standard of Living" dimensions were modified in 2010⁵. One of the

dimensions that remained the same was that of “long and healthy life” which still uses life expectancy at birth as its indicator.

“Knowledge” was previously measured by a combination of adult literacy rate and school enrolment rates, but has now been modified to be measured by the expected years of schooling (the years of schooling that a child can expect to receive given the current enrolment rates) combined with the mean years of schooling for adults aged 25 years and older. Finally, the dimension „A decent Standard of living“ which was earlier measured by GDP per capita adjusted for PPP US\$, has now been modified as Gross National Income (GNI) per capita adjusted for PPP.

Inequalities in human development are profound and affect societies, weakening social cohesion and people’s trust in government, institutions and each other. Inequalities hurt economies, wastefully preventing people from reaching their full potential at work and in life. Gender inequality is one of the greatest barriers to human development. Gender inequality is complex and refers to various facets related to gender differences and consequential differential attainments. In order to measure gender disparity, Gender Inequality Index (GII) was introduced in the 2010 Human Development Report by the UNDP. The index, introduced as an experimental measure to remedy the shortcomings of the previous indicators, the Gender Development Index (GDI) and the Gender Empowerment Measure (GEM), is a composite measure of gender inequality. It uses three dimensions to measure opportunity cost: reproductive health, empowerment, and labour market participation.

Presently, Government of India has identified 29 Global Indices for observing and monitoring India’s position and using these as a tool for self-improvement on various important social, economic and other dimensions. It is envisaged that these indices can help in bringing about reforms in the policies and processes of government agencies and financial institutions while creating conducive ecosystem for foreign and domestic investment flow. These Global Indices have been assigned to 18 Nodal Ministries/Departments and more than 800 parameters/indicators, as relevant to these Global Indices, have been assigned across to the 47 Ministries/Departments. Ministry of Statistics and Program Implementation (MoSPI) has been assigned the role of assisting the Ministries/ Departments in identifying existing and alternate data sources for these indicators of the global indices.

Nodal Ministries/Departments have constituted Coordination Committee to review the progress on Global Indices on monthly basis. Cabinet Secretariat is also reviewing the performance and activity on

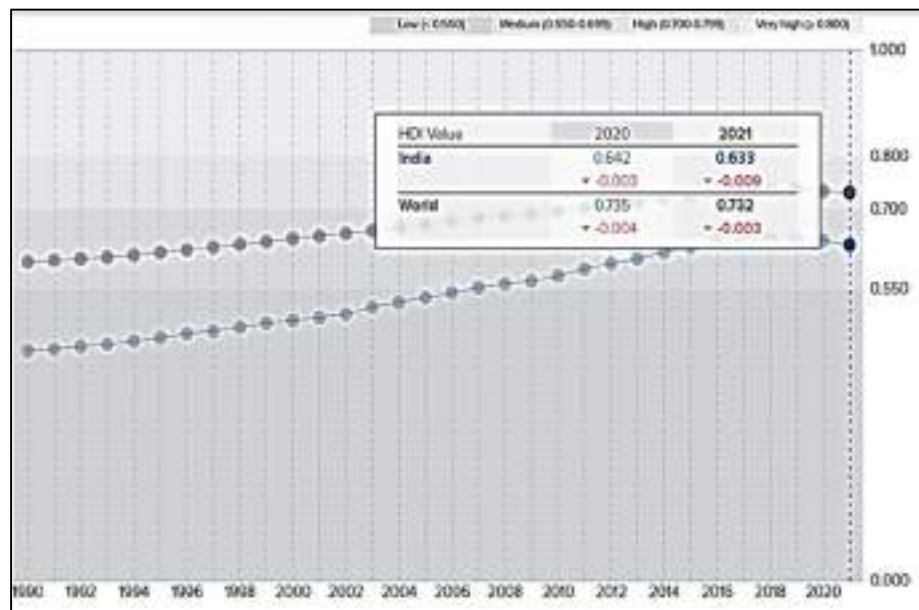
each index at least every quarter and for selected indices on a monthly basis. Development Monitoring and Evaluation Office (DMEO), NITI Aayog has been assigned the task to facilitate the Cabinet Secretariat in monitoring the performance of these global indices at all India level as well as State level through a Dashboard. NITI Aayog has already circulated the guidelines to all nodal Ministries to identify the areas of reform and actions for each parameter/indicators required to monitor the progress on Global Indices and also applicability of setting of targets for indices at state level.

Human Development Report Office (HDRO) of the UNDP calculates the indices related to human development at a national level for all countries and publishes the

“Human Development Report (HDR)” on an annual basis since 1990. These indices - Human Development Index (HDI) and Gender Inequality Index (GII) - are included in 29 Global Indices that the Government of India has identified for monitoring India’s performance in the global ranking. In this context, the computation of these indices at State/UT levels assumes significance. The state-wise analysis of HDI and GII would also prove to be an important tool to the nodal Ministries/Departments/States for measuring and monitoring the performance at sub-national level on the key social, economic and other parameters which can further enable improving India’s position in the global indices. This would also provide a tool for initiating systemic reforms in the policies and processes for human development to ensure that “No One is Left Behind”.

In view of importance of regular reporting of the state-wise values of HDI, GDI and GII, an attempt has been made to compute HDI, GDI and GII using the HDRO methodology and available data sets for the States/UTs as well as for the country as a whole for the years 2011-12 and 2017-18. This exercise also highlights the data gaps that constrain the computation of indices. Rankings of the States on the indices as well as sub-indices of HDI, GDI and GII have been analyzed to enable the stake-holders for taking up corrective policies, programs and schemes.

As of the last available data (2021), the global HDI was 0.732. For India, the HDI in 2021 was 0.633, placing it in the medium human development category. India has shown progress in various aspects of human development, including improvements in life expectancy, education, and income.



SBI Research group reported state wise HDI of India. Odisha secured 22nd place in year 2017 with **0.60** which is categories as **medium human development category** according to UNDP. Since 1990, HDI of Odisha was observed improved. In 2017, India was at 130th rank comparison to other countries.

India's Position in HDI (2017)	
Country	HDI Rank
Hong Kong	7
Singapore	9
UAE	34
Saudi Arabia	39
Argentina	47
Russia	49
Malaysia	57
Turkey	64
Sri Lanka	76
Brazil	79
Thailand	83
China	86
South Africa	113
Indonesia	116
India	130
Myanmar	148

Source: UNDP, SBI Research

Improvement in HDI across States							
States	1990		2017		Change (2017 over 1990)	CAUR of Social Expenditure (2017 over 1990)	Aspiration Index (2017 over 1990)
	Index	Rank	Index	Rank			
Chhattisgarh	0.45	15	0.70	5	7	15.7%	✓
Uttarakhand Pradesh	0.48	12	0.72	4	8	14.0%	✓
Tamil Nadu	0.47	13	0.70	7	4	13.4%	✓
Karnataka	0.46	16	0.68	12	4	14.9%	✓
Punjab	0.68	9	0.72	8	8	12.6%	✗
Assam Pradesh	0.43	18	0.63	15	3	15.1%	✓
Rajasthan	0.43	19	0.62	16	2	15.2%	✓
Kerala	0.54	1	0.77	1	1	19.6%	✓
Andhra Pradesh	0.42	20	0.64	18	2	12.8%	✓
Odisha	0.40	23	0.60	22	1	18.1%	✗
Goa	0.55	1	0.75	2	-1	14.4%	✓
Maharashtra	0.49	8	0.69	9	-1	14.3%	✓
Tripura	0.44	15	0.65	16	-1	15.6%	✓
Assam	0.41	20	0.61	21	-1	15.1%	✓
Sikkim	0.55	1	0.71	3	-2	16.8%	✓
Jammu & Kashmir	0.49	9	0.69	13	-2	14.8%	✓
Gujarat	0.47	12	0.47	16	-2	14.1%	✓
West Bengal	0.44	17	0.65	19	-2	13.9%	✓
Madhya Pradesh	0.40	22	0.60	25	-2	13.9%	✓
Mizoram	0.52	3	0.70	6	-3	12.0%	✓
Manipur	0.49	7	0.69	10	-3	12.9%	✓
Meghalaya	0.45	16	0.63	17	-2	13.3%	✓
Nagaland	0.53	4	0.67	14	-9	12.7%	✓
Uttar Pradesh	0.39	24	0.59	24	0	14.0%	✓
Bihar	0.38	25	0.57	26	0	13.8%	✓
All India	0.43	-	0.64	-	-	14.5%	-

Source: SBI Research, UNDP, Human Data Lab. Green (HDI increase) Red (HDI decrease) Yellow (HDI stable)

Categorizing States/UTs based on HDI Scores – 2011-12 and 2017-18

HDI Category	2017-18	2011-12
Very High HDI (0.800 and above)	Chandigarh, Delhi, Goa	Delhi
High HDI (0.700 to 0.799)	A&N Islands, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya, Mizoram, Puducherry, Punjab, Sikkim, Tamil Nadu, Telangana, Uttarakhand	Chandigarh, Goa, Himachal Pradesh, Kerala, Maharashtra, Puducherry, Tamil Nadu
Medium HDI (0.550 to 0.699)	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Dadra & N. Haveli, Daman & Diu, Gujarat, Jammu & Kashmir, Jharkhand, Lakshadweep, Madhya Pradesh, Manipur, Nagaland, Odisha, Rajasthan, Tripura, Uttar Pradesh, West Bengal	A&N Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Dadra & N. Haveli, Daman & Diu, Gujarat, Haryana, Jammu & Kashmir, Jharkhand, Karnataka, Lakshadweep, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Telangana, Tripura, Uttar Pradesh, Uttarakhand, West Bengal
Low HDI (below 0.550)	-	Bihar

Objectives

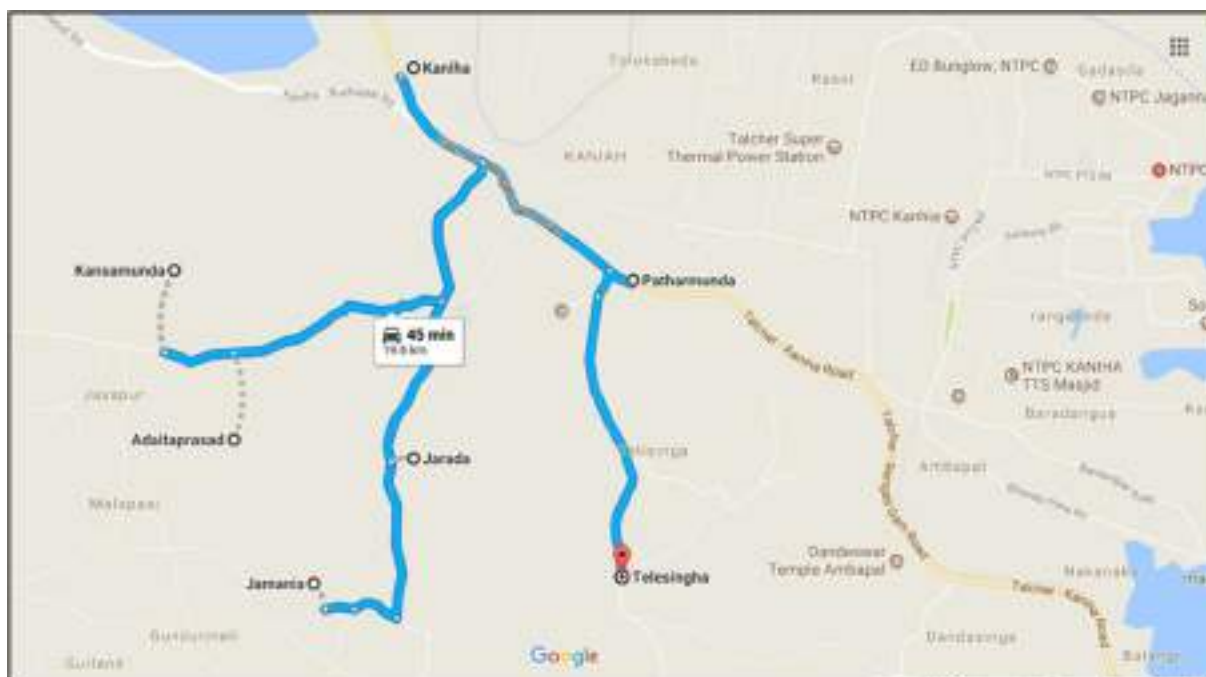
- I. To study the impact of CSR initiatives undertaken by MCL in the said 7 villages
- II. To measure socio-economic development of seven core villages by using three parameters life expectancy, education and income per capita.
- III. To measure Quality of Life Index of project villages.

Location of the Study

Seven core villages around Kaniha opencast mine in Kaniha Tahasil of Angul district, Odisha

SNO	Village	Total households	Total population	Literate population
1	Adaitaprasad	91	329	262
2	Jamania	66	214	178
3	Jarada	687	2225	1433
4	Kaniha	14182	55678	38621
5	Kansamunda	557	2102	1588
6	Patharamunda	314	1046	744
7	Telisingha	411	1490	1125
Total		16308	63084	43951

Source: Census 2011



Methodology adopted for calculation of Human Development Index (HDI):

As per Census 2011, there is a population of 63,084 in 16,308 households in seven core villages in Kaniha Tahasil. It is proposed simple random sampling method to select the sample households and, qualitative and quantitative both, research methods to measure HDI of seven villages.

A sample size of 522 households with 95 per cent confidence interval and five per cent margin of error is undertaken under this study to ensure statistical validity.

Target Group of the study

Men, women, youth, teacher, ASHA worker, Sarpanch, Sachiva, MCL representatives and other key resource persons.

Tools used for collection of data

The following mentioned tools will be used for primary and secondary data collection:

1. Focus group discussion (FGD)

Focus Group Discussion (FGD) is an effective way to bring together people with similar backgrounds to discuss a topic of common interest. The FGD allows participants to agree or disagree with each other so that it provides an insight into how a group thinks about an issue, about the range of opinion and ideas, and the inconsistencies and variation that exists in a particular community in terms of beliefs and their experiences and practices.

It is proposed to conduct eight FGDs and each group will have 10 members.

2. Semi-structured interviews

The semi-structured interviews will be conducted with relevant stakeholders, including local administration, company CSR coordinators, implementing agencies and other key persons of the communities. Both open and close-ended questions will be asked, though focus will be on open-ended questions to know views and opinions of respondents.

Five semi-structured interviews will be conducted with stakeholders.

3. Household survey

Survey will be conducted with the communities. The respondents will be identified using the sampling method mentioned earlier. Questionnaire has both open and close ended questions to capture objective and subjective details. 522 households will be covered under the study.

SNO	Village	Total Households	Total population	Surveyed Done Households
1	Adaitaprasad	91	329	25
2	Jamania	66	214	35
3	Jarada	687	2225	80
4	Kaniha	14182	55678	170
5	Kansamunda	557	2102	71
6	Patharamunda	314	1046	70
7	Telisingha	411	1490	71
Total		16308	63084	522

4. Secondary research

This will include reviewing project reports available with the company, data from implementing partners, and relevant reports published by governments and research organisations. Data will be taken from village gram panchayat government offices (block and district), journals, magazines, and other sources of information.

522 questionnaires, 8 FGD (10 members in each group) and 5 interviews with key stakeholders (Sarpanch, MCL representatives, teachers and health workers) will be conducted for the study.

Method of HDI Calculation:

The Human Development Index (HDI) is a summary measure of human development that was introduced by the United Nations Development Programme (UNDP). The HDI is designed to provide a holistic assessment of a country's development by considering various dimensions beyond economic indicators. It reflects the idea that development should not be measured solely by economic growth but should also encompass social and human well-being.

The HDI is calculated based on three key dimensions:

1. Health (Life Expectancy at Birth):

This dimension considers the average life expectancy at birth, reflecting the overall health and longevity of a country's population. Life expectancy in India's population at present is 63 years.

2. Education (Mean Years of Schooling and Expected Years of Schooling):

The education dimension includes two indicators. Mean Years of Schooling represents the average number of years of education received by people aged 25 and older, while Expected Years of Schooling reflects the total number of years of schooling a child entering school can expect to receive, assuming age-specific enrollment ratios remain the same throughout the child's life.

a. Adult Literacy Rate (ALR):

The rate or the percentage of people aged 15 and above who can understand, read and write a short and simple statement in their everyday life are known as literate. It implies that every literate must be capable of reading and writing certain sentences. If someone is able to sign but not capable of reading and writing simple statement is not literate. Thus, capability of reading only or writing only does not make a person literate. Literacy is the symbol of the quality of the people.

b. Gross Enrolment Ratio (GER)

Gross Enrolment Ratio refers to the number of students enrolled at different levels of education. It is the percentage of population of different age groups engaged in educational pursuit. The education level consists of primary, secondary and tertiary level. Basic elements of education are provided at primary level.

Secondary level education is studied at middle and secondary level. University level education is studied under tertiary level. General enrolment ratio shows the percentage population enrolled at primary, middle, secondary and university level. The higher GER indicates higher quality of life. It will be the sincere effort of every economy to increase general enrolment ratio as far as possible.

3. Standard of Living (Gross National Income per Capita):

The standard of living dimension is represented by the Gross National Income (GNI) per capita, adjusted for purchasing power parity (PPP). This accounts for differences in the cost of living and inflation rates among countries.

Once these three dimensions are calculated, they are normalized and combined into a single index value, with a scale ranging from 0 to 1. A higher HDI value indicates a higher level of human development.

The HDI has become a widely used and recognized measure for comparing the development levels of different countries. It provides a more comprehensive perspective on well-being by incorporating health, education, and income indicators. Over the years, the HDI has undergone refinements and updates to ensure its relevance and accuracy in capturing the complexities of human development worldwide.

Dimensions and Indicators of HDI, GDI and GII – Global is presented in the table below:

Dimension	Indicator
HDI and GDI	
Long and Healthy Life	Life Expectancy (years)
Knowledge	Expected Years of Schooling (years)
	Mean Years of Schooling (years)
A Decent Standard of Living	Gross National Income Per Capita (2011 PPP \$)
GII	
Health	Maternal Mortality Ratio (Maternal Death per 100000 live birth)
	Adolescent Birth Rate (Birth per 1000 women ages 15-19 years)
Empowerment	Women's share of seats in Parliament (%)
	Population with at least some secondary education age 25+ years (%)
Labour Market	Labour Force Participation Rate (%)

Dimensions and Indicators of HDI, GDI and GII – India is presented in table below:

Dimension	Indicator
HDI	
Long and Healthy Life	Life Expectancy (years)
Knowledge	Expected Years of Schooling (years)
	Mean Years of Schooling (years)
A Decent Standard of Living	Per Capita Gross State Domestic Product (GSDP) (Rs.)
GDI	
Long and Healthy Life	Life Expectancy (years)
Knowledge	Expected Years of Schooling (years)
	Mean Years of Schooling (years)
A Decent Standard of Living	Estimated Earned Income (Male and Female) Per Capita Per Annum

GII	
Health	Maternal Mortality Ratio (Maternal Death per 100000 live birth)
	Adolescent Birth Rate (Birth per 1000 women ages 15-19 years)
Empowerment	Women's share of seats in Parliament (%)
	Population with at least some secondary education age 25+ years (%)
Labour Market	Labour Force Participation Rate (%)

Quality Of Life Index (QLI)

Quality of life of the people is another index to measure the standard of living of the people in an economy. It is influenced by national and per capita income of the people. Many other factors like consumption, output, health, environment, education, freedom, security, non-violence peaceful atmosphere etc. also influence human welfare directly or indirectly. In other words, none of these factors alone determines the welfare of the people. At the same time, we should note that National Income is not itself the single representative factor of welfare.

It is as such necessary that all the determinants of welfare should be combined together to measure the quality-of-life index. But it is not possible that every variable should be accounted for because of conceptual and statistical difficulties. It is, therefore, said that an index comprising of certain selected social factors be made to determine the quality-of-life index. In fact, they make an attempt to measure quality of life and we should make reference to it towards the end. At the same time, we should remember that these indices were developed in the international context. They were used for ranking different countries according to its numerical value of achievement in descending order.

PQLI and HDI are the two most popular measures of development, besides per capita income. While PQLI considers only the physical variables--adult literacy, life expectancy at birth and infant survival rate, HDI has life expectancy at birth, educational attainment and real GDP per capita

The Physical Quality of Life Index (PQLI) is a composite indicator that was developed by sociologist Morris David Morris in the 1970s as an alternative measure of human development. It was designed to provide a broader assessment of the quality of life in different countries, taking into account not only economic factors but also social indicators. The PQLI focuses on three basic components of well-being: basic literacy, infant mortality, and life expectancy at age one.

Here are the key components of the Physical Quality of Life Index:

1. **Basic Literacy:** The PQLI incorporates an educational component by considering the literacy rate among people aged 15 and older. This provides an indication of the level of education within a population.
2. **Infant Mortality Rate:** Infant mortality is a crucial health indicator. The PQLI includes the infant mortality rate, which reflects the number of deaths of infants under one year of age per 1,000 live births. A lower infant mortality rate is generally associated with better healthcare and living conditions.
3. **Life Expectancy at Age One:** Life expectancy at age one takes into account the expected number of additional years a person who has survived to age one can expect to live. This component reflects the overall health and longevity of a population.

Each of these components is given equal weight in the PQLI calculation, and the index is normalized to produce a score between 0 and 100, with a higher score indicating a higher quality of life.

While the PQLI was a notable early attempt to create a composite measure of well-being, it is worth noting that it has been less widely used in comparison to other indices like the Human Development Index (HDI). The PQLI was influential in emphasizing the importance of considering non-economic factors in assessing the overall well-being of a population.

Normalization of Indicators:

We are familiar that life expectancy is measured in terms of years, infant mortality rate in terms of per thousand and basic literacy rate in terms of percentage. They cannot be simply added. Moreover, basic literacy can have a natural zero for minimum and 100 for maximum, thus there exists no natural minimum or maximum values for other indicators. For comparison, each of the levels should be normalized.

In the case of positive indicators of life expectancy and basic literacy the best is shown by the maximum and worst by the minimum. While in case of negative indicator of infant mortality, the best is denoted by the minimum and the worst by the maximum. For converting the actual levels of a positive variable into normalized indicators, first the minimum values are subtracted from the actual values and then the gap is divided by the range.

For positive indicators, the formula is:

$$Achievement\ Level = \frac{Actual\ Value - Minimum\ Value}{Maximum\ Value - Minimum\ Value}$$

For negative indicator of infant mortality, actual value has to be subtracted from the maximum value and the gap if any must be divided by the range. The Formula is:

$$Achievement\ Level = \frac{Minimum\ Value - Actual\ Value}{Maximum\ Value - Minimum\ Value}$$

In a nutshell, three indicators are averaged to give what is called the Physical Quality of Life Index (PQLI)

$$PQLI = \frac{1}{3}(LEI + IMI + BLI)$$

Choice of Minimum and Maximum Values:

In case of life expectancy and infant mortality, there exists no natural minimum and maximum values. The conversions from values to indices are linear. Put the actual value of these indicators of the country in the expression and get the reasonable indices as Physical Quality of Life Index.

Calculate HDI for seven project villages in Kaniha OCP, MCL

The Human Development Index is a summary measure of achievements in key dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living.

Human Development Index (HDI) is calculated as geometric mean of three indices viz., Education Index, Health Index and Income Index.

$$HDI = (I_{Health} \times I_{Education} \times I_{Income})^{1/3}$$

Dimension	Indicator	Dimension Index	Human Development Index (HDI)	Minimum	Maximum
Long and Healthy Life	Life expectancy at birth (years)	Life Expectancy Index		20	85
Knowledge Education	Expected years of schooling	Education Index		0	18
	Mean years of schooling			0	15

A Decent Standard of living	Gross National Income (GNI) per capita (Purchasing Power Parity, PPP 2011 \$) Per capita Income (PPP \$) of all families	GNI Index		100	75,000

Source: UNDP HDR 2019: Technical notes

Having defined the minimum and maximum values, the dimension indices are calculated as:

$$\text{Dimension Index} = \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}}$$

UNDP 2019 methodology is used to calculate human development indices.

Calculate Physical Quality of Life Index (PQLI)

PQLI parameters give better picture of the project area in terms of progress as it comprises a greater number of indicators. Quality of life study analyses 10 dimensions which can be measured statistically to represent the various aspects of quality of life. The ten of these dimensions can be considered to reflect people's well-being, which are education, health, income, land, housing condition, fuel used for cooking, sanitation (toilet), clean drinking water, assets and livestock.

The three-item PQLI is calculated on a scale that ranges from 0 to 100:

- (1) The percentage of the population that is literate (literacy rate),
- (2) *The rate of indexed infant mortality* = $(166 - \text{infant mortality}) \times 0.625$
- (3) *Indexed years of average life expectancy* = $(\text{life expectancy} - 42) \times 2.7$

The parameters are given score as given in the following table:

Parameter	Range	Score
Income Parameters – (Income in Rs.)	<35000	0.1
	35000 – 50000	0.2
	50000 - 75000,	0.3
	75000 – 100000	0.4
	100000 - 200000,	0.5
	200000 – 300000	0.6

	300000 – 500000		0.7
	500000 – 800000		0.8
	800000 – 1000000		0.9
	>1000000		1.0
Land	Landless		0
	Marginal		0.25
	Small		0.5
	Medium		0.75
	Big		1
Housing	Floor	Cement	1
		Stone	0.5
		Mud	0.25
	Roof	Cement	1
		Tiles	0.5
		Thatch	0.25
	House Type	Kutcha	0.25
		Semi Pucca	0.5
		Pucca	1
	Room per member	<0.5	0.25
		0.5 – 1	0.5
		=1	0.75
		>1	1
Fuel	LPG		1
	Wood/ Charcoal		0
Toilet	Available		1
	Not Available		0
Water	Available		1
	Not Available		0
Assets availability	Mobility Assets	If any Available	1
		no asset	0
	Asset for Info	If any Available	1
		no asset	0
	Other assets	If any Available	1
		no asset	0
Livestock	Available		1
	Not Available		0
Education	If 0		0
	0-4		0.1
	4-5		0.2
	5-6		0.3
	6-7		0.4
	7-10		0.6
	10-12		0.8

	12-15	0.9
	>15	1.0
Health	= 0	1
	between 0 - 0.25	0.75
	between 0.25 - 0.51	0.5
	between 0.5 – 1	0.25
	If > 1	0

Corporate Social Responsibility in MCL (CSR):

The concept of Corporate Social Responsibility (CSR) has gained prominence from all avenues. Organizations have realized that government alone will not be able to get success in its endeavor to uplift the downtrodden of the society. With the rapidly changing corporate environment, Mahanadi Coalfields Limited (MCL) has adopted CSR as a strategic tool for sustainable growth. For MCL in the present context, CSR means not only investment of funds for social activity but also integration of business processes with social processes.

Even much before the issue became a global concern, MCL was aware of its Corporate Social Responsibility and was fulfilling the aspiration of the society through well-defined "Community Development Policy within the periphery of 8 kilometres of its project sites. This has resulted in a harmonious relationship between MCL and the peripheral communities.

MCL has formulated the present 'CSR Policy containing a set of internal approaches/guidelines/principles to be followed while discharging CSR at different levels and as law-abiding corporate entity MCL will also adhere to all such statutes related to CSR in right earnest as and when applicable.

In the aforesaid backdrop, CSR policy of MCL has been framed after incorporating the features of the Companies Act, 2013 including amendments to it and notifications issued by Ministry of Corporate Affairs (MCA) and Department of Public Enterprises (DPE), Govt. of India from time to time.

1. 2% of average net profit of the company for the three immediately preceding financial years, as per Companies Act or
2. Rs.2.00 per tonne of coal production of immediately preceding financial year

The following guidelines shall be followed in selection of areas for CSR activities:

- a) MCL shall spend 80% of the CSR fund of a year within the radius of 25 kilometers. of its Project Sites/Mines/Area HQ/Company HQ and rest 20% within the state of Odisha in which MCL is operating. The above ratio of 80:20 may be dispensed with for a particular year with the approval of MCL board through board level CSR committee in case the Central Govt issues any such guidelines/administrative directions, which the company has to comply with.
- b) CIL (HQ) being the holding company shall also support for execution of CSR projects/programs where MCL is unable to execute such project due to fund crunch. In case available CSR budget of MCL is insufficient to meet the fund requirements of any govt. mandated CSR activity, MCL may refer the duly approved CSR activity/project/program to CIL (HQ) with the recommendation of seeking financial assistance after competent authority approvals at MCL level are taken. All such requests would have to be forwarded by CSR Dept. of MCL after obtaining approval of its Board/CMD. CIL approves the activity/project/programme, the activity shall be implemented by MCL whereas the expenditure will be accounted for by CIL. (HQ) against its CSR budget. CIL would finance such project subject to approval of the competent authority at CIL and the same will be treated to be the project of MCL whose implementation and monitoring will rest on MCL

The following guidelines/modalities shall be followed while executing/undertaking CSR activities:

1. Around the beginning of every financial year, CSR department will design an Annual Action Plan. Extant statute as regard to Annual Action Plan shall be abided.
2. Activities under CSR except those relating to contribution to funds specified in Schedule VII shall be in project mode and for every project, time framed periodic milestones should be finalized at the outset
3. As far as possible, the project should be completed within 2 years from the start and in no case, projects with duration exceeding three years from the start date shall be undertaken. The date of starting of work or release of first instalment, whichever is earlier, shall be considered as project starting date and that year shall be considered as project start year. MCL shall monitor the implementation of ongoing projects with reference to the approved timelines and year-wise allocation and shall make modifications, if any, for smooth

implementation of the project within the overall permissible time period. CSR department of MCL shall put up a progress report of all ongoing projects for review/information of Board through CSRSD Sub-committee of Board, preferably once in a quarter.

4. Activities identified under CSR shall be implemented either departmentally or through implementing agencies as per extant statute.
5. Implementing agencies having only local presence shall be considered only for small value projects of upto Rs.5.00 lakhs.
6. Need and justification of all CSR projects/activities shall have to be ascertained. Need assessment shall be carried out either departmentally using in house expertise or through external reputed agencies including implementing agencies. Need assessment may be based on already conducted web surveys, indices, research papers & reports, census reports, demographic & development study reports, DPE surveys, various Ministry/Govt. Reports & publications etc. Wherever required methods such as household surveys, stakeholder interviews, participatory research exercises, baseline surveys etc, may also be used
7. The suggestions given by the elected representatives/bodies shall be duly considered while finalizing the CSR activities.
8. Memorandum of Understanding (MoU) shall be signed with all implementing agencies for projects having value more than Rs.5.00lakhs.
9. Extant statute as regard to Impact Assessment of CSR Projects is to be abided.
10. Company may appoint consultants/reputed institutes/paid interns from reputed institutes following due process, for evaluation of proposals reckonable as CSR proposals, need assessment or impact assessment of CSR projects.
11. Extant statute as regard to Creation and acquisition of Capital assets are to be abided.
12. Extant statute as regard to Surplus arising out of CSR activities are to be abided.

List of CSR Activities carried out by Kaniha OCP, Kaniha Area MCL during the period 2014-15 to 2023-24:

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2014 to 31st March 2015.					
Sl. No.	Area/ location	District	Name of the Project/Activity	Budget allocation (in Lakhs)	Expenditure made during 2014-2015 (in Lakhs)
1	Kaniha Area	Angul	Construction of Road from Aam Gaon Hotel near MGR, TSTPS/NTPC at NH-200 to village Telisingha	74.57	27.65
2	Kaniha Area	Angul	Water supply arrangement to village Jarada through Deep Bore well & pipelines.	64.09	56.71
3	Kaniha Area	Angul	Supply of drinking water through tankers to Jarada Village, Telisingha Village, Chhelia Village, Kansamunda Village and Jaipur Village under CSR of Kaniha Area	10.54	5.68
4	Kaniha Area	Angul	Construction of road from Matha chowk, Telisigha to Basanti Lodge Chowk connecting to NH-200(1 KM)	40.59	20.74
5	Kaniha Area	Angul	Procurement of 2 nos. of Submersible pumps for Telisingha Village	0.73	0.73
6	Kaniha Area	Angul	Others	0.15	0.15
7	Kaniha Area	Angul	Sports	8.45	8.45
Total CSR expenditure made during the period 2014-15 (in Lakhs)				199.12	120.10

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2015 to 31st March 2016.					
Sl. No.	Area/ location	District	Name of the Project/Activity	Budget allocation (In Lakhs)	Expenditure made during 2015-16 (In Lakhs)
Drinking Water Supplied to villages under CSR activity in Kaniha OCP					

1	Kaniha	Angul	Supply of drinking water through tankers to Jarada Village, Telisingha Village, Chhelia Village, Kansamunda Village and Jaipur Village under CSR of Kaniha Area	10.54	10.27
2	Kaniha	Angul	Supply of drinking water through tankers to Jarada Village, Telisingha Village, Chhelia Village, Kansamunda Village and Jaipur Village under CSR of Kaniha Area	6.32	6.32
3	Kaniha	Angul	Water Supply arrangment through tankar, village Jarada in 2013	0.96	0.96
4	Kaniha	Angul	Supply of drinking water to Jarada Village in 2015	7.70	7.70
5	Kaniha	Angul	Supply of drinking water to Jarada Village in 2016	0.99	0.99
6	Kaniha	Angul	Water supply arrangement to village Jarada through deep borewell and pipelines	4.00	4.00
7	Kaniha	Angul	Supply of drinking water to various villages near Kaniha OCP	6.22	6.22
8	Kaniha	Angul	Conducting Vertical Sounding (VES) test at Jarada & Telesingha villages of Kaniha OCP.	0.15	0.15
Total amount spent in Drinking Water Supply to different villages located at periphery of Kaniha OCP (in Lakhs)				36.88	36.61
Construction works carried out in different villages under CSR activity of Kaniha OCP					
9	Kaniha	Angul	Construction of road from Aam Gaon Hotel near MGR, TSTPS/NTPC at NH-200 to village Telisingha(2 KM)	81.44	49.88
10	Kaniha	Angul	Deepening of part of existing Palasa Gadia pond in Jarada village for enhancing the capacity of water at Kaniha OCP of Kaniha Area.	2.26	2.26
11	Kaniha	Angul	Repair and maintenance of 4 nos. class rooms of tile roof and one no. office at Kansamunda up school in Kaniha OCP of Kaniha Area.	3.05	3.05
12	Kaniha	Angul	Provision for construction of road from Matha Chak, Telisingha to Basanti	0.75	0.75

			Lodge connecting to NH 200 (1km) at Kaniha OCP		
13	Kaniha	Angul	Deepening and Strengthening of Nuabandh with provision of sluice gate and its drainage system at village Badatribida near Kaniha OCP of Kaniha Area.	35.66	35.66
Total amount spent in carrying out Construction work in different villages surrounding Kaniha OCP (in Lakhs)				123.16	91.60
Others social works carried out under CSR activity of Kaniha OCP					
14	Kaniha	Angul	Financial Assistance for Organising Annual Sports	0.10	0.10
18	Kaniha	Angul	Financial Assistance to Organise various Cultural activity	1.26	1.26
19	Kaniha	Angul	Medical Camp	0.02	0.02
20	Kaniha	Angul	Medical Camp	0.10	0.10
21	Kaniha	Angul	Financial Assistance for distribution of Butter Milk & Water Melon at Hingula Yatra	0.67	0.67
22	Kaniha	Angul	Financial Assistance To mahila Mandal	0.60	0.60
23	Kaniha	Angul	Celebration of Independence Day at the office premises of Jarda Gram Panchayat	0.30	0.30
24	Kaniha	Angul	Towards organising of various Socio-Cultural activity etc	1.2	1.2
26	Kaniha	Angul	Financial Assistance to Sanjeevani Mahila Mandal for different social activity	1.00	1.00
27	Kaniha	Angul	Financial Assistance to Sanjeevani Mahila Mandal for organising of various Socio-Cultural activity	1.00	1.00
28	Kaniha	Angul	Financial Assistance on the occasion of Republic Day 2016	0.10	0.10
29	Kaniha	Angul	For organising of Athletic meet 2016	1.00	1.00
30	Kaniha	Angul	Supply of furniture to Kansamunda UP School	1.25	1.25
Total amount spent in carrying out social works in different peripheral villages in Kaniha OCP				8.59	8.59
Construction of Toilets under SVA through CSR activity of Kaniha OCP					
31	Kaniha	Angul	Construction of 15 nos. Of toilet for boy's and 15 nos. Of toilets for girls in different schools of Parjang block of Dhenkanal district under CSR of MCL, Kaniha OCP of Kaniha Area.	50.51	49.53

32	Kaniha	Angul	Construction of 25 nos. Of toilet for boy's and 17 nos. Of toilets for girls in different schools of Kankadahad block of Dhenkanal district under CSR of MCL, Kaniha OCP of Kaniha Area.	84.73	74.40
	Total amount spent for Construction of Toilets under SVA in Kaniha OCP			135.24	123.93
	Total amount spent for other CSR works excluding Toilets under SVA in Kaniha OCP			168.63	136.80
Total CSR expenditure made during the period 2015-16 (in Lakhs)				303.87	260.73

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2016 to 31st March 2017.

SL NO.	Name of the Area	Name of Project/Activity	Expenditure made during 2016-17 (Rs. In Lakh)
Drinking Water Supplied to villages under CSR activity in Kaniha OCP			
1	Kaniha	Supply of Drinking Water to various villages near Kaniha OCP	16.57
2	Kaniha	Supply of Drinking water through tankers to Jarada, Telisingha, Kansamunda under CSR activities of Kaniha OCP	3.50
3	Kaniha	Supply of Drinking water through tankars to different villages like Jarda, Telisinga, Chhelia, Kansamunda, Jaipur, Aditya prasad and Gundrunali	6.66
4	Kaniha	Supply of Drinking water through tanker to Jarda, Telisingha & Kansamunda village	9.11
Total amount spent in Drinking Water Supply to different villages located at periphery of Kaniha OCP (in Lakhs)			35.84
Construction works carried out in different villages under CSR activity of Kaniha OCP			
5	Kaniha	Repair and Maintenance of 4 nos. class rooms of tile roof and one no. office at Kansamunda UP School in Kaniha OCP of Kaniha Area.	0.76
6	Kaniha	Construction of two rooms in Saraswati Sishu Mandir at Nalam village of Kaniha Block under Kaniha OCP of Kaniha Area	10.12
7	Kaniha	Digging of pond in Govt land at Aditya Prasad village	6.00
8	Kaniha	Upkeeping of floor outside premises of Kansamunda	0.12

9	Kaniha	Deepening and Strengthening of Nuabandh with provision of sluice gate and its drainage system at village Badatribida near Kaniha OCP of Kaniha Area.	5.19
Total amount spent in carrying out Construction work in different villages surrounding Kaniha OCP (in Lakhs)			22.20
Construction of Toilets under Swachh Vidyalaya Abhayan (SVA) through CSR activity of Kaniha OCP			
10	Kaniha	Construction of 15 nos. of Toilet for Boy's and 15 nos. of Toilets for Girls in different schools of Parjang Block of Dhenkanal District under CSR activities of MCL Kaniha OCP of Kaniha Area.	0.83
11	Kaniha	Construction of 25 nos. of Toilet for Boy's and 17 nos. of Toilets for Girls in different schools of Kankadahad Block of Dhenkanal district under CSR of MCL Kaniha OCP of Kaniha Area.	1.87
Total amount spent for Construction of Toilets under SVA in Kaniha OCP			2.70
Others social works carried out under CSR activity of Kaniha OCP			
12	Kaniha	Urban Plantation in Kaniha Tahsil under Kaniha OCP of Kaniha Area	10.74
13	Kaniha	Purchase of Firecrackers for providing and supplying fire crackers to Talcher and Kaniha Forest Range	0.20
14	Kaniha	Financial assistance to the Mahila Mandal for organising welfare activities during Hingula yatra	0.70
15	Kaniha	Financial assistance to Head Master Regional High School, Gandaberena for organising Rural Sports & Cultural Meet.	1.00
Total amount spent in carrying out social works in different peripheral villages in Kaniha OCP			12.64
Total amount spent for other CSR works excluding Toilets under SVA in Kaniha OCP			70.69
Total CSR expenditure made during the period 2016-17 (in Lakhs)			73.39

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2018 to 31st March 2019.

Sl. No.	DESCRIPTION OF JOB/ACITIVITY	TOTAL EXPENDITURE
1	Urban Plantation in Kaniha Tahsil Under Kaniha OCP Of Kaniha Area	860178.5

2	Supply of Drinking Water Through Tankers To Villages Jarada, Telesingha, Kansamunda, Chhelia, Jaipur, Adityaprasad, Gundrunali, Gulendo Under CSR For 120 Days at Kaniha OCP	9385.37
3	Construction of Dining Hall with Tubewell And Compound Wall at Kaliadama Ashram School of Balipasi Grampanchayat of Kaniha Tahsil of Kaniha OCP	41092.81
4	Deepening Of Existing Pond Of Bareahpur Village Under CSR At Kaniha Ocp	108407.6738
5	Repair of 1 No. class room and maintenance of high school of Jarada Village	35126.24
6	Deepening of existing pond in village Sardhapur of Badatiribida GP	699760.92
7	Repair & Maintenance of Primary School of Chhelia Village under CSR of Kaniha OCP	141456.18
8	Supply of Sports Materials for High School Of Jarada	19553
9	Observance of Swachhta Pakhwada (2017-18) 15th august 2017 to 31st at Kaniha area	60000
10	Supply of furniture materials for high school of Jarada village under CSR of Kaniha OCP	89326
11	Supply of Drinking Water through tankers to Village Jarada, Telisingha, Chhelia, Kansamunda, Jaipur, Aditya Prasad, Gundrunali & Gulendo under CSR for a period of 120 Days (Summer Season) at Kaniha OCP of Kaniha Area for 2018	1967142.24
12	For Organizing welfare activity during Hingula yatra 2017	70000
13	Supply of Medicine For CSR Camp At KOCP	20349.17
14	supply of medicine for CSR camp at KOCP	9181.33
15	Supply of firecrackers to Talcher & Kaniha range	9940.48
16	For Health Camp in KOCP	5000
	Total CSR expenditure made during the period 2018-19	4241970.494
	Total CSR expenditure made during the period 2018-19(in Lakhs)	42.42

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2019 to 31st March 2020.

Sl. No.	Name of Activity	Total Expenditure (Figure in Rs)

1	Urban Plantation in Kaniha Tahsil Under Kaniha OCP Of Kaniha Area	123456.52
2	Supply Of Drinking Water Through Tankers To Villages Jarada, Telesingha, Kansamunda, Chhelia, Jaipur, Adityaprasad, Gundrunali, Gulendo Under Csr For 120 Days At Kaniha Ocp	22671.59
3	Supply Of Drinking Water to Different Village Jarada Telesinga Chhelia Etc Wo No 14 Dt 04.04.2019	2465877.09
4	Renovation /pending of esisting pond of badatribida village of KOCP	1031009.61
5	Supply Of Medicine For CSR Health Camp So No 39 Dt 25.02.2019	71293.2
6	Procurement Of Medicine For Health Camp FC/KA/Rev/TCR/CSR/2018-19/04/15 Dt. 20.02.19	22899.4
7	For Swachhata Pakhwada-2019 KOCP	93809
8	Construction of Concrete Road in Khairabania Sahi of Kansamunda Village under CSR work at KOCP of KA	660141.63
9	Construction of water cooler and purifier room at Bijigol Grama Panchayat at Kaniha OCP of Kaniha Area under CSR	289062.67
10	Supply of Drinking Water through tankers to Jarada Village, Telisingha, Village, Kansamunda Village under CSR at Kaniha OCP of Kaniha Area	350000
11	Welfare Activities Under CSR Through Sanjibani Mahila Mandal, Kaniha Area	76627
12	Financial Assistance for organising cultural meet of Sankirtan Trope	50000
13	Towards Observation of Swachhata Hi Seva (SHS) From 11.09.19 To 27.10.19	17471
	Total CSR expenditure made during the period 2019-20	5269447.946
	Total CSR expenditure made during the period 2019-20(in Lakhs)	52.69

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2020 to 31st March 2021.

Sl. No.	DESCRIPTION OF JOB/ACITIVITY	TOTAL EXPENDITURE
1	Urban Plantation in Kaniha Tahsil Under Kaniha OCP of Kaniha Area	569099.65
2	Digging of Pond in Govt Land at Aditya Prasad Village	33722.39

3	Supply of Drinking Water through tankers to Jarada Village, Telisingha, Village, Kansamunda Village under CSR at Kaniha OCP of Kaniha Area	225823.97
4	Construction of Training Hall for Skill Upgradation at Kaniha in Kaniha Block under CSR of Kaniha OCP of Kaniha Area	2421143.16
5	Digging of drain for connecting Laxmisagar pond of Kansamunda village under CSR work of Kaniha OCP of Kaniha Area	412977.34
6	Supply of Drinking Water through tankers to Village Jarada, Telisingha, Chhelia, Kansamunda, Jaipur, Aditya Prasad, Gundrunali Gulendo & Mallpasi under CSR for a period of 120 Days (Summer Season) at Kaniha OCP of Kaniha Area (Re Tender)-2020	2464691.24
7	Supply Of Drinking Water Through Tankers To Jarada, Telesingha and Kansamunda Villages Under CSR At Kaniha OCP	51219.07
8	Construction of Boundary Wall of Play ground at Arkil High School of Kaniha Block of Kaniha OCP of Kaniha Area under CSR Work	1174990.57
9	Construction of Compound wall at Kothaghara of Badatiribida Village under CSR work of Kaniha OCP of Kaniha Area	678938.19
10	Deepening & Making Bath Ghat (2 Nos) in Tenteibereni Wo-902/25.5.2020	453500.98
11	Supply of Water during summer through water tanker to Village Jarada, Telesingha, Chhelia, Kansamunda, Jaipur, Aditya Prasad, Gundurinali, Gulendo and Malipasi under Kaniha Area for the Year 2021 (Package S1)	175000
12	Construction of Hall at Pabitra Mohan School, Kaniha under CSR of Kaniha Area. (Re Tender)	650000
13	Deepening & Making bath ghat (2 Nos) in Juliabandh of Kamarei GP	442177.45
	Total CSR expenditure made during the period 2020-21	9753284.01
	Total CSR expenditure made during the period 2020-21(in Lakhs)	97.53

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2021 to 31st March 2022.

Sl. No.	Name of Activity	Total Expenditure (Figure in Rs)
1	Supply of Water during summer through water tanker to Village Jarada, Telesingha, Chhelia, Kansamunda, Jaipur, Aditya Prasad, Gundurinali, Gulendo and Malipasi under Kaniha Area for the Year 2021 (Package S1)	2292462.92
2	Construction of Hall at Pabitra Mohan School, Kaniha under CSR of Kaniha Area. (Re Tender)	2453608.77
3	Deepening of existing Pond of Sanatribida Village at Kaniha OCP of Kaniha Area under CSR	1035439.27
4	Renovation / Deepening of Badabandha of Kansamunda village at Kaniha OCP of Kaniha Area under CSR work	1763323.08
5	Deepening and Making Bathghat (Two) nos. in Nua Bandha of Kamarei Village at Kamarei Panchayat of Kaniha OCP of Kaniha Area under CSR work	840452.73
6	Construction of One number of additional class room at Regional High School of Gandaberna village under CSR work, Kaniha Area. (Re Tender)	1237946.34
7	Annual Supply of Water (Excluding Summer Package) through water tanker to Village Jarada, Telesingha and Kansamunda under Kaniha Area for the year 2021 (Package A1)	1067030.06
8	Construction of Guard Wall with Steps and Benches in Western Side of Badatribida Village Pond under CSR work of Kaniha Area	634596.57
9	Construction of Boundary Wall in Govt. Upgraded High School of Barihapur Village under CSR work of Kaniha Area	688417
10	Celebration of Swachhat Pakhwada from 1st oct to 15 th oct 2021in Kaniha Area	11304
11	Sanjivani Mahila Mandal	92882
12	Supplying of fire crackers	9990
13	Deepening and Making Bathghat (Two) nos. in Dandasinga Nua Bandha of Dandasinga Village at Kamarei GP under CSR work of Kaniha OCP of Kaniha Area	665612.59
14	Deepening & Beutification of pond Chardabili village GP	427128.69
	Total CSR expenditure made during the period 2020-22	12329154.4
	Total CSR expenditure made during the period 2020-22(in Lakhs)	123.29

**List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period
01st April 2022 to 31st March 2023.**

Sl. No.	Name of Activity	Expenditure (Figure in Rs)
1	Annual Supply of Water (Excluding Summer Package) through water tanker to Village Jarada, Telisingha and Kansamunda under Kaniha Area for the year 2021 (Package A1)	352658.93
2	Deepening of Pond of Gundurinali Village at Kaniha OCP of Kaniha Area under CSR	1386847.85
3	One dining hall and one sumersible pump set in girl"s hostel at Palasabahali Ashram School	505510.84
4	Supply of Water during summer through water tanker to Village Jarada, Telesingha, Chhelia, Kansamunda, Jaipur, Aditya Prasad, Gundurinali, Gulendo and Malipasi under Kaniha Area for the Year 2022 (Package S1)	3634480.54
5	Annual Supply of Water (Excluding Summer Package) through water tanker to Village Jarada, Telesingha and Kansamunda under Kaniha Area for the year 2022-23	1177672.5
6	Construction of two class room at Pabitrnanagar Mahavidyalaya Parabil under CSR work Kaniha area	1487864.97
7	Supply of Water during summer through Water Tanker to village Jarada, Telisingha Chhelia Kansanuda, Jaipur, Adityaprasad, Gudrurinali Gulendo and Malipasi under CSR for a period of 120 days (summer season) at Kaniha OCP Kaniha area	298620.44
8	Construction of Additional building for class room and stage in Kamarei primary school of Kamarei village under CSR work of Kaniha Area	103711.7
9	Construction of Water cooler room with purifier at Regional High School, Gandaberena under CSR work, Kaniha Area	19709.9
10	Providing & supplying Fire Crackers for Talcher & Kaniha range forest office.	9989.88

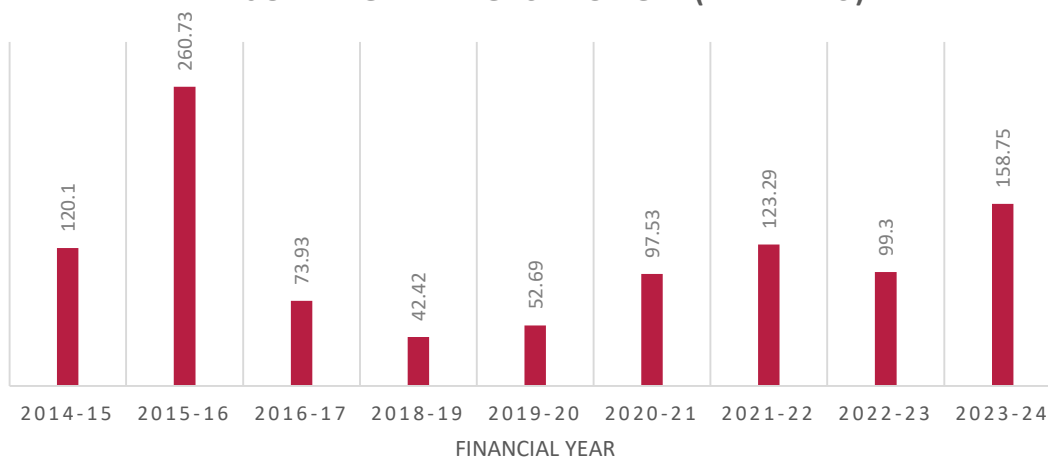
11	Procurement of 500 nos. of Jute bags with MCL logo for celebrating 2nd year of Azadi Ka Amrit Mahostav 2022 (AKAM)	67200
12	Cess @ 1% on CSR Expenditures upto FY 2022-23	914116.78
	Total CSR expenditure made during the period 2022-23	9930507.1
	Total CSR expenditure made during the period 2022-23(in Lakhs)	99.30

List of activity wise CSR Expenditure made by Kaniha OCP, Kaniha Area, MCL during the Period 01st April 2023 to 31st March 2024.

Sl. No.	Area/ location	District	Name of the Project/Activity	Budget allocation (in Lakhs)	Expenditure made during 2023-2024
1	Kaniha Area	Angul	one dining hall and one sumersible pump set in girl's hostel at Palasabahali Ashram School	2,42,034.56	2,42,034.56
2	Kaniha Area	Angul	Annual Supply of Water (Excluding Summer Package) through water tanker to Village Jarada, Telesingha and Kansamunda under Kaniha Area for the year 2021 (Package A1)	4,40,185.23	4,40,185.23
3	Kaniha Area	Angul	Supply of Water during summer through water tanker to Village Jarada, Telesingha, Chhelia, Kansamunda, Jaipur, Aditya Prasad, Gundurinali, Gulendo and Malipasi under Kaniha Area for the Year 2022 (Package S1)	7,88,093.28	7,88,093.28
4	Kaniha Area	Angul	Annual Supply of Water (Excluding Summer Package) through water tanker to Village Jarada, Telesingha and Kansamunda under Kaniha Area for the year 2022-23	2,42,034.56	2,42,034.56
5	Kaniha Area	Angul	Construction of two Class Room at Pabitr Nagar Mahavidyalaya Parabil under CSR work Kaniha Area	4,40,185.23	4,40,185.23
6	Kaniha Area	Angul	Construction of Additional building for class room and stage in Kamarei	7,88,093.28	7,88,093.28

			primary school of Kamarei village under CSR work of Kaniha Area		
7	Kaniha Area	Angul	Construction of Water cooler room with purifier at Regional High School, Gandaberena under CSR work, Kaniha Area	2,42,034.56	2,42,034.56
8	Kaniha Area	Angul	Providing and Laying Pipe Line at Sabhaghat Pond of Sanhar village under CSR work of Kaniha Area	4,40,185.23	4,40,185.23
9	Kaniha Area	Angul	Construction of Rest Shelters Near Kothaghar of Badatiribida Village Under CSR Work Kaniha Area	7,88,093.28	7,88,093.28
10	Kaniha Area	Angul	Supply of drinking water through tankers to Village Jarada, Telesingha, Chhelia, Kansamunda, Jaipur, Aditya Prasad, Gundurinali, Guiland, Mallapasi and Kamarei under CSR for a period of 120 days (Summer Season-2023) at Kaniha OCP, Kaniha Area	43,82,692.04	43,82,692.04
11	Kaniha Area	Angul	Annual Supply of Water (Excluding Summer Package) through water tanker to Village Jarada, Telesingha, Kansamunda and Adaita Prasad under Kaniha Area for the year 2023-24	22,30,154.45	22,30,154.45
12	Kaniha Area	Angul	Construction of Road Safety Control Room Cum Training Hall in the premises of Kaniha Police Station under CSR of Kaniha Area. (Re Tender)	7,23,709.28	7,23,709.28
13	Kaniha Area	Angul	Provision of Sound and Light for Hingula Yatra 2023	14,85,950.40	14,85,950.40
14	Kaniha Area	Angul	Sound and Light for Mahostav for Hingula Yatra 2023	6,49,000.00	6,49,000.00
15	Kaniha Area	Angul	Sanjeevani Mahila Mandal	33,256.00	33,256.00
16	Kaniha Area	Angul	Swachhta hi seva-2023 under Kaniha Area , MCL	99,952.50	99,952.50
16	Kaniha Area	Angul	BOCW Cess	78,169.29	78,169.29
Total CSR expenditure made during the period 2014-15 (in Lakhs)				158.75	158.75

**YEARWISE CSR EXPENSES BY MCL IN KANIHA AND
ADJOINING VILLAGES BUDGET(IN LAKHS)**



Interventions by Mahanadi Coalfields Limited



The interventions to meet the community demands. Improving human development is considered a community demand because the human development approach depicts development in terms of access to health, education, and decent living. In this framework, if the interventions are demand-driven, more interventions should have been in districts with low HDI. To understand this, district-wise average CSR expenditure during seven years is compared with the HDI of the district. The data reveals different combinations of HDI and average expenditure. Some districts which are performing well in HDI also received higher average CSR spending. The following table shows in maximum cases Expenditure of higher CSR fund shows a higher HDI ranking.

District	Average CSR investment between 2014-15 and 2020-21 (INR in million)*	Rank in amount	Human development index**	Rank in HDI
Bagalkot	11.26	19	0.643	27
Bangalore Rural	550.49	1	0.682	19
Bangalore Urban	337.10	2	0.831	2
Belgaum	30.51	12	0.684	18
Bellary	75.13	9	0.635	28
Bidar	3.44	30	0.661	24
Chamarajanagar	5.02	29	0.74	12
Chikballapur	22.47	15	0.671	22
Chikmagalur	7.92	24	0.746	8
Chitradurga	52.27	10	0.658	26
Dakshina Kannada	266.25	3	0.826	3
Davanagere	6.98	25	0.741	11
Dharwad	97.90	6	0.764	5
Gadag	10.81	21	0.679	20
Gulbarga	5.63	28	0.663	23
Hassan	9.84	22	0.745	9
Haveri	8.38	23	0.729	14
Kodagu	20.41	17	0.752	7
Kolar	79.26	8	0.709	16
Koppal	5.94	26	0.672	21
Mandya	10.85	20	0.739	13
Mysore	96.43	7	0.742	10
Raichur	21.74	16	0.584	29
Ramanagara	117.34	5	0.718	15
Shimoga	27.00	14	0.76	6
Tumkur	29.58	13	0.696	17
Udupi	154.12	4	0.837	1
Uttara Kannada	36.18	11	0.771	4
Vijayapura	11.31	18	0.66	25
Yadgiri	5.75	27	0.528	30

Source: *National CSR portal <https://csr.gov.in/>;
 ** Rao and Ravishankar (2020).

Data Processing and Analysis:

All the questionnaires will be scrutinised in the field on the same day so that the respondents can be contacted again, if required to get the additional or missing information. The filled-out questionnaires will be coded properly and will be entered in database specifically designed in MS Access for this study. The data from the household questionnaire, semi-structured interviews and focus group discussions will be analysed thematically and the data from all the sources will be integrated as per the responses to get a clear picture of the project villages. The software to be used for data analysis will be MS Excel and MS Access.

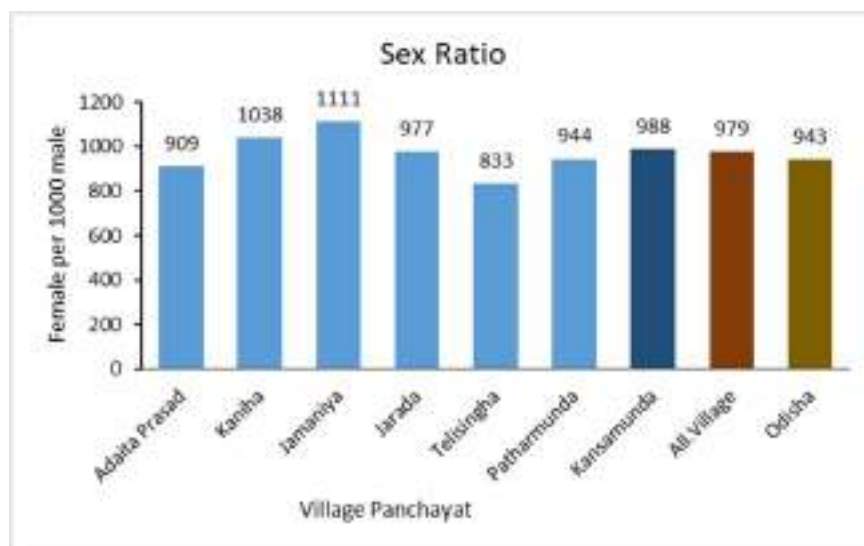
Findings.

It was observed that most of the residents of village panchayat Adaita Prasad living with an annual income of less than Rs. 35,000. Similar observations were found in all the village panchayat except Telisingha and Jamania. For both the villages, i.e., Telisingha and Jamania, most of the resident having annual income more than Rs 35,000. As ownership of land is concern, most of the resident don't have ownership of a land in village panchayat including Adaita Prasad, Jamania, Jarada, Telisingha. On the other hand, most of the resident having medium landholding in village panchayat Kaniha and Kansamunda and having marginal landholding in village panchayat Patharmunda. Firewood was observed being used widely as fuel in all village panchayat except Telisingha and Patharmunda. As for water and sanitation, most of the resident has not access of clean water and toilet facility except Telisingha. Most of the resident has bike and smart phone as asset for mobility and information in all village panchayat without exceptions. Livestock is rarely managed by residents in all village panchayat. As education and health condition are concerned, most of the residents found with education more than high school and having a good health condition. Though women member of the family still facing challenges for better education and accessibility of health.

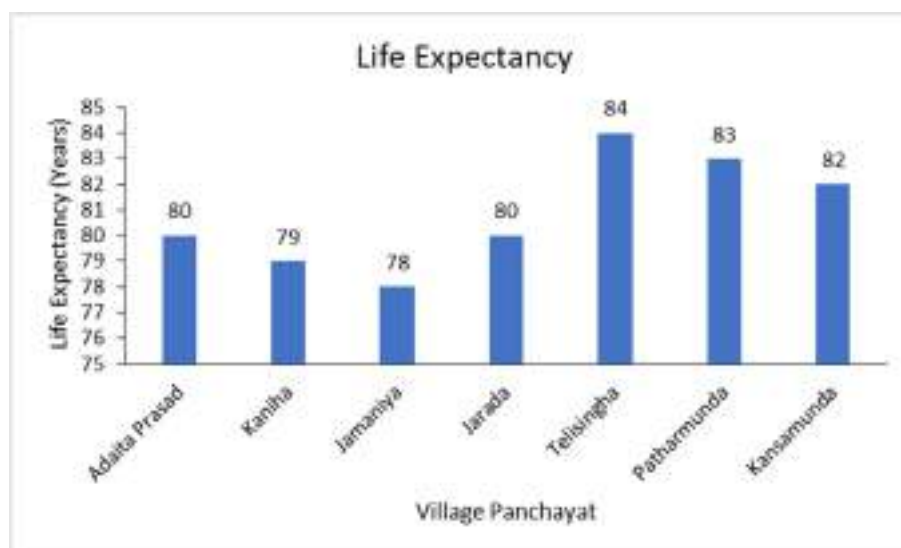
Cumulative sex ratio of the family of respondent including all village panchayat was observed 969 women per 1000 men which are comparative slightly less than sex ratio in state Odisha i.e. 979, but better than national sex ratio 943 according to census 2011 data. Among all, sex ratio of village panchayat Jamania was observed the highest i.e. 1111 female per 1000 male.

Village	Sex Ratio	Life Expectancy (Years)	Expected Year of Schooling (Years)	Income/capita	Infant Mortality Rate (Live Births per 1000)
Adaitaprasad	909	80	19	30000	41
Kaniha	1038	79	20	31000	40
Jamania	1111	78	21	40000	39
Jarada	977	80	21	35000	38
Telisingha	833	84	21	45000	38
Patharamunda	944	83	19	35000	42
Kansamunda	988	82	18	35000	39
All Villages	979	-	-	-	-
Odisha	943	-	-	-	-

Source: Survey



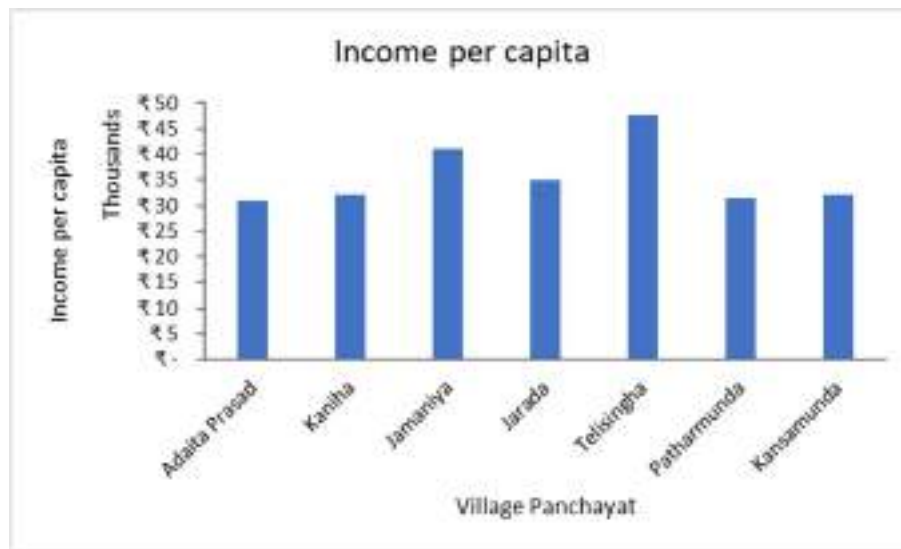
As per life expectancy is concerned, village panchayat Telisingha and Pathamunda was found better than another studied village panchayat. It might be because of better education and economy conditions. According to United Nations- World Population Prospects, 2024, The life expectancy from birth of India is 70.62.



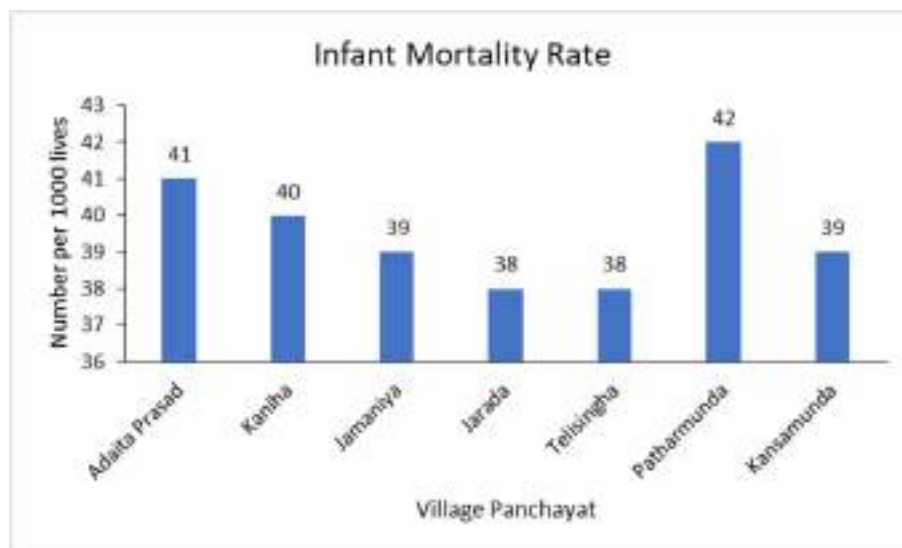
Most of the residents of village panchayat studied showed education level more than graduation. Though, Trend of education is getting better with time, awareness, economic condition and accessibility. The student life in year expected in the village was found better for village panchayat Jamania, Jarada and Telisingha.



Economic conditions in term of income per capita, village panchayat Jamaniya and Telisingha were performing better. Most of the households having one income source i.e. mainly from male of the family. There are few households having alternative income source including the female of the family. There are few households having females as primary bread winner for the family.



Village panchayat Jarada and Telisingha showed better condition in terms of infant mortality rate with lesser death of infants per 1000 lives comparative another village panchayat. The infant mortality rate is reported 30 and 38 for India and Odisha respectively in the year 2019 by Registrar General of India.



Including all the dimensions, All village panchayat was observed with **Low human development category** having HDI less than 0.550 comparing to National **Medium human development categories**. It is remarkable that villages were performing well and near than threshold of HDI 0.550 to enter in the category of Medium human development categories. Inter village panchayat comparison revealed that village panchayat Telisingha and Jamania has better human development condition than other village panchayat. **India's rank in Physical Quality of Life index (PQLI) is 117 out of 189 countries**, according to the 2020 Human

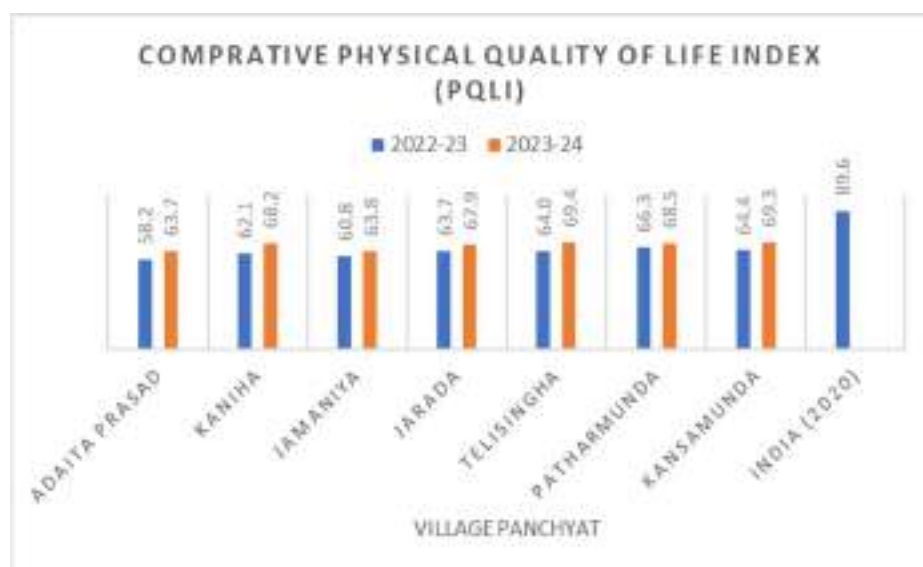
Development Index (HDI) report by the United Nations Development Programme (UNDP). At Quality of Life index, village panchayata Telisingha and Jarada were showed better living quality.

Calculation of Human Development Index (HDI) 2022-23							
Prameters	Adaita Prasad	Kaniha	Jamaniya	Jarada	Telisingha	Patharmunda	Kansamunda
Long and Healthy Life	75	74	70	78	77	80	79
Expected years of schooling	18	17	15	18	17	15	16
Mean years of schooling	11	10	13	14	12	13	13
Average Income/Month (INR)	29600.0	32124.3	40000.0	34870.0	47525.0	30200.0	31800.0
GNI Index(in \$)	4262.40	4625.90	5760.00	5021.28	6843.60	4348.80	4579.20
Annual Income(INR)	355200.0	385491.7	480000.0	418440.0	570300.0	362400.0	381600.0
Dimension Index of Health(I_{health})	0.84615	0.83077	0.76923	0.89231	0.87692	0.92308	0.90769
Expected years of schooling Index	0.85714	0.80952	0.71429	0.85714	0.80952	0.71429	0.76190
Mean years of schooling Index	0.73333	0.66667	0.86667	0.93333	0.80000	0.86667	0.86667
GNI Index	0.05557	0.06043	0.07557	0.06570	0.09003	0.05673	0.05980
	Adaita Prasad	Kaniha	Jamaniya	Jarada	Telisingha	Patharmunda	Kansamunda
Dimension Index of Health(I_{health})	0.92308	0.90769	0.89231	0.92308	0.98462	0.96923	0.95385
Education Index($I_{\text{Education}}$)	0.79524	0.73810	0.79048	0.89524	0.80476	0.79048	0.81429
Income Index(I_{Income})	0.05809	0.06043	0.07770	0.06595	0.09015	0.05886	0.06023
HDI	0.349	0.343	0.380	0.379	0.415	0.356	0.360

Calculation of Physical Quality of Life Index(PQLI) in 2022-23							
	Adaita Prasad	Kaniha	Jamania	Jarada	Telisingha	Patharmunda	Kansamunda
Life Expectancy	37.800	32.400	37.800	40.500	48.600	51.300	35.100
Infant Mortality Rate	75.000	76.250	77.500	78.125	75.000	76.250	77.500
Basic Literacy	61.658	77.637	66.987	72.370	68.524	71.237	80.456
PQLI	58.2	62.1	60.8	63.7	64.0	66.3	64.4

Calculation of Human Development Index (HDI) in 2023-24							
Prameters	Adaita Prasad	Kaniha	Jamaniya	Jarada	Telisingha	Patharmunda	Kansamunda
Long and Healthy Life	80	79	78	80	84	83	82
Expected years of schooling	19	20	21	21	21	19	18
Mean years of schooling	12	15	14	15	14	12	15
Average Income/Month (INR)	30909.1	32124.3	41111.1	35000.0	47586.2	31309.1	32024.3
GNI Index(in \$)	4450.91	4625.90	5920.00	5040.00	6852.41	4508.51	4611.50
Annual Income(INR)	370909.1	385491.7	493333.3	420000.0	571034.5	375709.1	384291.7
Dimension Index of Health(I_{health})	0.92308	0.90769	0.89231	0.92308	0.98462	0.96923	0.95385
Expected years of schooling Index	0.90476	0.95238	1.00000	1.00000	1.00000	0.90476	0.85714
Mean years of schooling Index	0.80000	1.00000	0.93333	1.00000	0.93333	0.80000	1.00000
GNI Index	0.05809	0.06043	0.07770	0.06595	0.09015	0.05886	0.06023
	Adaita Prasad	Kaniha	Jamaniya	Jarada	Telisingha	Patharmunda	Kansamunda
Dimension Index of Health(I_{health})	0.92308	0.90769	0.89231	0.92308	0.98462	0.96923	0.95385
Education Index($I_{\text{Education}}$)	0.85238	0.97619	0.96667	1.00000	0.96667	0.85238	0.92857
Income Index(I_{Income})	0.05809	0.06043	0.07770	0.06595	0.09015	0.05886	0.06023
HDI	0.358	0.377	0.406	0.393	0.441	0.365	0.376

Calculation of Physical Quality of Life Index (PQLI) in 2023-24							
	Adaita Prasad	Kaniha	Jamania	Jarada	Telisingha	Patharmunda	Kansamunda
Life Expectancy	48.600	45.900	43.200	48.600	59.400	56.700	48.600
Infant Mortality Rate	78.125	78.750	79.375	80.000	80.000	77.500	79.375
Basic Literacy	64.286	80.000	68.750	75.000	68.750	71.429	80.000
PQLI	63.7	68.2	63.8	67.9	69.4	68.5	69.3



Conclusion:

The CSR interventions of MCL that were considered for impact assessment have left a lasting imprint on the economic, social situation & Environmental situation (Water requirements in the area) of the beneficiaries. The main thrust areas of the interventions were education and health, nutrition and environment . Projects were also taken up to develop rural infrastructure to ease the daily life of communities in the remote areas and bring in prosperity

through economic development. These efforts have significantly improved the access to education for both boys and girls, especially from the tribal hamlets and communities and acted as stepping stones for these marginalized communities into the mainstream. Infrastructure has improved in schools with boundary walls, academic and residential complexes and other supporting amenities. These factors are important to improvement of HDI & PQLI which is quality indicators

Quality indicators including HDI and PQLI demonstrated the need of interventions for improvement of living standards of these village panchayats studied. Two points must be considered. Firstly, these indicators are designed to estimate the quality life and human development condition at large level i.e. state or country level. To get more accurate insight, optimisation of the estimate at the village level is needed. Secondly, these are baseline study of these village panchayat. Mahanadi Coalfield Limited are intensively working for the improvement of living standards for the village through infrastructure development for access of quality education, clean water and health clinic etc. The positive affect on quality of life is visible as HDI is near to touch 0.550 threshold and increasing as shown in below table and become medium human development category. Similarly, PQLI index is also increasing year wise more than 60% in 2023-24 all the village which improving indicator due to initiatives and program. This study is significant as it opens the dimension of estimation of HDI and PQLI for these villages which will help to quantify the level of improvement due to interventions of MCL.

Field Survey for Assessment of Quality Life









Latitude: 21.07459
Longitude: 85.030819
Elevation: 94.77±100 m
Accuracy: 13.4 m
Time: 05-10-2023 13:30
Note: AditaprasD

AditaprasD

Sample of filled Survey Form:



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QUESTIONNAIRE FOR HDI

Schedule A – Family details

- 1.1 Name of the Gram Panchayat : Kanina
 1.2 Name of the District : Anantpur
 1.3 Name of the Taluk : Kanina
 1.4 Name of the Respondent : Jasabanta Dehera
 1.5 Contact Number : 8249759819
 1.6 Religion and caste of the household : Hindia
 1.7 Whether your family is APL/BPL?
 1.8 Number of members in the family 4 Male 1 Female 3
 1.9 Details of the family members

Sl. No	Name	Relationship with the respondent	Age	Sex	Marital status	Educational status	Employment status	Monthly income
1	Anita Dehera (Wife)		29	F	M	10th	No	10000
2	Devi Shree Devi Dehera (Daughter)		9	F	NO	3rd		
3	Preethi Dehera (Daughter)		10	F	NO	No		
4								
5								

- 1.10 Type of house:
 a) Pucca b) Semi Pucca c) Katcha
 1.11 Ownership of house
 a) Own b) Rented
 1.11. How much land your family possess?
 b) a) <10 cent b) 10-20 cent c) 21-30 cent d) 31-40 cent e) 41-50 cent f) >50 cent
 c) Amenities of the family
 d) a) Newspaper b) Electricity c) Telephone d) LPG e) Motorcycle f) Car g) TV
 h) Fridge i) Washing machine k) Mobile phone
 e) Number of rooms in the house
 f) one b) two c) three d) more than three
 g) Sources of drinking water
 h) own well b) public tap c) neighbor's well d) other sources
 1.12 Whether sanitary facilities are available in the house?
 a) Yes b) No
 1.13 Sources of energy used for lighting



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Schedule C-Health status

- 3.1 Do you have any health problems?
a) ☒ Yes b) ☐ No
- 3.2 If so, state the nature
Fever, cold/ cough, Head ache, Tooth ache, Diarrhea, Skin disease, Body
pain, Fracture, Chest pain, Asthma, Bronchitis, Typhoid, Cholera, Gynec
problems, Heart diseases, B P problems, Diabetes, Knee/ Joint pain, Back /
Neck pain, Chronic diseases (TB, Cancer etc), any other diseases.
- 3.3 Do you consider it as due to the nature of the work?
a) ☒ Yes b) ☐ No
- 3.4 How long do you suffer from these problems?
- 3.5 Frequency of health problems
a) ☒ Regularly b) ☐ Weekly c) ☐ Monthly d) ☐ Rarely
- 3.6 Are you taking medicine? (Yes or No)
- 3.7 If yes, which type of medicine is used?
a) ☐ Allopathy b) ☐ Homeopathy c) ☐ Ayurveda
- 3.8 Type of hospital in which treatment is taken
a) ☐ Private b) ☐ Government
- 3.9 Why do you select government hospital?
a) ☒ Less distance b) ☐ Lesser finance c) ☐ Proper diagnosis d) ☐ Freemedicine e)
Better treatment
- 3.10 Whether sufficient staff is provided at the government medical centre?
a) ☒ Yes b) ☐ No
- 3.11 Whether adequate medicines are available at the nearest Health centre?
a) ☒ Yes b) ☐ No
- 3.12 If no, from where do you get the medicine?
a) ☐ From nearest town b) ☐ go to other hospitals
- 3.13 Why do you select private hospitals?
a) ☐ Less distance b) ☒ Better care and treatment c) ☐ Proper diagnosis
d) ☐ Better facilities of private hospitals
- 3.14 Are you satisfied with the services rendered by the private hospitals?
a) ☒ Yes b) ☐ No
- 3.15 In your opinion, which hospital provide the better services?
a) ☒ Private b) ☐ Public
- 3.16 Are you hospitalized during the last year?
a) ☒ Yes b) ☐ No
- 3.17 If yes, for how many days?
- 3.18 Have you postponed medical treatment at the time of illness at anytime



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	300000 – 500000	0.7		
	500000 – 800000	0.8		
	800000 – 1000000	0.9		
	>1000000	1.0		
	Landless	0		
	Marginal	0.25	✓	
	Small	0.5		
	Medium	0.75		
	Big	1		
Housing	Floor	Cement	1	
		Stone	0.5	✓
		Mud	0.25	
	Roof	Cement	1	✓
		Tiles	0.5	
		Thatch	0.25	
	House Type	Kutcha	0.25	
		Semi Pucca	0.5	✓
		Pucca	1	
	Room per member	<0.5	0.25	
		0.5 – 1	0.5	✓
		=1	0.75	
		>1	1	
Fuel	LPG		1	✓
	Wood/ Charcoal		0	
Toilet	Available		1	



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	between 0.25 - 0.51	0.5	
	between 0.5 – 1	0.25	
	If > 1	0	

Opinion/ perception regarding the project (Present & proposed):

.....
.....

Remarks:.....
.....

Respondent's Signature
Josabanta Acharya
Date of Survey:

Signature of Surveyor
Souhasree Pradhan



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QUESTIONNAIRE FOR HDI

Schedule A – Family details

- 1.1 Name of the Gram Panchayat : Kanika
1.2 Name of the District : Angul
1.3 Name of the Taluk : Kanika
1.4 Name of the Respondent : Patomangda Samra
1.5 Contact Number :
1.6 Religion and caste of the household : Hindu
1.7 Whether your family is APL/BPL?
1.8 Number of members in the family 2 Male 1 Female 1
1.9 Details of the family members

Sl. No	Name	Relationship with the respondent	Age	Sex	Marital status	Educational status	Employment status	Monthly income
1	<u>Duti</u> <u>(wife)</u>	<u>Samra</u>	<u>56</u>	<u>F</u>	<u>m</u>	<u>NO</u>	<u>NO</u>	<u>NO</u>
2								
3								
4								
5								

- 1.10 Type of house:
a) Pucca b) Semi Pucca c) Katcha
1.11 Ownership of house
a) Own b) Rented
1.11. How much land your family possess?
b) a) ≤ 10 cent b) 10-20 cent c) 21-30 cent d) 31-40 cent e) 41-50 cent f) >50 cent
c) Amenities of the family
d) a) Newspaper b) Electricity c) Telephone d) LPG e) Motor cycle f) Car g) TV
h) Fridge i) Washing machine k) Mobile phone
e) Number of rooms in the house
f) one b) two c) three d) more than three
g) Sources of drinking water
h) own well b) public tap c) neighbor's well d) other sources
1.12 Whether sanitary facilities are available in the house?
a) Yes b) No
1.13 Sources of energy used for lighting



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Schedule C-Health status

- 3.1 Do you have any health problems?
a) Yes ☒ b) No
- 3.2 If so, state the nature
Fever, cold/ cough, Head ache, Tooth ache, Diarrhea, Skin disease, Body pain, Fracture, Chest pain, Asthma, Bronchitis, Typhoid, Chelera, Gynec problems, Heart diseases, B P problems, Diabetes, Knee/ Joint pain, Back / Neck pain, Chronic diseases (TB, Cancer etc), any other diseases.
- 3.3 Do you consider it as due to the nature of the work?
a) Yes ☒ b) No
- 3.4 How long do you suffer from these problems?
- 3.5 Frequency of health problems
a) Regularly b) Weekly c) Monthly d) Rarely
- 3.6 Are you taking medicine? (Yes or No)
- 3.7 If yes, which type of medicine is used?
a) Allopathy b) Homeopathy c) Ayurveda
- 3.8 Type of hospital in which treatment is taken
a) Private b) Government
- 3.9 Why do you select government hospital?
a) Less distance b) Lesser finance c) Proper diagnosis d) Freemedicine e) Better treatment
- 3.10 Whether sufficient staff is provided at the government medical centre?
a) Yes ☒ b) No
- 3.11 Whether adequate medicines are available at the nearest Health centre?
a) Yes ☒ b) No
- 3.12 If no, from where do you get the medicine?
a) From nearest town b) go to other hospitals
- 3.13 Why do you select private hospitals?
a) Less distance b) Better care and treatment c) Proper diagnosis
d) Better facilities of private hospitals
- 3.14 Are you satisfied with the services rendered by the private hospitals?
a) Yes ☒ b) No
- 3.15 In your opinion, which hospital provide the better services?
a) Private b) Public
- 3.16 Are you hospitalized during the last year?
a) Yes ☒ b) No
- 3.17 If yes, for how many days?
- 3.18 Have you postponed medical treatment at the time of illness at anytime



Eco Consultant Services



	300000 – 500000	0.7		
	500000 – 800000	0.8		
	800000 – 1000000	0.9		
	>1000000	1.0		
	Landless	0		
	Marginal	0.25	✓	
	Small	0.5		
	Medium	0.75		
	Big	1		
Housing	Floor	Cement	1	✓
		Stone	0.5	
		Mud	0.25	
	Roof	Cement	1	✓
		Tiles	0.5	
		Thatch	0.25	
	House Type	Kutcha	0.25	
		Semi Pucca	0.5	
		Pucca	1	✓
	Room per member	<0.5	0.25	
		0.5 – 1	0.5	
		=1	0.75	
		>1	1	✓
Fuel	LPG		1	✓
	Wood/ Charcoal		0	
Toilet	Available		1	



Eco Consultant Services



	between 0.25 - 0.51	0.5	☒
	between 0.5 - 1	0.25	☐
	if > 1	0	☐

Opinion/ perception regarding the project (Present & proposed):

.....

Remarks:.....

Respondent's Signature
Parmananda Sahoo
Date of Survey:

Signature of Surveyor
Sankar Kumar Pradhan

ANNEXURE-3

महानदी कोलफील्ड्स लिमिटेड के ५ मिलियन घन मीटर (कोल+ अधिभार) से अधिक उत्पादन क्षमतावाले १६ खुली खदानों की भूमि पुनरुद्धार हेतु २०२३ के उपग्रह डाटा के आधार पर निगरानी का वार्षिक प्रतिवेदन

Land Restoration / Reclamation Monitoring of 16 opencast coal mines of Mahanadi Coalfields Ltd. (MCL) producing more than 5 million cu.m. (Coal+OB) per annum based on satellite data of the Year 2023



Submitted to
Mahanadi Coalfields Limited



महानदी कोलफील्ड्स लिमिटेड के ५ मिलियन घन मीटर (कोल+ अधिभार) से अधिक उत्पादन क्षमतावाले १६ खुली खदानों की भूमि पुनरुद्धार हेतु २०२३ के उपग्रह डाटा के आधार पर निगरानी का वार्षिक प्रतिवेदन

Land Restoration / Reclamation monitoring of 16 opencast coal mines of Mahanadi Coalfields Ltd. (MCL) producing more than 5 million cu.m. (Coal+OB) per annum based on satellite data of the Year 2023

March 2024



**Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi**

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कार्यकारी सारांश

१.० परियोजना

महानदी कोलफील्ड्स लिमिटेड के ५ मिलियन घन मीटर (कोल+अधिभार) से अधिक उत्पादन क्षमतावाले १६ खुली खदानों के भूमि पुनरुद्धार हेतु वर्ष २०२३ के उपग्रह डाटा पर आधारित प्रत्येक साल का नियमित निगरानी।

२.० उद्देश्य

भूमि पुनरुद्धार (लैंड रिक्लेमेशन) का उद्देश्य कुल पट्टाक्षेत्र में बैकफील, वृक्षारोपण, सामाजिक वानिकी, सक्रिय खनन क्षेत्र, जल निकाय (वाटर ड्रेनेज) बंजर भूमि, कृषि भूमि और जंगल के विभिन्न प्रकार के वितरण प्रणाली के क्षेत्र का आकलन करने के लिए है। यह अध्ययन न केवल उपरोक्त सभी खुली खदानों के भूमि पुनरुद्धार (लैंड रिक्लेमेशन) का निगरानी के प्रगति का आकलन में मदद करेगा बल्कि पर्यावरण संरक्षण के लिए आवश्यक उपचारात्मक उपायों को क्रियान्वित करने में भी सहायता करेगा।

३.० मुख्य निष्कर्ष

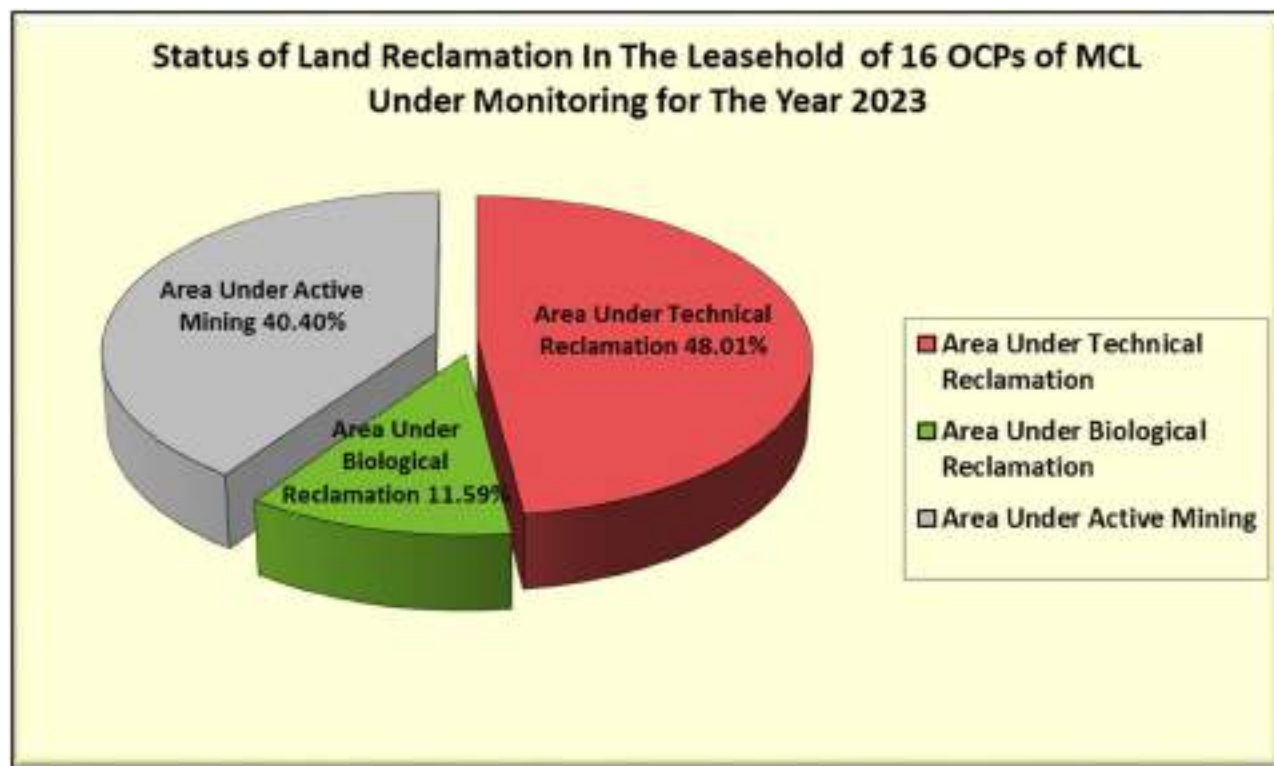
- २०२३-२४ के दौरान निगरानी के लिए एमसीएल की १६ ओपनकास्ट परियोजनाओं में कुल खदान पट्टा क्षेत्र १८२.१२ वर्ग किलोमीटर है, जिसमें से कुल उत्खनन क्षेत्र ६८.५१ वर्ग किलोमीटर है, जिसके ३२.८९ वर्ग किलोमीटर क्षेत्र (४८.०१%) बैकफिलिंग (तकनीकी रूप से पुनर्ग्रहण के तहत), ७.९४ वर्ग किलोमीटर क्षेत्र (११.५९%) वृक्षारोपण (जैविक रूप से पुनर्ग्रहण) के तहत और २७.६८ वर्ग किलोमीटर क्षेत्र (४०.४०%) सक्रिय खनन के तहत है। विश्लेषण से यह स्पष्ट है कि उपर्युक्त १६ ओपनकास्ट परियोजनाओं की कुल उत्खनन भूमि का संचयी रूप से ५९.६०% पहले से ही पुनर्ग्रहण के अधीन है और कुल उत्खनन क्षेत्र का शेष ४०.४०% सक्रिय खनन के अंतर्गत है। परियोजनावार विवरण तालिका-१ में दिया गया है और चित्र-१ में ग्राफिक रूप से दर्शाया गया है।

- एमसीएल में जैविक पुनर्ग्रहण (बैकफ़िलिंग पर वृक्षारोपण) का क्षेत्र ८.०६ वर्ग किलोमीटर (वर्ष २०२२) से घटकर ७.९४ वर्ग किलोमीटर (वर्ष २०२३) हो गया है और तकनीकी पुनर्ग्रहण का क्षेत्र (बैकफ़िलिंग के तहत क्षेत्र) २९.५८ वर्ग किलोमीटर (वर्ष २०२२) से बढ़कर ३२. ८९ वर्ग किलोमीटर (वर्ष २०२३) हो गया है। भूमि पुनर्ग्रहण के कुल क्षेत्र में ३.१९ वर्ग किमी की वृद्धि भूमि पुनर्ग्रहण और पर्यावरण संरक्षण की दिशा में किए गए महानदी कोलफील्ड्स लिमिटेड के प्रयासों का परिणाम है।
- उपरोक्त चयनित १६ परियोजनाओं में वर्ष २०२२ के संबंध में वर्ष २०२३ के लिए भूमि पुनर्ग्रहण की स्थिति की तुलना करने पर, विश्लेषण से यह स्पष्ट है कि भूमि पुनर्ग्रहण के तहत कुल क्षेत्र ३७.६४ वर्ग किलोमीटर (वर्ष २०२२) से बढ़कर ४०.८३ वर्ग किलोमीटर (वर्ष २०२३) हो गया है। एमसीएल की १६ परियोजनाओं में से, बेलपहाड़ ओसी भूमि पुनर्ग्रहण (७५.९०%) के लिए शीर्ष पर है, इसके बाद बलराम ओसी (७०.३७%) और समलेश्वरी ओसी (७०.०२%) है।
- जू कुछ परियोजनाओं में फील्ड दौरे के दौरान यह देखा गया है कि एमसीएल द्वारा किए गए पौधरोपण के अलावा मिट्टी की उर्वरता अधिक होने के कारण पुराने और स्थिर बैकफिल क्षेत्र और डम्पों पर प्राकृतिक वनस्पति भी उगनी शुरू हो गई है। कुछ परियोजनाओं में नए वृक्षारोपण किए गए हैं लेकिन कम ऊंचाई के कारण यह उपग्रह डेटा में स्पष्ट नहीं है।

Executive Summary

- 1.0 Projects** Land restoration / reclamation monitoring of 16 opencast coal mines of Mahanadi Coalfields Ltd. (MCL) producing 5 million cu.m. and more (Coal+OB) per annum based on satellite data on annual basis.
- 2.0 Objective** Objective of the land restoration / reclamation monitoring is to assess the area under backfilling, plantation, social forestry, active mining area, water bodies, distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.
- 3.0 Salient Findings**
- Out of the total mine leasehold area of 182.12 Km² of the 16 opencast projects of MCL viz. Ananta, Balram, Lingaraj, Bharatpur, Bhubaneshwari, Jagannath, Hingula, Belpahar, Lakhanpur, Samleswari, Lajkura, Siarmal, Basundhara W. Extn., Garjanbahal, Kulda and Kahina considered for monitoring during 2023-24; total excavated area is 68.51 Km², out of which 7.94 Km² area (11.59%) has been planted, 32.89 Km² area (48.01%) is under backfilling and 27.68 Km² area (40.40%) is under active mining. It is evident from the analysis that 59.60% areas of the OC projects is under reclamation (biological and technical) and balance 40.40% area is under active mining. Project wise details are given in Table-1 & Fig-1.
 - On comparing the status of land reclamation for the year 2023 with respect to the year 2022 in different projects, it is evident from the analysis that total area under land reclamation has increased from 37.64 Km² (Yr.2022) to 40.83 Km² (Yr.2023). Out of 16 projects of MCL, Belpahar OC ranks on top for land reclamation (75.90%) followed by Balram OC (70.37%) and Samleswari OC (70.02%).
 - Area of biological reclamation (plantation on backfill) has been decreased nominally from 8.06 Km² (Yr.2022) to 7.94 Km² (Yr. 2023) and area of technical reclamation (area under backfilling) has increased from 29.58 Km² (Yr.2022) to 32.89 Km² (Yr.2023) in MCL. The increase of 3.19 Km² in total area of reclamation is the result of the efforts of the Mahanadi Coalfields Ltd. taken up towards land reclamation and environmental protection.
 - In some of the projects it has been observed during field visit that natural vegetation has also started growing on the old and stabilized backfilled area and dumps due to high soil fertility besides plantation carried out by

MCL. New plantation has been carried out in some projects but due to low height it's signature not clear in satellite data.



