Steel Limited

Regd. Office: JSW CentreBandra
Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925Phone :
+91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2025/233

Date: 27/05/2025

To,
Deputy Director General of Forests (C),
Ministry of Environment, Forest and Climate Change, Regional Office (Eastern Zone),
A/3, Chandersekharpur, Bhubaneswar – 751023

Sub: - Submission of Six-monthly EC compliance report in respect of **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd for the period October 2024 to March 2025**.

Ref: -1. Environment Clearance Letter No. J-11015/288/2008-IA.II(M) dated 18.06.2019 issued by MOEF&CC, GOI.

Dear Sir,

We are submitting herewith six-monthly EC compliance report of Narayanposhi Iron and Manganese Ore Mine, M/s JSW Steel Ltd. for the period October 2024 to March 2025 as per EIA notification 2006. The same is also attached in Soft copy to your good office on e-mail to roez.bsr-mef@nic.in; for your ready reference.

We trust that the measures taken towards environmental safeguards comply with the stipulated conditions. We look forward to your guidance which shall certainly help us in our endeavor for improving upon our environmental management practices.

Seeking your co-operation as always.

Thanking you, Yours

Faithfully
For JSW Steel Ltd

Vijay Kumar 27/05/25

Vijay Kumar
(Authorized Signatory)

Encl: As above

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Copy to:

1. Zonal Office Kolkata, Central Pollution Control Board, South end Conclave, Block 502, 5th and 6th Floors, 1582 Razidanga Main Road, Kolkata, West Bengal 700107.
2. The Member Secretary, State Pollution Control Board, A/118, Nilakantha Nagar, Bhubaneswar, Odisha-751012.
3. Copy to: The Regional Officer, Regional Office, Rourkela Office of the State Pollution Control Board, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha.
4. Copy to: Monitoring Cell (Environment, Forests and Wildlife Clearances) Ministry of Environment, Forest and Climate Change Government of India New Delhi.

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ENVIRONMENT CLEARANCE COMPLIANCE STATUS – NARAYANPOSHI MINE

Compliance report of Environmental Clearance for Narayanposhi Iron & Manganese Ore Mine, JSWSteel Ltd.

Reference letter from MoEF&CC, New Delhi- J-11015/288/2008-IA.II(M), Dtd. 18.06.2019.

Capacity- 6.0 MTPA Iron Ore (ROM) & 0.036 MTPA Mn Ore and 2 MTPA Beneficiation Plant.

<table>
<tr><th>Sl No</th><th>Stipulated Conditions</th><th>Self Declaration</th><th>Compliance</th></tr>
<tr><td>A.</td><td>SPECIFIC CONDITIONS</td><td></td><td></td></tr>
<tr><td>1</td><td>The enhanced production shall be on pro- rata basis for the effective period of valid environment clearance granted herein. The PP shall ensure its compliance by getting concurrence in mining plan approved by concern authority in this regard.</td><td>COMPLIED</td><td>EC accorded for 6.0MTPA(ROM) of Iron ore and 0.036 MTPA Mn ore

PRODUCTION DETAILS as per Annually submitted IBM Returns.

<table>
<tr><td>Year</td><td colspan="2">Production in Million Tonnes</td></tr>
<tr><td>Mineral</td><td>Fe</td><td>Mn</td></tr>
<tr><td>2020-21</td><td>4.48</td><td>0.0004</td></tr>
<tr><td>2021-22</td><td>5.44</td><td>0.0047</td></tr>
<tr><td>2022-23</td><td>5.3</td><td>0.0052</td></tr>
<tr><td>2023-24</td><td>5.63</td><td>0.0005</td></tr>
<tr><td>2024-25</td><td>5.84</td><td>0.00016</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>This EC for expansion proposal (Iron ore production from 3.0 MTPA to 6.0 MTPA (ROM) and existing 0.036 MTPA Manganese ore and establishment of Beneficiation Plant with capacity of 2.0 Million TPA along with crusher and screening plant within the mine lease area) shall be operational after submission of an undertaking through affidavit to MoEF & CC within 15 days of receipt of this letter, for compliance of all the conditions prescribed herein.</td><td>COMPLIED</td><td>EC capacity of 6.0 MTPA was accorded to ex-lease in the year 2019 in the name of M/s Aryan Mining & Trading Corp. Pvt. Ltd. Vesting order was given to M/s. JSW Steel Limited from Steel & Mines Department, Government of Odisha vide Order no. 4212/SM, dated 30th May 2020 as per MMDR Act, 1957 and Mineral concession Rules, 2016. Further it was vested for 50 years vide order no. 1335/ 1V (B) SM -21/2020.

Undertaking through affidavit for compliance of all the conditions given in EC is attached.
Enclosed the affidavit copy as <u>ANNEXURE-I</u></td></tr>
<tr><td>3</td><td>Project Proponent and Department of Steel &Mines, Govt. of Odisha shall ensure the implementation of recommendations of carrying capacity study report conducted by CSIR-NEERI w.r.t. mining proposal of Iron Ore and/or manganese in the State of Odisha.</td><td>COMPLIED</td><td>The recommendations of CSIR-NEERI are effectively implemented at the site. The CSIR-NEERI Compliance Status Report is submitted to the board on annual basis. The last report was submitted via letter no. JSW/S/CO/2025/227 dated 22/05/2024.

The CSIR-NEERI Compliance Status Report is hereby attached as <u>ANNEXURE II.</u></td></tr>
</table>

<table>
<tr>
<td>4</td>
<td>Department of Steel & Mines, Govt. of Odisha should prepare 5 years' regional plan for annual Iron ore requirement from the state, which in turn shall be met from different mines/zones (e.g. Joda, Koira.) in the state. Accordingly, sustainable annual production (SAP) for each zone/mine may be followed adopting necessary environmental protection measures</td>
<td>COMPLIED</td>
<td>Detail of production furnished below: -
<table>
<tr><td>Year</td><td colspan="2">Production in Million Tonnes</td></tr>
<tr><td>Mineral</td><td>Fe</td><td>Mn</td></tr>
<tr><td>2020-21</td><td>4.48</td><td>0.0004</td></tr>
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</table>
EC accorded for 6.0MTPA(ROM) of Iron ore and 0.036 MTPA Mn ore</td>
</tr>
<tr>
<td>5</td>
<td>Project Proponent shall construct the cement concrete road from mine entrance and exit to the main road with proper drainage system and green belt development along the roads and also construction of road with minimum 300 m inside the mine. This should be done within one year for existing mines and new mine should have since beginning. The Department of Steel & Mines, Govt. of Odisha should ensure the compliance and should not issue the Mining Permits, if mine lease holder has not constructed proper cement concrete road as suggested. This Environmental Clearance for the expansion project shall be operated only after the compliance of the above-mentioned specific condition.</td>
<td>COMPLIED</td>
<td>Concrete road is provided from the exit of Manganese quarry to NH. Concrete road is also available at Gate 2, the main entrance and exit gate of the mines.
Photographs of concrete roads submitted as <u>ANNEXURE III</u></td>
</tr>
<tr>
<td>6</td>
<td>The Committee observed that as per the recommendations of NEERI report the PP needs to do regular vacuum cleaning of all mineral carrying roads aiming at "zero dust re-suspension" within 3 months. This Environmental Clearance for the expansion project shall be operated only after the</td>
<td>COMPLIED</td>
<td>One Vacuum Road Sweeping Machine is deployed in the mines that operates on the mineral carrying roads every day.