Pie Chart indicating distribution of reclamation activities in OC mines of MCL

Table 1: Project wise Land Reclamation Status in Opencast Projects of MCL based on Satellite Data of the year 2023

Table 1: Project wise Land Reclamation Status in Opencast Projects of MCL based on Satellite Data of the year 2023																				(Area in Sq.km.)	
Sl. No.	Project	Total Leasehold Area 2020	Total Leasehold Area 2021	Technical Reclamation		Plantation						Area Under Active Mining		Total Excavated Area		Total Area Under Plantation (%Green Cover Generated in Leasehold)		Total Area Under Reclamation			
				Area under Backfilling	Biological Reclamation	Plantation		Other Plantation		7	8	9	10(=5+6+9)	11(=6+7+8)	12(=5+6)						
						Plantation on Excavated/Backfilled Area	Plantation on External Over Burden Dump	Social Forestry, Avenue Plantation Etc.													
1	2	3	4	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023		
1	Ananta	14.20	14.20	2.62	3.18	1.05	0.97	0.10	0.08	0.22	0.21	1.95	2.12	5.62	6.27	1.37	1.26	3.67	4.15		
				46.62%	50.72%	18.68%	15.47%			34.70%	33.81%					9.65%	8.87%	65.30%	66.19%		
2	Balram	13.09	13.09	2.98	3.05	0.98	0.94	0.22	0.22	0.35	0.32	1.58	1.68	5.54	5.67	1.55	1.48	3.96	3.99		
				53.79%	53.79%	17.69%	16.58%			28.52%	29.63%					11.84%	11.31%	71.48%	70.37%		
3	Lingaraj	11.73	14.10	1.98	2.52	0.16	0.16	0.52	0.56	0.44	0.45	2.68	3.04	4.82	5.72	1.12	1.17	2.14	2.68		
				41.08%	44.06%	3.32%	2.80%			55.60%	53.15%					9.55%	8.30%	44.40%	46.85%		
4	Bharatpur	9.27	9.27	2.83	2.84	1.63	1.63	0.45	0.45	0.16	0.15	1.76	2.00	6.22	6.47	2.24	2.23	4.46	4.47		
				45.50%	43.89%	26.21%	25.19%			28.30%	30.91%					24.16%	24.06%	71.70%	69.09%		
5	Bhubaneswari	6.58	6.58	2.29	2.45	0.02	0.06	0.01	0.01	0.09	0.06	2.17	2.11	4.48	4.62	0.12	0.13	2.31	2.51		
				51.12%	53.03%	0.45%	1.30%			48.44%	45.67%					1.82%	1.98%	51.56%	54.33%		
6	Jagannath	5.54	5.54	1.05	1.11	1.80	1.78	0.00	0.00	0.15	0.11	1.13	1.31	3.98	4.20	1.95	1.89	2.85	2.89		
				26.38%	26.43%	45.23%	42.38%			28.39%	31.19%					35.20%	34.12%	71.61%	68.81%		
7	Hingula	15.75	15.75	1.69	1.85	0.04	0.05	0.18	0.17	0.29	0.29	2.47	2.50	4.20	4.40	0.51	0.51	1.73	1.90		
				40.24%	42.05%	0.95%	1.14%			58.81%	56.82%					3.24%	3.24%	41.19%	43.18%		
8	Kaniha	7.18	7.18	0.36	0.49	0.00	0.00	0.00	0.00	0.07	0.09	1.48	1.57	1.84	2.06	0.07	0.09	0.36	0.49		
				19.57%	23.79%	0.00%	0.00%			80.43%	76.21%					0.97%	1.25%	19.57%	23.79%		
9	Belpahar	14.44	14.44	3.50	3.80	0.66	0.61	0.48	0.35	0.50	0.50	1.33	1.40	5.49	5.81	1.64	1.46	4.16	4.41		
				63.75%	65.40%	12.02%	10.50%			24.23%	24.10%					11.36%	10.11%	75.77%	75.90%		
10	Lakhanpur	22.40	22.40	4.76	5.26	0.89	0.99	0.59	0.59	0.38	0.35	3.99	4.48	9.64	10.73	1.86	1.93	5.65	6.25		
				49.38%	49.02%	9.23%	9.23%			41.39%	41.75%					8.30%	8.62%	58.61%	58.25%		
11	Samleswari	13.35	13.35	3.12	3.22	0.66	0.61	0.49	0.49	0.48	0.47	1.45	1.64	5.23	5.47	1.63	1.57	3.78	3.83		
				59.66%	58.87%	12.62%	11.15%			27.72%	29.98%					12.21%	11.76%	72.28%	70.02%		
12	Lajkura	7.21	7.21	1.32	1.52	0.16	0.13	0.19	0.12	0.16	0.16	1.07	1.14	2.55	2.79	0.51	0.41	1.48	1.65		
				51.76%	54.48%	6.27%	4.66%			41.96%	40.86%					7.07%	5.69%	58.04%	59.14%		
13	Siarmal	22.90	22.90	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.59	0.00	0.00	0.00	0.00	0.61	0.59	0.00	0.00		
				0.00%	0.00%	0.00%	0.00%			0.00%	0.00%					2.66%	2.58%	-	-		
14	Basundhara W Extn.	3.23	3.23	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00		
				0.00%	0.00%	0.00%	0.00%			0.00%	0.00%					0.93%	0.93%	-	-		
15	Garjanbahal	6.54	6.54	0.17	0.43	0.00	0.00	0.00	0.00	0.03	0.02	0.79	0.98	0.96	1.41	0.03	0.02	0.17	0.43		
				17.71%	30.50%	0.00%	0.00%			82.29%	69.50%					0.46%	0.31%	17.71%	30.50%		
16	Kulda	6.34	6.34	0.91	1.17	0.01	0.01	0.01	0.01	0.03	0.03	1.76	1.71	2.68	2.89	0.05	0.05	0.92	1.18		
				33.96%	40.48%	0.37%	0.35%			65.67%	59.17%					0.79%	0.79%	34.33%	40.83%		
	Total	179.75	182.12	29.58	32.89	8.06	7.94	3.24	3.05	3.99	3.83	25.61	27.68	63.25	68.51	15.29	14.82	37.64	40.83		
				46.77%	48.01%	12.74%	11.59%			40.49%	40.40%					8.51%	8.14%	59.51%	59.60%		

Note: In reference to the above Table-1, different parameters are classified as follows:

1. Area under **Biological Reclamation** includes Area under Plantation done on Backfilled Area only.
2. Area under **Technical Reclamation** includes Area under Barren Backfilling only.
3. Area under **Active Mining** includes Coal Quarry, Advance Quarry Site, Quarry Filled with Water, if any. Areas under coal dump have been excluded from Active Mining in this table.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in the Table above.
5. (%) calculated in the above Table is in respect to Total Excavated Area except for "Total Area under Plantation" where % is in terms of "Leasehold Area"

FIG 1.1 LAND RECLAMATION STATUS OF PROJECTS IN TALCHER CF, MCL, YEAR 2023

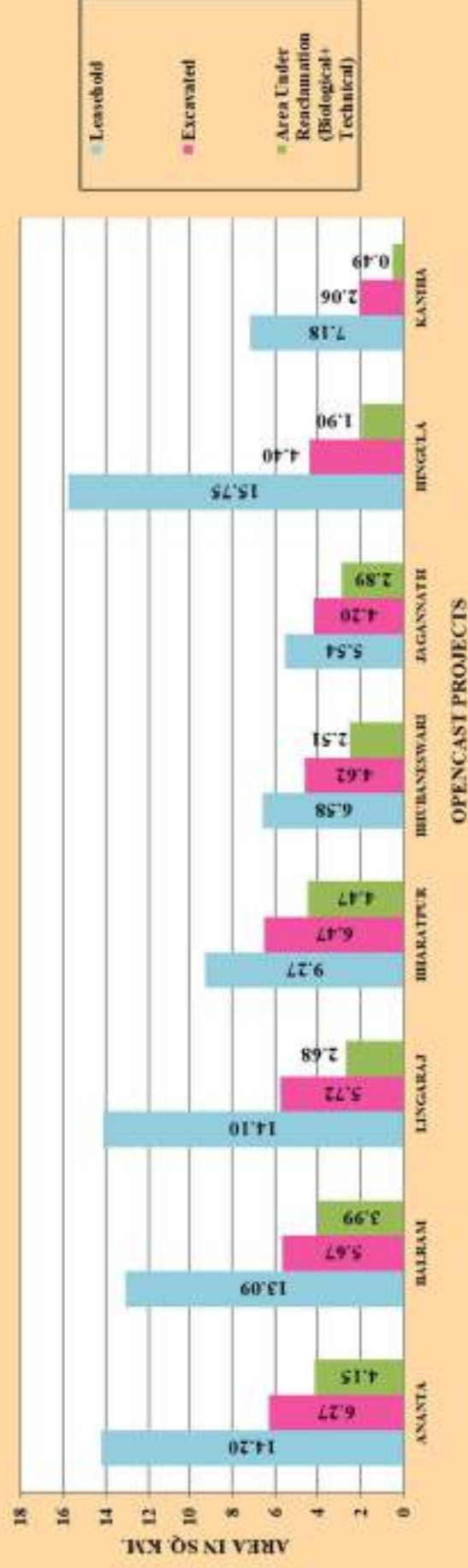


Fig.1.1: Land reclamation status of OC projects in Talcher CF, MCL for the year 2023

FIG 1.2 LAND RECLAMATION STATUS OF PROJECTS IN IB VALLEY CF, MCL, YEAR 2023

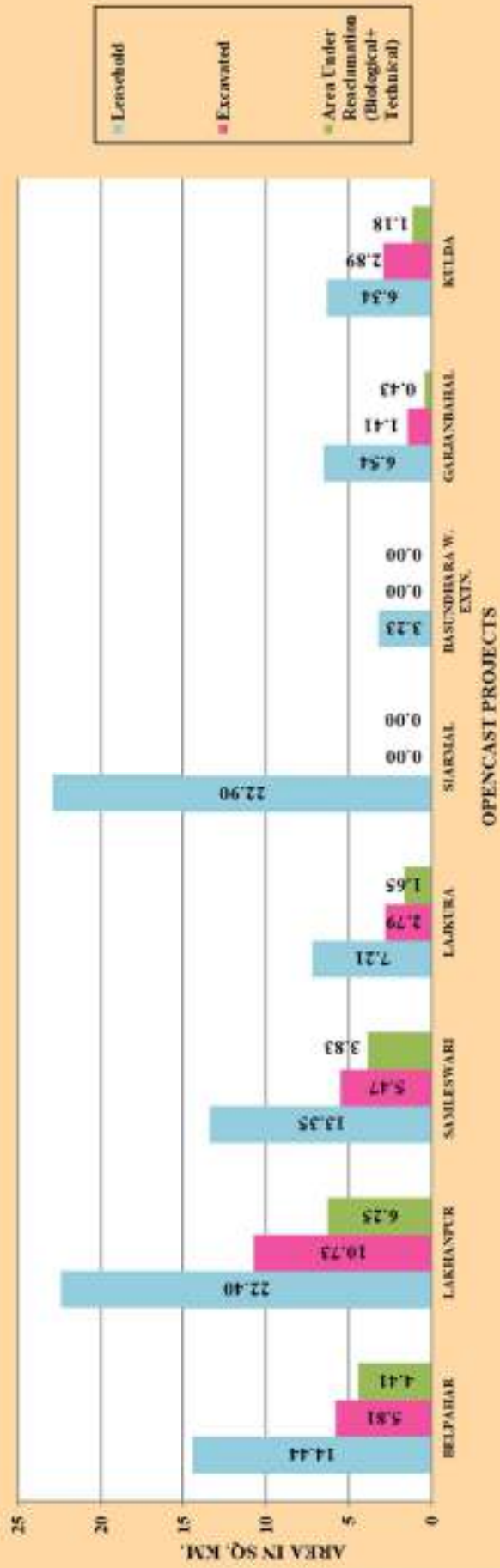


Fig.1.2: Land reclamation status of OC projects in Ib Valley CF, MCL for the year 2023

1.0 Background

- 1.1** Land is the most important natural resource which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land, which is the most scarce natural resource in our country. Mining is a site specific industry and it could not be shifted anywhere else from the location where mineral occurs. It is a fact that surface mining activities do effect the land environment due to ground breaking. Therefore, there is an urgent need to reclaim and restore the mined out land for its productive use for sustainable development of mining. This will not only mitigate environmental degradation, but would also help in creating a more congenial environment for land acquisition by coal companies in future.
- 1.2** Keeping above in view, Coal India Ltd. (CIL) issued a work order vide letter no. CIL/WBP/Env/2009/2428 dated 29.12.2009 to Central Mine Planning & Design Institute (CMPDI), Ranchi, for monitoring land reclamation. status of all the opencast coal mines having production of more than 5 million m³ per annum (coal + OB taken together per annum) based on remote sensing satellite data, regularly on annual basis for sustainable development of mining. Further, a revised work order was issued vide letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 from Coal India Limited for the period 2012-13 to 2016-17 followed by another work order vide letter no. CIL/WBP/Env/2017/DP/8477 dated 21.09.2017 from Coal India Limited for the period 2017-18 to 2021-22 and another work order on CIL/ENV/2022-23/W.O./10899 dated 06.07.2022 for land reclamation monitoring of 110 opencast projects and vegetation cover monitoring of 13 major coalfields for the period 2022-2024. According to this work order, all mines in CIL with output capacity of 5 million cu. m (Coal +OB) shall be monitored every year and all mines below this capacity shall be monitored at an interval of 3 years. Total 13 number of coalfields in CIL shall also be monitored between 2022-2024. The result of land reclamation status of all such mines to be put on the website of CIL, (www.coalindia.in), CMPDI (www.cmpdi.co.in) and the concerned coal companies in public domain. Detail report to be submitted to Coal India and respective subsidiaries.

- 1.3** Land reclamation monitoring of all opencast coal mining projects would also comply the statutory requirements of Ministry of Environment, Forest and Climate Change (MoEF & CC). Such monitoring would not only facilitate in taking timely mitigation measures against environmental degradation, but would also enable coal companies to utilize the reclaimed land for larger socio-economic benefits in a planned way.
- 1.4** Present report is embodying the finding of the study based on satellite data of the year 2023 carried out for 16 OC projects producing more than 5 mcm (Coal+OB) for Mahanadi Coalfields Ltd.

2.0 Objective

Objective of the land reclamation/restoration monitoring is to assess the area of backfilled, plantation, OB dumps, social forestry, active mining area, settlements and water bodies, distribution of wasteland, agricultural land and forest land in the leasehold area of the project. This is an important step taken up for assessing the progressive status of mined land reclamation and for taking up remedial measures, if any, required for environmental protection.

3.0 Methodology

There are number of steps involved between raw satellite data procurement and preparation of final map. National Remote Sensing Centre (NRSC) Hyderabad, being the nodal agency for satellite data supply in India, provides only raw digital satellite data, which needs further digital image processing for extracting the information and map preparation before uploading the same in the website. Methodology for land reclamation monitoring is given in Fig 2. Following steps are involved in land reclamation /restoration monitoring:

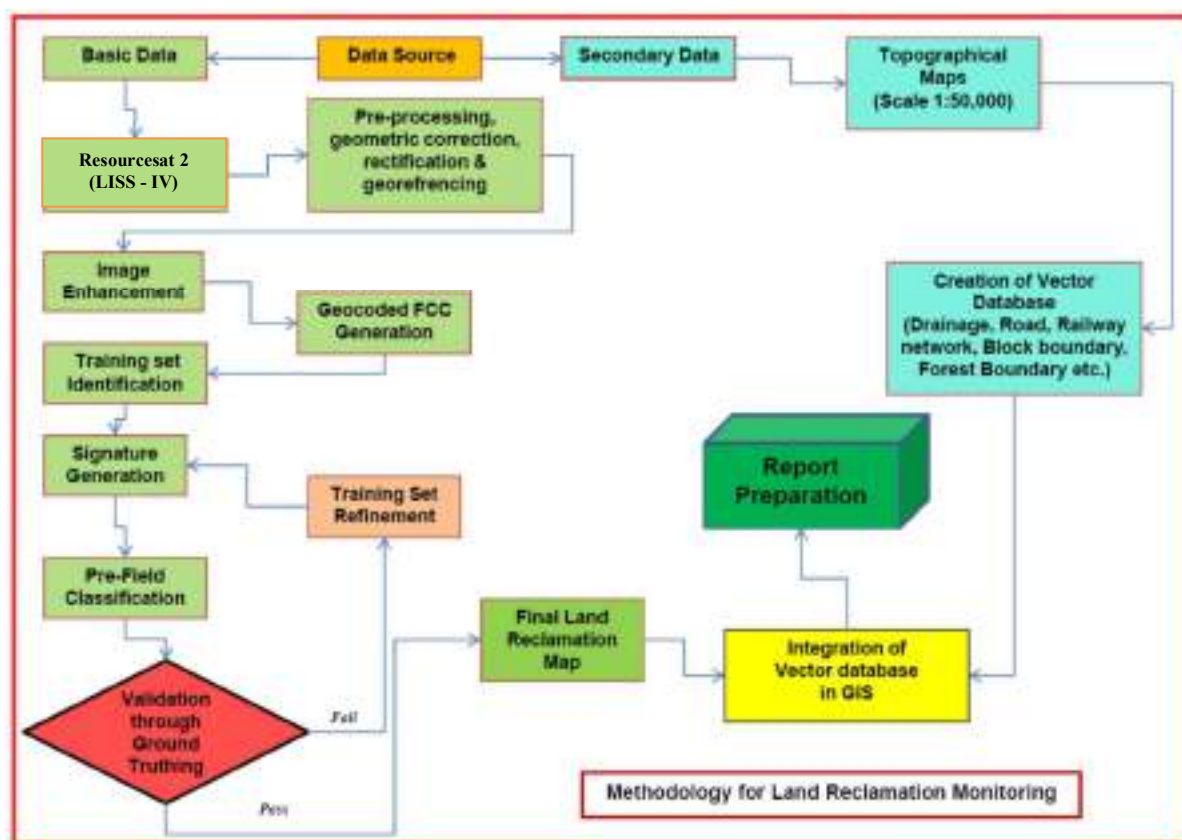


Figure: 2 - **Methodology for Land Reclamation Monitoring**

3.1 Data Procurement: After browsing the data quality and date of pass on internet, supply order for data is placed to NRSC. Secondary data like leasehold boundary, topo sheets are procured for creation of vector database.

Satellite Data Used: The following data are used in the current study, IRS-R2/LISS-IV data of 5th March, 2023 for mines of Talcher Coalfield and IRS-R2A/LISS-IV data of 16th February, 2023 for mines of Ib Valley Coalfield.

3.2 Satellite Data Processing: Satellite data are processed using ERDAS IMAGINE 2022 digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Georeferencing:** Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to satellite receiving station itself. Raw digital images contain geometric distortions, which make them unusable as maps.

Therefore, georeferencing is required for correction of image data using ground control points (GCP) to make it compatible to Sol toposheet.

- **Image enhancement:**

To improve the interpretability of the raw data, image enhancement is necessary. Local operations modify the value of each pixel based on brightness value of neighbouring pixels using ERDAS IMAGINE 2022 s/w. and enhance the image quality for interpretation.

- **Training set selection**

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

- **Classification and Accuracy assessment**

Image classification is carried out using the maximum likelihood algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e. signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels. After evaluating the statistical parameters of the training sets, reliability test of training sets is conducted by measuring the statistical separation between the classes that resulted from

computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data.

- **Area calculation**

The area of each land use class in the leasehold is determined using ERDAS IMAGINE v.2022 software.

- **Overlay of Vector data base**

Vector data base created based on secondary data. Vector layer like drainage, railway line, leasehold boundary, forest boundary etc. are superimposed on the image as vector layer in the Arc GIS 10.8 database.

- **Pre-field map preparation**

Pre-field map is prepared for validation of the classification result

3.3 Ground Truthing:

Selective ground verification of the land use classes are carried out in the field and necessary corrections if required, are incorporated before map finalization.

3.4 Land reclamation database on GIS:

Land reclamation database is created on GIS platform to identify the temporal changes identified from satellite data of different cut-of dates.

4.0 Land Reclamation Status in Mahanadi Coalfields Limited

4.1 Following sixteen opencast projects of MCL producing more than 5 million cubic meter and more (Coal + OB) were taken up for land reclamation monitoring based on satellite data of the year 2023.

- Ananta
- Balram
- Lingaraj
- Bharatpur
- Bhubaneswari
- Jagannath
- Hingula
- Kaniha
- Belpahar
- Lakhanpur
- Samleswari
- Lajkura
- Siarmal
- Basundhara West Extension
- Garjanbahal
- Kulda

4.2 Area statistics of different land use class present in the mine leasehold of the above projects for the year 2023 are shown in the Table -1. Land use maps derived from satellite data are shown in Plate 1 - 16. Land reclamation status of the above mentioned 16 projects, are mentioned in the tables 2.1 and 2.2 for the year 2023. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig. 3 - 18.

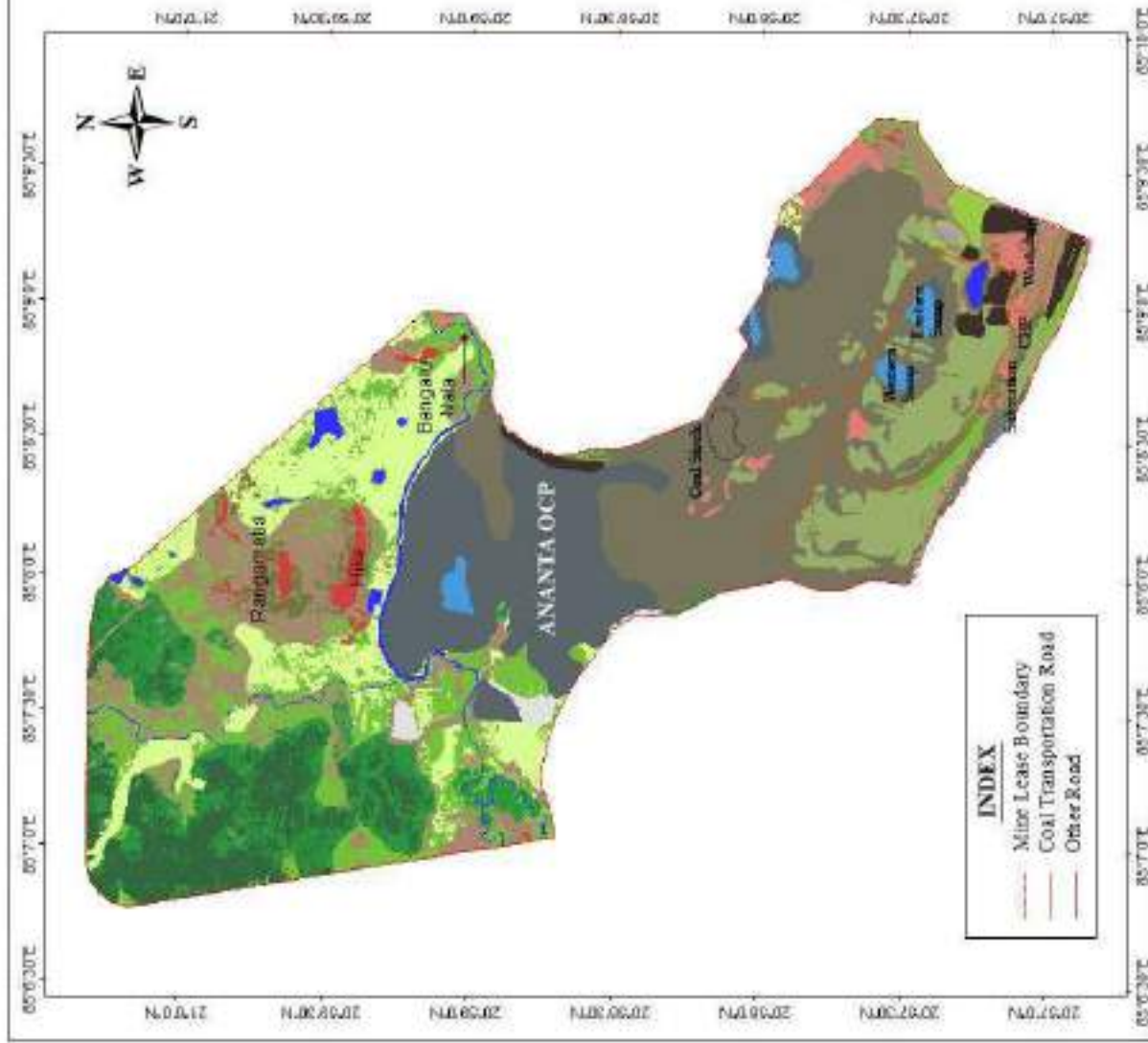
- 4.3** Study reveals that out of total 68.51 Km² excavated area; 40.83 Km² area (59.60%) is under reclamation. Out of which 7.94 Km² (11.59%) area has been re-vegetated and 32.89 Km² (48.01%) area is under backfilling.
- 4.4** Total Area under active mining has increased from 25.61 Km² (Yr. 2022) to 27.68 Km² (Yr. 2023).
- 4.5** Analysis of satellite data indicates that plantation on backfill has reduced in some projects as Ananta, Balram, Jagannath, Belpahar, Samleswari and Lajkura for fresh backfilling activities and for construction of roads, camp, silo and railway connectivity projects.
- 4.6** Plantation on External OB dump has marginally reduced in Ananta, Hingula, Belpahar and Lajkura OCP due to construction of camp, silo and roads. Area of Social forestry has reduced marginally in some projects due to mine advancement.
- 4.7** Study also reveals that area under barren backfilling (Technical Reclamation) has increased from 29.58 Km² in 2022 to 32.89 Km² in 2023.
- 4.8** It was observed that Green Cover has reduced in some projects of MCL due to reduction in plantation and social forestry in the leasehold areas resulted from mining activities.
- 4.9** On comparing the status of land reclamation for the year 2023 with respect to the year 2022 in different projects, it is evident that area of land reclamation has increased from 37.64 Km² (Yr.2022) to 40.83 Km² (Yr.2023).
- 4.11** Out of 16 projects of MCL, Belpahar OC ranks on top for land reclamation (75.90%) followed by Balram OC (70.37%) and Samleswari OC (70.02%).

Table 2.1: STATUS OF LAND RESTORATION / RECLAMATION IN MAHANADI COALFIELDS LIMITED BASED ON SATELLITE DATA OF THE YEAR 2023

		(Area in Sq. Kms.)																	
		ANANTA		BAIRAM		LINGARAJ		BHARATPUR		BHUBANESHWARI		JAGANNATHI		HUNGULA		KANHA		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	1.00	7.04	0.00	0.00	0.00	0.00	0.01	0.11	0.00	0.00	0.00	0.00	1.00	6.35	0.00	0.00	2.01	2.35
	Open Forest	1.06	7.46	0.57	4.35	0.31	2.20	0.00	0.00	0.20	3.04	0.02	0.36	1.51	9.59	0.00	0.00	3.67	4.28
	Total Forest (A)	2.06	14.51	0.57	4.35	0.31	2.20	0.01	0.11	0.20	3.04	0.02	0.36	2.51	15.94	0.00	0.00	5.68	6.63
SCRUBS	Scrubbs (B)	1.55	10.92	2.00	15.28	1.96	13.90	0.39	4.21	0.33	5.02	0.24	4.33	2.72	17.27	0.65	10.17	9.84	11.48
PLANTATION	Social Forestry	0.21	1.48	0.32	2.44	0.45	3.19	0.15	1.62	0.06	0.91	0.11	1.99	0.29	1.84	0.09	0.97	1.68	1.96
	Plantation on External OB Dump	0.08	0.56	0.22	1.68	0.56	3.97	0.45	4.85	0.01	0.08	0.00	0.00	0.17	1.08	0.00	0.00	1.49	1.73
	Plantation on Backfill/Excavated Area(Biological Reclamation)	0.97	6.83	0.94	7.18	0.16	1.13	1.63	17.58	0.06	0.91	1.78	32.13	0.05	0.32	0.00	0.00	5.59	6.52
	Total Plantation (Green Cover) (C)	1.26	8.87	1.48	11.31	1.17	8.30	2.23	24.06	0.13	1.90	1.89	34.12	0.51	3.24	0.09	0.97	8.76	10.22
	Total Vegetation (A+B+C)	4.87	34.30	4.05	30.94	3.44	24.40	2.63	28.37	0.66	9.96	2.15	38.81	5.74	36.44	0.74	11.14	24.28	28.32
ACTIVE MINING	Coal Dump	0.22	1.55	0.28	2.14	0.36	2.55	0.18	1.94	0.06	0.91	0.09	1.62	0.40	2.54	0.18	1.67	1.77	2.07
	Coal Quarry	1.85	13.03	0.88	6.72	2.64	18.72	1.08	11.65	1.80	27.38	0.58	10.47	1.52	9.65	1.49	16.29	11.84	13.82
	Advance Quarry Site	0.09	0.63	0.22	1.68	0.20	1.42	0.16	1.73	0.13	1.98	0.14	2.53	0.13	0.83	0.03	0.14	1.10	1.29
	Quarry Filled with Water	0.18	1.27	0.58	4.43	0.20	1.42	0.76	8.20	0.18	2.74	0.59	10.65	0.85	5.40	0.05	0.84	3.39	3.96
	Total Area under Active Mining	2.12	14.93	1.68	12.83	3.04	21.56	2.00	21.57	2.11	32.09	1.31	23.65	2.50	15.87	1.57	17.27	16.33	19.06
	Barren OB dump	0.02	0.14	0.13	0.99	0.76	5.39	0.05	0.54	0.81	12.32	0.00	0.00	0.97	6.16	0.55	5.85	3.29	3.84
	Area Under Backfilling(Technical Reclamation)	3.18	22.39	3.05	23.30	2.52	17.87	2.84	30.64	2.45	37.26	1.11	20.04	1.85	11.75	0.49	4.32	17.49	20.41
	Total Area under Mine Operation	5.54	39.01	5.14	39.27	6.68	47.38	5.07	54.69	5.43	82.59	2.51	45.31	5.72	36.32	2.79	29.11	38.88	43.31
WASTELANDS	Waste Lands	1.70	11.97	0.97	7.41	2.05	14.54	0.64	6.90	0.21	3.19	0.36	6.50	1.62	10.29	0.90	13.93	8.45	9.86
	Fly Ash Pond/Sand Body	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	1.99	0.06	0.38	0.00	0.00	0.17	0.20
	Total Wastelands	1.70	11.97	0.97	7.41	2.05	14.54	0.64	6.90	0.21	3.19	0.47	8.48	1.68	10.67	0.90	13.93	8.62	10.06
WATER	Reservoir, nullah, ponds etc.	0.21	1.48	0.26	1.99	0.07	0.50	0.04	0.43	0.01	0.15	0.04	0.72	0.31	1.97	0.07	0.97	1.01	1.18
	Total Waterbodies	0.21	1.48	0.26	1.99	0.07	0.50	0.04	0.43	0.01	0.15	0.04	0.72	0.31	1.97	0.07	0.97	1.01	1.18
AGRICULTURE	Crop Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	2.79	0.18	0.21
	Fallow Lands	1.52	10.70	1.95	14.90	0.80	5.67	0.60	6.47	0.17	2.59	0.23	4.15	2.07	13.14	2.19	37.74	9.53	11.12
	Total Agriculture	1.52	10.70	1.95	14.90	0.80	5.67	0.60	6.47	0.17	2.59	0.23	4.15	2.07	13.14	2.37	40.53	9.71	11.33
SETTLEMENTS	Urban Settlement	0.00	0.00	0.00	0.00	0.45	3.19	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.00	0.00	0.46	0.54
	Rural Settlement	0.15	1.06	0.30	2.29	0.24	1.70	0.04	0.43	0.04	0.61	0.03	0.54	0.19	1.21	0.25	3.48	1.24	1.45
	Industrial Settlement	0.21	1.48	0.42	3.21	0.37	2.62	0.25	2.70	0.06	0.91	0.11	1.99	0.03	0.19	0.05	0.84	1.50	1.75
	Total Settlements	0.36	2.54	0.72	5.50	1.06	7.52	0.29	3.13	0.10	1.52	0.14	2.53	0.23	1.46	0.30	4.32	3.20	3.74
	GRAND TOTAL	14.20	100.00	13.09	100.00	14.10	100.00	9.27	100.00	6.58	100.00	5.54	100.00	15.75	100.00	7.18	100.00	85.70	100.00

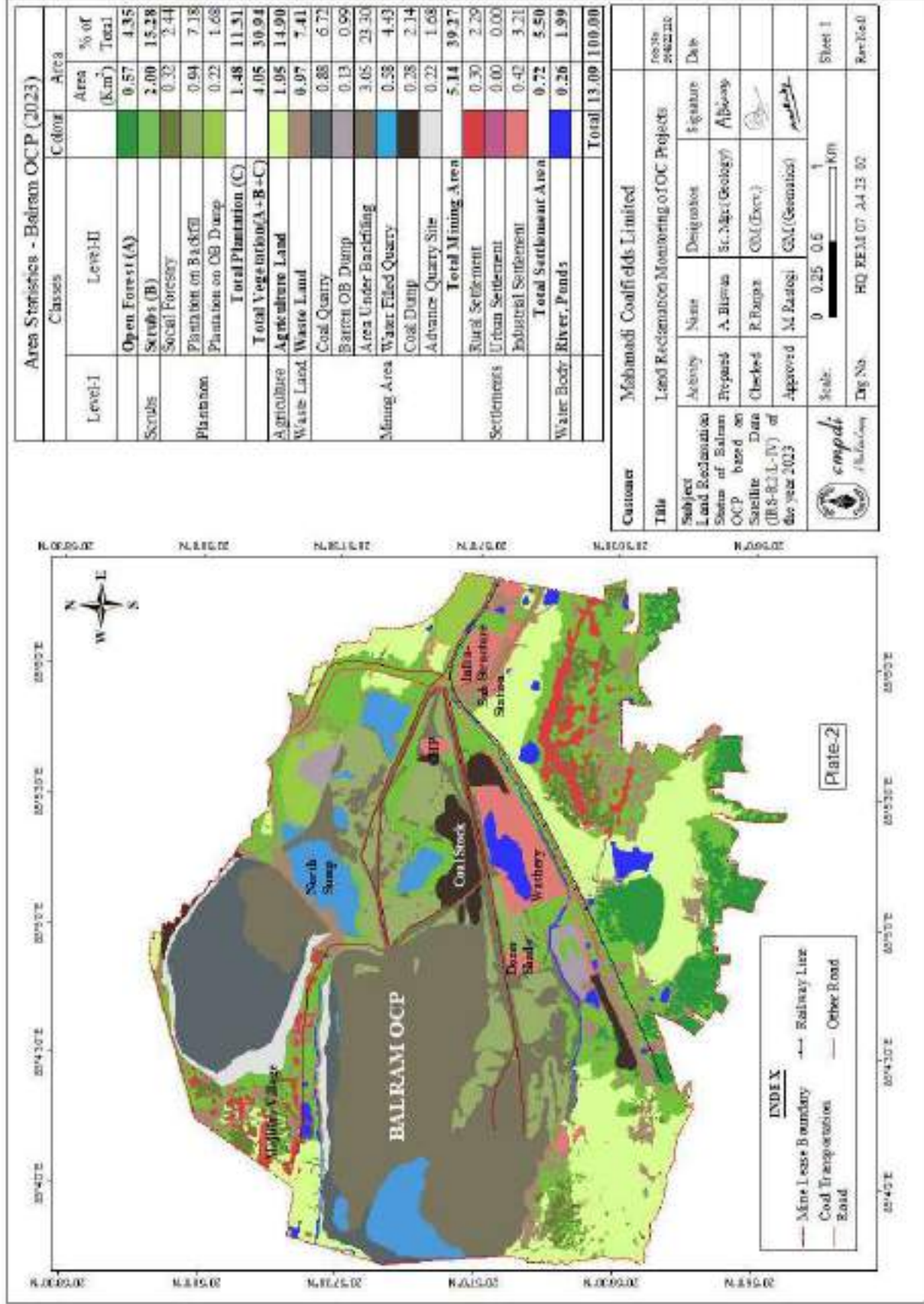
Table 2.2: STATUS OF LAND RESTORATION / RECLAMATION IN MAHANADI COALFIELDS LIMITED BASED ON SATELLITE DATA OF THE YEAR 2023

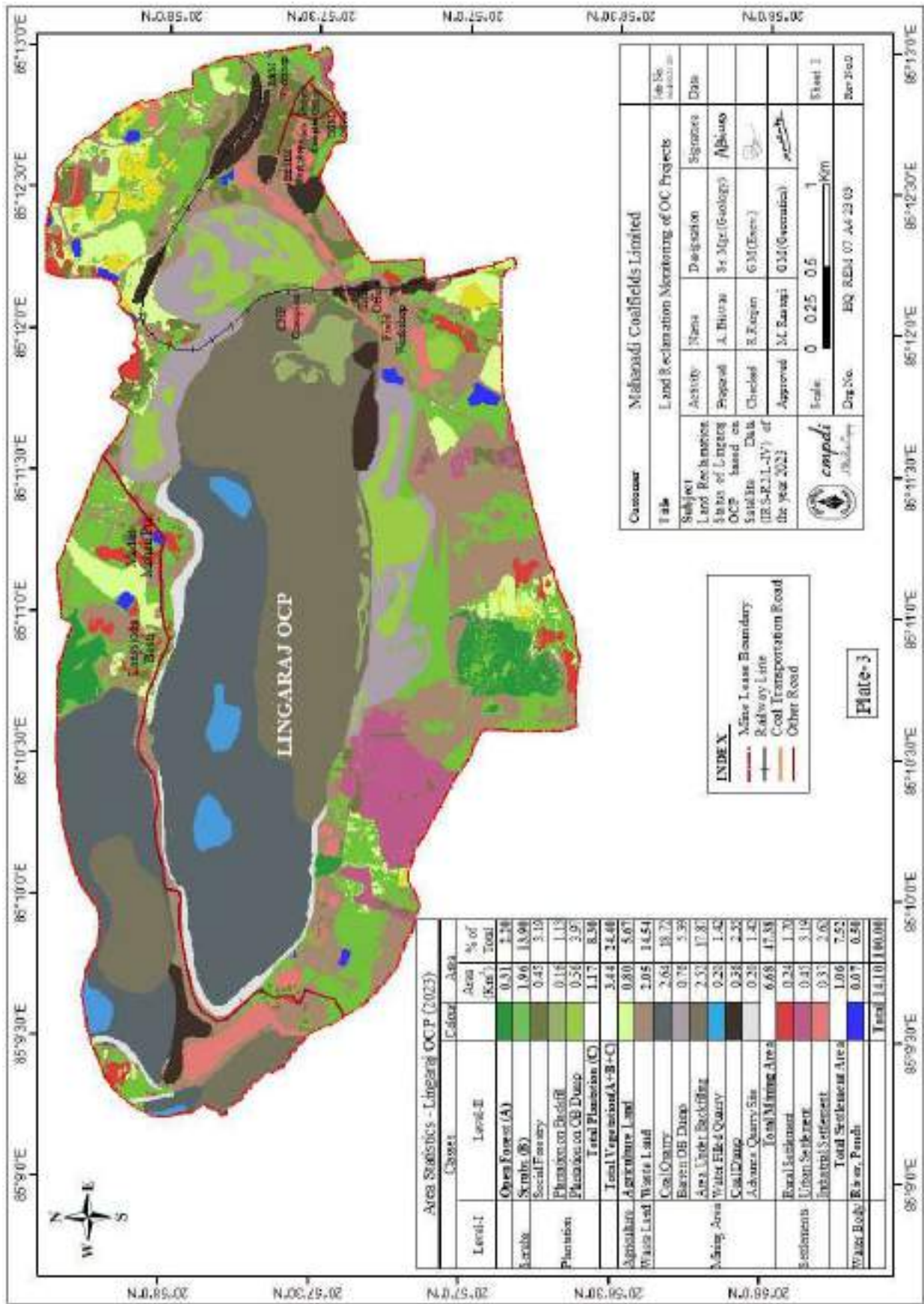
		(Area in Sq. Kms.)																		TOTAL		ALL TOTAL	
FORESTS		BELPAHAR		LAKHANPUR		SAMLESWARI		LAJIPURA		SIARNAL		BASUNDHARA WESTIN		GARJANBAHAL		KILDA							
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Dense Forest		0.00	0.00	1.19	5.31	0.16	1.20	0.48	6.66	0.00	0.00	0.00	0.00	0.18	2.75	0.00	0.00	2.01	2.08	4.02	2.21		
		0.85	5.89	1.90	8.48	0.51	3.82	0.51	7.07	0.87	3.80	0.78	24.15	0.57	8.72	0.04	0.63	6.03	6.25	9.70	5.33		
Total Forest (A)		0.85	5.89	3.09	13.79	0.67	5.02	0.99	13.73	0.87	3.80	0.78	24.15	0.75	11.47	0.04	0.63	8.00	8.34	13.68	7.51		
SCRUBS		2.84	19.67	2.28	10.18	2.36	17.67	0.82	11.37	6.07	26.51	1.35	41.80	0.94	14.37	1.08	17.03	17.74	18.40	27.58	15.14		
		0.50	3.46	0.35	1.56	0.47	3.52	0.16	2.22	0.59	2.58	0.03	0.93	0.02	0.31	0.03	0.47	2.15	2.23	3.83	2.10		
PLANTATION		0.35	2.42	0.59	2.63	0.49	3.67	0.12	1.66	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.16	1.56	1.62	3.05	1.67		
		0.61	4.22	0.99	4.42	0.61	4.57	0.13	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.16	2.35	2.44	7.94	4.36		
Total Plantation (Green Cover) (C)		1.46	10.11	1.93	8.62	1.57	11.76	0.41	5.69	0.59	2.58	0.03	0.93	0.02	0.31	0.05	0.79	6.06	6.29	14.82	8.13		
Total Vegetation (A+B+C)		5.15	35.66	7.30	32.59	4.60	34.45	2.22	30.79	7.53	32.88	2.16	66.87	1.71	26.15	1.17	18.46	31.84	33.02	56.12	30.81		
ACTIVE MINING		0.13	0.90	0.30	1.34	0.21	1.57	0.05	0.69	0.00	0.00	0.00	0.00	0.22	3.36	0.08	1.26	0.99	1.03	2.76	1.52		
		1.04	7.20	3.39	15.13	1.36	10.19	0.91	12.62	0.00	0.00	0.00	0.00	0.71	10.86	1.44	22.71	8.85	9.18	20.69	11.36		
Advance Quarry Site		0.05	0.35	0.84	3.75	0.15	1.12	0.20	2.77	0.00	0.00	0.00	0.00	0.16	2.45	0.08	1.26	1.48	1.54	2.58	1.42		
		0.31	2.15	0.25	1.12	0.13	0.97	0.03	0.42	0.00	0.00	0.00	0.00	0.11	1.68	0.19	3.00	1.02	1.06	4.41	2.42		
Total Area under Active Mining		1.40	9.70	4.48	20.00	1.64	12.28	1.14	15.81	0.00	0.00	0.00	0.00	0.98	14.98	1.71	26.97	11.35	11.77	27.68	15.20		
Barren OB dump		0.30	2.08	0.16	0.71	0.14	1.05	0.51	7.07	0.00	0.00	0.00	0.00	0.46	7.03	0.62	9.78	2.19	2.27	5.48	3.01		
		3.80	26.32	5.26	23.48	3.22	24.11	1.52	21.08	0.00	0.00	0.00	0.00	0.43	6.57	1.17	18.45	15.40	15.97	32.89	18.06		
Area Under Backfilling (Technical Reclamation)		5.63	38.99	10.20	45.54	5.21	39.02	3.22	44.66	0.00	0.00	0.00	0.00	2.09	31.96	3.58	56.47	29.93	30.02	68.81	37.79		
Waste Lands		2.33	16.14	1.20	5.36	1.79	13.41	0.92	12.76	3.82	16.68	0.64	19.81	0.49	7.49	0.69	10.88	11.88	12.32	20.33	11.16		
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.09		
Total Wastelands		2.33	16.14	1.20	5.36	1.79	13.41	0.92	12.76	3.82	16.68	0.64	19.81	0.49	7.49	0.69	10.88	11.88	12.32	20.50	11.26		
Reservoir, nallah, ponds etc.		0.22	1.52	0.25	1.12	0.27	2.02	0.06	0.83	0.21	0.92	0.03	0.93	0.03	0.46	0.13	2.05	1.20	1.24	2.21	1.21		
		0.22	1.52	0.25	1.12	0.27	2.02	0.06	0.83	0.21	0.92	0.03	0.93	0.03	0.46	0.13	2.05	1.20	1.24	2.21	1.21		
Crop Lands		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.54	6.72	0.00	0.00	0.00	0.00	0.15	2.37	1.69	1.75	1.87	1.03		
		0.52	3.60	3.08	13.75	1.07	8.01	0.47	6.52	9.14	39.91	0.38	11.76	2.00	30.58	0.57	8.99	17.23	17.87	26.76	14.69		
Total Agriculture		0.52	3.60	3.08	13.75	1.07	8.01	0.47	6.52	10.68	46.64	0.38	11.76	2.00	30.58	0.72	11.36	18.92	19.62	28.63	15.72		
Urban Settlement		0.02	0.14	0.00	0.00	0.003	0.02	0.08	1.11	0.02	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.13	0.58	0.32		
		0.17	1.18	0.10	0.45	0.19	1.42	0.03	0.42	0.64	2.79	0.02	0.62	0.07	1.07	0.01	0.16	1.23	1.28	2.47	1.36		
Industrial Settlement		0.40	2.77	0.27	1.21	0.22	1.65	0.21	2.91	0.00	0.00	0.00	0.00	0.15	2.29	0.04	0.63	1.29	1.34	2.79	1.53		
		0.59	4.09	0.37	1.65	0.413	3.09	0.32	4.44	0.66	2.88	0.02	0.62	0.22	3.36	0.05	0.79	2.64	2.74	5.84	3.21		
GRAND TOTAL		14.44	100.00	22.40	100.00	13.35	100.00	7.21	100.00	22.90	100.00	3.23	100.00	6.54	100.00	6.34	100.00	96.41	100.00	182.12	100.00		

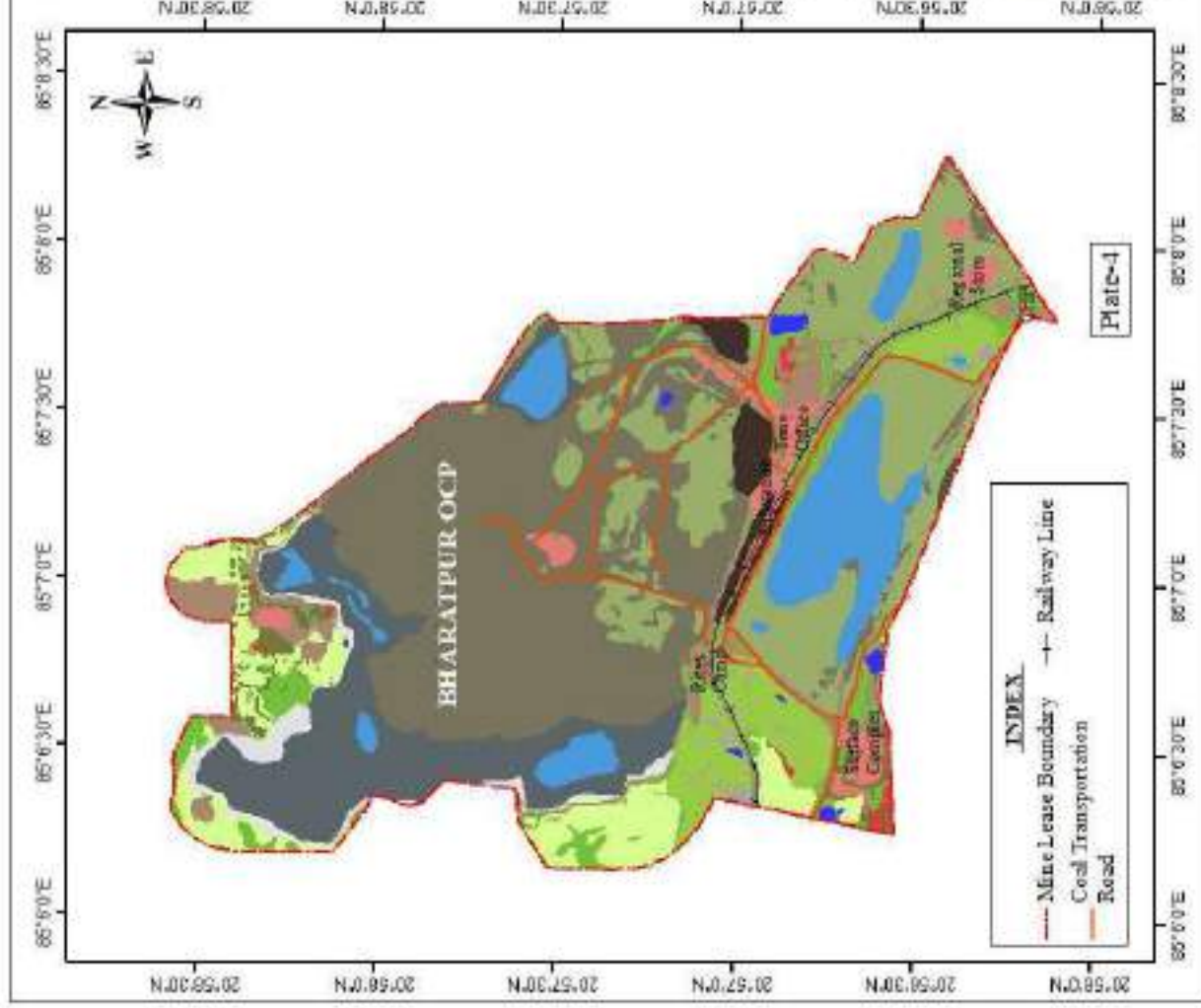


Area Statistics - Ananta OCP (2023)			
Classes		Colour	Area
Level-I	Level-II		% of Total
Forest Area	Dense Forest		1.00 7.04
	Open Forest		1.06 7.46
Total Forest (A)			2.06 14.51
Scrubs	Scrubs (B)		1.55 10.92
	Social Forestry		0.21 1.48
Plantation	Plantation on Backfill		0.07 0.56
	Plantation on OB Dump		0.06 0.56
Total Plantation (C)			1.26 8.87
Total Vegetation(A+B+C)			4.87 34.30
Agriculture	Agriculture Land		1.52 10.70
	Waste Land		1.70 11.97
Coal Quarry	Coal Quarry		1.85 13.03
	Area Under Backfilling		3.18 22.39
Mining Area	Barren OB Dump		0.02 0.14
	Water Filled Quarry		0.18 1.27
Coal Dump	Coal Dump		0.20 1.55
	Advance Quarry Site		0.09 0.63
Total Mining Area			5.54 39.01
Settlements	Rural Settlement		0.13 0.98
	Industrial Settlement		0.21 1.48
Total Settlement Area			0.36 2.54
Water Body	River, Ponds		0.21 1.48
Total			14.20 100.00

Customer: Mahanadi Coalfields Limited	
Title: Land Reclamation Monitoring of OC Projects	SR No: 2022/120
Subject: Land Reclamation	Date: 2022/12/01
Location: Ananta OCP	Signature: [Signature]
Scale: 0: 0.4 0.8 1.6 Km	Date: 2022/12/01
Drawn By: [Name]	Rev No: 0

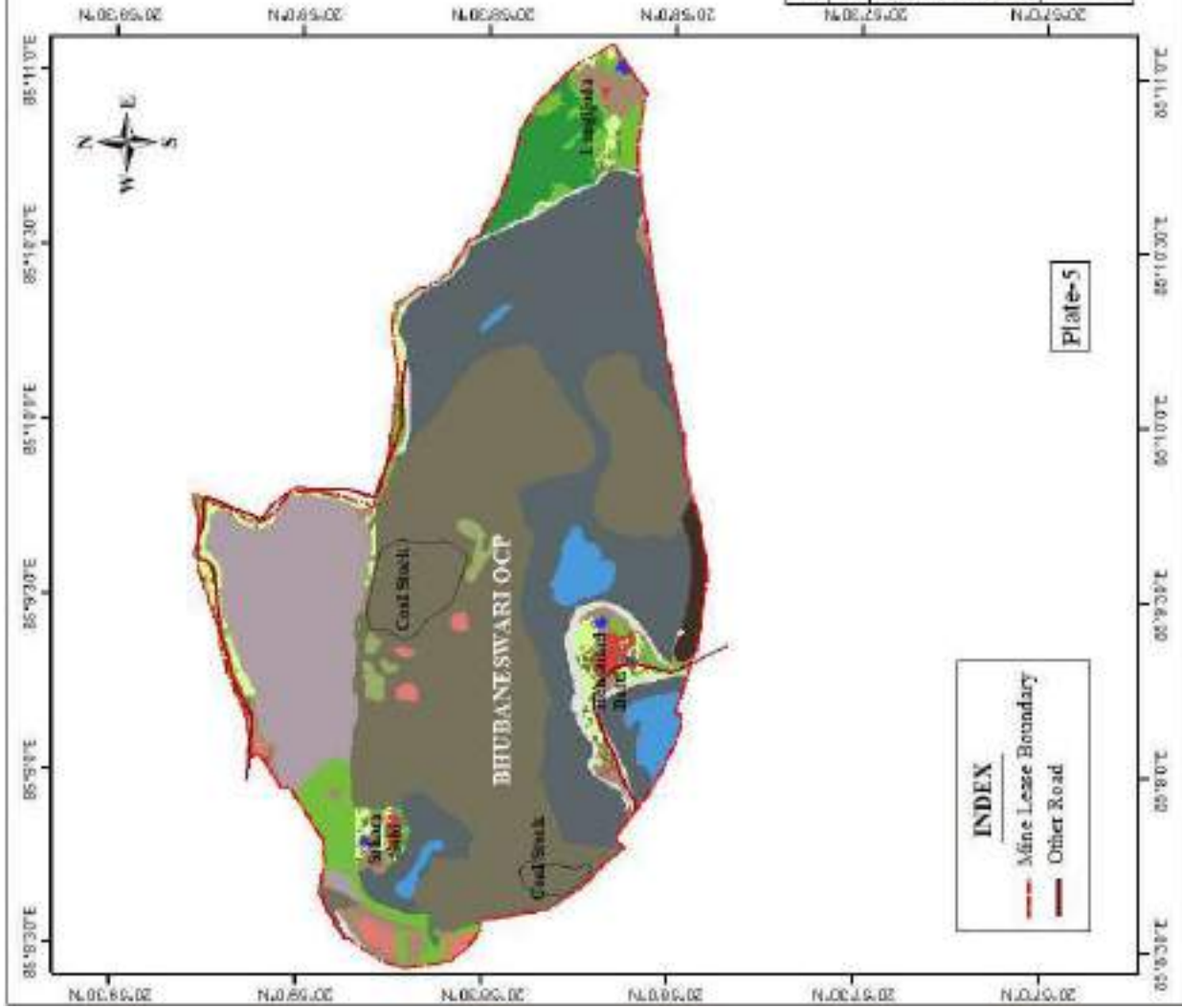






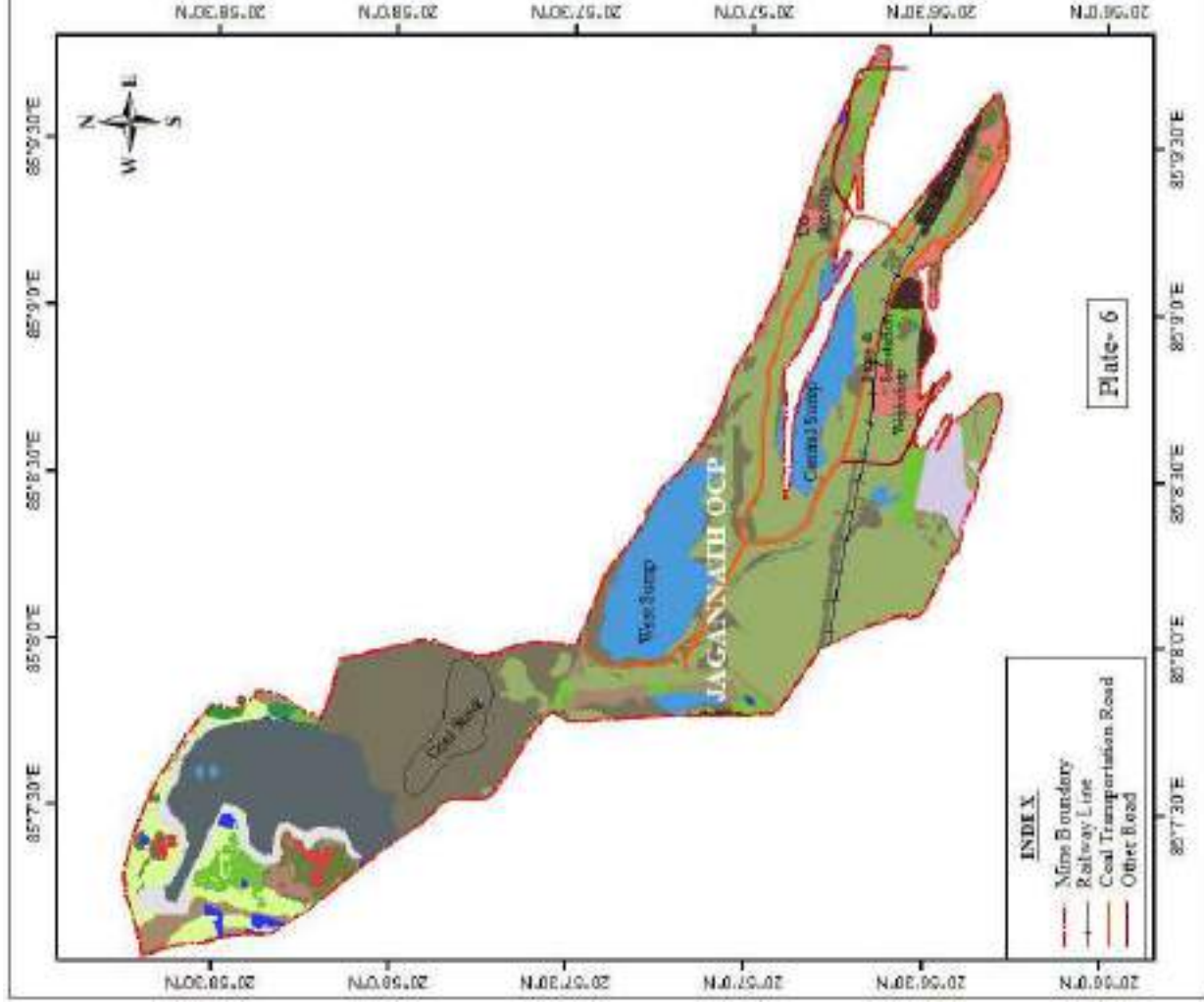
Area Statistics - Bharatpur OCP (2023)			
Classes		Column	Area
Level-I	Level-II		Area (Km ²)
Forest Area	Dense Forest(A)		0.01
	Scrub (B)		0.39
	Social Forestry		0.15
Plantation	Plantation on Backfill		1.63
	Plantation on OB Dump		0.45
	Total Plantation (C)		2.23
Total Vegetation(A+B+C)			2.63
Agriculture	Agriculture Land		0.60
	Waste Land		0.64
	Coal Quarry		1.09
Mining Area	Barren OB Dump		0.05
	Area Under Backfilling		2.83
	Water Filled Quarry		0.76
	Coal Dump		0.18
	Advance Quarry Site		0.16
Total Mining Area			5.07
Settlements	Rural Settlement		0.04
	Industrial Settlement		0.25
	Total Settlement Area		0.29
Water Body	River, Ponds		0.04
	Total		9.27

Customer		Mahanaadi Coalfields Limited				
Title		Land Reclamation Monitoring of OC Projects				
Subject Land Reclamation of Bharatpur OCP based on Satellite Data (IRS-R2/L-IV) of the year 2023	Activity	Name	Designation	Signature	Date	
	Prepared	A. Sharma	Sr. Mgr.(Geology)	A. Sharma		
	Checked	R. Rajan	GM (Ex-ct)			
	Approved	M. Rajan	GM (Geology)			
Scale		0	0.3	0.6	1.2	Sheet 1
						Rev No.0
Drg No.		HQ REM/07-A4/23/04				
						



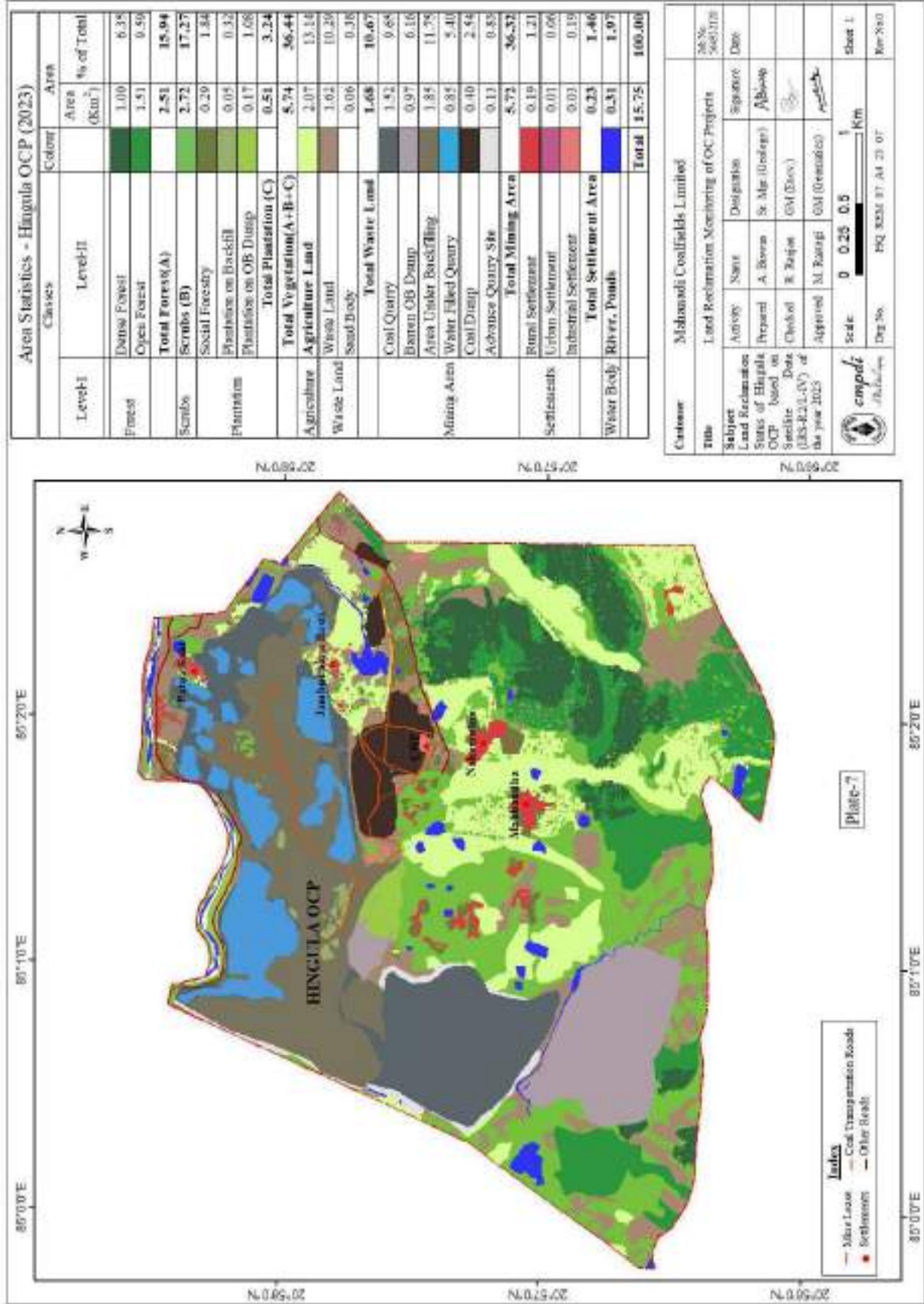
Area Statistics - Bhubaneswari OCP (2023)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
Scrubs	Open Forest (A)		0.20	3.04
	Scrubs (B)		0.33	5.02
	Social Forestry		0.06	0.91
Plantation	Plantation on Backfill		0.06	0.91
	Plantation on OB Dump		0.01	0.08
	Total Plantation (C)		0.13	1.90
Total Vegetation (A+B+C)			0.66	9.96
Agriculture Land	Waste Land		0.17	2.59
	Coal Quarry		1.80	27.38
	Barren OB Dump		0.81	12.32
Mining Area	Area Under Backfilling		2.45	37.26
	Water Filled Quarry		0.18	2.74
	Coal Dump		0.06	0.91
Settlements	Advance Quarry Site		0.13	1.98
	Total Mining Area		5.43	82.59
	Rural Settlement		0.04	0.61
Water Body	Industrial Settlement		0.06	0.91
	Total Settlement Area		0.10	1.52
	River, Ponds		0.01	0.15
Total			6.58	100.00

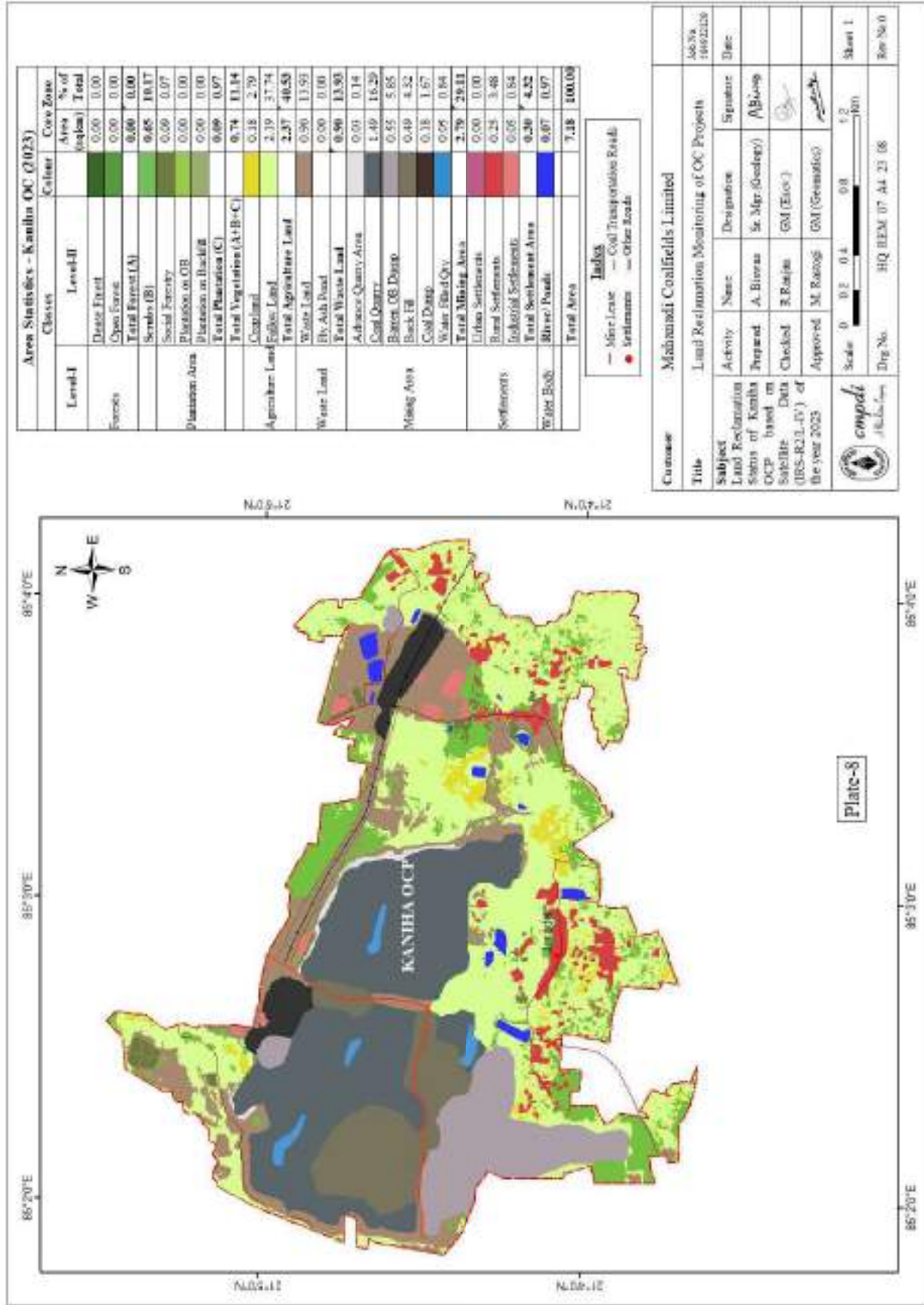
Customer: Mahansadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects			
Subject	Activity	Name	Designation	Signature
Land Reclamation Status of Bhubaneswari OCP based on Satellite Data (RS-R3 L-IV) of the year 2023	Prepared	A. Banas	Sr. Mgr. (Geology)	A. Banas
	Checked	R. Raju	GM (Exec.)	R. Raju
	Approved	M. Ranjith	GM (Geomatics)	M. Ranjith
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Dwg No. HQ HEAD 07 Jul 23 05		Sheet 1		
KMS-2023-05		Rev: 01		

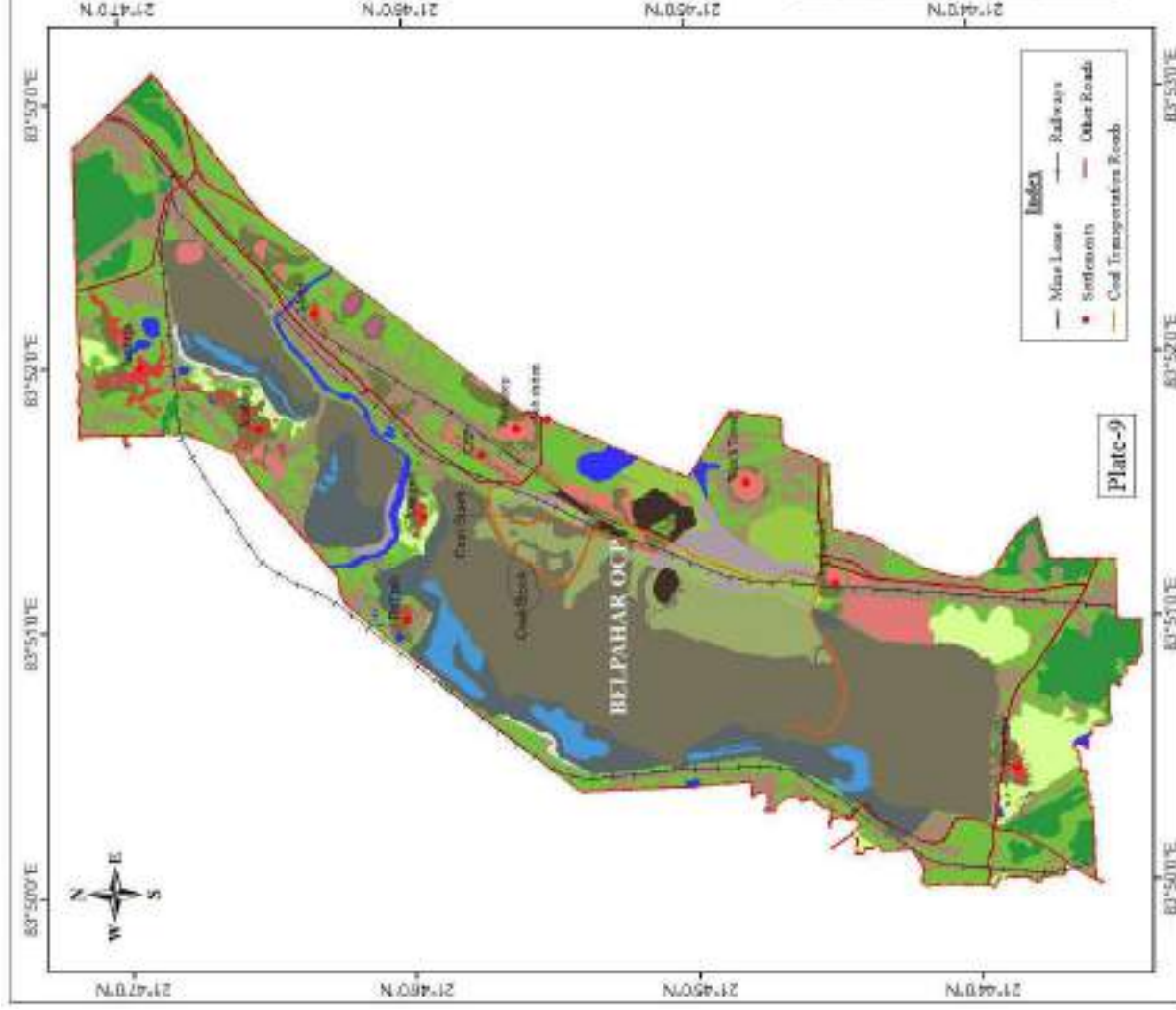


Area Statistics - Jagannath OCP (2023)			
Classes		Colour	Area
Level-I	Level-II		% of Total
	Open Forest (A)		0.02
Scrubs	Scrubs (B)		0.24
	Social Forestry		0.11
Plantation	Plantation on Backfill		1.78
	Total Plantation (C)		1.89
	Total Vegetation (A+B+C)		2.15
Agriculture	Agriculture Land		0.23
Waste Land	Waste Land		0.36
	Ash Pond		0.11
	Total Waste Land		0.47
	Coal Quarry		0.58
	Area Under Backfilling		1.11
Mining Area	Water Filled Quarry		0.59
	Coal Dump		0.09
	Advance Quarry Site		0.14
	Total Mining Area		2.51
	Rural		0.03
Settlement	Industrial		0.11
	Total Settlement Area		0.14
Water Body	River, Ponds		0.04
	Total		5.54
			100.00

Customer	Mahanadi Coalfields Limited			
Title	Land Reclamation Monitoring of OC Projects			
Subject	Activity	Name	Designation	Signature
Land Reclamation	Prepared	A. Bhowik	Sr. Supt.(Geology)	ABhowik
Status of	Checked	P. Ranjan	GM (Exec.)	
Jagannath OCP	Approved	M. Bhatnagar	GM (Operations)	
based on Satellite				
Data (IRS-E27L-IV) of the year				
2023				
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Sheet 1		Rev No: 0		

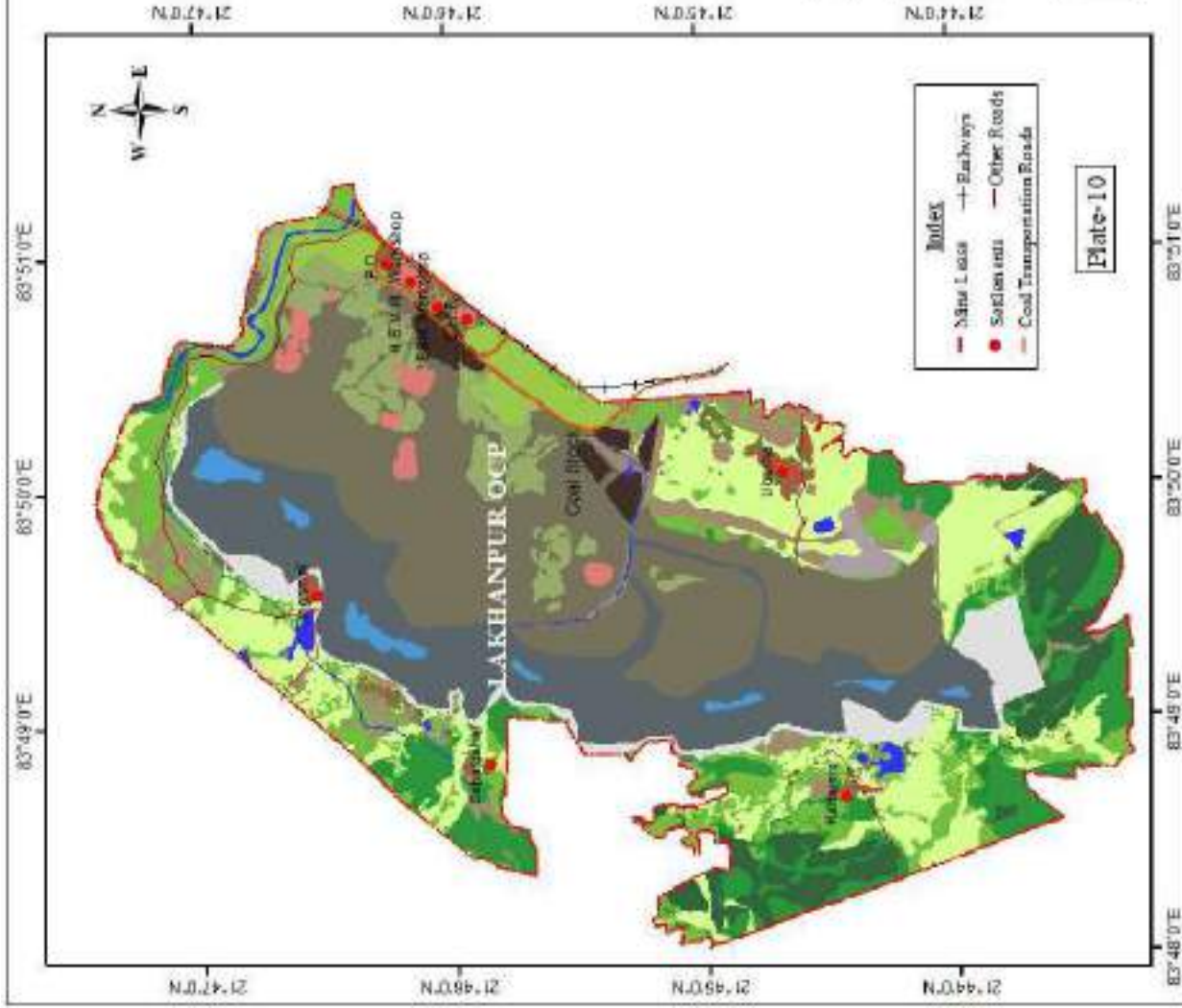






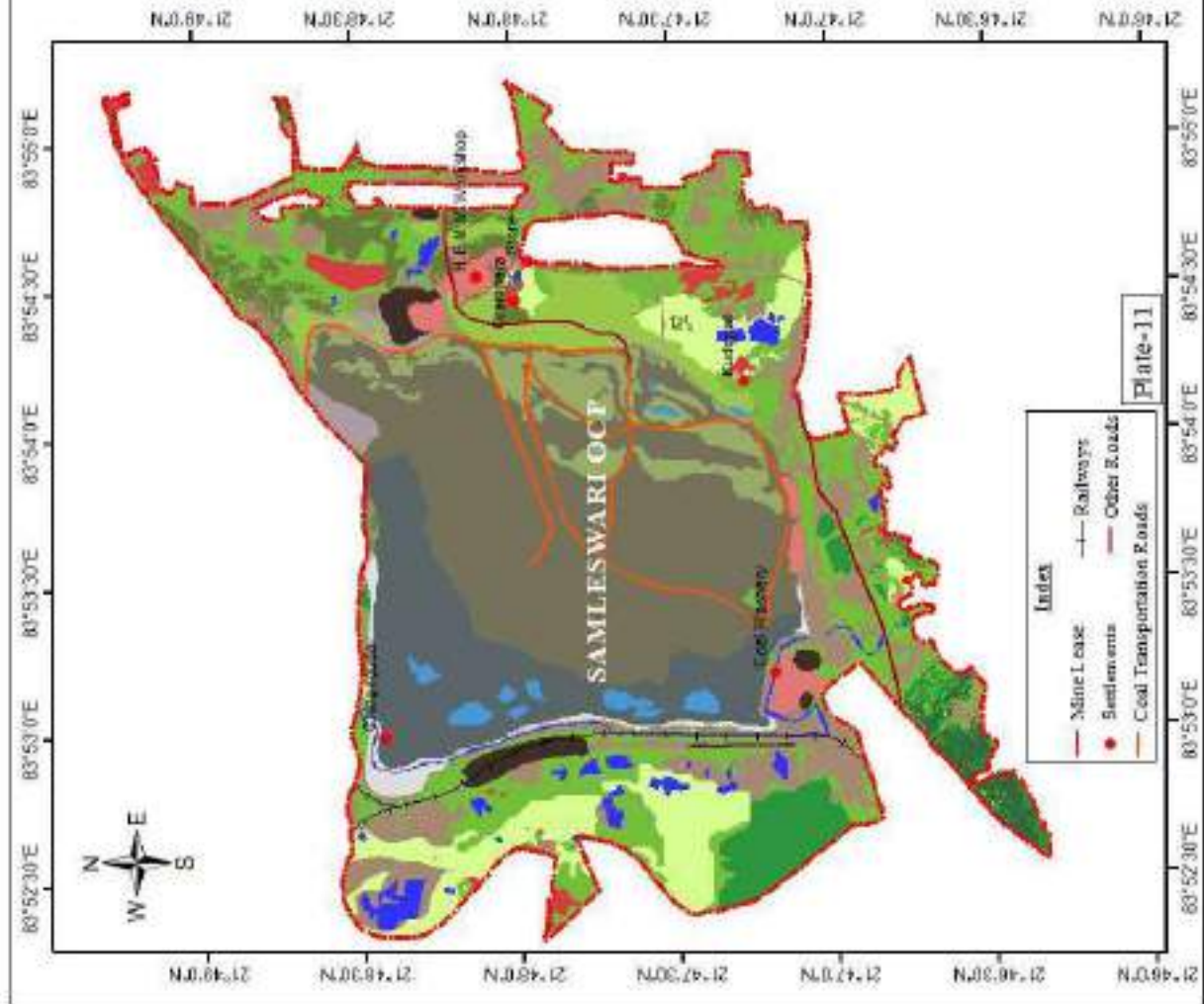
Area Statistics - Belpahar OCP (2023)				
Classes		Cobut	Area	% of Total
Leveld	Leveld		(Km ²)	
Forest Savris	Open Forest(A)		0.85	5.89
	Scrubs (B)		2.84	19.67
	Social Forestry		0.50	3.46
	Plantation on Backfill Plantation on OB Dump		0.61 0.35	4.22 2.42
	Total Plantation (C)		1.46	10.11
	Total Vegetation(A+B+C)		5.15	35.66
Agriculture Waste Land	Agriculture Land		0.52	3.60
	Waste Land		2.33	16.14
	Coal Quarry		1.04	7.20
	Barren OB Dump		0.40	2.86
Mining Area	Area Under Backfilling		3.89	26.32
	Water Filled Quarry		0.31	2.15
	Coal Dump		0.13	0.90
	Advance Quarry Site		0.05	0.35
	Total Mining Area		5.63	38.99
Settlements	Rural Settlement		0.17	1.18
	Urban Settlement		0.02	0.14
	Industrial Settlement		0.40	2.77
	Total Settlement Area		0.59	4.09
Water Body	River, Ponds		0.22	1.52
	Total		14.44	100.00

Customer		Mubamudi Coalfields Limited				Job No. 54402113
Title		Land Reclamation Monitoring of OC Projects				Date
Subject	Activity	Name	Description	Signature		
Land Reclamation	Prepared	A. Bivas	Asst. Mgr (Geology)	ABivas		
Status of Borehole	Checked	R. Raju	GM (Exec.)			
OCF based on Satellite Data (IRS-P2A, L-IV) of the year 2023	Approved	M. Ravi	GM (Communications)			
		Scale: 0	0.5	1	2	Sheet 1
		Deg. No. HQ REM. 07 A4 23 00				Rev No.0



Area Statistics - Lakhampur OCP (2023)				
Classes		Colour	Area	% of Total
Level-I	Level-II		(Km ²)	
Forest Area	Dense Forest		1.19	5.31
	Open Forest		1.90	8.48
Total Forest Area (A)			3.09	13.79
Scrubs	Scrubs (B)		2.28	10.18
	Social Forestry		0.35	1.56
Plantation	Plantation on Backfill		0.99	4.42
	Plantation on OB Dump		0.59	2.63
Total Plantation (C)			1.53	6.62
Total Vegetation (A+B+C)			7.30	32.59
Agriculture	Agriculture Land		3.08	13.75
	Waste Land		1.10	5.16
	Coal Quarry		3.39	15.13
	Barren OB Dump		0.16	0.71
Mining Area	Area Under Backfilling		5.26	23.48
	Water Filled Quarry		0.25	1.12
	Coal Dump		0.30	1.34
	Advance Quarry Site		0.84	3.75
Total Mining Area			10.10	45.54
Settlements	Rural Settlement		0.10	0.45
	Industrial Settlement		0.27	1.21
Total Settlement Area			0.37	1.65
Water Body	River, Ponds		0.15	1.12
Total			22.40	100.00

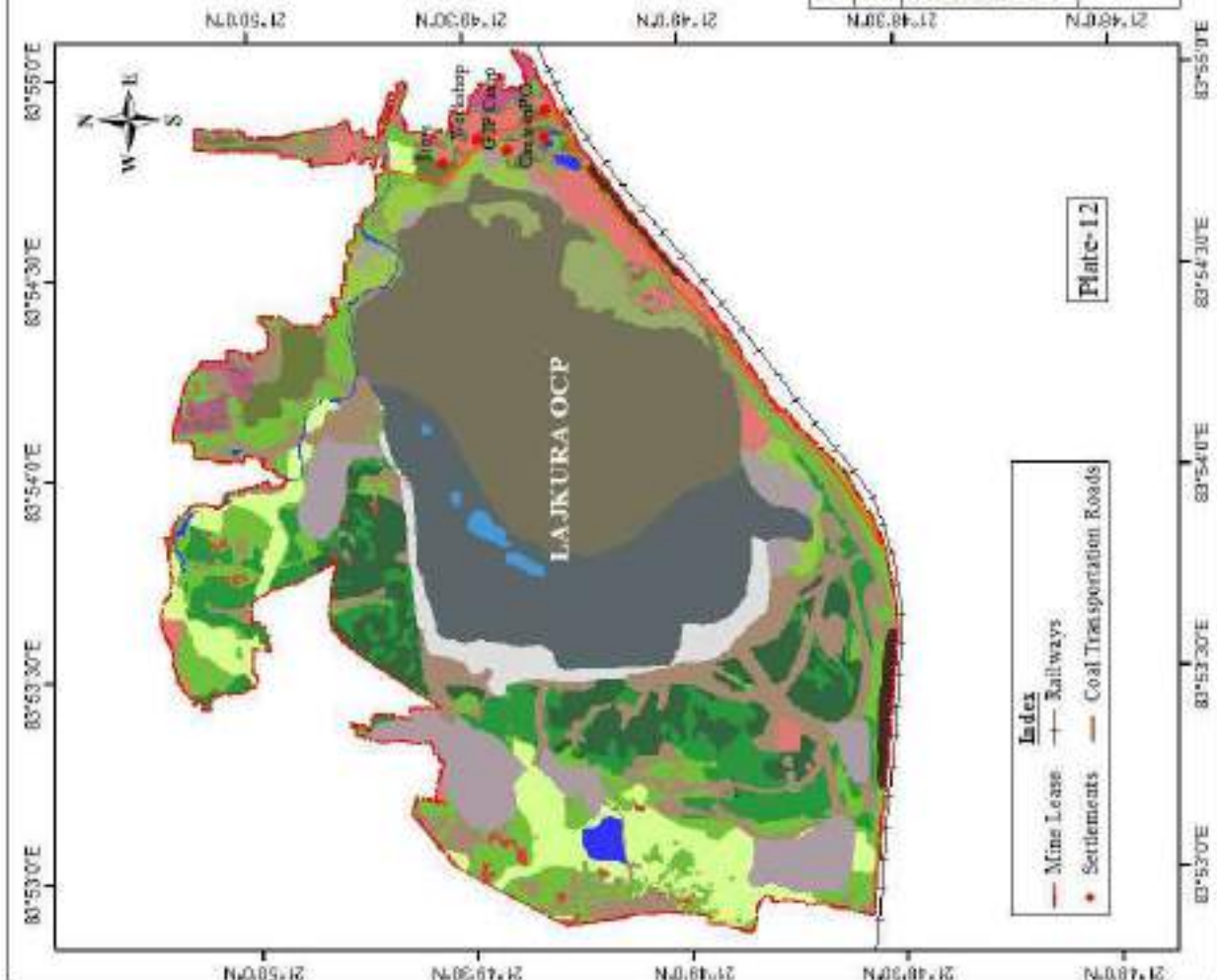
Customer		Mahanadi Coalfields Limited			
Title		Land Reclamation Monitoring of OC Projects			
Subject Land Reclamation of Lakhampur OCP Based on Satellite Data (IRS, R2A, L1V) of the year 2023	Activity	Name	Designation	Signature	Date
	Prepared	A. Bora	3rd Agr. (Geology)	A. Bora	
	Checked	B. Banjan	GM (Envy)		
	Approved	M. Banjan	GM (Operations)		
	Scale:	0	0.25	0.75	1.5
Job No.		HQ/REM/07		Sheet 1	
Rev. No.		Rev. No. 0		Rev. No. 0	



Area Statistics - Samleswari OCP (2023)				
Classes		Color	Area	% of Total
Level-II	Level-I		(Hect)	
Forest Area	Dense Forest		0.18	1.29
	Open Forest		0.51	3.82
	Total Forest Area (A)		0.67	5.02
Scrubs	Scrubs (B)		2.36	17.67
	Social Forestry		0.47	3.52
	Total Scrub Area (B)		2.83	21.19
Plantation	Plantation on Backfill		0.61	4.57
	Plantation on OB Dump		0.49	3.67
	Total Plantation (C)		1.10	8.24
	Total Vegetation (A+B+C)		4.60	34.45
Agriculture	Agriculture Land		1.07	8.01
Waste Land	Waste Land		1.79	13.41
	Coal Quarry		1.36	10.19
	Barren OB Dump		0.14	1.05
	Total Waste Land (D)		3.29	24.65
Mining Area	Water Filled Quarry		0.13	0.97
	Coal Dump		0.21	1.57
	Advance Quarry Site		0.15	1.12
	Total Mining Area (E)		0.49	3.66
Settlements	Urban Settlement		0.03	0.22
	Rural Settlement		0.10	0.75
	Industrial Settlement		0.22	1.65
	Total Settlement Area (F)		0.35	2.62
Water Body	River, Ponds		0.27	2.02
	Total		13.35	100.00

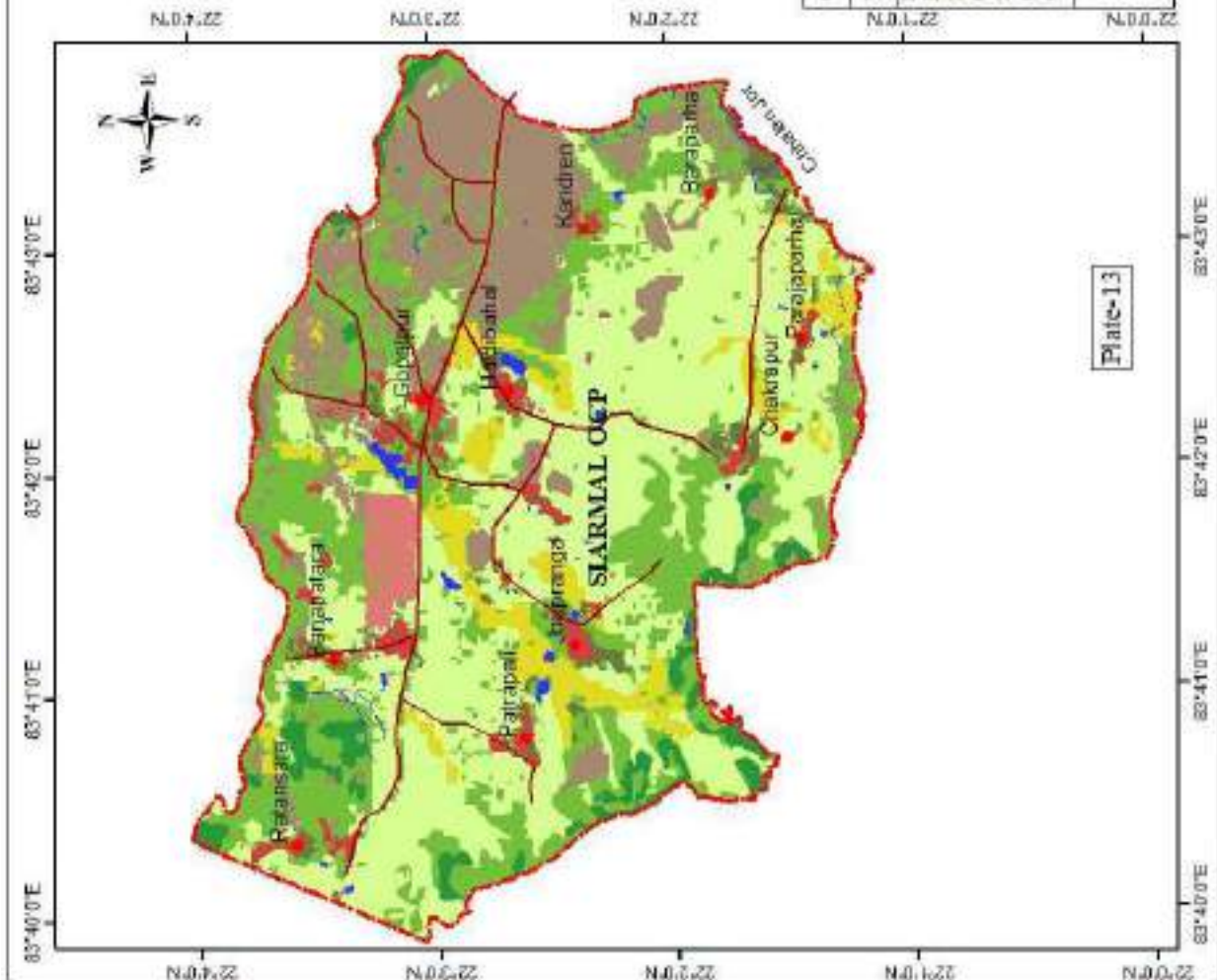
Company: Mahanadi Coalfields Limited

Title: Land Reclamation Monitoring of OC Projects					Doc No. 564922120
Subject Land	Reclamation	Activity	Name	Designation	Signature
Status of Samleswari OCP based on Satellite Data (IRS P2A.L-3V) of Dec 2023.		Prepared	A. Bhanu	GM (Ecology)	A. Bhanu
		Checked	S. Rajan	GM (Ecology)	S. Rajan
		Approved	M. Ramani	GM (Operations)	M. Ramani
Scale: 0 0.375 0.75 1.5 Km					Sheet 1 of 1
Date: 07.04.23					Rev: 0.0



Area Statistics - Lajkura OCP (2023)				
Classes		Colour Area		
Level-I	Level-II		Area (Km ²)	% of Total
Forest Area	Dense Forest		0.48	6.66
	Open Forest		0.51	7.07
Total Forest Area (A)			0.99	13.73
Scrubs	Scrubs (B)		0.82	11.37
	Social Forestry		0.16	2.22
Plantation	Plantation on Backfill		0.13	1.89
	Plantation on OB Dump		0.12	1.66
Total Plantation (C)			0.41	5.69
Total Vegetation (A+B+C)			2.22	30.79
Agriculture	Agriculture Land		0.47	6.52
	Waste Land		0.92	12.76
Coal Quarry	Coal Quarry		0.91	12.62
	Barren OB Dump		0.51	7.07
Mining Area	Area Under Backfilling		1.52	21.08
	Water Filled Quarry		0.03	0.42
Coal Dump	Coal Dump		0.05	0.69
	Advance Quarry Site		0.20	2.77
Total Mining Area			3.22	44.66
Settlement	Urban Settlement		0.08	1.11
	Rural Settlement		0.03	0.42
Industrial	Industrial		0.21	2.91
	Total Settlement Area		0.32	4.44
Water Body	River, Ponds		0.06	0.83
	Total		7.21	100.00

Customer	Maharadi Coalfields Limited			
Title	Land Reclamation Monitoring of OC Projects			
Subject	Activity	Name	Designation	Signature
Land Reclamation	Prepared	A. Bhaswa	Sr. Nig. (Geology)	A. Bhaswa
Status of Lajkura OCP based on	Checked	R. Ranjan	GM (Exec.)	R. Ranjan
Satellite Data (IRS-R2A/L-4V) of the year 2023	Approved	M. Rastogi	GM (Operations)	M. Rastogi
	Scale:	0 0.3 0.6 1.2		Sheet 1
	Deg No.	HQ REM 07 A4 23 12		Rev No.0



Area Statistics - Siamal OCP (2023)				
Classes		Colour	Area	% of Total
Level-I	Level-II		(Km ²)	
	Open Forest		0.87	3.80
Scrubs	Scrubs		6.07	26.51
Plantation	Social Forestry		0.59	2.58
	Total Vegetation Cover		7.53	32.88
Agriculture	Fallow Land		9.14	39.91
	Crop Land		1.54	6.72
	Total Agriculture Land		10.68	46.64
Waste Land	Waste Land		3.92	16.68
Settlement	Rural Settlement		0.64	2.79
	Urban settlement		0.02	0.09
	Total Settlement Area		0.66	2.88
Water Body	River, Ponds		0.21	0.92
	Total		22.90	100.00

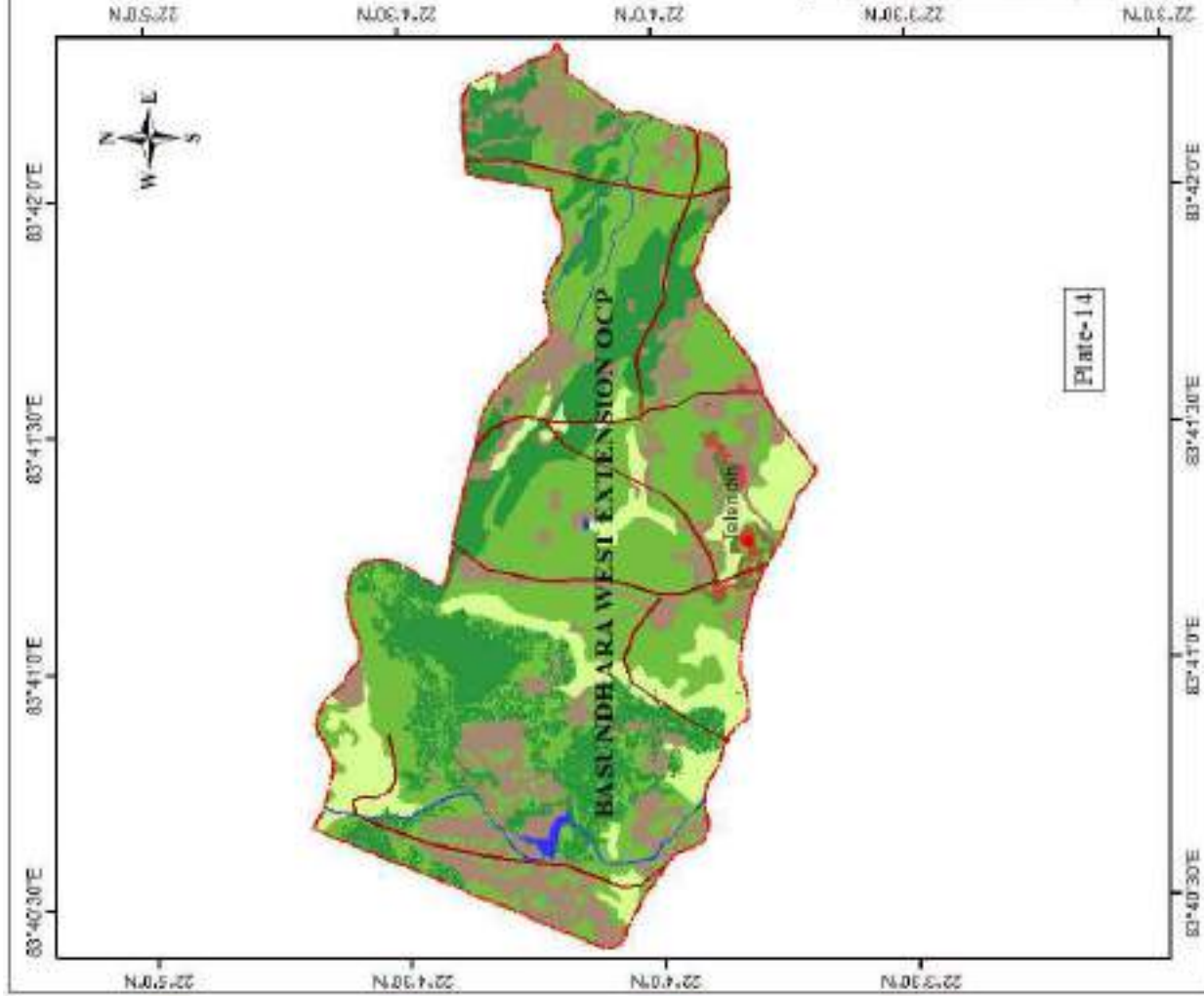
Index

Mine Lease — Roads

• Settlements

Customer	Maharadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				
Subject	Activity	Name	Designation	Signature	Date
Land Reclamation Status of Siamal OCP based on Satellite Data (IRS-R2A/L-IV) of the year 2023	Prepared	A. Biswas	Sr. Mgr (Geology)	A. Biswas	
	Checked	R. Ranjan	DM (Exec.)		
	Approved	M. Rastogi	GM (Geomatics)		
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	Dep. No.	HQ REM 07 A4 13 13			Bar No 0

Plate-13

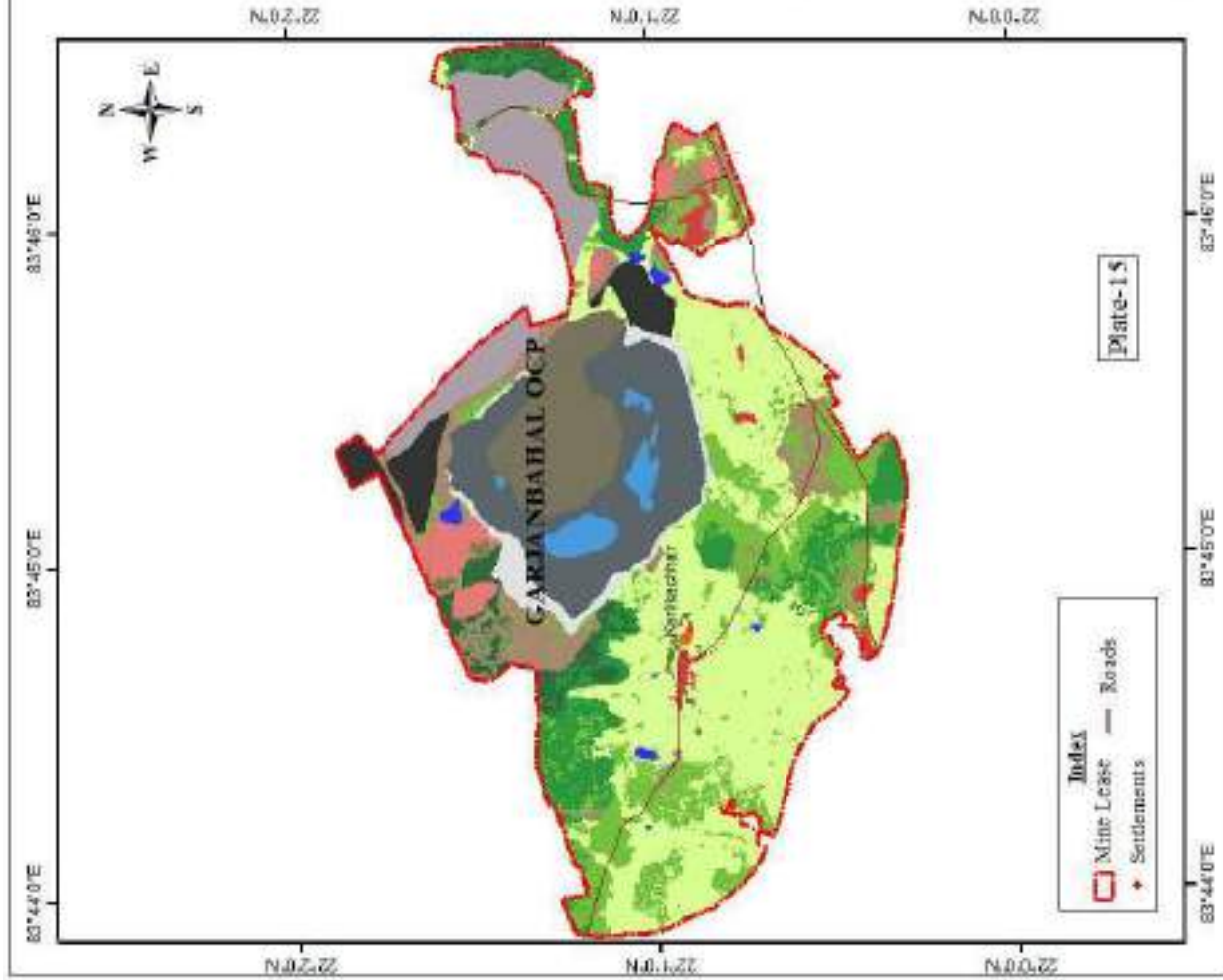


Area Statistics - Basundhara West Extn. OCP (2023)

Classes		Colour	Area	
Level-I	Level-II		Area (Km ²)	% of Total
	Open Forest		0.78	24.15
Scrubs	Scrubs		1.35	41.80
Plantation	Social Forestry		0.03	0.93
Total Vegetation Cover			2.16	66.87
Agriculture	Fallow Land		0.38	11.76
Waste Land	Waste Land		0.64	19.81
Settlement	Rural Settlement		0.02	0.62
Water Body	River, Ponds		0.03	0.93
Total			3.23	100.00

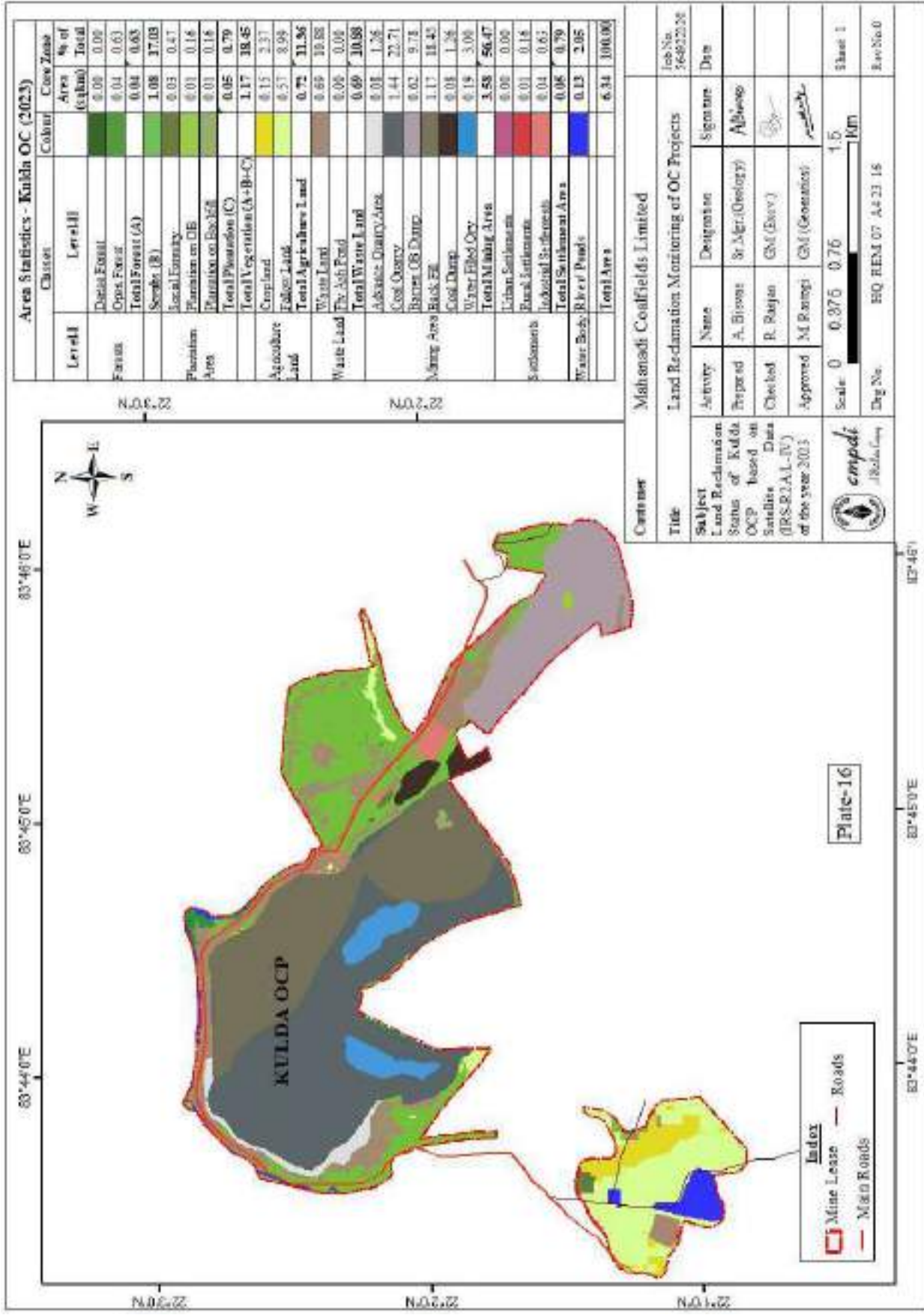


Customer	Maharishi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				
Subject	Activity	Name	Designation	Signature	Date
Land Reclamation of Basundhara West Extn. OCP based on Satellite Data (IRS-RZAT-IV) of the year 2023	Prepared	A. Biswas	Sr Mgr./Geology	Abhishek	
	Checked	P. Barua	GM (Env.)		
	Approved	M. Pasagi	GM (Geomatics)		
 cmpdi Coalfields Monitoring & Planning Division	Scale: 0 0.275 0.55 1.1 Km		Sheet 1		
	Dwg No. HQ/REM/07/A4/23/14		Rev No. 0		



Area Statistics - Gariabahal OCP (2023)				
Classes		Color	Area	% of Total
Level-I	Level-II		(Km ²)	
Forest Area	Dense Forest		0.18	2.72
	Open Forest		0.57	8.72
Total Forest Area (A)			0.75	11.47
Scrub	Scrub (B)		0.94	14.37
	Social Forestry		0.02	0.31
Plantation	Plantation on Backfill		0.00	0.00
	Plantation on OB Dump		0.00	0.00
Total Plantation (C)			0.02	0.31
Total Vegetation (A+B+C)			1.71	26.15
Agriculture	Agriculture Land		2.00	30.58
Waste Land	Waste Land		0.49	7.49
Mining Area	Coal Quarry		0.71	10.82
	Barren OB Dump		0.46	7.03
Mining Area	Area Under Backfilling		0.43	6.57
	Water Filled Quarry		0.11	1.68
Coal Dump	Coal Dump		0.22	3.36
	Advance Quarry Site		0.16	2.45
Total Mining Area			2.09	31.96
Settlements	Rural Settlement		0.07	1.07
	Industrial Settlement		0.15	2.29
Total Settlement Area			0.22	3.36
Water Body	River, Ponds		0.03	0.46
Total			6.54	100.00

Customer		Mahanadi Coalfields Limited			
Title		Land Reclamation Monitoring of OC Projects			
Subject Land Reclamation Status Gariabahal OCP based on Satellite Data (RS-R2A L- V) of the year 2023	Activity	Name	Description	Signature	Date
	Prepared	A. Biswas	Sr. Mgr. (Geology)	A. Biswas	
	Checked	R. Banjan	GM (Exec)		
	Approved	M. Rautogi	GM (Geomatics)		
Scale		0	0.375	0.75	1.5
		Km			
Sheet 1					
Rev No. 0					
Job No. 564922120					



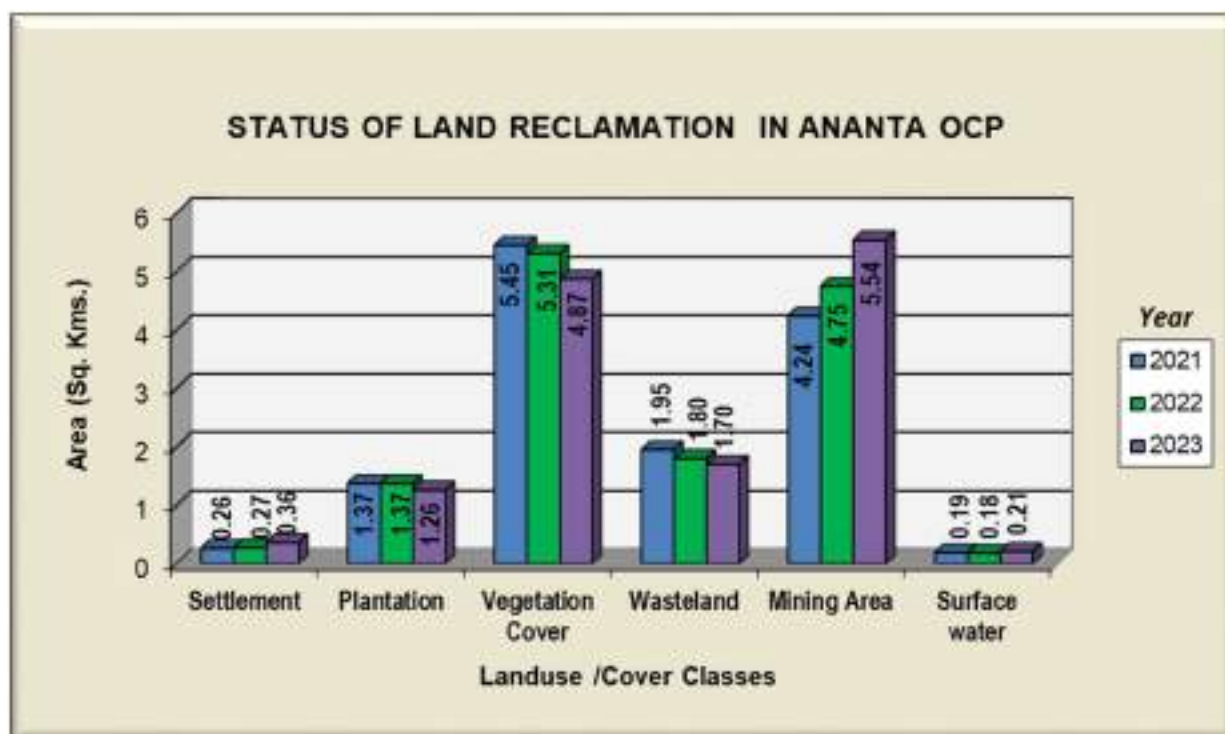


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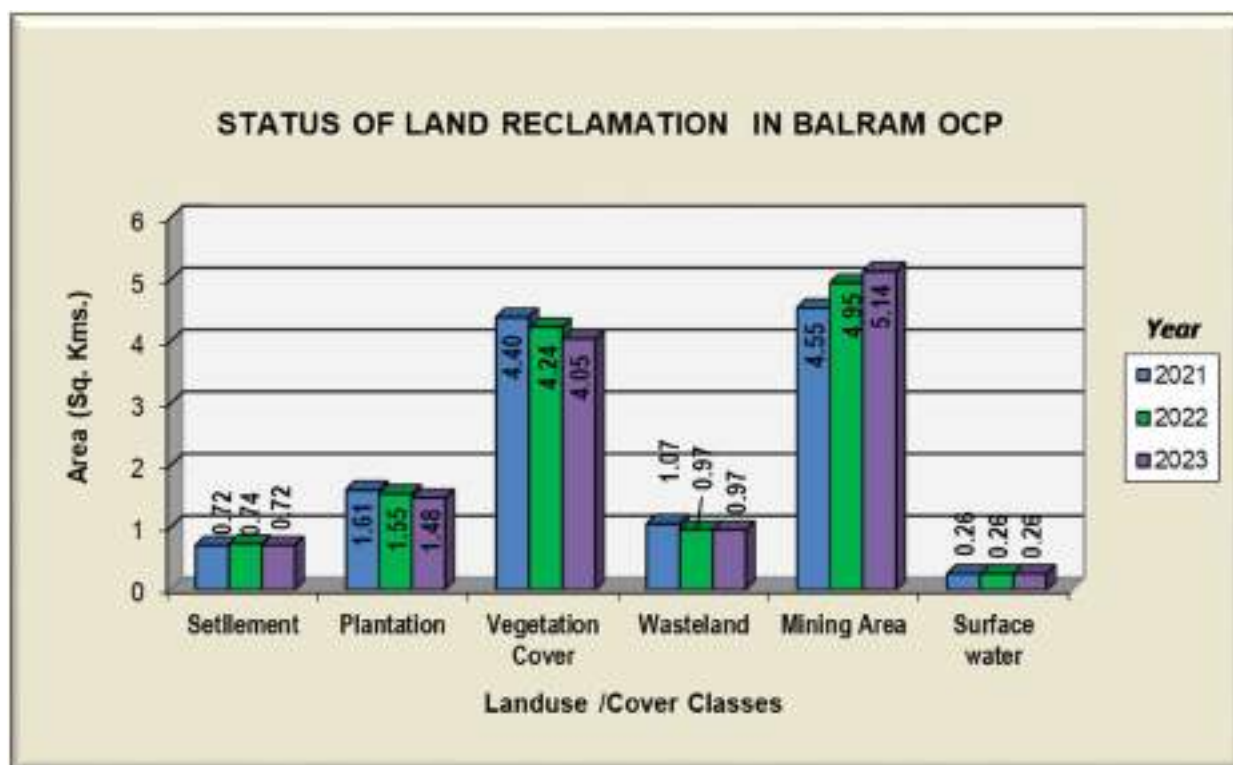


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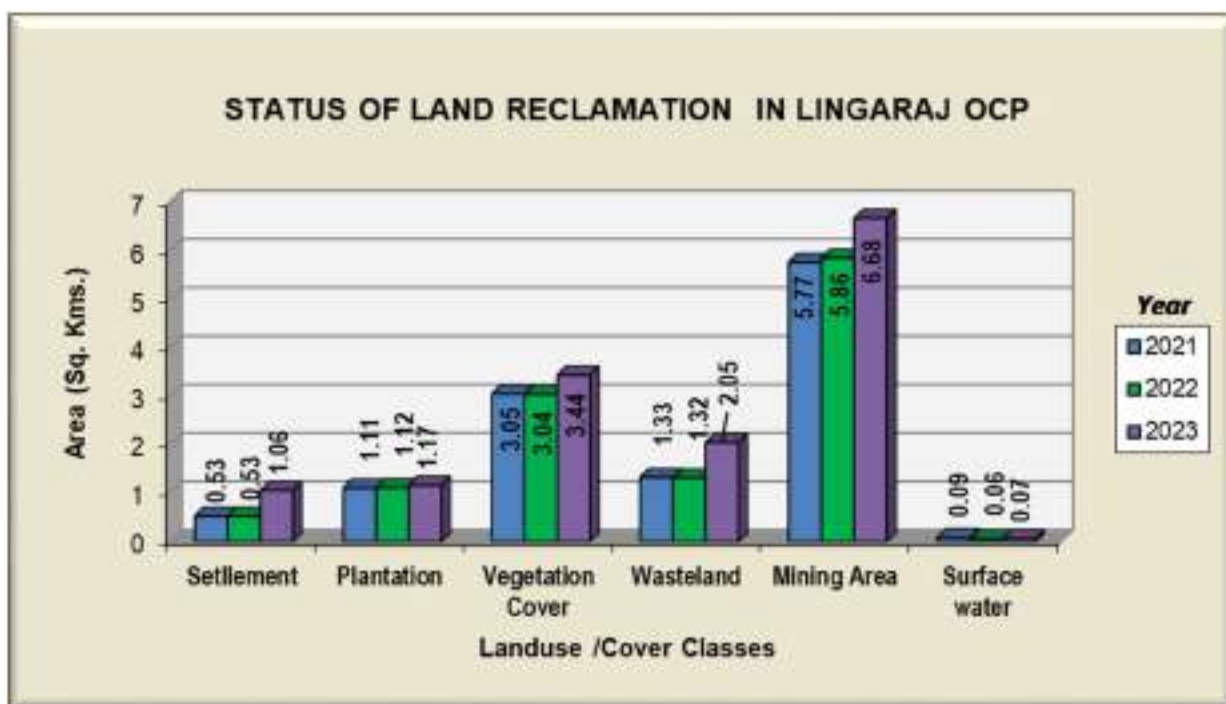


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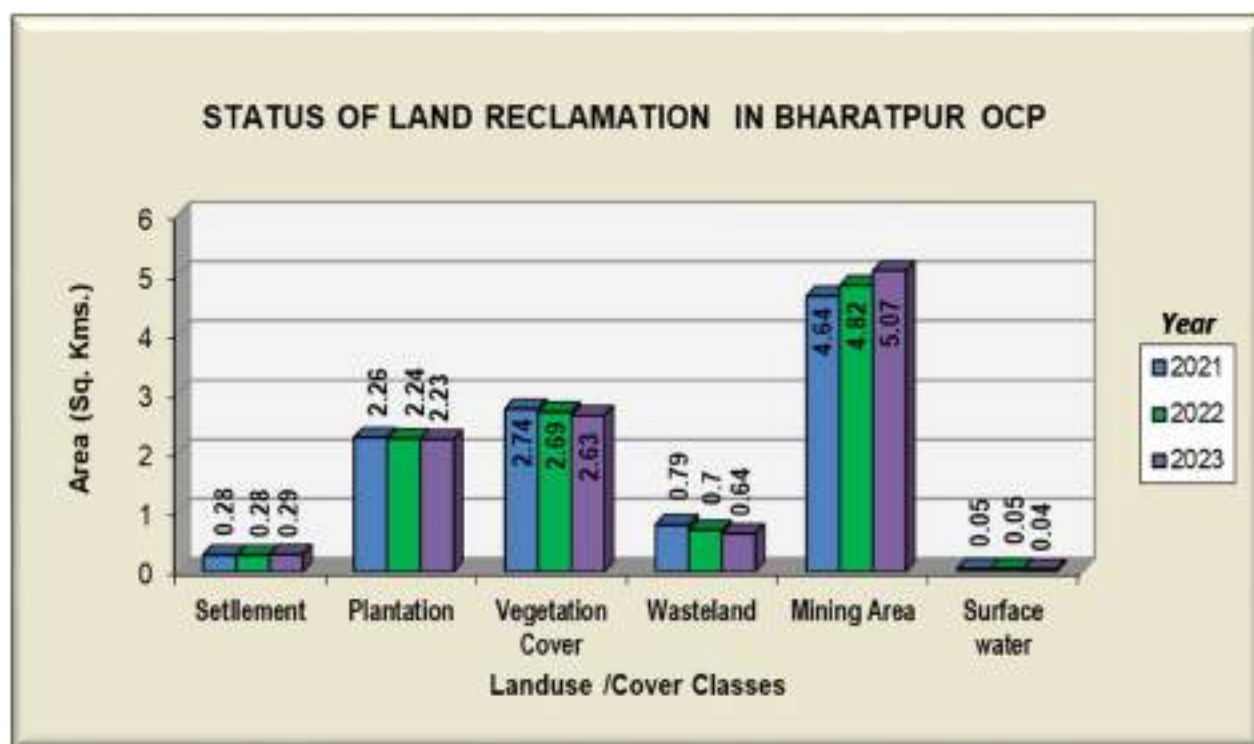


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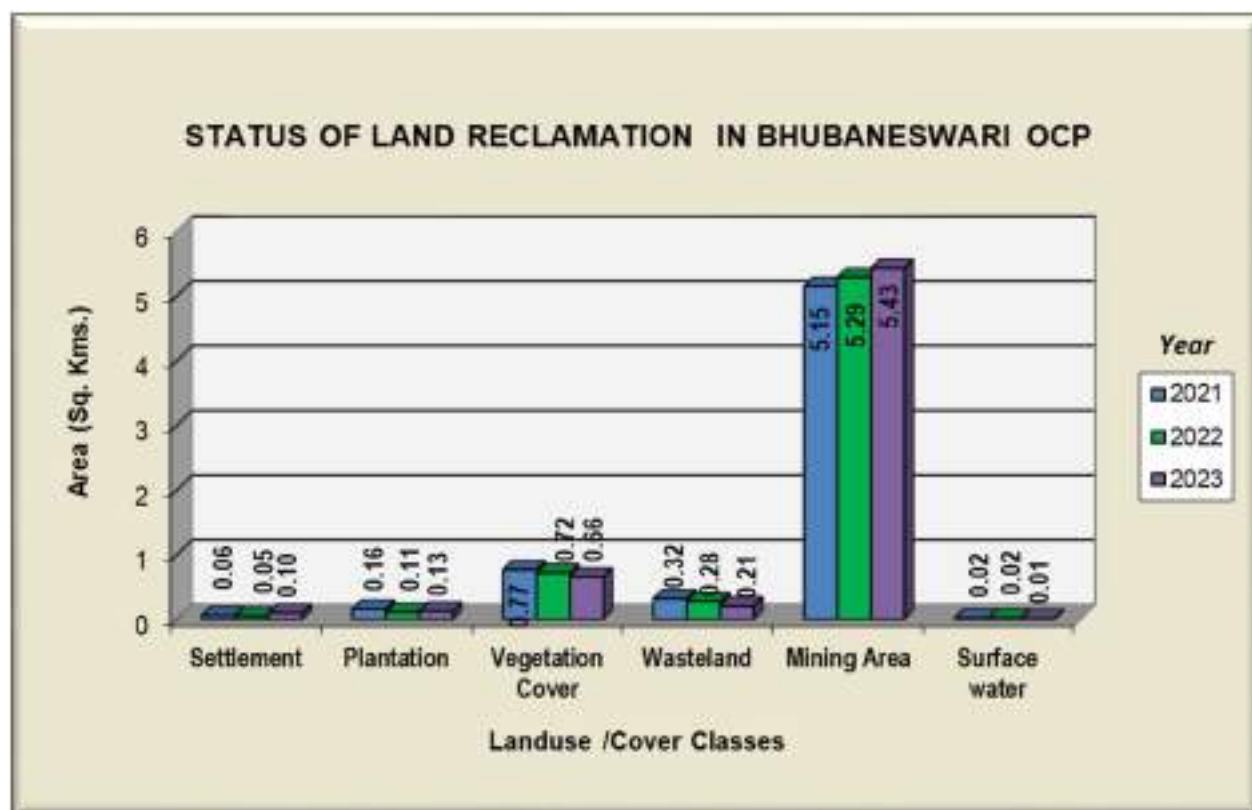


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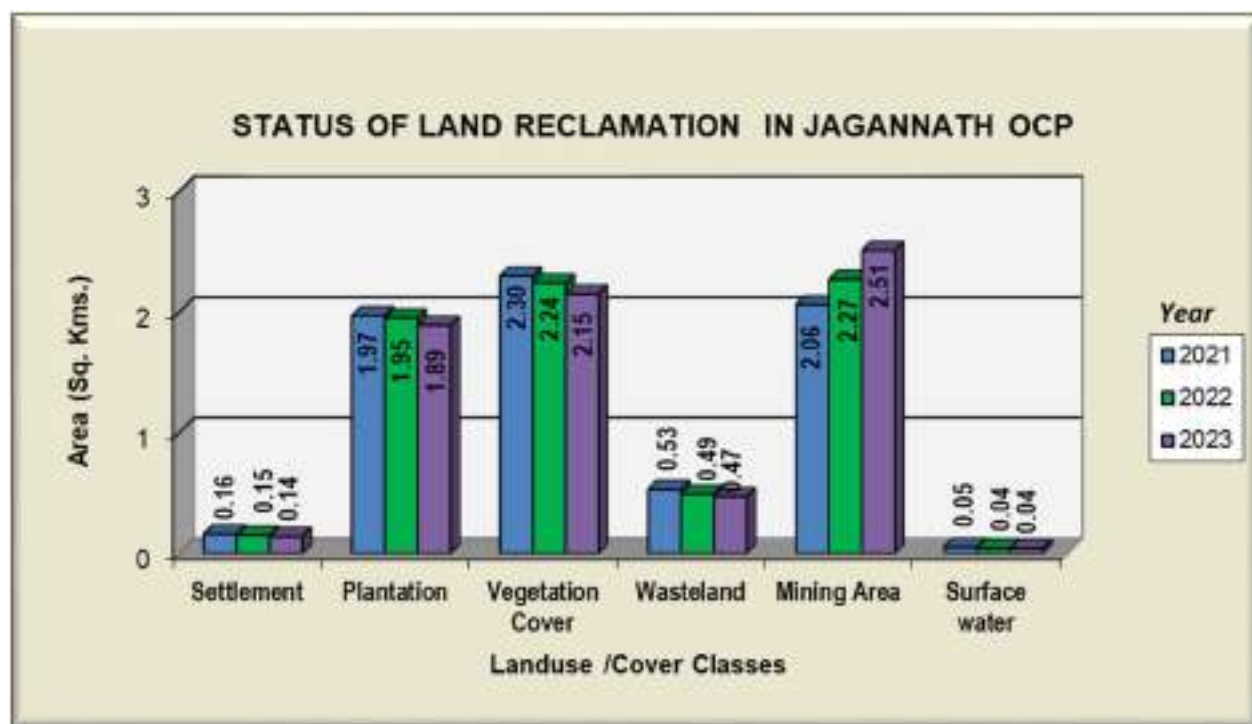


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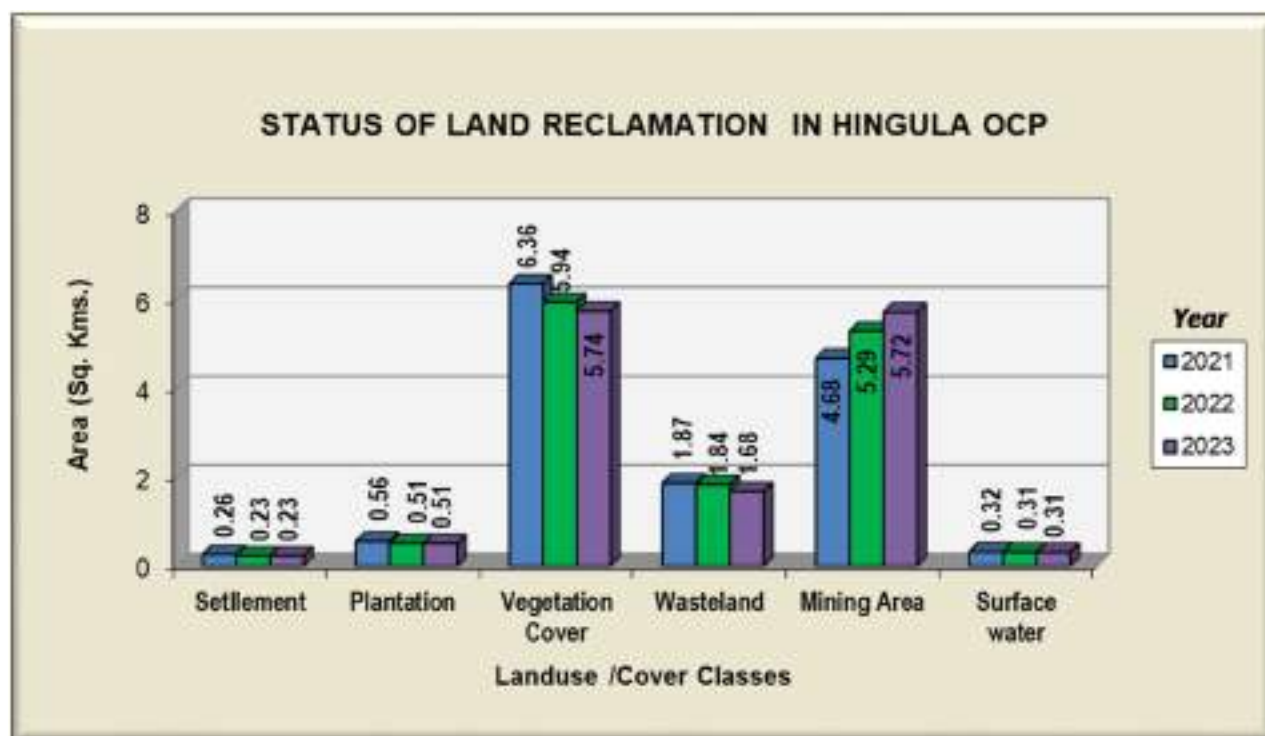


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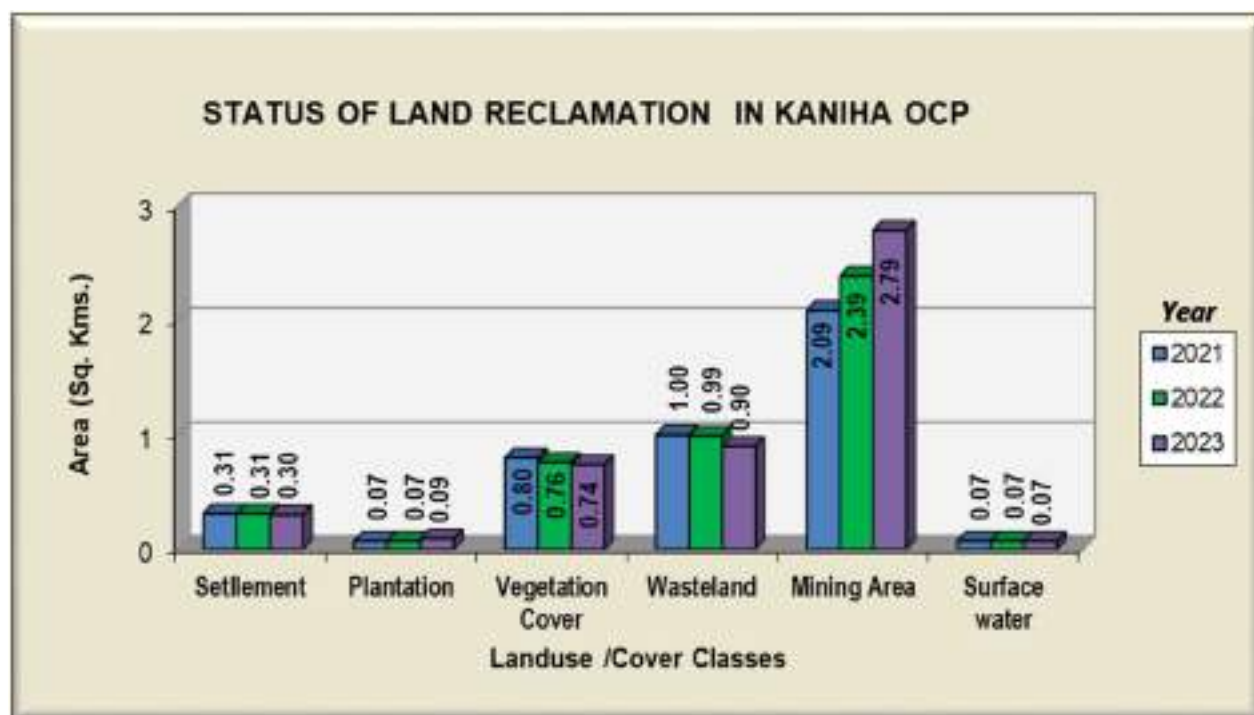


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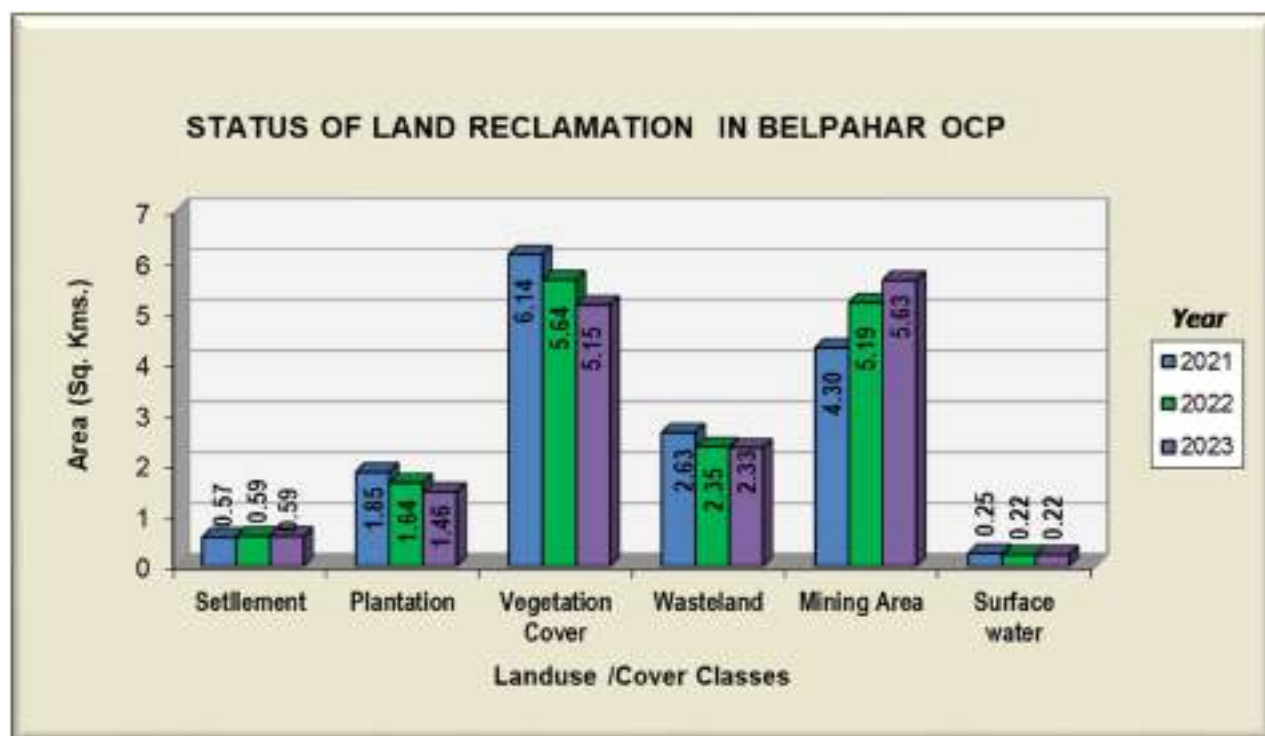


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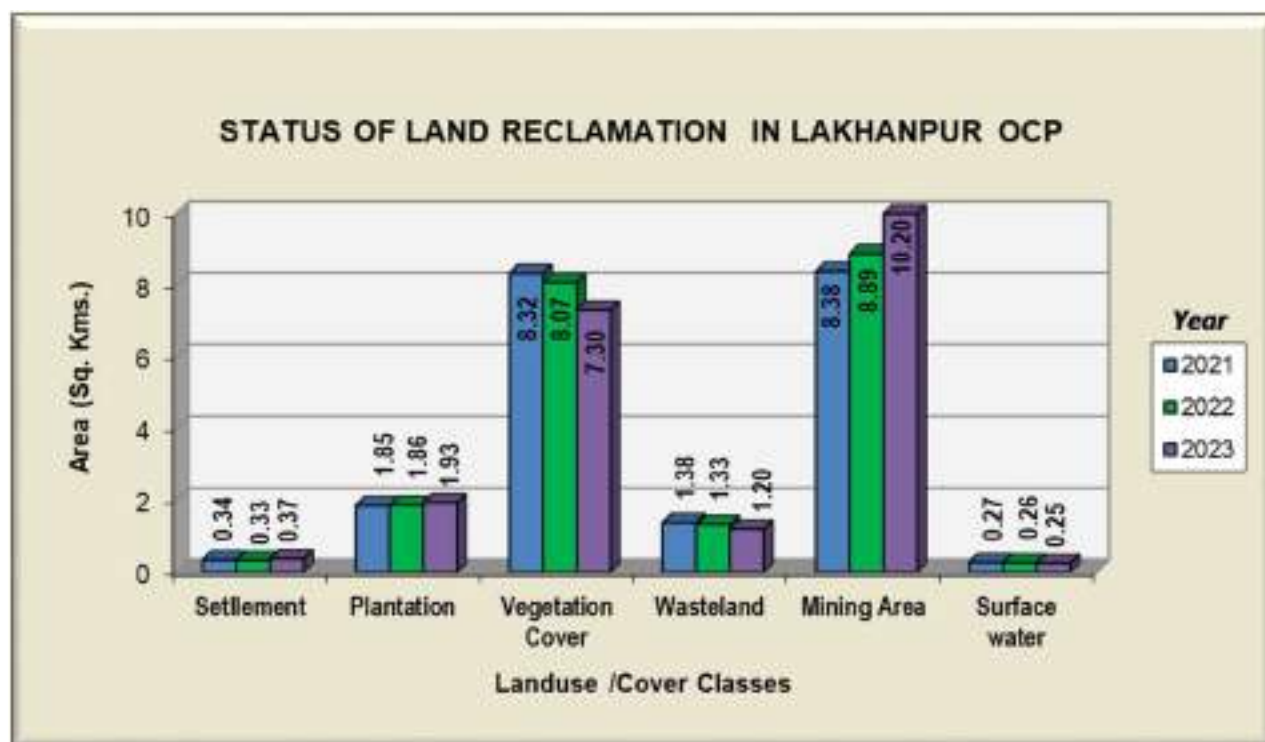


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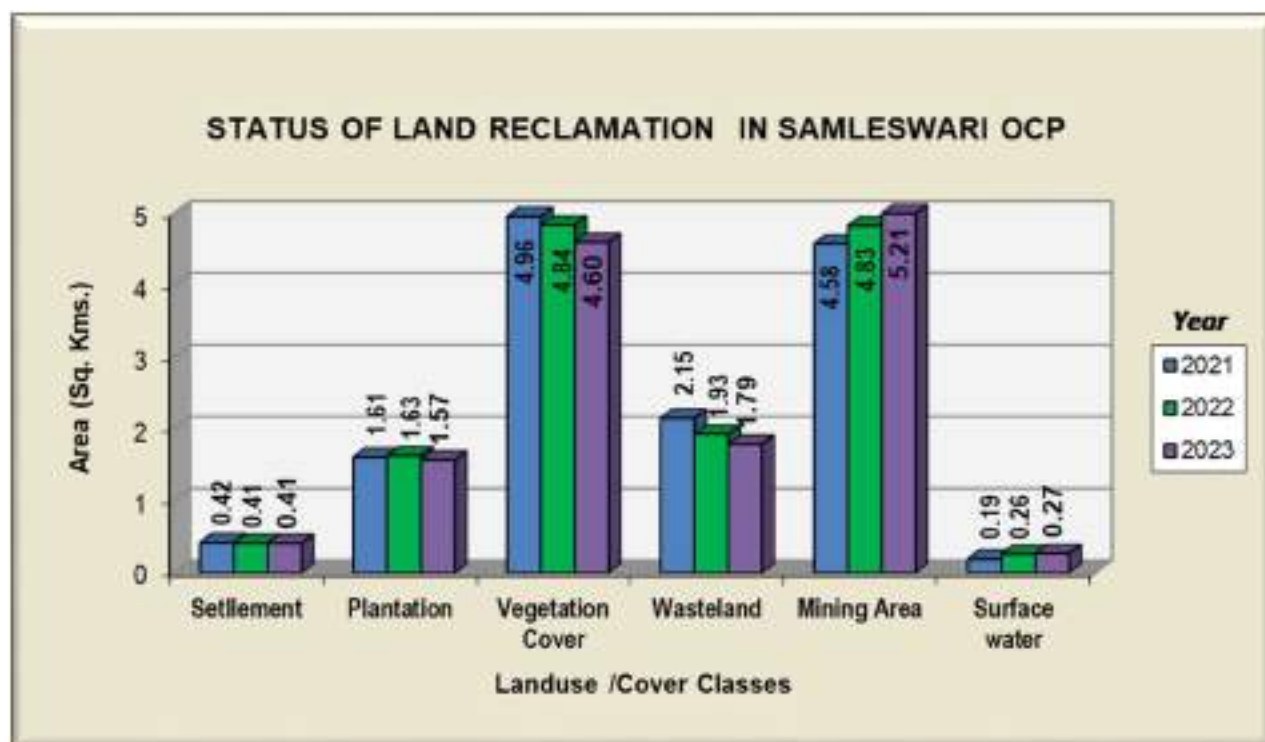


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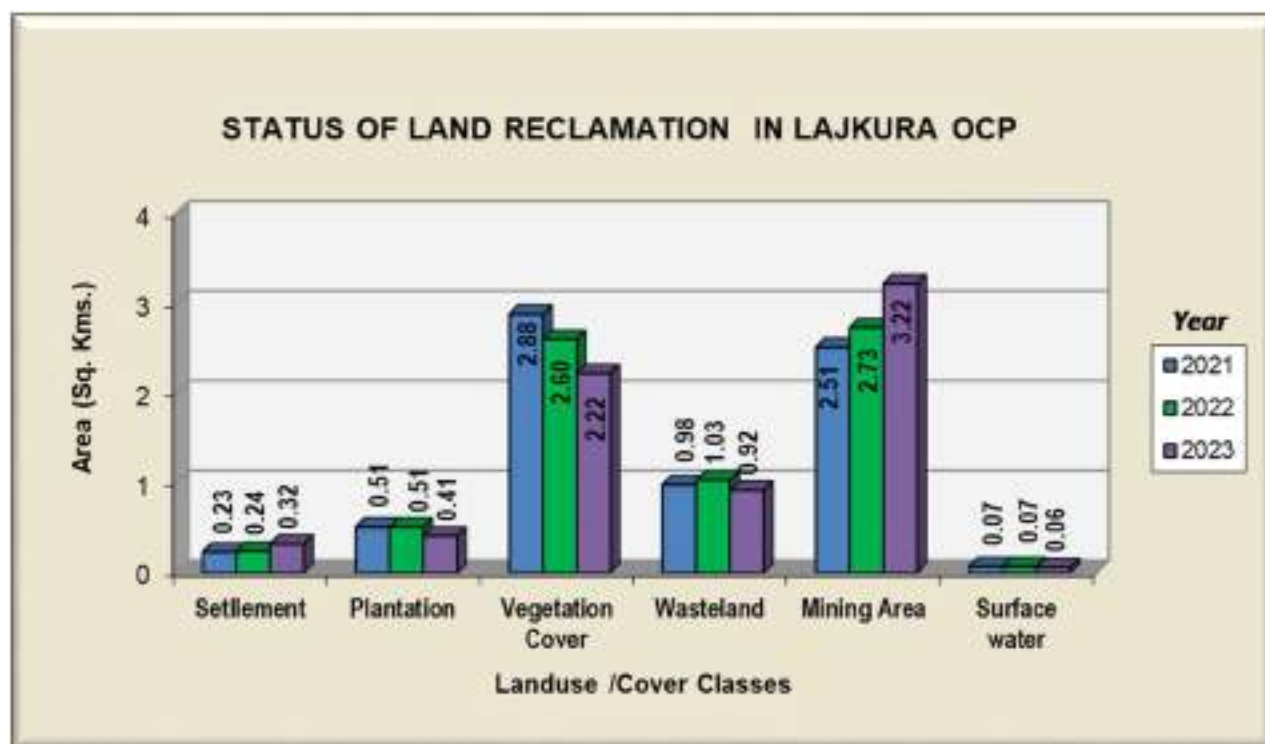


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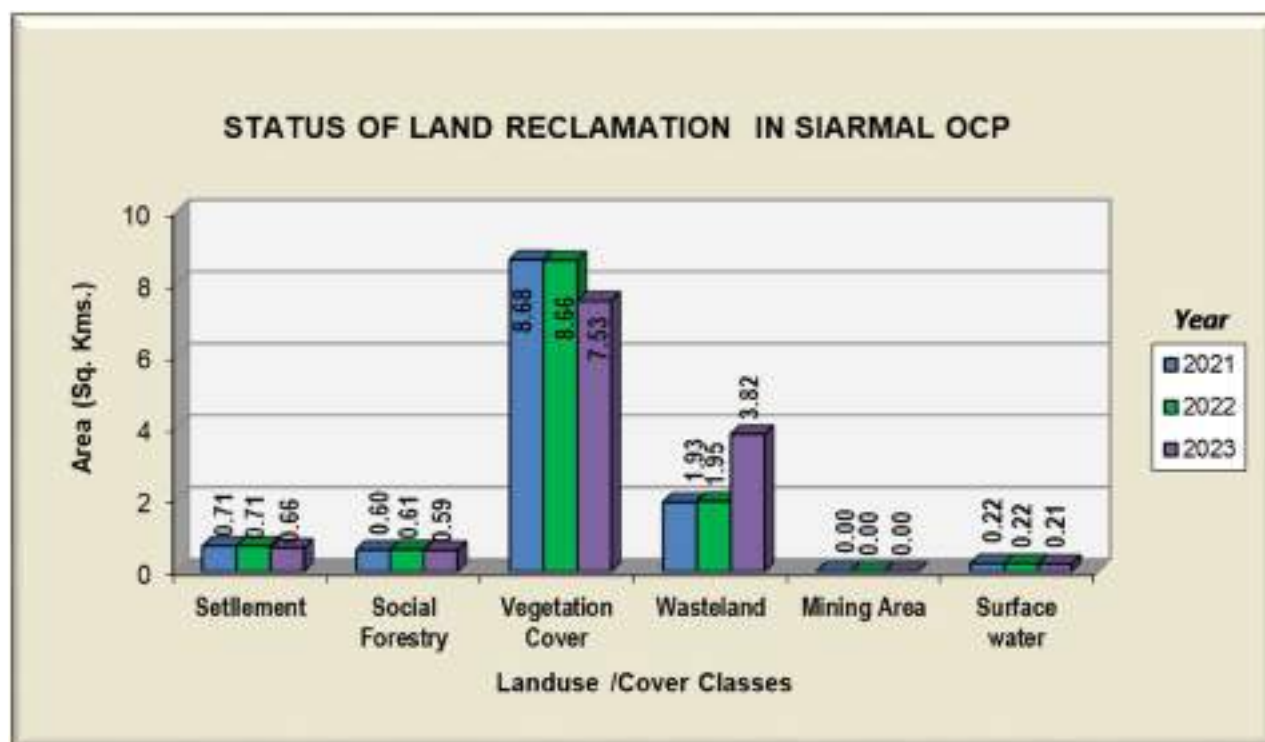


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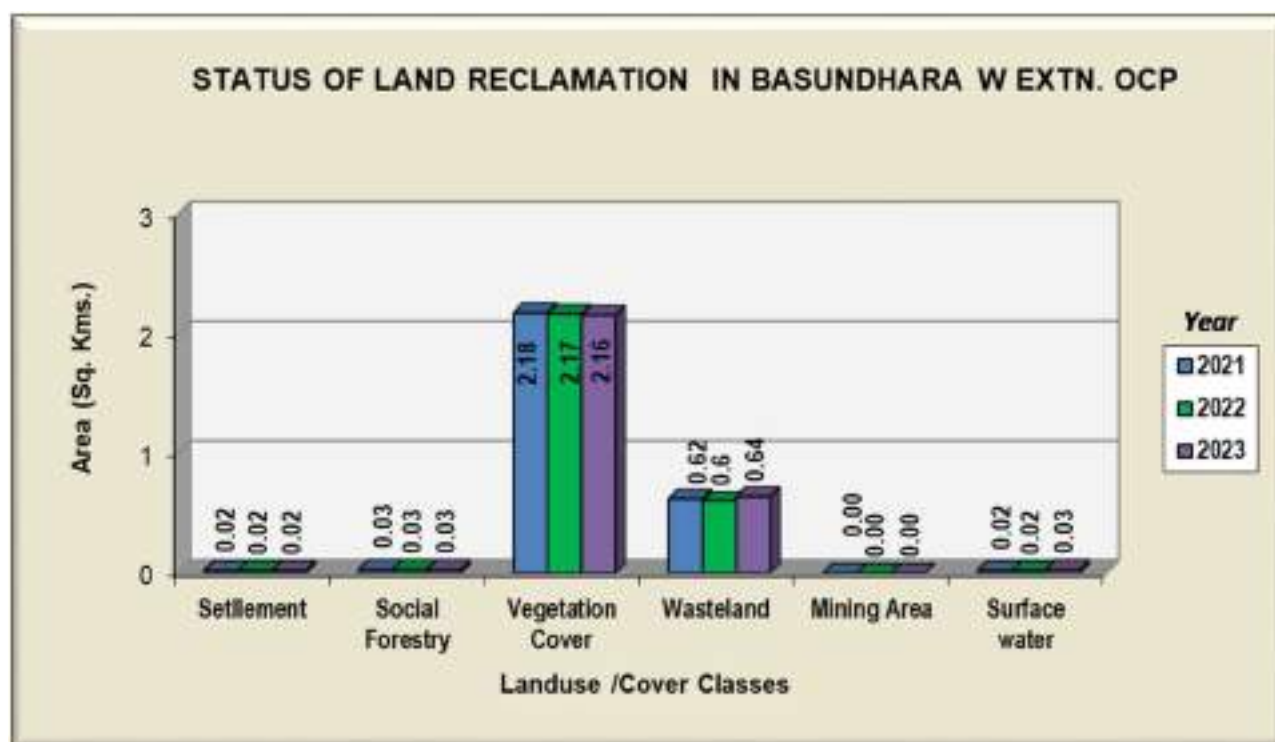


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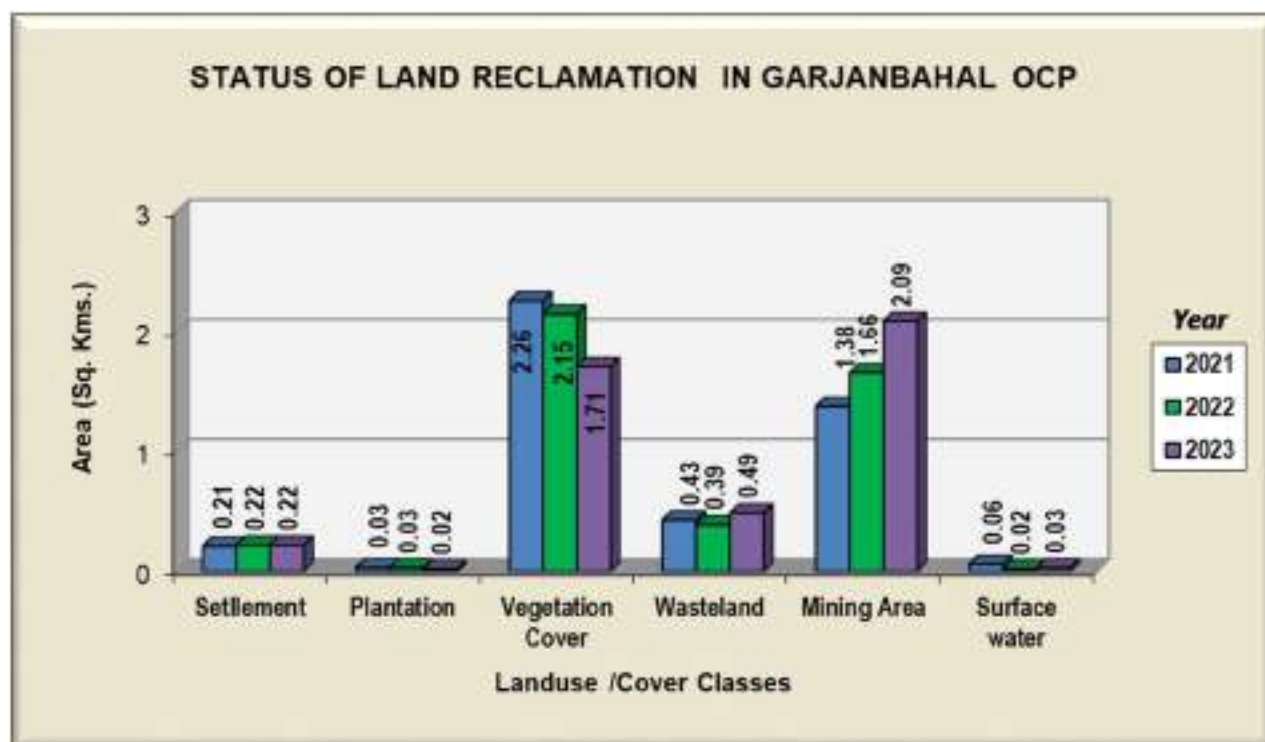


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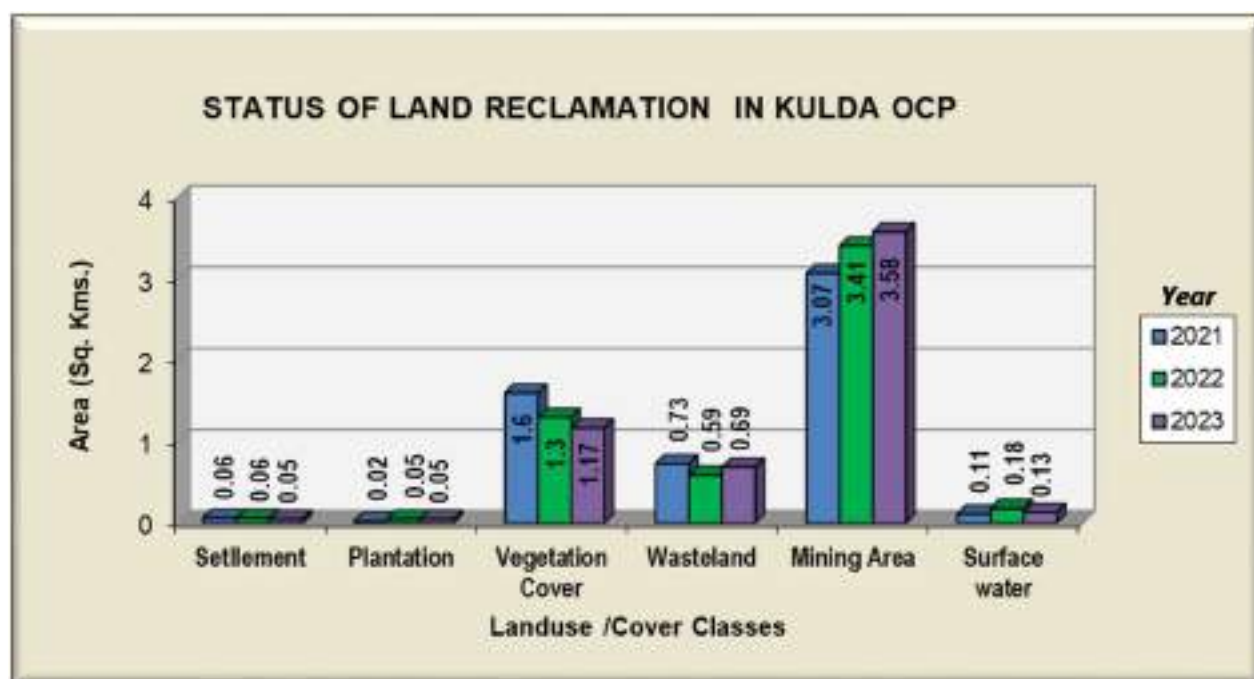


Figure 18



Photograph-1: Plantation on Internal OB/Backfill (Ananta OC Mine)



Photograph-2: Plantation on Internal OB/Backfill (Balram OC Mine)



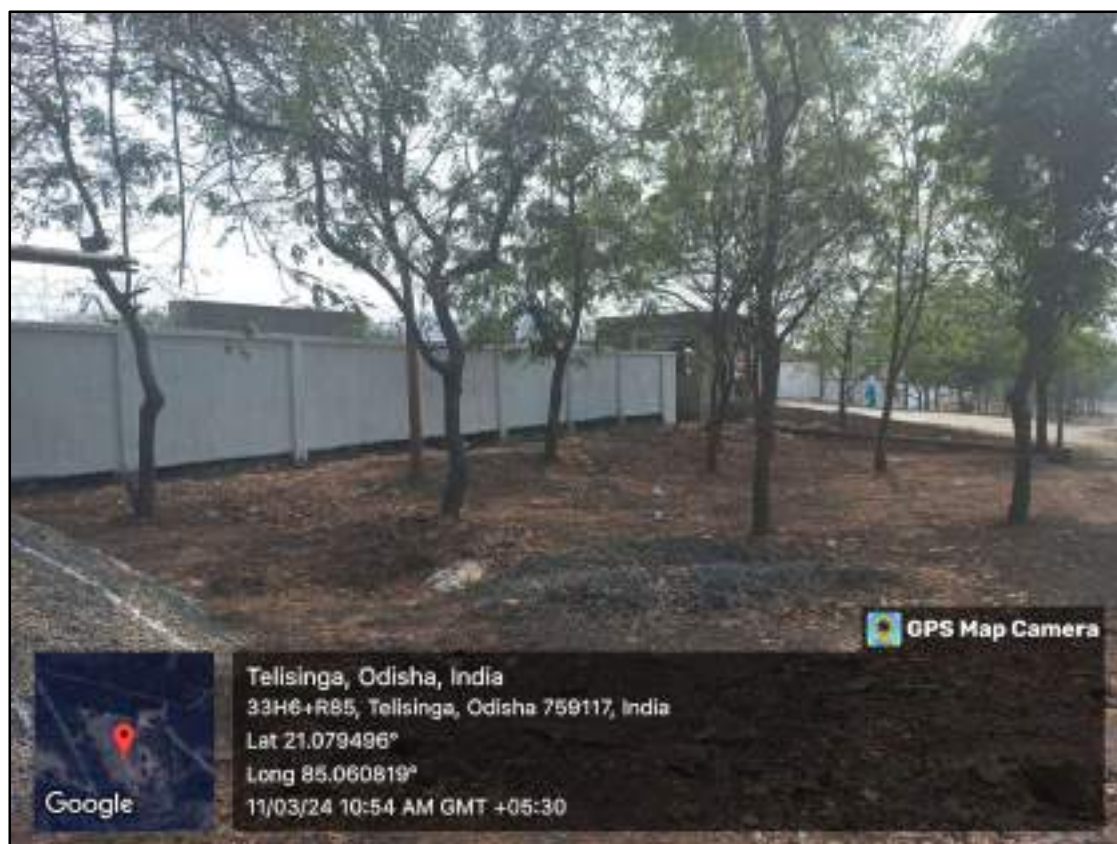
Photograph-3: Plantation on Internal OB/Backfill (Bharatpur OC Mine)



Photograph-4: Plantation on Internal OB/Backfill (Hingula OC Mine)



Photograph-5: Plantation under Social Forestry (Kaniha OC Mine)



Photograph-6: Plantation under Social Forestry (Kaniha OC Mine)



Photograph-7: Plantation under Social Forestry (Lingaraj OC Mine)



Photograph-8: Plantation on Internal OB/Backfill (Belpahar OC Mine)



Photograph-9: Plantation on Internal OB/Backfill (Lakhanpur OC Mine)



Photograph-10: Plantation on Internal OB/Backfill (Samleswari OC Mine)



Photograph-11: Plantation on External OB (Lajkura OC Mine)



Photograph-12: Plantation on External OB (Kulda OC Mine)



Photograph-13: Plantation on Internal OB/Backfill (Garjanbahal OC Mine)

शब्द-कोष

1	Land Reclamation	भूमि पुनरुद्धार
2	Over Burden	अधिभार
3	Monitoring	निगरानी
4	Report	प्रतिवेदन
5	Executive Summary	कार्यकारी सारांश
6	Opencast Mine	खुली खदान
7	Objective	उद्देश्य
8	Methodology	कार्य प्रणाली अथवा प्रक्रिया
9	Table	तालिका
10	List of Tables	तालिकाओं की सूची
11	Map	मानचित्र
12	Social Forestry	सामाजिक वानिकी
13	Plantation	पौधारोपण
14	Million	घनमीटर
15	Background	पृष्ठभूमि
16	Planning	योजनाबद्ध
17	Asses	आकलन
18	Status	स्थिति
19	Regularly	निरंतर
20	Satellite	उपग्रह
21	Subsidiary	अनुषांगिक
22	Production	उत्पादन
23	Biological Reclamation	जैविक पुनरुद्धार
24	Technical Reclamation	तकनीकी पुनरुद्धार

25	Leasehold Area	पट्टा क्षेत्र
26	Excavated Area	उत्खनन क्षेत्र
27	Active mining	सक्रिय खनन
28	Environmental Protection	पर्यावरण संरक्षण
29	Remedial Measure	उपचारात्मक उपाय
30	Interval	अंतराल
31	Systematic Error	व्यवस्थित त्रुटियाँ।
32	Error	अशुद्धियाँ
33	Curvature	वक्रता
34	Geometric	ज्यामितिक
35	Distortion	विरूपण
36	Plantation	पौधारोपण
37	Capacity	क्षमता
38	Software	सॉफ्टवेयर
39	Class	वर्ग
40	Accuracy	सटीकता
41	Statistical Separation	सांख्यिकीय पृथक्करण
42	Cubic meter	घनमीटर
43	Depicted	दर्शाया गया
44	Percentage	प्रतिशत
45	Salient Findings	मुख्य निष्कर्ष
46	Methodology	पद्धति
47	Data Procurement	डाटा क्रय
48	Satellite data Processing	उपग्रह डेटा प्रसंस्करण
49	Rectification and geo-referencing	सुधार और भूसन्दर्भ-

50	Image enhancement	छविगुण - बृद्धि
51	Training set selection	प्रशिक्षण सेट का चयन
52	Classification and Accuracy assessment	वर्गीकरण और मूल्यांकन की सटीकता
53	Area calculation	क्षेत्र गणना
54	Temporal	लौकिक
55	Processing	प्रसंस्करण
56	Overlay of Vector data base	वेक्टर डेटा बेस का अरोपन
57	Area calculation	क्षेत्रगणना-
58	Pre-field map preparation	क्षेत्र जाने के पहले नक्शे की तैयारी
59	Ground Truthing	भू-सत्यापन
60	Ground Information	भू-सूचना
61	Interpretation	व्याख्या
62	Eco-system	पारिस्थितिकी तंत्र
63	Minor	मामूली
64	Water Drainage	जल निकाय
65	Interval	अंतराल
66	Maximum	अधिकतम
67	Coal field	कोयला क्षेत्र
68	Design	परिकल्पना
69	Superimpose	आरोपित
70	Update	अद्यतनीकरण/नवीनीकरण
71	Cumulative	संचयित
72	Embankment	तटबंध
73	Cluster	खुली तथा भूमिगत खदानों के समूह

ABBREVIATIONS

Sol	Survey of India
MoEF&CC	Ministry of Environment, Forest & Climate Change
CIL	Coal India Limited
ECL	Eastern Coalfields Limited
BCCL	Bharat Coking Coal Limited
CCL	Central Coalfields Limited
WCL	Western Coalfields Limited
SECL	South Eastern Coalfields Limited
NCL	Northern Coalfields Limited
MCL	Mahanadi Coalfields Limited
NEC	North Eastern Coalfields
CMPDIL	Central Mine Planning & Design Institute Ltd
NRSC	National Remote Sensing Centre
R2/ R2A	Resource-Sat Satellites
LISS - 4	Linear Imaging and Self Scanning Sensor
FCC	False Colour Composite
OCP	Opencast Project
UGP	Underground Project
OB	Over Burden
GCP	Ground Control points
GIS	Geographic Information System
WGS-84	World Geodetic System
UTM	Universal Transverse Mercator

GLOSSARY

Sl.	Term	Definition
1.	Land Reclamation	To manage, reclaim and restore mined out/ degraded land as close as possible to its original stage
2.	Over Burden	The material that lies above the coal seam/ deposit
3.	Monitoring	A process of evaluation to check or keep record for a period of time.
4.	Opencast Coal Mine	Open-pit mining, also known as opencast mining, is a surface mining technique that extracts minerals from an open pit in the ground.
5.	Social Forestry	Social forestry is the management and protection of forests and afforestation of barren and deforested lands with the purpose of helping environmental, social and rural development. Plantation (Social/ Avenue or other) carried out outside mining area.
6.	Biological Reclamation	Plantation on Backfilled areas (Stabilized Internal Dumps)
7.	Technical Reclamation	Area under backfilling (Over burden dumped inside the mine voids) in mining area.
8.	Green Cover Generation	Total Plantation carried out in the lease area of Project. This include Plantation on Backfill, Plantation on OB and Social Forestry
9.	Leasehold Area	The area, for which lease is granted for the purpose of undertaking mining and allied operations
10.	Excavated area	Mined out area which includes active mining, area under backfilling and plantation on backfilled areas
11.	Active Mining	Mining areas which include Coal Quarry, Advance Quarry, Quarry Filled with Water etc.
12.	Environmental Protection	It is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to mitigate damage and reverse trends.
13.	Remedial Measure	Any measure or action required or undertaken to investigate, monitor, clean up, remove, treat, prevent, contain or otherwise remediate the presence or release of any hazardous substance or activity.

14.	Systematic Error	Every measurement differing from the true measurement in the same direction, and even by the same amount in some cases
15.	Geometric Distortion	It refers to the improper positioning of any image with respect to their true geographic position when viewed in a properly scaled common image display plane.
16.	Land Use/Cover Class	Land cover is what covers the surface of the earth and land use describes how the land is used.
17.	Accuracy	The closeness of agreement between a measured quantity value and a true quantity value.
18.	Environmental Clearance	Environmental Clearance (EC) for any developmental projects like coal mining projects etc. has been made mandatory by the Ministry of Environment, Forests and Climate Change (MoEF&CC) through its Notification issued on 27.01.1994 under the provisions of Environment (Protection) Act, 1986.
19.	Rectification and Geo-referencing	Geo-referencing is the assigning of absolute location of a data point or data points. Geo-rectification refers to the removal of geometric distortions between sets of data points, most often the removal of terrain, platform, and sensor induced distortions from remote sensing imagery
20.	Image Enhancement	It is the process of modifying digital images so that the results are more suitable for processing or further image analysis.
21.	Training set selection	It is a portion of a data set used to fit or train a model for prediction or classification of values that are known in the training set, but unknown in other (future) data
22.	Image Classification	It refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps.
23.	Temporal Changes	The 'temporal change' means the change in any entity with a period of time.
24.	Ground Truthing	Collection of primary/ basic information from ground realities for satellite image interpretation and thematic mapping.
25.	Cluster	Group of opencast and/ or underground minesclubbed together for administrative purposes.
26.	Arc GIS	GIS Software used for Map preparation
27.	ERDAS IMAGINE	Satellite Image Data Classification Software



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Annexure-4

**Comprehensive Hydrogeological Report with
numerical modeling in Core and Buffer Zones of
Kaniha Open cast Mine, Talcher Coalfield, MCL
(Kaniha Block, Angul District, State Odisha)**

**(NOC Renewal: 4031 m³/day/ 14,71,315 m³/year, Second
Renewal)**

(Existing Validity: From 11/11/2023 up to 10/11/2025)

NOCAP Application No.: 21-4/2108/OR/MIN/2018

NOC NO: CGWA/NOC/MIN/REN/1/2025/11362

SUBMITTED TO
Central Ground Water Authority
Bhubaneswar/ New Delhi



Oct 2025

SUBMITTED BY
Mahanadi Coalfields Limited
[A Government of India Undertaking (A Mini Ratna Company)]
Burla, Sambalpur, Odisha

PREPARED BY
CMPDIL
Regional Institute-VII,
Hydrogeology Section, Exploration Department
Bhubaneswar, Odisha
(Accredited Ground Water Professional Institution
By RGNWTRI, Raipur, Ministry of Jal Shakti, GoI. and QCI-NABET)

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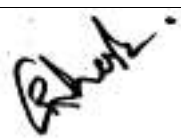
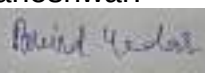
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LIST OF ANNEXURES

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1 SALIENT FEATURES OF THE PROPOSAL

S. No.	Particulars	Information			
1.	Application No.	21-4/2037/OR/MIN/2018			
2.	Submission Date	Renewal received vide NOC no. CGWA/NOC/MIN/REN/1/2025/11362, dt 08.04.2025 and the NOC is valid up to 10.11.2025			
3.	Fresh or Renewal	Renewal			
4.	Existing or New/ Proposed	Existing			
5.	If Renewal, date of validity of existing/ last NOC	11/11/2023 to 10/11/2025			
6.	CTE Issue Date	-			
7.	Name of Project with Address	Office Of The Project Officer, Kaniha Opencast Project, M/s Mahanadi Coalfields Limited			
8.	State	Odisha			
9.	District	Angul			
10.	Block/ Taluka	Kaniha			
11.	Category of Block/ Taluka (as per prevailing GWRE)	Safe			
12.	Quantum of GW applied (KLD)	Fresh Water		Dewatering	
13.	Quantum of GW applied (m ³ /Year)	m ³ /day	m ³ /year	m ³ /day	m ³ /year
		50	18,250	3981	14,53,065.00
14.	Alluvium/ Non-alluvium	Non-alluvium			
15.	GW Modelling Required (Yes/ No)	Yes			
16.	Name of Authorized Signatory of Project & Designation	General Manager Kaniha Area, MCL			
17.	Consultant Details with Name of Authorized Signatory (If Institution)	M/s Central Mine Planning and Design Institute Ltd. (CMPDIL), Ranchi, Jharkhand			

18.	In case report is prepared jointly by accredited institute and individual consultant, name details of chapters prepared by the individual consultant	CHR report is prepared by CMPDIL and Groundwater modelling report prepared by Mr. N.C.Nayak in association with CMPDIL
19.	Accreditation Certificate No. and Date/ Validity (In case jointly as per Point No. 14, No. and validity of both institution and individual are to be given)	CMPDIL Accreditation Certificate No.: CGWA/RGI/013 Date:07.07.2021 Validity: 15.02.2021 to 14.02.2026 Mr. N.C.Nayak Accreditation Certificate No.: CGWA/RGI/038; Date:30.07.2021; Validity: 15.02.2021 to 14.02.2026
20	Signature of Consultants	 Shri Rajit Ghosh HoD(Exploration)/Sr.Manager (Geology), Exploration Dept., CMPDIL, RI-VII, Bhubaneswar.  Umesh Patsute , Sr.Manager (Geology), Exploration Dept., CMPDIL, RI-VII, Bhubaneswar.  H.M. Naveen Kumar , Dy.Manager (Geology), Exploration Dept., CMPDIL, RI-VII, Bhubaneswar.  Dr. Arvind Yadav , Dy.Manager (Geology), Exploration Dept., CMPDIL, RI-VII, Bhubaneswar.

Check List of CHR with Groundwater Modelling Report

S. No.	To Check	Yes/ No
1.	Whether all salient features have been entered in the Table (Chapter-1).	Yes
2.	Whether Accreditation Certificate has been attached.	Yes
3.	Whether Work Order or relevant document having proof of date of Work Order has been attached.	Yes
4.	Whether all sections as per report SOP have been covered (even if certain section is not deemed relevant, same should also be inserted in the text with comment like not required/ not applicable etc. with reason)	Yes
5.	Whether Water Level maps have colour zoning as per SOP for report	Yes
6.	Whether all figures in the report have been referred to/ discussed in text with Figure No.	Yes
7.	Whether all tables in the report have been referred to/ discussed in text with Table No.	Yes
8.	Whether all Maps have good resolution with Scale, Coordinates, North and Legend and whether legend is legible.	Yes
9.	Whether source of data (in tables/ values etc.) taken from elsewhere (i.e. Secondary Data) has been quoted in the text/ below the table.	Yes
10.	Whether details of references cited in text/ source of data have been given at the end of report as Bibliography.	Yes
11.	Whether all certificates/ documents bearing signatures (such as Work Order, Certificate by Consultant etc.) have the name of signatory below signature.	Yes
12.	Whether Quantum of Ground water withdrawal/ dewatering in submitted CHR and NOCAP application are same.	Yes

 5.11.25
General Manager

Kaniha Area, MCL

2 ABOUT THE PROJECT

The Kaniha Opencast mine of Mahanadi Coalfield Limited (MCL) is located in Kaniha Block of Angul District. The mine is situated at a distance of 28 km from Talcher Town and is 36 km north of Angul town. Lease area falls in 73 G/4 toposheet of Survey of India. Kaniha Open Cast Project is in Talcher coalfield, situated on the western part of Brahmani River, in the Mahanadi River basin. It is an existing mine with 14.0 MTY production capacity with total mine lease area of 1880 Ha., for Phase -I the mine lease area is 718 Ha. The project is formulated within Kaniha Geological Block & Neelachal Geological Block of Talcher coalfield of Odisha. This mine supplies coal to NTPC Super Thermal Power Station, Kaniha. A map showing the location and boundary of the Project Area is given in **Figure 2.1**.

Need of the work

The project has already acquired NOC (21-4/2108/OR/MIN/2018) for use of ground water from Central Ground Water Authority vide NOC No: CGWA/NOC/MIN/REN/1/2025/11362 dt 08.04.2025 and the NOC is valid up to 10.11.2025. Therefore, it is imperative to renew groundwater clearance (NOC) for the mine seepage water alongside groundwater extracted through the tube well and bore wells in the project area. The Kaniha OC Project is located in the **Kaniha development Block**, which falls under the “**Safe Category**” as per CGWB assessment in **GWRA 2024**. In terms of the Hydrogeology of the study area, major portions of the study area are covered by the Barakar Formation, Karharbari formation and Talchir Formation. Geologically the area is underlain by the Non-Alluvial Formation (as per CGWA Classification). As the mine site falls in a Non-Alluvial Formation and proposed withdrawal is more than **500 m³/day** of ground water, it is mandatory to undertake a Comprehensive Hydrogeology study along with Ground Water Modeling study as per the Central Ground Water Authority SOP, May 2023 (for CHR) & August 2024 (for GWM).

To that end, MCL has entrusted the CHR with Ground Water Modelling work to CMPDIL. As per CGWA Public Notice No. 20/2021 dated 20th December 2021 (“*With effect from 01.01.2022, accredited Ground Water Agencies/Institutions may enter into a Memorandum of Understanding (MoU) with up to a maximum of 3 accredited individual Consultants for utilizing their services in the preparation of Impact Assessment Report /*

Hydrogeological Report Ground Water Modelling report as the case may be”), CMPDIL has signed MoU with Mr. N.C. Nayak (CGWA Accredited Consultant) for the period of three years for undertaking the groundwater modelling studies upon requirement basis.

Accordingly, the Comprehensive Hydrogeology Report for core zone of 2 km radius and buffer zone of 10 km radius has been prepared by M/s. Central Mine Planning and Design Institute Ltd. (CMPDIL), Hydrogeology Division, Exploration Department, RI-VII, Bhubaneswar (A QCI-NABET and CGWA accredited consultant). Whereas, the “Groundwater modelling report is prepared by Mr N.C Nayak (CGWA Accredited Consultant- Ground Water Modelling) in association with CMPDIL”.

Scope of the work

The following scope (**Table 2.1**) has taken into account for hydro-geological investigation of the study area: Comprehensive hydrogeological report with ground water modelling (as per CGWA guidelines).

Table 2.1: Scope of the Work.

REPORTS	
Comprehensive Hydrogeological Report (CHR) on ground water conditions in both core and buffer zones of the mine, depth wise and year wise mine seepage calculations, impact assessment of mining and dewatering on ground water regime and analysis of collected data and preparation of Maps, Graphs, Charts, etc. and compilation of report.	Numerical Ground water modelling with the following aspects:
To assess the present hydrological scenario of the study area.	Preparation of the conceptual model resembling the natural structure of the study area.
To find out aquifer disposition in the mining area.	Calibration and Validation of the model
To evaluate the status of ground water condition in the area.	Generation of Model result-scenario for 5 to 10 year, water level map, observed and predicted contours shape matching

To study the ground water flow direction.	Compilation of the modelling results and incorporation in the comprehensive report
To assess year wise dewatering and pumping details.	Provision of Visual MODFLOW files of GW modelling as per requirement.
To assess the impact of withdrawal (dewatering) of groundwater on ambient ground water regime.	
To find out the quality of ground water in the buffer zone of mine and pumped out water.	
Augmentation of groundwater resource in the area.	
BASELINE STUDIES	
Hydrogeology field visit to collect/generate the ground water related primary data and collection of secondary data from the PP.	
Assessment of the likely impacts of ground water quality in the core and buffer zone of mine due to mining activity. Suggest technically viable strategies/plans for utilization of pumped water and ground water recharge measures.	
Submission of NOC application, supporting Hydrogeology report for obtaining NOC from CGWA for withdrawal of groundwater during extraction of coal by Opencast mining method.	
Replying to queries, if any, received from CGWB/CGWA.	

A hydrogeological study was carried out towards the aforementioned work and the basic required data were collected from the PP and studied, such as:

- Site plan
- Geological Report (Graphic/ descriptive lithology, geological cross-sections, subsurface borehole data, and Coalfield Geological Plan)
- Previous Hydrogeological study reports
- Mine plan or feasibility report
- Project Report and mine stage plans
- EIA/EMP reports.

The field visits were undertaken during pre-monsoon (May 2024) and post-monsoon

(October -November 2024) to collect the baseline data like groundwater levels, water samples for quality and other relevant records. Additional data like the details of existing mining / other major projects located in and around the study area are also collected and incorporated in the report. The details about sources of various data used for this study are provided in **Table 2.2**.

Table 2.2: Details about sources of data used for this study.

Data	Data Source
River, Water body	Survey of India Topo Sheet / Satellite Imagery (NRSA)
Rainfall	IMD/PP/ WRIS
Geology	Geological Survey of India
Geomorphology	Interpreted from Satellite Imagery/GSI
Topography (Physiography)– Surface	<i>SRTM-DEM of 90 m</i> spatial resolution (USGS website)
Aquifer Parameters	Published reports of CGWB and site-specific Pumping Test by CGWB-accredited consultants &
Hydraulic conductivity, Kx, Ky, Kz and Specific capacity, Specific Storage, Porosity	Published reports of CGWB and site-specific Pumping Test by CGWB/CMPDI & CGWB accredited consultant Organisation/ Consultants
Lithology	Lithological data from exploratory boreholes of CIL and Published reports of CGWB, Geophysical Survey interpreted results
Aquifer Thickness	Lithological data from exploratory boreholes of CIL/CMPDI and Published reports of CGWB, Geophysical Survey interpreted results
Ground water level	Field observation from the key wells/ PP

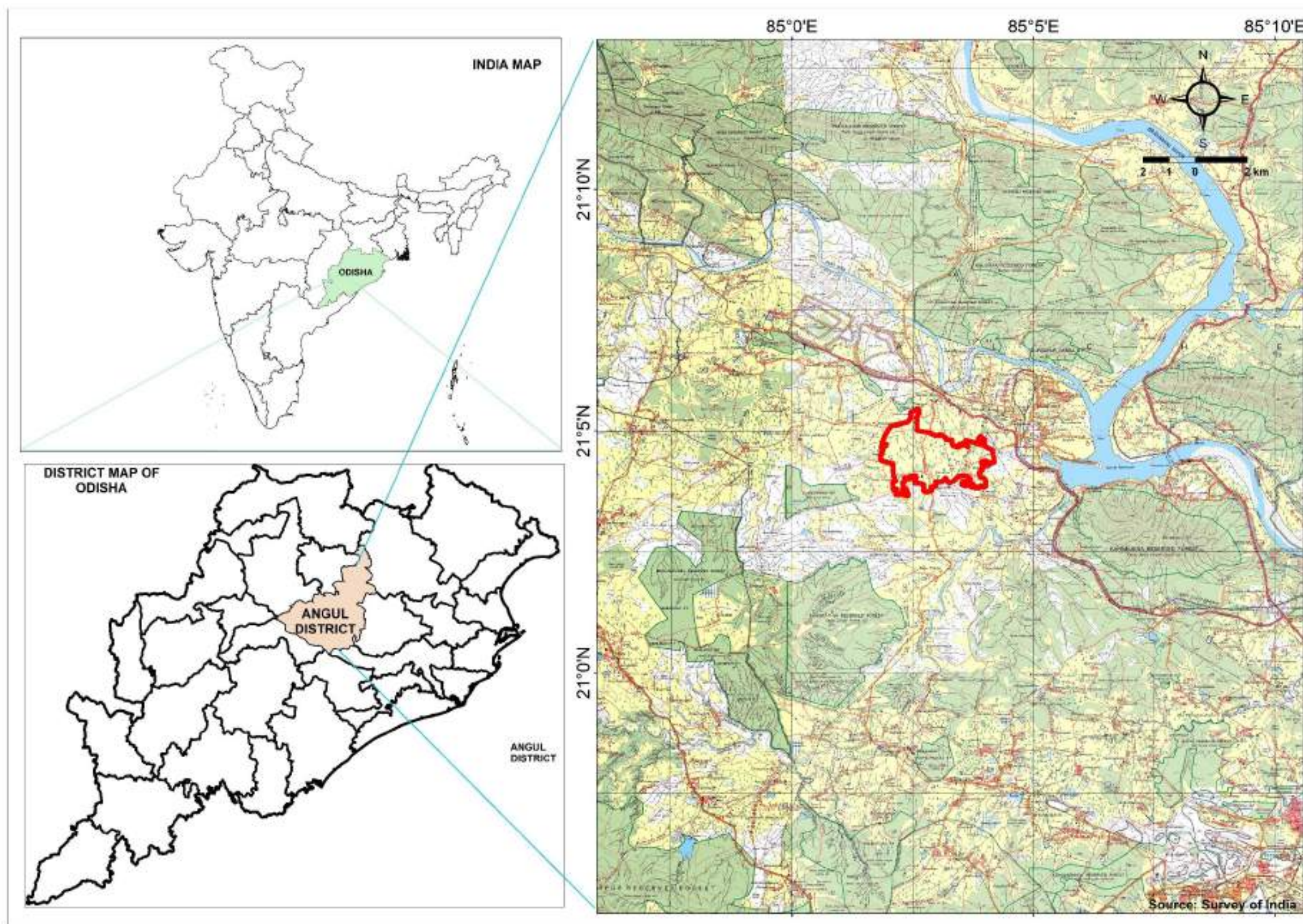


Figure 2.1 Map showing the location and boundary of the Kaniha OC, Talcher Coalfield, MCL.