Photograph of the operational Road Sweeping Machine is attached as <u>ANNEXURE IV.</u></td>
</tr>
</table>

	compliance of the above-mentioned specific condition.		
7	Project Proponent shall monitor the environmental quality parameters as per EC and CTE/CTO conditions, and implementation of suggested measures for control of road dust and air pollution. Odisha State Pollution Control Board has to ensure the compliance of CTE/CTO. Regional office of the MoEF&CC, Bhubaneswar shall monitor the compliance of the EC conditions. Regional office of the Indian Bureau of Mines (IBM) shall monitor the compliance of mining plan and progressive mine closure plan. Any violation by mine lease holder may invite actions per the provisions of applicable Acts.	COMPLIED	Environmental quality parameter such as Ambient air quality, Fugitive emission, Noise level, Surface water quality, Ground water quality etc. has been monitored through NABL Accredited Agency M/S ECOMEN MINING PVT LTD. Regional Office of MOEFCC monitors the compliance status of the stipulated Environmental clearance conditions. Six monthly average Environmental Monitoring report for the period Oct 2024 – March 2025 is attached herewith as **ANNEXURE V.**
8	Project Proponent shall ensure the compliance of Suggested Ore Transport Mode (SOTM) with association of the State Government of Odisha. All existing mines should ensure adoption of SOTM within next 5 years. New mines or mines seeking expansion should incorporate provision of SOTM in the beginning itself, and should have system in place within next 5 years	Being Complied	Ore transportation through dumper truck has been observed. 24 percent ore are being transported to railway siding (located at a distance of 10 km to 25 km approx.), 51 percent for shipping (located at a distance 300 km approx.) and to the end user (25% located at a distance of 200 km. approx) by dumper. EC was accorded in the year 2019 and period of 5 year yet to be completed. We propose to undertake construction of slurry pipeline through which the ore/concentrate will be transported from Nuagaon to Paradeep.
9	The State Govt. of Odisha shall ensure dust free roads in mining areas wherever the road transportation of mineral is involved. The road shoulders shall be paved with fence besides compliance with IRC guidelines. All the roads should have proper drainage system and apart from paving of entire carriage width the remaining right of way should have native plantation (dust capturing species). Further, regular maintenance should also be ensured by the Govt. of Odisha. Progress on development of dust free roads, implementation of		Adequate cleaning of transport roads is carried out by a dedicated Road sweeping machine (mechanical type) on regular basis. In addition to this water tankers have also been deployed for dust control measures. Avenue plantation along road side has been done by NHAI Photographs of avenue planatation along road side done is attached as **Annexure VI**

<table>
<tr><td></td><td>SOTM, increased use of existing rail network, development of additional railway network/ conveyor belt/ pipelines etc. shall be submitted periodically to regional office of the MoEF&CC.</td><td></td><td></td></tr>
<tr><td>10</td><td>Project Proponent shall develop the parking plazas for trucks with proper basic amenities/ facilities inside the mine. This should be done within one year for existing mines and new mines should have since beginning. This Environmental Clearance for the expansion project shall be operated only after the compliance of the above- mentioned specific condition.</td><td>COMPLIED</td><td>A Parking Plaza of capacity of 200 trucks has been developed at the site along with facilities such as toilet and rest area.

Photographs of the same has been attached as <u>ANNEXURE VII.</u></td></tr>
<tr><td>11</td><td>Department of Steel & Mines shall ensure the construction of NH 215 as minimum 4 lane road with proper drainage system and plantation and subsequent regular maintenance of the road as per IRC guidelines. Construction of other mineral carrying roads with proper width and drainage system along with road side plantation to be carried out. This shall be completed within 2 Years.</td><td>COMPLIED</td><td>NH 215 with proper drainage system and plantation has been constructed by State government and subsequent regular maintenance are being carried out.

Photographs are attached as ANNEXURE VIII.</td></tr>
<tr><td>12</td><td>Regular vacuum cleaning of all mineral carrying roads aiming at “Zero Dust Re- suspension” shall be adopted by PWD / NHAI/ Mine Lease Holders within a time Period of 3 months for existing roads. This Environmental Clearance for the expansion project shall be operated only after the compliance of the above-mentioned specific condition.</td><td>COMPLIED</td><td>One Vacuum Road Sweeping Machine is deployed in the mines that operates on the mineral carrying roads every day.

Photograph of the operational Road Sweeping Machine is attached as <u>ANNEXURE V.</u></td></tr>
<tr><td>13</td><td>In case the total requirement of iron ore exceeds the suggested limit for that year, permission for annual production by an individual mine may be decided depending on approved EC capacity (for total actual dispatch) and actual production rate of individual mine during last year or any other criteria set by the State Govt., i.e. Dept. of Steel & Mines. Department of Steel and Mines in consultation with Indian Bureau of Mines-RO should prepare in advance mine-wise annual production scenario so</td><td>COMPLIED</td><td>The Iron ore production for FY 2024-2025 is within the capacity of 6 MTPA mentioned in EC.

PRODUCTION DETAILS as per Annually submitted IBM Returns
<table>
<tr><td>Year</td><td colspan="2">Production in Million Tonnes</td></tr>
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</table></td></tr>
</table>

<table>
<tr>
<td></td>
<td>that demand for iron ore can be anticipated, and actual production/dispatch does not exceed the suggested annual production.</td>
<td></td>
<td>
<table>
<tr><td>2022-23</td><td>5.3</td><td>0.0052</td></tr>
<tr><td>2023-24</td><td>5.63</td><td>0.0005</td></tr>
<tr><td>2024-25</td><td>5.84</td><td>0.00016</td></tr>
</table>
</td>
</tr>
<tr>
<td>14</td>
<td>R&D studies towards utilization of low- grade iron ore should be conducted through research/academic institutes like IMMT, Bhubaneswar, NML, Jamshedpur, and concerned metallurgical departments in IITs, NITs etc., targeting full utilization of low-grade iron ore (Fe content up to 45% by 2020 and up to 40% by 2025). In fact, life cycle assessment of whole process including environmental considerations should be done for techno- economic and environmental viability. R&D studies on utilization of mine waste water having high concentration of Fe content for different commercial applications in industries such as cosmetics, pharmaceutical, paint industry should also be explored. Responsibility: IBM, Dept. of Steel & Mines, Individual Mine Lease Holders.</td>
<td>COMPLIED</td>
<td>R & D studies were conducted through IMMT, Bhubaneshwar.

Report on washing and de-sliming of iron ore fines prepared by IMMT Bhubaneswar for Narayanposhi Mines has been attached as <u>Annexure IX.</u>

JSW has not set up beneficiation plant at Narayanposhi mines. All low-grade ores are being transported to JSW steel plant (Bhushan Power & Steel Limited), where beneficiation plant is established and beneficiation is being carried out. As per the mining process no waste water is generated and discharged outside the lease, hence commercial application in other industries is not feasible.</td>
</tr>
</table>

15	The mining activity in Joda-Koira sector is expected to continue for another 100 years, therefore, it will be desirable to develop proper rail network in the region. Rail transport shall not only be pollution free mode but also will be much economical option for iron ore transport. The rail network and/or conveyor belt system up to public railway siding needs to be created. The total length of the conveyor belt system/ rail network to be developed from mines to nearest railway sidings by 11 mines in Joda region is estimated to beabout 64 km. Similarly, in Koira region, total length of rail network/ conveyor system for 8 mines (under SOTM 1 & 2) isestimated to be around 95 km. Further, it is suggested to develop a rail network connecting Banspani (Joda region) and Roxy railway sidings in Koira region. Responsibility: Dept. of Steel & Mines, Govt. of Odisha and Concerned Mines along with Indian Railways. Time Period: Maximum 7 years (by 2025). The Department of Steel & Mines, Govt. of Odisha should follow-up with the concerned Departments and railways so that proposed proper rail network is in place by 2025.	Being Complied	Ore transportation through dumper truck has been observed. 24 percent ore are being transported to railway siding (located at a distance of 10 km to 25 km approx.), 51 percent for shipping (located at a distance 300 km approx.) and to the end user (25% located at a distance of 200 km. approx) by dumper. EC was accorded in the year 2019 and period of 5 year yet to be completed. We propose to undertake construction of slurry pipeline through which the ore/concentrate will be transported from Nuagaon to Paradeep.
16	State Govt. of Odisha shall make all efforts to ensure exhausting all the iron & manganese ore resources in the existing working mines and from disturbed mining leases/zones in Joda and Koira region. The criteria suggested shall be applicable while suggesting appropriate lease area and sustainable mining rate. Responsibility: Dept. of Steel & Mines, Govt. of Odisha	Being complied	As per the directives of State Govt. of Odisha the necessary steps are taken for sustainable mining.
17	**Mining Operations/Process Related:** Project Proponent shall implement the following mitigation measures: (i) Appropriate mining process and machinery (viz. right capacity, fuel efficient) should be selected to carry out various mining operations that generate minimal dust/air	COMPLIED	(i) It is to submit that Opencast Mechanized Mining process is carried out by deploying following machineries:

	pollution, noise, wastewater and solid waste. e.g. drills should either be operated with dust extractors or equipped with water injection system. (ii) After commencement of mining operation, a study should be conducted to assess and quantify emission load generation (in terms of air pollution, noise, waste water and solid waste) from each of the mining activity (including transportation) on annual basis. Efforts should be made to further eliminate/ minimize generation of air pollution/dust, noise, wastewater, solid waste generation in successive years through use of better technology. This shall be ensured by the respective mine lease holders. (iii) Various machineries/equipment selected (viz. dumpers, excavators, crushers, screenplants etc.) and transport means should have optimum fuel/power consumption, and their fuel/power consumption should be recorded on monthly basis. Further, inspection and maintenance of all the machineries/ equipment/ transport vehicles should be followed as per manufacturer's instructions/ recommended time schedule and record should be maintained by the respective mine lease holders. (iv) Digital processing of the entire lease area using remote sensing technique should be carried out regularly once in 3 years for monitoring land use pattern and mining activity taken place. Further, the extent of pit area excavated should also be demarcated based on remote sensing analysis. This should be done by ORSAC (Odisha Space Applications Centre, Bhubaneswar) or an agency of national repute or if done by a private agency, the report shall be vetted/ authenticated by ORSAC, Bhubaneswar. Expenses towards the same shall be borne by the respective mine lease holders. Responsibility: Individual Mine Lease Holders.		<table><tr><th>Type of Fleet</th><th>Make/Model</th></tr><tr><td>Komatsu Excavator</td><td>PC 1250-8R 5.5 m³</td></tr><tr><td>Komatsu Dumpers</td><td>HD785 91 MT / 100 US ST</td></tr><tr><td>Komatsu Wheel Loader</td><td>WA-900 9 m³</td></tr><tr><td>Komatsu Track Dozer</td><td>D275A-5R 13.6 m³</td></tr><tr><td>Komatsu Wheel Dozer</td><td>WD600-6R 10.3 m³</td></tr><tr><td>Komatsu Motor Grader</td><td>GD825A-2 4.8 mts</td></tr><tr><td>Komatsu Water Sprinkler</td><td>HD465-7E0 50 KL</td></tr><tr><td>Epiroc Blast Hole Drill (Top Ham)</td><td>Epiroc- Smart ROC D65 165 mm</td></tr><tr><td>Epiroc Blast Hole Drill (DTH)</td><td>Epiroc- Smart ROC T45 165 mm</td></tr><tr><td>Epiroc Exploration Drill</td><td>Epiroc - Boyle C15 100 mm</td></tr></table> The selection of equipment is made keeping in view the terrain condition, productivity of each equipment, equipment required for support activity, care required for working environment. Due care is taken for adopting latest technology and track record of equipment in surrounding area. Accordingly, Komatsu make equipment fleet of latest model is deployed. Excavator with 5.5cum is grouped with 3 nos. of 100T dumpers. Each such group is planned for an excavation of 3.0 million T per annum. Accordingly, 4 excavators and 12 dumpers are deployed which will have a cumulative capacity of 10MTPA. Standby capacity is in built to care of exigencies. Matching capacity drills, dozers and support equipment are deployed. All the noise generating units in the machinery is provided with padded enclosures for attenuation of noise. Drill machine is provided with dual system of water injection and dust extraction system. Excavators are provided with smart idling systems for fuel efficiency (ii) Annual Study report of emission load calculation attached as **Annexure- X.** (iii) All the equipments are having latest state of art technology with very low level of emission and best fuel efficiency engine. Maintenance

<table>
<tr><td></td><td></td><td></td><td>is done as per the manufacturer’s instructions/ recommended time schedule

(iv) The digital processing of entire lease area using remote sensing technique is carried out through drone.</td></tr>
<tr><td>18</td><td>Air Environment Related: Project Proponent shall implement the following mitigation measures: (i) Fugitive dust emissions from all the sources should be controlled regularly on daily basis. Water spraying arrangement on haul roads, loading and unloading and at other transfer points should be provided and properly maintained. Further, it will be desirable to use water fogging system to minimize water consumption. It should be ensured that the ambient air quality parameters conform to the norms prescribed by the CPCB in this regard. (ii) The core zone of mining activity should be monitored on daily basis. Minimum four ambient air quality monitoring stations should be established in the core zone for SPM, PM10, PM2.5, SO2, NOx and CO monitoring. Location of air quality monitoring stations should be decidedbased on the meteorological data, topographical features and environmentally and ecologically sensitive targets and frequency of monitoring should be undertaken in consultation with the State Pollution Control Board (based onEmission Load Assessment Study). The number of monitoring locations may be more for larger capacity mines and working in larger area. Out of four stations, one should be online monitoring station in the mines having more than 3 MTPA EC</td><td>COMPLIED</td><td>(i) Fugitive dust emissions are regularly controlled at all the sources.
<table>
<tr><td>Activity</td><td>Control Mechanism</td></tr>
<tr><td>Drill machine</td><td>Wet drilling and dust extractors</td></tr>
<tr><td>Haul road</td><td>Water sprinkling using fixed sprinklers for a stretch of 1.1 km on haul road and 2 nos. of mobile sprinklers of 50 KL and 16 KL capacity fitted with atomizer spray.</td></tr>
<tr><td>Blasting</td><td>Sequential blasting using Nonel, Wet stemming & face wetting</td></tr>
<tr><td>Crushing and screening</td><td>Dry fog systems</td></tr>
</table>
Ambient air quality parameters conform to the prescribed standards. The monitoring report is attached as <u>ANNEXURE – V</u> for favor of reference.

(ii) Core zone of mining activity is monitored regularly. Three numbers of Online monitoring stations are installed in the core zone for regular monitoring and monitored data is directly connected to the SPCB Server.
In addition to the above, required numbers of ambient and fugitive air quality monitoring stations are also installed and regular monitoring is carried out.
The photos for reference have been attached as <u>ANNEXURE - XI</u>.

(iii) Monitoring in buffer zone is carried out regularly.
All the monitoring is carried out through NABET Accredited Agency Ecomen. The NABET Accreditation certificate is enclosed as <u>ANNEXURE XII</u>.

(iv) We are regularly monitoring the emission of the vehicle (PUC) to ascertain emission limits as per the pollution norms.</td></tr>
</table>

	Capacity. (iii) Monitoring in buffer zone should be carried out by SPCB or through NABET accredited agency. In addition, air quality parameters (SPM, PM10, PM2. 5, 5O2, NOx and CO) shall be regularly monitored at locations of nearest human habitation including schools and other public amenities located nearest to source of the dust generation as applicable. (iv) Emissions from vehicles as well as heavy machinery should be kept under control and regularly monitored. Measures should be taken for regular maintenance of vehicles used in mining operations and in transportation of mineral. (v) The vehicles shall be covered with a tarpaulin and should not be overloaded. Further, possibility of closed container trucks should be explored for direct to destination movement of iron ore. Air quality monitoring at one location should also be carried out along the transport route within the mine (periodically, near truck entry and exit gate), Responsibility: Individual Mine Lease Holders and SPCB.		(v) Iron Ore is transported through tarpaulin covered trucks up to the nearest railway siding and port from where it is transported to user destination by railway wagons and ships respectively. Closed container truck is not readily available in the market for iron ore transportation We propose to undertake construction of slurry pipeline through which the ore/concentrate will be transported from Nuagaon to Paradeep. Photos of the tarpaulin covered trucks; dust control systems are attached as **ANNEXURE – XIII.**
19	**Noise and Vibration Related:** Project Proponent shall implement the following mitigation measures: (i) Blasting operation should be carried out only during daytime. Controlled blasting such as Nonel, should be practiced. The mitigation measures for control of ground vibrations and to arrest fly rocks and boulders should be implemented. (ii) Appropriate measures should be taken for control of noise levels below 85 DB in the work environment. Workers engaged in operations of	COMPLIED	(i) Blasting operation is carried out only during daytime. Controlled blasting for control of ground vibrations and to arrest fly rocks and boulders are practiced with Sequential blasting using Nonel, Wet stemming & face wetting . (ii) All the equipments are having latest state of art technology with very low level of emission and best fuel efficiency engine. All the noise generating units in the machinery is provided with padded enclosures for attenuation of noise. Workers engaged are provided with ear plugs. (iii) Source noise are monitored on weekly basis near the major sources of noise generation within the core zone. The monitored data is within