2.1 LANDUSE / LAND COVER OF THE SURROUNDING AREA

Most of the area around the project site is covered by agricultural land. Additionally, significant areas are covered by wasteland, forest, built up land, water bodies, mine area and others. Mining & Industrial activities are confined to the northern part adjacent to Tikra river covering quite a notable portion of the study area. Urban settlement is mostly confined to administrative and mining townships while rural settlements are somewhat uniformly distributed in the area. The area under plantation/vegetation is profusely found near Similisahi & Kosala area and mainly confined to mine dumps and rehabilitations. The land use pattern of the mine lease area is given below in Table 2.3. The land use/ cover map of the Kaniha OC study area is shown in **Figure 2.2** (source Bhukosh, GSI portal).

2.1.1 Description of Project Area

The summary of Land-Use distribution of the project area is given in **Table 2.3**. In terms of land-use, the project area is dominated by tenancy/ government land for quarry area:

Table 2.3: Land-use distribution of the project area

S.No	Particulars	For existing 10.0 MTPA	Phase-1
1	Quarry excavation	1131.00	363.00
2	OB Dumps	312.26	172.00
3	Blasting Danger Zone	373.98	183.00
4	Infrastructure	75.40	
5	Diversion of Road	9.30	
6	Rationalization of project Boundary	8.06	
Mine lease area (1+2+3+4+5+6)		1880.00	718.00
7	Residential Colony	40.00	40.00
8	Resettlement Site	276.00	276.00
	Total	2196.00	1034.00

2.1.2 Description of Core Zone & Buffer Zone (2km & 10 km)

The total mine lease area required for the proposed project is 1880 Ha. and for phase-I, required mine lease area is 718 Ha. The core zone of the project comprising of excavation zone, infrastructure area, OB dump sites, safety zone for blasting, etc., covers partly and/or fully the land from Eight (08) villages namely Dhandasinga, Ambapal, Jorada, Kamarei, Patharmunda, Telisinga, Gandaberini and Chhelia (Partly). The buffer zone i.e. area within 10 km radius from the periphery of the project boundary.

Core Zone (2 Km): Agriculture Land > Wastelands > Built-up, Mining > Built-up, Rural > Forest > River

Buffer Zone (10 Km): Wastelands > Agriculture > Forest > Built-up, Mining > Built-up, Urban > River.

Description-1	Description-2	Classes from NRC LULC50K Mapping Project
Builtup	Urban	Built up – Compact (Continuous), Built up – Sparse (Discontinuous), Built up – Vegetated / Open area, Industrial area, Ash / Cooling Pond / effluent and other waste
	Rural	Rural
	Mining	Mining – Active, Mining – Abandoned, Quarry
Agriculture	Crop land	Kharif, Rabi, Zaid, Cropped in 2 seasons, Cropped in more than 2 seasons
	Plantation	Agriculture Plantation
	Fallow	Fallow land
	Current Shifting cultivation	Shifting cultivation – Current
Forest	Evergreen / Semi evergreen	Dense / Closed and Open category of Evergreen / Semi evergreen
	Deciduous	Dense / Closed and Open category of Deciduous and Tree Clad Area
	Forest Plantation	Forest Plantation
	Scrub Forest	Scrub Forest, Shifting Cultivation – Abandoned

Description-1	Description-2	Classes from NRC LULC50K Mapping Project
	Swamp / Mangroves	Dense / Closed & Open Mangrove
Grass/ Grazing	Grass/ Grazing	Grassland: Alpine / Sub-Alpine, Temperate / Sub Tropical, Tropical / Desertic
Barren/unculturable/Wasteland	Salt Affected Land	Salt Affected Land
	Gullied / Ravinous Land	Gullied, Ravinous
	Scrub land	Dense / Closed and Open category of scrub land
	Sandy area	Desertic, Coastal, Riverine sandy area
	Barren rocky	Barren rocky
	Rann	Rann
Wetlands / Water Bodies	Inland Wetland	Wetland - Inland Natural (Ox-bow lake, cut off meander, waterlogged etc.), Inland Manmade (Water logged, saltpans etc.)
	Coastal Wetland	Wetland – Lagoon, creeks, mudflats, Saltpan etc.
	River / Stream / canals	Perennial & Non-Perennial River, Canal / Drain
	Water bodies	Aquaculture, Permanent & seasonal Lake/Ponds, Reservoir/Tanks
	Snow	Snow

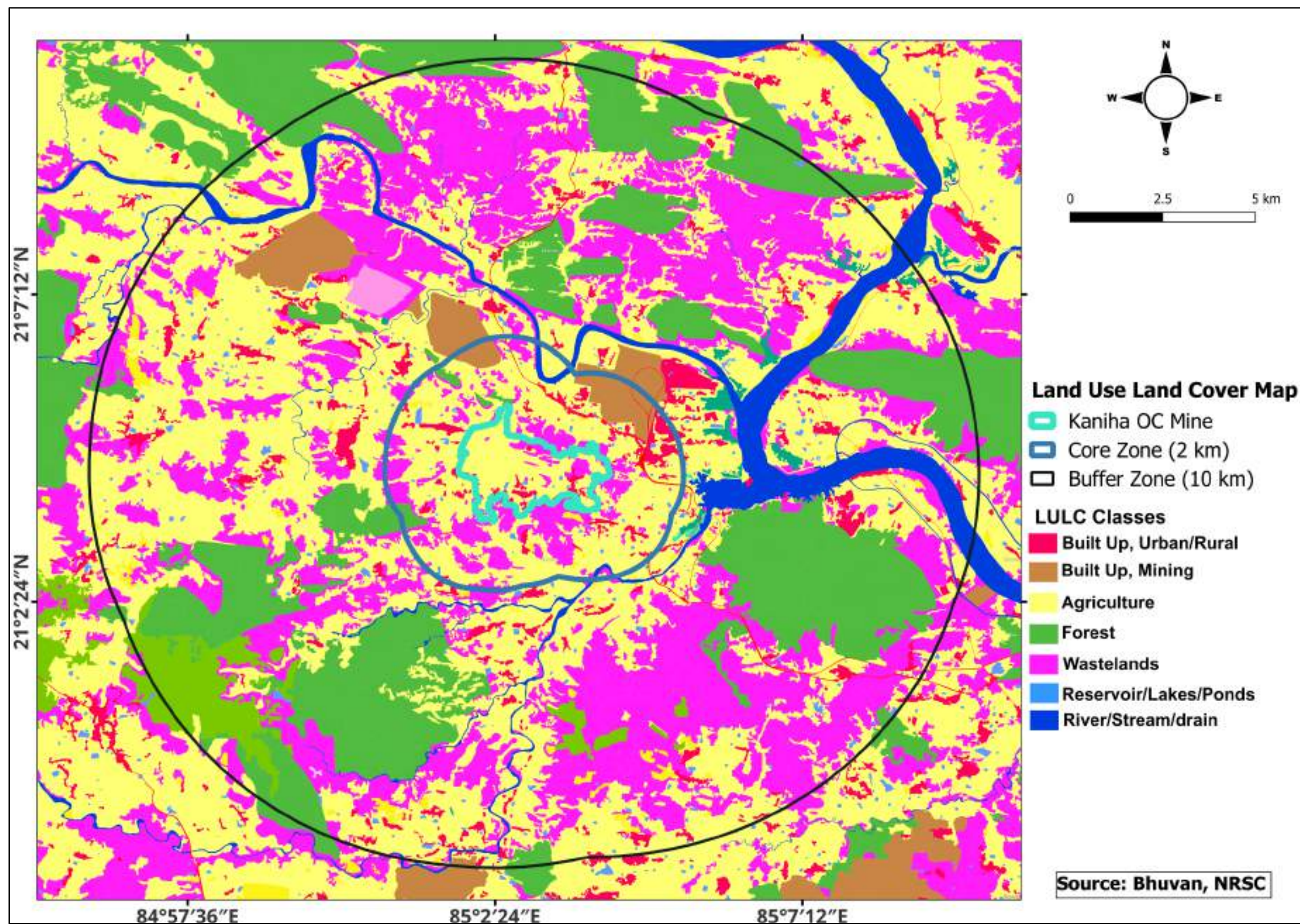


Figure 2.2: Land Use/ Land Cover map of Kaniha OC study area, Talcher Coalfield, MCL (source ESRI portal).

2.2 DEM / TOPOGRAPHY

The DEM/ Topographic contour map of the study area is extracted from **SRTM-DEM of 90 m** spatial resolution data (USGS website). Study area is characterised by an elongated plateau with intervening valleys exhibiting a moderate to gentle slope towards the river Brahmani (Figure 2.3). An isolated hill with elevations is observed in the north-eastern part. The northwest side of the study area has higher elevations as compared to the southeast part. In the Buffer zone, the topographic elevation ranges from 65 m to 372 m above MSL. In the Core zone, the elevation ranges from 68 m to 183 m above MSL. The DEM and/ or topographic contour map of the area within 2 and 10 km radii of the study area is given in **Figure 2.3**.

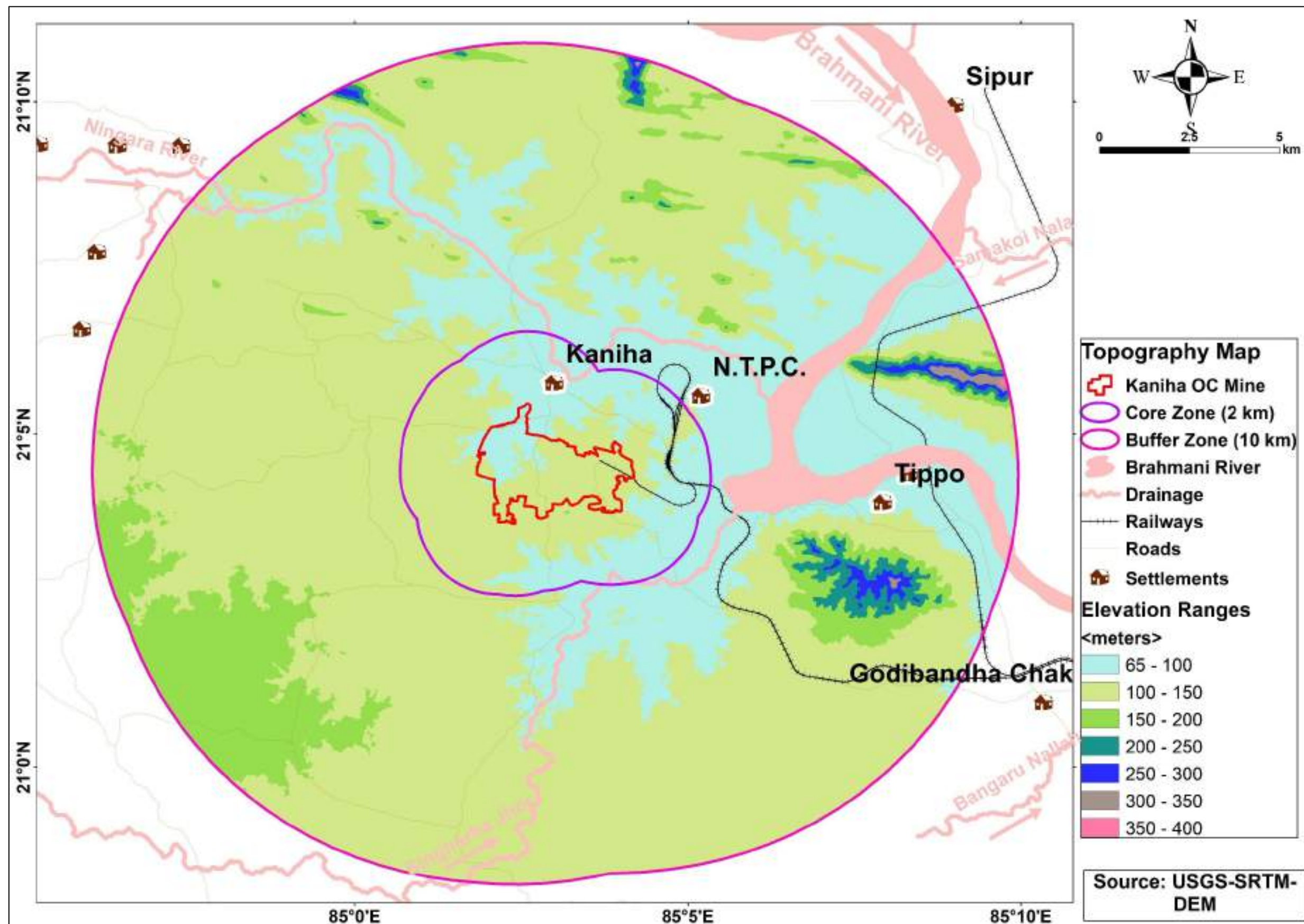


Figure 2.3: DEM/ Topographic contour map of Kaniha OC study area, Talcher Coalfield, MCL (source USGS portal, SRTM-DEM).

2.3 GEOMORPHOLOGY AND DRAINAGE

2.3.1 Geomorphology

The hydro geomorphological units pertaining to the buffer zone are mentioned below:

Highly dissected Structural Hills and valley: Major faults, fractures, and joints controlling the structural hills and valleys act as primary conduits for groundwater flow in hard rock terrains. These structural features enhance secondary porosity and permeability, facilitating groundwater movement and storage. These features occur as small patches in the northern, and north eastern regions of the buffer zone. often show moderate to poor groundwater potential directly in rock but surrounding fracture zones and valleys enhance potential.

Pediment and Pediplain Complex: This unit is the most prominent geomorphic unit of the area. This unit is developed as a result of intensive weathering under humid tropical climatic conditions, representing final stage of the cyclic erosion. The altitudinal variations and land slope is relatively low as compared to the neighboring plateau. Some dissected valleys and gullies are observed due to massive soil erosion. The groundwater prospect in this unit is good due to the moderate thickness of weathering materials. Some undulating bedrocks, devoid of any structural control occurs isolated mounds and small hillocks within this unit.

Moderately dissected Hills and valley: This is one of the prominent geomorphic units in the study area, located at the North to Northwestern part of the buffer zone. These hills are structurally controlled mainly by lithology and are traversed by numerous joints/fractures which facilitate some infiltration and mostly act as run off zones. The structural trend of the hill ranges are in east – west direction. Major parts of the hills slope are more than 20%, which facilitate more run off. Groundwater prospects are very poor in this unit.

The geomorphological map of the study area is shown in **Figure 2.4** (Source: *Bhukosh portal*).

2.3.2 Drainage of the study area

The study area is well drained by Brahmani River and its tributaries, Tikra river and Singhara Jhor. The drainage is mainly of Trellis pattern which is modified to sub-angular to sub-dendritic pattern at their lower reaches. The main drainage is structurally controlled and is parallel to the strike direction of the formations. Streams and rivers following lithological contacts, fold axial traces, fractures and lineaments are generally perennial in nature. Two streams i.e., Tikra river and Singhara Jhor flowing in a WNW to ENE & NE to SW direction serves as the principal drainage of the study area (**Figure – 2.5**). Brahmani river which ultimately receives water from these drainage channels is confined to the eastern part of the buffer zone.

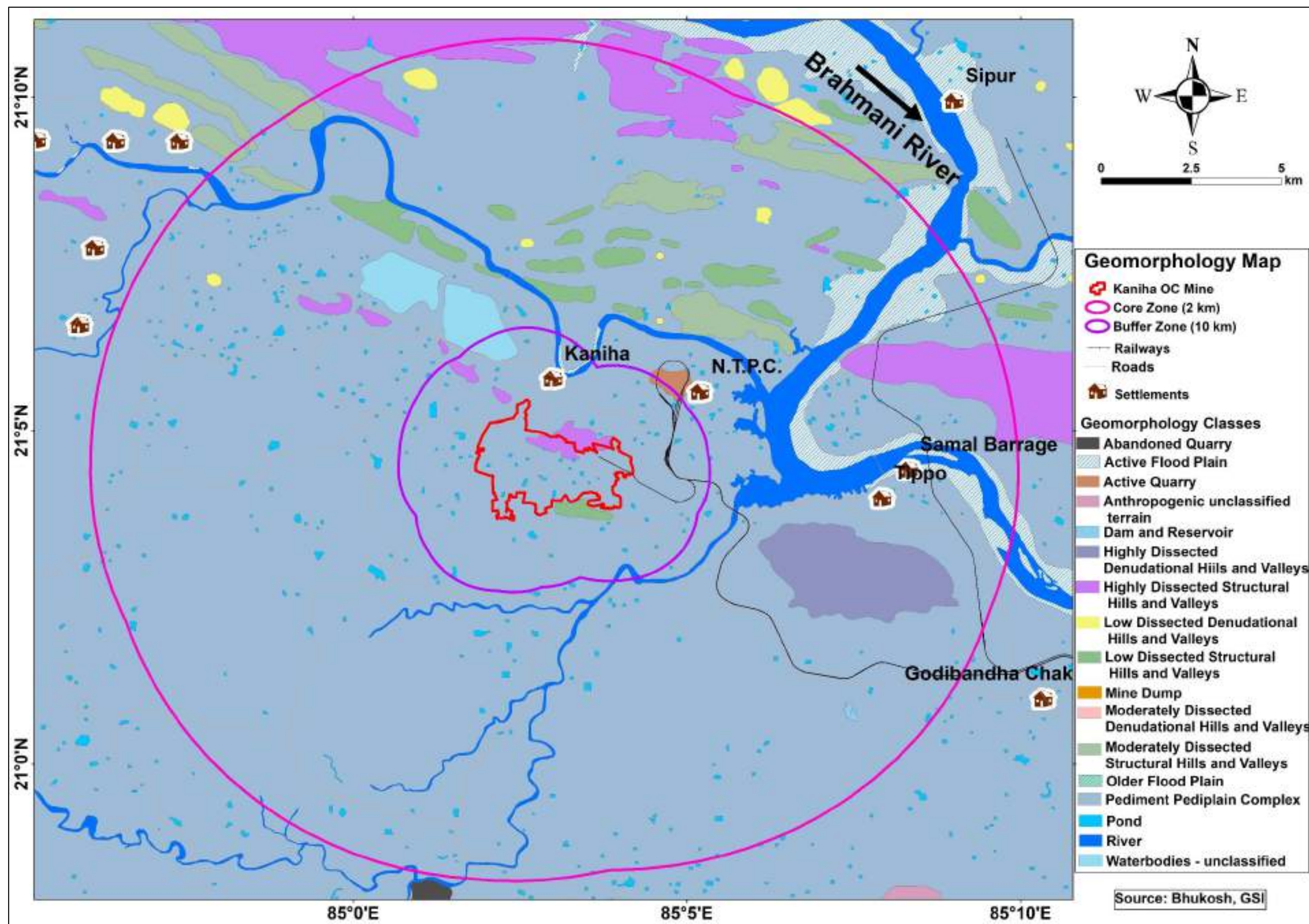


Figure 2.4: Geomorphology map of Kaniha OC study area, Talcher Coalfield, MCL (Source: Bhukosh, GSI portal).

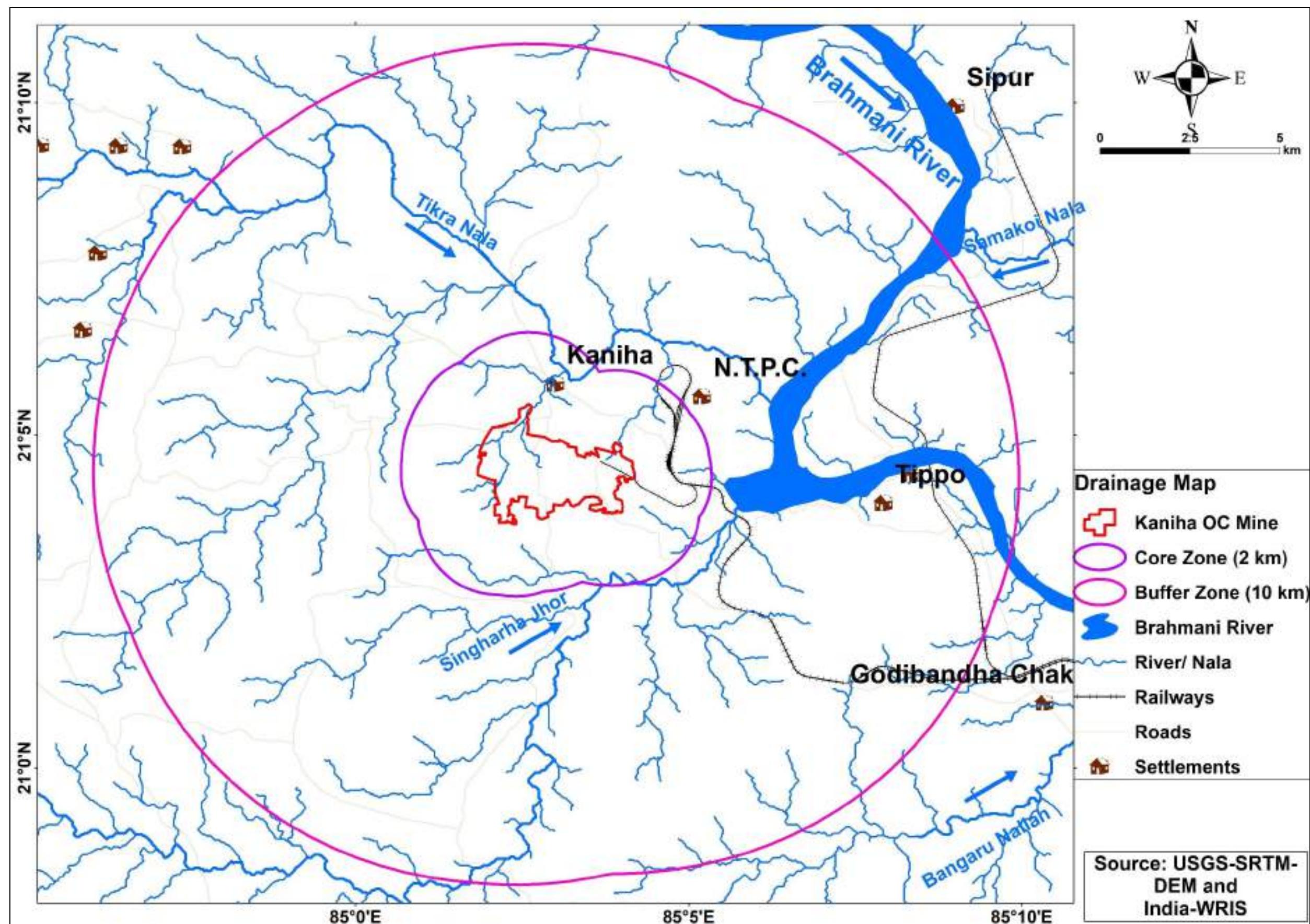


Figure 2.5: Drainage map of Kaniha OC study area, Talcher Coalfield, MCL (Source: USGS, SRTM-DEM).

2.4 DETAILS OF WETLANDS/ MAJOR WATER BODIES

None of the major *Ramsar* wetlands, Lakes under the National Plan for Conservation of Aquatic- Eco-systems fall in the 10-km study area of Kaniha OC mines, as evident from **Table 2.4 & 2.5** and **Figure 2.6**.

Table 2.4: List of Ramsar Wetland sites in India

S. No.	State Location	Name of Ramsar Site	Date of Declaration	Area
1	Andhra Pradesh	Kolleru Lake	19.8.2002	901.00
2	Assam	Deepor Beel	19.8.2002	40.00
3	Bihar	Kabartal Wetland	21.07.2020	26.20
4	Bihar	Nagi Bird Sanctuary	11.10.2023	2.06
5	Bihar	Nakti Bird Sanctuary	11.10.2023	3.33
6	Goa	Nanda Lake	06.08.2022	0.42
7	Gujarat	Khijadia Wildlife Sanctuary	13.04.2021	5.12
8	Gujarat	Nalsarovar Bird Sanctuary	24.09.2012	120.00
9	Gujarat	Thol Lake Wildlife Sanctuary	05.04.2021	6.99
10	Gujarat	Wadhvana Wetland	05.04.2021	6.30
11	Haryana	Bhindawas Wildlife Sanctuary	25.05.2021	4.12
12	Haryana	Sultanpur National Park	25.05.2021	1.43
13	Himachal Pradesh	Chandertal Wetland	8.11.2005	0.49
14	Himachal Pradesh	Pong Dam Lake	19.8.2002	156.62
15	Himachal Pradesh	Renuka Wetland	8.11.2005	0.20
16	Jammu and Kashmir	Hokera Wetland	8.11.2005	13.75
17	Jammu and Kashmir	Hygam Wetland Conservation Reserve	13.08.2022	8.02
18	Jammu and Kashmir	Shallbugh Wetland Conservation Reserve	13.08.2022	16.75
19	Jammu and Kashmir	Surinsar-Mansar Lakes	8.11.2005	3.50
20	Jammu and Kashmir	Wular Lake	23.3.1990	189.00

S. No.	State Location	Name of Ramsar Site	Date of Declaration	Area
21	Karnataka	Ranganathittu Bird Sanctuary	15.02.2022	5.18
22	Karnataka	Ankasamudra Bird Conservation Reserve	10.03.2023	0.99
23	Karnataka	Aghanashini Estuary	14.02.2023	48.01
24	Karnataka	Magadi Kere Conservation Reserve	14.02.2023	0.54
25	Kerala	Asthmudi Wetland	19.8.2002	61.40
26	Kerala	Sasthamkotta Lake	19.8.2002	3.73
27	Kerala	Vembanad Kol Wetland	19.8.2002	1512.50
28	Ladakh	Tso Kar Wetland Complex	17.11.2020	95.77
29	Ladakh	Tsomoriri Lake	19.8.2002	120.00
30	Madhya Pradesh	Bhoj Wetlands	19.8.2002	32.01
31	Madhya Pradesh	Sakhya Sagar	01.07.2022	2.48
32	Madhya Pradesh	Sirpur Wetland	01.07.2022	1.61
33	Madhya Pradesh	Yashwant Sagar	13.08.2022	8.23
34	Madhya Pradesh	Tawa Reservoir	08.01.2024	200.50
35	Maharashtra	Lonar Lake	22.7.2020	4.27
36	Maharashtra	Nandur Madhameshwar	21.6.2019	14.37
37	Maharashtra	Thane Creek	13.08.2022	65.21
38	Manipur	Loktak Lake	23.3.1990	266.00
39	Mizoram	Pala Wetland	31.08.2021	18.50
40	Odisha	Ansupa Lake	13.08.2022	2.31
41	Odisha	Bhitarkanika Mangroves	19.8.2002	650.00
42	Odisha	Chilka Lake	1.10.1981	1165.00
43	Odisha	Hirakud Reservoir	13.08.2022	654.00
44	Odisha	Satkosia Gorge	10.12.2021	981.97
45	Odisha	Tampara Lake	13.08.2022	3.00
46	Punjab	Beas Conservation Reserve	26.9.2019	64.29
47	Punjab	Harike Lake	23.3.1990	41.00
48	Punjab	Kanjli Lake	22.1.2002	1.83
49	Punjab	Keshopur-Miani Community Reserve	26.9.2019	3.44

S. No.	State Location	Name of Ramsar Site	Date of Declaration	Area
50	Punjab	Nangal Wildlife Sanctuary	26.9.2019	1.16
51	Punjab	Ropar Lake	22.1.2002	13.65
52	Rajasthan	Keoladeo Ghana NP	1.10.1981	28.73
53	Rajasthan	Sambhar Lake	23.3.1990	240.00
54	Tamil Nadu	Chitrangudi Bird Sanctuary	13.08.2022	2.60
55	Tamil Nadu	Gulf of Mannar Marine Biosphere Reserve	04.08.2022	526.72
56	Tamil Nadu	Kanjirankulam Bird Sanctuary	13.08.2022	0.97
57	Tamil Nadu	Karikili Bird Sanctuary	04.08.2022	0.58
58	Tamil Nadu	Koonthankulam Bird Sanctuary	11.08.2021	0.72
59	Tamil Nadu	Pallikaranai Marsh Reserve Forest	04.08.2022	12.48
60	Tamil Nadu	Pichavaram Mangrove	04.08.2022	14.79
61	Tamil Nadu	Point Calimere Wildlife and Bird Sanctuary	19.8.2002	385.00
62	Tamil Nadu	Suchindram Theroor Wetland Complex	13.08.2022	0.94
63	Tamil Nadu	Udhayamarthandapuram Bird Sanctuary	04.08.2022	0.44
64	Tamil Nadu	Vaduvur Bird Sanctuary	13.08.2022	1.13
65	Tamil Nadu	Vedanthangal Bird Sanctuary	04.08.2022	0.40
66	Tamil Nadu	Vellode Bird Sanctuary	04.08.2022	0.77
67	Tamil Nadu	Vembannur Wetland Complex	04.08.2022	0.20
68	Tamil Nadu	Karaivetti Bird Sanctuary	24.05.2023	4.54
69	Tamil Nadu	Longwood Shola Reserve Forest	24.05.2023	1.16
70	Tamil Nadu	Kazhuveli Bird Sanctuary	16.01.2024	51.52
71	Tamil Nadu	Nanjarayan Bird Sanctuary	16.01.2024	1.26
72	Tripura	Rudrasagar Lake	8.11.2005	2.40
73	Uttar Pradesh	Bakhira Wildlife Sanctuary	29.06.2021	28.94
74	Uttar Pradesh	Haiderpur Wetland	8.12.2021	69.08
75	Uttar Pradesh	Nawabganj Bird Sanctuary	19.9.2019	2.25
76	Uttar Pradesh	Parvati Agra Bird Sanctuary	2.12.2019	7.22
77	Uttar Pradesh	Saman Bird Sanctuary	2.12.2019	5.26

S. No.	State Location	Name of Ramsar Site	Date of Declaration	Area
78	Uttar Pradesh	Samaspur Bird Sanctuary	3.10.2019	7.99
79	Uttar Pradesh	Sandi Bird Sanctuary	26.9.2019	3.09
80	Uttar Pradesh	Sarsai Nawar Jheel	19.9.2019	1.61
81	Uttar Pradesh	Sur Sarovar	21.8.2020	4.31
82	Uttar Pradesh	Upper Ganga River	8.11.2005	265.90
83	Uttarakhand	Asan Conservation Reserve	21.7.2020	4.44
84	West Bengal	East Kolkata Wetlands	19.8.2002	125.00
85	West Bengal	Sunderbans Wetland	30.1.2019	4230.00

(Source: ENVIS portal, Ministry of Environment, Forest and Climate Change, Wetlands Division, Government of India.)

Table 2.5: State wise details of lakes covered under National Plan for Conservation of Aquatic- Eco-systems (NPCA)/ National Lake Conservation Plan (NLCP)

S. No.	State	Name of Lake
1.	Telangana	Banjara (Hyderabad)
2.	Jammu & Kashmir	Dal (Srinagar)
3.	Karnataka	Vengaiahkere (Bangalore)
		Nagvara (Bangalore)
		Jarganahalli (Bangalore)
		Bellandur (Bangalore)
		Kotekere (Belgaum)
		Bhishma (Gadag)
		Lal Bagh (Bangalore)
		Channapatna (Hasan)
		Sharanbhasveshwara (Gulbarga)
		Akkamahadevi (Haveri)
		Kundawada (Davangere)
		Kote Tavarekere (Chikmagalur)
		Tripuranthkeshwar (Bidar)
		Gowramma (Bangalore Rural)
		Hombalamma (Magadi town)
		Amanikere (Tumkur)
4.	Kerala	Veli Akkulum (Thiruvananthapuram)
5.	Madhya Pradesh	Rani Talab (Rewa)
		Sagar lake (Sagar)
		Shivpuri (Shivpuri)
		Sindhsagar (Ashok Nagar)
6.	Maharashtra	Powai lake (Mumbai)
		Rewale (Thane)
		Jail lake (Thane)
		Makhamali (Thane)
		Kharegon (Thane)

S. No.	State	Name of Lake
		Kusa (Thane)
		Upvan (Thane)
		Kasaradawli (Thane)
		Naar/oval (Thane)
		Khidkali (Thane)
		Mahalaxmi (Vadagaon)
		Rankala (Kolhapur)
		Varhala Devi (Bhiwandi)
		Siddheshwar (Solapur)
7.	Nagaland	Mokokchung (Lake-A)
		Mokokchung (Lake-B)
8.	Odisha	Bindu Sagar (Bhubaneswar)
9.	Rajasthan	Mansagar (Jaipur)
		Anasagar (Ajmer))
		Pushkar (Ajmer)
		Fatehsagar (Udaipur)
		Pichola (Udaipur)
		Nakki (Mount Abu)
10.	Tamil Nadu	Ooty (Ooty)
		Kodaikanal (Dindigul)
11.	Tripura	Dimasagar
		Laxminarayanibari
		Durgabadi
12.	Uttarakhand	Bhimtal (Bhimtal)
		Naukuchiatal
		Sattal
		Khurpatal
		Nainital (Nainital)
13.	Uttar Pradesh	Mansi Ganga (Goverdhan)
		Ramgarh Tal (Gorakhpur)
		Laxmi Tal (Jhansi)

S. No.	State	Name of Lake
14.	West Bengal	Rabindra Sarovar
		Mirik (Darjeeling)
		Adi Ganga (South 24 Parganas)
		Sahib Bundh (Purulia)

(Source: MoEFCC, GoI)

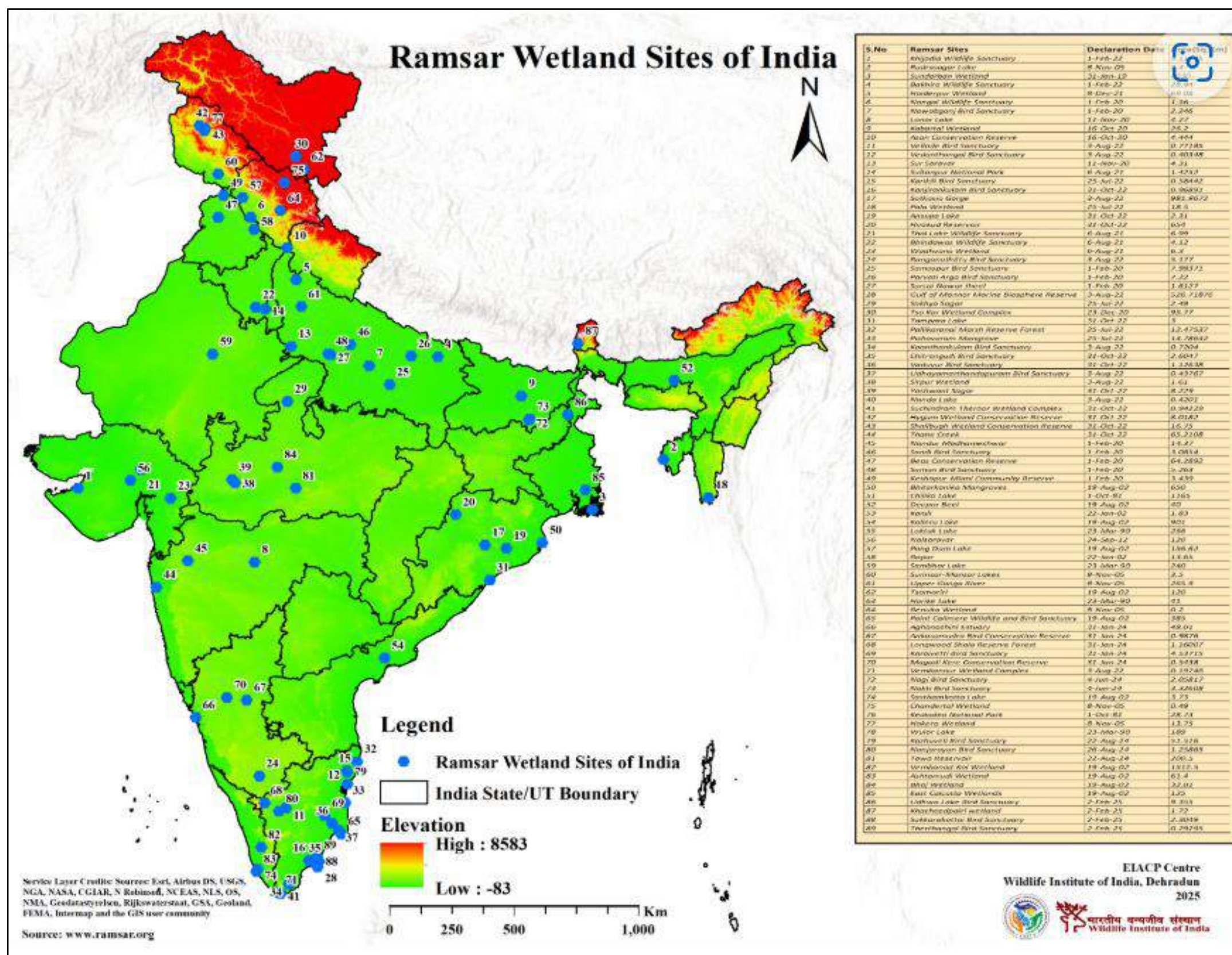


Figure 2.6: Ramsar Wetland sites in India (Source: ENVIS portal).

3 HYDROGEOLOGY

The details of the ground water conditions in and around the study area that includes geological framework and hydrogeological conditions, water level and quality data and maps along with quality issues are provided in the following sub-sections.

3.1 GEOLOGICAL SETUP

Talcher coal field is situated in the southern part of Lower Gondwana basin trending in NW-SE direction. The Talcher Gondwana Basin is almost rectangular in shape, 80 km in strike direction (E-W) and about 26 km in dipping direction (N-S). The Basin covers an area of about 1800 km² with potential coal bearing area of around 1000 km². The different geological formations found in the basin are:

1. Talcher formation

The base of the Gondwana sediments is marked by a pile of glacial and pre-glacial deposits. They were originally recognised by Blanford et al (1856) and had been designated as the Talchir Formation after the type locality. These rocks are well exposed along the southern boundary of the basin, though outcrops do occur in other areas as well. In fact, tongue-like NW-SE trending extension of Talchir sediments occur in the western part of the basin along the Mahanadi Valley and almost join up with similar outcrops of the Ib-River basin situated further to the north west. The Talchir Formation comprises diamictites, sandstones, needle shales, turbidites, rhythmites and varves which are all typified by a khaki green colour. The vertical organisation of lithofacies indicates that diamictites representing both tillite and outwash conglomerates usually overlie the basement unconformably. They are, in turn, succeeded by a turbidite sequence comprising siltstone, shale, rhythmite etc. The turbidites also display a wide range of sedimentary structure including flute castes, groove casts, flame structures, ripple marks, cross ripple lamination etc. The turbidite sequence is followed upwards into cross bedded fine to medium grained sandstone. No estimate of the thickness of the Talchir Formation is available.

2. Karaharbari formation

The Talchir Formation is conformably overlain by the Karharbari Formation, which is exposed as a narrow strip both along the southern and northern margins of the basin. Karharbari Formation has a distinct lithological and palynological entity in this coalfield. The sandstones are characteristically pale brownish yellow in colour, massive, medium to coarse grained and contains clasts of Talchir shale, all held together loosely by a clay matrix bearing a slightly greenish tint. Besides, thin shale bands and some superior quality coal seams are developed.

3. Barakar formation

Barakar formation overlies Karharbaris and is characterized by a thick and conspicuous basal conglomerate horizon at its base. The conglomerate contains well- rounded quartz and quartzite clasts of various sizes embedded in a sandy matrix. The basal conglomerate unit is overlain by a thick sequence (more than 500m) of medium to coarse-grained greyish feldspathic sandstones, grey to dark grey shale, carbonaceous shale, thick coal seams mostly interbanded with shale and clay bands. Barring central and western part of the basin, it occurs extensively.

4. Barren Measures formation

The Barren Measure Formation conformably overlies the Barakar Formation and the contact between the two is gradational. Lithologically the two formations are very similar near the contact and identification and fixation of boundary between them pose problem. As the name indicates, the Barren Measures are devoid of any economical coal seams but a few thin coal and carbonaceous shale zones are present within it. The Barren Measures comprises fine to very fine grained sandstone, gray shale often with siderites, ferruginous sandstone, siltstone and occasionally thin coal and carbonaceous shale.

S.N Chakrobarty and others of GSI divided Super-Barakar formation into 3 formations in 1962, these are Raniganj formation, Panchet formation, Mahadeva formation. C.S Raja Rao in 1982 named the entire Super-Barakar strata as Kamthi

formation. Further in 1997 it is subdivided into lower part and upper part of Super-Barakar formation as Barren Measure and Kamthi formation. Map showing the geology of the study area in and around Kaniha OC, Talcher Coalfield is given in **figure 3.1**.

Structure: The Talcher coalfield, the south-eastern extremity of the NW-SE trending Son-Mahanadi masterbasin belt, depicts a north-westerly plunging synclinal structure. The basin closes both in the east and west. The younger horizon outcrops progressively towards west. The Gondwana-Precambrian boundary in the north is marked by a set of WNW-ESE trending faults. It follows closely the alignment of Mahanadi valley rift, and is apparently enechelon with the faults which mark the southern boundary of the Ib-River basin occurring towards north-west. The southern boundary of the basin, however, is more or less free from any major faulting.

The regional strike of the Gondwana sediments is more or less east-west but varies from ENE-WSW to ESE-WNW. In the southern part the beds have low northerly dip whereas in the north the beds dip at low angles towards south. Local variations in dip and strike are present and may be attributed to faulting. The stratigraphic succession of the Talcher Coalfield based on surface and sub-surface data is given in the **Table 3.1** below:

Table 3.1: Generalized stratigraphic succession of Talcher Coalfield, India.

(After GSI 1997)

Group	Age	Formation	Thickness (m)	Lithology
	Quaternary	Quaternary deposits (Recent)	40+	Colluvial fills, sand, silt deposits and clay of older alluvium, older and younger floodplain deposits, channel fills etc
	Cenozoic	Laterite	40+	Laterites, lateritised detrital pebble bed

Group	Age	Formation	Thickness (m)	Lithology
GONDWANA SUPER GROUP	Upper Permian to Lower Triassic	Undifferentiated Kamthi Formation	575+	Fine to medium grained light grey to reddish sandstone and shale at the base and pale greenish sandstone with rare shale and pink clay bands, ferruginous coarse grained to pebbly sandstone at top
	Unconformity			
	Upper Permian	Barren Measures	461+	Greenish grey to buff coloured pebbly, coarse to medium grained highly ferruginous sandstone with variable proportions of fresh K-feldspar
	Lower Permian	Barakar Formation	500+	Medium to coarse grained greyish feldspathic sandstone, grey to dark grey shale and coal seams
	Lower Permian	Karharbari Formation	279+	Pale brownish yellow coloured massive medium to coarse grained sandstone containing clasts of Talchir shale and coal seams
	Upper Carboniferous to Lower Permian	Talchir Formation	327+	Diamictite, sandstone, needle shale, turbidite, rhythmites and varves
	Unconformity			
	Archaean(?) to Lower Proterozoic	Pre-Cambrian Metamorphics		Granites, gneisses and associated supracrustals

Geology of the Kaniha OC core zone

The Lithology sequence that closely resembles the mine lease and core areas of the study area based on detailed drill hole data are as below in **Table 3.2**:

**Table 3.2: Generalized stratigraphic succession from boreholes of Kaniha OC mines,
Talcher Coalfield, MCL**

(Source: GR of Kaniha-Neelachal Block ,CMPDI)

Period	Group	Sub-Group	Formation	Lithology
Recent & Sub-recent	-	-	Alluvium & Laterite	Soil, Laterite
----- Unconformity -----				
Triassic - Upper Permian	Lower Gondwana	-	Supra Barakar (Kamthi and Barren Measures)	Ferruginous sandstone and shale
Lower Permian		Damuda	Barakar	Sandstone, shale, pebbles, boulders and coal seams (Seam II, III, IV)
			Karharbari	Sandstone with bands of shales and conglomerates
Permo-carboniferous	-	-	Talchir	Fine to medium grained greenish sandstone and shale
----- Unconformity -----				
Pre-cambrian	-	Archaeans	Metamorphics	Granites and amphibolites

The Kaniha OCP is belongs to Kaniha geological coal block which is located in north – central edge of Talcher coal field. Kaniha geological coal block spreading over an area of 12.4 sq. km comprising of rocks of Talcher, Karharbari and Barakar formations. The central and north- central part is capped by laterite and lateritic soil. Surface exposures of Barakar formations are scanty. Outcrops of Talchirs are being seen in the area west of Ambapal village in the north-east and beyond the north-western boundary of the block. Occurrences of 3 main coal seams, viz., II,III, IV and Local seam have proved

under the cover of soil and sub soil by detailed exploration in Kaniha geological coal block. Seam-II occurs in nine split sections which combine with each other in different manner in different parts of the block. Seam-III occurs either in one combined section in the southern & central portion of the block or in two split sections in other parts of the block. Seam - IV also occurs in two split sections. One local seam between seam - II & III occur only in north western part of the block.

Structure:

The Kaniha block represents a slice between two step faults - the northern one having a throw of 90 m. towards south while the southern fault, a very major one has a downthrow also towards south. The structure within the block limited by these two faults is highly complex. The western part of the block is represented by an anticline in the central region with the axis trending EW and having plunge towards east. This anticline is followed, laterally towards north, by a syncline with the axis plunging towards north-west. In the central part, because of a number of criss-cross faults with differential throw, the structure is highly complicated and not easily definable. The structure of the eastern part is in the form of a simple basin with total closure at the core and intercepted by a few faults.

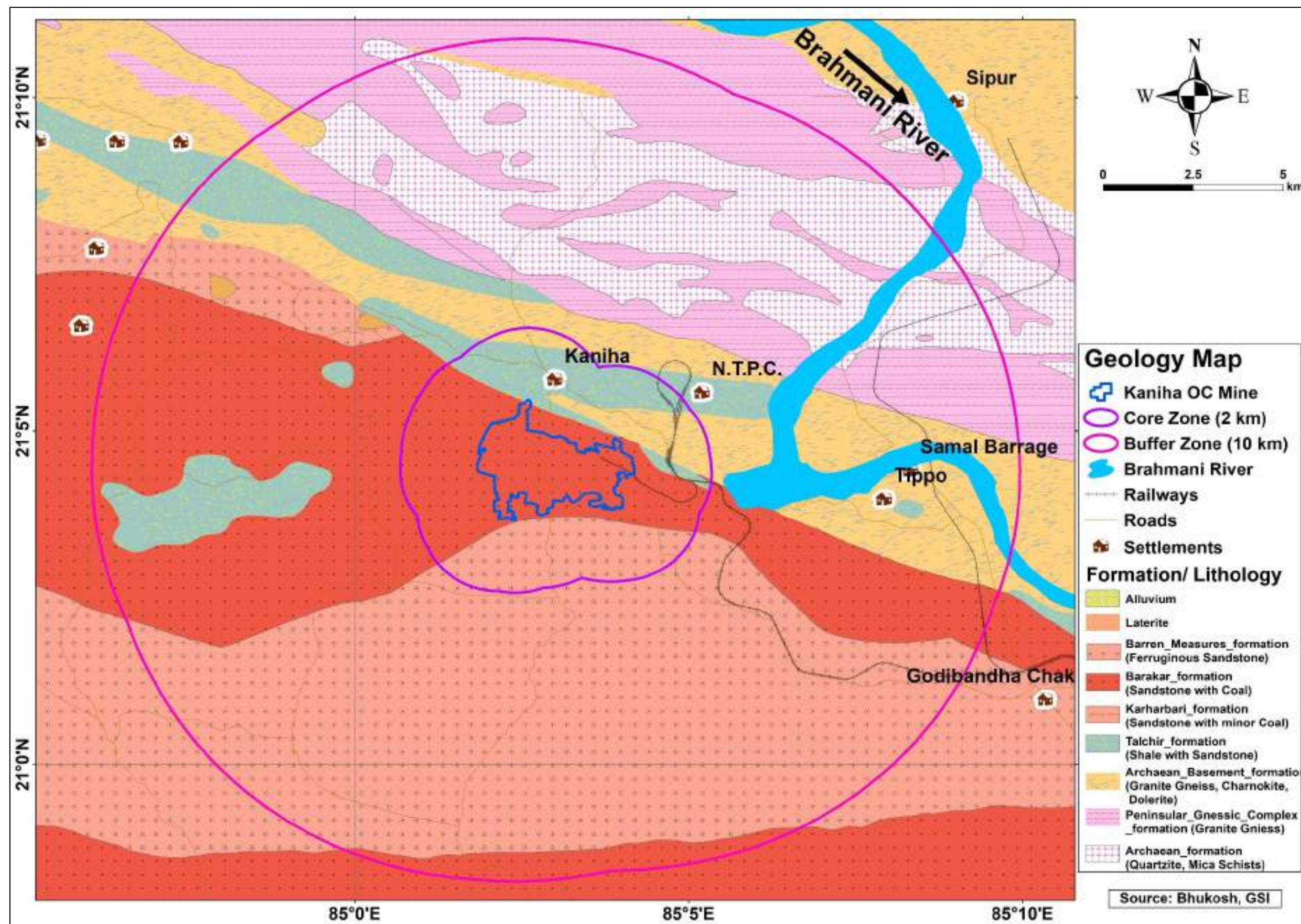


Figure 3.1: Map showing the geology of the study area in and around Kaniha OC, Talcher Coalfield, MCL (source GSI portal).

3.2 GEOPHYSICAL STUDIES

The geophysical studies play a vital role in the identification of groundwater potential zones. The Electrical resistivity imaging (ERI) survey is one of the best surface geo-electrical survey techniques for delineating groundwater potential zones. The five numbers of ERI surveys done around the Kaniha OCP mines area. The approximate radial distance of ERI surveys is 2.6 km in the southern part of the Kaniha OCP mines area. As shown in Fig.3.2.1. The details of the geophysical survey undertaken are as follows:



Figure.3.2.1: The Electrical resistivity imaging (ERI) survey Location, near Kaniha OCP mines.

3.2.1 Equipment used

The SYSCAL PRO Switch type resistivity meter of M/s IRIS Instruments, France, was used for an imaging survey. Multi-electrode cables (6nos, each with 8 cut-outs) were laid on the ground and connected with 48 metallic electrodes separated at a constant

distance. Then, depending upon the length of the profile line, a sequence with predetermined electrode spacing was prepared. The Creation of this sequence is very important as this determines the electrode array, electrode spacing, etc., to be used for the investigation. Once the operation started, the measurements were taken automatically for all the possible combinations, and the data was stored in the memory of the field equipment.

3.2.2 Methodology and Data Acquisition

The Resistivity instrument has a built-in potentiometer circuitry to measure current sent into the ground and potential difference thus developed between two potential electrodes. The equipment also has a facility to get direct reading of the resistance value on a liquid crystal display. The point of observation was taken as the midpoint of the separation of two inner potential electrodes. The resistivity at each observation point was calculated by Ohm's Law:

$$\rho = K (\Delta V / I)$$

Where ρ – Apparent Resistivity in Ωm

K – Constant (Geometrical factor depending upon electrode configuration)

ΔV – Potential difference due to the corresponding current.

I – Current

The constant K is different for different electrode arrangements used for taking observations. The electrode arrangements are commonly used for resistivity profiling.

The electrode arrangements of the Wenner-Schlumberger configurations are shown in Fig. 3.2.2. The geometrical factor for the Wenner-Schlumberger array is

$$K = \pi m(m + 1)a$$

Where a and m are the dipole length and the dipole separation factor respectively. However, m factor can be used as integer or non-integer value.

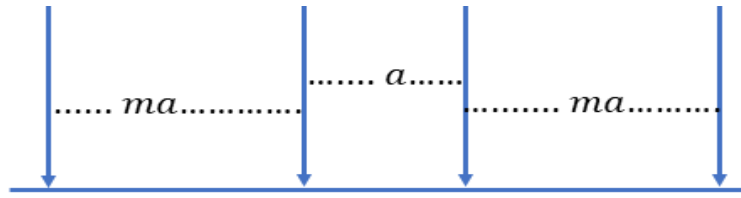


Figure 3.2.2 The Wenner-Schlumberger electrode configurations.

3.2.3 Electrical Resistivity Imaging (ERI) Survey

Geo-electrical resistivity imaging has played an important role in addressing a wide variety of hydrogeological, environmental and geotechnical issues as conventional resistivity profiling but in more accurate 2D model of the subsurface by giving the resistivity changes in the vertical direction, as well as in horizontal direction of the survey line.

The objective of ERI profiling was to detect lateral variation of electrical resistivity of the formation caused by coal incrop, faults, and water bearing zone are change in lithology.

3.2.4 Data Processing and Interpretation

The collected data are transferred from the field equipment to a laptop through PROSYS II software available with the instrument. This software converts the resistance measurements into apparent resistivity values for further data processing. These data are then used for resistivity inversion through the RES2DINV programme provided with the instrument. The final output is the 2-D resistivity distribution of the subsurface.

3.2.5 Results and discussions

Profile-P1:

The resistivity data acquired in profile-P1 are from approximately the N-S direction along dip direction, and the length of the profile is 1200 m. The 2D inversion result shows six low resistivity anomalies in Fig. 3.2.3, and the interpreted details are mentioned in Table 3.2.1. The low resistivity anomaly zone and interpreted as a water-bearing zone with average resistivity values (10 Ω m -13 Ω m) at a depth of 26-40 m.

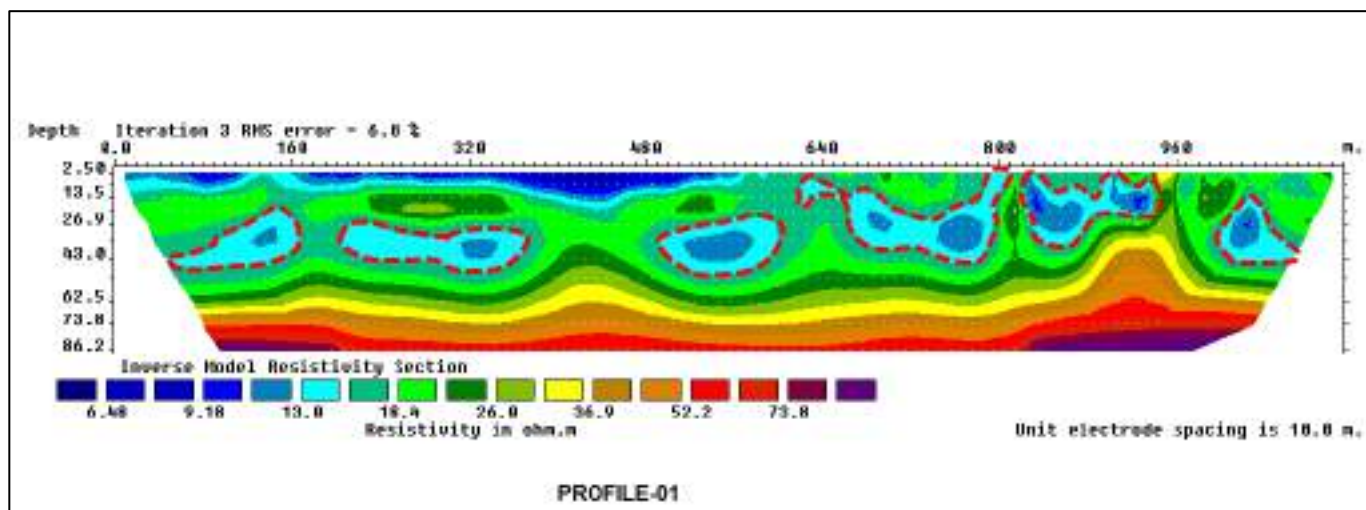


Figure 3.2.3. 2D resistivity inverted sections (in Ωm) for profile P1, using Wenner-Schlumberger array configurations, and the profile is 1200 m long with 10 m electrode spacing in the N-S direction.

Table 3.2.1: Details of low resistivity anomalies and possible attributes delineated in the Profile-P1 section.

S. No.	Low Resistivity Anomaly at Horizontal Distance (m)	Approx Depth (m) by ERI	Inverted ERI (Ωm) Value	Possible Attributes
1	30-170	26-40	10-13	Loose sandstone formation, as expected, is a water-bearing zone
2	200-370	26-40		
3	490-520	26-45		
4	620-810	5-43		
5	820-940	5-43		
6	990-1070	15-43		

Profile-P2:

The resistivity data acquired in profile-P2 are from approximately the N-S direction along dip direction, and the length of the profile is 860 m. The 2D inversion result shows five low resistivity anomalies in Fig. 3.2.4, and the interpreted details are mentioned in Table 3.2.2. The low resistivity anomaly zone and interpreted as a water-bearing zone with average resistivity values ($10\ \Omega\text{m}$ - $15\ \Omega\text{m}$) at a depth of 26-50 m.

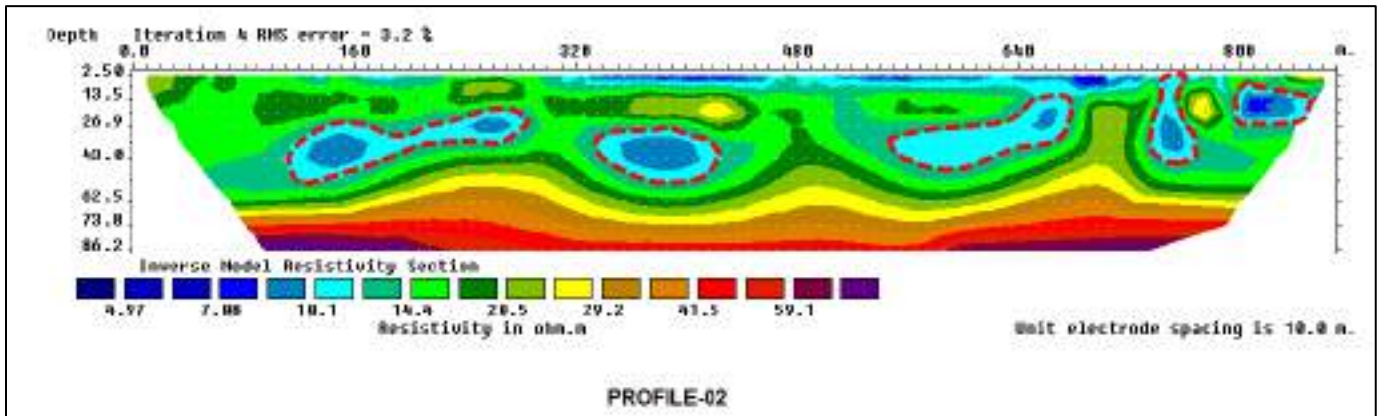


Figure 3.2.4. 2D resistivity inverted sections (in Ωm) for profile-P2, using Wenner-Schlumberger array configurations, and the profile is 860 m long with 10 m electrode spacing in the N-S direction.

Table 3.2.2: Details of low resistivity anomalies and possible attributes delineated in the Profile-P2 section.

S. No.	Low Resistivity Anomaly at Horizontal Distance (m)	Approx Depth (m) by ERI	Inverted ERI (Ωm) Value	Possible Attributes
1	110-290	26-50	10-15	Loose sandstone formation, as expected, is a water-bearing zone
2	330-410	50-60		
3	540-670	15-50		
4	730-770	5-45		

5	800-850	5-43		

Profile-P3:

The resistivity data acquired in profile-P3 are from approximately the S-N direction along dip direction, and the length of the profile is 950 m. The 2D inversion result shows two low resistivity anomalies in Fig. 3.2.5, and the interpreted details are mentioned in Table 3.2.3. The low resistivity anomaly zone and interpreted as a water-bearing zone with average resistivity values (10 Ω m -15 Ω m) at a depth of 26-50 m.

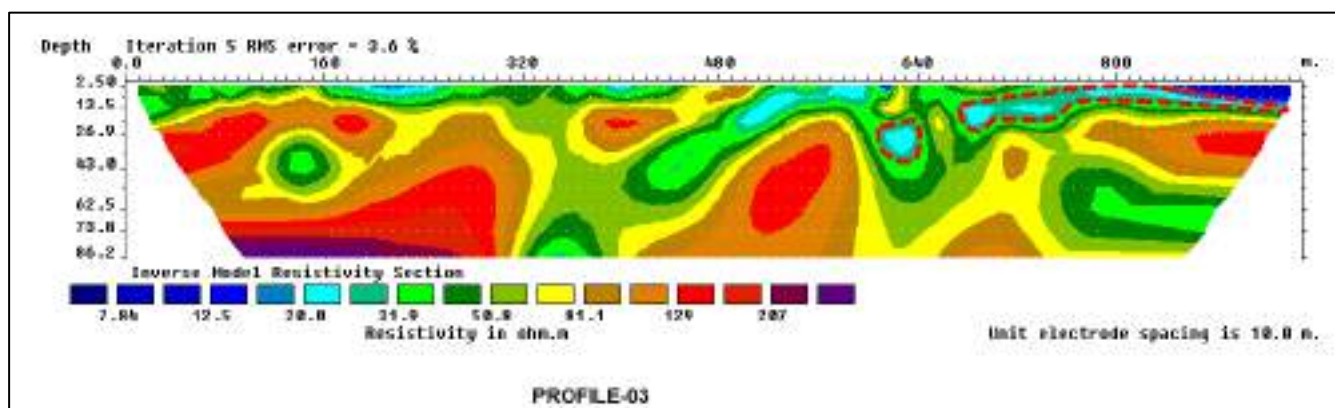


Figure 3.2.5. 2D resistivity inverted sections (in Ω m) for profile-P3, using Wenner-Schlumberger array configurations, and profile is 950 m long with 10 m electrode spacing in the S-N direction.

Table 3.2.3: Details of low resistivity anomalies and possible attributes delineated in the Profile-P3 section.

S. No	Low Resistivity Anomaly at Horizontal Distance (m)	Approx Depth (m) by ERI	Inverted ERI (Ω m) Value	Possible Attributes
1	600-640	26-43	20-30	Loose sandstone formation, as expected, is a water-bearing zone
2	670-920	10-20		

Profile-P4:

The resistivity data acquired in profile-P4 is from approximately S-N direction along dip direction, and the length of the profile is 1160 m. The 2D inversion result shows that high resistivity anomalies in Fig. 3.2.6 and interpreted shows that high resistivity zone and a lower possibility of a water-bearing zone in this profile line.

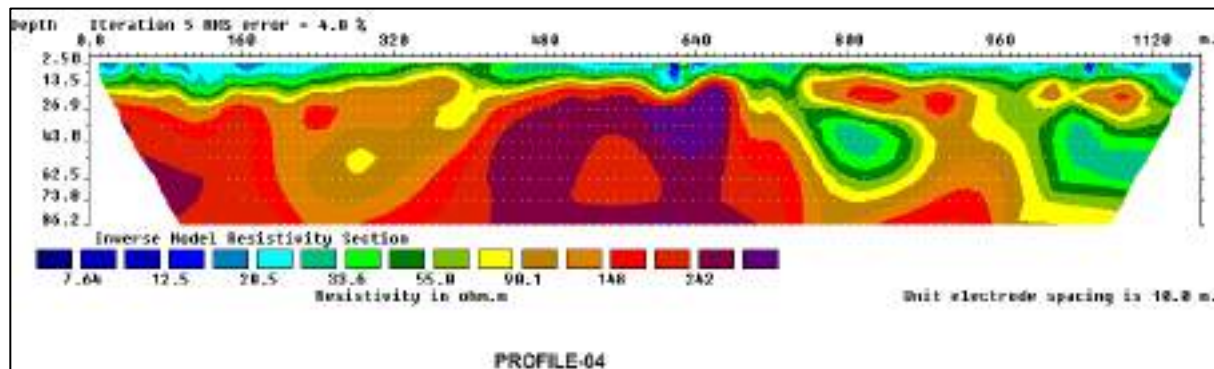


Figure 3.2.6. 2D resistivity inverted sections (in Ωm) for profile-P4, using Wenner-Schlumberger array configurations, and the profile is 1160 m long with 10 m electrode spacing in the S-N direction.

Profile-P5:

The resistivity data acquired in profile-P5 are from approximately S-N direction along dip direction, and the length of the profile is 460 m. The 2D inversion result shows that three low resistivity anomalies in Fig. 3.2.7 and interpreted details are mentioned in Table 3.2.4. The low resistivity anomaly zone and interpreted as a water-bearing zone with average resistivity values (6 Ωm -10 Ωm) at a depth of 26-50 m.

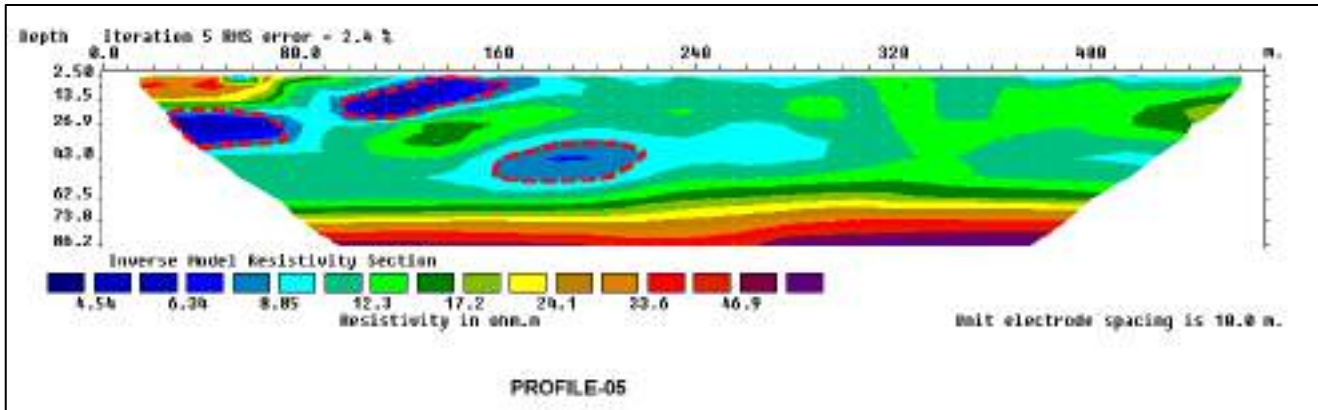


Figure 3.2.6. 2D resistivity inverted sections (in Ωm) for profile-P5, using Wenner-Schlumberger array configurations, and the profile is 460 m long with 10 m electrode spacing in the S-N direction.

S. No.	Low Resistivity Anomaly at Horizontal Distance (m)	Approx Depth (m) by ERI	Inverted ERI (Ωm) Value	Possible Attributes
1	20-70	26-43	6-10	Loose sandstone formation, as expected, is a water-bearing zone
2	100-160	5-20		
3	160-220	43-50		

3.2.6 Conclusions

The Electrical resistivity imaging survey is the most suitable geophysical method for groundwater investigation. Since the resistivity values are conducive for the accumulation of water, they could be marked out. The present area of investigation does not promise to be good for tapping the groundwater; however, from the study of the above results and the regional geology, it is clear that the area is dominated by softer rocks and hard rock, and thus, there are feasible chances of finding a good aquifer that can meet the requirements of the whole complex in hard rock formation. It is only with the help of faults, fractures, cracks and fissures in hard rocks that water can percolate down and get accumulated. The

interpreted results of all profile lines indicate that the average resistivity values for softer/loose sandstone formation are varies from 10-15 Ω m and these low resistivity values indicates that the probable water-bearing zone at an approximate depth of 20-45 m.

3.3 HYDROGEOLOGICAL SETUP

From various geological and hydrogeological investigation studies conducted by CMPDI and CGWB in the area, it is depicted that the hydrogeological frame work of the study area is mainly controlled by geological setup, the rainfall distribution in the coalfield area and the degree of secondary and primary porosity of the geological formation for storage and movement of groundwater. The area is mainly underlain by Gondwana formations which are gently dipping in a northerly direction. Faulting is quite common in the formations and form a conduit for groundwater movement.

Aquifer description: Ground water occurs under water table condition in shallow phreatic aquifer, where as in semi-confined to confined condition in deeper aquifers. The entire hydrogeological units in the buffer zone can be divided into two groups as; Consolidated & Semi-consolidated formations.

Consolidated formations: Consolidated formations include meta-sedimentary rocks comprising quartzites and granite. They mainly occupy the northern, southern and eastern part of study area. These formations generally do not have thick weathered zone developed on them due to massive nature and moderate slope. Ground water in these formations occurs under unconfined conditions. The presence of pegmatitic veins and associated fractures associated with structural deformations form good areas for groundwater. However, their presence is highly uncertain and can be exploited by deep-bore wells. As per literature of CGWB studies conducted in the area, the yield in Consolidated formation is of the order of 1-2 LPS.

Semi-consolidated formations: This formation comprises of sandstone, conglomerate, shale & claystone of Talcher, Karharbari, Barakar & Barren Measure formations. Generally, sandstones are massive and devoid of any primary porosity. However thick weathered zone developed on these formations have high porosity and

permeability and form good repository of ground water. Ground water occurs under unconfined conditions and is commonly been exploited by dug wells. The area is getting good rainfall and in the presence of boulder bed and thick forest cover, these formations are naturally replenished. Moreover, the presence of canal system of Samal Barrage gives additional recharge to the aquifer. Thus, the ground water potential of this aquifer is good. However, the water level is deeper and drying up of wells is also reported and may be natural and at some localities due to adjacent mining activities. Bore wells are locally feasible due to presence of faults and related fractures. .Depth of open wells varies from 7.5 to 12.0 m and the average pre-monsoon depth to water level is around 5.25 mbgl and the post-monsoon average depth to water levels is around 2.6 mbgl. As per literature of CGWB studies conducted in the area, the yield in Consolidated formation is of the order of 0.5 LPS. However, based on actual field investigations by CMPDI yields up to 3LPS have also been encountered in Talcher Coalfield.

The various hydrogeological units developed in the project area are furnished in **Table 3.3**.

Table 3.3: Various Hydrogeological units developed in the study area /Kaniha OC mine, Talcher Coalfield, MCL.

Coal Seams/ Parting (Potential Hydrogeological Unit (PHU))	Thickness (m)	
	From	To
IX	0.76	4.23
PARTING(PHU)	21.22	29.55
VIII T	0.80	6.74
PARTING(PHU)	3.63	10.14
VIII M	0.43	2.89
PARTING(PHU)	3.21	17.80
VIII B	0.50	5.30
PARTING(PHU)	27.04	29.73
VII	0.48	1.85
PARTING(PHU)	12.39	17.71
VI	0.38	2.30
PARTING(PHU)	49.06	51.22
V T	2.09	4.05

Coal Seams/ Parting (Potential Hydrogeological Unit (PHU))	Thickness (m)	
	From	To
PARTING(PHU)	11.28	15.30
V B	0.47	4.55
PARTING(PHU)	26.33	27.85
IV T	0.21	1.87
PARTING(PHU)	23.40	26.28
IV M	0.30	5.17
PARTING(PHU)	3.53	25.63
IV B	0.15	10.13
PARTING(PHU)	33.06	56.20
III T	0.27	8.08
PARTING(PHU)	3.30	8.35
III B	0.20	6.59
PARTING(PHU)	5.85	21.65
II LOCAL	0.30	3.66
PARTING(PHU)	2.66	165.12
II T4	0.49	10.97
PARTING(PHU)	3.43	11.41
II T3	0.32	3.46
PARTING(PHU)	3.30	11.83
II T2	0.30	9.71
PARTING(PHU)	3.10	19.67
II T1	4.45	15.52
PARTING(PHU)	3.48	24.55
II B3	0.45	10.04
PARTING(PHU)	7.92	28.33
II B2	0.23	13.78
PARTING(PHU)	3.20	20.55
II B1	0.27	8.65
PARTING(PHU)	1.25	12.90
II BOB	0.13	8.55
PARTING(PHU)	1.29	16.87
PARTING(PHU)	1.29	16.87
II BOA	0.12	2.43
PHU- Coarse to fine grained Sandstone and Shale intercalations which can be potential water yielding strata.		

(Source: GR of Kaniha,CMPDI)

For the preparation of hydrogeological map depicting aquifers available in the area and ground water table elevation contours and ground water flow direction, the 30 dug wells/ observation wells data are used. Inverse distance weighted (IDW) technique is implemented for interpolating the points (wells) data for generating the raster layer. The hydrogeological map is shown in **Figure 3.8** for pre-monsoon (May 2024) and in **Figure 3.9** for the post-monsoon season (Nov 2024). The water table in the study area follows the local topography and slopes towards the eastern side ultimately towards the Brahmani River.

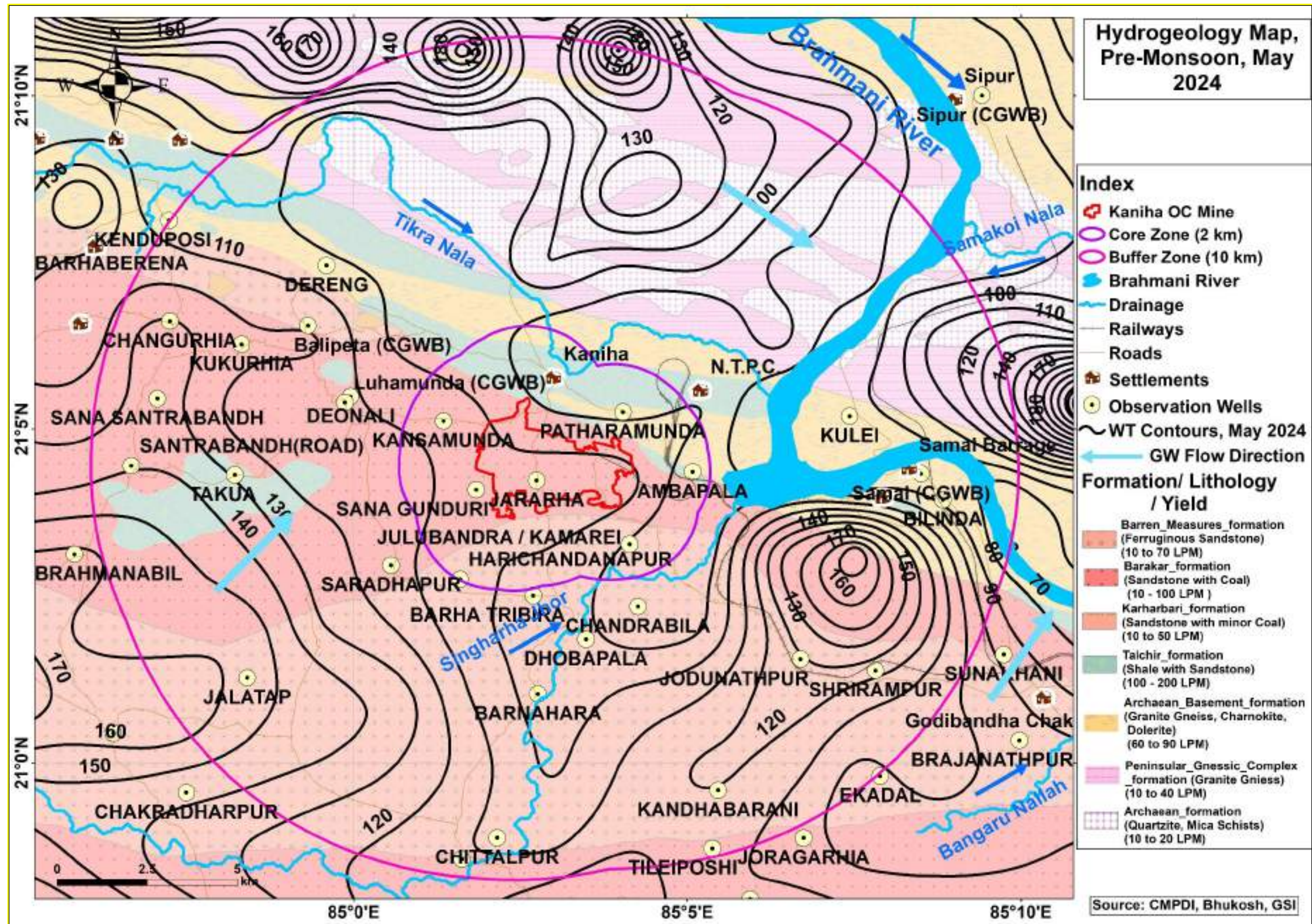


Figure 3.8: Hydrogeology map for pre-monsoon (May 2024) of Kaniha OC study area, Talcher Coalfield, MCL.

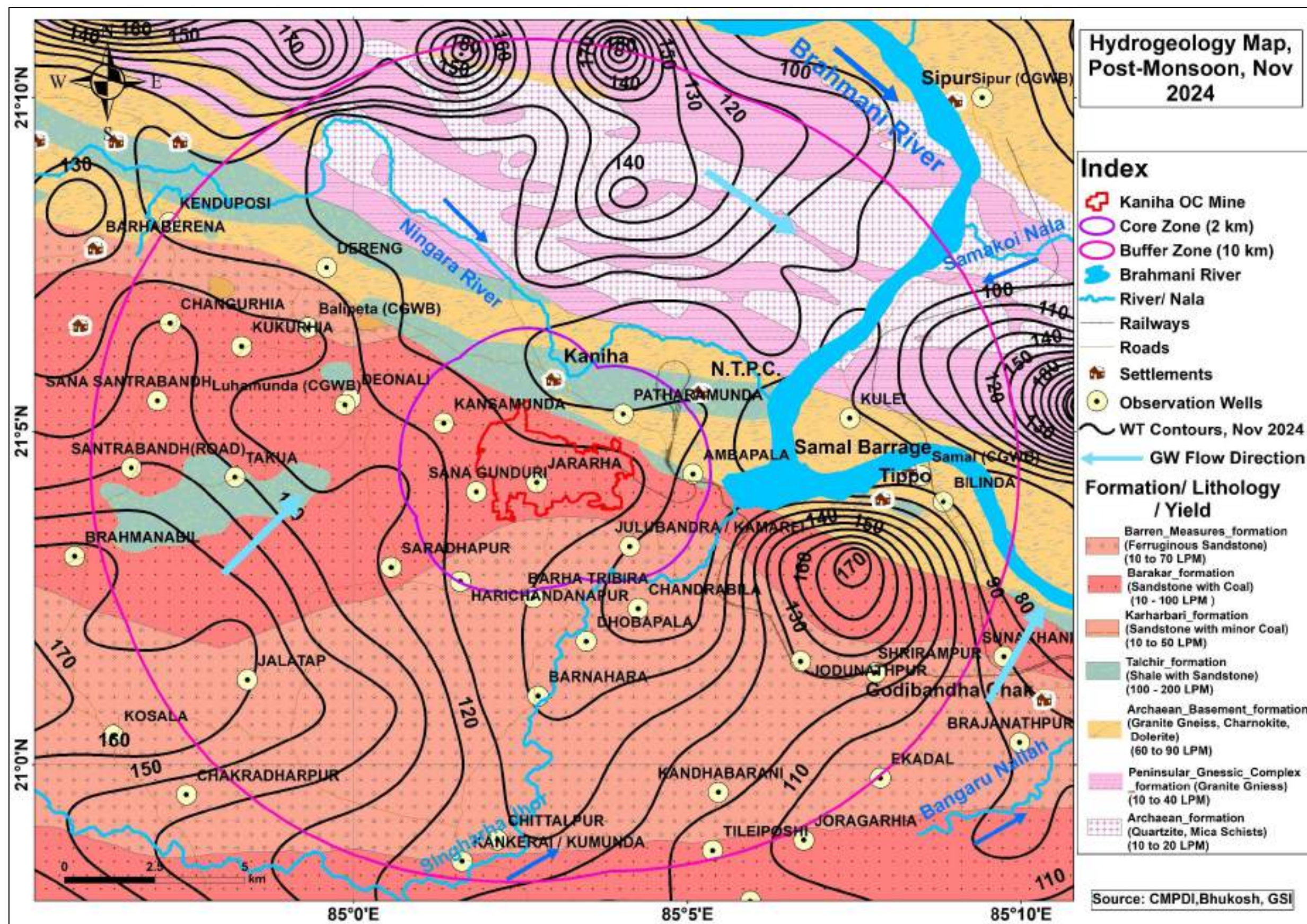


Figure 3.9: Hydrogeology map for post-monsoon (Nov 2024) of Kaniha OC study area, Talcher Coalfield, MCL.

3.3.1 Aquifer characteristics

The Barren measures and Karharbari sandstone acts as the principal aquifer system in the project area. The aquifer parameters evaluated in the area in earlier investigations are discussed in this section. CMPDI had conducted Constant discharge pumping test bore well of 171-meter depth situated Outside Golaghar sahi primary school, Bijigo Lat 21.0804661 N ,Long:85.086708 E in the year 2017. The static water level was measured as 4.65 m bgl. Pumping at a constant discharge was continued for 420 minutes and drawdown data in regular time intervals was recorded in the pumping well. Recovery data was also taken after pumping stopped.

Pumping tests conducted by CMPDI in the past in nearby villages are detailed below **Table 3.4**:

Table 3.4: Aquifer parameters from various sources in the Kaniha OC study area.

Piezometer No.	Location	Total depth of piezometer (m)	Piezometric head of the aquifer (m bgl)	Averaged Permeability or hydraulic conductivity (m/day)
MTP-19	Outside Golaghar sahi primary school, Bijigo Lat 21.0804661 N Long:85.086708 E	171	3.46	0.125

Source: A REPORT ON GROUNDWATER SURVEY AND ANALYSIS BEFORE AND DURING MINING ACTIVITIES TO ASCERTAIN THE IMPACT OF COAL MINING IN GROUNDWATER RESOURCES AT TALCHER COALFIELD ODISHA,2017

Considering the above observations, the maximum permeability value (K) of **0.125 m/day** in the study has been considered for estimating the groundwater inflow into the mine from the formation.

3.3.2 Ground water flow and aquifer interaction with surface water bodies

The groundwater-surface water interaction in the study area can be observed with respect to the Tikra Nadi (North of the mine), Singhara Jhor (South of the mine) and Brahmani river in the eastern part. The Kaniha OC mine fall in the catchments of Singhara Jhor and Tikra Nadi. The term Jhor is used locally for small streams. The flood hydrograph (**Figure 3.10**) is similar to majority of perennial rivers in India and is a classic response to a rainfall event and consists of three main stages:

- i) Pre-monsoon, prior low-flow conditions in the stream consist entirely of base flow at the end of a dry period.
- ii) With monsoon rainfall, an increase in stream flow with input of quick flow dominated by runoff and interflow. This initiates the rising limb towards the crest of the flood hydrograph. The rapid rise of the stream level relative to surrounding groundwater levels reduces the hydraulic gradient towards the stream. This is expressed as a reduction in the base flow component at this stage.
- iii) Post-monsoon, the quick flow component passes, expressed by the falling limb of the flood hydrograph. With declining stream levels timed with the delayed response of a rising water table from infiltrating rainfall, the hydraulic gradient towards the stream increases. At this time, the base flow component starts to increase. At some point along the falling limb, quick flow ceases and stream flow is again entirely base flow. Over time, base flow declines as natural storages are gradually drained during the dry period up until the next significant rainfall event.

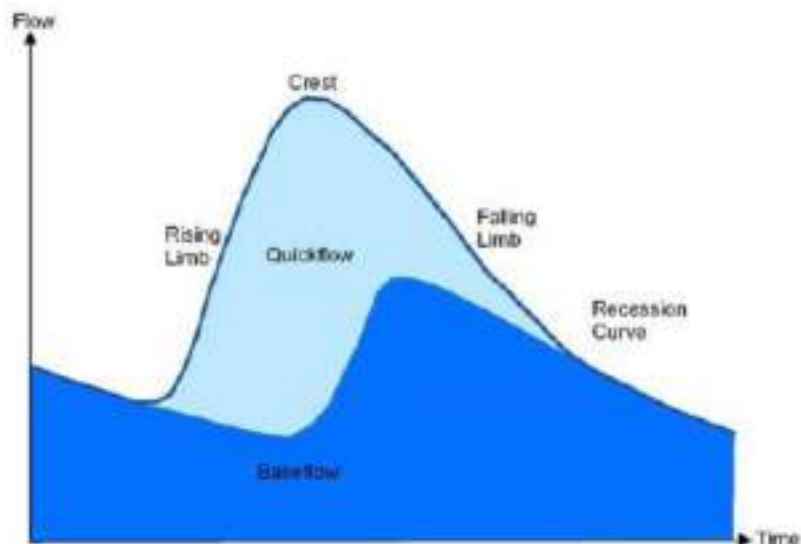


Figure 3.10: Flood hydrograph of major perennial rivers like Brahmini River.

The regional flow direction of groundwater towards the Brahmini river in the study area is evident from the hydrogeological map (**Figure 3.8** and **Figure 3.9**). However localized directions may vary due to wide use of land in open-cast mining in the area.

3.3.3 Depth to water level

To assess the water table configuration, a network consisting 30 dug wells, covering most of the villages falling within the core(9 wells) and buffer zone(21 wells), were selected for the study area. The wells are mostly used for domestic water needs. The water levels in the observation wells were recently monitored during the pre-monsoon period (May 2024) and post-monsoon season (November 2024), and the details of other available data are given in **Table 3.7**. Map illustrating the groundwater regime monitoring wells in the core and buffer zone of the study area is provided in the **Figure 3.11**.

The statistical summary of groundwater levels monitored during the month of May 2024 and November 2024 in the study area is provided in **Table 3.5** and **Table 3.6** respectively. In the pre-monsoon season, the water level varies from 2.30 m (Barha Tribira observation well) to 8.05 m (Harichandanpur observation well) with an average of 5.18 m in the core zone (2 km), and from 2.0m (Dhobapala observation well) to 9.0 m (Ekadal observation well) with an average of 5.25 m in the buffer zone (10 km).

Table 3.5: Statistical summary of groundwater level monitored during pre-monsoon season (May 2024) in the study area.

Value	Core zone (2 km), GW levels (m)	Buffer zone (10 km), GW levels (m)
Minimum	2.30 (Barha Tribira)	2.0 (Dhobapala)
Maximum	8.05 (Harichandanpur)	9.0 (Ekadal)
Average	5.18	5.25

In the post-monsoon season, the water level varies from 1.30 m (Barha Tribira observation well) to 4.0 m (Patharamunda observation well) with an average of 2.86 m in the core zone (2 km), and from 1.50 m (Kankerei/Kumunda observation well) to 4.55 m (Ekadal observation well) with an average of 2.49 m in the buffer zone (10 km).

Table 3.6: Statistical summary of groundwater level monitored during post-monsoon season (Nov 2024) in the study area.

Value	Core zone (2 km), GW levels (m)	Buffer zone (10 km), GW levels (m)
Minimum	1.30 (Jambubahalli)	1.50 (Kankarei/Kumunda)
Maximum	4.00 (Patharamunda)	4.55 (Ekadal)
Average	2.86	2.49

Spatial and temporal variations in water levels

The Depth to Water Level (DWL) contour map of the study area prepared using the pre-monsoon (May 2024) and post-monsoon (November 2024) water level data is furnished in **Figure 3.12** and **Figure 3.13** respectively and the details of monitoring wells and water levels are given in **Table 3.7**.

The groundwater level fluctuation of the study area in core zone ranges from 0.50 – 5.0 m. The mine (buffer) area falls under the fluctuation zone of 0.50 – 5.2 m. The

groundwater level fluctuation map of the study area is shown in **Figure 3.14**. The water level fluctuation map indicates that the fluctuations is more near to western part of the study area and central part is showing moderate fluctuation.

The depth to water level measured manually in piezometer for the period 2018 to 2024 is given below:

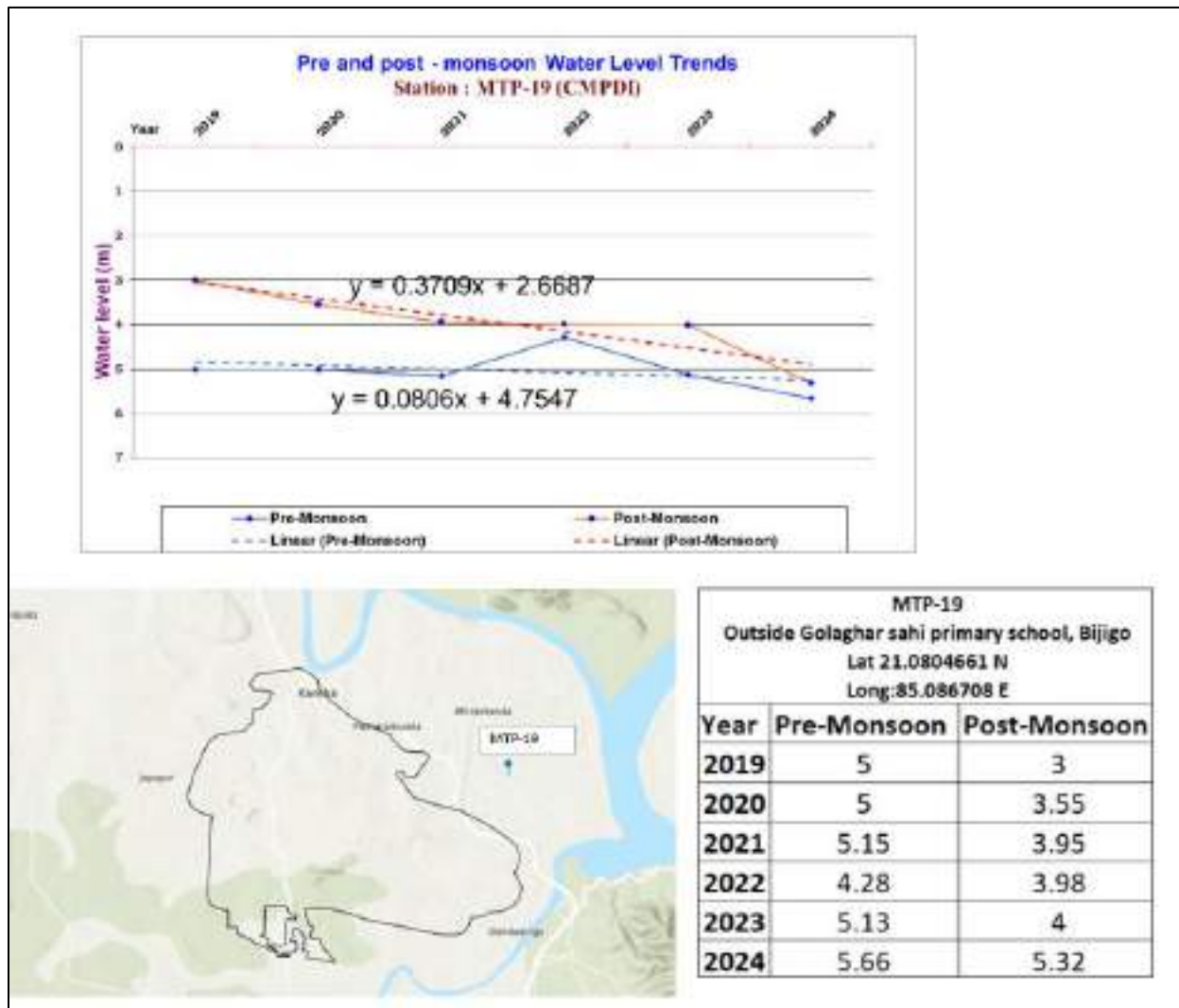


Figure 3.10A: Pre and Post-monsoon groundwater level trends at Piezometer station MTP 19, Talcher Coalfield

(Source REM CMPDI)

Table 3.7: Well inventory details for Kaniha OC study area

S.No.	Well ID	Village	LONGITUDE	LATITUDE	R.L(in m)	Pre-monsoon (May 24) Water Level (in m)	Post-monsoon (Nov 24) Water Level (in m)	Fluctuation (in m) [Pre-monsoon - Post-Monsoon]
Core Zone								
1	K085	CHANDRABILA	85.07102	21.03906	94.11	6.35	3.50	2.85
2	K086	JULUBANDRA / KAMAREI	85.06893	21.05460	90.14	4.50	3.50	1.00
3	K087	BARHA TRIBIRA	85.04488	21.04178	103.51	2.30	1.30	1.00
4	K088	HARICHANDANAPUR	85.02661	21.04586	113.41	8.05	3.05	5.00
5	K090	JARARHA	85.04569	21.07054	111.10	4.30	2.30	2.00
6	K091	SANA GUNDURI	85.03061	21.06821	110.05	5.50	2.50	3.00
7	K092	KANSAMUNDA	85.02247	21.08539	111.42	5.60	3.60	2.00
8	K143	PATHARAMUNDA	85.06727	21.08763	97.00	7.00	4.00	3.00
9	T096	AMBAPALA	85.08468	21.07267	90.87	3.00	2.00	1.00
Buffer Zone								
1	K083	BARNAHARA	85.04604	21.01720	101.20	4.40	2.40	2.00
2	K084	DHOBAPALA	85.05804	21.03089	97.95	2.00	1.50	0.50
3	K089	SARADHAPUR	85.00934	21.04937	129.73	7.00	3.00	4.00
4	K146	DERENG	84.99321	21.12423	119.31	6.20	2.40	3.80
5	K152	KUKURHIA	84.97199	21.10454	131.83	2.76	1.76	1.00
6	K154	SANA SANTRABANDH	84.95098	21.09099	133.62	4.10	2.10	2.00
7	K155	TAKUA	84.97035	21.07193	144.96	6.00	3.00	3.00
8	K156	DEONALI	84.99926	21.09150	116.55	3.70	1.70	2.00
9	K179	JALATAP	84.97344	21.02126	162.22	8.80	3.60	5.20
10	K215	CHITTALPUR	85.03584	20.98130	116.61	5.50	2.50	3.00
11	K216	KANKERAI / KUMUNDA	85.02703	20.97596	113.14	4.50	1.50	3.00
12	K222	SANTRABANDH(ROAD)	84.94446	21.07421	145.83	4.20	2.50	1.70
13	T066A	KULEI	85.12385	21.08662	85.34	3.80	1.80	2.00

*Comprehensive Hydrogeological Report on ground water conditions in core and buffer zone of
Kaniha OC Project, Talcher Coalfield, MCL*

S.No.	Well ID	Village	LONGITUDE	LATITUDE	R.L(in m)	Pre-monsoon (May 24) Water Level (in m)	Post-monsoon (Nov 24) Water Level (in m)	Fluctuation (in m) [Pre-monsoon - Post-Monsoon]
14	T070	EKADAL	85.13148	20.99672	116.00	9.00	4.55	4.45
15	T071	TILEIPOSHI	85.08963	20.97864	116.69	4.50	2.50	2.00
16	T072	KANDHABARANI	85.09102	20.99317	126.00	6.29	3.10	3.19
17	T074	JORAGARHIA	85.11237	20.98124	108.27	4.25	2.25	2.00
18	T099	JODUNATHPUR	85.11158	21.02589	129.13	2.70	2.00	0.70
19	T100	SHRIRAMPUR	85.13032	21.02309	137.87	8.00	3.00	5.00
20	T148	SUNAKHANI	85.16232	21.02708	89.52	6.05	2.55	3.50
21	CGWB	Samal (CGWB)	85.14170	21.07220	76.00	6.55	-	-

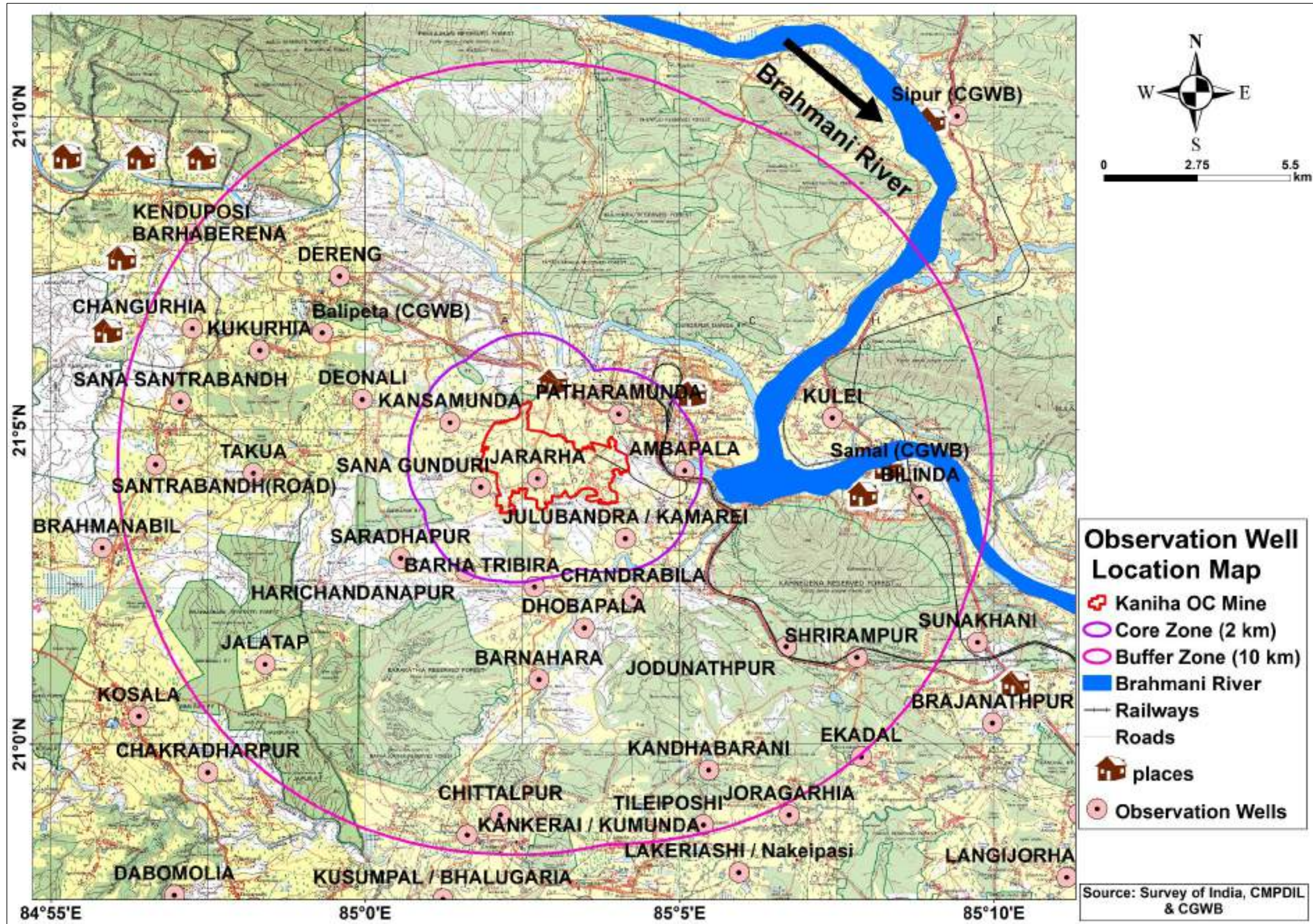


Figure 3.11: Map showing the locations of groundwater monitoring wells in Kaniha OC study area



Figure 3.12: Depth to Water Level contour map for Pre-monsoon season (May 2024) of the study area in and around Kaniha OC, Talcher Coalfield, MCL.

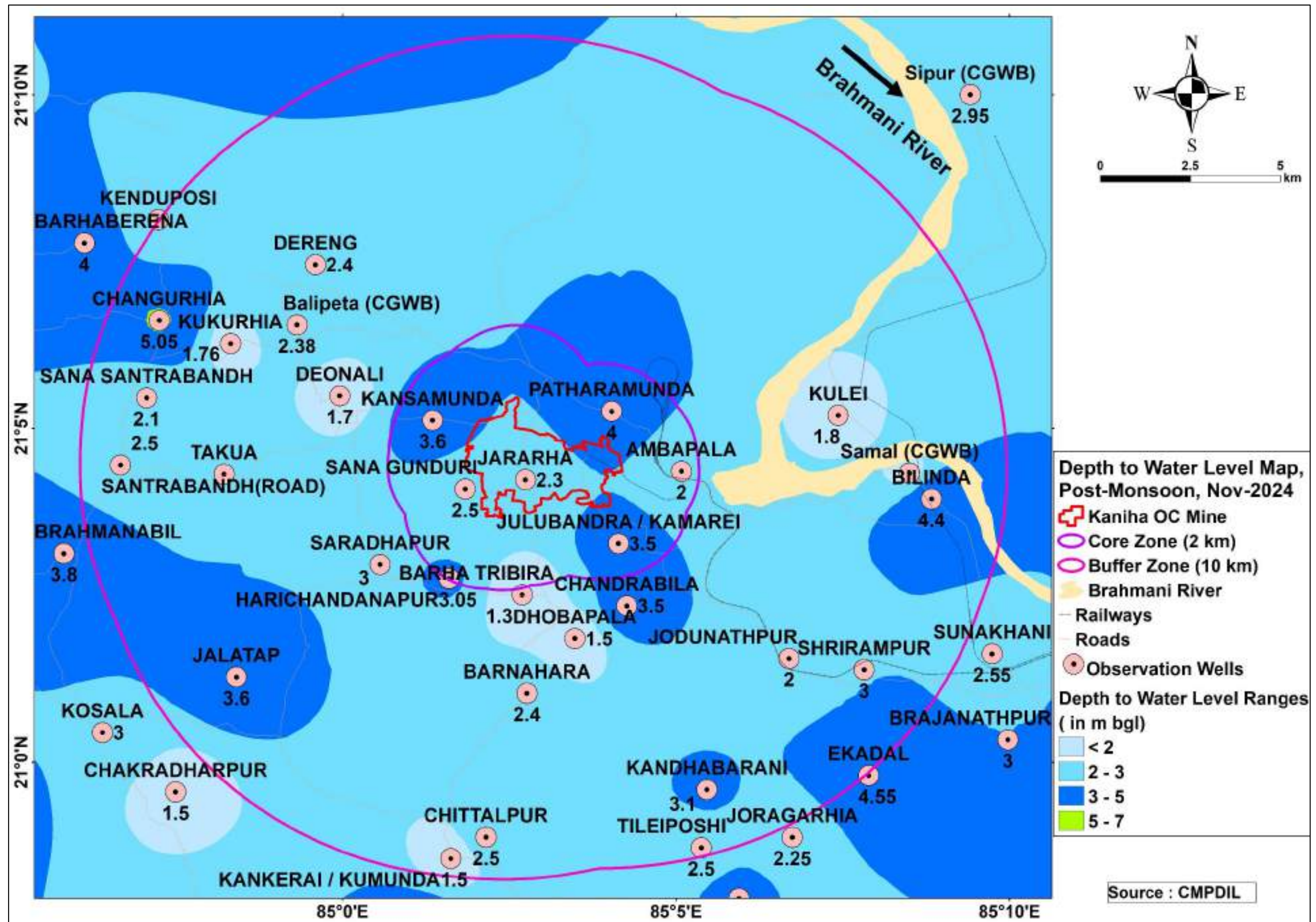


Figure 3.13: Depth to Water Level contour map for Post-monsoon season (Nov 2024) of the study area in and around Kaniha OC, Talcher Coalfield, MCL.

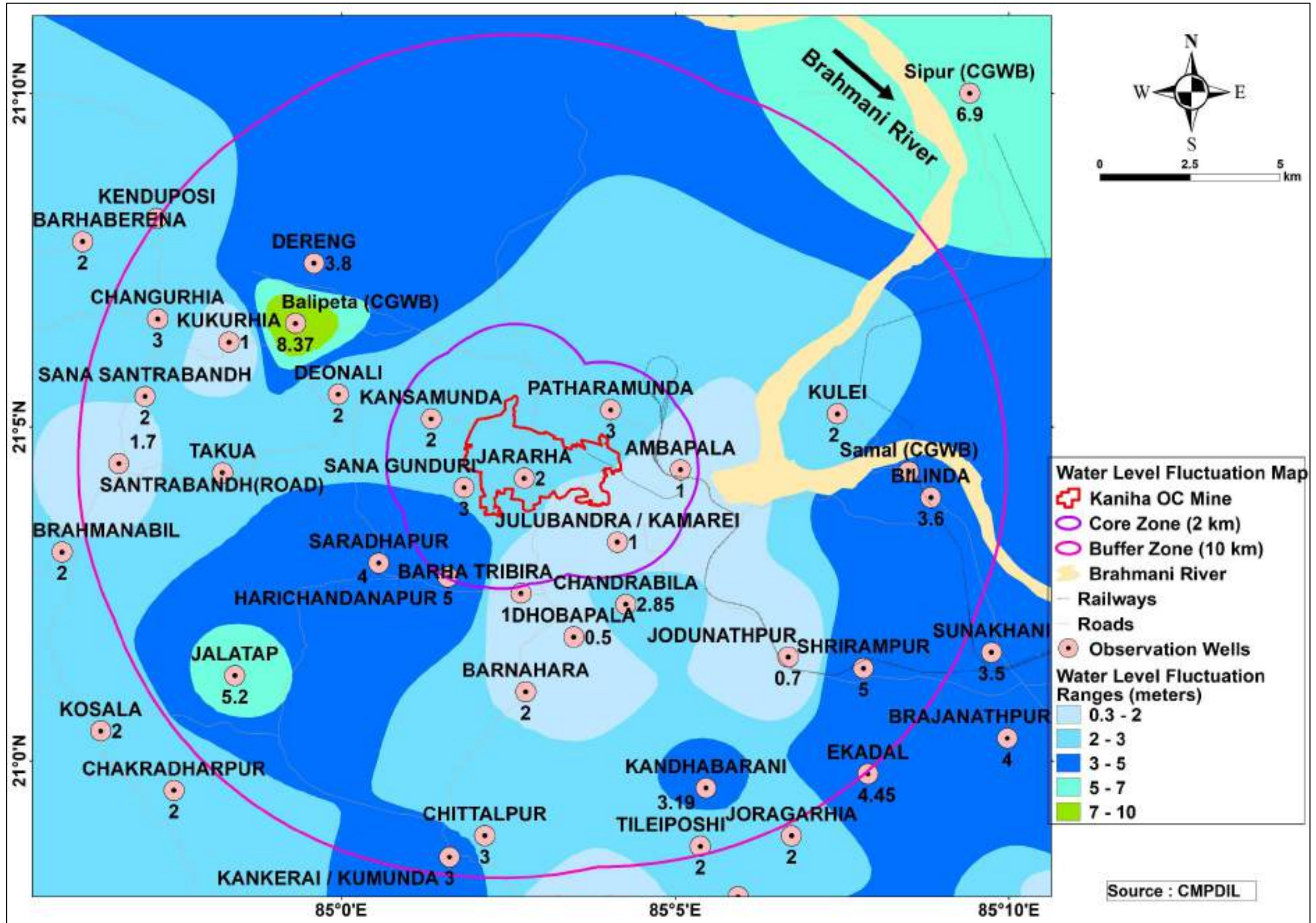


Figure 3.14: Water level fluctuation map of the study area in and around Kaniha OC, Talcher Coalfield, MCL.

3.3.4 Long term water level data analysis

Hydrograph stations from village Kosala & Samal (core zone) monitored by the Central Ground Water Board's monitoring stations from the study area have been used for the water-level trend analysis. As a representative of the water-level trend in the study area, the pre-monsoon and post-monsoon historical groundwater levels for 10 years (2014 to 2023), recorded at the nearby permanent monitoring stations were collected and are presented below (**Table 3.8**).

Table 3.8: Historic groundwater levels in the Kaniha OC study area.

[Water level in meters below ground level (b.g.l)]

Hydrograph Station / Year	Kosala (CGWB) Latitude 21.0075 N Longitude 84.9489 E			Samal (CGWB) Latitude 21.0722 N Longitude 85.1417 E		
	Pre - Monsoon	Post - Monsoon	Fluctuation	Pre - Monsoon	Post - Monsoon	Fluctuation
2014	5.8	1.8	4.0	2.6	1.9	0.7
2015	4.9	2.8	2.1	3.3	2.0	1.3
2016	7.8	3.2	4.7	2.5	1.4	1.2
2017	5.6	1.9	3.7	2.9	1.6	1.3
2018	4.6	-	-	2.5	-	-
2019	4.1	1.8	2.3	2.9	1.8	1.2
2020	-	1.2	-	-	1.5	-
2021	-	2.5	-	-	1.6	-
2022	5.2	1.5	3.8	2.7	1.7	1.0
2023	6.5	2.8	3.7	2.8	-	-
Average	5.6	2.1	3.4	2.8	1.7	1.1

The historical groundwater levels monitored at above mentioned monitoring stations in table 3.8, the pre-monsoon water levels vary from at **station Kosala** 4.1 m to 7.8 m below ground levels with an average of 5.6 m. The post-monsoon water levels at Kosala village vary from 1.20 m to 3.2 m below ground levels with an average of 2.1 m. Thus, the water level fluctuation in the area varies from 2.1 m to 4.0 m with an average of 3.4 m. For **station Samal**, the pre-monsoon water levels vary from 2.5 m to 3.3 m with an average of 2.8 m. The post-monsoon water levels in the area vary from 1.5 m to 2.0 m with an average of 1.7 m. The water level fluctuation in the area

varies from 0.7 m to 1.3 m with an average of 1.1 m

3.3.4.1 Groundwater level trend analysis

The pre-monsoon and post-monsoon water level trends for the above Hydrograph stations are given in **Figure 3.17 & 3.18** and **Table 3.9 & 3.10**. As per the GEC-2015 guidelines, the trend of depth to water table below ground level during the various seasons in the area in centimeters per year can be calculated as follows (**Equation 1**):

$$a = (N \cdot S_4 - S_1 \cdot S_2 / N \cdot S_3 - S_1^2) \times 100$$

.... Eq. 1

Where,

N = Number of pairs of data considered (Groundwater years)

S1 = Sum of monitoring years (Xi)

S2 = Depth to water level below ground level in m during single season (Yi)

S3 = Sum of Xi²

S4 = Sum of (Xi * Yi)

Groundwater level trend near the study area

The groundwater level trend analysis of water level at the CGWB monitoring station Kosala, during pre-monsoon and post-monsoon season for 10 years is computed and provided in the below mentioned **Table 3.9**.

Table 3.9: Water level trend during pre-monsoon and post-monsoon season at Kosala monitoring station, Talcher Coalfield, MCL. (CMPDI)

Sl. No.	GW Year	Year (xi)	Depth to water table below GL in meters during		(xi) ²	Pre-monsoon (xi * yi)	Post-monsoon (xi * yi)
			Pre-monsoon (yi)	Post-monsoon (yi)			
1	2014	1	5.8	1.8	1	5.8	1.83
2	2015	2	4.9	2.8	4	9.8	5.68
3	2016	3	7.8	3.2	9	23.4	9.45
4	2017	4	5.6	1.9	16	22.2	7.4
5	2018	5	4.6		25	23	
6	2019	6	4.1	1.8	36	24.3	10.8
7	2020	7		1.2	49		8.05
8	2021	8		2.5	64		19.6
9	2022	9	5.2	1.5	81	46.8	13.05
10	2023	10	6.5	2.8	100	79	28
	N =10	S1 =55	S2_{Pre} =44.4	S2_{Post} =19.3	S3 =385	S4_{Pre}=234.3	S4_{Post} = 103.86

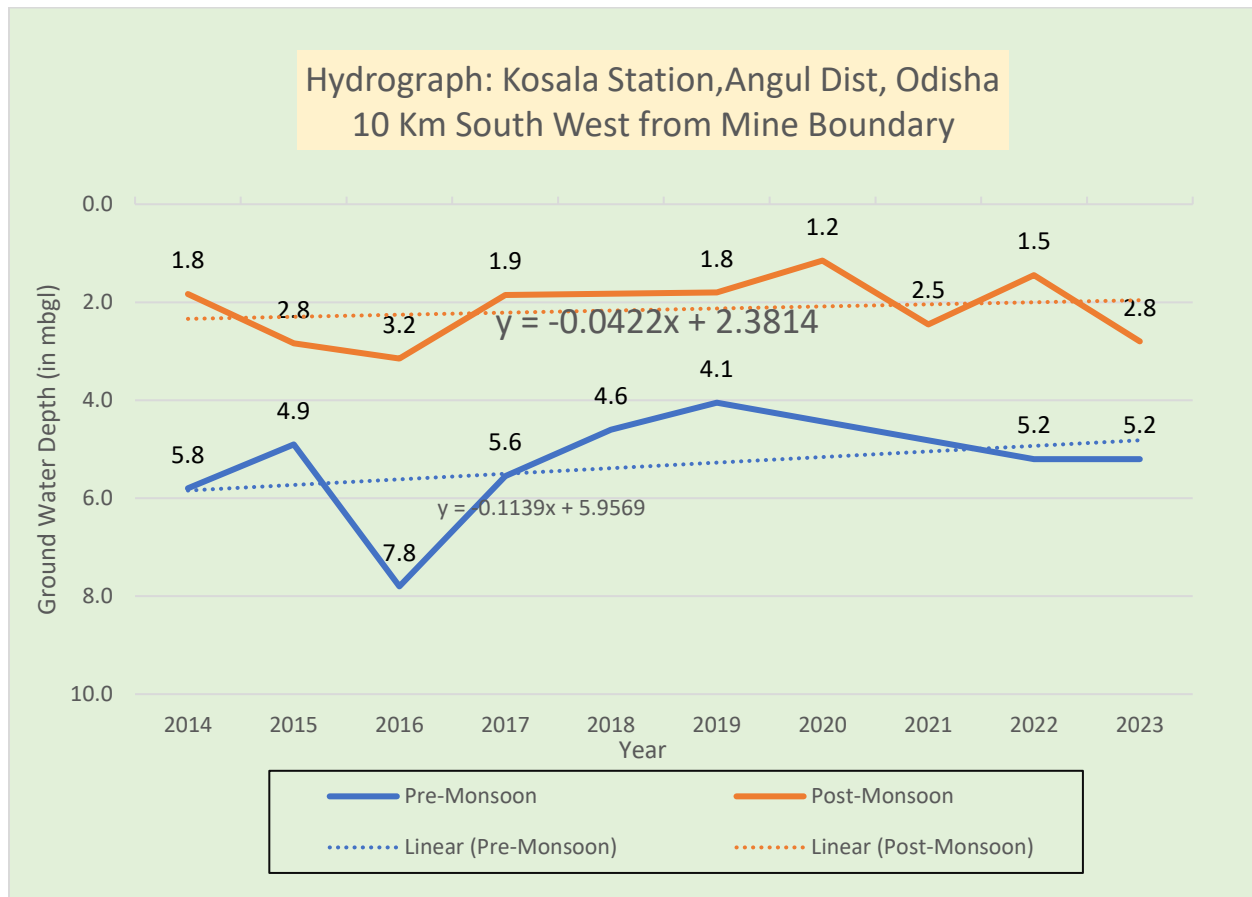
Thus,

Trend of water level during the pre-monsoon season (a) = -12 cm/year

Trend of water level during the post-monsoon season (a) = -4.2 cm/year

Therefore, the water level trend at Kosala station during pre-monsoon and post-monsoon is showing a slightly rising trend. Furthermore, the Line (water levels) plot prepared for Kosala station is shown in **Figure 3.15** and which also depicts the same.

Figure 3.15: Pre and Post-monsoon groundwater level trends at Kosala station.



The trend of water table at the CGWB monitoring station, Samal for the period 2014 till 2023 is considered for understanding variability and long-term trend in the buffer area. Calculated and provided in the below mentioned **Table 3.10**.

Table 3.10: Water level trend during pre-monsoon and post-monsoon season at Samal station, Talcher Coalfield, MCL.

Sl. No.	GW Year	Year (xi)	Depth to water table below GL in meters during		(xi) ²	Pre-monsoon (xi * yi)	Post-monsoon (xi * yi)
			Pre-monsoon (yi)	Post-monsoon (yi)			
1	2014	1	2.6	1.9	1	2.57	1.87
2	2015	2	3.3	2.0	4	6.52	4.02
3	2016	3	2.5	1.4	9	7.62	4.05
4	2017	4	2.9	1.6	16	11.4	6.4
5	2018	5	2.5		25	12.4	
6	2019	6	2.9	1.8	36	17.58	10.68
7	2020	7		1.5	49		10.36
8	2021	8		1.6	64		12.96
9	2022	9	2.7	1.7	81	24.57	15.57
10	2023	10	2.8		100	28	
	N =10	S1 =55	S2_{Pre} =22.2	S2_{Post} =13.4	S3 =385	S4_{Pre}=110.66	S4_{Post} = 65.91

Thus,

Trend of water level during the pre-monsoon season (a) = -2.2 cm/year

Trend of water level during the post-monsoon season (a) = - 0.2 cm/year

Therefore, the water level trend at Balanda station during pre-monsoon & post monsoon is slightly rising trend. Furthermore, the Line (water levels) plot prepared for Samal station is shown in **Figure 3.16** and which also depicts the same.

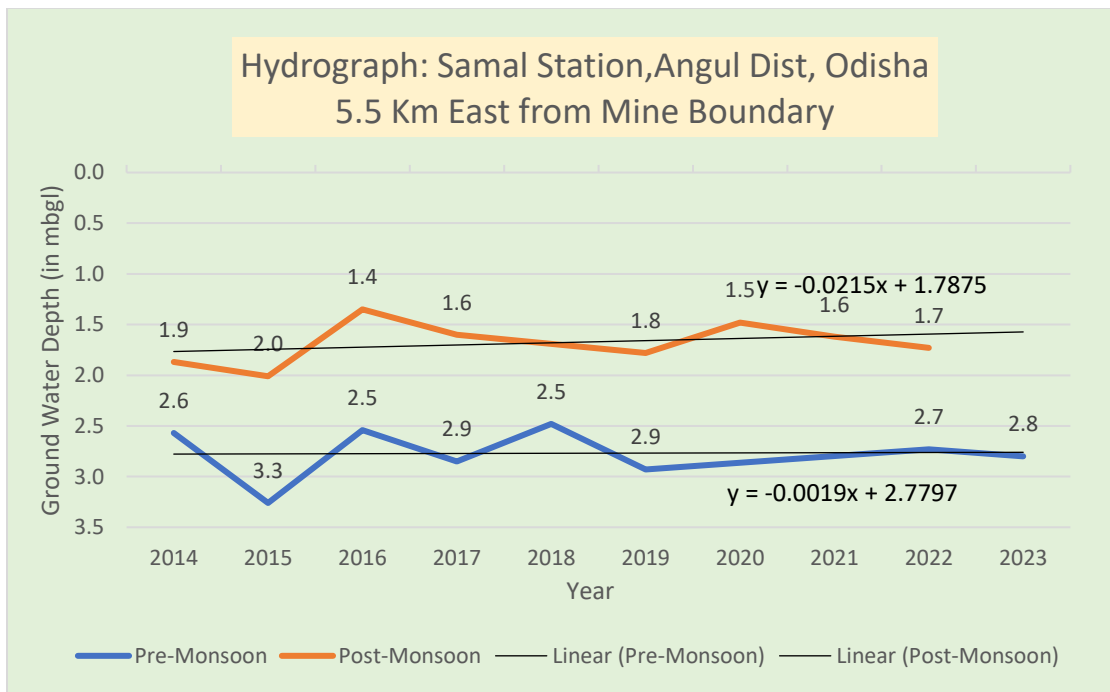


Figure 3.16: Pre and Post-monsoon water level trends at Samal station.

3.3.4.2 Predicted water level trends for affected aquifers

The Water Table contour map of the top aquifer shows the water table behavior and flow direction of shallow aquifers (**Figure 3.8 & 3.9**). However, average groundwater level trends have been estimated using pre-monsoon and post-monsoon water level data in the study area. The result is given in **Table 3.11**.

Due to mining and domestic use, water levels in some of the dug wells are affected. Especially in the pre-monsoon season the effects are reflected greatly. To counter this affect and for domestic use, in many places, the dug wells are replenished through mine seepage water by MCL.

Table 3.11: Groundwater levels trend scenario in the study area.

Source of data	Monitoring station	Aquifer tapped	Groundwater level fluctuation [cm/Year]		Remarks
			Pre-monsoon	Post-monsoon	
CGWB	Kosala	Unconfined to Semi-confined	-12	-4.2	Slightly rising in Premonsoon and Post Monsoon season.
CGWB	Samal		-2.2	- 0.2	Very Slightly rising in Premonsoon and Post Monsoon season.

3.3.5 Ground water quality

Total 17 ground water samples were collected during 06-05-2024 to 25-05-2024. The sampling location has been shown in **Figure-3.17**. Groundwater samples were collected in 500 ml plastic bottle and chemical analyses were done by following the standard guidelines (APHA 1998). The samples were collected after pumping the wells for 5 min. pH, and total dissolved solid (TDS) were measured in situ by Portable Multi-Meter. Major anions chloride (Cl^-), nitrate (NO_3^-), sulfate (SO_4^{2-}), and fluoride (F^-) were measured by spectrophotometer. Alkalinity was determined by titration with HCl. The trace elements, manganese (Mn), iron (Fe), boron (B), Aluminium (Al), Copper (Cu), and Zinc (Zn) were determined using AAS.

With no processing activity in coal mining, the mine water is free from any serious pollutants, except for suspended solids and that too in surface water. The groundwater chemistry indicates that the groundwater in the area is potable and does not contain any toxic elements. With the movement of mine equipment, the only serious observed contamination is Total Suspended Solids (TSS). With the provision of sufficient sump capacity, which act as primary settling tanks, the quality is improved significantly. To reduce TSS further, the mine water would be discharged only after passing through sedimentation tanks constructed on the surface. With low sulphur content in coal, no acid mine drainage is anticipated. During baseline data generation and as a part of Environmental Management Plan (EMP) preparation, the groundwater quality was monitored and found to be within the permissible standards as stipulated by the Government of India norms.

The groundwater water analytical results for pre-monsoon season (May 2024) have been appended in **Table 3.12 and Table 3.13**. The groundwater quality maps (EC, , Nitrate, Chloride and Fluoride) of the study area are provided in the **Figure 3.18 to Figure 3.21**. It can be interpreted that the Chloride, Fluoride and Nitrate concentration in the groundwater of all 17 locations is within the permissible limits (BIS, 2012). The water

quality assessment for the locations around the coal mines provides insightful findings regarding the environmental conditions in these areas.

Key parameters like odour and taste were consistently marked as "Agreeable" across all stations, indicating no sensory deviations or immediate issues related to smell or flavour. The colour, measured using the Hazen scale, varied slightly between 1 and 8, reflecting minimal differences in water clarity. Turbidity values, measured in NTU, ranged from 1 to 3, suggesting low levels of suspended particles in the water. The physicochemical parameters further indicate the general quality of water. The pH levels, ranging from 6.88 to 8.21, show the water is neutral to slightly alkaline, which is within acceptable standards for drinking water. Electrical conductivity (EC), a measure of the ionic concentration in the water, exhibited significant variation, with the lowest value at Kandhabarani (237 $\mu\text{S/cm}$) and the highest at Patharamunda (1822 $\mu\text{S/cm}$). This indicates possible differences in dissolved salt content across the sampling locations. Total alkalinity ranged from 37 mg/L to 452 mg/L, signifying variations in the buffering capacity of the water, which is crucial for maintaining pH stability. The chemical constituents, including chloride (Cl), sulphate (SO_4), and nitrate (NO_3), were well within permissible limits. Chloride concentrations ranged between 12 mg/L and 384 mg/L, with the highest observed at Patharamunda, indicating no harmful salinity issues. Sulphate levels remained low, varying from 4.12 mg/L to 95.6 mg/L, while nitrate values ranged from <0.5 mg/L to 24.6 mg/L, reflecting limited agricultural or industrial contamination. Total hardness, a crucial indicator of water quality, ranged from 154 mg/L to 1184 mg/L, with higher value at Patharamunda (1184 mg/L). These levels, primarily influenced by calcium (23.9 mg/L to 132 mg/L) and magnesium concentrations, suggest the water in these areas could lead to scaling issues in domestic and industrial applications.

The trace metal analysis showed copper levels consistently at 0.03 mg/L, which is below harmful thresholds. Metals like iron (Fe), zinc (Zn), lead (Pb), and cadmium (Cd) were present in negligible amounts, ensuring no immediate heavy metal contamination. Similarly, arsenic (As), selenium (Se), and total chromium (T Cr) were reported at levels below detection limits, highlighting the absence of toxic element contamination. Organic pollutants, such as phenolic compounds, were below 0.001 mg/L, and residual chlorine

levels were consistently under 0.2 mg/L, indicating no significant chemical contamination or treatment residues.

The microbial analysis further reinforces the safety of the water, as the Most Probable Number (MPN) of coliform bacteria was marked as "Not Detected" for all stations. This confirms the absence of microbial contamination, which is critical for human consumption and public health safety. The findings suggest that while the water quality around the coal mines appears to be within acceptable environmental limits, ongoing monitoring is crucial to detect any long-term impacts from mining and related industrial activities on the surrounding aquatic ecosystems. These results provide a foundation for sustainable water management and pollution mitigation strategies in coal mining regions.

Table 3.12: Groundwater analytical results of Major ion chemistry for pre-monsoon season (May 2024).

S.No	Monitoring Station	Long	Lat	Date of Sampling	Colour (Hazen)	Odour	Taste	Turbidity (NTU)	pH	Total Alkalinity (mg/L)	Chloride (mg/L)	Sulphate (mg/L)	Nitrate (mg/L)	Total Hardness (Ca CO ₃) (mg/L)	Calcium (mg/L)	Fluoride (mg/L)	Total Dissolve Solid (mg/L)	EC
1	Kamarei	85.06893	21.0546	11-05-2024	1	Agreeable	Agreeable	2	7.55	340	59.13	10.55	<0.5	305.97	65.21	0.58	490	754
2	Kansamunda	85.02247	21.08539	11-05-2024	4	Agreeable	Agreeable	2	6.89	152	11.83	8.34	<0.5	158.94	52.49	0.97	228	351
3	Patharamunda	85.06727	21.08763	20-05-2024	2	Agreeable	Agreeable	3	7.86	396	384.34	95.58	22.52	472.86	132.01	0.62	1184	1822
4	Ambapala	85.08468	21.07267	21-05-2024	2	Agreeable	Agreeable	1	8.02	64	61.1	66.63	21.85	210.6	24.08	<0.3	334	514
5	Harichandanapur	85.02661	21.04586	22-05-2024	4	Agreeable	Agreeable	1	6.88	37	53.22	32.76	23.19	186.76	41.35	0.34	252	388
6	Jarada	85.04569	21.07054	24-05-2024	2	Agreeable	Agreeable	2	8.14	296	31.54	20.37	<0.5	139.08	28.63	1.6	356	548
1	Kamarei	85.06893	21.0546	11-05-2024	1	Agreeable	Agreeable	2	7.55	340	59.13	10.55	<0.5	305.97	65.21	0.58	490	754
2	Kansamunda	85.02247	21.08539	11-05-2024	4	Agreeable	Agreeable	2	6.89	152	11.83	8.34	<0.5	158.94	52.49	0.97	228	351
3	Patharamunda	85.06727	21.08763	20-05-2024	2	Agreeable	Agreeable	3	7.86	396	384.34	95.58	22.52	472.86	132.01	0.62	1184	1822
4	Changurhia	84.95416	21.11032	20-05-2024	4	Agreeable	Agreeable	2	7.85	292	15.77	10.8	1.32	246.36	62.03	1.31	388	597
5	Sana Santrabandh	84.95098	21.09099	20-05-2024	3	Agreeable	Agreeable	1	7.51	308	13.8	6.17	3.14	246.36	55.67	1.24	396	609
6	Ambapala	85.08468	21.07267	21-05-2024	2	Agreeable	Agreeable	1	8.02	64	61.1	66.63	21.85	210.6	24.08	<0.3	334	514
7	Bilinda	85.14719	21.06575	21-05-2024	2	Agreeable	Agreeable	2	7.66	292	68.98	27.73	<0.5	107.29	30.22	0.7	398	612
8	Dhobapala	85.05804	21.03089	22-05-2024	5	Agreeable	Agreeable	2	7.12	272	43.36	9.16	<0.5	162.92	38.17	0.6	354	545
9	Harichandanapur	85.02661	21.04586	22-05-2024	4	Agreeable	Agreeable	1	6.88	37	53.22	32.76	23.19	186.76	41.35	0.34	252	388
10	Barihapur	84.9876	21.04361	22-05-2024	2	Agreeable	Agreeable	2	7.16	84	72.93	31.29	24.64	270.2	63.62	0.34	340	523
11	Jarada	85.04569	21.07054	24-05-2024	2	Agreeable	Agreeable	2	8.14	296	31.54	20.37	<0.5	139.08	28.63	1.6	356	548
12	Kankera / Kumunda	85.02703	20.97596	25-05-2024	3	Agreeable	Agreeable	3	8.21	428	149.8	67.48	20.51	341.73	28.63	1.19	806	1240
13	Gopalprasad	85.03854	20.9739	25-05-2024	2	Agreeable	Agreeable	2	8.17	452	21.68	10.06	<0.5	262.26	31.81	0.77	530	815
14	Solada	85.07853	20.97303	08-05-2024	4	Agreeable	Agreeable	2	7.85	448	23.65	8.14	<0.5	309.94	52.49	0.58	538	828
15	Akadal	85.13148	20.99672	06-05-2024	1	Agreeable	Agreeable	2	7.68	348	67.01	58.04	9.53	401.33	65.21	0.92	614	945
16	Kandhabarani	85.09102	20.99317	06-05-2024	1	Agreeable	Agreeable	1	7.18	52	41.39	4.12	<0.5	107.29	23.86	<0.3	154	237
17	Kulei	85.12385	21.08662	06-05-2024	3	Agreeable	Agreeable	2	7.92	320	59.13	17.3	18.47	234.44	47.71	0.79	486	748
Indian Drinking Standard (IS-10500):2012				Acceptable	5	Agreeable	Agreeable	1	6.5-8.5	200	250	200	45	200	75	1	500	
				Permissible	15	Agreeable	Agreeable	5	No relaxation	600	1000	400	No relaxation	600	200	1.5	2000	

Table 3.13: Groundwater analytical results of PTEs for pre-monsoon season (May 2024).

S.No	Monitoring Station	Long	Lat	Date of Sampling	Cu (mg/L)	Mn (mg/L)	Fe (mg/L)	Zinc (mg/L)	Pb (mg/L)	Cd (mg/L)	Total Chromium (mg/L)	Arsenic (mg/L)	Selenium (mg/L)	Boron (mg/L)	Phenolics (mg/L)	Residual Free Chlorine (mg/L)	MPN (Index/100 ml)
1	Kamarei	85.068926	21.054604	11-05-2024	<0.03	<0.04	<0.1	0.25	0.007	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
2	Kansamunda	85.022468	21.085394	11-05-2024	<0.03	0.14	<0.1	0.45	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
3	Patharamunda	85.067273	21.087627	20-05-2024	<0.03	0.05	<0.1	<0.04	0.01	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
4	Ambapala	85.084676	21.072667	21-05-2024	<0.03	<0.04	<0.1	0.05	0.006	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
5	Harichandanapur	85.026612	21.045863	22-05-2024	<0.03	<0.04	<0.1	0.32	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
6	Jarada	85.045693	21.070537	24-05-2024	<0.03	<0.04	<0.1	<0.04	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
1	Kamarei	85.068926	21.054604	11-05-2024	<0.03	<0.04	<0.1	0.25	0.007	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
2	Kansamunda	85.022468	21.085394	11-05-2024	<0.03	0.14	<0.1	0.45	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
3	Patharamunda	85.067273	21.087627	20-05-2024	<0.03	0.05	<0.1	<0.04	0.01	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
4	Changurhia	84.954161	21.110318	20-05-2024	<0.03	<0.04	<0.1	0.46	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
5	Sana Santrabandh	84.950983	21.090987	20-05-2024	<0.03	<0.04	<0.1	0.13	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
6	Ambapala	85.084676	21.072667	21-05-2024	<0.03	<0.04	<0.1	0.05	0.006	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
7	Bilinda	85.147189	21.065747	21-05-2024	<0.03	<0.04	<0.1	0.04	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
8	Dhobapala	85.058038	21.03089	22-05-2024	<0.03	<0.04	<0.1	0.07	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
9	Harichandanapur	85.026612	21.045863	22-05-2024	<0.03	<0.04	<0.1	0.32	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
10	Barihapur	84.987595	21.043613	22-05-2024	<0.03	<0.04	<0.1	0.27	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
11	Jarada	85.045693	21.070537	24-05-2024	<0.03	<0.04	<0.1	<0.04	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
12	Kankera / Kumunda	85.027032	20.975959	25-05-2024	<0.03	<0.04	<0.1	0.09	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
13	Gopalprasad	85.038544	20.9739	25-05-2024	<0.03	<0.04	<0.1	0.37	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
14	Solada	85.078533	20.973033	08-05-2024	<0.03	<0.04	<0.1	0.23	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
15	Akadal	85.131481	20.996722	06-05-2024	<0.03	<0.04	<0.1	<0.04	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected

S.No	Monitoring Station	Long	Lat	Date of Sampling	Cu (mg/L)	Mn (mg/L)	Fe (mg/L)	Zinc (mg/L)	Pb (mg/L)	Cd (mg/L)	Total Chromium (mg/L)	Arsenic (mg/L)	Selenium (mg/L)	Boron (mg/L)	Phenolics (mg/L)	Residual Free Chlorine (mg/L)	MPN (Index/100 ml)
16	Kandhabarani	85.091023	20.993173	06-05-2024	<0.03	0.33	<0.1	0.45	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
17	Kulei	85.123854	21.086616	06-05-2024	<0.03	<0.04	<0.1	0.04	<0.005	<0.001	<0.01	<0.005	<0.005	<0.2	<0.001	<0.2	Not Detected
Indian Drinking Standard (IS-10500):2012				Acceptable	0.05	0.1	1.0	5	0.01	0.003	0.05	0.01	0.01	0.5	0.001	0.2	–
				Permissible	1.5	0.3	No relaxation	15	No relaxation	No relaxation	No relaxation	No relaxation	No relaxation	2.4	0.002	1.0	–

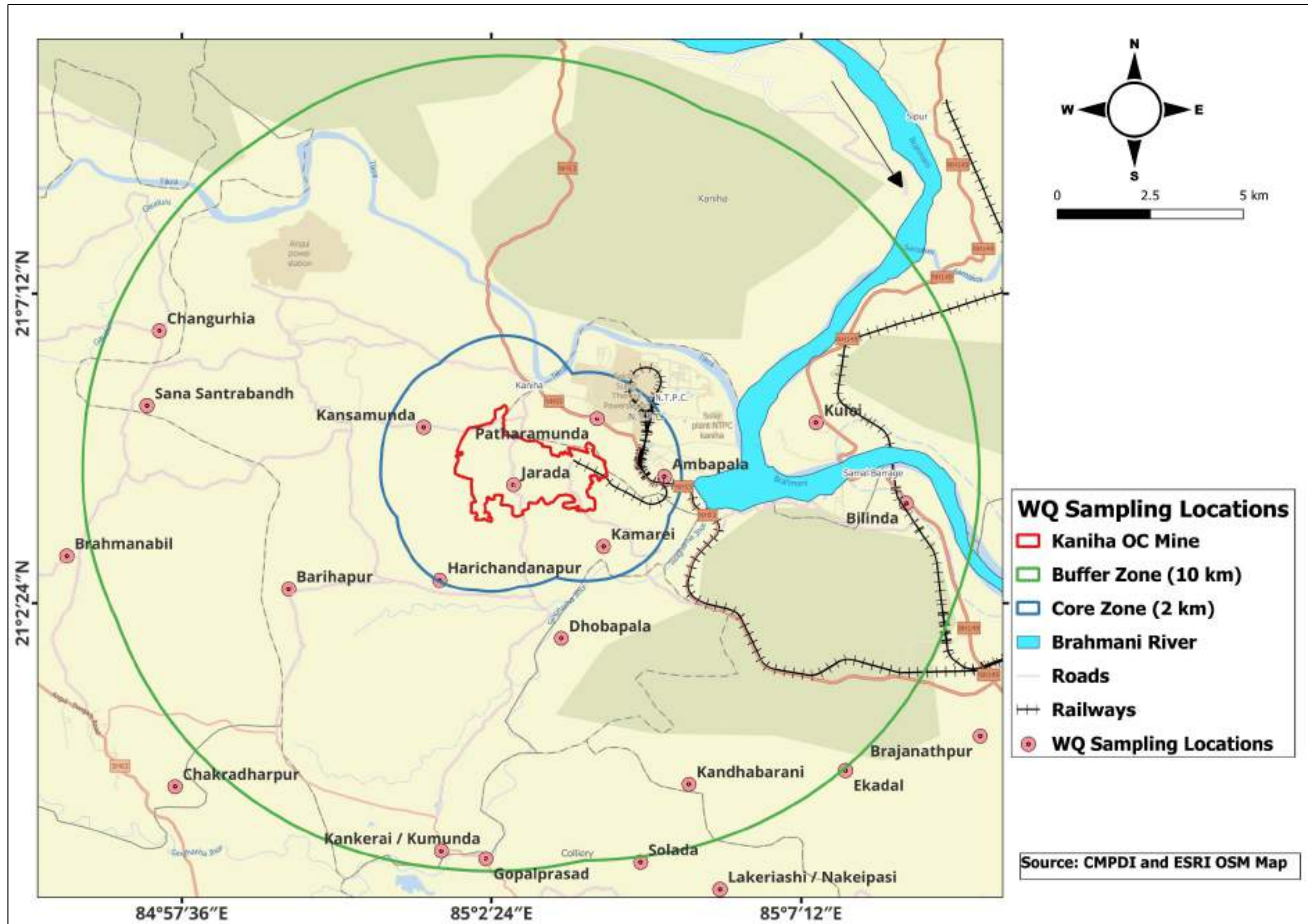


Figure 3.17: Water Sampling Location Plan

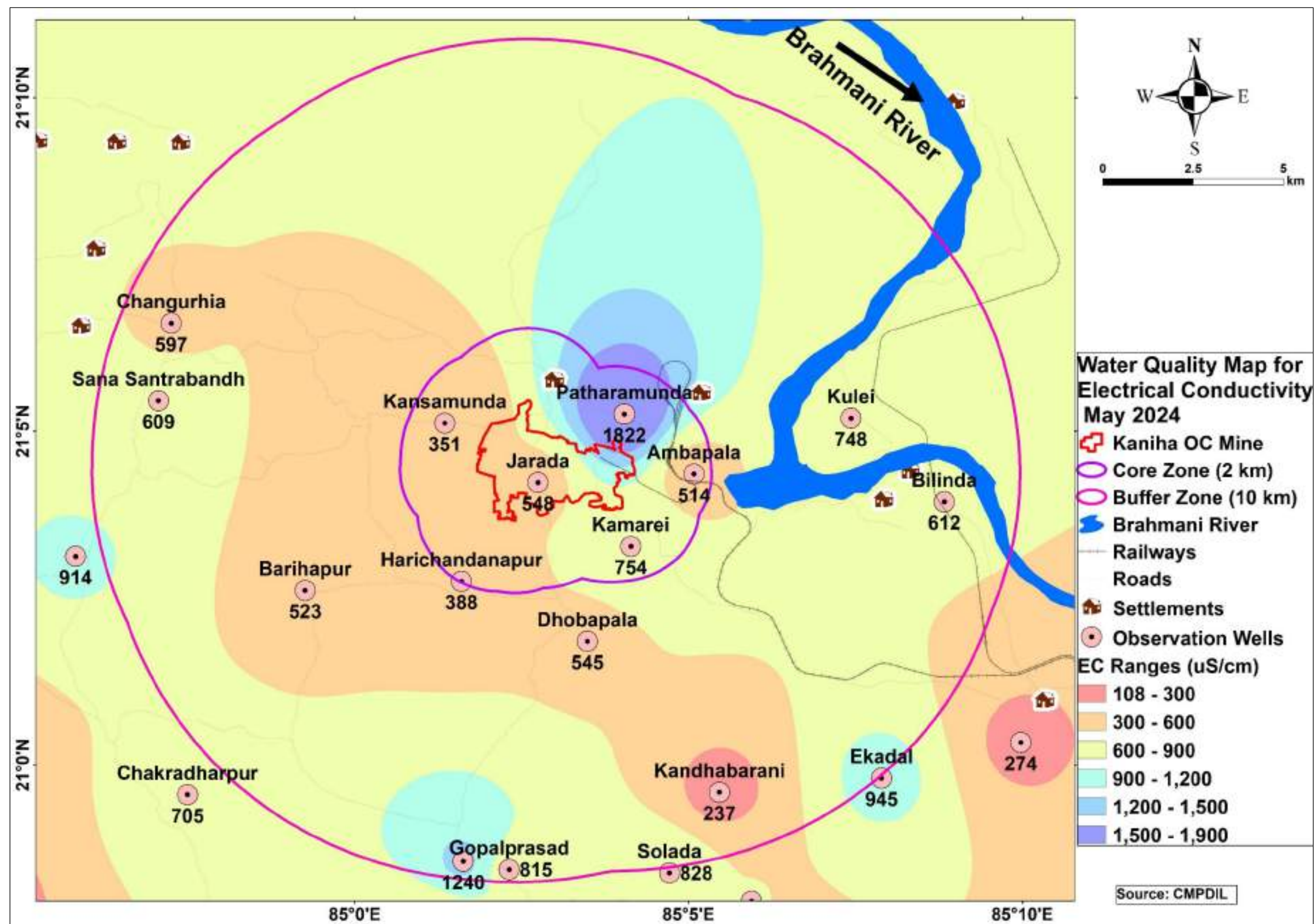


Figure 3.18: EC concentration map for May 2024 of the Kaniha OC study area.

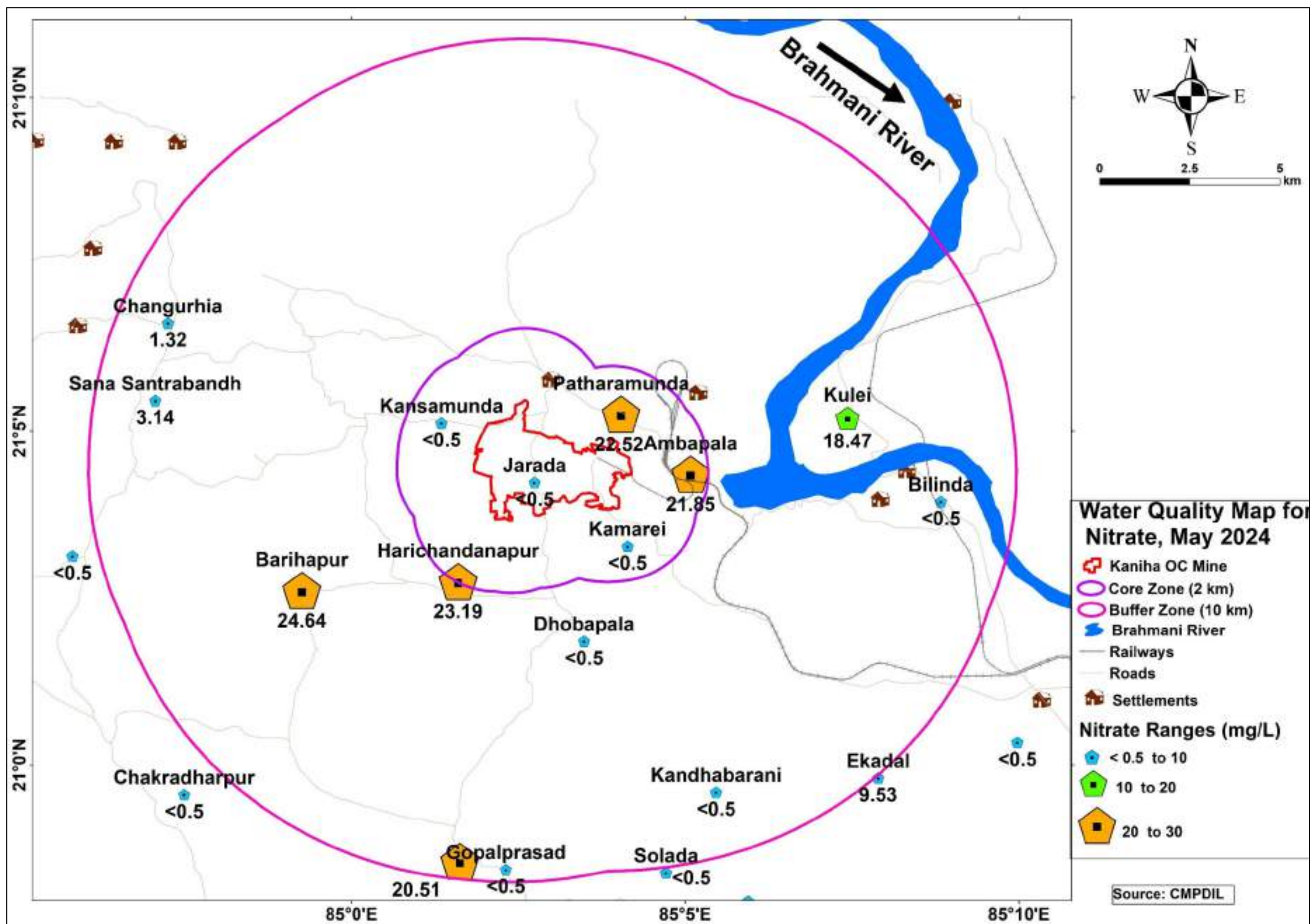


Figure 3.19: Nitrate concentration map for May 2024 of the Kaniha OC study area.

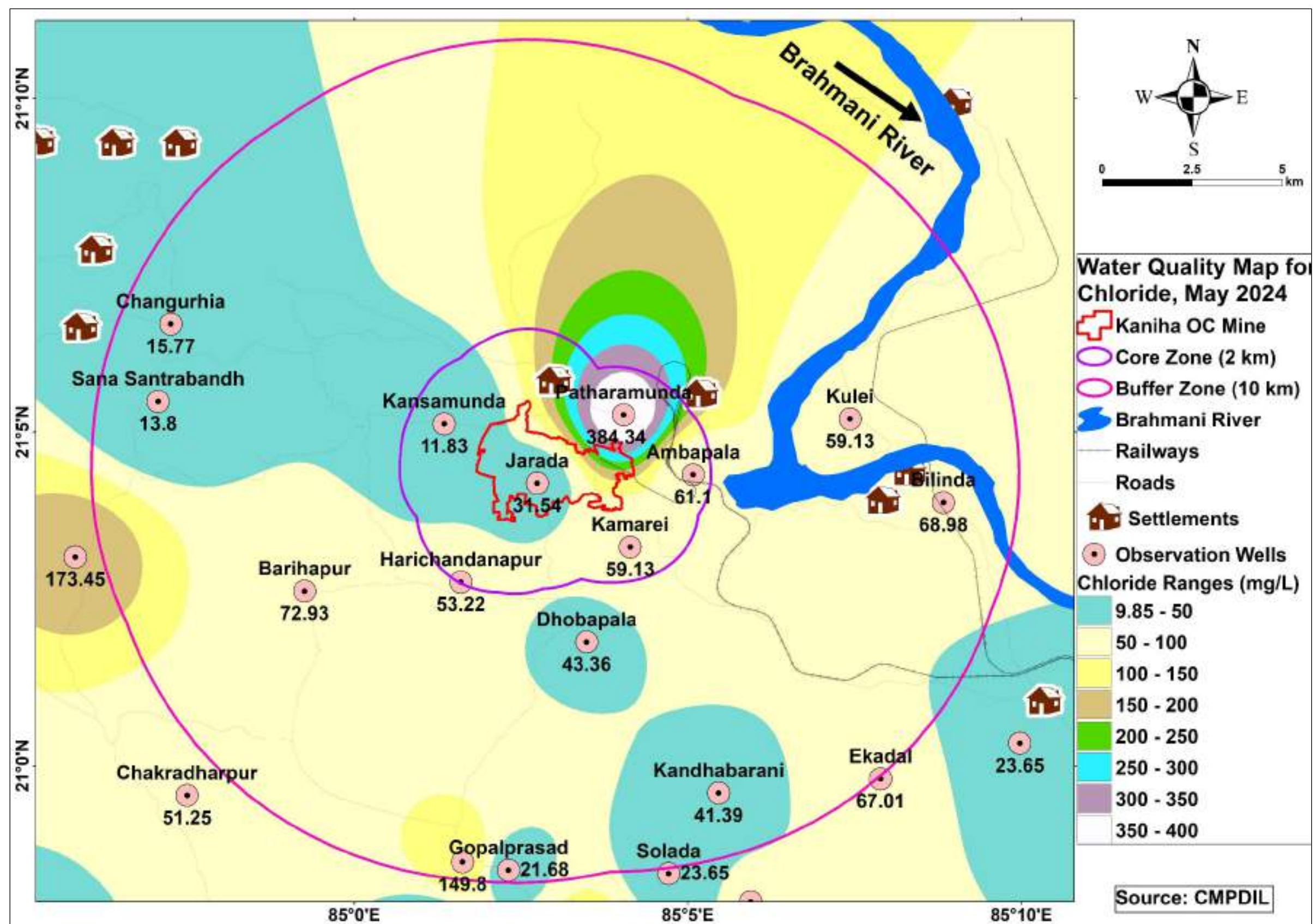


Figure 3.20: Chloride concentration map for May 2024 of the Kaniha OC study area.

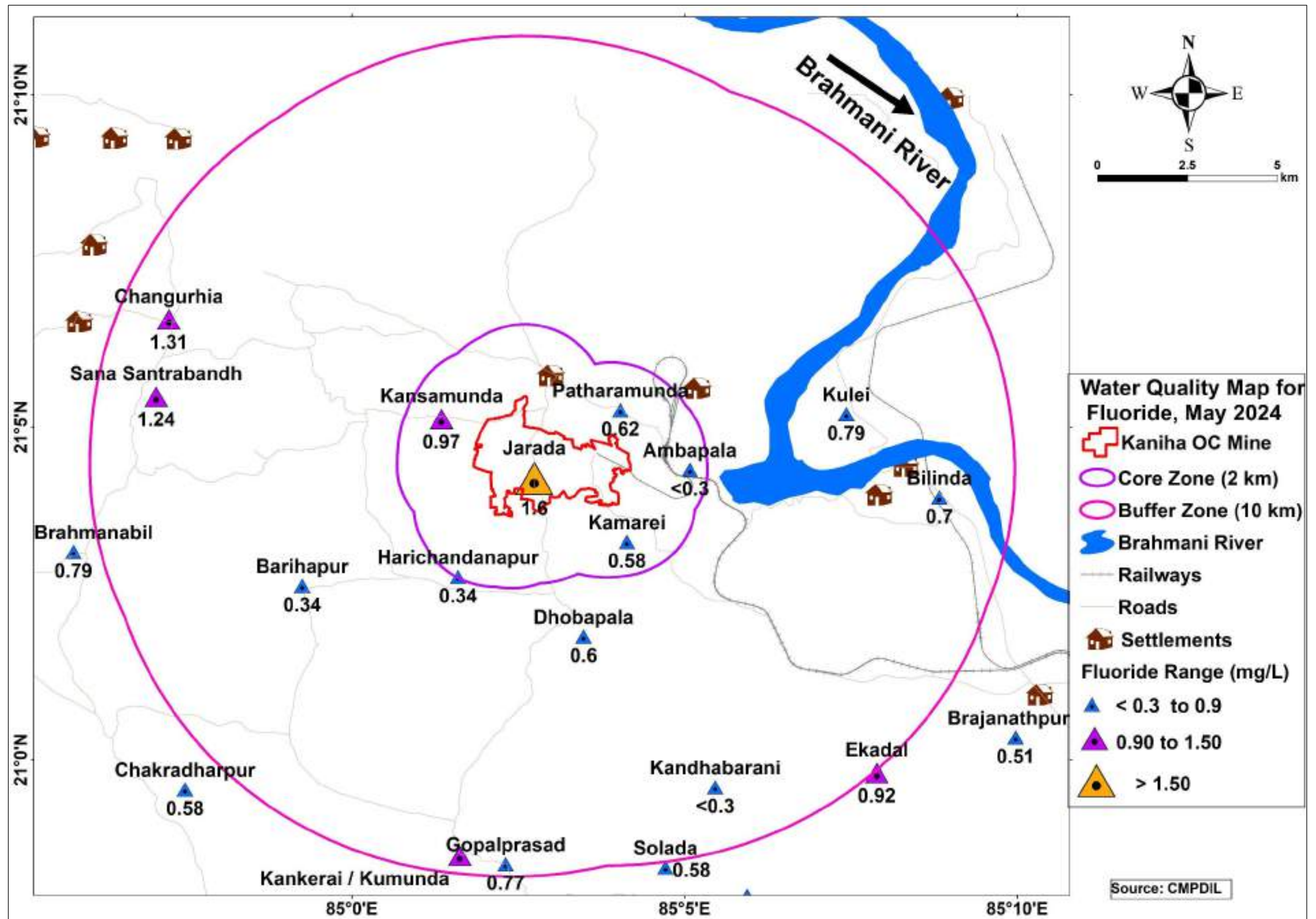


Figure 3.21: Fluoride concentration map for May 2024 of the Kaniha OC study area.

3.3.6 Water quality of nearby water bodies

To assess the water quality of nearby water bodies, two locations were selected for surface water sampling. The surface water quality of Brahmani river monitored for the pre-monsoon season (May-24) is given in **Table 3.14**. The major river passing from the nearby of the mine is the Brahmani river. The water quality of river is well within the compliance of IS 2296. The pH of river is in neutral range for upstream as well downstream. The TDS is varying from 110 to 138 mg/L. The impact of mining which is anticipated on river is an increase of TSS concentration in the waterbody. The TSS concentration from upstream to downstream is varying from 34 mg/L to 40 mg/L. It is therefore concluded that there is no impact of coal mining on river water quality.

Table 3.14: Surface Water Analytical Results for Brahmani River

S.No	NAME OF STATIONS	Upstream of Brahmani near Mandapal Village	Downstream of Brahmani near Mandapal Village	IS:2296-1982 Tolerance for inland Surface water (Class C)
	Date of sampling	28-May-24	28-May-24	
1	pH	7.84	7.91	6.5-8.5
2	Dissolved Oxygen(mg/L)	6.6	6.0	4
3	BOD (3 days 27°C(mg/L)	<2	<2	3
4	Color (Hazen unit)	3	2	300
5	Total dissolved solids (mg/L)	110	138	1500
6	TSS(mg/L)	34	40	-
7	Total Hardness(mg/L)	71.71	91.63	-
8	Copper(mg/L)	<0.03	<0.03	1.5
9	Iron(mg/L)	<0.1	<0.1	50
10	Chlorides(mg/L)	13.8	17.74	600
11	Sulphate(mg/L)	18.72	20.14	400
12	Nitrate(mg/L)	<0.5	<0.5	50

S.No	NAME OF STATIONS	Upstream of Brahmani near Mandapali Village	Downstream of Brahmani near Mandapal Village	IS:2296-1982 Tolerance for inland Surface water (Class C)
	Date of sampling	28-May-24	28-May-24	
13	Fluoride(mg/L)	0.37	0.65	1.5
14	Cadmium(mg/L)	<0.001	<0.001	0.01
15	Arsenic(mg/L)	<0.005	<0.005	0.2
16	Lead(mg/L)	<0.005	<0.005	0.1
17	Zinc(mg/L)	<0.04	<0.04	15
18	Oil & Grease (mg/L)	<4.0	<4.0	0.1
19	Selenium(mg/L)	<0.005	<0.005	0.05
20	Total Chromium (mg/L)	<0.01	<0.01	—
21	Phenolics(mg/L)	<0.001	<0.001	0.005
22	MPN (Index/100 ml)	140	170	—
23	Chromium(as Cr ⁶)(mg/L)	<0.05	<0.05	0.05
24	Residual Free Chlorine(mg/L)	<0.2	<0.2	0.2

4 APPROVED MINE PLAN

Kaniha Opencast project is a running mine having approval letter No. 34012/(04)/2011-CPAM dated 08.02.2017. The total lease area as per the mining plan is 1800 Ha (718 Ha for Phase I 1082 Ha for Phase II). The block is bounded by Neelachal block towards the west, Chhelia block to the south, and non-coal bearing areas to the north and east. The Talcher Coalfield, located in Brahmani Valley to the north of the Mahanadi River, constitutes a member of the lower Gondwana basin within the Mahanadi Valley group of coalfields. EMP clearance for the Kaniha OCP (10 Mty) was obtained from MoEF vide letter no J-11015/134/2007-IA.II(M) dtd 31.10.2007. EMP for the 14 Mty project was conditionally granted in 2016. The grade of coal is D to G, mostly F&G. The bench slope for shovel-dumper operations is designed at 70 degrees, whereas for surface miner operations, it is maintained at 60 degrees to ensure safe excavation and operational efficiency. Coal from the lower seam will be transported through a 30 m wide main haul road laid on the quarry floor, while coal from the upper seams will be evacuated via flank haul roads leading to the surface. At present coal is being extracted by outsource agencies by surface miners and OB is also being removed by outsourcing agency by shovel dumper combination.

At present overburden from the mine is totally dumped externally. Internal backfilling will be started very soon and same will be merged with external dumping. Both internal & external dumps will be formed in 30m tiers with an overall slope of about 26°, angle of individual dump tier will be around 37° depending on angle of repose of material and there should be horizontal berm of width 30m in between the individual 30 m dump tiers. Height of each dump may even be kept at a lesser height where the dump is near any road or locality. Berm between each dump tier should be properly graded and drains should be provided at toe with proper gradient. Fencing may be done near bottommost tier to stop unauthorized entry near the dump, adequate safety distance from dump toe as per safety regulations or as decided by statutory authority should be maintained to avoid any accident due to slope failure. The mine plan is provided in **Figure 4.1 A &B**.

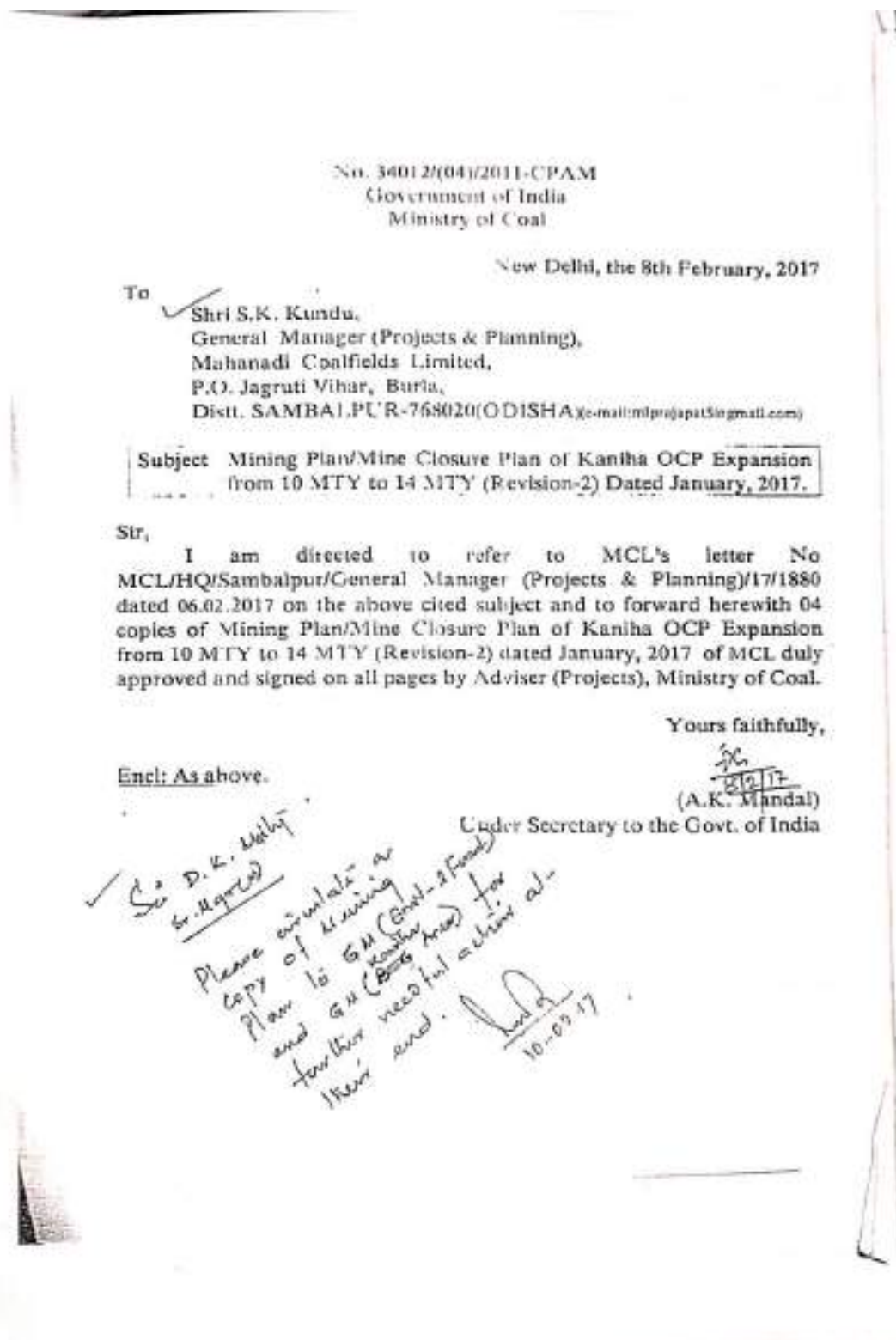


Figure 4.1A: Letter of Approved Mine plan

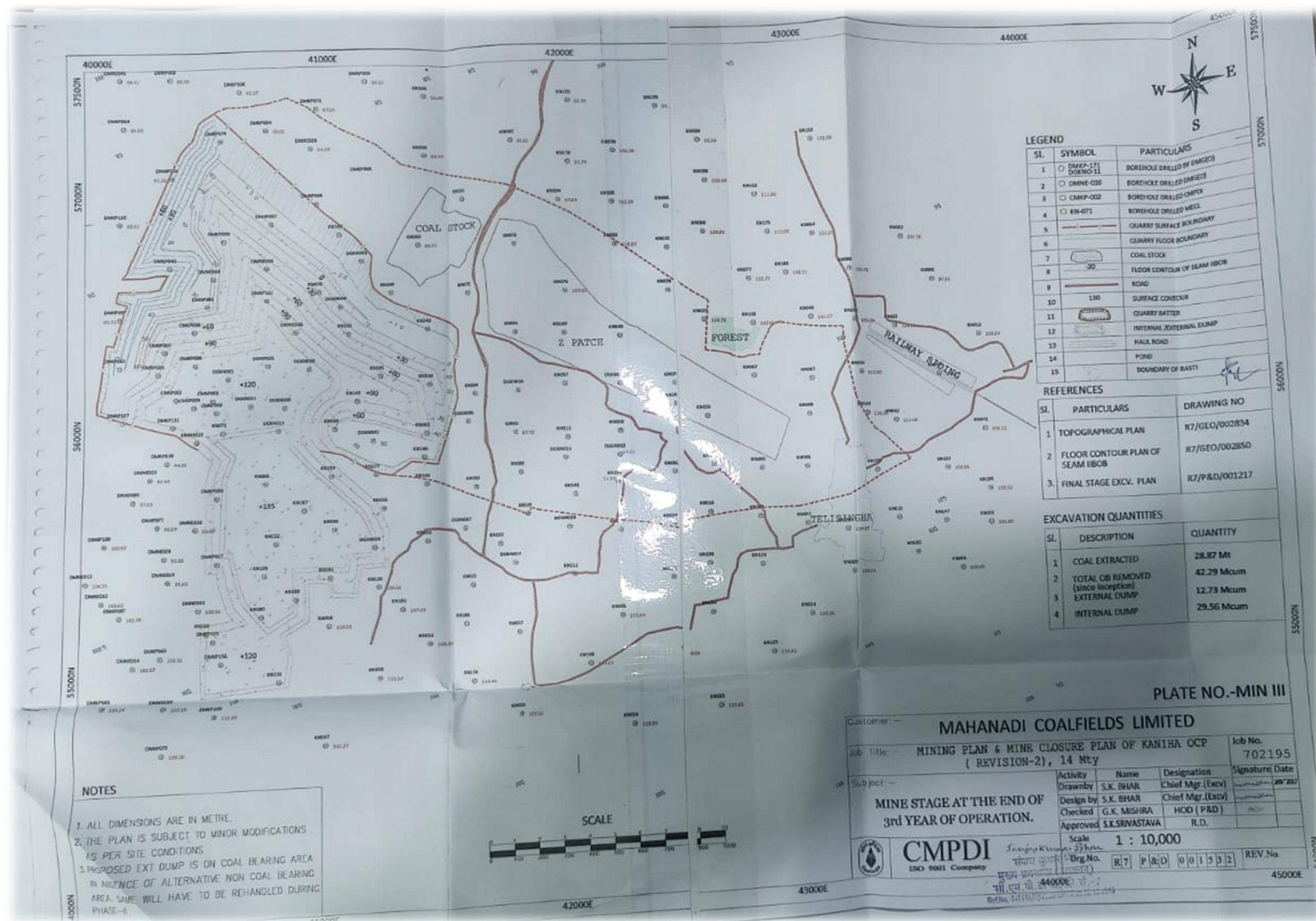


Figure 4.1B(A): Approved Mine plan (3rd Year) for Kaniha OCP, Talcher Coalfield.

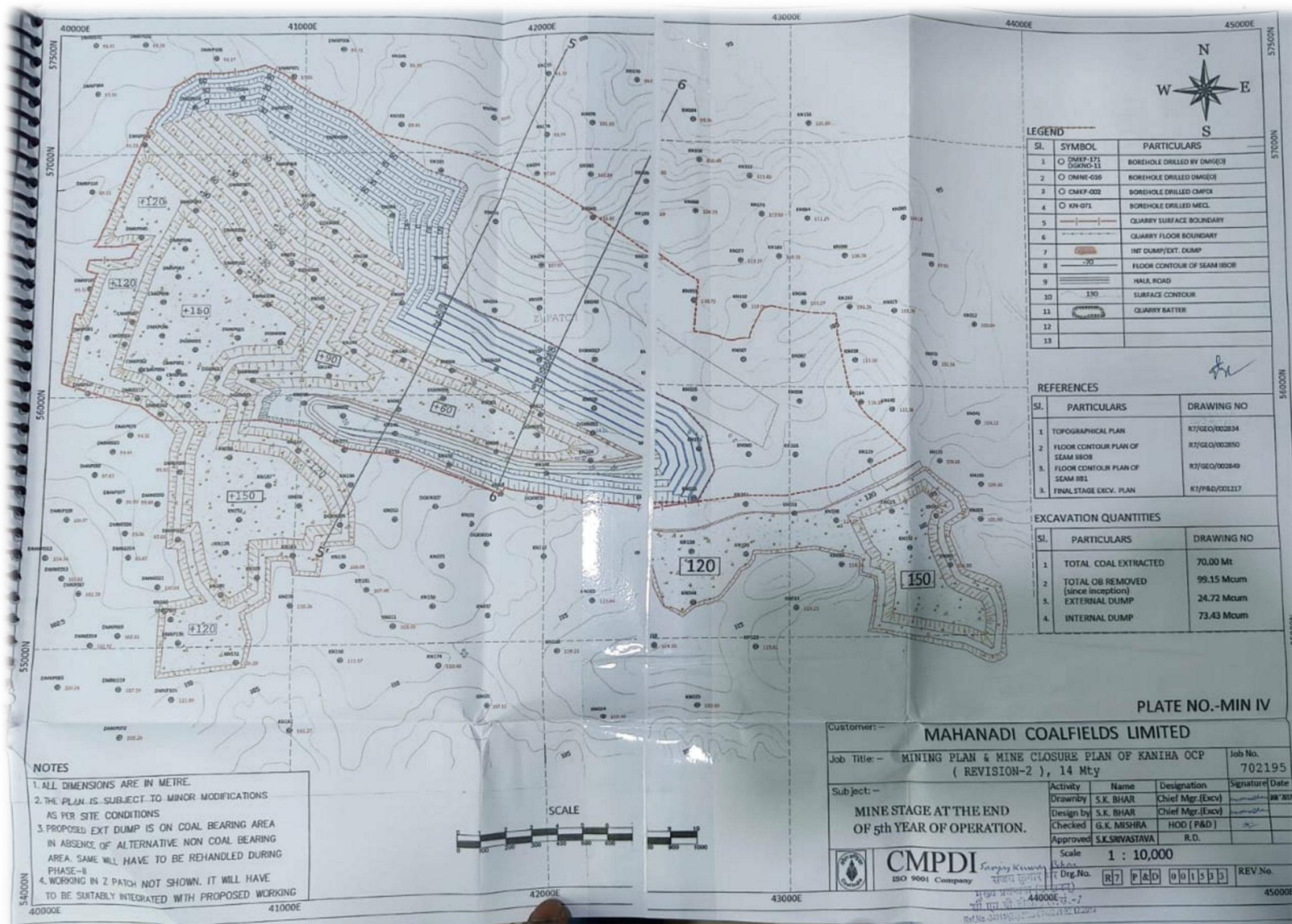


Figure 4.1B(B): Approved Mine plan (5th Year) for Kaniha OCP, Talcher Coalfield.

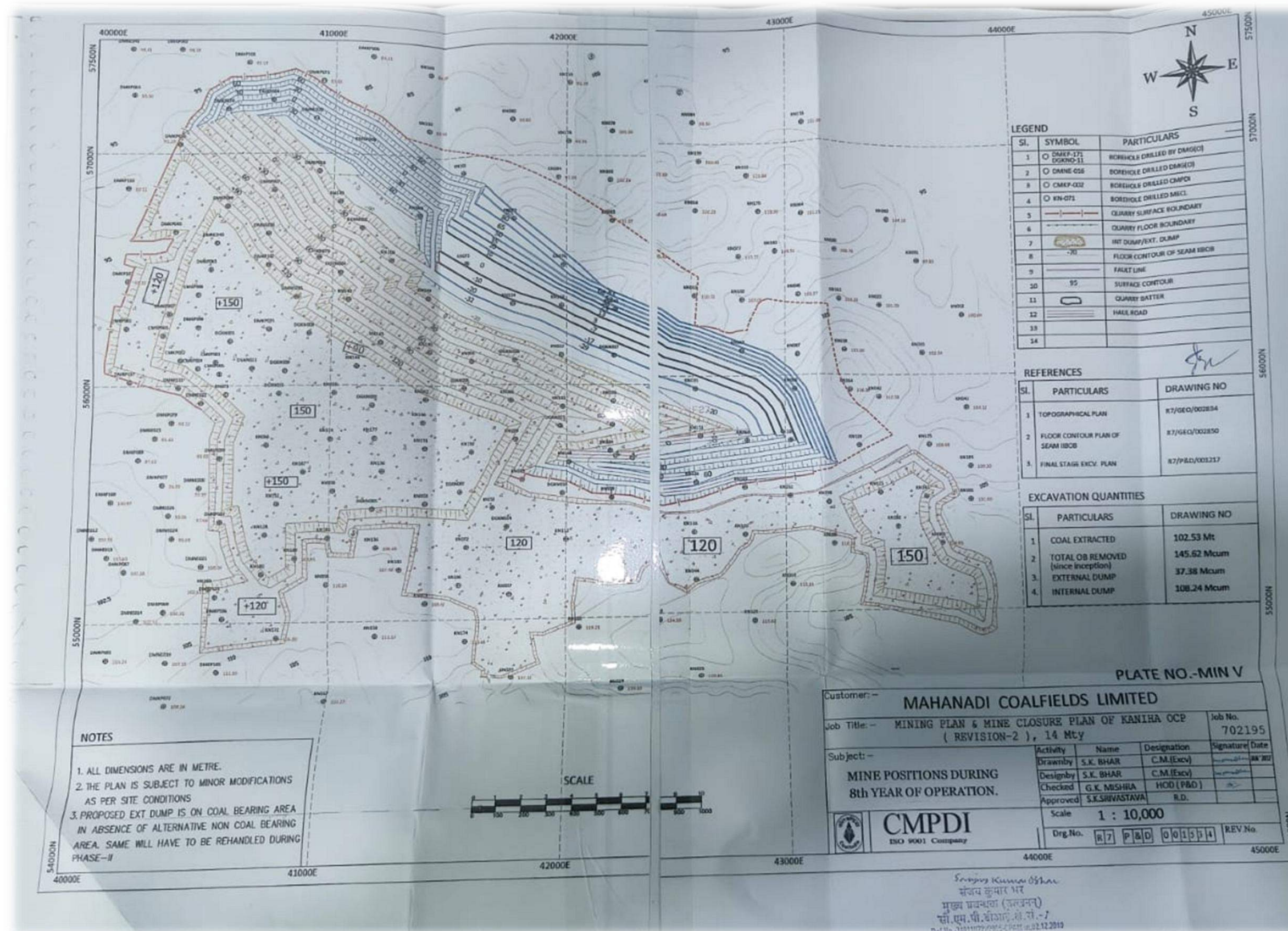


Figure 4.1B(C): Approved Mine plan (Year 8th) for Kaniha OCP, Talcher Coalfield.

5 ESTIMATION OF MINE SEEPAGE AND ADVANCED DEWATERING PLAN

Type of mine (Opencast)

The Kaniha opencast project of Talcher Coalfield, MCL, is a “**Brownfield**” **Opencast project**. Currently, the mine is in *Development stage*. Development of coal seams of Seam IV to Seam II in splits respectively is being undertaken currently by adopting opencast method with Shovel-Dumper Combination.

In terms of the hydrogeology, multi-layered aquifer system exists in the study area. During mining, the sandstone beds existing in the open face of working pits become the major source for inflow into the mine.

Elevation of water table at mining area

To assess the water table configuration, a network consisting of 30 dug wells, covering most of the villages falling within the core and buffer zone, was selected for the study area. The wells are mostly used for domestic water needs. The water levels in the observation wells were recently monitored during the pre-monsoon period (May 2024) and post-monsoon season (November 2024). The elevation of core zone (2 km radius) ranges from 68 m to 183 m above M.S.L. The elevation of the buffer zone (10 km radius) ranges from 64 m to 372 m above M.S.L.

Details of Mine pit with dimensions (Length, width, depth))

The dimension / mine geometry of the active mine area for Kaniha OC(phase-I) are as follows:

- Strike length (along floor)

Maximum	m	2600

Minimum	m	1100

- Strike length (along surface)

Maximum	m	3100

Minimum	m	1200

- Depth

Maximum	m	220

Minimum	m	15

Perimeter	m	9300

The total mining Lease Hold Area of the project is **1880** Ha. (718 Ha for Phase -I).

Details of mine pit stage wise have been presented in **Figure 4.1B** above.

The mine pit receives water from three sources namely, direct precipitation over excavated area, surface run-off from the surrounding area and seepage from the strata.

However, the impact of precipitation over the excavated quarry area and Surface run off water is more in case of open cast projects than the underground mining projects. Therefore, it is imperative to predict probable mine inflows at different developmental stages by means of either analytical or numerical methods or combinations of two. Thereby, to guard against this eventuality, the following steps will be taken depending upon the method of mining and other various hydro-meteorological factors and physiographic features.

- Provision of garland drain around the mine to prevent ingress of precipitation, run off and keeping the same
- Generation of conventional and face sumps to impound the seepage water
- Precaution against danger from local stream
- Prognostication of mine seepages at each stage of mine development
- Provision of sufficient number of pumps to pump out mine water during the critical rainfall period.

The generalized protocol used for water management in the coal mining areas of MCL command area is provided in the **Figures 5.1**.

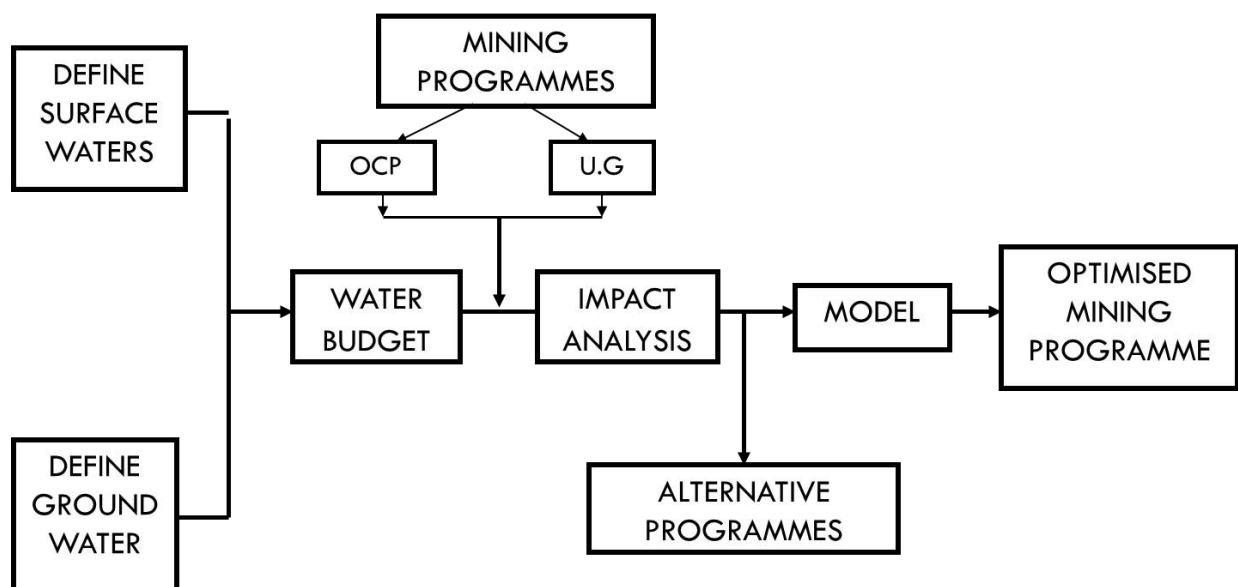


Figure 5.1: Water management in coal mining areas.

5.1 ESTIMATION OF MINE SEEPAGE

In sedimentary rocks, due to the stratification of formations, the horizontal permeability (K_H) is usually many folds higher than the vertical permeability (K_V). Thereby, the groundwater velocity along the bedding plane is higher than that across it. With the presence of local seams or coal streaks, some places the aquifer system behaves as multi-layer aquifers.

During mining, the sandstone beds existing in the roof of the working seams become the major source for inflow into the mine. The development of younger coal seams in the roof behaves as aquicludes and restricts the connection between the phreatic aquifer and the lower confining aquifers. The aquifer lying only in the immediate vicinity of mine workings get largely drained.

However, with the presence of alluvium, sandy and clayey soil, loosely cemented and poorly consolidated and weathered sandstone in the unconfined aquifer system is the major potential bed in this aquifer system. In the initial stage the mine inflow is in proportion to the rate of mine expansion. In due course, due to partial de-saturation of the aquifer, the inflow reduces and gets stabilized in time. With the presence of low permeable formations, the inflow is significantly small in lower aquifer units.

Prognostication of probable groundwater inflows into the surface mining excavation is achieved by an analytical approach: i.e., Darcy's Law ($Q = T \cdot I \cdot L$). Wherein, the groundwater inflow from different mine faces (i.e., perimeter) and the corresponding aquifer units is assessed initially and then an addition of all flow components depending on the depth of mine yields the mine inflow prediction, owing to the assumptions that flow into the mining excavation is laminar and one-phase flow.

The hydraulic gradient calculation maps for pre and post monsoon seasons are provided in **Figure 5.2 and Figure 5.3**. As per the calculations, the gradient is about 0.015 near the study area for respectively pre and post monsoon season, considering the depth of the working depth of the mine the hydraulic gradient of 0.015 has been used in the seepage calculation.

5.1.1 Seepage from the roof of the gallery

The year-wise, depth-wise mine seepage predictions according to the approved mine plan of Kaniha OC is provided in the Table 5.1. The estimated average mine seepage is

anticipated to vary between 1746 m³/day to 2329 m³/day (from current year till & 5th year) based on current rate of mine expansion. The estimated average mine seepage as per norms based on TIL method(For Second year) is 1892.00m³/day.

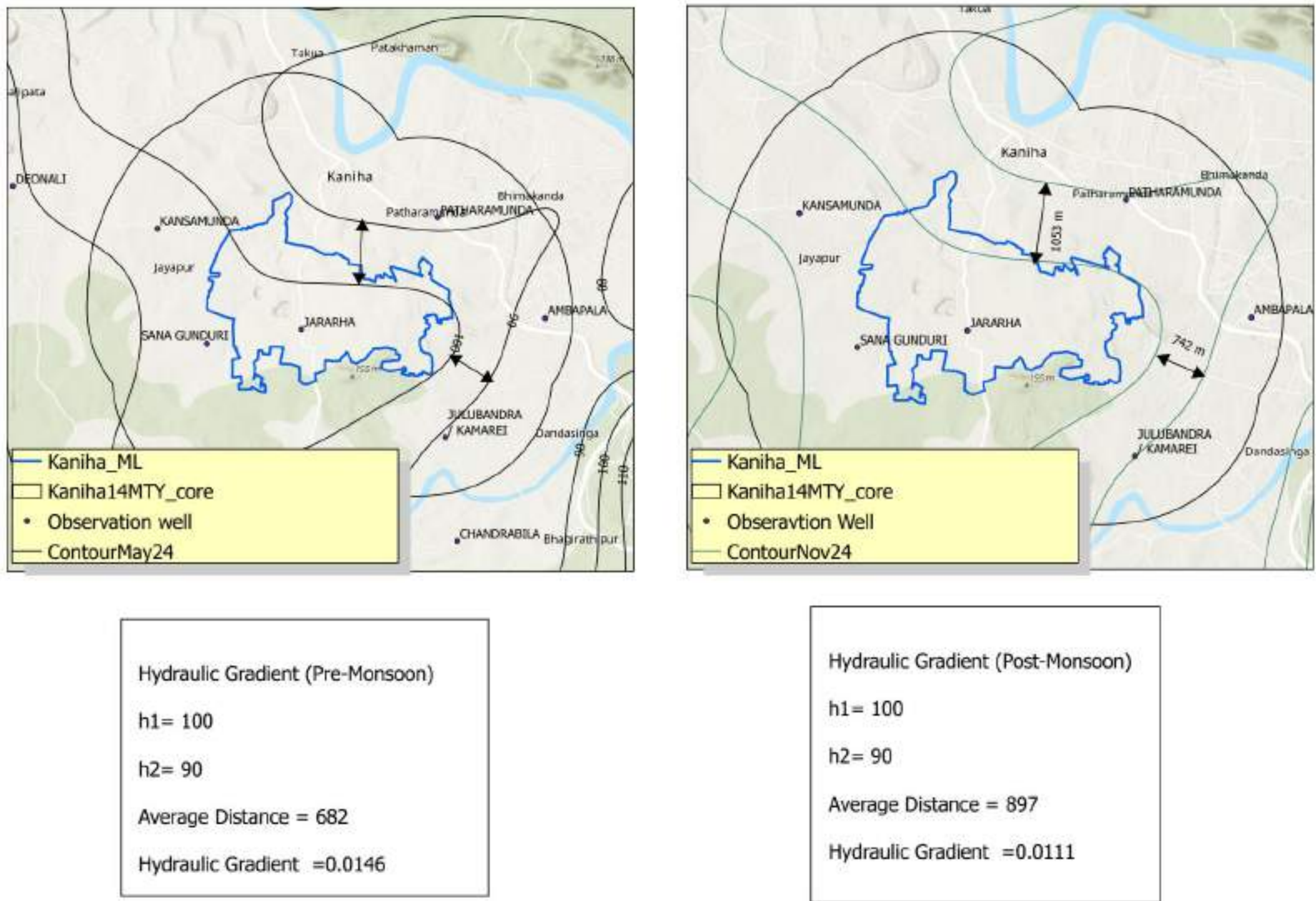


Figure 5.2: Hydraulic Gradient map (pre-monsoon) & Figure 5.3: Hydraulic Gradient map (post-monsoon), Kaniha OC, Talcher Coalfield, MCL.

Table 5.1: Mine seepage from walls of the pit for Kaniha OC, Talcher Coalfield, MCL.