<table>
<tr><td></td><td>HEMM, etc. should be provided with ear plugs/muffs. (iii) Noise levels should be monitored regularly (on weekly basis) near the major sources of noise generation within the core zone. Further, date, time and distance of measurement should also be indicated with the noise levels in the report. The data should be used to map the noise generation from different activities and efforts should be made to maintain the noise levels with the acceptable limits of CPCB (CPCB, 2000) (iv) Similarly, vibration at various sensitive locations should be monitored at least once in month, and mapped for any significant changes due to successive mining operations. Responsibility: Individual Mine Lease Holders.</td><td></td><td>the acceptable limits of CPCB (CPCB, 2000). The report is attached in <u>ANNEXURE V.</u>

(iv) Noise level at various sensitive locations are monitored once in month. Reports are available in <u>ANNEXURE V.</u></td></tr>
<tr><td>20</td><td>Water/Wastewater Related: Project Proponent shall implement the following mitigation measures: (i) In general, the mining operations should be restricted to above ground water table and it should not intersect groundwater table. However, if enough resources are estimated below the ground water table, the same may be explored after conducting detailed geological studies by GSI and hydro- geological studies by CGWB or NIH or institute of national repute, and ensuring that no damage to the land stability/ water aquifer system shall happen. The details/ outcome of such study may be reflected/incorporated in the EIA/EMP report of the mine appropriately. (ii) Natural watercourse and/or water resources should not be obstructed due to any mining operations. Regular monitoring of the flow rate of the springs and perennial nallas should be carried out and</td><td>COMPLIED</td><td>(i) Mining Operations in Iron ore pits are restricted to above groundwater table. In Manganese quarry the mine has touched the ground water table
<table>
<tr><td>Name of ore</td><td>Name of the quarry</td><td>Bottom RL (m)</td><td>Water table (m)</td></tr>
<tr><td>Iron</td><td>Q-3/4</td><td>551</td><td>544</td></tr>
<tr><td>Iron</td><td>RF block</td><td>573</td><td>544</td></tr>
<tr><td>Manganese</td><td>Q-5</td><td>542</td><td>544</td></tr>
</table>
Hydrogeological study has been conducted for and clearance (NOC) obtained from CGWA indicating ground water seepage in Manganese pit.

Hydrogeological Report attached as <u>ANNEXURE XIV</u>

Hydrogeological study of the area is conducted by M/s GCRS (an empaneled agency of CGWB). Suitable conservation measures are enlisted in the report and implementation is done accordingly. The report is submitted to CGWB as part of consultation, which was perused and suitable updations are also done based on specific query. Based on this consideration, NOC is awarded. Document in support of consultation and report is enclosed at <u>Annexure XV.</u></td></tr>
</table>

	records should be maintained. Further, regular monitoring of water quality of nallas and river passing thorough the mine lease area (upstream and downstream locations) should be carried out on monthly basis. (iii) Regular monitoring of ground water level and its quality should be carried out within the mine lease area by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring should be carried out on monthly basis. (iv) In order to optimize water requirement, suitable conservation measures to augment ground water resources in the area should be undertaken in consultation with Central Ground Water Board (CGWB). (v) Suitable rainwater harvesting measures on long term basis should be planned and implemented in consultation with CGWB, to recharge the ground water source. Further, CGWB can prepare a comprehensive plan for the whole region. (vi) Appropriate mitigation measures (viz. ETP, STP, garland drains, retaining walls, collection of run off etc.) should be taken to prevent pollution of nearby river/other water bodies. Water quality monitoring study should be conducted by State Pollution Control Board to ensure quality of surface and ground water sources on regular basis. The study can be conducted through NABL/NABET approved water testing laboratory. However, the report should be vetted by SPCB. (vii) Industrial wastewater (workshop and wastewater from the mine) should be properly		(ii) It is confirmed that no natural water course has been obstructed due to mining operations. Surface flow rate and water quality analysis (upstream and downstream locations) of the springs and perennial nallas are carried out and records are maintained. The monitoring report is attached as **ANNEXURE – V** for favor of reference. (iii) Ground water level and its quality is monitored on a regular basis and the reports are submitted to the board on quarterly basis. Quarterly ground water report submitted to the board is attached as **ANNEXURE XVI.** (iv)Suitable conservation measures have been implemented for ground water augmentation in mining area in accordance with a detailed study carried out by M/s Geo Climate Risk Solutions (an empaneled agency of CGWB). (v) Rainwater is stored in the mined-out pits and other settling ponds within the mine lease area to facilitate groundwater recharge. **Sl No** | **Location** | **Capacity (m^3)** 1 | Pond 1 | 2478.7 2 | Pond 2 | 5779.5 3 | Pond 3 | 6789.7 4 | Manganese Quarry pit | 37800.0 In addition to this, rainwater harvesting measures have also been implemented through roof top rain water harvesting structures in the colony premises with recharging system. Photos of the same are attached as **ANNEXURE – XVII.**

	collected, treated in ETP so as to conform to the discharge standards applicable. (viii) Oil and grease trap should be installed before discharge of workshop effluents. Further, sewage treatment plant should be installed for the employees/colony, wherever applicable. (ix) Mine lease holder should ensure that no silt originating due to mining activity is transported in the surface water course or any other water body. Appropriate measures for prevention and control of soil erosion and management of silt should be undertaken. Quantity of silt/soil generated should be measured on regular basis for its better utilization. (x) Erosion from dumps site should be protected by providing geo-textile matting or other suitable material, and thick plantation of native trees and shrubs should be carried out at the dump slopes. Further, dumps should be protected by retaining walls. (xi) Trenches/ garland drain should be constructed at the foot of dumps to arrest silt from being carried to water bodies. Adequate number of check dams should be constructed across seasonal/perennial nallas (if any) flowing through the mine lease areas and silt be arrested. De-silting at regular intervals should be carried out and quantity should be recorded for its better utilization, after proper soil quality analysis. (xii) The water so collected in the reservoir within the mine should be utilized for the sprinkling on hauls roads, green belt development etc.		(vi) No wastewater is discharged out. Water quality monitoring study is conducted by NABL and NABET approved laboratory M/s Ecomen Laboratories Pvt Ltd. The NABL Accredited certificate is hereby attached as **ANNEXURE XVIII.** (vii) ETP of 15KLD capacity established along with washing bay system. Additionally, Oil and grease trap system is also installed for the workshop waste water treatment. The treated water is recirculated and used for washing the vehicles. Photograph of ETP is attached as **ANNEXURE-XIX.** **(viii) STP of 50 KLD is in operation. The treated water is used for gardening and watering plantations.** Photograph of STP is attached as **ANNEXURE-XX.** (ix) Proper Runoff management is carried out to and preventive measures have been taken accordingly such that no silt is transported in the surface water course. Plan showing the runoff management plan is attached as **ANNEXURE-XXI.** (x) Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. Photos of the same are attached as **ANNEXURE – XXII.** **(xi) Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. Adequate check dams are constructed. The drains and settling ponds are de-silted on a regular basis.** **Photographs of the same are attached as ANNEXURE XXIII.** **(xii)** Water collected in reservoir are used for dust suppression using fixed and mobile water sprinklers. Photos of the same are attached as in **ANNEXURE – XXIV.** No wastewater is discharged to outside of mines lease.