Year	Period	Working bench Reduce Level with respect to MSL (m)	Depth to Water RL (m)	Length of the Face (m)	Width of the Face(m) or Dia (m) in case of tunnel	Saturated Thickness (m)	GW Gradient (m/m)	*Hydraulic Conductivity (m/day)	Per Day Mine Seepage (Cub m/Day)	Annual Mine Seepage (m ³ /Year)	Total Annual Mine Seepage (m ³ /Year)	Total Mine Seepage (m ³ /day)
Year 1 (2025-26)	Pre monsoon	-122.0	93	6972	NA	133	0.015	0.125	1736	425391	637385	1746
	Post monsoon	-122.0	96	6972	NA	135	0.015	0.125	1767	211994		
Year 2 (2026-27)	Pre monsoon	-122.0	93	7554	NA	133	0.015	0.125	1881	460901	690592	1892
	Post monsoon	-122.0	96	7554	NA	135	0.015	0.125	1914	229691		
Year 3 (2027-28)	Pre monsoon	-122.0	93	8136	NA	133	0.015	0.125	2026	496411	743799	2038
	Post monsoon	-122.0	96	8136	NA	135	0.015	0.125	2062	247387		
Year 4 (2028-29)	Pre monsoon	-122.0	93	8718	NA	133	0.015	0.125	2171	531922	797006	2184
	Post monsoon	-122.0	96	8718	NA	135	0.015	0.125	2209	265084		
Year 5 (2029-30)	Pre monsoon	-122.0	93	9300	NA	133	0.015	0.125	2316	567432	850212	2329
	Post monsoon	-122.0	96	9300	NA	135	0.015	0.125	2357	282780		

5.1.2 Seepage from bottom of the pit

During coal mining, the sandstone beds existing in the roof of the working seams become the major source for groundwater inflow into the mine. The roof and floor of coal seams are associated with carbonaceous shale/ shale, which behave as aquicludes and restrict the seepage from the lower confining aquifers. Thus, seepage from the bottom of the pit is not observed in the coal mines (**Table 5.2**).

Table 5.2: Seepage from Bottom of the Pit.

Year	Period	Hydraulic Conductivity (m/day)	Per day Mine Seepage (m ³ /day)	Annual Mine Seepage (m ³ /Year)
Year 1 (2024-2025)	Pre monsoon	0	0	0
	Post monsoon	0	0	0
Year 2 (2025-2026)	Pre monsoon	0	0	0
	Post monsoon	0	0	0
Year 3 (2026-2027)	Pre monsoon	0	0	0
	Post monsoon	0	0	0
Year 4 (2027-2028)	Pre monsoon	0	0	0
	Post monsoon	0	0	0
Year 5 (2028-2029)	Pre monsoon	0	0	0
	Post monsoon	0	0	0

5.1.3 Total Mine Seepage

The total stage wise mine inflow predictions from the walls and bottom of pit, Kaniha OC, Talcher Coalfield, MCL is provided in **Table 5.3**.

Table 5.3: Total mine inflow predictions stage wise of Kaniha OC

Year	Period	Annual Mine Seepage (m ³ /year)
Year 1 (2025-2026)	Pre-monsoon	425391
	Post-monsoon	211994
Year 2 (2026-2027)	Pre-monsoon	460901
	Post-monsoon	229691

Year	Period	Annual Mine Seepage (m ³ /year)
Year 3 (2027-2028)	Pre-monsoon	496411
	Post-monsoon	247387
Year 4 (2028-2029)	Pre-monsoon	531922
	Post-monsoon	265084
Year 5 (2029-2030)	Pre-monsoon	567432
	Post-monsoon	282780

5.2 ADVANCED DEWATERING PLAN

Mine dewatering is the process of controlling and managing surface water and ground water to allow mining in relative dry conditions and improve the Geotechnical stability and efficiency of mining methods. In mining, the purpose of dewatering is to create and maintain a cone of depression in the mine area (gallery) for the duration of mining so that mining operations can continue above the modified water table. In the Kaniha OC, the potentiality of the aquifers is low so advance dewatering is not required for this project.

5.3 GROUND-WATER MODELLING

Sri N.C. Nayak , a CGWA Accredited Consultant have undertaken GW modelling study for the Kaniha OC. Comparison of mine seepage estimated by 'TIL' method and by numerical groundwater modelling study has been furnished in **Table 5.4** below:

Table 5.4: Comparison of mine seepage estimation from analytical and numerical modeling methods

Year	Average Mine Seepage (m ³ / day)	
	TIL method	GW Modeling
Year 2 (2026-2027)	1892	2195

In comparison, the Groundwater Modeling-estimated value is higher compared to the seepage value predicted using 'TIL' method.

The Ground Water Modelling report is enclosed at the end of this report.

5.4 ESTIMATION OF RAINWATER QUANTUM DEWATERING

Precipitation, with varying intensity and duration, happens from time to time. Last 32 years of monthly rainfall have been collected from India-WRIS portal for Angul district (where Kaniha OCP lies) (**Table 5.5**). The monthly normal rainfall for 32 years have been used for mine pit rainwater collection estimation.

Table 5.5: Monthly Average Rainfall data of nearest IMD Station

Year	January	February	March	April	May	June	July	August	September	October	November	December
Average	12.00	11.10	18.70	25.90	66.10	191.90	327.60	325.60	227.00	95.00	10.30	8.80

During the mining process, there will be two ways of water collection in the mine pit.

- 1) Ground water inflow in the mine when the mine intersects the ground water.
- 2) Rainfall storage in the mine pit.

The estimation of mine pit rainwater collection has been attempted and the quantity is included in the NOC quantity.

In open cast mining, a depression is created. Based on the normal monthly rainfall, the rainwater storage in the mine pit is estimated. The ground water seepage is expected below the ground water table. While mine pits are being excavated, protection arrangements/ Garland drains are made all along the periphery of the mine to channelize the rain water in the mines for easy operation of mines. Hence, no surface runoff into the mine pit is considered in the case of garland drains located outside of the mine pit area.

Normally, the dumps are used for the protection arrangement and green belt are developed to reduce the erosion and to avoid dust pollution. In the above situation, the rainfall occurs over the mine pits alone collected in the pits. Since there is no runoff from the mine pit, the co-efficient of 1.0 (100 % direct rainfall) is considered as rainwater collection.

Evaporation

Evaporation records from pans are frequently used to estimate evaporation from lakes and reservoirs and ET from an area. Evaporation data obtained by multiplying pan-coefficient of value with Evapotranspiration data (Year-2024) from INDIA-WRIS.

Pan-coefficient of 1.0 and 0.80 has been considered for Non-monsoon and Monsoon season respectively. (**Table-5.6**)

Table 5.6: Variation of Pan Coefficient values with month

Pan-Coefficient	
0.8	1.0
Monsoon	Non-Monsoon

Recharge

As per the CGWA Manual for Recharge (GEC Norms -2015), the recharge structures like Check Dam / Percolation Pond will contribute 20% of the stored volume in both monsoon and non-monsoon season to the recharge of groundwater system. The mine pits can be considered as ponds (manmade structures). Hence, the above percentage is considered as ground water recharge from the mining pits. Accordingly, the ground water recharge quantity from the mine pit is estimated. The estimation of monthly rainwater collection is presented in

Table 5.7.

Table 5.7: Estimation of rainwater collection at mine pit.

Estimation of Mine Pit Rainwater collection										
Name of Mine	OC Mine pit Boken area (sq.m)	Average OC mine sump area (sq.m)	OC Mine pit Boken area excluding sump area (sq.m)	#Run-off coeff. (Broken Area excluding sump)	#Run-off coeff. (Sump Area)		Annual rainwater collection in mine pit (cum)	Annual estimated EV loss (Cum)	Annual estimated seepage / recharge from mine sump (Cum)	Net Annual Rainwater available in mine sump (Cum)
Kaniha OCP	930019	151809	778210	0.65	1.00		863641	108305	103637	651698
							Percentage wrt. Gross storage	12.54	12	75.46
Month	*32 years of Normal Rainfall in mm	Estimated Rainwater storage (cum)		**Evapotranspiration (m/month) (Source: WRIS)	Pan-coefficient	Evaporation Factor (m/month)	Estimated Evaporation loss (cum)	Recharge factor	Recharge from storage (Cum)	Estimated Rainwater accumulation (Cum/day)
		Through Pit Area excluding sump	Through Sump area							
January	12.00	6070.04	1821.71	0.01672	1	0.01672	2538	0.12	947	1785

*Comprehensive Hydrogeological Report on ground water conditions in core and buffer zone of
Kaniha OC Project, Talcher Coalfield, MCL*

February	11.10	5614.79	1685.08	0.01351	1	0.01351	2051	0.12	876	
March	18.70	9459.14	2838.83	0.0323	1	0.0323	4903	0.12	1476	
April	25.90	13101.17	3931.85	0.02478	1	0.02478	3762	0.12	2044	
May	66.10	33435.79	10034.57	0.04871	1	0.04871	7395	0.12	5216	
June	191.90	97070.02	29132.15	0.08741	0.8	0.069928	10616	0.12	15144	
July	327.60	165712.04	49732.63	0.09972	0.8	0.079776	12111	0.12	25853	
August	325.60	164700.36	49429.01	0.15326	0.8	0.122608	18613	0.12	25696	
September	227.00	114824.89	34460.64	0.14525	0.8	0.1162	17640	0.12	17914	
October	95.00	48054.47	14421.86	0.10868	1	0.10868	16499	0.12	7497	
November	10.30	5210.12	1563.63	0.05321	1	0.05321	8078	0.12	813	
December	8.80		1335.92	0.02701	1	0.02701	4100	0.12	160	
Total	1320	663253	200388				108305		103637	1785

Note: Less than 10 mm of Annual Rainfall is not considered for storage collection.

Rainfall data Source : https://srcodisha.nic.in/rain_fall.php (for Angul District)

After factoring the evaporation losses and recharge, the net volume of water available in the mine pits is around 651698 m³/year. Therefore, the per day estimated net volume is around 1785.48(~1786) m³/day. The **1786 m³/day** is added to the mine seepage and the same is also considered in the NOC Application.

It is worth-mentioning that apart from above figure, **50 m³/day** from ground water sources through proposed bore well will also be withdrawn and will be considered in the final quantum for NOC.

Mine Pumping Details from Mine flow Meter (one at Kansamunda Patch & other at Z Patch) Telemetry is as follows

The total discharge for the period 19-03-2025 to 25-09-2025 as measured from both telemeters is 515436.70 m³. Hydrograph analysis of Flowmeter abstraction data is shown in figure 5.3 A The average abstraction during the period is 2629 m³ / day for the said period.

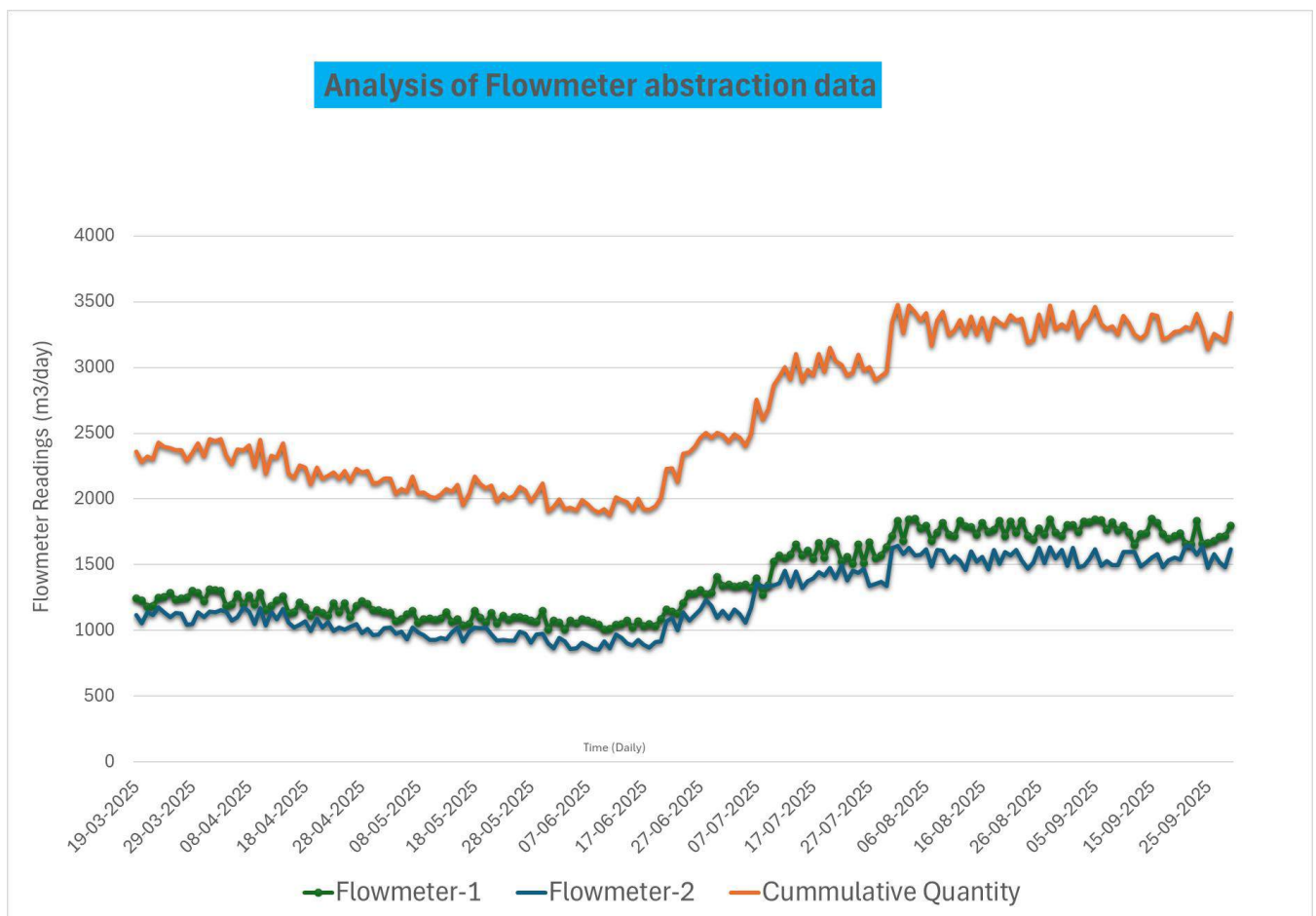


Figure. Flowmeter Abstraction data

6 MINE WATER MANAGEMENT

6.1 EXISTING/ PROPOSED USAGE OF WATER AVAILABLE

Mines require water for both domestic (*housing, service buildings, etc.*) and industrial (*workshop, dust suppression, CHP, greenbelt development and firefighting, etc.*) uses. The details of utilization of dewatered/ pumped out water of the project are given below (**Table 6.1**).

Table 6.1: Details of utilization of dewatered/ pumped out water for Kaniha OC, Talcher Coalfield, MCL.

S.No		Demand (m ³ /day)	Demand (m ³ / year)	Remarks
1	Water Supply for community usage and Domestic usage	Nil	Nil	
2	Agriculture	Nil	Nil	
3	Greenbelt Development	04	1460	
4	Dust Suppression	3383	12,34,795	
5	Fire fighting	186	67,890	
6	Office Requirements	30	10,950	
7	Workshop	07	2555	
8	Any other items	-	-	
Total		3610	13,17,650	

6.2 SOURCES OF WATER SUPPLY

The total water demand for project-related industrial and domestic purpose (being catered from groundwater) is 3610 KLD.

Mine pumps are being used for dewatering the mine-seepage water (**Table 6.2**), while tube wells/ bore wells (to be constructed) (**Table 6.3**) are being used to abstract groundwater for domestic/ potable use in Kaniha OC mine. Their details are given below:

Table 6.2: Details of existing/ proposed dewatering structures at Kaniha OC mine.

Sl. No.	Type of Structure/Year Of Construction	Depth (m)/ Diameter (mm)	Discharge (m ³ / hour)	Operational hours (hrs/day)	Mode of lift	Pump capacity (HP)	Whether fitted with water meter	Whether Permission Registered with CGWA. If so details thereof
1	Mine Pump (Kansamunda Patch)/2014	200 mm & 109 m	388	5 hrs	Centrifugal Pump	660		Obtained
2	Mine pump (Z-Patch)/2017	150 mm & 106 m	388	5 hrs	Centrifugal Pump	660		Obtained

Table 6.3: Details of proposed Tube well/ Bore well structures.

Structure/ Year of construction	Depth (m) / Diameter (mm) of BW/TW	Discharge (m ³ /Hour)	Operational Hours/(Day) / Days (Year)	Horse Power of Pump	Present Condition	NOC Status	Proposed Quantum
Borewell	200 m /160 mm	5	5hrs 365 days	3 HP	Proposed	Applied	50 m ³ /day
Borewell	150 m /160 mm	5	5hrs 365 days	3 HP	Proposed	Applied	
Borehole/	200m /160 mm	5	5hrs 365 days	3 HP	Proposed	Applied	

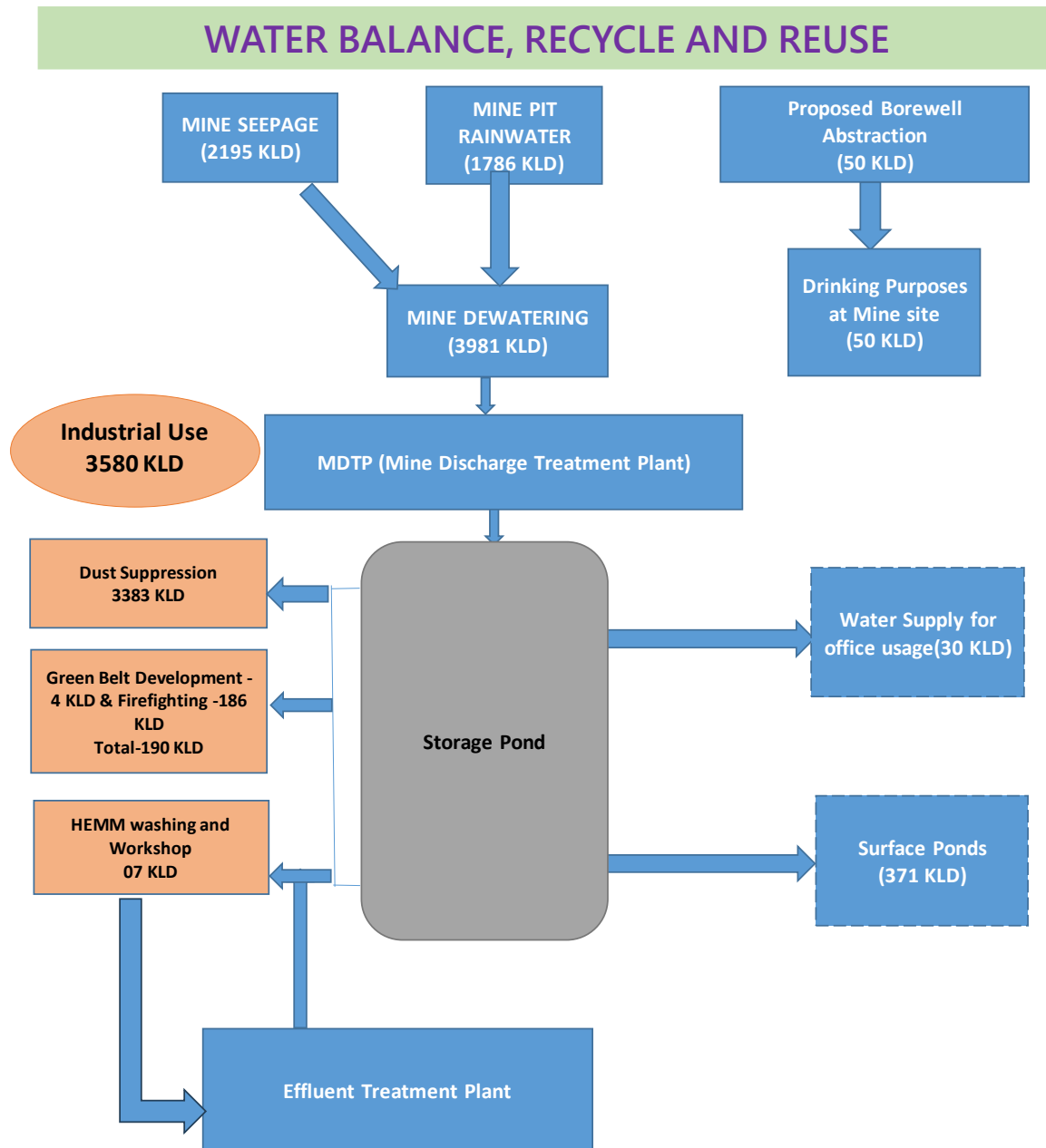


Figure 6.1: Water Usage for various purposes at Kaniha OC, Talcher Coalfield, MCL.

7 IMPACT OF MINE DEWATERING/ ABSTRACTION AND MITIGATION MEASURES

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

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

The general need in mine planning from the hydrogeological point of view is the estimation of make of water (groundwater seepage) into the mine, its rate, the technique of extraction of groundwater from the aquifer for advance dewatering if required, extent of depression of piezometric surface and management of mine effluent (mine water). It is also desirable that the consequences of mining operation on the groundwater regime be determined in advance.

7.1 IMPACT ON THE GROUND WATER REGIME

7.1.1 Impact on Aquifer System

The mining activities may cause changes in aquifer potential, the water level in the vicinity of the mine and disturb the groundwater flow direction. Due to blasting, the hydrogeological units close to the working face will get disturbed and the fractures and joints will get dilated. This increase in secondary porosity and development of higher permeability zones close to the working face will influence the mine inflow rate and drawdown.

The impact of opencast mining on the local water regime largely depends on mine geometry, groundwater recharge and aquifer parameters of the formations. As the permeability decreases with depth, the inflow from lower most formations also reduces proportionally and

marginal to negligible impact may be anticipated. As the unconfined aquifer (i.e., the OB benches), with comparatively high K, contributes the maximum inflow and the top hydro-geological unit receives the maximum impact. Thus, with the presence of multi-layered aquifer system and low permeability the drawdown cones in the individual hydro-geological units will be small and stacked.

In the reclaimed area, the permeability is usually higher and receives up to 40% of rainfall as recharge. With this, the impact on the up-dip side gets reduced with time and even improves the groundwater system. In the down-dip direction, due to blasting, improvement in secondary porosity near to the coal face as well as in the overlying beds will get increased. In turn, this will increase the groundwater recharge and mine inflow. Also, the mine water discharged into the local drainage/ tanks behaves as constant source of recharge and improves the water levels in the study area. Thus, with increase in groundwater recharge and return flow from mine discharge, the impact is usually lower than the anticipated.

After the mining activity, the aquifer restores its original water level and the mined out area behave as groundwater reservoirs. The impact of mining activity on groundwater regime has been simulated by the aid of Groundwater Flow Modeling study and same has been addressed in the Ground Water Modeling report.

7.1.2 Radius of Influence

The impact of mining on groundwater regime can be quantified by estimating the radius of influence, which can be defined as the radial distance from the center of the borehole to the point where there is no lowering of groundwater table/potentiometric surface. The radius of probable impact on groundwater levels is predicted based on Sichardt's method for various hydraulic conductivity (k) values. However, due to non-homogenic and non-isotropic nature of the aquifers, the radius of influence will be limited to a small distance. With the variation in aquifer/ mine geometry, return flow from mine discharge and abundant recharge potential, the zone of disturbance will be reduced further.

The radius of influence (R) calculated after referring to the Sichardt's formula as mentioned in the following equation (**Equation 2**) in **Table 7.1**.

$$R = C \cdot (H - H_w) \cdot \sqrt{K}$$

...Eq. 2

R = Radius of Influence (m)

C = Constant having value of 3000,

(H-H_w) = Drawdown (m),

K = Permeability of aquifer (m/sec)

As mentioned earlier, with the presence of low permeable aquifers and shallow mining, the radius of influence will be limited to a small distance. Thus, the impact of mining on local water regime will be marginal. With no major stresses involved, the impact will be negligible. So also, due to stratification, the permeable beds develop individual drawdown cones. Thereby, the impact will be close to the mine face or limited to the mine lease boundary.

In the present calculation, it has been considered that the entire saturated thickness of the combined aquifer is dewatered due to mining. As the permeability varies largely in the mine area, the radius of influence has been estimated based on the average “K” value for the Kaniha OCP area although with depth the K value is anticipated to reduce but considering blasting which will induce fractures the average K Value of 0.125 m/day is considered. The maximum thickness of the combined aquifer in the study area is 138 m approximately and the total column of saturated zone that is anticipated till second year is 138 m, average water level in the post-monsoon season for the area from piezometers installed varies 2.86 mbgl. So, the maximum saturated thickness in the aquifer would be impacted is estimated to be 135.14 m. Hence, the probable maximum drawdown due to coal mining in the Kaniha OC may be 135.14 m. This drawdown value has been used to calculate the radius of influence for the cone of depression created due to dewatering of the combined aquifer.

Table 7.1: Anticipated Radius of influence on the groundwater regime of Kaniha OC study area, Talcher Area, MCL.

Project	Maximum Depth of Mine Operation (m)	Radius of influence (m)
		K= 0.125 m/d
Kaniha OC	220	488

Therefore, the zone of influence in the Kaniha OCP may extend to about 0.48 km from the mine edge.

As is practiced, maximum effort is been done to hold the water in voids of upper benches and during the year and under unusual circumstances the surplus mine water during monsoon is discharged into the local drainage after adequate treatment. Thereby, the local village water supply will be least affected and rather, source augmentation can be anticipated.

Moreover, the impact of mining activity on groundwater regime has been simulated by the aid of Groundwater Flow Modeling study and same has been addressed in the Ground Water Modeling report.

7.2 IMPACT ON SURFACE WATER SOURCES

7.2.1 Change in land use

Land is the most natural resource, which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land, which is the scarcest natural resource in our country. Impact assessment on land use has been shown below in **Table 7.1**.

Table 7.1: Impact assessment on land use

Sl. No.	Parameters	Impact Assessment	
		Within mining area	Outside mining area
1	Topography	In the quarry area, the dump area and the mining equipment area, there will be a marked change in topography.	No appreciable damage is envisaged.
2	Change in Landscape and Land use pattern than pre-mining scenario such as visual impact-loss of aesthetic beauty, ugly scar on land; deforestation-loss of surface soil and vegetation cover	Total scenario of landscape land use pattern undergo a stark change.	Landscape and land use pattern will change where erection and development of plants, service /allied services buildings are established.
3	Change in Surface Drainage	There will be a stark change in surface drainage; rather new pattern of drainage will be developed.	Surface drainage is likely to change where construction of colony, roads and drainage are to be executed.

7.3 IMPACT ON WATER QUALITY

7.3.1 Impact of Mining on Ground Water Quality

Key parameters like odour and taste were consistently marked as "Agreeable" across all stations, indicating no sensory deviations or immediate issues related to smell or flavour. The colour, measured using the Hazen scale, varied slightly between 1 and 8, reflecting minimal differences in water clarity. Turbidity values, measured in NTU, ranged from 1 to 3, suggesting low levels of suspended particles in the water. The physicochemical parameters further indicate

the general quality of water. The pH levels, ranging from 6.88 to 8.21, show the water is neutral to slightly alkaline, which is within acceptable standards for drinking water. Electrical conductivity (EC), a measure of the ionic concentration in the water, exhibited significant variation, with the lowest value at Kandhabarani (237 $\mu\text{S}/\text{cm}$) and the highest at Patharamunda (1822 $\mu\text{S}/\text{cm}$). This indicates possible differences in dissolved salt content across the sampling locations. Total alkalinity ranged from 37 mg/L to 452 mg/L, signifying variations in the buffering capacity of the water, which is crucial for maintaining pH stability. The chemical constituents, including chloride (Cl), sulphate (SO_4), and nitrate (NO_3), were well within permissible limits. Chloride concentrations ranged between 12 mg/L and 384 mg/L, with the highest observed at Patharamunda, indicating no harmful salinity issues. Sulphate levels remained low, varying from 4.12 mg/L to 95.6 mg/L, while nitrate values ranged from <0.5 mg/L to 24.6 mg/L, reflecting limited agricultural or industrial contamination. Total hardness, a crucial indicator of water quality, ranged from 154 mg/L to 1184 mg/L, with higher value at Patharamunda (1184 mg/L). These levels, primarily influenced by calcium (23.9 mg/L to 132 mg/L) and magnesium concentrations, suggest the water in these areas could lead to scaling issues in domestic and industrial applications.

The trace metal analysis showed copper levels consistently at 0.03 mg/L, which is below harmful thresholds. Metals like iron (Fe), zinc (Zn), lead (Pb), and cadmium (Cd) were present in negligible amounts, ensuring no immediate heavy metal contamination. Similarly, arsenic (As), selenium (Se), and total chromium (T Cr) were reported at levels below detection limits, highlighting the absence of toxic element contamination. Organic pollutants, such as phenolic compounds, were below 0.001 mg/L, and residual chlorine levels were consistently under 0.2 mg/L, indicating no significant chemical contamination or treatment residues.

The microbial analysis further reinforces the safety of the water, as the Most Probable Number (MPN) of coliform bacteria was marked as "Not Detected" for all stations. This confirms the absence of microbial contamination, which is critical for human consumption and public health safety. The findings suggest that while the water quality around the coal mines appears to be within acceptable environmental limits, ongoing monitoring is crucial to detect any long-term impacts from mining and related industrial activities on the surrounding aquatic ecosystems. These results provide a foundation for sustainable water management and pollution mitigation strategies in coal mining regions.

7.4 MITIGATION MEASURES

As a part of environmental protection, the project has been adopting all possible measures to increase the groundwater recharge potential in the influenced and nearby areas. Moreover, the waste water recycling after due treatment will enable the conservation of water. Storage of conserved water in mine pits/ underground galleries will be given due emphasis to providing water round the year and quality of water will be maintained before and after storage.

7.4.1 Water Conservation Measures Adopted

7.4.1.1 Management of Surface Water Drainage

Garland drains will be made around the periphery of the mine leasehold area. These garland drains will be connected to the local stream which is not likely to be disturbed by mining operation. In the workings, heavy duty pumps will be deployed in rainy season which will throw the accumulated water from the working face into these garland drains.

7.4.1.2 Afforestation and plantation

To improve the environment and greenery in the area, MCL had taken up plantation on a larger scale. The improvement in vegetation cover has a direct bearing on augmentation of ground water recharge. The compensatory afforestation has been carried out through the State Forest Departments.

7.4.1.3 Water harvesting and artificial recharge measures

Computation of groundwater recharge by existing RTRWHS in the study area

Artificial Rain Water Harvesting Structures or Roof Top Rainwater Harvesting Structures (RTRWHS) have been constructed at Coal Sampling Lab, Kaniha of the study area. The groundwater recharge from these structures have been assessed by the aid of following formulae (**Equation 3**) and norms as prescribed in the Manual on Artificial Recharge of Ground Water, CGWB, 2007.

Water available from roof is obtained from the following relation:

$$\text{Water available (in litres)} = \text{Annual rainfall (in mm)} \times \text{Roof area (in sq.m)} \times \text{Runoff Coefficient}$$

Area of a roof shall be measured as the area projected on a horizontal surface. For practical purpose, it is measured on the ground surface and the area calculated as the product of length and breadth. The coefficient of runoff varies depending on the type of roof and indicates the fraction of rainwater that can be collected from roof. Run-off coefficients for common types of roofs are shown in **Table 7.2**.

Table 7.2: Runoff Coefficients of common types of roofs.

Sl. No	Types of roof	Runoff Coefficient
1	Roof Top of building/ Shed	0.85
2	Road/ Paved area	0.65
3	Open Land	0.20
4	Green Belt	0.15

Therefore, from the aforementioned table, Runoff Coefficient of 0.85 has been considered for the computation of availability of water from the roofs and consequently amplifying the groundwater recharge of the area. The details of the computation are furnished in following **Table 7.3**.

Table 7.3: Computation of groundwater recharge by RTRWHS in the Kaniha OC study area.

S.No.	Location	Nos. of RWH	Area (Sq.m)	Average Rainfall (m)	Runoff Coefficient	Recharge, Q (m3/year)
1	Coal Sampling Lab	1	185	1.33	0.85	209.14
Total						209.14

MDTP (Mine Discharge Treatment Plant)

Another treatment plant is constructed near the Railway Siding to treat the water discharging from railway siding, coal transportation road and mine sump. The discharge water is collected in pre-sedimentation pond I & II. After sedimentation, the effluent is passed through masonry drain to screening chamber. Alum dosing is done in the flash mixture tank and the treated

water is guided to sedimentation pond. Finally the supernatant fluid is taken to the clear water pond for storage. The water stored in the clear water pond is being used for the purpose of dust suppression in railway siding through the installed sprinklers and other uses. Details of sedimentation pond is given below:

Sl. No	Place	Length (m)	Width (m)	Depth (m)	Area (m ²)
1	Pre-Sedimentation Pond-I	68	28	2	1904
2	Pre-Sedimentation Pond-II	98	28	2.7	2744
3	Sedimentation Pond	115	88	2.5	10120
4	Clear Pond	135	95	4.5	12825

It is apparent from the above assessment that all these RTRWHS are augmenting the groundwater recharge to the tune of 209.14 m³/year in the Kaniha OC study area.

7.4.2 Mine Water Treatment & Disposal Plan (recycling, reuse and treatment)

Mine treatment plant is constructed near the Railway Siding to treat the water discharging from railway siding, coal transportation road and mine sump. The discharge water is collected in pre-sedimentation pond I & II. After sedimentation, the effluent is passed through masonry drain to screening chamber. Alum dosing is done in the flash mixture tank and the treated water is guided to sedimentation pond. Finally, the supernatant fluid is taken to the clear water pond for storage. The water stored in the clear water pond is being used for the purpose of dust suppression in railway siding through the installed sprinklers and other uses.

Kaniha OCP has installed the Effluent Treatment Plant with 8 m³/day capacity, which is adequate to treat the effluents generated during the process and designed for 6hrs operational time on daily basis. This is a chemical and bio chemical treatment plant which involves in three processes such as; effluent screening processes followed by oil and grease removal process and PH correction process at the end. The water from workshop, washing ramp, etc flows to

primary settling tank (PST). The sludge is retained and the supernatant water flows under Baffle wall to second part of PST and oil is retained at oil skimmer chamber (OSC). The deposited sludge is pumped out by a sludge pump to a drying bed. The flow moves to oxidation tank from OSC where air is pumped by the compressor. After oxidation, the water passes through a multimedia filter and is sent to the clear water reservoir. There is also a provision for clear water backwash process to multimedia filter for better function. The treated water from this plant will be collected in a tank for recycling the same for industrial use resulting in zero discharge. The sludge collected in the setting chamber will be disposed of as land fill in de-coaled area. Oil and grease which is manually reclaimed in the trap will be stored in drums safely for disposal through auction. Oily sludge will be disposed of in specially designed pit with impervious layer lined. Details of flow diagram of Water treatment is given in **Figure 7.1**

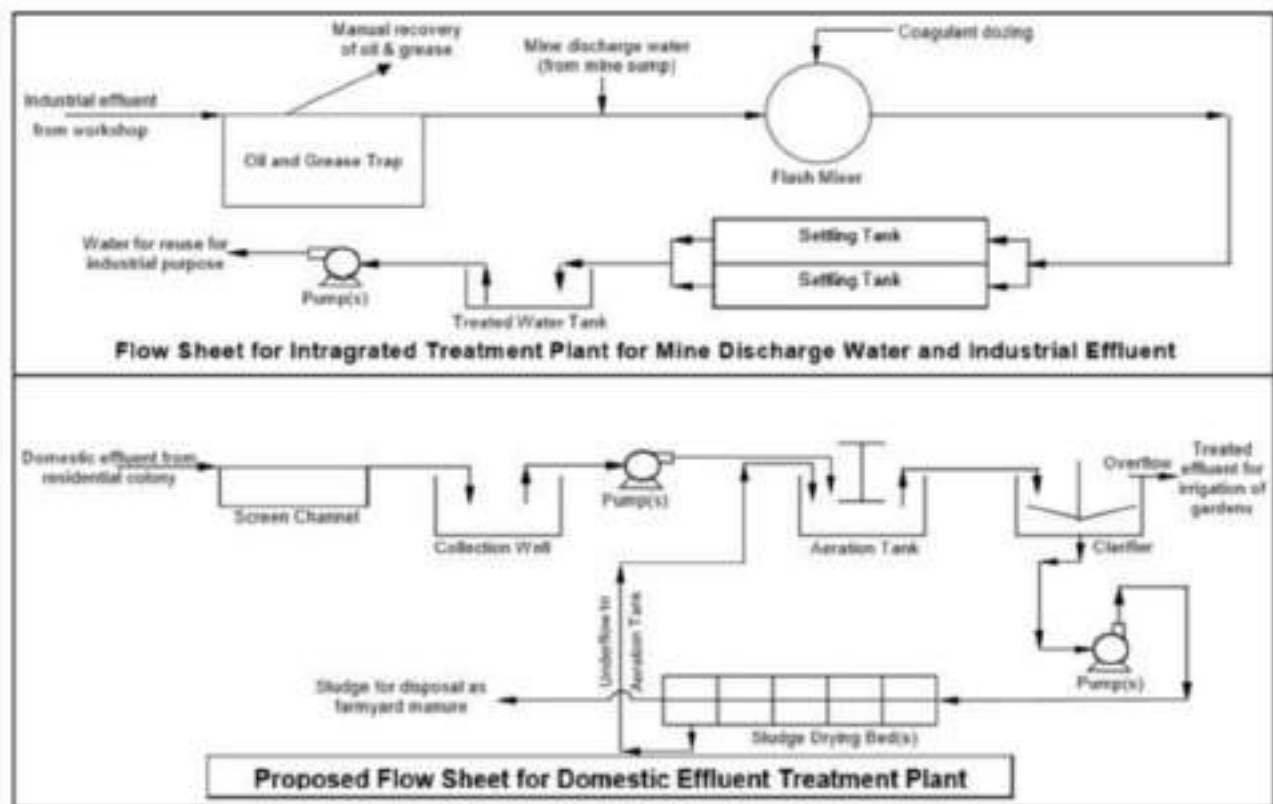


Figure 7.1: Water treatment flow diagram in the Kaniha OC study area.

7.5 SALINE WATER DISPOSAL STRATEGIES (IN CASE OF SALINE WATER ABSTRACTION)

Not applicable.

8 ANY OTHER DETAILS PERTAINING TO THE PROJECT

For the purposes of groundwater budgeting (as per the GEC 2015 methodology), the whole area on a regional scale is considered to be a one-aquifer system. This is, in part, because the different aquifer layers are in all probability interlinked and hence structurally contiguous due to the presence of many small-scale faults. Moreover, at the mine front/faces, all the confined/semi-confined aquifers behave as unconfined aquifers mainly because of removal of overburden material and thereby, exposed to the zone of aeration and hence, convergence of water tables.

Central Ground Water Board (CGWB) has computed the Block-wise groundwater draft based on several data like well census, crop water requirement, and electricity usage as per the Groundwater Estimation Committee (GEC-2015 Methodology). This is the regular program of CGWB and block-wise groundwater resources for 2024 are available. Since the study area falls in Kaniha Block of Angul district, their groundwater resource is given below

Table 8.1: Groundwater Resources Budget at Kaniha Block

Ground Water Recharge (ham)	Natural Discharges (ham)	Annual Extractable Ground Water Resources (ham)	Ground Water Extraction (ham)	Categorization of Block as per GWRA 2024
8716.48	871.65	7844.83	4826.11	Safe
Stage of Extraction (%)			61.52	

9 SUMMARY AND CONCLUSION

Kaniha OC is a brownfield opencast coal mining project situated adjacent to the located in the central part of the Talcher Coalfield in the Talcher development block, Angul district of Odisha.

The Kaniha OC Project is located in the **Kaniha Block**, which is a **Safe category block** as per CGWB assessment in **GWRA 2024**. Moreover, none of the major Ramsar wetlands, Lakes under the National Plan for Conservation of Aquatic- Eco-systems fall in the 10-km study area of Kaniha OC.

The project has a GW NOC from CGWA vide NOC No: CGWA/NOC/MIN/REN/1/2025/11362 dt 08.04.2025 and the NOC is valid up to 10.11.2025. This CHR and GW modeling study is prepared towards the renewal application of this NOC, which will be valid for 2 years. The average groundwater seepage (from TIL method) into the mine for the maximum of first two years will be about **1892 m³/day** and that from Groundwater modeling is estimated at **2195 m³/day**.

The project proponent has constructed one number of Roof-Top rainwater harvesting structures in the study area having a groundwater recharge potential of **209.14 m³/year**.

Net groundwater withdrawn as per the model and considered for granting of NOC is:

Net Ground Water Withdrawn

= 2195 m³/day (Mine seepage from GW Modeling) + 1786 m³/day (Mine pit rainwater

(Accumulation) +50 m³/day (fresh water)

= 4031 m³/day (Considered for NOC)

10 ACCREDITATION CERTIFICATE

CMPDIL, a subsidiary of Coal India Limited, is accredited by CGWA, QCI-NABET, and NABL.

The details of accreditation are furnished below:

- a. Accredited by CGWA for preparation of reports in the functional area of 'Hydrogeological Condition in Mining projects', valid from 15.02.2021 to 14.02.2026 (Certificate enclosed below)
- b. Accredited by QCI-NABET scheme for i) Comprehensive report on groundwater condition/situation and ii) Impact Assessment Reports without modelling studies, valid since Oct 27, 2021 to Oct 13, 2026. (Certificate enclosed below)
- c. Accredited by QCI-NABL (Certificate enclosed below)

REFERENCES/ BIBLIOGRAPHY

Anderson, M.P. and Woessner, W.W., 1992. Applied Groundwater Modeling— Simulation of Flow and Advective Transport. Academic Press, Inc., San Diego, CA, 381 p.

DEM and/ or topographic contour map of the area (The details of elevation of the surrounding area) <https://earthexplorer.usgs.gov/>

Geomorphology map (including drainage and water bodies).
<https://bhukosh.gsi.gov.in/Bhukosh/MapView.aspx>

Langevin, CD and Weixing Guo, 2006. MODFLOW/MT3DMS-Based simulation of variable density groundwater flow and transport, Groundwater Vol.44, No.3, pp.339-351.

Maps of both regional Geology and the local Geology of the surrounding area
<https://bhukosh.gsi.gov.in/Bhukosh/MapView.aspx>

Map of Land use/ Land cover map of the surrounding area
<https://www.arcgis.com/home/item.html?id=d6642f8a4f6d4685a24ae2dc0c73d4ac>

Open street map (includes roads, places and railways) <https://extract.bbbike.org/>

Rainfall data collected from <https://indiawris.gov.in/wris/#!/rainfall>

Mine Water and the Environment. 26. 264-270. 10.1007/s10230-007-0017-1.

Toposheets collected from Survey of India
<https://onlinemaps.surveyofindia.gov.in/FreeMapSpecification.aspx>

Wang, M., Li, J. (1987). Technology of mine water control in China. International Journal of Mine Water 6, 25–38. <https://doi.org/10.1007/BF02498103>.

Water level data collected from <https://indiawris.gov.in/wris/#!/groundWater>

Annexure I: Work order to CMPDIL

ମହାନଦୀ କୋଇଲା ଫିଲ୍ଡ ଲିମିଟେଡ୍
ମହାନଦୀ କୋଇଲାଫିଲ୍ଡସ ଲିମିଟେଡ୍
Mahanadi Coalfields Limited
(A subsidiary of Coal India Limited)

ମହାନଦୀ କୋଇଲାଫିଲ୍ଡ (ପର୍ଯ୍ୟାମ ସ୍ଥଳ)
Office of the General Manager (Envt & Forest)
P.O. Jagmohan, Buxi
Dist. Sambalpur, Odisha-768028
Ph: +91 6766222025
e-mail: gm@mccl.coil.co.in, gm@mccl.coil.co.in



Ref no: MCL/SBP/Envt & Forest/ 25-26/ ୧୭୫୮

Dr: 6.05.2025

To The Regional Director CMPDIL -RI-7, Plot No. 2-4, Near Gandhi Park At- Sarmantapur, PO: RRI, Bhubaneswar-751033 (Odisha)	ସିଏସି ଞ୍ଚିତ୍ତ ନିର୍ଦ୍ଦେଶକ, ସଞ୍ଚିତ୍ତ ନିର୍ଦ୍ଦେଶକ କ୍ଷେତ୍ର ସମିତି - ୭, ପ୍ଲଟ ନଂ - ୨-୪ ଗାନ୍ଧୀ ପାର୍କ ନିକଟରେ, ସାମନ୍ତପୁରୀ, ପି.ଓ.ଆର୍.ଆର୍.ଓ. ଭୁବନେଶ୍ୱର - ୭୫୧୦୩୩, (ଓଡ଼ିଶା)

Subj: Work-Order for "Preparation of Comprehensive Hydrogeological Report (CHR) along with Groundwater modelling as per the latest guideline in respect of Kaniha OCP, Kaniha Area, MCL".

Ref: E-office computer no. 1877652 regarding your offer submission.

Dear Sir,

This is to communicate that the Competent Authority of MCL is pleased to approve the award of work for "Preparation of Comprehensive Hydrogeological Report (CHR) along with Ground Water modelling as per the latest guideline in respect of Kaniha OCP, Kaniha Area, MCL" in your favour at a total value of Rs. 34,85,720.00 (Thirty-four Lakh Eighty-Five Thousand Seven Hundred and Twenty Only) including 18% GST with the following terms and conditions.

1. Scope of Work:

The work involves the "Preparation of comprehensive hydro-geological report of core and buffer zones in the radius of 2 sq.Km. and 10 sq.Km. respectively along with groundwater modelling in accordance with the prescribed format of CGWA for mining projects" for Kaniha OCP of Kaniha Area. The report is to be prepared following the latest SOP issued by CGWA for mining projects, applicable during the period of work. Report will be prepared with available water level data collected in 2025.

Details of value of job:

Details	Kaniha OCP
EDs assigned	100
ED rate (Exclu. GST) (₹)	29,540.00
Amount (₹)	29,54,000.00
GST @ 18% (₹)	5,31,720.00
Grand Total (Including 18% GST) (₹)	34,85,720.00

2. Commencement & Completion of Work:

The work shall commence from the date of issuance of work order and the report shall be submitted within 150 Days from issue of work order.

3. Payment terms:

- CMPDI RI-VII shall raise the bills addressing to General Manager (Environment & Forest).
- Raised bill will be accepted and certified from General Manager (Kaniha Area) and Staff Officer (Envt.), Kaniha Area, on completion of work.
- General Manager (E&F) will accept the bill for payment after necessary examination.
- General Manager (Finance), MCL HQ will be the paying authority for this work.

4. Penalty Clause

- Since the completion time stipulated above is the essence of the Work-Order, MCL management reserves the right to impose penalty, at the rate of 0.5 % of the total awarded value of the work for each week of delay up to the ceiling limit of 10% of the awarded value of the work. The aforesaid penalty will be deducted from the payment of bills.

Annexure II: Accreditation Certificate & Water Quality Analysis Results

*Comprehensive Hydrogeological Report on ground water conditions in core and buffer zone of
Kaniha OC Project, Talcher Coalfield, MCL*

 cmpdi <i>A MCL Reva Company</i>	Drinking Water Quality Data Kaniha Area

Project / OCP	Kaniha OCP			Indian Drinking Standards (IS-10500):2012	
Monitoring Station	Ambapala	Bilinda	Brahmanabil	Acceptable	Permissible
Date of Sampling	21-May-2024	21-May-2024	21-May-2024	Acceptable	Permissible
Colour(Hazen)	2	2	2	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity(NTU)	1	2	2	1	5
pH	8.02	7.66	7.45	6.5-8.5	No relaxation
Total Alkalinity(mg/L)	64	292	164	200	600
Chloride(mg/L)	61.1	68.98	173.45	250	1000
Sulphate(mg/L)	66.63	27.73	34.11	200	400
Nitrate(mg/L)	21.85	<0.5	<0.5	45	No relaxation
Total Hardness (Ca CO ₃)(mg/L)	210.60	107.29	401.33	200	600
Calcium(mg/L)	24.08	30.22	128.83	75	200
Fluoride(mg/L)	<0.3	0.70	0.79	1	1.5
Total Dissolve Solid(mg/L)	334	398	594	500	2000
Copper(mg/L)	<0.03	<0.03	<0.03	0.05	1.5
Manganese(mg/L)	<0.04	<0.04	<0.04	0.1	0.3
Iron(mg/L)	<0.1	<0.1	<0.1	1.0	No relaxation
Zinc(mg/L)	0.05	0.04	0.11	5	15
Lead(mg/L)	0.006	<0.005	0.007	0.01	No relaxation
Cadmium(mg/L)	<0.001	<0.001	<0.001	0.003	No relaxation
Total Chromium (mg/L)	<0.01	<0.01	<0.01	0.05	No relaxation
Arsenic(mg/L)	<0.005	<0.005	<0.005	0.01	No relaxation
Selenium(mg/L)	<0.005	<0.005	<0.005	0.01	No relaxation
Boron(mg/L)	<0.2	<0.2	<0.02	0.5	2.4
Phenolics(mg/L)	<0.001	<0.001	<0.001	0.001	0.002
Residual Free Chlorine(mg/L)	<0.2	<0.2	<0.2	0.2	1.0
MPN (Index/100 ml)	Not Detected	Not Detected	Not Detected	-	-

A. Jais

File-7
Authorised Signatory
CMPDI, RI-VII, LAB
BHUBANESWAR

 cmpdi <i>A Miniratna Company</i>	Drinking Water Quality Data Kaniha Area

Project / OCP Monitoring Station	Kaniha OCP			Indian Drinking Standards (IS-10500):2012	
	Kamarei	Kansamunda	Brahmanidel	Acceptable	Permissible
Date of Sampling	11-May-2024	11-May-2024	11-May-2024		
Colour(Hazen)	1	4	5	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity(NTU)	2	2	1	1	5
pH	7.55	6.89	6.77	6.5-8.5	No relaxation
Total Alkalinity(mg/L)	340	152	24	200	600
Chloride(mg/L)	59.13	11.83	47.30	250	1000
Sulphate(mg/L)	10.55	8.34	16.20	200	400
Nitrate(mg/L)	<0.5	<0.5	17.13	45	No relaxation
Total Hardness (Ca CO ₃)(mg/L)	305.97	158.94	75.50	200	600
Calcium(mg/L)	65.21	52.49	27.04	75	200
Fluoride(mg/L)	0.58	0.97	<0.3	1	1.5
Total Dissolve Solid(mg/L)	490	228	158	500	2000
Copper(mg/L)	<0.03	<0.03	<0.03	0.05	1.5
Manganese(mg/L)	<0.04	0.14	<0.04	0.1	0.3
Iron(mg/L)	<0.1	<0.1	<0.1	1.0	No relaxation
Zinc(mg/L)	0.25	0.45	0.26	5	15
Lead(mg/L)	0.007	<0.005	<0.005	0.01	No relaxation
Cadmium(mg/L)	<0.001	<0.001	<0.001	0.003	No relaxation
Total Chromium (mg/L)	<0.01	<0.01	<0.01	0.05	No relaxation
Arsenic(mg/L)	<0.005	<0.005	<0.005	0.01	No relaxation
Selenium(mg/L)	<0.005	<0.005	<0.005	0.01	No relaxation
Boron(mg/L)	<0.2	<0.2	<0.2	0.5	2.4
Phenolics(mg/L)	<0.001	<0.001	<0.001	0.001	0.002
Residual Free Chlorine(mg/L)	<0.2	<0.2	<0.2	0.2	1.0
MPN (Index/100 ml)	Not Detected	Not Detected	Not Detected	-	-

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Authorised Signatory
CMPDI, RI-VH, LAB
BHUBANESWAR

 cmpdi <i>A Mini Ratna Company</i>	Drinking Water Quality Data Kaniha Area

Project / OCP Monitoring Station	Kaniha OCP				Indian Drinking Standards (IS-10500):2012	
	Patharamunda	Khajuria	Changurhia	Sana Santrabandh	Acceptable	Permissible
Date of Sampling	20-May-2024	20-May-2024	20-May-2024	20-May-2024		
Colour(Hazen)	2	3	4	3	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity(NTU)	3	2	2	1	1	5
pH	7.86	7.68	7.85	7.51	6.5-8.5	No relaxation
Total Alkalinity(mg/L)	396	356	292	308	200	600
Chloride(mg/L)	384.34	29.56	15.77	13.8	250	1000
Sulphate(mg/L)	95.58	11.78	10.80	6.17	200	400
Nitrate(mg/L)	22.52	<0.5	1.32	3.14	45	No relaxation
Total Hardness (Ca CO ₃)(mg/L)	472.86	341.73	246.36	236.42	200	600
Calcium(mg/L)	132.01	49.3	62.03	55.67	75	200
Fluoride(mg/L)	0.62	0.65	1.31	1.24	1	1.5
Total Dissolve Solid(mg/L)	1184	476	388	396	500	2000
Copper(mg/L)	<0.03	<0.03	<0.03	<0.03	0.05	1.5
Manganese(mg/L)	0.05	0.05	<0.04	<0.04	0.1	0.3
Iron(mg/L)	<0.1	<0.1	<0.1	<0.1	1.0	No relaxation
Zinc(mg/L)	<0.04	<0.04	0.46	0.13	5	15
Lead(mg/L)	0.01	<0.005	<0.005	<0.005	0.01	No relaxation
Cadmium(mg/L)	<0.001	<0.001	<0.001	<0.001	0.003	No relaxation
Total Chromium (mg/L)	<0.01	<0.01	<0.01	<0.01	0.05	No relaxation
Arsenic(mg/L)	<0.005	<0.005	<0.005	<0.005	0.01	No relaxation
Selenium(mg/L)	<0.005	<0.005	<0.005	<0.005	0.01	No relaxation
Boron(mg/L)	<0.2	<0.2	<0.2	<0.2	0.5	2.4
Phenolics(mg/L)	<0.001	<0.001	<0.001	<0.001	0.001	0.002
Residual Free Chlorine(mg/L)	<0.2	<0.2	<0.2	<0.2	0.2	1.0
MPN (Index/100 ml)	Not Detected	Not Detected	Not Detected	Not Detected	—	

Handwritten Signature
Authorised Signatory
CMPDI, RI-VII, LAB
BHUBANESWAR

 cmpdi <i>A Mini Ratna Company</i>	Drinking Water Quality Data Kaniha Area

Project / OCP Monitoring Station	Kaniha OCP		Indian Drinking Standards (IS-10500):2012	
	HANUMANAPUR	KUKURHIA		
Date of Sampling	6-May-2024	6-May-2024	Acceptable	Permissible
Colour(Hazen)	1	2	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable
Taste	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity(NTU)	1	1	1	5
pH	7.24	7.96	6.5-8.5	No relaxation
Total Alkalinity(mg/L)	120	314	200	600
Chloride(mg/L)	24.62	58.26	250	1000
Sulphate(mg/L)	8.64	18.24	200	400
Nitrate(mg/L)	<0.5	16.46	45	No relaxation
Total Hardness (Ca CO ₃)(mg/L)	124.62	236.84	200	600
Calcium(mg/L)	24.84	48.86	75	200
Fluoride(mg/L)	0.72	0.54	1	1.5
Total Dissolve Solid(mg/L)	196	472	500	2000
Copper(mg/L)	<0.03	<0.03	0.05	1.5
Manganese(mg/L)	<0.04	<0.04	0.1	0.3
Iron(mg/L)	<0.1	<0.1	1.0	No relaxation
Zinc(mg/L)	<0.04	<0.04	5	15
Lead(mg/L)	<0.005	<0.005	0.01	No relaxation
Cadmium(mg/L)	<0.001	<0.001	0.003	No relaxation
Total Chromium (mg/L)	<0.01	<0.01	0.05	No relaxation
Arsenic(mg/L)	<0.005	<0.005	0.01	No relaxation
Selenium(mg/L)	<0.005	<0.005	0.01	No relaxation
Boron(mg/L)	<0.2	<0.2	0.5	2.4
Phenolics(mg/L)	<0.001	<0.001	0.001	0.002
Residual Free Chlorine(mg/L)	<0.2	<0.2	0.2	1.0
MPN (Index/100 ml)	Not Detected	Not Detected	-	-

Ante

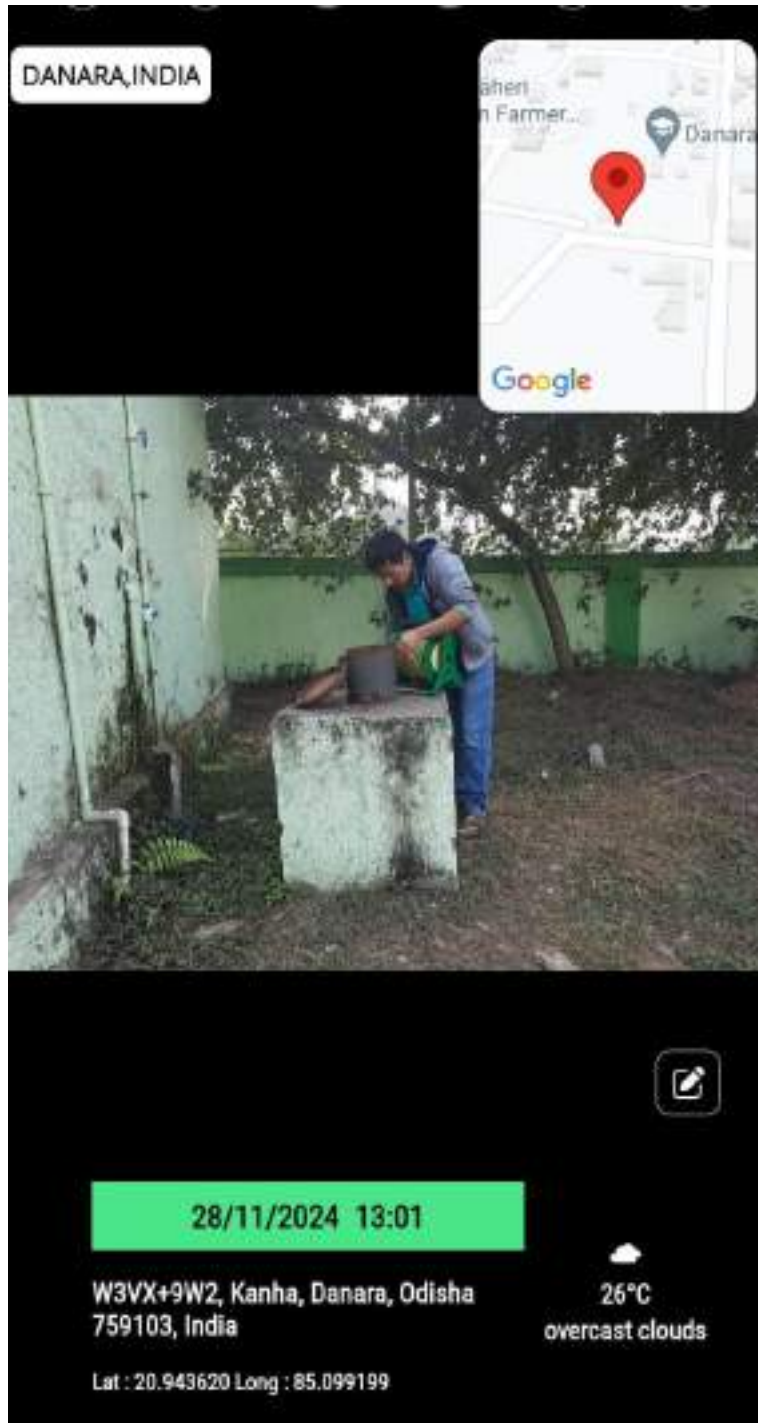
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Authorised Signatory
CMPDI, RI-VII, L&E
BHUBANESWAR

		National Accreditation Board for Testing and Calibration Laboratories
CERTIFICATE OF ACCREDITATION		
REGIONAL ENVIRONMENT AND CHEMICAL LABORATORY		
has been assessed and accredited in accordance with the standard		
ISO/IEC 17025:2017		
"General Requirements for the Competence of Testing & Calibration Laboratories"		
for its facilities at		
REGIONAL INSTITUTE VII, CENTRAL MINE PLANNING AND DESIGN INSTITUTE LIMITED, BHUBANESWAR, KHORDHA, ODISHA, INDIA		
in the field of		
TESTING		
Certificate Number:	TC-7052	
Issue Date:	22/03/2024	Valid Until: 21/03/2026
This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL. (To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)		
Name of Legal Entity: CENTRAL MINE PLANNING & DESIGN INSTITUTE LIMITED		
Signed for and on behalf of NABL		
	 N. Venkateswaran Chief Executive Officer	

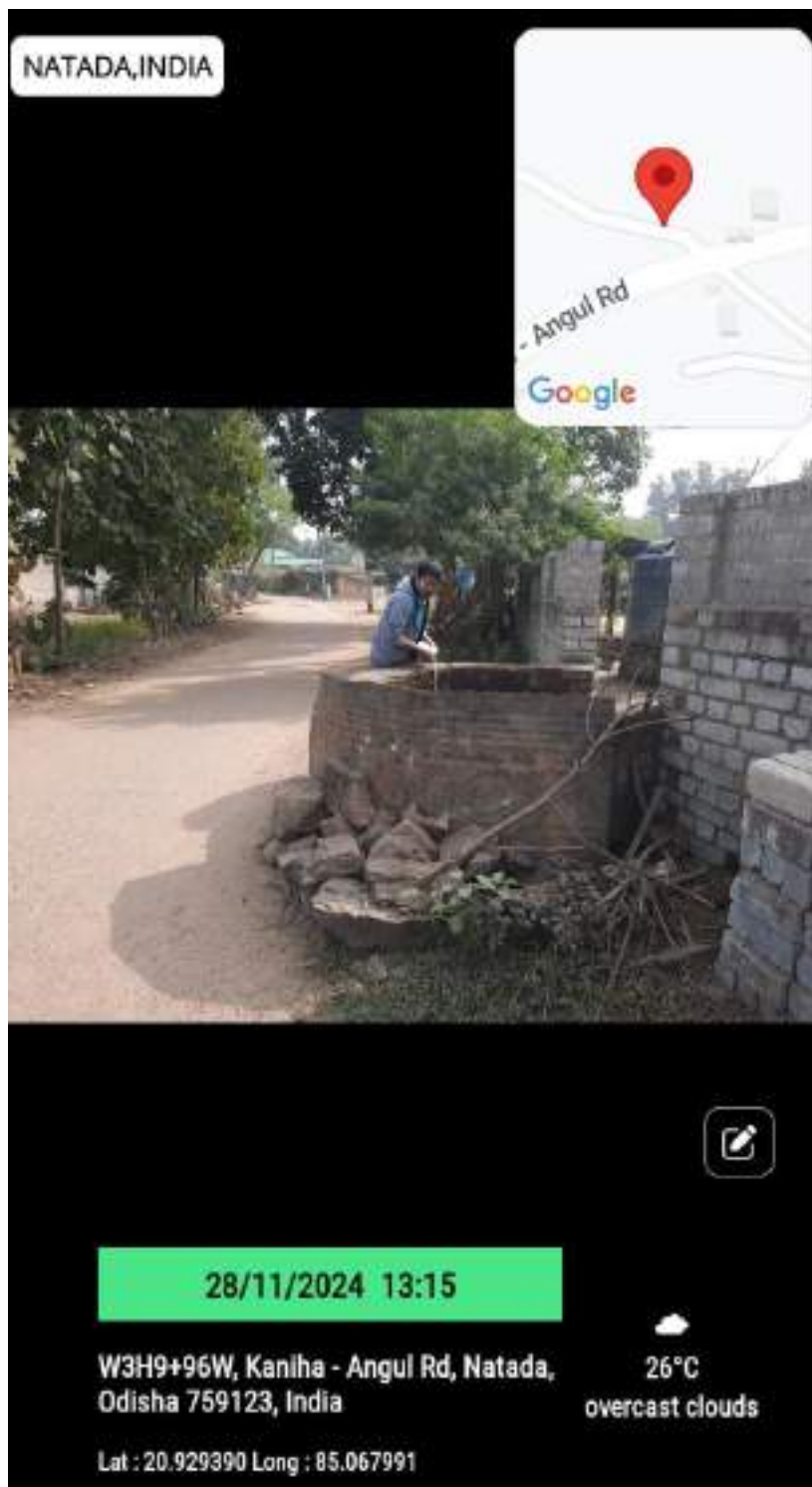




Annexure III: Photo documentation



Groundwater Level monitoring at Danara Piezometer Station



Groundwater Level Monitoring at Natada Dugwell Station.



Storage Pond for Storing pumped water after Sedimentation

Annexure IV: Numerical Modelling Report

MATHEMATICAL MODELLING STUDIES

OF

KANIHA OPENCAST MINE (COAL)

(1034 Ha)

MAHANADI COALFIELD LIMITED

DIST- ANGUL, ODISHA

PREPARED BY:

Dr. Nirad Chandra Nayak, Former Scientist-D, CGWB

Accreditation Number: CGWA/RGI/038

October 2025

Mathematical Modelling Report
Hingula Opencast Project (Coal) of M/s Central Coalfield Ltd.

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Mathematical Modelling Report
Hingula Opencast Project (Coal) of M/s Central Coalfield Ltd.

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1.0 Introduction

Opencast mine, also known as open-pit mine, is a typical surface mining method by which mineral deposits are extracted by removing large amounts of overlying rock and soil. It is commonly used for minerals close to the Earth's surface, like coal, gold, or iron ore. The process involves digging out the ore in layers in a funnel shape quarry. Opencast mining is often cost-effective due to simple mining operation, but can have significant environmental impacts, such as habitat destruction and pollution. Mine generally cut across the water table and deeper fracture zones, which contributes ground water seepage into the mine. Depending on the hydrogeological properties of formations, significant groundwater inflows occur. Sometimes proximity of streams, rivers, ponds and lakes also have significant impact on seepage. The magnitude of these inflows must be estimated so that pumping systems can be designed to collect and dispose of the water. The adverse impact of mining is reflected in significant drawdown of the water table in the surrounding areas, which can have some impact on water supply wells and baseflow to streams.

The Kaniha Opencast mine of Mahanadi Coalfield Limited (MCL) is located in Kaniha Block of Angul District. The mine is situated at a distance of 28 km from Talcher Town and is 36 km north of Angul town (Figure-1). Lease area falls in 73 G/4 topo-sheet of Survey of India. The total lease area is bounded by Latitude 21°03'04"N to 21°05'00"N and Longitude 85°02'20"E to 85°06'00"E (Figure -1).

The Kaniha Opencast mine is operating under MCL in Talcher coalfield to supply coal mainly to Thermal Power Plant of NTPC at Kaniha. The depth of the mine varies from 100 to 120 m below ground level depending on the land elevation and the location of a place in the mine with reference to dip of the coal seam. The land elevation varies from 105 to 147 m above mean sea level (amsl) in the mine lease area. Mining is carried out using conventional Opencast Mining method with Heavy Earth Moving Machinery (HEMM). Coal is mainly being extracted from seam II, III & IV of Barakar formation with seam II being the main thick seam which is situated at 60 to 70 m bgl. Since the mine is situated on a raised plateau, seepage from the phreatic aquifer is limited and dries out as the mine progresses. However, seepage from faces where fractures are opened up in mining operation, contributes ground water seepage into the mine. The water is collected at the deepest sump and is pumped out as per the requirement.

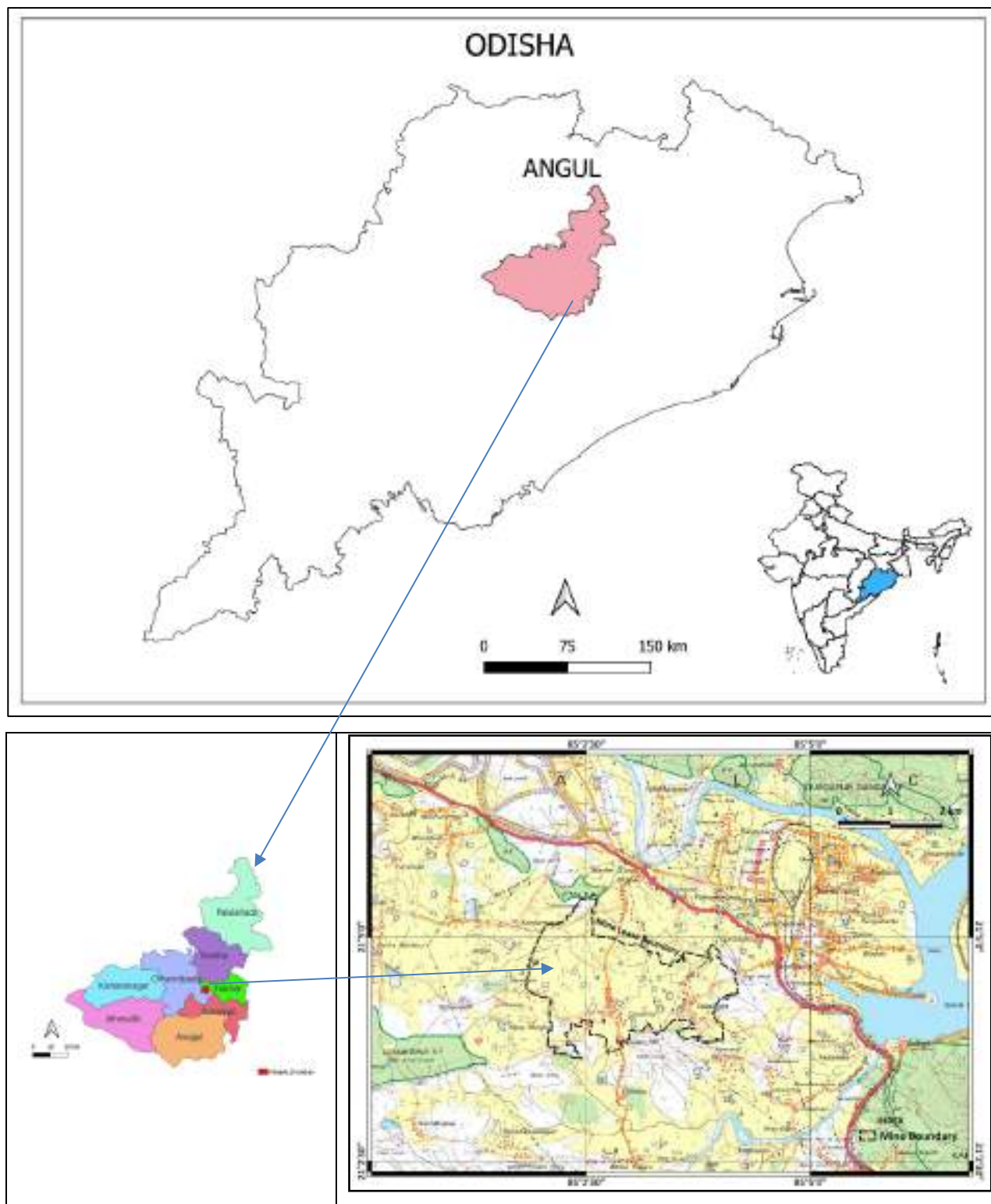


Figure - 1: Location map of the Kaniha Opencast Mine

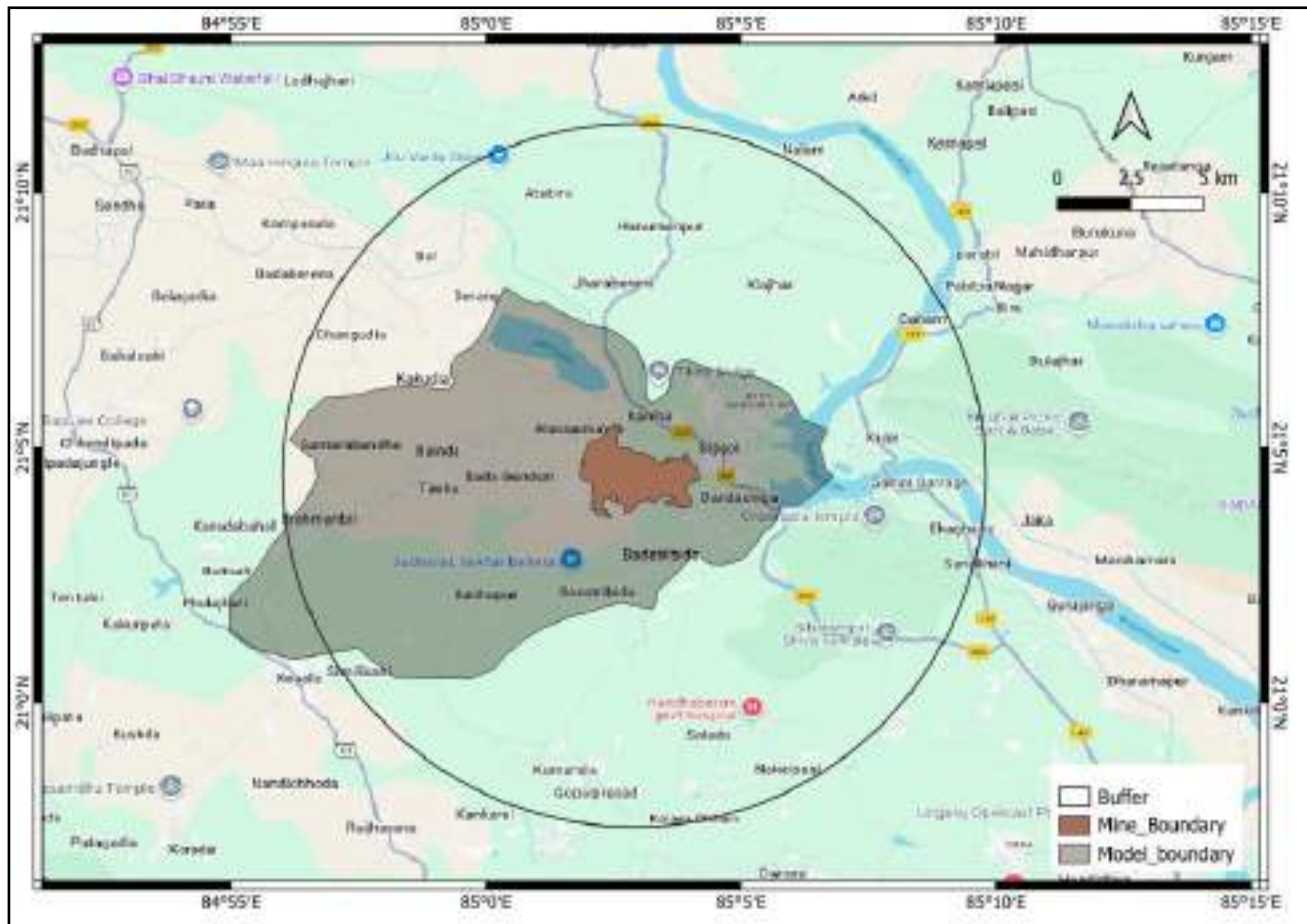


Figure - 2: Location map of Model area

Before proceeding for numerical modelling of an area, it is imperative to delineate model boundary based on Physiography, drainage and hydrogeological considerations. SOP of CGWA recommends to consider mine buffer zone as the model boundary. However, the physiography & drainage map of the area has tempted for taking watershed for the model to represent it in a better way (Figure -3). The model area is characterized by a well-drained plateau developed by the tributaries of Tikra & Brahmani River. The model has a geographical area of around 168 Km² with land elevation varies from 67 to 203 m amsl. the general slope of the area is towards northeast with an average slope of 8 to 15 m per kilometer.

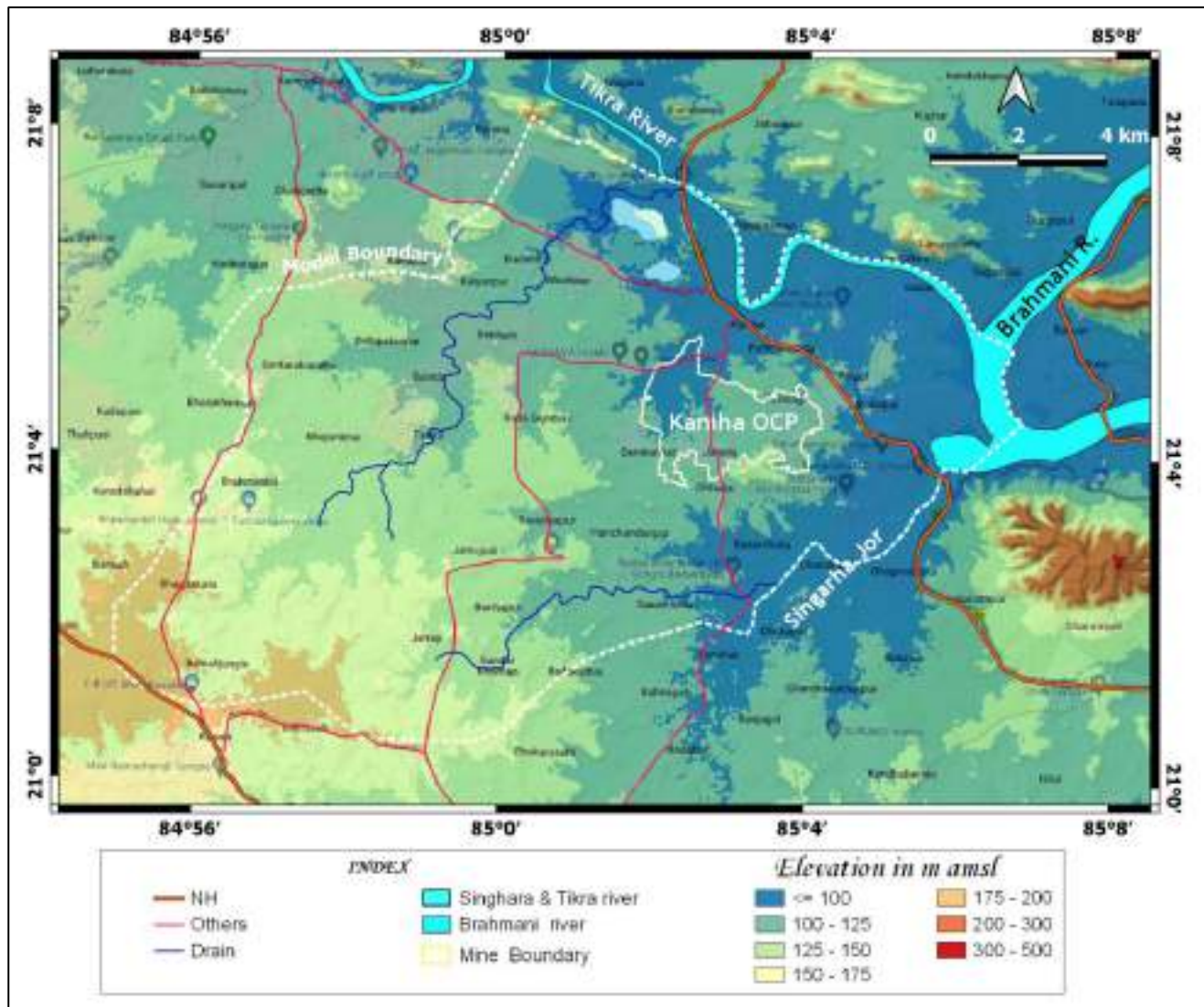


Figure-3: Location map showing physiography and drainage features of the model area

Geology:

The Talcher Gondwana Basin is situated in Brahmani River Basin. It is almost rectangular in shape with 80 km in strike direction (E-W) and about 26 km in dipping direction (N-S) spreading over a geographical area of 1800 sq km. However, the southern part of Lower Gondwana basin is trending in NW-SE direction. Around 1000 sq km area have potential coal bearing horizons/seams which have leased to different Public & Private sectors for coal extraction.

Stratigraphic Succession of Talcher Coalfield, Orissa

AGE	FORMATION	THICKNESS	LITHOLOGY
Quaternary	Recent	Around 40	Alluvial fills, sand, silt, clay of older alluvium, older and younger flood plain deposits, channel fills, etc.
Cenozoic	Laterite	Around 40	Laterised detrital pebble bed.

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Upper Permian To Lower Triassic	Un-differentiated Kamthi Formation	Above 575	Fine to medium grained light gray to reddish sandstone and shale at the base and pale greenish sandstone with rare shale and pink clay bands
Unconformity			
Upper Permian	Barren Measure formation	Up to 50	Greenish gray to buff coloured pebbly, coarse to medium grained highly ferruginous sandstone with variable properties of fresh K-feldspar
Lower Permian	Barakar Formation	Upto 500	Arkosic sandstone, medium - coarse grained, gray coloured, gray to dark gray shale and coal seams (Seam - II to XIII)
Lower Permian	Karharbari formation	Upto 300	Pale brownish yellow coloured, medium to coarse grained sandstone containing clasts of Talcher shale and coal seams (Seam -I)
Up-Carboniferous to lower Permian	Talcher formation	Above 170	Diamictites, sandstone, needle shale, turbidite and varves, (devoid of coal)
Unconformity			
Precambrian	Metamorphics	Basement	Granite gneisses, and associated supra-crustals

PRECAMBRIAN BASEMENT: Precambrian rocks serve as basement for Gondwana basin which comprises mainly of granites with Pegmatitic veins, Hornblendegneiss, porphyritic gneiss and Eastern Ghat group of rocks.

TALCHER FORMATION: Talchir formation is recognized by Blanford in 1956, which comprises mainly diamictites, sandstone, needle shales, turbidites, etc. Turbidite displays wide range of sedimentary structures such as- flute casts, groove casts, flame structures and ripple marks.

KARHARBRI FORMATION: This formation is well exposed at northern and southern margin of the basin and conformably lays over Talcher formation. Sandstone found in this formation typically characterized by pale brownish yellow colour and is massive in nature. Some thin shale bands and some superior qualities of coal seams are identified. High grade coal bearing Seam -1 which is being mined by Nandira, Handidhua, Deulbera & Talcher underground mines.

BARAKAR FORMATION: This formation overlies Karharbari formation and is characterized by basal conglomerate at its base, which contains rounded quartz and quartzite clasts of various sizes. The basal conglomerate is exposed in the central and western part of the basin. This unit is underlain by a thick sequence of medium to coarse grained greyish feldspathic sandstones, grey to dark grey shale, thick coal seams inter-banded with shale and clay.

BARREN MEASURE FORMATION: The Barren Measures comprise of fine to very fine grained sand stone, gray shale with siderites, siltstone, ferruginous sandstone and carbonaceous shale conformably overlies the Barakar Formation. Gradational contact is observed between Barakar and Barren measures which creates problem for its identification. Barren measures are devoid of any economical coal seams but a few coal seams and carbonaceous shale zone are present.

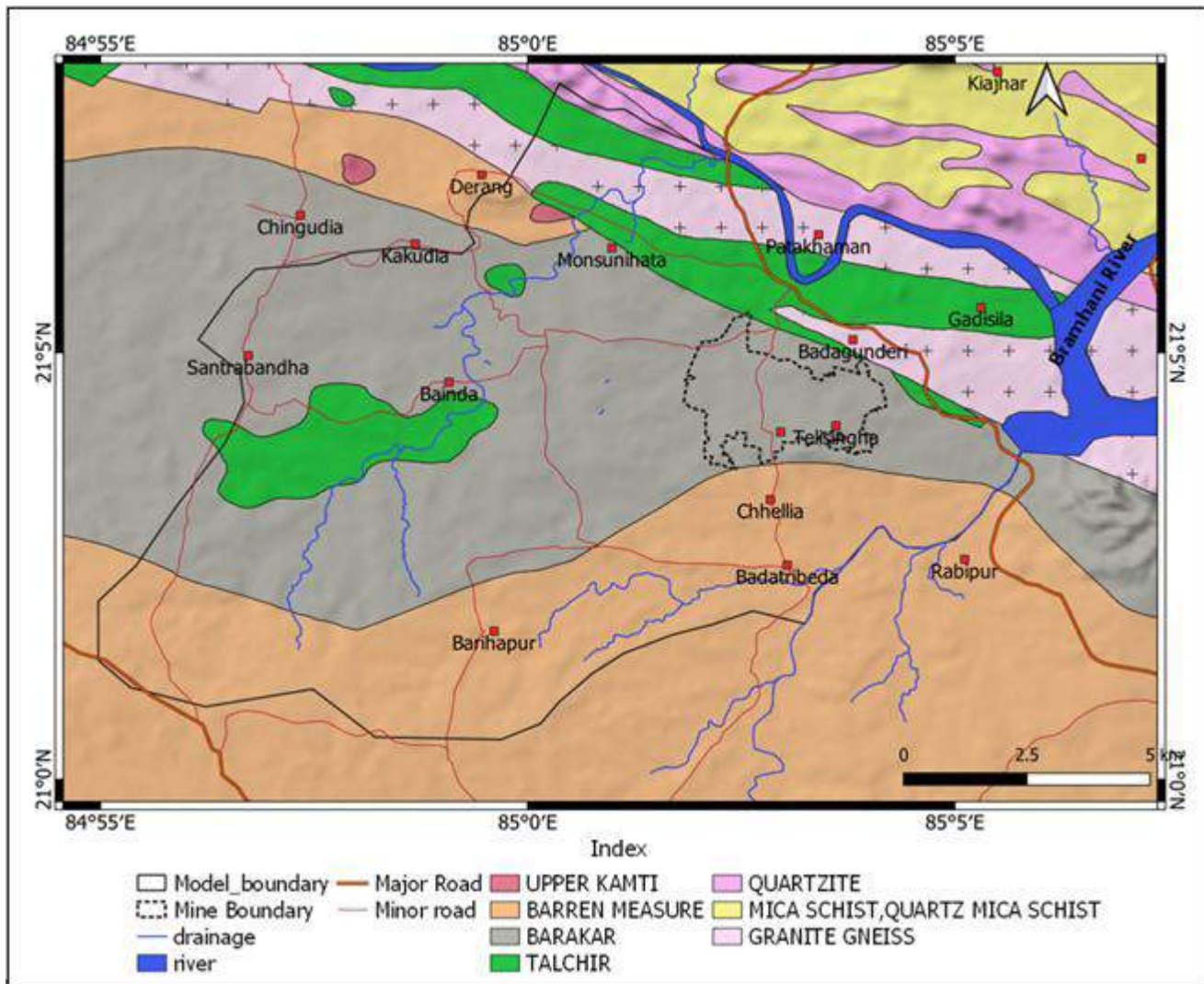


Figure- 4: Geology map of the model area

UNDIFFERENTIATED KAMTHI FORMATION: It is well exposed in high hills and plateau in western part of the coal field which comprises of fine to medium grained light grey to reddish sand stone and shale. The formation can be subdivided into two members; Upper one having thickness of 375 m dominantly coarse to very coarse sandstone with numbers of pebbly horizons and very little shale. The lower one

having a thickness of around 200 m is medium to fine grained sandstone with grey and brown shale. The red shale beds are noticed on plateau.

LATERITE& ALLUVIUM: Laterites occur as capping over plateau and is mainly of Cenozoic age. Alluvium occurs as patches mainly in the eastern part of the area near Brahmani River and is of recent origin.

TECTONIC SETUP OF BASIN: Regional strike of the Gondwana basin is more or less E-W but varies from ENE-WSW to ESE-WNW. In the Southern part formations dip northerly where as in north part, the bed dips at low angle towards south. Southern boundary of the basin is more or less free from major faulting whereas the northern boundary is marked by NNW-SSE trending set of faults. The coal field is characterised by a system of intra basinal faults, three sets of which have been recognised on the basis of surface and subsurface data. One set trend parallel or sub-parallel to the strike of the Gondwana sediments, i.e. more or less in an east-west direction.

2.0 Hydrogeological characterization

Hydrogeologically the area is underlain by moderate weathered zone developed over Gondwana rocks. The weathered zone being good porosity & permeability is conducive for the storage and flow of groundwater thus serving as prolific aquifer. Groundwater occurs under unconfined condition and is commonly tapped by dug wells which are the common ground water extraction structure and are used for both domestic and irrigation purposes. The depth to water level of the phreatic aquifer during pre & post monsoon season varies from 2.30 to 8.80 and 1.30 to 4.0 mbgl respectively. The yield of phreatic aquifer varies between 10 to 30 m³/day, with higher yield being observed near to rivers and lineaments supporting thick weathered mantle. The phreatic aquifer is underlain by massive formation which is devoid of primary porosity and groundwater occurs in fracture zones. Unlike sedimentary formations, the depth and areal extension of these fractures are highly erratic and unpredictable. Groundwater occurs under confined to semi-confined condition and is tapped by bore wells. The yield of the borewells is generally less and varies from 1 to 5 lps. However high yielding bore wells are sometimes observed in Kamptee formations and disturbed Lower Gondwana formations.

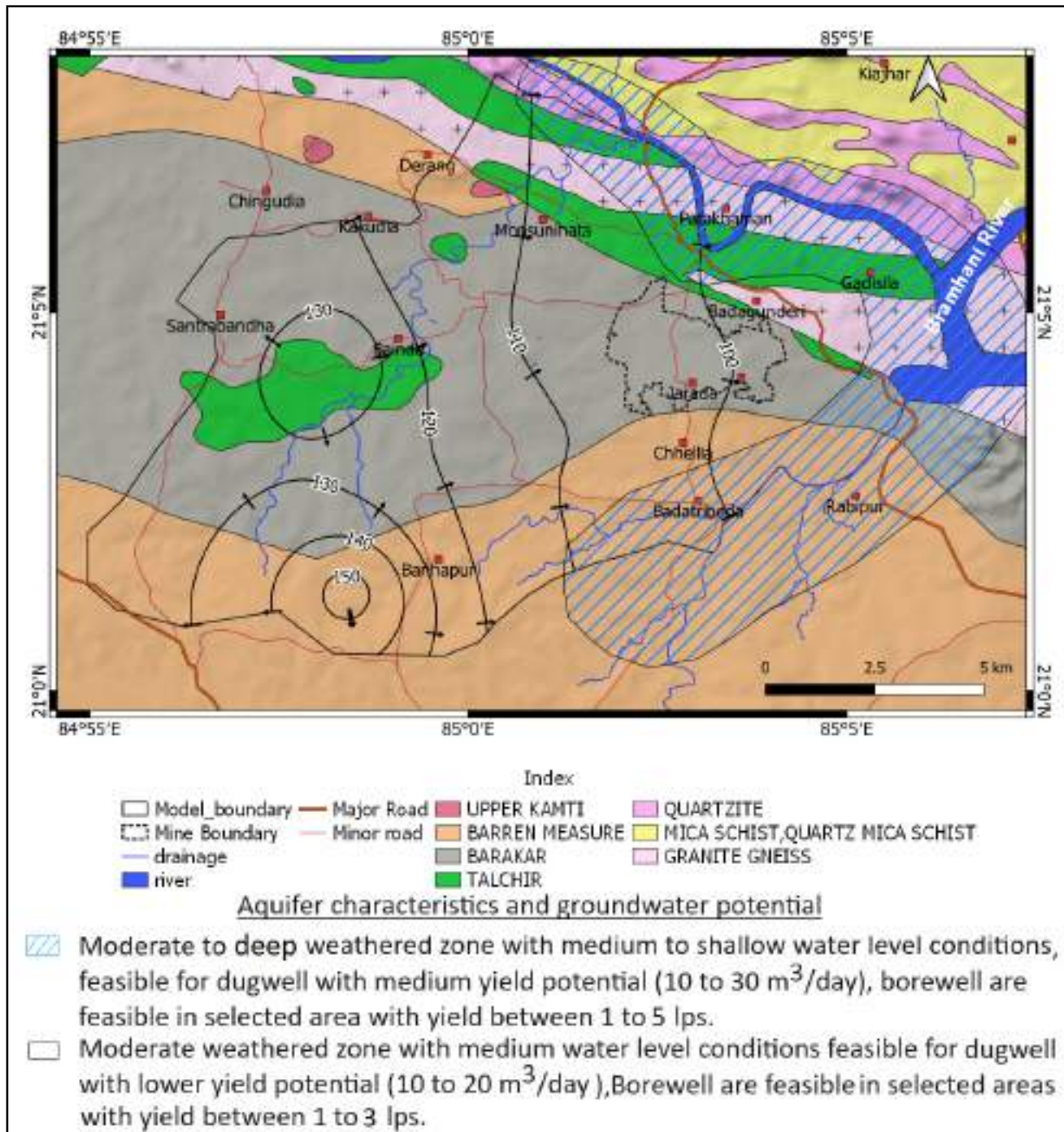


Figure - 5: Hydrogeology map of the model area

Central Ground Water Board (CGWB) has computed the Blockwise groundwater draft based on several data like well census, crop water requirement and electricity usage as per its Groundwater Resource Estimation Program using GEC-2015 Methodology. The block-wise groundwater resources & draft calculated for 2022 is published and used in the model for Groundwater draft.