	There should be zero waste water discharge from the mine. Based on actual water withdrawal and consumption/ utilization in different activities, water balance diagram should be prepared on monthly basis, and efforts should be made to optimize consumption of water per ton of ore production in successive years. Responsibility: Individual Mine Lease Holders, SPCB and CGWB.		
21	**Land/Soil/Overburden Related**: Project Proponent shall implement the following mitigation measures: (i) The top soil should temporarily be stored at earmarked site(s) only and it should not be kept unutilized for long (not more than 3 years or as per provisions mentioned in the mine plan/ scheme). The topsoil should be used for land reclamation and plantation appropriately. (ii) Fodder plots should be developed in the non-mineralised area in lieu of use of grazing land, if any. (iii) Over burden/ low grade ore should be stacked at earmarked dump site (s) only and should not be kept active for long period. The dump height should be decided on case-to- case basis, depending on the size of mine and quantity of waste material generated. However, slope stability study should be conducted for larger heights, as per IBM approved mine plan and DGMS guidelines. The OB dump should be scientifically vegetated with suitable native species to prevent erosion and surface run off. In critical areas, use of geo textiles should be undertaken for stabilization of the dump. Monitoring and management of	COMPLIED	(i) No top soil is generated as it is a working mines. (ii) Fodder plots have been developed in the non-mineralized area of the Mining lease. Photographs of the same is enclosed as **ANNEXURE – XXV.** **(iii)** Overburden and low-grade iron ore are stacked at earmarked area as per approved mining plan. Slope stability study has been conducted as per DGMS guidelines. Copy of the report is attached as **ANNEXURE – XXVI.** Dump site is scientifically protected by providing and maintaining geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. The growth and lifecycle of the species are monitored. Photos of the same are attached as **ANNEXURE – XXII.** **(iv) Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. Settling ponds and check dams are constructed with adequate sump capacity** designed with appropriate safety margin based on long term rainfall data to arrest silt and sediment flows from mine operation, soil, OB and mineral dumps, thus collected water is used for dust suppression and green belt development**. The drains and settling ponds are de-silted on a regular basis.** **(v)** Backfilling is in progress in line with approved mining plan. (vi) Hazardous waste has been disposed of as per provisions of Hazardous waste management Rules 2016. Waste oil, lubricants (as per Cat.5.1, Schedule-I) are disposed to authorized recyclers. Annual

	rehabilitated areas should continue until the vegetation becomes self- sustaining. Proper records should be maintained regarding species, their growth, area coverage etc. (iv) Catch drains and siltation ponds of appropriate size shouldbe constructed to arrest silt and sediment flows from mine operation, soil, OB and mineral dumps. The water so collected can be utilized for watering the mine area, roads, green belt development etc. The drains should be regularly de-silted, particularly after monsoon and should be maintained properly. Appropriate documents should be maintained. Garland drain of appropriate size, gradient and length should be constructed for mine pit, soil, OB and mineral dumps and sump capacity should be designed with appropriate safety margin based on long term rainfall data. Sump capacity should be provided for adequate retention period to allow proper settling of silt material. Sedimentation pits should be constructed at the corners of the garland drains and de- silted at regular intervals. (v) Backfilling should be done as per approved mining plan/scheme. There should be no OB dumps outside the mine lease area. The backfilled area should be afforested, aiming to restore the normal ground level. Monitoring and management of rehabilitated areas should continue till the vegetation is established and becomes self- generating. (vi) Hazardous waste such as, waste oil, lubricants, resin, and coal tar etc. should be disposed off as per provisions of Hazardous Waste Management Rules, 2016, as amended from time to time. Responsibility: Individual Mine Lease Holders.		returns in Form-IV are being submitted to SPCB, Odisha in regular basis. Copy of last annual return is attached as **ANNEXURE- XXVII**
22	**Ecology/Biodiversity (Flora-Fauna) Related**: Project Proponent shall implement the following mitigation measures: (i) All precautionary		It is to inform that study on biological environment have been carried out in core zone and buffer zone. Floral species like Shorea robusta, Terminalia tomentosa, Grewia tiliaefolia, Syzygium cumini, Adina

	measures should be taken during mining operation for conservation and protection of endangered fauna namely elephant, sloth bear etc. spotted in the study area. Action plan for conservation of flora and fauna should be prepared and implemented in consultation with the State Forest and Wildlife Department within the mine lease area, whereas outside the mine lease area, the same should be maintained by State Forest Department. (ii) Afforestationis to be done by using local and mixed species saplings within and outside the mining lease area. The reclamation and afforestation is to be done in such a manner like exploring the growth of fruit bearing trees which will attract the fauna and thus maintaining the biodiversity of the area. As afforestation done so far is very less, forest department needs to identify adequate land and do afforestation by involving local people in a time bound manner. (iii) Green belt development carried out by mines should be monitored regularly in every season and parameters like area under vegetation/plantation, type of plantation, type of tree species /grass species/scrubs etc., distance between the plants and survival rate should be recorded. (iv) Green belt is an important sink of air pollutants including noise. Development of green cover in mining area will not only help reducing air and noise pollution but also will improve the ecological conditions and prevent soil erosion to a greater extent. Further, selection		cordifolia, Madhuca Indica and Ficus religiosa, Morinda tinctoria, Azadirachata indica, Tamarindus chebula and Syzygium cumini are available. Study of Faunal composition reveals that there is no National Park, Wildlife Sanctuary, Elephant Reserve, Biosphere Reserve, Ramsar site or Tiger Reserve in the study area. Karo - Karampada elephant corridor is located at about 18.0 km from the mine lease area in North direction. Elephant, Sloth bear, Python and Monitor Lizard are placed under Schedule-I as per Wild Life (Protection) Act, 1972 is found in the buffer area, for which Site-Specific Wild life conservation plan was prepared and got approved from PCCF (Wildlife) & Chief Wildlife Warden, Odisha. Accordingly, Rs. 288.00 lakh of which Rs. 92.00 lakh has been earmarked for implementation of the Plan within the Mining Lease area and Rs. 196.00 Lakh has been earmarked for implementation in the buffer zone area. It is requested to DFO, Bonai division, Dist. Sundergarh to get the implementation status. Copy of the letter is enclosed as **ANNEXURE-XXIX and ANNEXURE-XXVIII**. These scheme covers conservation measures for wildlife management and development of flora by plantation of intimate mixture of food and cover species, goe-textile, grass seedling, etc. In addition to this afforestation covering 21,000 nos. of saplings of mixed local species is carried out with in last three years, which has a survival of 67%. This is in addition to the afforestation carried out by Ex-leassee (M/s. AMTC) before 2020. Green belt development is regularly being carried out by mines and maintained/ monitored regularly. The plantation includes local species such as Gulmohar, Imli, jamun which helps in arresting the dust. Vetiver grass is planted on inactive dumps for the slope stabilization. Photographs of vetiver grass plantation over inactive dump is enclosed as **ANNEXURE – XXX.** Compensatory afforestation is being carried out by State Forest department. Financial outlay for activities in project area given Rs. 27,43,000 for Compensatory afforestation and implementation certificate is awaited from DFO, Bonai, Odisha

	of tree species for green belt should constitute dust removal/dust capturing plants since plants can act as efficient biological filters removing significant amounts of particulate pollution. Thus, the identified native trees in the mine area may be encouraged for plantation. Tree species having small leaf area, dense hair on leaf surface (rough surface), deep channels on leaves should be included for plantation. (v) Vetiver plantation on inactive dumps may be encouraged as the grass species has high strength of anchoring besides medicinal value. (vi) Details of compensatory afforestation done should be recorded and documented by respective forest divisions, and State Forest Department shouldpresent mine-wise annual status, along with expenditure details. Responsibility: Individual Mine Lease Holders and State Forest & Wildlife Department.		A SSWLCP was prepared and approved by PPCF and Chief wild life warden enumerating Fauna in core and buffer zone. Remittance of financial outlay for conservation measures as enlisted in the plan is made. We have requested the O/o DFO for furnishing the information regarding implementation status of SSWLCP. SSWLCP is attached as **Annexure- XXXII** Mail correspondence is attached as **Annexure- XXXI** On receipt, we undertake to submit the status report forthwith.
23	**Socio-Economic Related**: Project Proponent shall implement the following mitigation measures: (i) Public interaction should be done on regular basis and social welfare activities should be done to meet the requirements of the local communities. Further, basic amenities and infrastructure facilities like education, medical, roads, safe drinking water, sanitation, employment, skill development, training institute etc. should be developed to alleviate the quality of life of the people of the region. (ii) Land outees and land losers/affected people, if any, should be compensated and rehabilitated as per the	COMPLIED	Public interactions are being carried out on regular basis and social welfare activities are being done to meet the requirements of the local communities Activities like education, medical, roads, safe drinking water, sanitation, employment, skill development, training institute etc. has been developed to alleviate the quality of life of the people.

	national/state policy on Resettlement and Rehabilitation. (iii) The socio-economic development in the region should be focused and aligned with the guidelines/initiatives of Govt. of India/ NITI Aayog around prosperity, equality, justice, cleanliness, transparency, employment, respect to women, hope etc. This can be achieved by providing adequate and quality facilities foreducation, medical and developing skills inthe people of the region. District administration in association with mine lease holders should plan for "Samagra Vikas" of these blocks well as other blocks of the district. While planning for different schemes in the region, the activities should be prioritized as per Pradhan Mantri KhanijKshetra Kalyan Yojna (PMKKKY), notified by Ministry of Mines, Govt. of India, vide letter no. 16/7/2017-M.VI (Part), dated September 16, 2015. Responsibility: District Administration and Individual Mine Lease Holders.		
24	**Road Transport Related**: Project Proponent shall implement the following mitigation measures: (i) All the mine lease holders should follow the suggested ore transport mode (SOTM), based on its EC capacity within next 5 years. (ii) The mine lease holders should ensure construction of cement road of appropriate width from and to the entry and exit gate of the mine. Further, maintenance of all the roadsshould be carried out as per the requirement to ensure dust free road transport. (iii) Transportation of ore should be done by covering the trucks with tarpaulin or other suitable mechanism so that no spillage of ore/dust takes place. Further, air quality in terms of dust,	COMPLIED	Concrete road is provided from the exit of Manganese quarry to NH. Concrete road is also available at Gate 2, the main exit gate of the mines. Photographs of concrete roads submitted as **<u>ANNEXURE III</u>** Iron Ore is transported through tarpaulin covered trucks up to the nearest railway siding and port from where it is transported to user destination by railway wagons and ships respectively. We propose to undertake construction of slurry pipeline through which the ore/concentrate will be transported from Nuagaon to Paradeep.

	PM:10should be monitored near the roads towards entry & exit gate on regular basis, and be maintained within the acceptable limits. Responsibility: Individual Mine Lease Holders and Dept. of Steel & Mines.		Photos of the tarpaulin covered trucks; dust control systems are attached as **ANNEXURE – XIII.** PM10 along with other parameters are monitored near the roads towards entry & exit gate on regular basis and are maintained within the acceptable limits. The monitoring data is attached as **ANNEXURE V**
25	**Occupational Health Related**: Project Proponent shall implement the following mitigation measures: (i) 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 periodically. (ii) Occupational health surveillance program for all the employees/workers (including casual workers) should be undertaken periodically (on annual basis) to observe any changes due to exposure to dust, and corrective measures should be taken immediately, if needed. (iii) Occupational health and safety measures related awareness programs including identification of work related health hazard, training on malaria eradication, HIV and health effects on exposure to mineral dust etc., should be carried out for all the workers on regular basis. A full time qualified doctor should be engaged for the purpose. Periodic monitoring (on 6 monthly basis) for exposure to respirable minerals dust on the workers should be conducted, and record should be maintained including health record of all the workers. Review of impact of various health measures undertaken (at an interval of 3 years orless) should be conducted followed by follow-up of actions, wherever required.		(i) All workers are provided with proper PPE, with adequate training and information on safety and health aspects periodically. (ii)Occupational health surveillance program for all the employees/workers are done on annual basis to observe any changes due to exposure to various parameters including dust . PPEs like safety shoes, reflective jacket, safety glass, ear plugs, helmets etc. have been distributed. Personnel working in dusty areas wear protective respiratory devices and vocational training and information on safety and health aspects are being given to them periodically. All employees and workers will be given trainings in the Vocational Training centers. IME is a mandate to work inside the mines.

	Occupational health centre should be established near mine site itself. Responsibility: Individual Mine Lease Holders and District Administration (District Medical Officer).		
	B. Standard Conditions **I. Statutory Compliance**		
1	This Environmental Clearance (EC) is subject to orders/judgment of Hon'ble Supreme Court of India, Hon'ble High Court, Hon'ble NGT and any other Court of Law, Common Cause Conditions as may be applicable.		Agreed to abide by the condition
2	This EC is valid up to 31.03.2020 as the lease validity i.e. valid up to 31st March 2020 as per the Amended MMDR Act. 2015		EC has been vested to JSW Steel Ltd for 2 years and then further for 50 years. As per MOEF&CC OM dated 13.07.2021, EC transfered till life of the mine. EC capacity of 6.0 MTPA was accorded to ex-lease in the year 2019 in the name of M/s Aryan Mining & Trading Corp. Pvt. Ltd. Vesting order was given to M/s. JSW Steel Limited from Steel & Mines Department, Government of Odisha vide Order no. 4212/SM, dated 30th May 2020 as per MMDR Act, 1957 and Mineral concession Rules, 2016. Further it was vested for 50 years vide order no. 1335/ 1V (B) SM -21/2020. Vesting order copy is attached as **ANNEXURE XXXIII**
3	The Project proponent complies with all the statutory requirements and judgment of Hon'ble Supreme Court dated 2nd August, 2017 in Writ Petition (Civil) No. 114 of 2014 in matter of Common Cause versus Union of India &Ors. before commencing the mining operations.		Agree to abide by the condition
4	The State Government concerned shall ensure that mining operation shall not be commenced till the entire compensation levied, if any, for illegal mining paid by the Project Proponent through their respective Department of Mining & Geology in strict compliance of Judgment of Hon'ble Supreme Court dated 2nd August, 2017 in Writ Petition		State Government (Steel & Mines Department) has given vested order in favour of M/s. JSW Steel Limited vide No. 1335/SM, dated 15.02.2022 for grant of mining lease for 50 years and all clearances, vested under section-8A, Sub section-2 of Mines and Mineral Development Regulation Act, 1957.

	(Civil} No. 114 of 2014 in matter of CommonCause versus Union of India & Ors.		
5	This Environmental Clearance shall become operational only after receiving formal NBWL Clearance from MoEF&CC subsequent to the recommendations of the Standing Committee of National Board for Wildlife, if applicable to the Project		As per the information furnished No Wild Life Sanctuary/Tiger Reserve/National Park/ within the core as well as within the buffer zone of the project
6	This Environmental Clearance shall become operational only after receiving formal Forest Clearance (FC) under the provision of Forest Conservation Act, 1980, if applicable to the Project.		As per the EC accorded total forest area is 259.191Ha. Forest Clearance accorded for 244.327 Ha to M/s JSW Steel Ltd. 19.25 Ha yet to diverted. (As reported by PP) out of 244.327 Ha ,184.591 Ha has been transferred to the new lessee. FC transfer letter is attached as **ANNEXURE XXXIV**
7	Project Proponent (PP) shall obtain Consent to Operate after grant of EC and effectively implement all the conditions stipulated therein. The mining activity shall not commence prior to obtaining Consent to Establish / Consent to Operate from the concerned State Pollution Control Board/Committee.		Consent to establish has been accorded vide letter no 536/IND-II-CTE-6207 dated 14.01.2019 and Consent to operate accorded by Odisha Pollution Control Board vide letter no 4651/IND-I-CON-2258 dated 30.03.2024 valid up to 31.03.2026.
8	The PP shall adhere to the provision of the Mines Act, 1952, Mines and Mineral (Development & Regulation), Act, 2015 and rules & regulations made there under. PP shall adhere to various circulars issued by Directorate General Mines Safety (DGMS) and Indian Bureau of Mines from time to time.	Agreed upon	Agreed to comply
9	The Project Proponent shall obtain consents from all the concerned land owners, before start of mining operations, as per the provisions of MMDR Act, 1957 and rules made there under in respect of lands which are not owned by it.	COMPLIED	Present mining operation has been restricted within vested lease granted over 347.008 ha (as per DGPS).
10	The Project Proponent shall follow the mitigation measures provided in MoEFCC's Office Memorandum No. Z- 11013/57/2014-IA.II (M), dated 29th October, 2014, titled "Impact of	COMPLIED	As per the Office Memorandum No. Z- 11013/57/2014- IA.II (M), dated 29th October, 2014, titled "Impact of mining activities on Habitations-Issues of MoEFCC's, mitigative measures are being taken care of. This includes construction of garland drains, check dams, retaining walls and settling ponds.OM also states about the regular monitoring of