Sl	Name of Block	Geographical Area (Km ²)	Annual Extractable GW Resources (HaM)	Gross Ground water draft (HaM)	Stage of Development
1	Kaniha	725.31	8037.99	4617.17	57.44
2	Chendipada	852.02	7658.90	3913.98	51.10

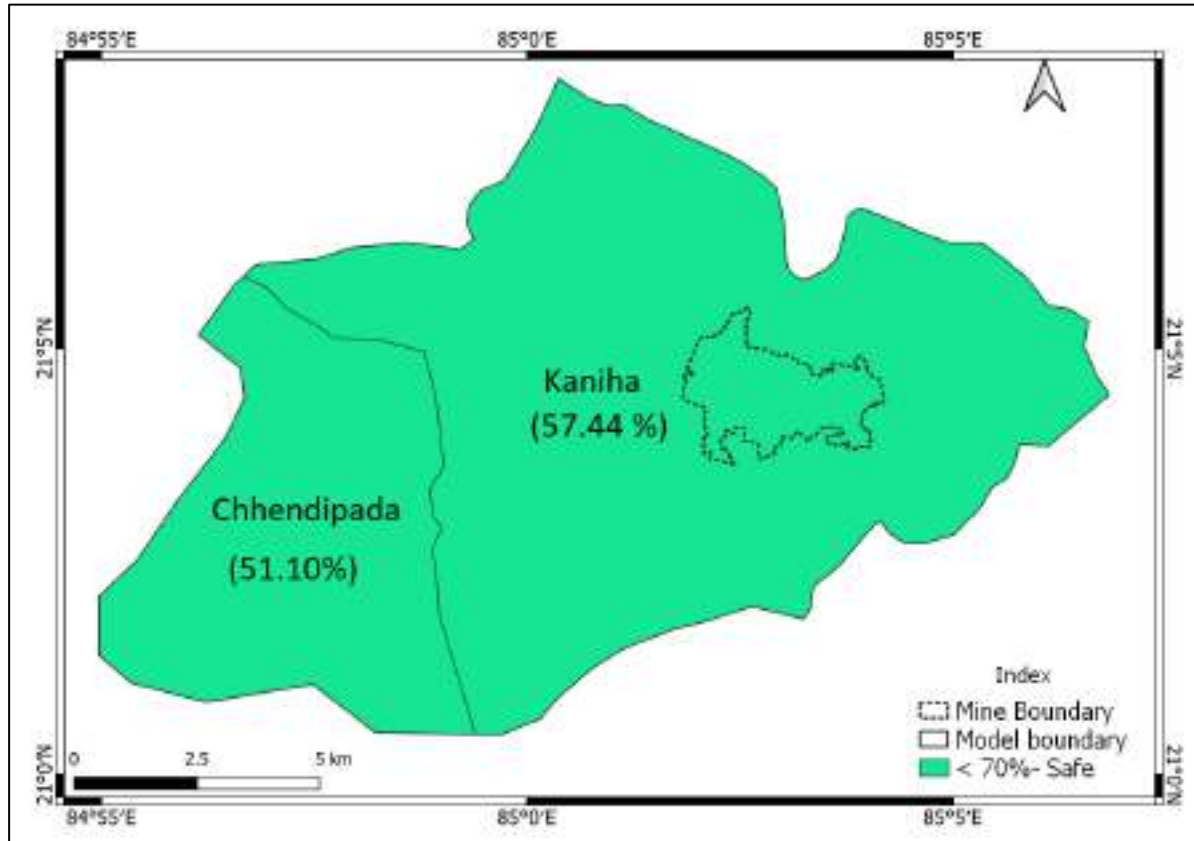


Figure - 6: Stage of Groundwater Development of the Blocks of the study area

3. Model Conceptualization:

The study area is mainly confined to northeastern part of Talcher sedimentary basin with Brahmani River forming its eastern margin. The Tikra river which is a tributary of Brahmani River is flowing on the northern part of the study area. Due to the presence of the Samal Barrage on the downstream, both the rivers are conceptualised as constant head boundary. Most of the other streams draining this watershed are gaining streams and hence conceptualized as drain boundary.

The area is underlain by Talcher, Barakar, Barren Measure, Raniganj of Lower Gondwana & Kamthi formations of Upper Gondwana Age. All of them have been highly weathered and lateritised especially in the plateau and valleys and serves as the main aquifer of the model area. This aquifer has good primary porosity and permeability and ground water occurs under phreatic condition. Hence this aquifer is conceptualized as the first aquifer system of the region. Based on the dug well depths

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and drill casing, the thickness of this aquifer is taken as 25 meter. This is underlain by moderately pervious formation consisting of sandstone, shale and coal horizons with very low porosity & permeability and is conceptualized as aquitard. This formation is considered as 2nd layer for the model with a thickness of 50 meter as deduced from the mine exposure and drilling data. Fractures have been encountered in the mine between 70 to 80 mbgl and hence a confined aquifer is conceptualized having a thickness of 25 m and is regarded as 3rd layer of the model. The 4th layer is again made up of non yielding formations and thus is treated as aquitard. Under this backdrop, a four layer model is conceptualized.

Parameter	Value
Grid	137 Columns & 94 Rows 150m × 150m
Top of aquifer (m) range of elevation	67 to 203 m amsl
Bottom of aquifer (m) range of elevation	-83 to 53 m amsl
Initial Piezometric Heads (m amsl)	Land elevation for steady state Simulation
Aquifer Type	Layer-1: Unconfined Layer-2: Semi-confined Layer-3: Confined Layer-4: Confined
Boundary Condition Used	Constant Head Boundary for Brahmani & Tikra River Drain Boundary for the other streams draining the area No Flow Boundary for the outside area (Inactive)
K (m/day) (K _x = K _y & K _z = K _x /10)	Layer-1: 1.0 Layer-2: 0.005 Layer-3: 0.25 Based on Pumping test results Layer-4: 0.005
Specific Yield (%)	Layer-1: 0.02 Layer-2: 0.001 Layer-3: 0.002 Layer-4: (not necessary as it is a confined aquifer)
Storage Parameters	Layer-1: 0.000006 m ⁻¹ Layer-2: 0.000003 m ⁻¹ Layer-3: 0.0000076 m ⁻¹ Layer-4: 0.000003 m ⁻¹
Recharge Applied	183 mm/year applied both in steady state
Evapo-transpiration	973 mm/Annum
Draft Applied	29249 m ³ /day for steady State

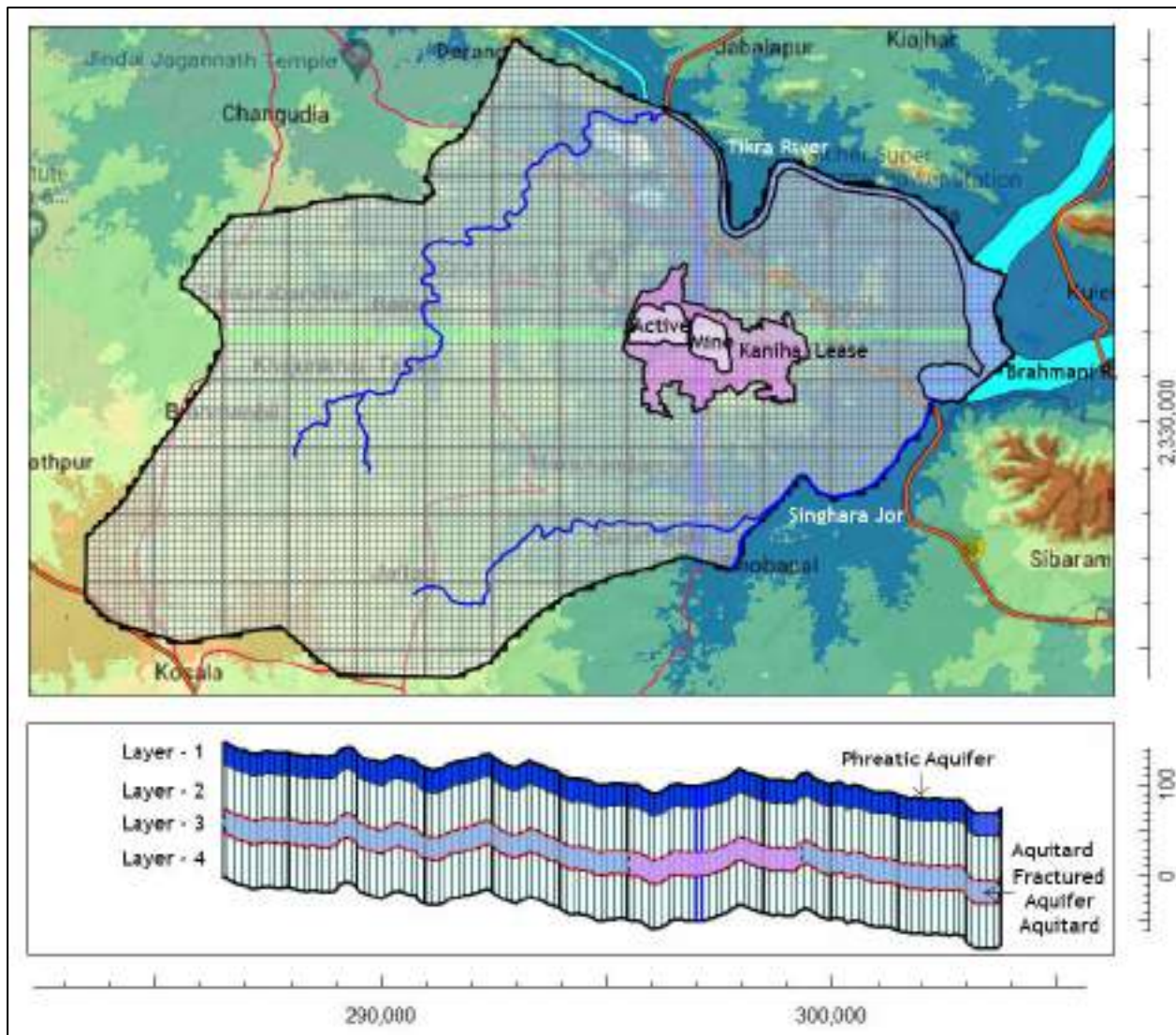


Figure-7: Areal and vertical discretization of the model area

3.1 Domain & Discretization

The model area is first re-projected from EPSG 4326 (Latitude, Longitude coordinate system) to EPSG 32645 (metric system) for discretization. The model area extends from 283444 to 303976 eastwards and from 2324425 to 2338486 northwards covering a geographical area of 168 Km². It is then subdivided into 94 rows and 137 columns corresponding to a finite difference grid consisting of 150 × 150 meter (Figure-7). As per the conceptual model, four layers are created. The layer top elevation of the model is imported from the SRTM data after refining to accommodate to the model grid size. Based on dug well and casing data, the depth of the phreatic aquifer is taken as 25 meter below ground level. The 2nd layer is considered as aquitard and its thickness is taken as 50 m. The 3rd layer thickness is taken as 25 meter and is considered as third layer representing confined aquifer in the

form of fracture zone. Since the fractures are getting recharge from top, it is treated as a convertible layer. The bottom aquifer is conceptualized as aquitard having low storage and permeability with few deeper fractures and hence is conceived as 4th layer truly confined nature. Since the outside grids are not being used for computational purpose, they have been made inactive.

3.2 Model Input

3.21 Permeability and Storage

Based on the weathered zone condition as deciphered from the monitoring dug well data, a low Transmissivity value of 10 to 25 m²/day is presumed. Hence permeability value of around 1.0 m/day was considered for most part of the 1st layer (phreatic aquifer). As the aquifer is presumed as isotropic, permeability in X and Y direction (K_x & K_y) is taken as same. However, K_z is taken as one tenth of K_x value as per the standard procedure. Since the layer comprises of weathered zone developed on Gondwana sandstone and laterites (both insitu & transported) at most localities of the model area, specific yield value of 0.02 is considered.

Pumping test conducted in one successful bore wells gives a transmissivity value 11.54 m²/day. However it is observed at a depth below 140 m. Hence for the shallow fractures leaking water to the mine, half of its transmissivity is considered for confined aquifer, i.e., 3rd layer. Hence K of 0.25 m/day is assigned to 3rd layer. Based on the pumping test result (Storativity of 0.000152), different specific storage value based on the thickness of the aquifer/aquitard is assigned to the layers. Since the 2nd & 4th layer serves as a poor aquifer / aquitard, a low permeability of 0.005 m/day is assigned.

3.22 Recharge & Evapo-transpiration

The study area gets water mainly from precipitation and thus vertical recharge is the only source of ground water in the basin. 10 years average rainfall of 1502.7 mm is taken for recharge. Using Modified Chaturvedi Formulae (2002) and taking the monsoonal rainfall as input, the recharge can be calculated as 209.7 mm.

Recharge = $1.35 (\text{Precipitation} - 14)^{0.5}$ where precipitation is in inch

The recharge value is put in the model both for steady & transient state and proved to be high after the model run & calibration. Hence a lower value of 182.8 mm is finally considered for the model by taking a Rainfall Infiltration Factor (RIF) of 14%. As the rainfall is low & scanty in the non-monsoon months, it will not infiltrate to the aquifer unless until there is a high downpour. Hence an infiltration factor of 7% is taken for recharge calculation during the non-monsoon season. The model recharge is assigned to the Top Active Cell, so that all the cells (even dry cells) get recharge.

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Annual Rainfall in mm	Monsoon Rainfall in mm (150 days)	Non-monsoon Rainfall in mm (215 days)	Monsoon RIF	Non-Monsoon RIF	Recharge in mm (monsoon)	Recharge in mm (non-monsoon)
1502.66	1305.83	196.83	14%	7%	182.8	13.8

Appreciable amount of ground water is being lost by evapo-transpiration especially in ground water discharge areas characterized by shallow water table condition. The Actual Evapotranspiration (ETa) data of ICRISAT averaged for the period of 10 years of Anugul District is given below:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
ETa in mm	50.04	55.09	63.58	57.42	81.17	134.79	112.2	109.92	103.93	98.36	58.91	47.58

Period	Months	No of days	ETa in mm
Monsoon	June - Oct	150	559.2
Non-monsoon	Nov - May	215	413.79
Total	June - May	365	972.99

As per the above calculation, evapo-transpiration rates have been assigned to different time periods (Stress periods) both for steady state and transient simulation.

3.23 Boundary Conditions

The Brahmani River which is flowing on the eastern border of the model area is assigned a constant head boundary due to its large size as compared to the model area. Since flow of the river is negligible during post monsoon season, stage is considered as the base of river. All other streams flowing through the model area are considered as a gaining stream and hence Head Dependent Boundary (Drain) is assigned to it. Considering its width of 10 - 20 meter and taking river bed thickness & vertical permeability of 1.0 m & 0.5 m/day respectively, conductance is calculated as 5 to 20 m²/day and is assigned to the drain. The drain depth is assumed as 2 m below the adjacent ground and is assigned to the drain. No Flow Boundary is assigned to the rest part of the model boundary due to non entry of ground water as it is a watershed boundary. This has been achieved by making outside cells as inactive.

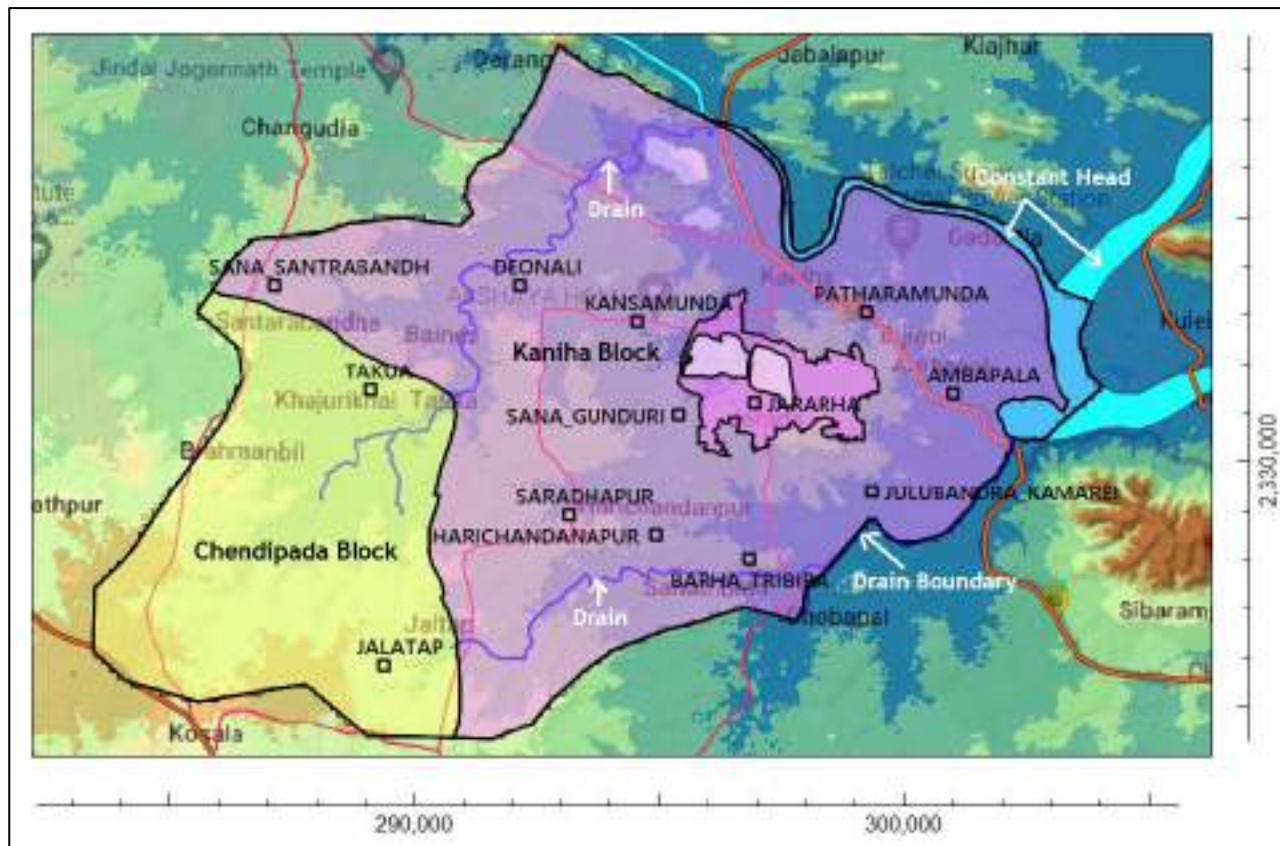


Figure-8: Boundary & draft assigned to the model

3.24 Groundwater Abstraction

Central Ground Water Board (CGWB) has computed the Block-wise groundwater draft based on several data like well census, crop water requirement and electricity usage as per its Groundwater Estimation Committee (GEC-2015 Methodology). This is the regular program of CGWB and the block-wise groundwater draft calculated for 2022 is available. Since the study area falls in two blocks of Angul district, their ground water resource is given below:

Sl	Name of Block	Geographical Area (Km ²)	Annual Extractable GW Resources (HaM)	Gross Ground water draft (HaM)	Stage of Development
1	Kaniha	725.31	8037.99	4617.17	57.44
2	Chendipada	852.02	7658.90	3913.98	51.10

Based on the above data, the groundwater draft for the model area is calculated on pro-rata basis and is applied to the model in steady state simulation.

Sl	Name of Block	Irrigation Draft (HaM)	Other Draft (HaM)	Model Area in the block (Km ²)	Model Irrigation Draft (HaM)	Model other Draft (HaM)	Model Total draft (HaM)	Model Draft in m ³ /day

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1	Kaniha	4163.41	453.76	136	780.7	85.1	865.7	23712.8
2	Chendipada	2908.09	1005.9	44	150.2	51.9	202.1	5536.2

As per the above table, the total ground water draft of 29249 m³/day is applied to the steady state model. However, pumping from the aquifer occurs mainly during the Ravi season and a small quantity of groundwater is used for Kharif paddy during the lean patches of monsoon. Thus 75% & 25% of the ground water draft for irrigation is considered for Ravi & Kharif season.

Sl	Name of Block	Irrigation Draft (monsoon)	Irrigation Draft (Ravi)	Domestic & Industrial Draft	Total Draft (Monsoon) 150 days	Total Draft (Ravi) 150 days	Total Draft (Summer) 65 days
1	Kaniha	13011.1	39033.2	2331.0	15342.1	41364.3	2331.0
2	Chendipada	2503.0	7509.0	1423.2	3926.2	8932.2	1423.2

Though the pumping varies during the different period of the crop growth, a uniform rate of pumping is assigned to the region for the whole season. In the absence of cultivation during summer season, only domestic and industrial draft is applied to the model. Hence a total draft of 19268, 50296 & 3754.2 m³/day is applied to the whole model during the three stress periods (Kharif, Ravi & Summer).

Head Observation wells

13 wells are monitored by MCL in the periphery of Kaniha Opencast Mine, out of which water level data of 12 wells have been considered for model calibration. The May & November water level data is used for pre & Post-monsoon model calibration. The water level data is given in the table below:

Sr. No.	ID	Village	Latitude	Longitude	WL May-24	WL Nov-24	RL In (M)	WT May-24	WT Non-24
6	T096	AMBAPALA	85.0846	21.0726	3	2	93	90	91
7	K156	DEONALI	84.9992	21.0915	3.7	1.7	116	112.3	114.3
10	K089	SARADHAPUR	85.0093	21.0493	7	3	129	122	126
9	K154	SANA SANTRABANDH	84.9509	21.0909	4.1	2.1	132	127.9	129.9
12	K087	BARHA TRIBIRA	85.0448	21.0417	2.3	1.3	103	100.7	101.7
11	K088	HARICHANDANAPUR	85.0266	21.0458	8.05	3.05	115	106.95	111.95
1	K179	JALATAP	84.9734	21.0212	8.8	3.6	161	152.2	157.4
13	K086	JULUBANDRA / KAMAREI	85.0689	21.0546	4.5	3.5	90	85.5	86.5
3	K092	KANSAMUNDA	85.0224	21.0853	5.6	3.6	111	105.4	107.4
2	K143	PATHARAMUNDA	85.0672	21.0876	7	4	96	89	92
5	K090	JARARHA	85.0456	21.0705	4.3	2.3	111	106.7	108.7
4	K091	SANA GUNDURI	85.0306	21.0682	5.5	2.5	112	106.5	109.5

* WL – Water Level in mbgl WT – Water Table amsl

4 Groundwater flow model:

4.1 Model Run & Calibration:

ModelMuse Software (USGS freeware using Modflow Code) is used for modeling this system. Land elevation is given to the model as initial head and a steady state model is primarily run. Running the model gives simulated head for each grid in the form of water table or piezometric contour map. The simulated head should match with the head measured at the observation wells and is known as calibration. A good agreement will give rise to low Root Mean Square Error (RMSE). This makes the model valid and the output of the model can represent regional ground water flow. The simulated heads are calibrated with the average head values available and the permeability values have been adjusted for arriving at an acceptable fit and a low root mean square error. After successful run of the Model, the groundwater head of each grid has been obtained as model output. Actual head data of 12 observation wells are compared with the simulated head and the head calibration plot is given in Figure - 9a. Since the RMSE is only 3.61, the simulation is accepted for further calculations.

The heads obtained from the steady state run is used as the initial head for the transient run. One hydrological year of 365 days is divided into two stress periods of 150 days corresponding to Monsoon (June-October) and 215 days corresponding to (November-May). Recharge and evapotranspiration is applied accordingly. However, for groundwater draft, three stress periods have been assigned to the model 150 days for Kharif, 150 days for Rabi & 65 days for summer. The details of these stress periods and input values have been summarized in the earlier chapter. The transient model is run and is calibrated against pre & post-monsoon water level data. After proper calibration, the model results have been used for GW Budget analysis. The calibration fit plots are given both for steady and transient run in Figure - 9 a, b & c). The statistics details (minimum, maximum, range & Standard Deviation of residuals, Root Mean Square Error, Normalized Root Mean Square Error and Mean Absolute Error are also summarized in the table.

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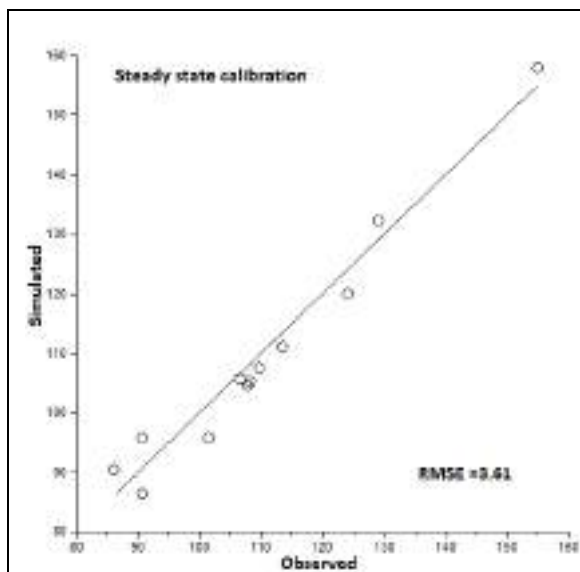


Fig - 9a: Steady State Calibration

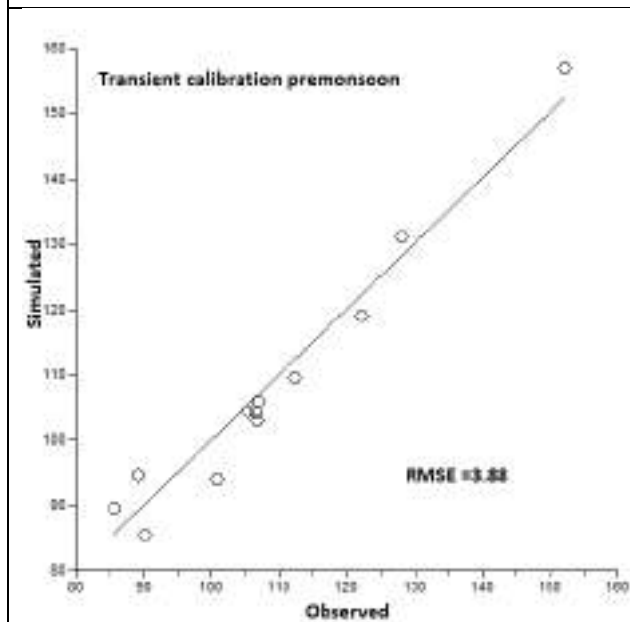


Fig - 9 b: Pre-monsoon Calibration

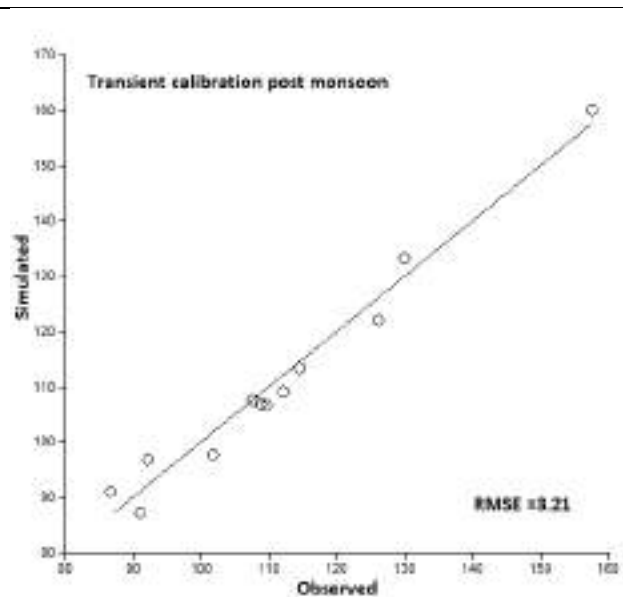


Fig - 9 c: Post-monsoon Calibration

	<i>Min (m)</i>	<i>Max(m)</i>	<i>Range(m)</i>	<i>SD(m)</i>	<i>RMS (m)</i>	<i>NRMS (%)</i>	<i>MAE(m)</i>
Steady State 2024	86	154.80	68.80	3.73	3.61	5.26	3.35
Transient Pre-monsoon 2024	85.50	152.20	66.70	4.02	3.88	5.82	3.52
Transient Post-monsoon 2024	86.50	157.40	70.90	3.35	3.21	4.54	2.83

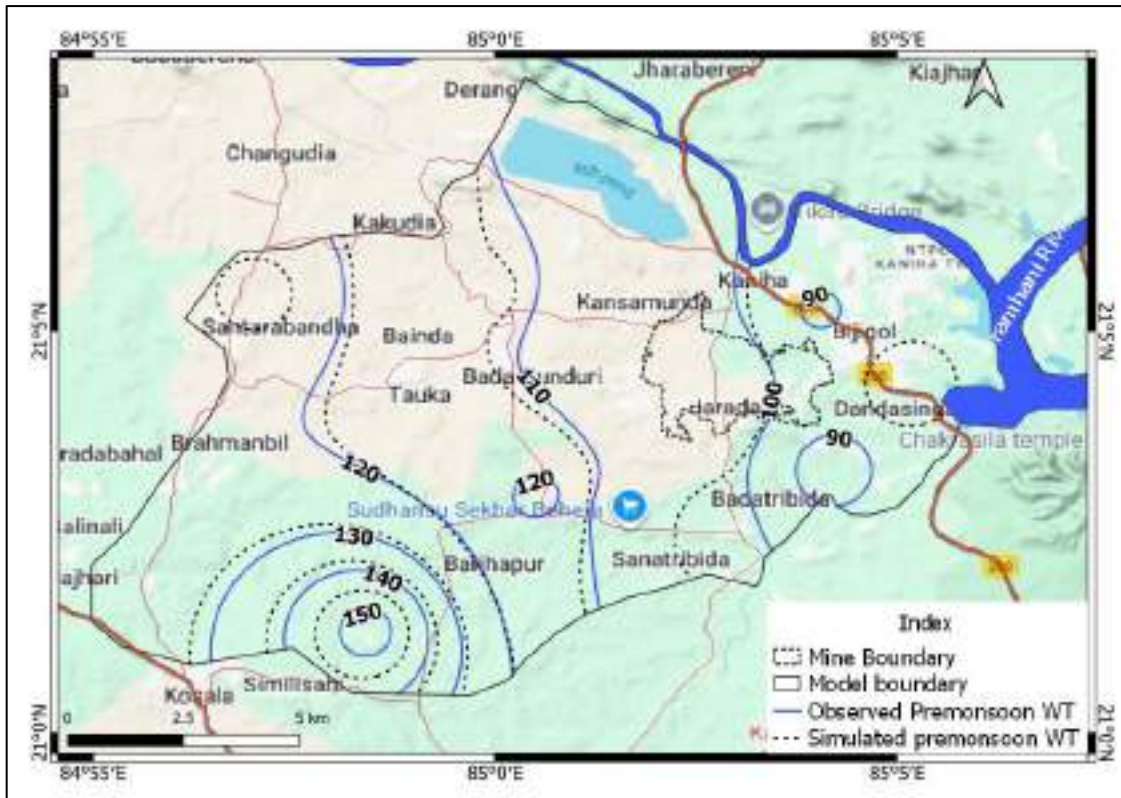


Figure - 10 a: Pre-monsoon transient calibration 2024

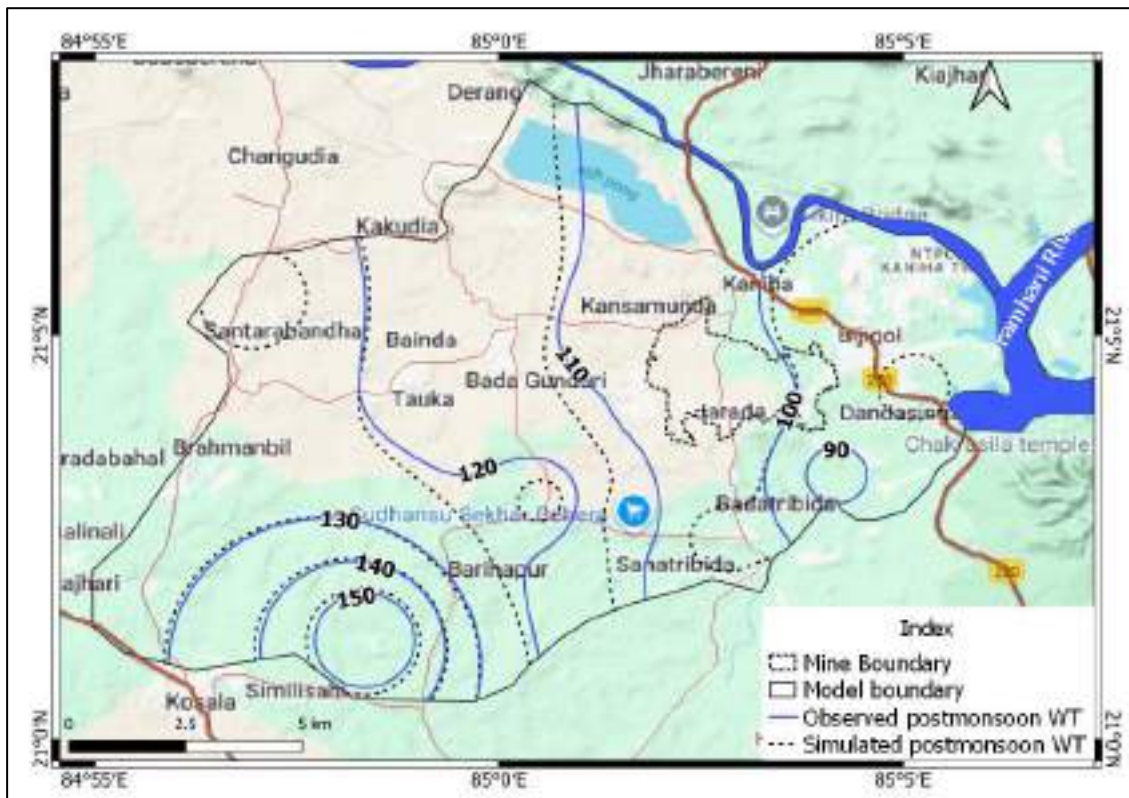


Figure - 10 b: Post-monsoon transient calibration 2024

Water level monitoring data of 2024 is taken for the preparation of the actual & predicted head contours of the model area. The predicted and actual head contours of pre & post monsoon season match well and are shown in Figure - 10 a & 10 b.

4.2 Groundwater head contours and flow directions

Based on the model output, Head contour maps at different time steps have been generated. The water table map shows that the local groundwater flow is perpendicular to the head contours and is mainly towards the rivers and drains (figure - 11). However, the regional groundwater flow is towards northeast. Some changes in the shape of the contours and their upstream migration is observed during post monsoon season which is attributed to recharge.

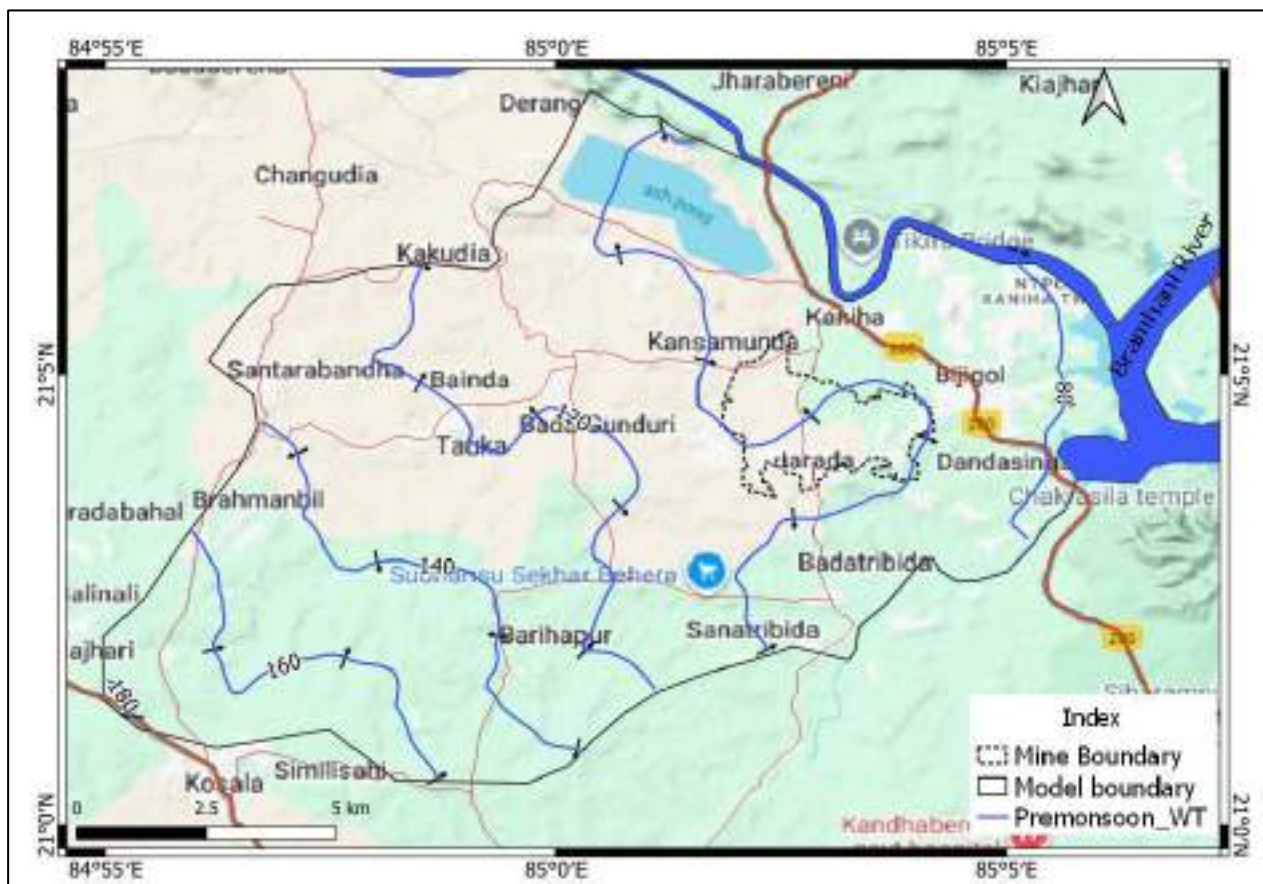


Figure - 11 (a): Pre-monsoon water table map (Layer-1)

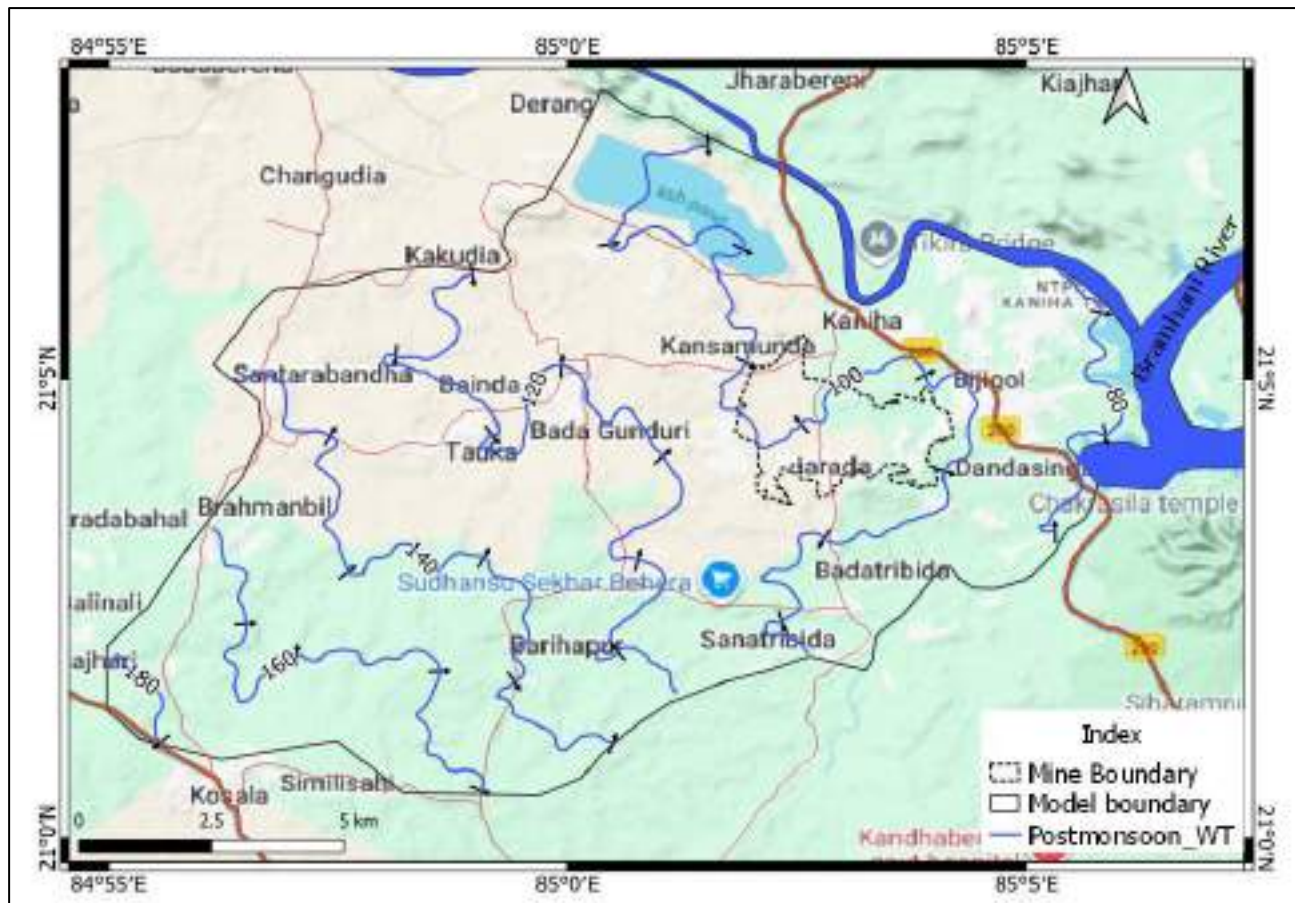


Figure - 11 (b): Post-monsoon water table map (Layer-1)

4.3 Ground water budgeting

The ground water budget for one hydrological year is elaborated in the table below and in Figure - 12. Monsoon rain contributes 178.5 mm recharge, out of which 62.4 mm is taken by the aquifer as storage and the rest 20 & 79.2 mm goes out of the system as baseflow to river & drain and evapotranspiration. 17 mm is used for irrigation to Kharif crop. After the end of monsoon, the storage of aquifer is mainly being used for Ravi Irrigation (45.8 mm) & evapotranspiration (26.2 mm). 26.3 mm of recharge is spent to maintain the baseflow to the streams while the river consumes a meagre 3.3 mm.

	Source			Sink				
Items	Aquifer (in)	Constant head (in)	Recharge (in)	Aquifer (out)	Well (Out)	Drain (out)	Constant head (Out)	Evapo transpiration
Monsoon (150 days)	0	1.1	178.5	62.4	17	17.6	3.5	79.2
Post Monsoon (215 days)	63.5	2.4	19.3	1.1	45.8	8.8	3.3	26.2
Full Year (365 days)	63.5	3.5	197.8	63.5	62.8	26.3	6.8	105.4

Mathematical Modelling Report

Hingula Opencast Project (Coal) of M/s Central Coalfield Ltd.

* All values are in mm

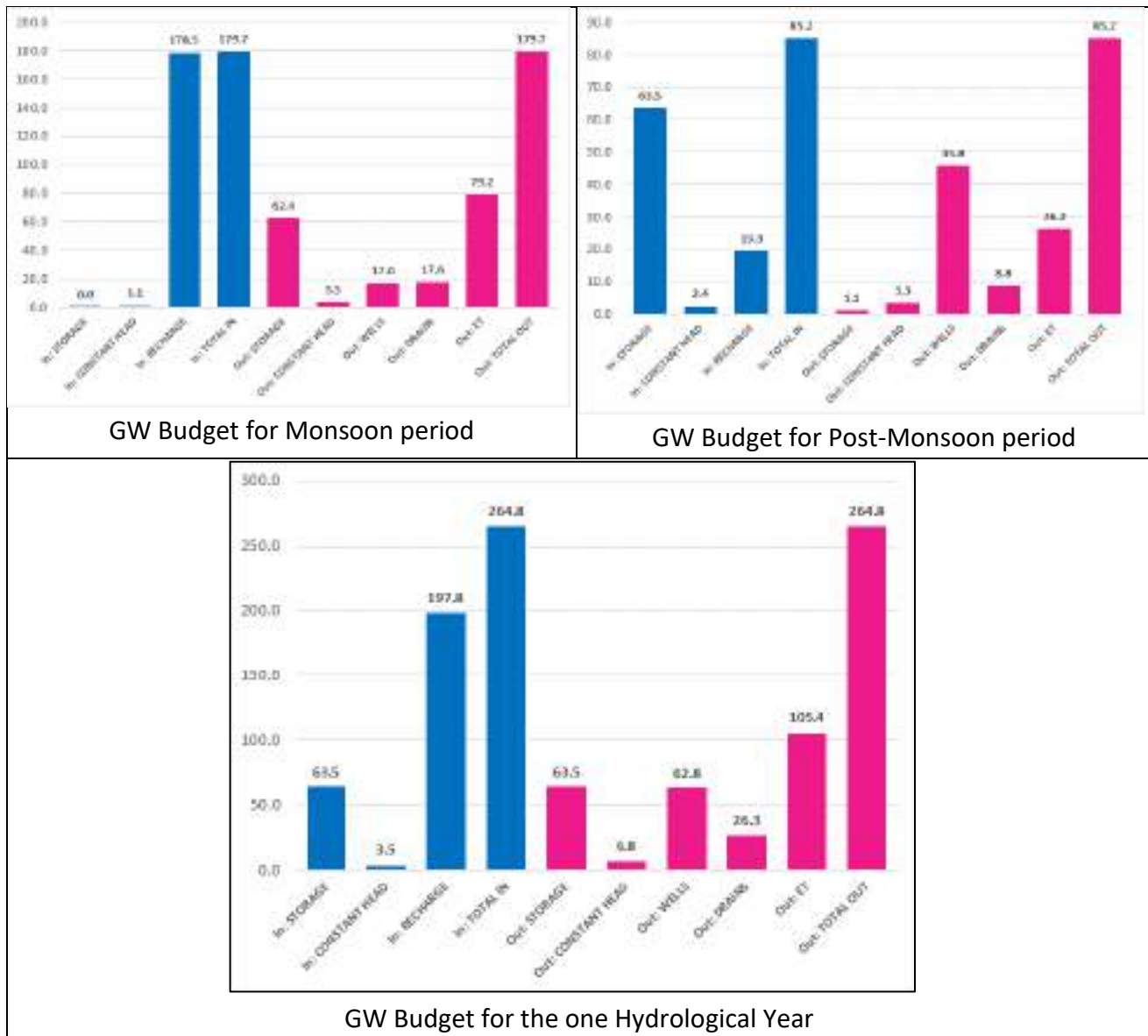


Figure-12: Ground Water Budget

The ground water budget of the area obtained from mathematical modeling is given below:

Sl No	Mid August (60 day)	Late October (150 days)	Late November (180 days)	Early March (270 days)	Early April (300 days)	Late May (365 days)
Source						
Aquifer (out)	0	0	87897	62734	51325	10983
Constant Head (out)	3737	4222	3300	2576	2236	2444
Recharge	199946	199946	15057	15057	15057	15057
Sink						
Aquifer (in)	86415	35040	23	0	0	1639
Constant Head (in)	1307	1186	1461	1837	2082	1880

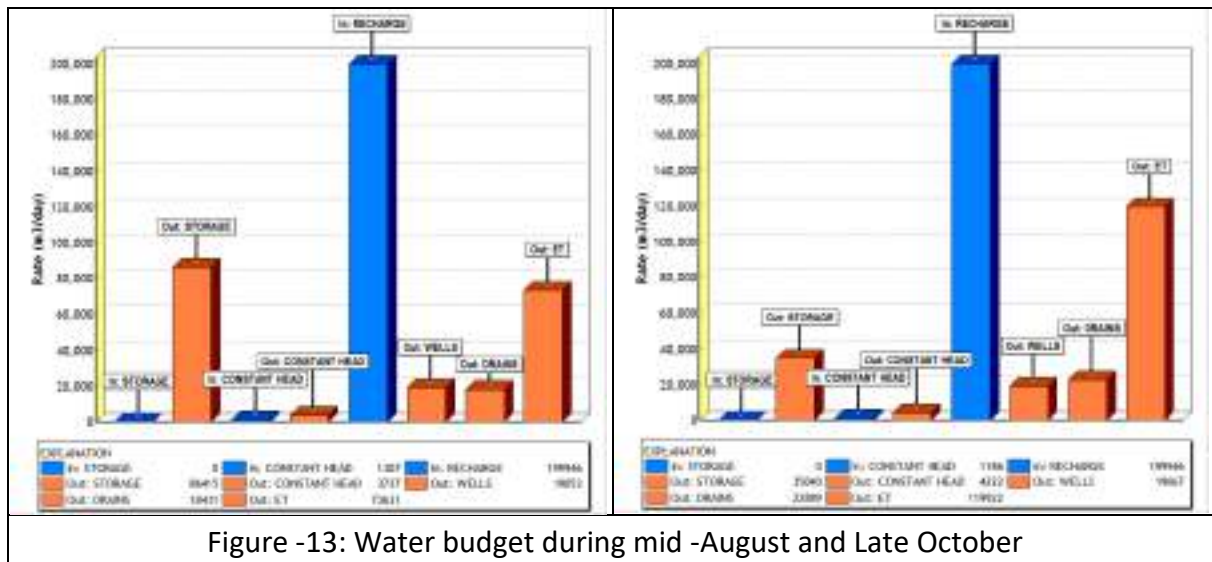
Mathematical Modelling Report

Hingula Opencast Project (Coal) of M/s Central Coalfield Ltd.

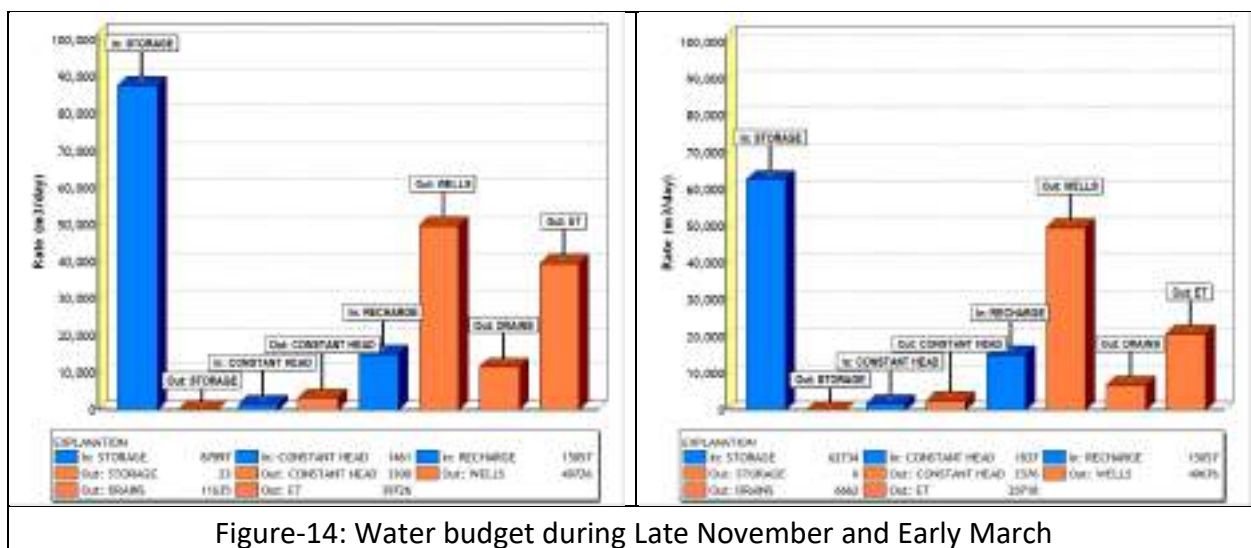
Well (out)	19053	19067	49726	49676	49624	3704
Drain (out)	18431	22889	11635	6662	4455	5934
Evapotranspiration	73631	119922	39726	20718	12149	14203

All values are in m³/day

During Early August, a good amount of recharge (43.2%) goes into the aquifer and is stored for future use while an appreciable amount of recharge returns to atmosphere as evapotranspiration (36.8%). As the aquifer got saturated towards monsoon end, aquifer takes only 17.5% of recharge while around 60% of recharge is being lost due to evapotranspiration.



However after the recession of monsoon, the aquifer storage takes care of different stresses on aquifer like ground water withdrawal, baseflow to stream, and evapo-transpiration. This leads to rapid decline of aquifer head which in turn leads to reduction of baseflow and evapotranspiration.



The baseflow to river & streams is around 18431 m³/day during the end of monsoon has reduced to 4455 m³/day during early April. Similarly, evapotranspiration has drastically reduced during post monsoon season with the summer evapotranspiration accounts to only 11.8% compared to that of late October. However, due to less groundwater draft during summer, baseflow to river and evapotranspiration slightly increases in the budget of Late May.

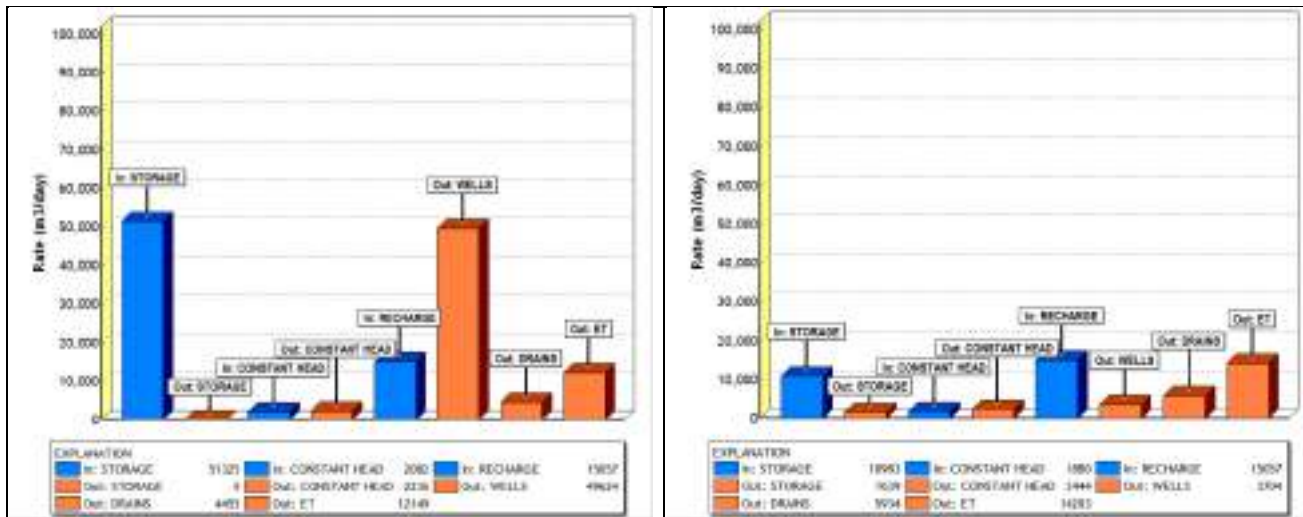


Figure -15: Water budget during Mid April and Late May

4.4 Sensitivity Analysis

Aquifer parameters & recharge have enormous impact on the distribution of ground water head and flow and model should be tested against its sensitive against them. Hence model's sensitivity against permeability & Specific yield is tested. The predicted head is moderately sensitive to permeability and somewhat less sensitive to specific yield compared to permeability. However, the groundwater flow is quite sensitive to permeability in the phreatic aquifer but less sensitive to specific yield.

5.0 Model Prediction

5.1 Impact assessment

Mining activity is located centrally which will spread subsequently over the lease area. The depth of the mine is around 94 to 116 meters in Z patch & Kansamunda quarry which will reach a depth of 100 to 125 meter in future (2025-27). Seepage generally occurs from deeper benches between 70 & 80 meter depth. Hence the major seepage amount will come from the third layer of the model. Based on the depth of seepage face and its bench area, 2140 m of seepage face is considered for modeling. A Drain Boundary is invoked to simulate seepage into the mine of the model. The model is rerun and after successful convergence, the head and budget outputs have been obtained.

5.2 Drawdown & Radius of Influence

The drawdown created in the deeper & phreatic aquifer due to mine seepage is plotted in the figure 16 & 17 respectively. The **maximum drawdown** of **5 m** is expected in the deeper aquifer (75 to 100 mbgl) at the lease boundary while the phreatic aquifer is affected by only 1.0 m.

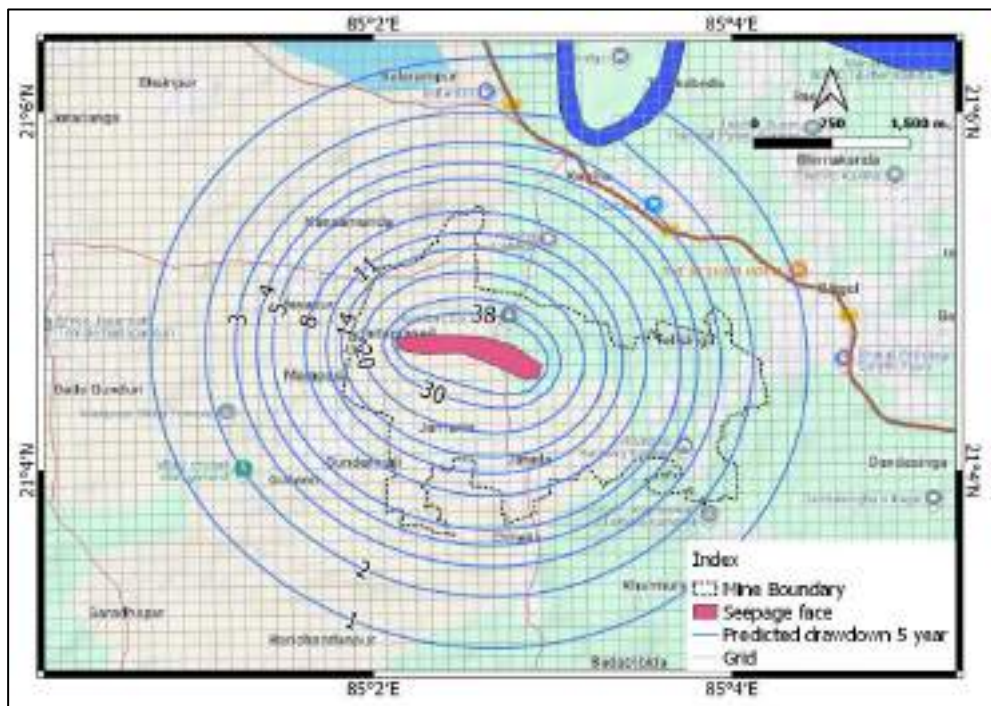


Figure-16: Drawdown created due to mine seepage in confined aquifer (Layer - 3)

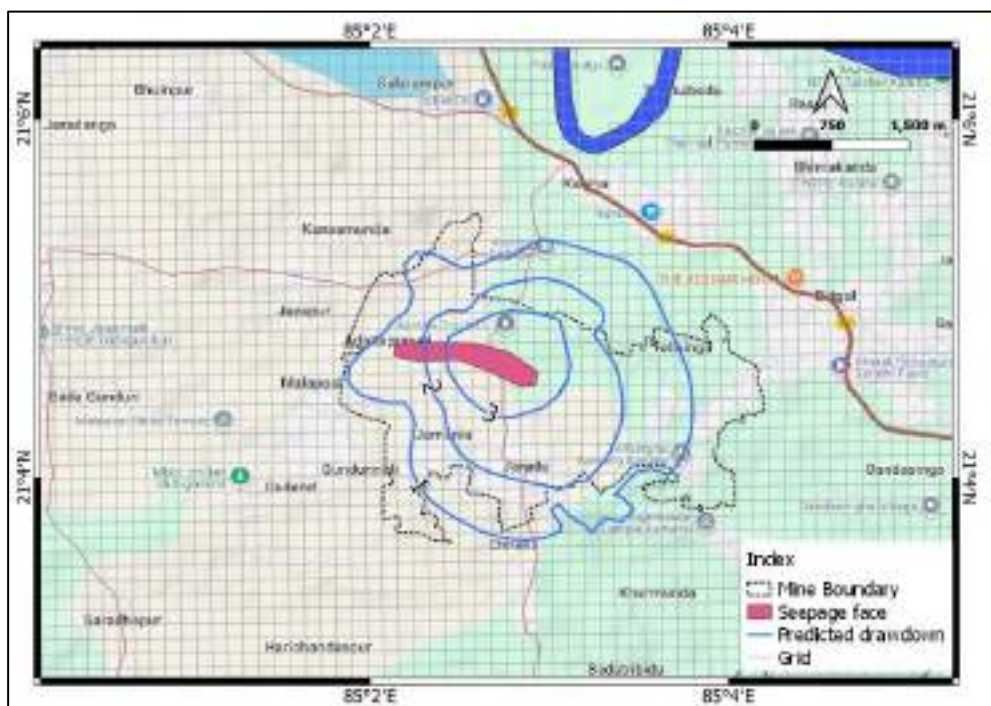


Figure-17: Drawdown created due to mine seepage in unconfined aquifer (Layer - 1)

A quick look of the radius of influence map (Figure - 18) shows that **radius of influence** is confined to **1.5 Km** from the mine lease boundary.

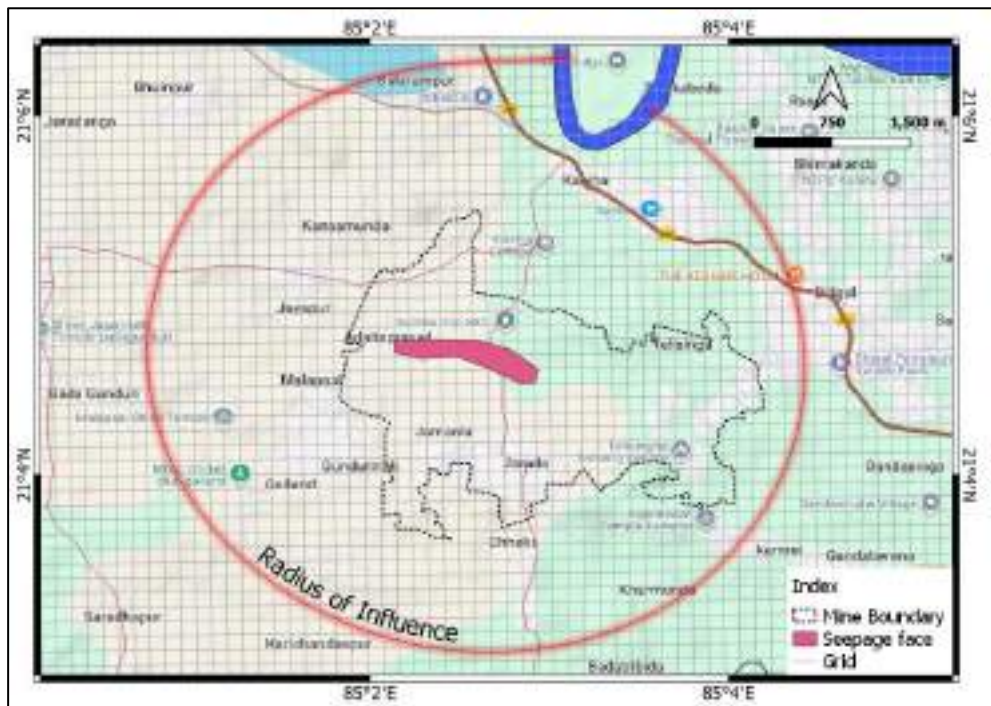


Figure-18: Radius of Influence around the mine boundary

5.3 Estimation of Mine seepage

The time series plot for the estimated seepage into the mine for 5 years is predicted keeping the mine depth and seepage face as constant. Hence the average seepage of **2195 m³/day** is considered for the mine.

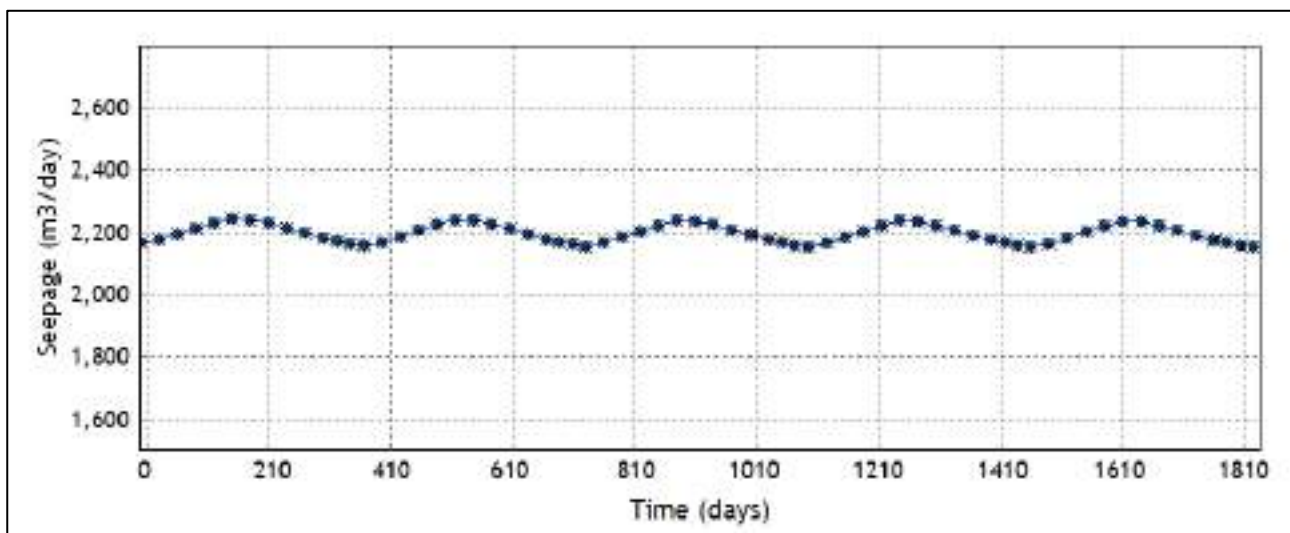


Figure-19: Seepage prediction for the next five years for the mine

5.4 Aquifer Resilience Scenario

If mining operation of Kaniha mine is presumed to be closed after 5 years of operation and the mine is reclaimed, then there will be cessation of seepage and the heads in the aquifer will bounce back to its pre-mining condition. The residual drawdown maps shown below clearly predict a as it is scenario after **240 days**.

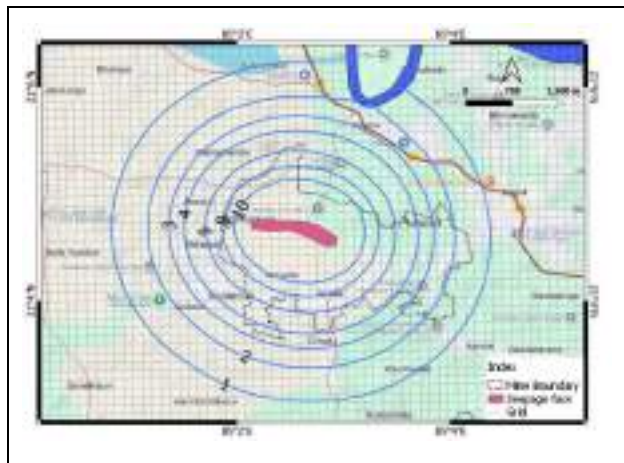


Fig 20 a: Residual drawdown after cessation of mining (Scenario after 30 Days)

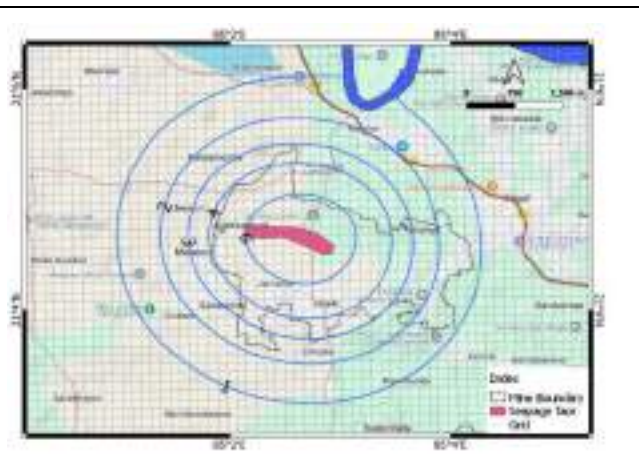


Fig 20 b: Residual drawdown after cessation of mining (Scenario after 60 Days)

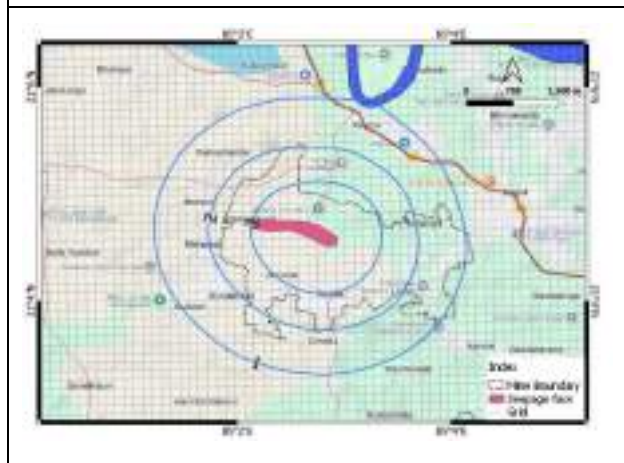


Fig 20 c: Residual drawdown after cessation of mining (Scenario after 90 Days)

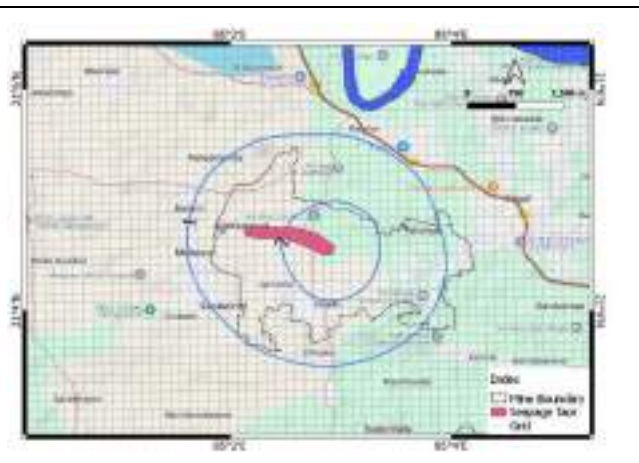
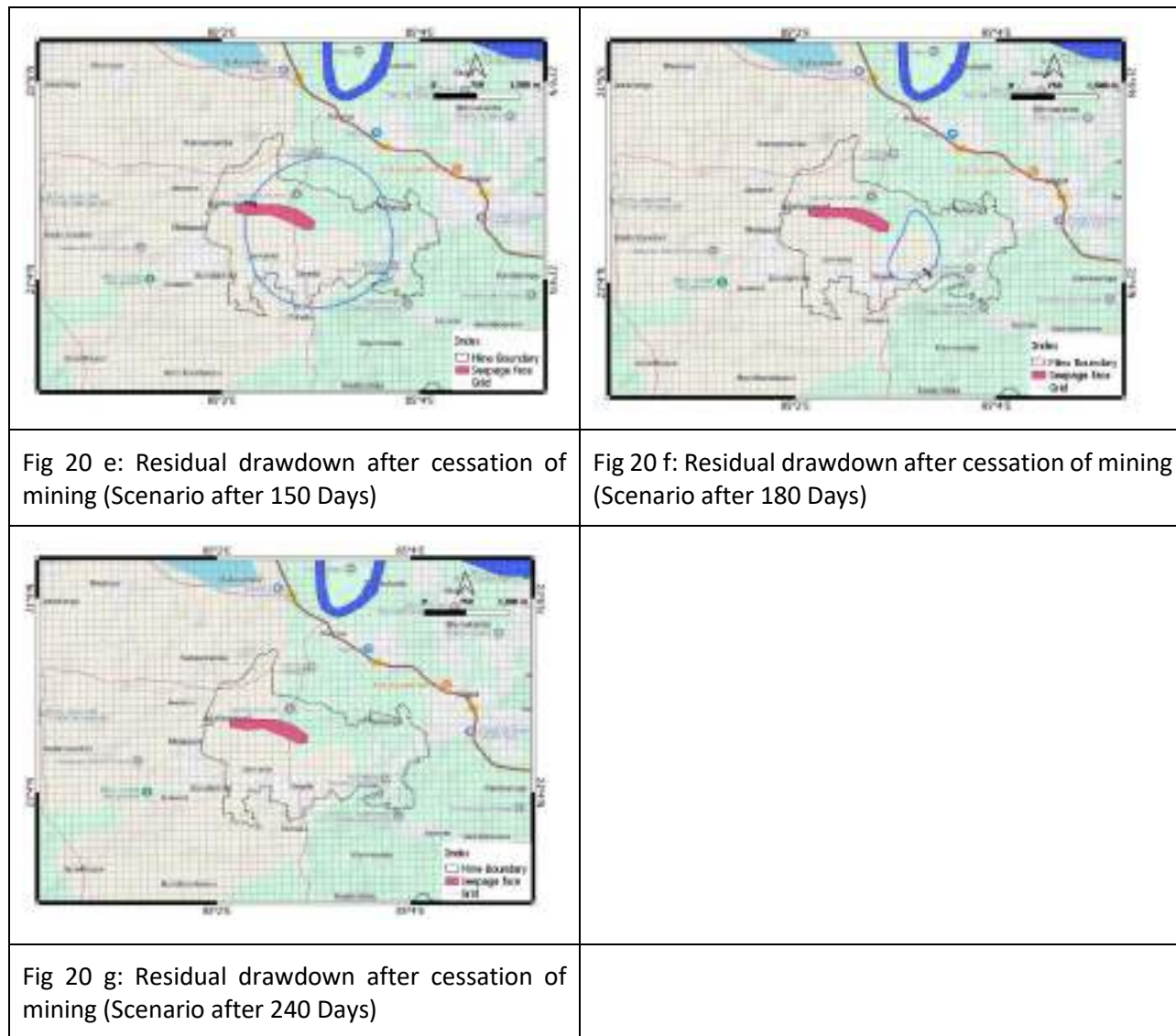


Fig 20 d: Residual drawdown after cessation of mining (Scenario after 120 Days)



5.5 Model Limitation

Modeling is a device that approximates a field condition. More is the availability of hydrological & hydrogeological data the more the model will approach reality and more will be the authenticity of the model results. So, most of the models have certain limitations and this modeling study is not an exception. Some of the limitations are mentioned below:

- Few drilling data regarding the depth of casing, fracture zones & discharge is available for the model area. Hence, the ground water exploration data of CGWB for Anugul District and drilling data of the mine is considered. Thus, the layer thickness data are quite generalized.

- Assigning aquifer parameters to the layers is based on one pumping test conducted by the Author and the published data of CGWB. So more pumping test data will definitely help in improving the model. Hence more pumping test data are required for fine tuning the model.
- The elevation data obtained from SRTM is re-sampled to 200 m grid and hence will differ from the actual height and will affect the result.
- Model Head is well calibrated, but volume calibration is not possible in the absence of stream gauging data. Hence, it is proposed to take up initiative for the establishment of gauging station at suitable location in the model domain especially on Singhara Jor, so that the stage of the river can be ascertained and the volume calibration will be possible. More monitoring wells in the model area are also proposed.

6.0 Conclusion

The numerical modeling studies is conducted in the Kaniha mine to predict the seepage into the mine and the possible impact on the ground water regime. The drawdown map shows that the impact of mining on the aquifer is limited to a maximum distance of 1.5 Kilometer from the lease boundary. The **maximum drawdown of 5 m** is expected in the deeper aquifer (75 to 100 mbgl) at the lease boundary while the phreatic aquifer is affected by only 1.0 m. Hence mining will not pose any severe impact on the ground water level of the nearby areas having habitations. The predicted seepage into the mine is estimated to be around **2195 m³/day during 2025-27 period**. Since mining has affected the confined aquifer, its recuperation rate is slow. However, the water level will return to its non-stress level after **240 days**.



Accreditation Board of CGWA

Certificate of Accreditation

Mr. Nirad Chandra Nayak

Has been accredited as a Ground Water Professionals to prepare reports in the Functional Areas of

- *Impact Assessment of Existing / Proposed GW Extraction*
- *GW Modelling*
- *Hydrogeological conditions in mining projects.*

Valid from : 15.02.2021

Certificate No. : CGWA/RGI/038

Valid thru : 14.02.2026

Dated : 30.07.2021

क्षेत्रीय निदेशक
Regional Director
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT & RI

सदस्य
Member
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT & RI

Reference

1. Mining plan of Kaniha OCP, Mahanadi Coalfield Limited.
2. DYNAMIC GROUND WATER RESOURCES OF ODISHA, 2024, Directorate of Ground Water Development Department of Water Resources Government of Odisha, January 2025, CGWB.
3. Report on National Aquifer Mapping and Management Plan, Angul district, Odisha, CGWB.

Mathematical Modelling Report

Hingula Opencast Project (Coal) of M/s Central Coalfield Ltd.

Annexure - 1: Evapotranspiration data of the study area

Year	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	Annual
2014	44.33	70.06	95.07	84.49	128.87	118.73	110.14	110.55	105.21	95.17	49.76	39.45	1051.83
2015	47.42	52.45	71.08	98.65	50.56	137.5	111.67	109.47	107.17	81.54	55.09	43.84	966.44
2016	44.44	65.43	68.67	33.44	80.67	143.41	101.16	105.24	90.61	94.57	61.4	46.23	935.27
2017	44.34	39.32	58.84	40.09	39.98	135.26	108.97	112.77	102.95	100.8	63.8	54.16	901.28
2018	45.39	44.6	41.09	51.13	108.1	143.66	102.91	102.18	106.85	98.11	52.69	45.43	942.14
2019	43.85	47.62	52.7	33.12	97.04	128.94	121.66	105.42	92.09	97.15	58.98	47.77	926.34
2020	60.24	91.59	92.7	115.89	78.55	124.94	119.63	105.71	113.69	103.6	59.88	48	1114.42
2021	44.29	42.29	33	27.17	158.15	136.96	115.42	113.09	109.81	97.6	68.1	57.22	1003.10
2022	81.28	54.32	60.88	35.28	35.9	121.63	110.66	114.13	112.81	107.63	58.85	47.28	940.65
2023	44.84	43.19	61.78	54.96	33.85	156.86	119.79	120.67	98.14	107.38	60.54	46.44	948.44
Average	50.04	55.09	63.58	57.42	81.17	134.79	112.20	109.92	103.93	98.36	58.91	47.58	972.99

Annexure - 2: Annual Rainfall data of the study area

Year	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Annual
2014	8.84	51.12	66.67	53.29	118.61	117.29	403.68	233.65	381.05	81.34	0.13	0	1515.67
2015	18.29	19.32	35.5	82.48	39.84	147.35	282.45	296.76	158.72	43.28	16.13	4.45	1144.57
2016	8.75	50.36	34.85	13.98	72.49	296.27	334.21	293.68	258.54	73.6	10	0.02	1446.75
2017	7.17	1.41	34.04	27.08	32.47	156.09	456.13	301.58	245.95	128.71	15.98	12.42	1419.03
2018	0.93	4.47	3.1	34.37	102.47	210.6	575.78	341.15	350.82	87.6	1.05	4.39	1716.73
2019	8.72	14.87	15.85	15.68	90.86	131.18	359.54	480.19	319.98	255.59	0.97	5.19	1698.62
2020	34.5	150.05	52.1	86.24	29.4	185.41	199.14	683.86	228.69	144.08	1.75	0	1795.22
2021	1.6	3.3	1.24	11.55	161.91	187.97	242.96	162.88	434.17	83.09	27.37	24.25	1342.29
2022	101.85	5.91	0.2	3.62	20.92	121.29	324.05	508.95	179.54	146.67	0.81	0.23	1414.04
2023	1.81	0.37	35.58	40.28	24.86	223.25	252.92	339.83	500	106.82	2.27	5.71	1533.70
Average	19.25	30.12	27.91	36.86	69.38	177.67	343.09	364.25	305.75	115.08	7.65	5.67	1502.66

ANNEXURE-5



क्रमांक संख्या: एम.सी.एल/मुख्यालय/ पर्यावरण एवं वन/2025/ 638

दिनांक: 27.09.2025

सेवा में,
सदस्य सचिव,
राज्य प्रदूषण नियंत्रण बोर्ड, उड़ीसा,
ए-118, नीलकंठ नगर, यूनिट-VIII, भुवनेश्वर-751012.

To,
The Member Secretary,
State Pollution Control Board, Odisha,
A-118, Nilakantha Nagar, Unit -VIII,
Bhubaneswar - 751012.

विषय: एम.सी.एल. के सभी कार्यरत परियोजनाओं का वर्ष 2024-25 का पर्यावरण संबंधी विवरण फॉर्म-V की प्रस्तुति।

Sub: Submission of Environmental Statement in Form- V of the Operating Projects of MCL for the year 2024-25.

महोदय,
पर्यावरण संरक्षण अधिनियम, 1986 एवं संशोधन, 1993 के अधिनियम 14 के पालनार्थ, एम.सी.एल. के निम्नलिखित 23 खदानों, 02 रेलवे साइडिंग और 01 वाशरी के वर्ष 2024-25 का पर्यावरण संबंधी विवरण फॉर्म-V में एक साथ जिल्दबद्ध कर एक किताब के रूप में इस पत्र के साथ संलग्न कर आपके सूचनार्थ प्रस्तुत है।

Sir,

In compliance of Rule-14 of Environmental Protection Rules, 1986 and Amendment, 1993, the Environmental Statement in Form- V for each of following 23 mines, 02 Railway siding & 01 Washery of MCL for the year 2024-25, bound together in the form of a book is enclosed along with this letter for your kind information.

क्र. सं.	इब-वैली कोलफील्ड्स के खदानों के नाम।	क्र. सं.	तालचर कोलफील्ड्स के खदानों के नाम।
1	इंट एलबीएल	16	अनंता खुली खदान।
2	इब-वैली कोल वाशरी।	17	भुवनेश्वरी खुली खदान।
3	लाजकुरा खुली खदान।	18	जगन्नाथ खुली खदान।
4	समलेस्वरी खुली खदान।	19	लिंगराज खुली खदान।
5	ओरिएंट 1&2 भूमिगत खदान।	20	कनिहा खुली खदान।
6	ओरिएंट 3 भूमिगत खदान।	21	हिंगुला खुली खदान।
7	ओरिएंट 4 भूमिगत खदान।	22	बलराम खुली खदान।
8	हिराखंड बुंदिया भूमिगत खदान।	23	भरतपुर खुली खदान।
9	कुलडा खुली खदान।	24	सुभद्रा ओसीपी
10	गरजनबहल खुली खदान।	25	नंदिरा भूमिगत खदान।
11	सियारमल खुली खदान।	26	तलचेर भूमिगत खदान।
12	कनिका RS.		
13	बसुंधरा (वेस्ट) खुली खदान।		
14	लाइकेरा रेलवे साइडिंग		

Sl. No.	Name of the Mines in Ib-Valley Coalfield	Sl. No.	Name of the Mines in Talcher Coalfield.
1	Int LBL	16	Ananta OCP
2	Ib Valley Coal Washery.	17	Bhubaneswari OCP
3	Lajkura OCP.	18	Jagannath OCP
4	Samaleswari OCP.	19	Lingraj OCP
5	Orient Mine No. 1&2	20	Kaniha OCP
6	Orient Mine No. 3	21	Hingula OCP
7	Orient Mine No. 4	22	Balaram OCP
8	Hirakhand Bundia Mine	23	Bharatpur OCP
9	Kulda OCP.	24	Subhadra OCP
10	Garjanbahal OCP.	25	Nandira UG Mine
11	Siarmal OCP	26	Talcher UG Mine
12	Kanika Railway Siding.		
13	Basundhara (West) OCP.		
14	Laikera Railway siding		

कृपया पावती भेजने की कृपा करें।
सधन्यवाद।

Kindly acknowledge the receipt.

अनुलग्नक: यथोपरि।

Thanking You.

Encl.: As above.

भवदीय,
दि. 27.09/25
डी सी कुंडू
महाप्रबन्धक (पर्या. एवं वन),
एमसीएल मुख्यालय।

Yours faithfully,

DC Kundu

General Manager,
Envt. & Forest, MCL HQ.

प्रतिलिपि:

- क्षेत्रीय अधिकारी, उ.रा.प्र.नि.बो., झारसुगुडा: एमसीएल के इब कोलफील्ड्स परियोजनाओं की वर्ष 2024-25 का पर्यावरण संबंधी विवरण फॉर्म-V में एक साथ जिल्दबद्ध कर एक किताब के रूप में संलग्न करते हुए प्रस्तुत।
- क्षेत्रीय अधिकारी, उ.रा.प्र.नि.बो., अंगुल: एमसीएल के तालचेर कोलफील्ड्स परियोजनाओं की वर्ष 2024-25 का पर्यावरण संबंधी विवरण फॉर्म-V में एक साथ जिल्दबद्ध कर एक किताब के रूप में संलग्न करते हुए प्रस्तुत।

Copy to:

- Regional Officer, OSPCB, Jharsuguda: along with Environmental Statement in Form-V for the year 2024-25 Projects of Ib Coalfields, MCL bound together in one volume book.
- Regional Officer, OSPCB, Angul: along with Environmental Statement in Form-V for the year 2024-25

FORM-V

ENVIRONMENTAL STATEMENT

Environmental statement for the financial year ending 31st March, 2025

Part – A

- i) Name & Address of the owner/ occupier : Sri Parmananda Guin
of the industry operation or process : Project Officer, KOCP
(Name of the Project Officer/ Sub-Area : P.O: Kaniha
Manager & Office address to be given) : Dist: Angul, Odisha
- ii) Industry Category : Primary (Coal Mining Operation)
- iii) Production Capacity : 14 MTPA
(Coal production during the year 2024-25) : 10.85 MT
- iv) Year of establishment : 24.11.2010
- v) Date of the last Environmental Statement submitted : 30.09.2024

Part – B

Water & Raw Material Consumption

Note: Average Water Consumption (Cu-m/ day) for the whole year is given. Raw material consumption is given per unit of coal produced.

(I) Water Consumption (Cu-m/ day):

Ser No.	Industrial/ Mining	Consumption in Cu-m/ day
1. a	Haul Road Dust Suppression	1020
b	Dust Suppression at CHP	-
c	Dust Suppression at Siding	2663
d	Fire Fighting	186
e	Workshop	07
f	Others (Plantation)	04
2.	Domestic	-
3.	Total in kℓ/ day	3880

Name of the Product	Water Consumption per unit of product (ℓ/ t)	
	2023-24	2024-25
Coal	87.91	130.52

(II) Raw Material Consumption (per tonne of coal):

Name of Raw Material	Consumption of Raw Material (per tonne of Coal produced)	
	2023-24 (Dept+Cont.)	2024-25 (Dept+Cont.)
H.S. Diesel (l/ t)	0.967L/te	1.023 L/te
Petrol (l/ t)	Nil	Nil
Lubricants (l/ t)	0.0067 L/te	0.0010 L/te
Electricity (Units/ t)	0.078 Unit/te	0.113 Unit/te
Explosives (kg/ t)	0.120 Kg/te (Only Dept)	0.168 Kg/te (Only Dept)

Part – C

Pollution Discharged to Environment/ Unit of Output

(Parameter as specified in the 'Consent' issued)

Pollutants	Quantity of pollutants discharged (mass/ day)	Concentrations of pollutants In discharges (mass/ volume)			Percentage variation from prescribed standards with reasons
Water (annual average)					
	Not possible to quantify	Mine Effluent	OGT Outlet	STP Outlet	All data are within permissible limit.
TSS (mg/l)		38.75	NA	NA	
BOD mg/l)		<2.00	NA	NA	
COD (mg/l)		30.33	NA	NA	
pH		7.37	NA	NA	
O&G (mg/l)		<4.00	NA	NA	
Air (Ambient air quality of one station – annual average)					
New Time Office/Near Z-Patch					
PM _{2.5} (µg/m ³)	Not possible to quantify	134.83			All data are within permissible limit.
PM ₁₀ (µg/m ³)		61.13			
SO ₂ (µg/m ³)		13.96			
NO _x (µg/m ³)		21.73			

Part – D

Hazardous Wastes

As specified under Hazardous Wastes (Management & Handling) Rules, 1989.

Hazardous Waste	Total Quantity (kg)	
	During the previous financial year (2023-24)	During the current financial year (2024-25)
(a) From process :		
i. Burnt Oil in Workshops	12.70T	16.79 T
ii. Oil soaked filters	1.85T	2.153 T
(b) From pollution control facilities:		
i. Oil/ Oil imulsion recovery from Oil & Grease Trap	-	-
ii. Oily sludge	-	-
iii. Chemical Waste(if any)	-	-

Part – E
Solid Wastes (other than hazardous)

Particulars	Total Quantity	
	During the previous financial year 2023-24	During the current financial year 2024-25
(a) From process (Top soil and Over burden)	6.519 (OBR)+0.615 (RH)+0.025 (Reject) = 7.159 Mm ³	6.576 (OBR)+ 0.52 Mm ³ (Top Soil) = 7.096 Mm ³
(b) From pollution control facilities (STP & Sed-Pond Sludge)	NIL	Nil
(c) 1- Quantity recycled or re-utilized (OB back-filled)	4.442 Mm ³	3.630 Mm ³
2- Sold	NIL	NIL
3- Disposed	NIL	NIL

Part – F

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

(I) Hazardous Wastes:

Name of Hazardous Wastes	Quantity generated in the year 2024-25	Disposal Practices
Burnt Oil, etc. (t)(from W/Shop)	11,39,000 Liters	Being sent to Authorized Recyclers at regular intervals (7.29 KL sold during 2024-25)
Oil soaked filters(kg) (from W/Shop)	303 Kg	Stored in impervious pit
Oil & Grease (kg)(from ETP/ OGT)	-	-
Oily Sludge (te.) (from ETP/ OGT)	-	-
Oil emulsion	-	-
Chemical Waste if any (kg)	-	-
Battery (nos.)		Stored

Note: A detailed note on disposal practices of the above should be given separately.

(II) Solid Wastes:

Solid Waste	Quantity generated in the year 2024-25	Disposal Practices
Top Soil (m ³)	0.52 Mm ³	Stored separately for use in future reclamation.
OB (m ³)	6.576 Mm ³	3.159 Mm ³ kept in External OB dump and 3.417 Mm ³ dumped in backfilling area.
STP & Sed-Pond Sludge	NIL	-

Land Reclamation & OB disposal – progressive till March, 2025:

	Area (ha.)	OB Volume/ Nos. of Plants
1) External OB dump	105.54	37.07 Mm ³
2) Excavated land	228.83	53.75 Mm ³
3) Land affected (1+2)	334.37	-
4) Backfilled (out of 2)	27.69	16.694 Mm ³
5) Land physically reclaimed (out of 3)	NIL	-
6) Land biologically reclaimed (out of 3)	NIL	-

Part – G

Impact of pollution control measures on conservation of natural resources and consequently on cost of production.

In order to carry out mining in an eco-friendly manner, a detailed Environmental Management Plan (EMP) was prepared by Regional Institute-VII of CMPDI. The main pollution control measures suggested in EMP along with the measures implemented so far have been summarized in the Table-1.1 to 1.3.

Table – 1.1
Air Pollution Control Measures

Sl. No.	EMP Provisions	Whether provided or not	Remarks
1	Water sprinkling and grading of all roads to minimize air-borne dust from vehicles.	Provided	Water sprinkling is done by 04 no. of 12KL mobile Fog Canon, 03 no. of ground mounted fog cannons & two no. of 12 KL mobile water tankers.
2	Biological reclamation of land.	Not Provided	Dumps are active in nature
3	Green belt around mine & infrastructures.	Provided	By plantation along mine lease boundary & infrastructure
4	Drills fitted with dust control devices.	Provided	
5	Dust suppression/ dust extraction system to be provided in CHP.	CHP does not exist so far.	
6	Improved maintenance of plant & machinery.	Maintained	Scheduled maintenance is being carried out.
7	Mechanized coal transportation system.	Provided	

Table – 1.2
Water Pollution Control Measures

Sl. No.	EMP Provisions/ Additional precautions	Whether provided or not	Remarks
1	Mine water is to be collected in central sump on dip side of pit. This will act as sedimentation lagoon.	Provided	Tender under finalization for additional 01 no. of sedimentation tank/pond near site old office
2	Run-off around reclamation area will be controlled by providing catch drains and sedimentation lagoon combination.	Provided	catch drains and sedimentation lagoon has been provided around the periphery of the mine
3	Surface run-off from external dump would be collected through a series of contour drains which would be connected to a water retention pond. The clear water from this pond will be re-utilised	Provided	Mine sump acts as water reservoir.
4	Domestic waste water will be treated in screens, oxidation pond/ aerated lagoon. Sanitary waste to be disposed off into septic tank & soak-pit.	Not Applicable	Colony not yet constructed
5	Workshop effluents will be treated in oil & grease trap & sedimentation tank.	Provided	Workshop effluent is being treated.
6	Zero discharge from mine shall be maintained.	Maintained	Sedimentation tank/Water bodies have been developed to store and reuse the water generated from the mine
7	Piezometers shall be installed for measurement of under-ground water depth and its quality	Provided	Piezometer MTP 19 & 20) installed at Golghar sahi Primary school and old site office of KOCP respectively.

Table – 1.3
Land Reclamation

Sl. No.	EMP Provisions	Whether provided or not	Remarks
1	Top soil Management: Proper stripping, Storage, and Relocation of top soil.	Provided	Dumped in a separate specified area and preserved by plantation of leguminous plant.
2	Physical Reclamation of OB Dump: Proper reshaping and re-grading of top surface, Providing drainage arrangements and top soil spreading on external and internal dumps.	Not Provided	Presently all dumps are active.
3	Biological Reclamation: Plantation of suitable species of herbs, shrubs & indigenous trees over technically reclaimed dumps.	Not Provided	Presently all dumps are active.

IMPACT OF POLLUTION CONTROL MEASURES ON COST OF PRODUCTION

COST OF ENVIRONMENTAL MANAGEMENT DURING 2024-25 was Rs.5.03 per tonne of Coal.

Part – H

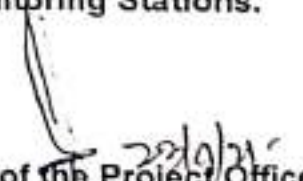
Additional measures/ investment proposal for environmental protection including abatement of pollution, prevention of pollution.

Head	Amount Rs. (approx)
Cleaning of dust along CT Road	45,00,000.00
Procurement of Fog Canon/Atomizer	55,00,000.00
Plantation	2,00,00,000.00
Routine Environmental monitoring	1,80,00,000.00
Fire Fighting	35,00,000.00
Repair & Maintenance of garland drain	30,00,000.00
Wheel washing System	10,00,000.00
Operation and maintenance of fixed sprinklers	25,00,000.00
Installation of fixed type fog canon at siding	25,00,000.00
Supply of water to peripheral villages	45,00,000.00
Statutory Fees	56,00,000.00
Installation of Wind barrier at new coal stockyard	4,15,83,000.00
TOTAL	10,76,83,000.00

Part – I

Any other particulars for improving the quality of the environment.

Note: Please attach a plan showing the relevant features like Present Working/ Quarries, External Dump, Back-filling, Plantation, Sedimentation Pond/ MDTP, Oil & Grease Trap/ ETP, Workshop, CHP, STP, etc. and Environmental Monitoring Stations.


Signature of the Project Officer

 (with seal)

परियोजना अधिकारी/Project Officer
कनिष्ठा ओमोरी/Kanishtha Omori JCP

COST OF ENVIRONMENTAL MANAGEMENT DURING 2024-25

Head	Amount (in Rs.)
Plantation of Saplings in Kaniha OCP	57,00,819.12
Celebration of Environment day	1,13,210.00
Environmental monitoring cost against demand from Head Quarter (CMPDIL)	2,45,26,027.42
Expenditure on water spraying for dust control through hired fog canon	46,99,295.06
Expenditure on cleaning of CT road through mechanical road sweeper	33,72,801.74
Supply of water to the peripheral villages	53,81,168.36
Expenditure on departmental fire fighting works	82,235.58
Statutory fees (Consent to Operate)	56,00,000.00
Statutory fees (CGWA)	51,90,630.00
TOTAL	5,46,66,187.28

22/9/24
Project Officer,
Kaniha OCP.

परियोजना अधिकारी/Project Officer
कनिहा ओपेसीटी/24-25

Annexure-6

**Environmental Monitoring Report
Of
Kaniha Area
For
April-2025**

Talcher Coalfield



Mahanadi Coalfields Limited



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Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)

Regional Institute-VII, Samantpuri, P.O : RRL, Bhubaneswar-751013 (Odisha)
[Assistance from Environment Division, CMPDI(HQs), Ranchi]

The test report shall not be reproduced in part or full without written approval of the competent authority

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Compliance Station)

Project :

Kaniha OCP

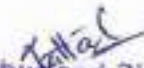
(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
12-Apr-25	Near External OB Dump, Jamania	211	90	46	19.75	40.95	Mining Activities	About 500m
12-Apr-25	New Time Office (Near Z-Patch)	221	97	49	18.77	29.62	Mining Activities	About 500m
12-Apr-25	Near Project Office	216	93	47	15.80	24.40	Mining Activities	About 500m
22-Apr-25	Near External OB Dump, Jamania	215	95	48	9.70	23.52	Mining Activities	About 500m
22-Apr-25	New Time Office (Near Z-Patch)	205	82	40	18.22	21.96	Mining Activities	About 500m
22-Apr-25	Near Project Office	209	87	44	9.29	31.37	Mining Activities	About 500m

MoEF Standards Notification dated 23rd September, 2000

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AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Reference Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
01-Apr-25	Near Harichandanpur	170	67	33	16.37	32.19		
01-Apr-25	Kaniha (North of the Mine)	174	74	36	10.16	28.38	Mining Activities	About 500m
02-Apr-25	Near Harichandanpur	184	70	36	13.78	29.01		
02-Apr-25	Kaniha (North of the Mine)	164	68	33	14.55	28.51	Mining Activities	About 500m
03-Apr-25	Kansamunda Village	201	76	42	11.21	19.09		
03-Apr-25	Gandaberna	159	72	34	11.70	38.79		
03-Apr-25	Guiland, South West of Mine	163	62	33	10.22	32.93		
03-Apr-25	South Of Proposed Quarry Limit of KOCP	186	77	39	14.14	23.52	Mining Activities	About 500m
04-Apr-25	South Of Proposed Quarry Limit of KOCP	178	74	36	12.37	23.18	Mining Activities	About 500m
04-Apr-25	Kansamunda Village	175	68	32	14.67	28.23		
04-Apr-25	Gandaberna	156	63	32	14.65	21.09		
04-Apr-25	Guiland, South West of Mine	169	69	34	10.82	28.64		
07-Apr-25	Kaniha (North of the Mine)	158	63	30	15.56	25.88	Mining Activities	About 500m
07-Apr-25	Near Harichandanpur	175	77	31	14.22	36.07		
08-Apr-25	Near Harichandanpur	148	55	27	14.22	33.72		
08-Apr-25	Kaniha (North of the Mine)	151	59	28	10.67	20.39	Mining Activities	About 500m
09-Apr-25	Kansamunda Village	184	73	35	11.56	35.29		
09-Apr-25	South Of Proposed Quarry Limit of KOCP	169	64	31	15.07	30.68	Mining Activities	About 500m
09-Apr-25	Gandaberna	184	73	42	11.31	20.67		
09-Apr-25	Guiland, South West of Mine	160	65	32	13.53	20.46		
10-Apr-25	South Of Proposed Quarry Limit of KOCP	143	52	24	14.55	25.66	Mining Activities	About 500m
10-Apr-25	Kansamunda Village	153	57	26	17.35	26.14		
10-Apr-25	Guiland, South West of Mine	149	55	26	9.29	19.96		

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Project :**Kaniha OCP****(conc. in µg/cu.m.)**

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
10-Apr-25	Gandaberna	155	59	31	17.78	34.50		
16-Apr-25	Kaniha (North of the Mine)	140	51	23	10.76	26.41	Mining Activities	About 500m
16-Apr-25	Near Harichandanpur	153	57	28	18.27	31.37		
17-Apr-25	Kaniha (North of the Mine)	167	71	34	13.59	37.82	Mining Activities	About 500m
17-Apr-25	Near Harichandanpur	171	66	35	9.82	31.37		
18-Apr-25	Guiland, South West of Mine	172	78	35	9.33	25.09		
18-Apr-25	South Of Proposed Quarry Limit of KOCP	168	69	33	12.35	27.01	Mining Activities	About 500m
18-Apr-25	Gandaberna	167	67	33	12.84	33.11		
18-Apr-25	Kansamunda Village	174	72	36	14.67	21.96		
19-Apr-25	Kansamunda Village	166	67	32	11.36	33.11		
19-Apr-25	Guiland, South West of Mine	188	74	37	12.26	24.34		
19-Apr-25	South Of Proposed Quarry Limit of KOCP	174	73	35	9.31	23.15	Mining Activities	About 500m
19-Apr-25	Gandaberna	159	64	30	10.67	21.96		
23-Apr-25	Guiland, South West of Mine	154	59	28	9.78	24.31		
23-Apr-25	Kaniha (North of the Mine)	149	56	27	11.36	38.34	Mining Activities	About 500m
23-Apr-25	Gandaberna	154	62	29	13.74	21.39		
23-Apr-25	Near Harichandanpur	157	60	32	13.14	25.91		
24-Apr-25	Gandaberna	179	77	38	14.67	21.96		
24-Apr-25	Guiland, South West of Mine	182	75	37	9.78	21.96		
24-Apr-25	Kaniha (North of the Mine)	173	73	35	12.63	23.11	Mining Activities	About 500m
24-Apr-25	Near Harichandanpur	176	68	36	9.31	31.37		
25-Apr-25	South Of Proposed Quarry Limit of KOCP	153	57	28	12.11	29.01	Mining Activities	About 500m
25-Apr-25	Kansamunda Village	160	60	29	16.89	35.29		
26-Apr-25	Kansamunda Village	144	52	23	18.77	27.88		
26-Apr-25	South Of Proposed Quarry Limit of KOCP	164	65	31	17.33	25.09	Mining Activities	About 500m
29-Apr-25	Near Harichandanpur	166	64	34	14.50	35.49		

*NAAQS, 2009

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Project :**Kaniha OCP****(conc. in $\mu\text{g}/\text{cu.m.}$)**

<i>Date of Sampling</i>	<i>Monitoring Station</i>	<i>SPM</i>	<i>PM10</i>	<i>PM2.5</i>	<i>SO2</i>	<i>NOx</i>	<i>Dust Generating Source(DGS)</i>	<i>Distance from DGS</i>
29-Apr-25	Kaniha (North of the Mine)	184	75	38	15.11	30.58	Mining Activities	About 500m
30-Apr-25	Near Harichandapur	153	55	27	12.44	23.52		
30-Apr-25	Kaniha (North of the Mine)	148	54	26	10.86	37.47	Mining Activities	About 500m

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Near Harichandanpur							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Apr-2025	<20.0	24.83	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
02-Apr-2025	<20.0	16.75	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
07-Apr-2025	<20.0	16.75	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
08-Apr-2025	<20.0	13.03	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
16-Apr-2025	<20.0	21.72	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
17-Apr-2025	<20.0	18	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
23-Apr-2025	<20.0	27	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
24-Apr-2025	<20.0	26.38	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
29-Apr-2025	<20.0	16.75	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
30-Apr-2025	<20.0	27.32	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0 (Annua l)	20(Ann ual)	02(8hou rs)	01(annu al)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kaniha North of the Mine							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
01-Apr-2025	<20.0	13.65	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
02-Apr-2025	<20.0	14.9	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
07-Apr-2025	<20.0	19.87	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
08-Apr-2025	<20.0	18.62	<0.1	<1.0	<1.0	1.7	BQL(QL=0.7)	BQL
16-Apr-2025	<20.0	22.35	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
17-Apr-2025	<20.0	18.32	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
23-Apr-2025	<20.0	22.03	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
24-Apr-2025	<20.0	21.72	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
29-Apr-2025	<20.0	25.75	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
30-Apr-2025	<20.0	18.32	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	South of Proposed Quarry Limit of KOCP							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (α) Pyrene	Benzene
	(μg/m ³)	(μg/m ³)	(μg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(μg/m ³)
03-Apr-2025	<20.0	24.52	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
04-Apr-2025	<20.0	13.35	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
09-Apr-2025	<20.0	18	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
10-Apr-2025	<20.0	13.35	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
18-Apr-2025	<20.0	20.78	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
19-Apr-2025	<20.0	24.2	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
25-Apr-2025	<20.0	27	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
26-Apr-2025	<20.0	26.38	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(hour)	1.0(24h ours)	6.0(Annual)	20(Annual)	02(8hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kansamunda Village							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
03-Apr-2025	<20.0	14.58	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
04-Apr-2025	<20.0	12.1	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
09-Apr-2025	<20.0	12.42	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
10-Apr-2025	<20.0	12.42	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
18-Apr-2025	<20.0	18.32	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
19-Apr-2025	<20.0	20.17	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
25-Apr-2025	<20.0	15.2	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
26-Apr-2025	<20.0	18.93	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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Government of India

AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Guiland, South West of the Mine							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
03-Apr-2025	<20.0	23.58	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
04-Apr-2025	<20.0	22.97	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
09-Apr-2025	<20.0	22.35	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
10-Apr-2025	<20.0	21.42	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
18-Apr-2025	<20.0	26.07	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
19-Apr-2025	<20.0	26.07	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
23-Apr-2025	<20.0	24.52	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
24-Apr-2025	<20.0	20.78	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Gandaberana							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (α) Pyrene	Benzene
	(μg/m ³)	(μg/m ³)	(μg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(μg/m ³)
03-Apr-2025	<20.0	25.45	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
04-Apr-2025	<20.0	21.42	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
09-Apr-2025	<20.0	20.48	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
10-Apr-2025	<20.0	21.42	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
18-Apr-2025	<20.0	25.13	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
19-Apr-2025	<20.0	15.2	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
23-Apr-2025	<20.0	22.03	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
24-Apr-2025	<20.0	16.75	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA

Area: Kaniha

Project	KanihaOCP
Monitoring Station	Near Project Office
Date of sampling	Carbon Monoxide (CO)
	mg/m3
12-Apr-2025	1.8
22-Apr-2025	1.9
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	New Time Office (Near Z-Patch)
Date of sampling	Carbon Monoxide (CO)
	mg/m3
12-Apr-2025	1.8
22-Apr-2025	1.7
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	Near External OB Dump, Jamania
Date of sampling	Carbon Monoxide (CO)
	mg/m3
12-Apr-2025/9418	1.6
22-Apr-2025/9670	1.8
Standard	02(8 Hours)

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TABLE--

NOISE LEVEL MONITORING DATA

AREA :

Kaniha

PROJECT :

Kaniha OCP

DATE OF SAMPLING	STATION	Noise Level Measurement in Leq dB(A)	
		DAY	NIGHT
04-Apr-25	Kansamunda Village (West of the Mine)	51.2	40.8
04-Apr-25	Near External OB Dump, Jamania	66.8	53.8
04-Apr-25	Near Time Office (Near Z-Patch)	65.8	54.3
04-Apr-25	Near Project Office	66.7	57.6
18-Apr-25	Kansamunda Village (West of the Mine)	50.9	40.8
18-Apr-25	Near External OB Dump, Jamania	67.4	52.8
18-Apr-25	Near Time Office (Near Z-Patch)	64.9	55.1
18-Apr-25	Near Project Office	65.8	56.4

MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 75dB(A) (Industrial)	10.00 PM - 6.00 AM Leq 70dB(A) (Industrial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 55dB(A) (Residential)	10.00 PM - 6.00 AM Leq 45dB(A) (Residential)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 65dB(A) (Commercial)	10.00 PM - 6.00 AM Leq 55dB(A) (Commercial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 50dB(A) (Silence Zone)	10.00 PM - 6.00 AM Leq 40dB(A) (Silence Zone)

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EFFLUENT QUALITY DATA

Area :

Kaniha

(All dimensions are in mg/l unless otherwise stated except pH)

Project :

Kaniha OCP

Date of Sampling	Sampling Station	pH	Oil & Grease	TSS	COD	BOD	Remarks
10-Apr-25	Clear Water Pond	8.18	<4.0	40	28	-	
10-Apr-25	Kansamunda Sump	8.21	<4.0	44	32	-	
10-Apr-25	Pre Sedimentation Pond	8.23	<4.0	43	32	-	
10-Apr-25	Z-Patch Sump	8.44	<4.0	37	40	-	
25-Apr-25	Clear Water Pond	8.40	<4.0	57	56	-	
25-Apr-25	Pre Sedimentation Pond	8.32	<4.0	53	48	-	

MoEF Standard Notification dated 25th September, 2000
and MoEF Schedule VI, General standard for discharge
of Environmental Pollutants Part A: Effluents

5.5-9.0	10	100	250	30

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**Environmental Monitoring Report
Of
Kaniha Area
For
May-2025**

Talcher Coalfield



Mahanadi Coalfields Limited



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Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)

Regional Institute-VII, Samantpuri, P.O : RRL, Bhubaneswar-751013 (Odisha)
[Assistance from Environment Division, CMPDI(HQs), Ranchi]

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Monitoring

Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Compliance Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
08-May-25	Near External OB Dump, Jamania	216	85	40	14.26	22.29	Mining Activities	About 500m
08-May-25	New Time Office (Near Z-Patch)	192	83	38	18.57	27.37	Mining Activities	About 500m
08-May-25	Near Project Office	205	88	41	18.39	34.92	Mining Activities	About 500m
21-May-25	Near Project Office	188	78	39	17.86	33.96	Mining Activities	About 500m
22-May-25	Near External OB Dump, Jamania	184	81	38	18.77	24.76	Mining Activities	About 500m
22-May-25	New Time Office (Near Z-Patch)	175	70	33	19.90	24.24	Mining Activities	About 500m

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MoEF Standards Notification dated 25th
September, 2009

600	300		120	120

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Reference Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO ₂	NO _x	Dust Generating Source(DGS)	Distance from DGS
05-May-25	Kansamunda Village	144	55	26	11.00	33.88		
05-May-25	Gandaberna	183	72	34	17.39	23.46		
05-May-25	South Of Proposed Quarry Limit of KOCP	155	64	31	22.71	36.32	Mining Activities	About 500m
05-May-25	Guland, South West of Mine	141	55	27	13.35	23.94		
05-May-25	Near Harichandpur	146	57	27	9.76	31.20		
05-May-25	Kaniha (North of the Mine)	169	66	32	12.47	18.82	Mining Activities	About 500m
06-May-25	South Of Proposed Quarry Limit of KOCP	152	62	30	14.91	33.43	Mining Activities	About 500m
06-May-25	Near Harichandpur	152	60	28	16.68	34.67		
06-May-25	Kansamunda Village	158	64	30	12.73	38.58		
06-May-25	Kaniha (North of the Mine)	165	64	30	14.78	21.96	Mining Activities	About 500m
06-May-25	Guland, South West of Mine	173	68	32	18.02	31.94		
06-May-25	Gandaberna	149	51	27	13.14	31.94		
12-May-25	Kaniha (North of the Mine)	137	51	24	16.98	27.82	Mining Activities	About 500m
12-May-25	South Of Proposed Quarry Limit of KOCP	133	55	26	18.38	26.41	Mining Activities	About 500m
12-May-25	Kansamunda Village	178	71	35	10.75	34.47		
12-May-25	Guland, South West of Mine	153	60	29	19.19	40.45		
12-May-25	Near Harichandpur	129	49	23	16.68	23.11		
12-May-25	Gandaberna	179	70	34	13.35	25.59		
13-May-25	Guland, South West of Mine	143	55	26	16.99	28.15		
13-May-25	South Of Proposed Quarry Limit of KOCP	146	63	29	13.47	33.63	Mining Activities	About 500m
13-May-25	Kansamunda Village	152	59	28	12.99	33.16		
13-May-25	Near Harichandpur	141	55	27	16.14	35.66		

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Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
13-May-25	Gandaberna	181	77	36	15.02	22.29		
13-May-25	Kaniha (North of the Mine)	140	55	26	10.59	32.93	Mining Activities	About 500m
19-May-25	Kansamunda Village	121	47	23	10.84	33.84		
19-May-25	South Of Proposed Quarry Limit of KOCP	134	52	25	22.89	35.66	Mining Activities	About 500m
19-May-25	Guiland, South West of Mine	140	54	27	16.20	35.97		
19-May-25	Near Harichandanpur	125	43	21	13.83	25.02		
19-May-25	Gandaberna	138	51	25	13.89	28.23		
19-May-25	Kaniha (North of the Mine)	121	47	23	17.47	40.78	Mining Activities	About 500m
20-May-25	South Of Proposed Quarry Limit of KOCP	128	41	23	20.35	33.02	Mining Activities	About 500m
20-May-25	Near Harichandanpur	130	48	26	11.06	17.54		
20-May-25	Kansamunda Village	133	51	26	16.20	36.75		
20-May-25	Kaniha (North of the Mine)	141	56	26	12.54	25.41	Mining Activities	About 500m
20-May-25	Guiland, South West of Mine	161	61	30	15.39	22.29		
20-May-25	Gandaberna	127	52	24	16.99	20.33		
26-May-25	Kaniha (North of the Mine)	159	61	31	13.94	37.64	Mining Activities	About 500m
26-May-25	Guiland, South West of Mine	121	47	23	10.54	29.72		
26-May-25	Kansamunda Village	167	66	31	11.26	35.66		
26-May-25	Near Harichandanpur	118	45	22	15.41	28.15		
26-May-25	Gandaberna	146	56	29	18.97	21.11		
26-May-25	South Of Proposed Quarry Limit of KOCP	145	53	27	12.60	21.23	Mining Activities	About 500m
27-May-25	South Of Proposed Quarry Limit of KOCP	123	42	20	14.53	26.80	Mining Activities	About 500m
27-May-25	Guiland, South West of Mine	133	51	26	15.02	22.64		
27-May-25	Kansamunda Village	154	52	29	14.26	23.77		
27-May-25	Gandaberna	121	49	23	17.39	24.24		
27-May-25	Near Harichandanpur	146	56	27	18.97	28.93		
27-May-25	Kaniha (North of the Mine)	174	69	32	11.09	18.82	Mining Activities	About 500m

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Near Harichandanpur							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
05-May-2025	<20.0	11.27	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
06-May-2025	<20.0	15.47	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
12-May-2025	<20.0	21.75	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
13-May-2025	<20.0	22.02	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
19-May-2025	<20.0	25.42	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
20-May-2025	<20.0	12.05	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
26-May-2025	<20.0	13.88	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
27-May-2025	<20.0	23.58	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0 (Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kaniha North of the Mine							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
05-May-2025	<20.0	17.03	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
06-May-2025	<20.0	14.93	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
12-May-2025	<20.0	22.80	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
13-May-2025	<20.0	18.87	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
19-May-2025	<20.0	25.68	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
20-May-2025	<20.0	13.3	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
26-May-2025	<20.0	16.77	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
27-May-2025	<20.0	16.77	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	South of Proposed Quarry Limit of KOCP							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (α) Pyrene	Benzene
	(μg/m ³)	(μg/m ³)	(μg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(μg/m ³)
05-May-2025	<20.0	16.25	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
06-May-2025	<20.0	26.98	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
12-May-2025	<20.0	27.52	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
13-May-2025	<20.0	11.27	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
19-May-2025	<20.0	21.75	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
20-May-2025	<20.0	12.32	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
26-May-2025	<20.0	17.03	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
27-May-2025	<20.0	12.58	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kansamunda Village							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
05-May-2025	<20.0	21.75	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
06-May-2025	<20.0	23.58	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
12-May-2025	<20.0	25.42	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
13-May-2025	<20.0	16.50	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
19-May-2025	<20.0	15.20	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
20-May-2025	<20.0	26.73	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
26-May-2025	<20.0	26.98	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
27-May-2025	<20.0	24.63	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Guiland, South West of the Mine							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (α) Pyrene	Benzene
	(μg/m ³)	(μg/m ³)	(μg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(μg/m ³)
05-May-2025	<20.0	16.50	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
06-May-2025	<20.0	17.03	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
12-May-2025	<20.0	22.80	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
13-May-2025	<20.0	15.47	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
19-May-2025	<20.0	23.05	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
20-May-2025	<20.0	19.13	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
26-May-2025	<20.0	22.02	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
27-May-2025	<20.0	21.75	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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CMPDI
Rini Ratna

AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Gandaberana							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
05-May-2025	<20.0	27.25	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
06-May-2025	<20.0	21.22	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
12-May-2025	<20.0	13.10	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
13-May-2025	<20.0	15.47	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
19-May-2025	<20.0	21.48	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
20-May-2025	<20.0	21.48	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
26-May-2025	<20.0	27.77	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
27-May-2025	<20.0	15.98	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA

Area: Kaniha

Project	KanihaOCP
Monitoring Station	Near Project Office
Date of sampling	Carbon Monoxide (CO)
	mg/m³
08-May-2025	1.4
22-May-2025	1.6
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	New Time Office (Near Z-Patch)
Date of sampling	Carbon Monoxide (CO)
	mg/m³
08-May-2025	1.5
22-May-2025	1.4
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	Near External OB Dump, Jamania
Date of sampling	Carbon Monoxide (CO)
	mg/m³
08-May-2025	1.3
22-May-2025	1.4
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	Old Site Office
Date of sampling	Carbon Monoxide (CO)
	mg/m³
08-May-2025	1.3
22-May-2025	1.5
Standard	02(8 Hours)

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NOISE LEVEL MONITORING DATA

AREA :

Kaniha

PROJECT :

Kaniha OCP

DATE OF SAMPLING	STATION	Noise Level Measurement in Leq dB(A)	
		DAY	NIGHT
15-May-25	Kansamunda Village (West of the Mine)	49.2	42.3
15-May-25	Near External OB Dump, Jamania	69.8	53.6
15-May-25	Near Time Office (Near Z-Patch)	70.1	64.3
15-May-25	Near Project Office	70.1	58.3
29-May-25	Kansamunda Village (West of the Mine)	48.7	40.3
29-May-25	Near External OB Dump, Jamania	64.7	51.2
29-May-25	Near Time Office (Near Z-Patch)	63.1	52.4
29-May-25	Near Project Office	62.3	53.7

MoEF Standard Notification dated 25th September, 2000	6.00 AM -10.00 PM Leq 75dB(A) (Industrial)	10.00 PM -6.00 AM Leq 70dB(A) (Industrial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM -10.00 PM Leq 55dB(A) (Residential)	10.00 PM -6.00 AM Leq 45dB(A) (Residential)
MoEF Standard Notification dated 25th September, 2000	6.00 AM -10.00 PM Leq 65dB(A) (Commercial)	10.00 PM -6.00 AM Leq 55dB(A) (Commercial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM -10.00 PM Leq 50dB(A) (Silence Zone)	10.00 PM -6.00 AM Leq 40dB(A) (Silence Zone)

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A. K. Saha



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EFFLUENT QUALITY DATA

Area :

Kaniha

(All dimensions are in mg/l unless otherwise stated except pH)

Project :

Kaniha OCP

Date of Sampling	Sampling Station	pH	Oil & Grease	TSS	COD	BOD	Remarks
15-May-25	Clear Water Pond	7.69	<4.0	41	28	-	
15-May-25	Kansamunda Sump	7.01	<4.0	56	64	-	
15-May-25	Pre Sedimentation Pond	7.73	<4.0	53	32	-	
15-May-25	Z-Patch Sump	7.30	<4.0	19	12	-	
31-May-25	Clear Water Pond	7.40	<4.0	42	24	-	
31-May-25	Pre Sedimentation Pond	6.14	<4.0	38	28	-	

MoEF Standard Notification dated 25th September, 2000
and MoEF Schedule VI, General standard for discharge
of Environmental Pollutants Part A: Effluents

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Drinking Water Quality Data Kaniha Area

Project / OCP	Kaniha		Indian Drinking Standards (IS-10500):2012	
Monitoring Station	Telisinga Well Water	Jarda Village Well Water		
Date of Sampling	15-May-2025	15-May-2025	Acceptable	Permissible
Colour(Hazen)	2	3	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable
Taste	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity(NTU)	2	4	1	5
pH	6.55	8.22	6.5-8.5	No relaxation
Total Alkalinity(mg/L)	16.81	239.51	200	600
Chloride(mg/L)	36.95	40.84	250	1000
Sulphate(mg/L)	39.97	11.12	200	400
Nitrate(mg/L)	12.19	<0.5	45	No relaxation
Total Hardness (Ca CO ₃)(mg/L)	99.6	175.3	200	600
Calcium(mg/L)	28.75	35.13	75	200
Fluoride(mg/L)	1.05	0.85	1	1.5
Total Dissolve Solid(mg/L)	224	384	500	2000
Copper(mg/L)	<0.03	<0.03	0.05	1.5
Manganese(mg/L)	<0.04	<0.04	0.1	0.3
Iron(mg/L)	<0.1	<0.1	1.0	No relaxation
Zinc(mg/L)	0.13	0.13	5	15
Lead(mg/L)	<0.005	0.007	0.01	No relaxation
Cadmium(mg/L)	<0.001	<0.001	0.003	No relaxation
Total Chromium (mg/L)	<0.01	<0.01	0.05	No relaxation
Arsenic(mg/L)	<0.005	<0.005	0.01	No relaxation
Boron(mg/L)	<0.2	<0.2	0.5	2.4

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Drinking Water Quality Data Kaniha Area

Project / OCP	Kaniha		Indian Drinking Standards (IS-10500):2012	
Monitoring Station	Telisinga Well Water	Jarda Village Well Water		
Date of Sampling	15-May- 2025	15-May- 2025	Acceptable	Permissible
Selenium(mg/L)	<0.005	<0.005	0.01	No relaxation
Sodium(mg/L)	13.00	24.38	—	—
Potassium(mg/L)	5.60	27.41	—	—
Phenolics(mg/L)	<0.001	<0.001	0.001	0.002
Residual Free Chlorine(mg/L)	<0.2	<0.2	0.2	1.0
MPN (Index/100 ml)	Not Detected	Not Detected	—	—

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**Environmental Monitoring Report
Of
Kaniha Area
For
June-2025**

Talcher Coalfield



Mahanadi Coalfields Limited



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Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)

Regional Institute-VII, Samantpuri, P.O : RRL, Bhubaneswar-751013 (Odisha)
[Assistance from Environment Division, CMPDI(HQs), Ranchi]

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Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Compliance Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
13-Jun-25	Near External OB Dump, Jamania	179	76	37	11.61	26.58	Mining Activities	About 500m
13-Jun-25	New Time Office (Near Z-Patch)	193	84	40	15.00	20.98	Mining Activities	About 500m
13-Jun-25	Near Project Office	182	75	36	13.19	25.55	Mining Activities	About 500m
21-Jun-25	Near External OB Dump, Jamania	203	87	41	14.92	28.86	Mining Activities	About 500m
21-Jun-25	New Time Office (Near Z-Patch)	215	93	42	11.84	25.32	Mining Activities	About 500m
21-Jun-25	Near Project Office	184	80	37	10.81	23.78	Mining Activities	About 500m

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MoEF Standards Notification dated 25th
September, 2008

800	300		120	120

Project :**Kaniha OCP****(conc. in $\mu\text{g}/\text{cu.m.}$)**

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
27-Jun-25	Guland, South West of Mine	116	48	23	15.20	21.10		
27-Jun-25	Kaniha (North of the Mine)	119	44	20	16.20	25.55	Mining Activities	About 500m
27-Jun-25	Kansamunda Village (West of the mine)	137	61	29	16.58	33.76		
27-Jun-25	Near Harichandapur	116	42	20	10.45	24.44		
27-Jun-25	South Of Proposed Quarry Limit of KOCP	149	53	27	13.03	23.87	Mining Activities	About 500m
28-Jun-25	South Of Proposed Quarry Limit of KOCP	137	45	25	15.07	24.17	Mining Activities	About 500m
28-Jun-25	Guland, South West of Mine	154	64	29	12.85	15.19		
28-Jun-25	Kaniha (North of the Mine)	131	51	27	12.63	13.02	Mining Activities	About 500m
28-Jun-25	Kansamunda Village (West of the mine)	106	43	21	17.45	37.58		
28-Jun-25	Near Harichandapur	142	53	24	10.81	23.12		
28-Jun-25	Gandaberna	120	50	23	14.28	39.66		

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Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Reference Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO ₂	NO _x	Dust Generating Source(DGS)	Distance from DGS
02-Jun-25	Kaniha (North of the Mine)	132	47	25	13.82	21.70	Mining Activities	About 500m
02-Jun-25	Near Harichandanpur	131	47	25	18.43	32.07		
02-Jun-25	South Of Proposed Quarry Limit of KOCP	115	44	21	13.97	23.99	Mining Activities	About 500m
02-Jun-25	Gandaberna	129	47	24	11.35	31.18		
02-Jun-25	Kansamunda Village (West of the mine)	134	53	27	13.27	28.10		
02-Jun-25	Guliland, South West of Mine	127	49	25	10.55	27.62		
03-Jun-25	Kansamunda Village (West of the mine)	115	39	21	13.68	22.03		
03-Jun-25	Near Harichandanpur	163	63	30	10.91	33.58		
03-Jun-25	South Of Proposed Quarry Limit of KOCP	139	52	27	11.19	21.27	Mining Activities	About 500m
03-Jun-25	Kaniha (North of the Mine)	157	63	30	11.85	20.98	Mining Activities	About 500m
03-Jun-25	Guliland, South West of Mine	119	44	23	15.34	20.51		
03-Jun-25	Gandaberna	133	47	25	13.97	24.78		
09-Jun-25	Kaniha (North of the Mine)	147	55	28	14.84	24.78	Mining Activities	About 500m
09-Jun-25	Kansamunda Village (West of the mine)	128	54	26	15.34	26.58		
09-Jun-25	Near Harichandanpur	135	50	26	11.35	27.98		
09-Jun-25	South Of Proposed Quarry Limit of KOCP	118	43	20	11.06	27.49	Mining Activities	About 500m
09-Jun-25	Guliland, South West of Mine	128	51	24	13.57	22.10		
09-Jun-25	Gandaberna	143	56	27	13.36	29.54		
10-Jun-25	Kansamunda Village (West of the mine)	120	43	23	16.58	23.99		
10-Jun-25	Near Harichandanpur	144	53	28	11.19	26.58		
10-Jun-25	South Of Proposed Quarry Limit of KOCP	126	44	23	10.36	22.03	Mining Activities	About 500m
10-Jun-25	Kaniha (North of the Mine)	126	52	27	15.79	28.21	Mining Activities	About 500m
10-Jun-25	Gandaberna	118	40	22	17.04	23.63		

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Project :**Kaniha OCP****(conc. in $\mu\text{g}/\text{cu.m.}$)**

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
10-Jun-25	Guland, South West of Mine	134	49	26	13.53	26.38		
16-Jun-25	South Of Proposed Quarry Limit of KOCP	143	53	26	16.12	32.07	Mining Activities	About 500m
16-Jun-25	Kansamunda Village (West of the mine)	125	44	23	16.14	19.99		
16-Jun-25	Gandaberna	140	53	27	13.35	42.20		
16-Jun-25	Guland, South West of Mine	125	52	24	17.50	22.79		
16-Jun-25	Kaniha (North of the Mine)	114	42	19	13.96	27.98	Mining Activities	About 500m
16-Jun-25	Near Harichandapur	153	53	27	11.05	33.27		
17-Jun-25	Kaniha (North of the Mine)	140	59	26	17.04	19.41	Mining Activities	About 500m
17-Jun-25	Near Harichandapur	159	67	32	12.22	36.78		
17-Jun-25	Kansamunda Village (West of the mine)	118	40	19	14.41	20.31		
17-Jun-25	Gandaberna	146	56	29	16.58	30.38		
17-Jun-25	South Of Proposed Quarry Limit of KOCP	138	46	24	18.88	28.69	Mining Activities	About 500m
17-Jun-25	Guland, South West of Mine	133	56	25	13.26	26.58		
23-Jun-25	Kaniha (North of the Mine)	151	63	28	17.50	23.63	Mining Activities	About 500m
23-Jun-25	Guland, South West of Mine	142	59	27	14.51	18.23		
23-Jun-25	Gandaberna	117	40	22	16.69	18.23		
23-Jun-25	Kansamunda Village (West of the mine)	146	55	27	16.14	27.98		
23-Jun-25	South Of Proposed Quarry Limit of KOCP	130	41	23	17.96	33.76	Mining Activities	About 500m
23-Jun-25	Near Harichandapur	151	53	26	12.43	28.10		
24-Jun-25	Guland, South West of Mine	155	63	30	13.82	29.54		
24-Jun-25	Gandaberna	110	37	18	13.82	15.19		
24-Jun-25	South Of Proposed Quarry Limit of KOCP	163	59	29	12.25	23.78	Mining Activities	About 500m
24-Jun-25	Kansamunda Village (West of the mine)	115	46	22	13.68	31.14		
24-Jun-25	Kaniha (North of the Mine)	131	55	24	16.18	29.66	Mining Activities	About 500m
24-Jun-25	Near Harichandapur	135	47	22	12.81	22.10		
27-Jun-25	Gandaberna	143	52	28	17.04	29.54		

*N/A/QS,2009

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NOISE LEVEL MONITORING DATA

AREA :

Kaniha

PROJECT :

Kaniha OCP

DATE OF SAMPLING	STATION	Noise Level Measurement in <i>Leq</i> dB(A)	
		DAY	NIGHT
11-Jun-25	Kansamunda Village (West of the Mine)	50.4	39.6
11-Jun-25	Near External OB Dump, Jamania	60.3	43.8
11-Jun-25	Near Time Office (Near Z-Patch)	69.5	58.1
11-Jun-25	Near Project Office	67.3	56.9
25-Jun-25	Kansamunda Village (West of the Mine)	50.4	39.8
25-Jun-25	Near External OB Dump, Jamania	62.8	45.6
25-Jun-25	Near Time Office (Near Z-Patch)	72.4	60.5
25-Jun-25	Near Project Office	70.1	59.3

MoEF Standard Notification dated 23rd September, 2000	6.00 AM - 10.00 PM <i>Leq</i> 75dB(A) (Industrial)	10.00 PM - 6.00 AM <i>Leq</i> 70dB(A) (Industrial)
MoEF Standard Notification dated 23rd September, 2000	6.00 AM - 10.00 PM <i>Leq</i> 55dB(A) (Residential)	10.00 PM - 6.00 AM <i>Leq</i> 45dB(A) (Residential)
MoEF Standard Notification dated 23rd September, 2000	6.00 AM - 10.00 PM <i>Leq</i> 45dB(A) (Commercial)	10.00 PM - 6.00 AM <i>Leq</i> 35dB(A) (Commercial)
MoEF Standard Notification dated 23rd September, 2000	6.00 AM - 10.00 PM <i>Leq</i> 30dB(A) (Silence Zone)	10.00 PM - 6.00 AM <i>Leq</i> 20dB(A) (Silence Zone)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kansamunda Village (West of the mine)							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
02-Jun-2025	<20.0	20.08	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
03-Jun-2025	<20.0	19.83	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
09-Jun-2025	<20.0	16.87	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
10-Jun-2025	<20.0	21.57	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
16-Jun-2025	<20.0	14.88	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
17-Jun-2025	<20.0	20.58	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
23-Jun-2025	<20.0	16.37	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
24-Jun-2025	<20.0	19.83	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
27-Jun-2025	<20.0	25.28	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
28-Jun-2025	<20.0	17.10	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	South of Proposed Quarry Limit of KOCP							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
02-Jun-2025	<20.0	25.78	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
03-Jun-2025	<20.0	17.35	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
09-Jun-2025	<20.0	24.55	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
10-Jun-2025	<20.0	21.57	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
16-Jun-2025	<20.0	22.57	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
17-Jun-2025	<20.0	17.10	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
23-Jun-2025	<20.0	23.30	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
24-Jun-2025	<20.0	16.62	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
27-Jun-2025	<20.0	15.87	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
28-Jun-2025	<20.0	26.28	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Guiland, South West of the Mine							
Date of sampling	Ammonia (NH₃)	Ozone (O₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (α) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
02-Jun-2025	<20.0	19.33	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
03-Jun-2025	<20.0	24.80	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
09-Jun-2025	<20.0	21.32	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
10-Jun-2025	<20.0	22.57	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
16-Jun-2025	<20.0	25.28	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
17-Jun-2025	<20.0	15.87	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
23-Jun-2025	<20.0	18.10	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
24-Jun-2025	<20.0	20.58	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
27-Jun-2025	<20.0	20.33	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
28-Jun-2025	<20.0	26.28	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Near Harichandanpur							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzene (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
02-Jun-2025	<20.0	15.37	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
03-Jun-2025	<20.0	18.35	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
09-Jun-2025	<20.0	19.08	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
10-Jun-2025	<20.0	27.27	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
16-Jun-2025	<20.0	20.58	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
17-Jun-2025	<20.0	14.13	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
23-Jun-2025	<20.0	27.27	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
24-Jun-2025	<20.0	13.38	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
27-Jun-2025	<20.0	21.82	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
28-Jun-2025	<20.0	15.37	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0 (Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kaniha North of the Mine							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
02-Jun-2025	<20.0	14.38	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
03-Jun-2025	<20.0	14.38	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
09-Jun-2025	<20.0	21.82	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
10-Jun-2025	<20.0	15.12	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
16-Jun-2025	<20.0	24.30	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
17-Jun-2025	<20.0	19.08	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
23-Jun-2025	<20.0	19.33	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
24-Jun-2025	<20.0	16.12	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
27-Jun-2025	<20.0	21.57	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
28-Jun-2025	<20.0	26.78	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Gandaberana							
Date of sampling	Ammonia (NH ₃) (µg/m ³)	Ozone (O ₃) (µg/m ³)	Lead (Pb) (µg/m ³)	Arsenic (As) (ng/m ³)	Nickel (Ni) (ng/m ³)	CO (mg/m ³)	Benzo (α) Pyrene (ng/m ³)	Benzene (µg/m ³)
02-Jun-2025	<20.0	18.35	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
03-Jun-2025	<20.0	13.38	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
09-Jun-2025	<20.0	14.13	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
10-Jun-2025	<20.0	12.90	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
16-Jun-2025	<20.0	26.28	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
17-Jun-2025	<20.0	21.82	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
23-Jun-2025	<20.0	19.83	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
24-Jun-2025	<20.0	14.38	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
27-Jun-2025	<20.0	17.35	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
28-Jun-2025	<20.0	22.57	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA

Area: Kaniha

Project	KanihaOCP
Monitoring Station	Near Project Office
Date of sampling	Carbon Monoxide (CO)
	mg/m³
13-Jun-2025	1.2
21-Jun-2025	1.1
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	New Time Office (Near Z-Patch)
Date of sampling	Carbon Monoxide (CO)
	mg/m³
13-Jun-2025	1.2
21-Jun-2025	1.3
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	Near External OB Dump, Jamania
Date of sampling	Carbon Monoxide (CO)
	mg/m³
13-Jun-2025	1.2
21-Jun-2025	1.3
Standard	02(8 Hours)

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EFFLUENT QUALITY DATA

Area :

Kaniha

(All dimensions are in mg/l unless otherwise stated except pH)

Project :

Kaniha OCP

Date of Sampling	Sampling Station	pH	Oil & Grease	TSS	COD	BOD	Remarks
14-Jun-25	Clear Water Pond	7.84	<4.0	54	48	-	
14-Jun-25	Kansamunda Sump	7.86	<4.0	38	28	-	
14-Jun-25	Pre Sedimentation Pond	7.86	<4.0	42	36	-	
14-Jun-25	Z-Patch Sump	7.85	<4.0	29	40	-	
28-Jun-25	Clear Water Pond	6.98	<4.0	49	36	-	
28-Jun-25	Pre Sedimentation Pond	6.99	<4.0	33	24	-	

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SHUBHAKSHWAR

MoEF Standard Notification dated 25th September, 2000
and MoEF Schedule VI, General standard for discharge
of Environmental Pollutants Part A: Effluents

5.5-9.0 10 100 250 30

**Environmental Monitoring Report
Of
Kaniha Area
For
July-2025**

Talcher Coalfield



MCL

Mahanadi Coalfields Limited



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Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)

Regional Institute-VII, Samantpuri, P.O : RRL, Bhubaneswar-751013 (Odisha)
[Assistance from Environment Division, CMPDI(HQs), Ranchi]
The test report shall not be reproduced in part or full without written approval of the competent authority



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Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Compliance Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
09-Jul-25	Near External OB Dump, Jamania	204	93	46	14.51	33.58	Mining Activities	About 500m
09-Jul-25	New Time Office (Near Z-Patch)	215	110	48	11.70	22.79	Mining Activities	About 500m
09-Jul-25	Near Project Office	187	80	42	15.83	31.18	Mining Activities	About 500m
24-Jul-25	Near External OB Dump, Jamania	184	85	37	11.87	21.59	Mining Activities	About 500m
24-Jul-25	New Time Office (Near Z-Patch)	214	86	42	9.67	23.19	Mining Activities	About 500m
24-Jul-25	Near Project Office	196	84	41	10.67	32.91	Mining Activities	About 500m

MoEF Standards Notification dated 25th September, 2000

600	300		120	120

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Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Reference Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
01-Jul-25	Kaniha (North of the Mine)	116	33	17	11.87	20.79	Mining Activities	About 500m
01-Jul-25	South Of Proposed Quarry Limit of KOCP	165	45	26	17.13	17.47	Mining Activities	About 500m
01-Jul-25	Guiland, South West of Mine	136	52	25	12.53	19.75		
01-Jul-25	Near Harichandanpur	165	57	30	11.43	33.58		
01-Jul-25	Gandaberna	150	53	29	13.46	32.91		
01-Jul-25	Kansamunda Village (West of the mine)	116	41	20	16.71	31.23		
02-Jul-25	Near Harichandanpur	135	47	24	16.71	20.79		
02-Jul-25	Kansamunda Village (West of the mine)	109	36	17	12.75	23.99		
02-Jul-25	South Of Proposed Quarry Limit of KOCP	151	59	28	15.04	24.31	Mining Activities	About 500m
02-Jul-25	Kaniha (North of the Mine)	129	52	23	19.03	21.10	Mining Activities	About 500m
02-Jul-25	Guiland, South West of Mine	147	60	28	15.83	23.19		
02-Jul-25	Gandaberna	131	43	25	16.71	28.69		
07-Jul-25	Guiland, South West of Mine	140	54	26	17.96	24.31		
07-Jul-25	Kaniha (North of the Mine)	141	49	27	18.47	34.38	Mining Activities	About 500m
07-Jul-25	Near Harichandanpur	144	55	27	15.46	27.34		
07-Jul-25	South Of Proposed Quarry Limit of KOCP	116	43	20	19.03	34.60	Mining Activities	About 500m
07-Jul-25	Gandaberna	144	49	28	13.63	30.38		
07-Jul-25	Kansamunda Village (West of the mine)	136	45	25	12.31	33.58		
08-Jul-25	South Of Proposed Quarry Limit of KOCP	148	56	27	15.04	27.34	Mining Activities	About 500m
08-Jul-25	Near Harichandanpur	127	43	22	12.53	28.69		
08-Jul-25	Kansamunda Village (West of the mine)	153	50	28	12.31	32.78		
08-Jul-25	Kaniha (North of the Mine)	116	40	19	20.42	32.91	Mining Activities	About 500m
08-Jul-25	Guiland, South West of Mine	152	66	30	16.71	33.58		

*N/AQS,2009

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Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
08-Jul-25	Gandaberna	127	41	22	14.07	25.58		
14-Jul-25	Kansamunda Village (West of the mine)	129	40	24	13.00	34.60		
14-Jul-25	Guiland, South West of Mine	135	51	24	15.78	22.79		
14-Jul-25	Near Harichandanpur	107	37	19	18.10	34.60		
14-Jul-25	Gandaberna	111	35	17	12.07	28.69		
14-Jul-25	Kaniha (North of the Mine)	138	47	23	17.15	30.38	Mining Activities	About 500m
14-Jul-25	South Of Proposed Quarry Limit of KOCP	132	53	23	15.87	24.31	Mining Activities	About 500m
15-Jul-25	Gandaberna	117	48	23	14.07	23.19		
15-Jul-25	South Of Proposed Quarry Limit of KOCP	122	40	18	16.71	22.79	Mining Activities	About 500m
15-Jul-25	Guiland, South West of Mine	144	57	27	14.95	23.99		
15-Jul-25	Near Harichandanpur	137	53	25	17.59	28.78		
15-Jul-25	Kaniha (North of the Mine)	145	51	27	10.86	27.34	Mining Activities	About 500m
15-Jul-25	Kansamunda Village (West of the mine)	105	33	16	13.92	34.60		
21-Jul-25	Kansamunda Village (West of the mine)	143	53	22	19.03	29.54		
21-Jul-25	Kaniha (North of the Mine)	162	53	27	11.01	21.41	Mining Activities	About 500m
21-Jul-25	Near Harichandanpur	173	67	30	17.64	22.79		
21-Jul-25	South Of Proposed Quarry Limit of KOCP	138	51	25	9.61	17.47	Mining Activities	About 500m
21-Jul-25	Guiland, South West of Mine	120	37	18	12.73	24.59		
21-Jul-25	Gandaberna	148	47	25	17.64	22.79		
22-Jul-25	Kaniha (North of the Mine)	136	45	23	16.29	30.38	Mining Activities	About 500m
22-Jul-25	South Of Proposed Quarry Limit of KOCP	118	42	19	10.63	27.62	Mining Activities	About 500m
22-Jul-25	Near Harichandanpur	150	56	27	16.24	18.37		
22-Jul-25	Gandaberna	164	67	28	17.17	33.76		
22-Jul-25	Kansamunda Village (West of the mine)	149	57	26	10.67	28.69		
22-Jul-25	Guiland, South West of Mine	137	49	22	13.63	19.99		
28-Jul-25	Near Harichandanpur	128	48	25	13.46	27.85		

*N/AQS, 2009

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Project :**Kaniha OCP****(conc. in $\mu\text{g}/\text{cu.m.}$)**

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
28-Jul-25	South Of Proposed Quarry Limit of KOCP	107	36	15	13.13	25.32	Mining Activities	About 500m
28-Jul-25	Kansamunda Village (West of the mine)	133	51	20	14.39	32.07		
28-Jul-25	Kaniha (North of the Mine)	166	54	25	13.53	28.21	Mining Activities	About 500m
28-Jul-25	Guiland, South West of Mine	127	42	20	11.60	20.25		
28-Jul-25	Gandaberna	134	57	23	18.56	19.41		
29-Jul-25	Kansamunda Village (West of the mine)	166	61	28	10.11	26.38		
29-Jul-25	South Of Proposed Quarry Limit of KOCP	168	74	31	17.54	26.58	Mining Activities	About 500m
29-Jul-25	Guiland, South West of Mine	141	56	25	11.60	20.25		
29-Jul-25	Near Harichandanpur	122	40	17	17.64	22.79		
29-Jul-25	Gandaberna	126	46	20	17.59	19.19		
29-Jul-25	Kaniha (North of the Mine)	182	75	30	9.67	27.18	Mining Activities	About 500m

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Sanjay



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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kansamunda Village (West of the mine)							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Jul-2025	<20.0	22.50	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
02-Jul-2025	<20.0	25.25	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
07-Jul-2025	<20.0	25.75	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
08-Jul-2025	<20.0	20.25	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
14-Jul-2025	<20.0	21.00	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
15-Jul-2025	<20.0	13.75	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
21-Jul-2025	<20.0	15.75	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
22-Jul-2025	<20.0	25.75	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
28-Jul-2025	<20.0	17.00	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
29-Jul-2025	<20.0	11.25	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	South of Proposed Quarry Limit of KOCP							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (α) Pyrene	Benzene
	(μg/m ³)	(μg/m ³)	(μg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(μg/m ³)
1-Jul-2025	<20.0	18.75	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
2-Jul-2025	<20.0	23.75	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
7-Jul-2025	<20.0	18.00	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
8-Jul-2025	<20.0	12.75	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
14-Jul-2025	<20.0	28.00	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
15-Jul-2025	<20.0	19.25	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
21-Jul-2025	<20.0	26.50	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
22-Jul-2025	<20.0	14.25	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
28-Jul-2025	<20.0	13.75	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
29-Jul-2025	<20.0	27.25	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Guiland, South West of the Mine							
Date of sampling	Ammonia (NH ₃) ($\mu\text{g}/\text{m}^3$)	Ozone (O ₃) ($\mu\text{g}/\text{m}^3$)	Lead (Pb) ($\mu\text{g}/\text{m}^3$)	Arsenic (As) (ng/m^3)	Nickel (Ni) (ng/m^3)	CO (mg/m^3)	Benzo (a) Pyrene (ng/m^3)	Benzene ($\mu\text{g}/\text{m}^3$)
01-Jul-2025	<20.0	17.00	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
02-Jul-2025	<20.0	17.75	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
07-Jul-2025	<20.0	15.00	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
08-Jul-2025	<20.0	21.00	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
14-Jul-2025	<20.0	23.75	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
15-Jul-2025	<20.0	19.00	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
21-Jul-2025	<20.0	26.50	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
22-Jul-2025	<20.0	14.25	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
28-Jul-2025	<20.0	13.75	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
29-Jul-2025	<20.0	27.25	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Near Harichandanpur							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
01-Jul-2025	<20.0	17.50	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
02-Jul-2025	<20.0	17.25	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
07-Jul-2025	<20.0	22.75	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
08-Jul-2025	<20.0	22.75	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
14-Jul-2025	<20.0	24.75	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
15-Jul-2025	<20.0	17.50	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
21-Jul-2025	<20.0	19.50	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
22-Jul-2025	<20.0	28.75	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
28-Jul-2025	<20.0	17.00	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
29-Jul-2025	<20.0	14.75	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(hour)	1.0(24h ours)	6.0 (Annual)	20(Annual)	02(8hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kaniha North of the Mine							
Date of sampling	Ammonia (NH ₃) (µg/m ³)	Ozone (O ₃) (µg/m ³)	Lead (Pb) (µg/m ³)	Arsenic (As) (ng/m ³)	Nickel (Ni) (ng/m ³)	CO (mg/m ³)	Benzo (a) Pyrene (ng/m ³)	Benzene (µg/m ³)
01-Jul-2025	<20.0	11.50	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
02-Jul-2025	<20.0	27.50	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
07-Jul-2025	<20.0	19.00	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
08-Jul-2025	<20.0	13.75	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
14-Jul-2025	<20.0	22.50	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
15-Jul-2025	<20.0	13.50	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
21-Jul-2025	<20.0	20.00	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
22-Jul-2025	<20.0	23.00	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
28-Jul-2025	<20.0	24.75	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
29-Jul-2025	<20.0	18.00	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Gandaberana							
Date of sampling	Ammonia (NH ₃) (µg/m ³)	Ozone (O ₃) (µg/m ³)	Lead (Pb) (µg/m ³)	Arsenic (As) (ng/m ³)	Nickel (Ni) (ng/m ³)	CO (mg/m ³)	Benzo (α) Pyrene (ng/m ³)	Benzene (µg/m ³)
01-Jul-2025	<20.0	14.00	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
02-Jul-2025	<20.0	15.25	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
07-Jul-2025	<20.0	24.00	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
08-Jul-2025	<20.0	25.00	<0.1	<1.0	<1.0	1.1	BQL(QL=0.7)	BQL
14-Jul-2025	<20.0	28.75	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
15-Jul-2025	<20.0	14.50	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
21-Jul-2025	<20.0	27.75	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
22-Jul-2025	<20.0	25.75	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
28-Jul-2025	<20.0	24.00	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
29-Jul-2025	<20.0	12.50	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA

Area: Kaniha

Project	KanihaOCP
Monitoring Station	Near Project Office
Date of sampling	Carbon Monoxide (CO)
	mg/m ³
09-Jul-2025	0.7
24-Jul-2025	0.8
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	New Time Office (Near Z-Patch)
Date of sampling	Carbon Monoxide (CO)
	mg/m ³
09-Jul-2025	0.8
24-Jul-2025	0.6
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	Near External OB Dump, Jamania
Date of sampling	Carbon Monoxide (CO)
	mg/m ³
09-Jul-2025	0.7
24-Jul-2025	0.9
Standard	02(8 Hours)

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Jaiswal



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Ministry of Environment
Government of India

AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP				
Monitoring Station	Project Office				
Date of sampling	Arsenic (As)	Nickel (Ni)	Mercury (Hg)	Chromium (Cr)	Cadmium (Cd)
	(ng/m ³)	(ng/m ³)	(ng/m ³)	(μg/m ³)	(μg/m ³)
22-May-2025	<1.0	<1.0	<1.0	<0.1	<0.1
Standard	6.0(Annual)	20(Annual)	-	-	-

Project	Kaniha OCP				
Monitoring Station	New Time Office (Near Z-Patch)				
Date of sampling	Arsenic (As)	Nickel (Ni)	Mercury (Hg)	Chromium (Cr)	Cadmium (Cd)
	(ng/m ³)	(ng/m ³)	(ng/m ³)	(μg/m ³)	(μg/m ³)
22-May-2025	<1.0	<1.0	<1.0	<0.1	<0.1
Standard	6.0(Annual)	20(Annual)	-	-	-

Project	Kaniha OCP				
Monitoring Station	Near External OB Dump, Jamania				
Date of sampling	Arsenic (As)	Nickel (Ni)	Mercury (Hg)	Chromium (Cr)	Cadmium (Cd)
	(ng/m ³)	(ng/m ³)	(ng/m ³)	(μg/m ³)	(μg/m ³)
22-May-2025	<1.0	<1.0	<1.0	<0.1	<0.1
Standard	6.0(Annual)	20(Annual)	-	-	-

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TABLE--

NOISE LEVEL MONITORING DATA

AREA :

Kaniha

PROJECT :

Kaniha OCP

DATE OF SAMPLING	STATION	Noise Level Measurement in Leq dB(A)	
		DAY	NIGHT
11-Jul-25	Kansamunda Village (West of the Mine)	50.2	40.5
11-Jul-25	Near External OB Dump, Jamania	62.8	54.6
11-Jul-25	Near Time Office (Near Z-Patch)	65.4	52.5
11-Jul-25	Near Project Office	63.1	55.3
26-Jul-25	Kansamunda Village (West of the Mine)	51.7	40.9
26-Jul-25	Near External OB Dump, Jamania	64.7	55.1
26-Jul-25	Near Time Office (Near Z-Patch)	67.4	53.0
26-Jul-25	Near Project Office	65.0	55.9

MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 75dB(A) (Industrial)	10.00 PM - 6.00 AM Leq 70dB(A) (Industrial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 55dB(A) (Residential)	10.00 PM - 6.00 AM Leq 45dB(A) (Residential)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 65dB(A) (Commercial)	10.00 PM - 6.00 AM Leq 55dB(A) (Commercial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 50dB(A) (Silence Zone)	10.00 PM - 6.00 AM Leq 40dB(A) (Silence Zone)

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EFFLUENT QUALITY DATA

Area :

Kaniha

(All dimensions are in mg/l unless otherwise stated except pH)

Project :

Kaniha OCP

Date of Sampling	Sampling Station	pH	Oil & Grease	TSS	COD	BOD	Remarks
16-Jul-25	Clear Water Pond	6.96	<4.0	37	28	-	
16-Jul-25	Kansamunda Sump	6.95	<4.0	44	32	-	
16-Jul-25	Pre Sedimentation Pond	6.79	<4.0	42	32	-	
16-Jul-25	Z-Patch Sump	6.94	<4.0	35	48	-	
31-Jul-25	Clear Water Pond	8.74	<4.0	48	40	-	
31-Jul-25	Pre Sedimentation Pond	8.53	<4.0	54	44	-	

MoEF Standard Notification dated 23rd September, 2000
and MoEF Schedule VI, General standard for discharge
of Environmental Pollutants Part A: Effluents

5.5-9.0	10	100	250	30

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Kaniha OCP

Kaniha (North of the mine)

New Time Office (Near Z. Patch)

Kansamunda (West of the mine)

Near Project Office

Guiland

Near External OB dump

South of Proposed Quarry Limit of KOC

Near Harichandapur

Gandaberna

Legend
Monitoring Station

Google Earth

**Environmental Monitoring Report
Of
Kaniha Area
For
August-2025**

Talcher Coalfield



Mahanadi Coalfields Limited



cmpdi

A Mini Ratna Company

Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)

Regional Institute-VII, Samantpuri, P.O : RRL, Bhubaneswar-751013 (Odisha)
[Assistance from Environment Division, CMPDI(HQs), Ranchi]

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AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Compliance Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
13-Aug-25	Near External OB Dump, Jamarua	181	85	35	15.66	33.63	Mining Activities	About 500m
13-Aug-25	New Time Office (Near Z-Patch)	185	84	38	12.50	18.40	Mining Activities	About 500m
13-Aug-25	Near Project Office	169	81	37	15.66	31.28	Mining Activities	About 500m
23-Aug-25	Near Project Office	176	81	37	10.83	16.27	Mining Activities	About 500m
30-Aug-25	Near External OB Dump, Jamarua	195	88	40	14.00	23.03	Mining Activities	About 500m
30-Aug-25	New Time Office (Near Z-Patch)	178	87	40	18.37	20.80	Mining Activities	About 500m

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Jaiswal

MoEF Standards Notification dated 25th
September, 2009

600	300		120	120



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Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Reference Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO ₂	NO _x	Dust Generating Source(DGS)	Distance from DGS
01-Aug-25	Kansamunda Village (West of the mine)	155	62	29	18.96	20.64		
01-Aug-25	Gandaberna	136	46	25	13.12	37.97		
01-Aug-25	South Of Proposed Quarry Limit of KOCP	140	55	26	9.58	25.47	Mining Activities	About 500m
01-Aug-25	Guiland, South West of Mine	140	56	26	19.34	32.06		
01-Aug-25	Near Harichandanpur	110	39	18	11.97	30.50		
01-Aug-25	Kaniha (North of the Mine)	110	37	18	14.16	26.89	Mining Activities	About 500m
02-Aug-25	South Of Proposed Quarry Limit of KOCP	126	44	20	17.08	29.72	Mining Activities	About 500m
02-Aug-25	Near Harichandanpur	128	47	20	16.04	36.32		
02-Aug-25	Kansamunda Village (West of the mine)	126	46	23	18.81	23.77		
02-Aug-25	Kaniha (North of the Mine)	144	63	26	13.52	19.59	Mining Activities	About 500m
02-Aug-25	Guiland, South West of Mine	120	38	18	19.34	27.37		
02-Aug-25	Gandaberna	162	63	29	19.44	38.79		
08-Aug-25	Kaniha (North of the Mine)	168	74	30	14.87	31.20	Mining Activities	About 500m
08-Aug-25	South Of Proposed Quarry Limit of KOCP	135	47	22	10.42	16.27	Mining Activities	About 500m
08-Aug-25	Kansamunda Village (West of the mine)	149	49	25	18.42	23.46		
08-Aug-25	Guiland, South West of Mine	141	47	24	12.15	31.37		
08-Aug-25	Near Harichandanpur	141	52	23	18.33	18.40		
08-Aug-25	Gandaberna	155	60	28	19.80	31.28		
09-Aug-25	Guiland, South West of Mine	130	44	21	15.55	28.89		
09-Aug-25	South Of Proposed Quarry Limit of KOCP	110	33	16	17.50	23.77	Mining Activities	About 500m
09-Aug-25	Kansamunda Village (West of the mine)	146	54	28	16.58	33.63		
09-Aug-25	Near Harichandanpur	116	36	17	11.37	28.23		
09-Aug-25	Gandaberna	145	56	26	13.12	21.46		

*NAQS, 2009

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Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
09-Aug-25	Kaniha (North of the Mine)	149	50	23	13.12	23.77	Mining Activities	About 500m
18-Aug-25	Kansamunda Village (West of the mine)	138	63	25	15.75	28.23		
18-Aug-25	South Of Proposed Quarry Limit of KOCP	115	39	20	15.91	24.31	Mining Activities	About 500m
18-Aug-25	Guiland, South West of Mine	133	49	27	18.96	33.84		
18-Aug-25	Near Harichandampur	165	53	28	17.50	32.84		
18-Aug-25	Gandaberna	167	72	31	11.97	28.93		
18-Aug-25	Kaniha (North of the Mine)	133	59	22	12.50	26.18	Mining Activities	About 500m
19-Aug-25	South Of Proposed Quarry Limit of KOCP	108	34	18	14.87	31.20	Mining Activities	About 500m
19-Aug-25	Near Harichandampur	132	45	20	14.10	22.29		
19-Aug-25	Kansamunda Village (West of the mine)	122	51	18	14.74	26.59		
19-Aug-25	Kaniha (North of the Mine)	124	47	19	18.47	35.49	Mining Activities	About 500m
19-Aug-25	Guiland, South West of Mine	112	43	16	19.44	18.98		
19-Aug-25	Gandaberna	128	41	23	18.47	28.89		
25-Aug-25	Kaniha (North of the Mine)	160	75	27	14.58	20.52	Mining Activities	About 500m
25-Aug-25	Guiland, South West of Mine	153	74	30	19.93	22.29		
25-Aug-25	Kansamunda Village (West of the mine)	129	47	23	12.89	30.50		
25-Aug-25	Near Harichandampur	144	48	23	10.59	32.06		
25-Aug-25	Gandaberna	136	53	25	10.13	17.99		
25-Aug-25	South Of Proposed Quarry Limit of KOCP	116	41	24	13.56	22.29	Mining Activities	About 500m
26-Aug-25	South Of Proposed Quarry Limit of KOCP	138	49	27	10.06	17.83	Mining Activities	About 500m
26-Aug-25	Guiland, South West of Mine	116	45	20	19.80	34.41		
26-Aug-25	Kansamunda Village (West of the mine)	157	73	29	16.58	31.11		
26-Aug-25	Gandaberna	122	49	17	12.43	27.37		
26-Aug-25	Near Harichandampur	164	70	31	10.50	23.03		
26-Aug-25	Kaniha (North of the Mine)	143	49	23	13.12	28.23	Mining Activities	About 500m

*N/AQS, 2009

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kansamunda Village (West of the mine)							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Aug-2025	<20.0	23.75	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
02-Aug-2025	<20.0	14.13	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
08-Aug-2025	<20.0	21.48	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
09-Aug-2025	<20.0	13.85	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
18-Aug-2025	<20.0	22.33	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
19-Aug-2025	<20.0	12.72	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
25-Aug-2025	<20.0	20.63	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
26-Aug-2025	<20.0	13.57	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Kaniha OCP								
Project	South of Proposed Quarry Limit of KOCP							
Monitoring Station								
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Aug-2025	<20.0	23.18	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
02-Aug-2025	<20.0	12.15	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
08-Aug-2025	<20.0	17.53	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
09-Aug-2025	<20.0	12.15	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
18-Aug-2025	<20.0	12.43	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
19-Aug-2025	<20.0	11.58	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
25-Aug-2025	<20.0	13.85	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
26-Aug-2025	<20.0	24.32	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Kaniha OCP								
Project	Guiland, South West of the Mine							
Monitoring Station								
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
01-Aug-2025	<20.0	22.33	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
02-Aug-2025	<20.0	13.57	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
08-Aug-2025	<20.0	21.48	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
09-Aug-2025	<20.0	20.92	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
18-Aug-2025	<20.0	18.93	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
19-Aug-2025	<20.0	11.30	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
25-Aug-2025	<20.0	21.48	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
26-Aug-2025	<20.0	23.18	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Kaniha OCP

Near Harichandanpur

Project	Kaniha OCP							
Monitoring Station	Near Harichandanpur							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Be nzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Aug-2025	<20.0	20.63	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
02-Aug-2025	<20.0	20.07	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
08-Aug-2025	<20.0	18.37	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
09-Aug-2025	<20.0	18.37	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
18-Aug-2025	<20.0	24.32	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
19-Aug-2025	<20.0	12.72	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
25-Aug-2025	<20.0	24.32	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
26-Aug-2025	<20.0	18.93	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0 (Annua l)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kaniha North of the Mine							
Date of sampling	Ammonia (NH ₃) (µg/m ³)	Ozone (O ₃) (µg/m ³)	Lead (Pb) (µg/m ³)	Arsenic (As) (ng/m ³)	Nickel (Ni) (ng/m ³)	CO (mg/m ³)	Benzo (α) Pyrene (ng/m ³)	Benzene (µg/m ³)
01-Aug-2025	<20.0	11.58	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
02-Aug-2025	<20.0	15.55	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
08-Aug-2025	<20.0	22.90	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
09-Aug-2025	<20.0	23.18	<0.1	<1.0	<1.0	1.0	BQL(QL=0.7)	BQL
18-Aug-2025	<20.0	14.42	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
19-Aug-2025	<20.0	20.63	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
25-Aug-2025	<20.0	22.33	<0.1	<1.0	<1.0	0.6	BQL(QL=0.7)	BQL
26-Aug-2025	<20.0	22.33	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annual)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Gandaberana							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
01-Aug-2025	<20.0	22.90	<0.1	<1.0	<1.0	0.9	BQL(QL=0.7)	BQL
02-Aug-2025	<20.0	13.57	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
08-Aug-2025	<20.0	18.93	<0.1	<1.0	<1.0	0.5	BQL(QL=0.7)	BQL
09-Aug-2025	<20.0	13.57	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
18-Aug-2025	<20.0	19.78	<0.1	<1.0	<1.0	0.7	BQL(QL=0.7)	BQL
19-Aug-2025	<20.0	18.37	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
25-Aug-2025	<20.0	22.05	<0.1	<1.0	<1.0	0.4	BQL(QL=0.7)	BQL
26-Aug-2025	<20.0	18.65	<0.1	<1.0	<1.0	0.8	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(Annual)	20(Annual)	02(8hours)	01(annual)	05(annual)

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 सीएमपीडीआई मिनी सत्रा cmpdi Mini Sotna	AMBIENT AIR QUALITY DATA Area: Kaniha

Project	KanihaOCP
Monitoring Station	Near Project Office
Date of sampling	Carbon Monoxide (CO)
	mg/m³
13-Aug-2025	0.6
30-Aug-2025	0.8
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	New Time Office (Near Z-Patch)
Date of sampling	Carbon Monoxide (CO)
	mg/m³
13-Aug-2025	0.7
30-Aug-2025	0.9
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	Near External OB Dump, Jamania
Date of sampling	Carbon Monoxide (CO)
	mg/m³
13-Aug-2025	0.6
30-Aug-2025	0.8
Standard	02(8 Hours)


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NOISE LEVEL MONITORING DATA

AREA :

Kaniha

PROJECT :

Kaniha OCP

DATE OF SAMPLING	STATION	Noise Level Measurement in Leq dB(A)	
		DAY	NIGHT
07-Aug-25	Kansamunda Village (West of the Mine)	49.9	42.1
07-Aug-25	Near External OB Dump, Jamania	64.3	50.9
07-Aug-25	Near Time Office (Near Z-Patch)	60.4	54.3
07-Aug-25	Near Project Office	60.3	32.7
23-Aug-25	Kansamunda Village (West of the Mine)	49.1	40.3
23-Aug-25	Near External OB Dump, Jamania	66.3	55.1
23-Aug-25	Near Time Office (Near Z-Patch)	64.9	54.3
23-Aug-25	Near Project Office	65.7	52.7

MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 75dB(A) (Industrial)	10.00 PM - 6.00 AM Leq 70dB(A) (Industrial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 55dB(A) (Residential)	10.00 PM - 6.00 AM Leq 45dB(A) (Residential)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 65dB(A) (Commercial)	10.00 PM - 6.00 AM Leq 55dB(A) (Commercial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 50dB(A) (Silence Zone)	10.00 PM - 6.00 AM Leq 40dB(A) (Silence Zone)

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EFFLUENT QUALITY DATA

Area :

Kaniha

(All dimensions are in mg/l unless otherwise stated except pH)

Project :

Kaniha OCP

Date of Sampling	Sampling Station	pH	Oil & Grease	TSS	COD	BOD	Remarks
14-Aug-25	Clear Water Pond	7.35	<4.0	31	28	-	
14-Aug-25	Kansamunda Sump	7.31	<4.0	36	32	-	
14-Aug-25	Pre Sedimentation Pond	7.21	<4.0	29	24	-	
14-Aug-25	Z-Patch Sump	7.19	<4.0	23	32	-	
30-Aug-25	Clear Water Pond	7.55	<4.0	36	28	-	
30-Aug-25	Pre Sedimentation Pond	7.50	<4.0	40	32	-	

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MoEF Standard Notification dated 25th September, 2000
and MoEF Schedule VI, General standard for discharge
of Environmental Pollutants Part A: Effluents

5.5-9.0	10	100	250	30



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Drinking Water Quality Data Kaniha Area

Project / OCP	Kaniha		Indian Drinking Standards (IS-10500):2012	
	Telisinga Well Water	Jarda Village Well Water		
Monitoring Station	14-Aug-2025	14-Aug-2025	Acceptable	Permissible
Date of Sampling	14-Aug-2025	14-Aug-2025	5	15
Colour(Hazen)	1	3	5	15
Odour	Agreeable	Agreeable	Agreeable	Agreeable
Taste	Agreeable	Agreeable	Agreeable	Agreeable
Turbidity(NTU)	1	4	1	5
pH	6.89	7.07	6.5-8.5	No relaxation
Total Alkalinity(mg/L)	29.41	243.71	200	600
Chloride(mg/L)	27.20	54.40	250	1000
Sulphate(mg/L)	40.4	48.12	200	400
Nitrate(mg/L)	<0.5	<0.5	45	No relaxation
Total Hardness (Ca CO ₃)(mg/L)	66.67	239.24	200	600
Calcium(mg/L)	12.57	66.02	75	200
Fluoride(mg/L)	0.58	0.74	1	1.5
Total Dissolve Solid(mg/L)	152	404	500	2000
Copper(mg/L)	<0.03	<0.03	0.05	1.5
Manganese(mg/L)	<0.04	0.18	0.1	0.3
Iron(mg/L)	<0.1	<0.1	1.0	No relaxation
Zinc(mg/L)	0.07	0.22	5	15
Lead(mg/L)	<0.005	<0.005	0.01	No relaxation
Cadmium(mg/L)	<0.001	<0.001	0.003	No relaxation
Total Chromium (mg/L)	<0.01	<0.01	0.05	No relaxation
Arsenic(mg/L)	<0.005	<0.005	0.01	No relaxation
Boron(mg/L)	<0.2	<0.2	0.5	2.4

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Drinking Water Quality Data Kaniha Area

Project / OCP	Kaniha		Indian Drinking Standards (IS-10500):2012	
	Telisinga Well Water	Jarda Village Well Water		
Monitoring Station			Acceptable	Permissible
Date of Sampling	14-Aug-2025	14-Aug-2025		
Selenium(mg/L)	<0.005	<0.005	0.01	No relaxation
Sodium(mg/L)	21.33	22.06		
Potassium(mg/L)	1.54	5.45		
Phenolics(mg/L)	<0.001	<0.001	0.001	0.002
Residual Free Chlorine(mg/L)	<0.2	<0.2	0.2	1.0
MPN (Index/100 ml)	Not Detected	Not Detected	-	-

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Effluent Quality (all Parameter): Kaniha Area

Project (OCP / UG)	Kaniha		MoEF-Sch-VI Standards
	Clear Water Pond (Inflow)	Z-Patch Sump	
NAME OF THE STATION	15-May-25	15-May-25	
Date of Sampling	15-May-25	15-May-25	
Odour	Unobjectionable	Unobjectionable	-
Colour(Hazen)	7	8	-
Temperature(°C)	25.5	25.8	Shall not exceed 5 °C above the receiving temperature
pH	7.93	7.44	5.5-9.0
Total Hardness (asCaCO ₃),mg/L	270.91	386.45	-
Total Dissolved Solids, mg/L	420	566	-
Nitrate Nitrogen(mg/L)(As N)	<0.5	3.08	10
Ammonical Nitrogen , mg/l (As N)	0.52	0.44	50
Total Kjeldhal Nitrogen, mg/l (As N)	4.43	4.43	100
Sulphide (mg/L)	<0.1	<0.1	2
BOD [3 days at 27°C] (mg/L)	<2.0	<2.0	30
Fluoride(mg/L)	1.56	1.05	2
Copper(mg/L)	<0.03	<0.03	3
Manganese(mg/L)	<0.04	0.19	2
Iron(mg/L)	<0.1	<0.1	3
Zinc(mg/L)	0.04	<0.04	5
Lead, mg/l	<0.005	<0.005	0.1
Cadmium, mg/l	<0.001	<0.001	2
Total Chromium(mg/L)	<0.01	<0.01	2
Hexavalent Chromium(mg/L)	<0.05	<0.05	0.1
Nickel(mg/L)	<0.02	<0.02	3
Arsenic, mg/l	<0.005	<0.005	0.2
Selenium (mg/L)	<0.0005	<0.005	0.05
Dissolved Phosphate(mg/L)	<4.0	<4.0	5
Phenolics (mg/L)	<0.001	<0.001	1

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Kanlha OCP

Legend

Monitoring Station

Kanlha (North of the mine)

New Time Office (Near Z-Patch)

Kansamunda (West of the mine)

Near Project Office

Guliland

Near External OB dump

Gandaberna

South of Proposed Quarry Limit of KOCPP

Near Harichandanpur

Google Earth

North Arrow

**Environmental Monitoring Report
Of
Kaniha Area
For
September-2025**

Talcher Coalfield



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Mahanadi Coalfields Limited



cmpdi

A Mini Ratna Company

Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)

Regional Institute-VII, Samantpuri, P.O : RRL, Bhubaneswar-751013 (Odisha)

[Assistance from Environment Division, CMPDI(HQs), Ranchi]

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सीएमपीडीआई
CMPDI
AIR QUALITY

Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Compliance Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
12-Sep-25	Near External OB Dump, Jamania	205	96	41	17.64	28.30	Mining Activities	About 500m
12-Sep-25	New Time Office (Near Z-Patch)	203	90	39	14.16	31.07	Mining Activities	About 500m
12-Sep-25	Near Project Office	226	108	44	11.78	20.80	Mining Activities	About 500m
26-Sep-25	Near External OB Dump, Jamania	194	92	40	21.04	32.19	Mining Activities	About 500m
26-Sep-25	New Time Office (Near Z-Patch)	188	88	37	15.23	34.67	Mining Activities	About 500m
26-Sep-25	Near Project Office	205	104	44	9.57	20.94	Mining Activities	About 500m

Authorised Signatory
CMPDI, RI-VII, LAB
BHUBANESWAR

MoEF Standards Notification dated 23rd
September, 2009

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CMPDI
भुवनेश्वर

Test Report

AMBIENT AIR QUALITY DATA

Area :

Kaniha

(Reference Station)

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO ₂	NO _x	Dust Generating Source(DGS)	Distance from DGS
01-Sep-25	Kansamunda Village (West of the mine)	129	49	21	13.56	33.84		
01-Sep-25	Gandaberna	188	74	35	16.84	21.90		
01-Sep-25	South Of Proposed Quarry Limit of KOCP	112	37	17	13.05	32.69	Mining Activities	About 500m
01-Sep-25	Guiland, South West of Mine	146	61	28	13.05	11.14		
01-Sep-25	Near Harichandanpur	113	35	16	13.56	18.16		
01-Sep-25	Kaniha (North of the Mine)	112	43	19	11.52	21.11	Mining Activities	About 500m
02-Sep-25	South Of Proposed Quarry Limit of KOCP	132	47	24	13.77	29.72	Mining Activities	About 500m
02-Sep-25	Near Harichandanpur	137	53	24	18.71	16.51		
02-Sep-25	Kansamunda Village (West of the mine)	174	69	32	11.22	23.11		
02-Sep-25	Kaniha (North of the Mine)	135	55	24	15.51	27.37	Mining Activities	About 500m
02-Sep-25	Guiland, South West of Mine	133	48	25	11.78	20.80		
02-Sep-25	Gandaberna	158	67	30	17.26	35.66		
08-Sep-25	Kaniha (North of the Mine)	138	61	27	9.22	22.64	Mining Activities	About 500m
08-Sep-25	South Of Proposed Quarry Limit of KOCP	123	42	19	10.33	29.72	Mining Activities	About 500m
08-Sep-25	Kansamunda Village (West of the mine)	150	64	29	13.39	11.48		
08-Sep-25	Guiland, South West of Mine	154	65	29	10.82	33.25		
08-Sep-25	Near Harichandanpur	117	43	19	9.62	30.42		
08-Sep-25	Gandaberna	109	34	16	13.05	15.60		
09-Sep-25	Guiland, South West of Mine	120	36	17	16.07	33.77		
09-Sep-25	South Of Proposed Quarry Limit of KOCP	148	43	22	9.15	28.42	Mining Activities	About 500m
09-Sep-25	Kansamunda Village (West of the mine)	142	60	25	15.23	24.76		
09-Sep-25	Near Harichandanpur	153	60	25	14.16	20.94		
09-Sep-25	Gandaberna	137	58	25	17.64	24.76		
09-Sep-25	Kaniha (North of the Mine)	126	51	22	15.99	34.92	Mining Activities	About 500m
15-Sep-25	Kansamunda Village (West of the mine)	132	51	22	14.43	19.10		

*NAAQIS, 2009

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BHUBANESWAR

Project :

Kaniha OCP

(conc. in $\mu\text{g}/\text{cu.m.}$)

Date of Sampling	Monitoring Station	SPM	PM10	PM2.5	SO2	NOx	Dust Generating Source(DGS)	Distance from DGS
15-Sep-25	South Of Proposed Quarry Limit of KOCP	146	53	27	16.84	28.30	Mining Activities	About 500m
15-Sep-25	Near Harichandanpur	125	40	19	14.92	27.69		
15-Sep-25	Gandaberna	142	60	26	22.28	33.21		
15-Sep-25	Near Harichandanpur	153	62	27	16.84	21.11		
15-Sep-25	Guiland, South West of Mine	138	57	24	12.44	28.42		
15-Sep-25	Kaniha (North of the Mine)	146	64	27	16.43	23.35	Mining Activities	About 500m
16-Sep-25	South Of Proposed Quarry Limit of KOCP	152	69	29	11.62	19.10	Mining Activities	About 500m
16-Sep-25	Kansamunda Village (West of the mine)	137	58	24	11.08	28.93		
16-Sep-25	Kaniha (North of the Mine)	158	68	30	16.45	30.39	Mining Activities	About 500m
16-Sep-25	Gandaberna	131	50	23	14.43	23.35		
16-Sep-25	Guiland, South West of Mine	143	64	28	15.57	20.80		
19-Sep-25	Kaniha (North of the Mine)	121	42	18	11.08	29.72	Mining Activities	About 500m
19-Sep-25	Gandaberna	159	67	30	15.99	26.00		
19-Sep-25	Kansamunda Village (West of the mine)	122	43	18	13.47	20.06		
19-Sep-25	Near Harichandanpur	137	51	23	19.49	21.90		
19-Sep-25	Guiland, South West of Mine	135	50	22	16.03	26.89		
19-Sep-25	South Of Proposed Quarry Limit of KOCP	164	75	30	11.22	31.84	Mining Activities	About 500m
20-Sep-25	South Of Proposed Quarry Limit of KOCP	151	60	27	16.84	27.49	Mining Activities	About 500m
20-Sep-25	Gandaberna	143	61	26	15.63	21.23		
20-Sep-25	Kansamunda Village (West of the mine)	149	67	28	17.72	24.24		
20-Sep-25	Guiland, South West of Mine	110	34	16	15.06	32.84		
20-Sep-25	Near Harichandanpur	112	38	17	10.71	28.36		
20-Sep-25	Kaniha (North of the Mine)	126	46	21	13.47	35.66	Mining Activities	About 500m

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*N/AQS, 2009

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kansamunda Village (West of the mine)							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (α) Pyrene	Benzene
	(μg/m ³)	(μg/m ³)	(μg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(μg/m ³)
01-Sep-2025	<20.0	12.32	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
02-Sep-2025	<20.0	19.17	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
08-Sep-2025	<20.0	23.53	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
09-Sep-2025	<20.0	25.18	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
15-Sep-2025	<20.0	14.23	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
16-Sep-2025	<20.0	14.23	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
19-Sep-2025	<20.0	24.90	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
20-Sep-2025	<20.0	15.33	<0.1	<1.0	<1.0	1.7	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Kaniha OCP								
Project	South of Proposed Quarry Limit of KOCP							
Monitoring Station								
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Sep-2025	<20.0	26.82	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
02-Sep-2025	<20.0	20.25	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
08-Sep-2025	<20.0	14.23	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
09-Sep-2025	<20.0	15.87	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
15-Sep-2025	<20.0	17.52	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
16-Sep-2025	<20.0	19.70	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
19-Sep-2025	<20.0	12.87	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
20-Sep-2025	<20.0	25.45	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0(Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Kaniha OCP								
Project	Guiland, South West of the Mine							
Monitoring Station								
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Sep-2025	<20.0	14.50	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
02-Sep-2025	<20.0	18.88	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
08-Sep-2025	<20.0	15.05	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
09-Sep-2025	<20.0	14.50	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
15-Sep-2025	<20.0	15.87	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
16-Sep-2025	<20.0	21.62	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
19-Sep-2025	<20.0	22.72	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
20-Sep-2025	<20.0	19.70	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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Sanat



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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Near Harichandanpur							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	(ng/m^3)	(ng/m^3)	(mg/m^3)	(ng/m^3)	($\mu\text{g}/\text{m}^3$)
01-Sep-2025	<20.0	25.45	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
02-Sep-2025	<20.0	25.45	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
08-Sep-2025	<20.0	17.78	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
09-Sep-2025	<20.0	23.27	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
15-Sep-2025	<20.0	15.05	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
16-Sep-2025	<20.0	14.78	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
19-Sep-2025	<20.0	19.70	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
20-Sep-2025	<20.0	24.37	<0.1	<1.0	<1.0	1.7	BQL(QL=0.7)	BQL
Standard	400(24 hours)	180(hour)	1.0(24 hours)	6.0 (Annual)	20(Annual)	02(8 hours)	01(annual)	05(annual)

Januati

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Januati



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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Kaniha North of the Mine							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Sep-2025	<20.0	13.68	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
02-Sep-2025	<20.0	23.27	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
08-Sep-2025	<20.0	26.28	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
09-Sep-2025	<20.0	24.08	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
15-Sep-2025	<20.0	22.45	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
16-Sep-2025	<20.0	13.13	<0.1	<1.0	<1.0	1.7	BQL(QL=0.7)	BQL
19-Sep-2025	<20.0	14.78	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
20-Sep-2025	<20.0	22.98	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)


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AMBIENT AIR QUALITY DATA (NAAQS PARAMETER)

Area: Kaniha

Project	Kaniha OCP							
Monitoring Station	Gandaberana							
Date of sampling	Ammonia (NH ₃)	Ozone (O ₃)	Lead (Pb)	Arsenic (As)	Nickel (Ni)	CO	Benzo (a) Pyrene	Benzene
	(µg/m ³)	(µg/m ³)	(µg/m ³)	(ng/m ³)	(ng/m ³)	(mg/m ³)	(ng/m ³)	(µg/m ³)
01-Sep-2025	<20.0	12.58	<0.1	<1.0	<1.0	1.6	BQL(QL=0.7)	BQL
02-Sep-2025	<20.0	13.97	<0.1	<1.0	<1.0	1.3	BQL(QL=0.7)	BQL
08-Sep-2025	<20.0	15.05	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
09-Sep-2025	<20.0	19.17	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
15-Sep-2025	<20.0	21.90	<0.1	<1.0	<1.0	1.7	BQL(QL=0.7)	BQL
16-Sep-2025	<20.0	14.50	<0.1	<1.0	<1.0	1.4	BQL(QL=0.7)	BQL
19-Sep-2025	<20.0	26.28	<0.1	<1.0	<1.0	1.5	BQL(QL=0.7)	BQL
20-Sep-2025	<20.0	14.78	<0.1	<1.0	<1.0	1.2	BQL(QL=0.7)	BQL
Standard	400(24h ours)	180(ho ur)	1.0(24h ours)	6.0(An nual)	20(Ann ual)	02(8hou rs)	01(annua l)	05(annu al)

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AMBIENT AIR QUALITY DATA

Area: Kaniha

Project	KanihaOCP
Monitoring Station	Near Project Office
Date of sampling	Carbon Monoxide (CO)
	mg/m ³
12-Sep-2025	1.2
26-Sep-2025	1.3
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	New Time Office (Near Z-Patch)
Date of sampling	Carbon Monoxide (CO)
	mg/m ³
12-Sep-2025	1.1
26-Sep-2025	1.3
Standard	02(8 Hours)

Project	KanihaOCP
Monitoring Station	Near External OB Dump, Jamania
Date of sampling	Carbon Monoxide (CO)
	mg/m ³
12-Sep-2025	1.4
26-Sep-2025	1.5
Standard	02(8 Hours)

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TABLE--

NOISE LEVEL MONITORING DATA

AREA :

Kaniha

PROJECT :

Kaniha OCP

DATE OF SAMPLING	STATION	Noise Level Measurement in Leq dB(A)	
		DAY	NIGHT
06-Sep-25	Kansamunda Village (West of the Mine)	48.3	39.1
06-Sep-25	Near External OB Dump, Jamania	61.9	55.2
06-Sep-25	Near Time Office (Near Z-Patch)	67.2	54.7
06-Sep-25	Near Project Office	64.3	55.9
26-Sep-25	Kansamunda Village (West of the Mine)	46.9	39.1
26-Sep-25	Near External OB Dump, Jamania	63.1	50.2
26-Sep-25	Near Time Office (Near Z-Patch)	61.9	53.4
26-Sep-25	Near Project Office	62.4	52.3

MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 75dB(A) (Industrial)	10.00 PM - 6.00 AM Leq 70dB(A) (Industrial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 55dB(A) (Residential)	10.00 PM - 6.00 AM Leq 45dB(A) (Residential)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 65dB(A) (Commercial)	10.00 PM - 6.00 AM Leq 55dB(A) (Commercial)
MoEF Standard Notification dated 25th September, 2000	6.00 AM - 10.00 PM Leq 50dB(A) (Silence Zone)	10.00 PM - 6.00 AM Leq 40dB(A) (Silence Zone)

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2016-18
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CENTRAL POLLUTION CONTROL BOARD

EFFLUENT QUALITY DATA

Area :

Kaniha

(All dimensions are in mg/l unless otherwise stated except pH)

Project :

Kaniha OCP

Date of Sampling	Sampling Station	pH	Oil & Grease	TSS	COD	BOD	Remarks
13-Sep-25	Clear Water Pond	7.47	<4.0	37	32	-	
13-Sep-25	Kansamunda Sump	7.34	<4.0	28	24	-	
13-Sep-25	Pre Sedimentation Pond	7.36	<4.0	34	28	-	
13-Sep-25	Z-Patch Sump	7.66	<4.0	24	20	-	
27-Sep-25	Clear Water Pond	7.62	<4.0	43	32	-	
27-Sep-25	Pre Sedimentation Pond	7.49	<4.0	40	36	-	

Jasmati
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See

MoEF Standard Notification dated 25th September, 2000
and MoEF Schedule VI, General standard for discharge
of Environmental Pollutants Part A: Effluents

5.5-9.0	10	100	250	30



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Effluent Quality (all Parameter): Kaniha Area

Project (OCP / UG)	Kaniha		MoEF-Sch-VI Standards
	Clear Water Pond (Inflow)	Z-Patch Sump	
NAME OF THE STATION			
Date of Sampling	30-Aug-25	30-Aug-25	
Odour	Unobjectionable	Unobjectionable	—
Colour(Hazen)	3	3	—
Temperature(oC)	29.4	29.8	Shall not exceed 5 °C above the receiving temperature
pH	7.69	7.34	5.5-9.0
Total Hardness (asCaCO ₃),mg/L	301.98	357.61	—
Total Dissolved Solids, mg/L	474	533	—
Nitrate Nitrogen(mg/L)(As N)	0.26	0.22	10
Ammonical Nitrogen , mg/l (As N)	0.80	0.66	50
Total Kjeldhal Nitrogen, mg/l (As N)	4.52	3.01	100
Sulphide (mg/L)	<0.1	<0.1	2
BOD [3 days at 27°C] (mg/L)	3.1	3.3	30
Fluoride(mg/L)	0.64	0.23	2
Copper(mg/L)	<0.03	<0.03	3
Manganese(mg/L)	<0.04	0.13	2
Iron(mg/L)	<0.1	<0.1	3
Zinc(mg/L)	<0.04	0.05	5
Lead, mg/l	<0.005	<0.005	0.1
Cadmium, mg/l	<0.001	<0.001	2.0
Total Chromium(mg/L)	<0.01	<0.01	2.0
Hexavalent Chromium(mg/L)	<0.05	<0.05	0.1
Nickel(mg/L)	<0.02	<0.02	3
Arsenic, mg/l	<0.005	<0.005	0.2
Selenium (mg/L)	<0.0005	<0.005	0.05
Dissolved Phosphate(mg/L)	<4.0	<4.0	5
Phenolics (mg/L)	<0.001	<0.001	1

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cmpdi
मिनी रेल

Surface Water Quality Data Kaniha Area

Kaniha					IS:2296-1982 Tolerance for inland Surface water (Class C)
Project/OCP					
NAME OF STATIONS	Singada jhor stream nearer to Village Khairnali as u/s Water for Kaniha OCP	Before Junction Point of Singadajhor & Brahmani River at Balangi Village as d/s for Kaniha OCP	Tikra Nadi Near Kaniah Village as u/s Water for Kaniah OCP	Tikra Nadi Near Shagarhi Pala Village as d/s Water for Kaniah OCP	
Date of sampling	30-Aug-25	30-Aug-25	30-Aug-25	30-Aug-25	
pH	6.63	6.85	7.62	7.74	6.5-8.5
Color (Hazen unit)	2	1	1	1	300
Dissolved Oxygen(mg/L)	6.3	6.3	6.4	6.1	4
BOD (3 days 27°c(mg/L)	2.3	<2.0	<2.0	2.1	3
Chlorides(mg/L)	17.61	9.78	13.70	15.65	600
Sulphate(mg/L)	99.87	20.92	23.29	50.79	400
Nitrate(mg/L)	0.51	1.56	<0.5	0.68	50
Fluoride(mg/L)	0.66	0.60	<0.30	<0.30	1.5
Total Hardness(mg/L)	175.06	39.78	71.61	79.57	-
Total dissolved solids (mg/L)	279	69	127	164	1500
TSS(mg/L)	37	33	37	44	-
Copper(mg/L)	<0.03	<0.03	<0.03	<0.03	1.5
Iron(mg/L)	0.18	1.05	0.59	0.59	50
Zinc(mg/L)	<0.04	<0.04	<0.04	<0.04	15
Lead(mg/L)	<0.005	<0.005	<0.005	<0.005	0.1
Cadmium(mg/L)	<0.001	<0.001	<0.001	<0.001	0.01
Arsenic(mg/L)	<0.005	<0.005	<0.005	<0.005	0.2
Selenium(mg/L)	<0.005	<0.005	<0.005	<0.005	0.05
Hexavalent Chromium(as Cr ⁶⁺)(mg/L)	<0.05	<0.05	<0.05	<0.05	0.05
Phenolics(mg/L)	<0.001	<0.001	<0.001	<0.001	0.005
Oil & Grease (mg/L)	<4.0	<4.0	<4.0	<4.0	0.1
MPN (Index/100 ml)	280	350	220	210	-

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