	mining activities on Habitations-Issues related to the mining Projects wherein Habitations and villages are the part of mine lease areas or Habitations and villages are surrounded by the mine lease area".		natural stream, illumination survey and others which are being carried out
11	The Project Proponent shall obtain necessary prior permission of the competent authorities for drawl of requisite quantity of surface water and from CGWA for withdrawal of ground water for the project	Being complied	CGWA NOC is obtained. NOC No.: CGWA/NOC/MIN/REN/2/2024/10057 dated 17/10/2024. NOC Copy is attached as **ANNEXURE XV.**
12	A copy of EC letter will be marked to concerned Panchayat / local NGO etc. if any, from whom suggestion / representation has been received while processing the proposal.	COMPLIED	EC is granted to ex-lessee vide EC No. J11015/288/2008-IA.II(M), dated 18.06.2019. EC was operational and same was vested to jsw vide order no. 4212/SM/IV(B) SM-21/2020 dated 30.05.2020. As per the EIA report and PH proceedings there were no such suggestions received from local Panchayat or NGO. However, a copy of EC is submitted to Koira Panchayat vide our letter No. JSW/NP/PAO/ 1968/23-24, dated 02.08.2023 Copy enclosed as **ANNEXURE XXXV**
13	State Pollution Control Board/Committee shall be responsible for display of this EC letter at its Regional office, District Industries Centre and Collector's office/ Tehsildar's Office for 30 days.	COMPLIED	State Pollution Control Board/Committee has displayed EC letter at its Regional office, District Industries Centre and Collector's office/ Tehsildar's Office
14	The Project Authorities should widely advertise about the grant of this EC letter by printing the same in at least two local newspapers, one of which shall be in vernacular language of the concerned area. The advertisement shall be done within 7 days of the issue of the clearance letter mentioning that the instant project has been accorded EC and copy of the EC letter is available with the State Pollution Control Board/Committee and web site of the Ministry of Environment, Forest and Climate Change (www.parivesh.nic.in). A copy of the advertisement may be forwarded to the concerned MoEFCC Regional Office for compliance and record		EC is granted to ex-lessee vide EC No. J-11015/288/2008-IA.II(M), dated 18.06.2019 and same was vested to JSW vide order no. 4212/SM/IV(B) SM-21/2020 dated 30.05.2020. Advertisement of EC may have been submitted by the erstwhile lessee. Copy of EC is submitted to Koira Panchayat vide our letter No. JSW/NP/PAO/ 1968/23-24, dated 02.08.2023. We have not received any suggestions in this regard. Copy enclosed as **ANNEXURE – XXXV** The condition requires compliance in 2019 within 7 days of issuance of EC. It was the period Erstwhile lessee was operating. We have tried to locate the copy of advertisement but couldn't succeed.

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>15</td><td>The Project Proponent shall inform the MoEF&CC for any change in ownership of the mining lease. In case there is any change in ownership or mining lease is transferred than mining operation shall only be carried out after transfer of EC as per provisions of the para 1I of EIA Notification, 2006 as amended from time to time</td><td>COMPLIED</td><td>EC has been accorded to M/s Aryan Mining & Trading Corporation Pvt. Ltd. Subsequently the due to expiry of lease on 31.03.2020 has been auctioned and M/s JSW has been declared as preferred bidder. Acknowledge letter has been accorded by MOEFCC vide letter dated 11/12/2021.

Copy for the same is attached as <u>ANNEXURE XXXVI.</u></td></tr>
<tr><td></td><td>II. Air quality monitoring and preservation</td><td></td><td></td></tr>
<tr><td>16</td><td>The Project Proponent shall install a minimum of 3 (three) online Ambient Air Quality Monitoring Stations with 1 (one) in upwind and 2 (two) in downwind direction based on long term climatological data about wind direction such that an angle of 120° is made between the monitoring locations to monitor critical parameters, relevant for mining operations, of air pollution viz. PM10, PM2.5, NO2, CO and SO2 etc. as per the methodology mentioned in NAAQS Notification No. B- 29016/2o/go/PCI/I, dated 18.11.2009 covering the aspects of transportation and use of heavy machinery in the impact zone. The ambient air quality shall also be monitored at prominent places like office building, canteen etc. as per the site condition to ascertain the exposure characteristics at specific places. The above data shall be digitally displayed within 03 months in front of the main Gate of the mine site.</td><td>COMPLIED</td><td>In consultation with SPCB, three numbers of Continuous ambient air monitoring stations (CAAQMS) have been installed for PM10, PM2.5, NO2, CO and SO2, maintaining an angle of 120^0

LocationS are as below-

CAAQMS 1. Narayanposhi Mines Office
CAAQMS 2 Gate No. 1
CAAQMS 3. Baba math area
Digital Display Board- Near Gate No. 2

Installation of online Continuous ambient air monitoring stations (CAAQMS) was done based on climatological data and site conditions in consultation with the SPCB, Rourkela and letter of communication with SPCB is attached as ANNEXURE – XXXVII and map in support of the location of CAAQMS is attached as ANNEXURE - XXXVIII</td></tr>
<tr><td>17</td><td>Effective safeguard measures for prevention of dust generation and subsequent suppression (like regular water sprinkling, metalled road construction etc.) shall be carried out in areas prone to air pollution wherein high levels of PM10 and PM2.5 are evident such as haul road, loading and unloading point and transfer points. The</td><td>COMPLIED</td><td>Fugitive dust emissions are regularly controlled at all the sources.
<table>
<tr><td>Activity</td><td>Control Mechanism</td></tr>
<tr><td>Drill machine</td><td>Wet drilling and dust extractors</td></tr>
<tr><td>Haul road</td><td>Water sprinkling using fixed sprinklers for a stretch of 1.1 km on haul road and 2 nos. of mobile sprinklers of 50 KL and 16 KL capacity fitted with atomizer spray.</td></tr>
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<tr><td></td><td>Fugitive dust emissions from all sources shall be regularly controlled by installation of required equipment's/ machineries and preventive maintenance. Use of suitable water-soluble chemical dust suppressing agents may be explored for better effectiveness of dust control system. It shall be ensured that air pollution level conform to the standards prescribed by the MoEFCC/ Central Pollution Control Board</td><td></td><td><table><tr><td>Blasting</td><td>Sequential blasting using Nonel, Wet stemming & face wetting</td></tr><tr><td>Crushing and screening</td><td>Dry fog systems</td></tr></table>
Dust suppressant chemicals are added in the mobile sprinklers which enhances the effectiveness of dust control system.

Photographs of the same are attached as <u>ANNEXURE XXXIX</u></td></tr>
<tr><td></td><td>III. Water quality monitoring and preservation</td><td></td><td></td></tr>
<tr><td>18</td><td>In case, immediate mining scheme envisages intersection of ground water table, then Environmental Clearance shall become operational only after receiving formal clearance from CGWA. In case, mining operation involves intersection of ground water table at a later stage, then PP shall ensure that prior approval from CGWA and MoEFCC is in place before such mining operations. The permission for intersection of ground water table shall essentially be based on detailed hydro-geological study of the area.</td><td></td><td>Mining Operations in Iron ore pits are restricted to above groundwater table. In Manganese quarry the mine has touched the ground water table
<table><tr><td>Name of ore</td><td>Name of the quarry</td><td>Bottom RL (m)</td><td>Water table (m)</td></tr><tr><td>Iron</td><td>Q-3/4</td><td>551</td><td>544</td></tr><tr><td>Iron</td><td>RF block</td><td>573</td><td>544</td></tr><tr><td>Manganese</td><td>Q-5</td><td>542</td><td>544</td></tr></table>
Hydrogeological study has been conducted for and clearance (NOC) obtained from CGWA indicating ground water seepage in Manganese pit.

Hydrogeological Report attached as <u>ANNEXURE XIV</u></td></tr>
<tr><td>19</td><td>Regular monitoring of the flow rate of the springs and perennial nallahs flowing in and around the mine lease shall be carried out and maintain records. The natural water bodies and or streams which are flowing in an around the village, should not be disturbed. The Water Table should be nurtured so as not to go down below the pre- mining period. In case of any water scarcity in the area, the</td><td>COMPLIED</td><td>Surface flow rate and water quality analysis (upstream and downstream locations) of the springs and perennial nallas are carried out and records are maintained.

The monitoring report is attached as <u>ANNEXURE – V</u> for favor of reference.</td></tr>
</table>

	Project Proponent has to provide water to the villagers for their use. A provision for regular monitoring of water table in open dug wall located in village should be incorporated to ascertain the impact of mining over groundwater table. The Report on changes in Ground water level and quality shall be submitted on six- monthly basis to the Regional Office of the Ministry, CGWA and State Groundwater Department / State Pollution Control Board		It is confirmed that no natural water course has been obstructed due to mining operations. Ground water level and its quality is monitored on a regular basis and the reports are submitted to the board on quarterly basis. Quarterly ground water report submitted to the board is attached as **ANNEXURE XVI.** Suitable conservation measures have been implemented for ground water augmentation in mining area in accordance with a detailed study carried out by M/s Geo Climate Risk Solutions (an empaneled agency of CGWB). The Monitoring Report on Ground water level and quality is being submitted on six-monthly basis to the Regional Office of the Ministry and State Pollution Control Board.
20	Project Proponent shall regularly monitor and maintain records w.r.t. ground water level and quality in and around the mine lease by establishing a network of existing wells as well as new piezo-meter installations during the mining operation in consultation with Central Ground Water Authority/ State Ground Water Department. The Report on changes in Ground water level and quality shall be submitted on six-monthly basis to the Regional Office of the Ministry, CGWA and State Groundwater Department / State Pollution Control Board.	COMPLIED	Ground water level and its quality is monitored on a regular basis and the reports are submitted to the board on quarterly basis. Quarterly ground water report submitted to the board is attached as **ANNEXURE XVI.** The Monitoring Report on Ground water level and quality is being submitted on six-monthly basis to the Regional Office of the Ministry and State Pollution Control Board.
21	The Project Proponent shall undertake regular monitoring of natural water course/ water resources/ springs and perennial nallahs existing/ flowing in and around the mine lease and maintain its records. The project proponent shall undertake regular monitoring of water quality upstream and downstream of water bodies passing within and nearby/ adjacent to the mine	COMPLIED	Surface flow rate and water quality analysis as per CPCB Criteria (upstream and downstream locations) of the springs and perennial nallas are carried out and records are maintained. The monitoring report is attached as **ANNEXURE – V** for favor of reference. No obstruction is made to the water bodies due to mining operations.

	lease and maintain its records. Sufficient number of gullies shall be provided at appropriate places within the lease for management of water. PP shall Carryout regular monitoring w.r.t. pH and included the same in monitoring plan. The parameters to be monitored shall include their water quality vis-à-vis suitability for usage as per CPCB criteria and flow rate. It shall be ensured that no obstruction and/or alteration be made to water bodies during mining operations without justification andprior approval of MoEFCC. The monitoring of water courses/ bodies existing in lease area shall be carried out four times in a Year viz. pre- monsoon(April-May). monsoon (August), post- monsoon (November) and winter (January)and the record of monitored data may be sent regularly to Ministry of Environment, Forest and Climate Change and its Regional Office, Central Ground Water Authority and Regional Director, Central Ground Water Board, State Pollution Control Board and Central Pollution Control Board. Clearly showing the trend analysis on six-monthly basis.		Water courses are monitored and the reports are sent regularly to the board on quarterly basis separately and also along with Six monthly EC Compliance Report.
22	Quality of polluted water generated from mining operations which include Chemical Oxygen Demand (COD) in mines run-off; acid mine drainage and metal contamination in runoff shall be monitored along with Total Suspended Solids (TDS), Dissolved Oxygen (DO), pH and Total Suspended Solids (TSS). The monitored data shall be uploaded on the website of the company as well as displayed at the project site in public	COMPLIED	The surface runoff water is monitored during monsoon. It is analysed for COD, TSS, TDS, DO, pH and other parameters. The monitored data is displayed in the digital display board of the mines for public domain is attached as **ANNEXURE XL.** Monitored data uploaded in the website of the company along with six monthly compliances.

<table>
<tr><td></td><td>domain, on a display board, at a suitable location near the main gate of the Company. The circular No. J- 20012/1/2006- IA.II (M) dated 27.05.2009 issued by Ministry of Environment, Forest and Climate Change may also be referred in this regard.</td><td></td><td></td></tr>
<tr><td>23</td><td>Project Proponent shall plan, develop and implement rainwater harvesting measures on long term basis to augment ground water resources in the area in consultation with Central Ground Water Board/ State Groundwater Department. A report on amount of water recharged needs to be submitted to Regional Office MoEFCC annually.</td><td>COMPLIED</td><td>Suitable conservation measures have been implemented for ground water augmentation in mining area in accordance with a detailed study carried out by M/s Geo Climate Risk Solutions (an empaneled agency of CGWB).

Rainwater is stored in the mined-out pits and other settling ponds within the mine lease area to facilitate groundwater recharge.
<table>
<tr><th>Sl No</th><th>Location</th><th>Capacity (m^3)</th></tr>
<tr><td>1</td><td>Pond 1</td><td>2478.7</td></tr>
<tr><td>2</td><td>Pond 2</td><td>5779.5</td></tr>
<tr><td>3</td><td>Pond 3</td><td>6789.7</td></tr>
<tr><td>4</td><td>Manganese Quarry pit</td><td>37800.0</td></tr>
</table>
In addition to this, rainwater harvesting measures have also been implemented through roof top rain water harvesting structures in the colony premises with recharging system.
Photos of the same are attached as ANNEXURE – XVII</td></tr>
<tr><td>24</td><td>Industrial waste water (workshop and waste water from the mine) should be properly collected and treated so as to conform to the notified standards prescribed from time to time. The standards shall be prescribed through Consent to Operate (CTO) issued by concerned State Pollution Control Board (SPCB). The workshop effluent shall be treated after its initial passage through Oil and grease trap.</td><td>COMPLIED</td><td>ETP of 15KLD capacity established along with washing bay system. Additionally, Oil and grease trap system is also installed for the workshop waste water treatment. The treated water is recirculated and used for washing the vehicles.
Photograph of ETP is attached as <u>ANNEXURE-XIX</u>.

The quality of inlet and outlet water of ETP is monitored every month, the results are within the standards prescribed in the CTO issued by State Pollution Control Board (SPCB).</td></tr>
</table>

			The report is attached as ANNEXURE V.
25	The water balance/water auditing shall be carried out and measure for reducing the consumption of water shall be taken up and reported to the Regional Office of the MoEF&CC and State Pollution Control Board/Committee.	COMPLIED	The rainwater stored in the settling pits are used for dust suppression in fixed and mobile sprinklers. Pressurized sprinklers are used for minimizing water requirement. Water balance sheet is attached as **ANNEXURE XLI**
	IV. Noise and vibration monitoring and prevention		
26	The peak particle velocity at 500m distance or within the nearest habitation, whichever is closer shall be monitored periodically as per applicable DGMS guidelines	COMPLIED	The peak particle velocity at 500m distance or within the nearest habitation is monitored periodically. Monitoring data is given in **ANNEXURE V.**
27	The illumination and sound at night at project sites disturb the villages in respect of both human and animal population. Consequent sleeping disorders and stress may affect the health in the villages located close to mining operations. Habitations have a right for darkness and minimal noise levels at night. PPs must ensure that the biological clock of the villages is not disturbed; by orienting the floodlights/ masks away from the villagers and keeping the noise levels well within the prescribed limits for day /night hours.	COMPLIED	Illumination and sound is restricted into core zone only. No project sites disturb the villages in respect of both human and animal population. Ambient Noise level monitoring are being carried out at 4 different locations in core zone as well as 4 locations in buffer zone. Monitoring report is attached as **ANNEXURE V.**
28	The Project Proponent shall take measures for control of noise levels below 85 dBA in the work environment. The workers engaged in operations of HEMM, etc. should be provided with ear plugs /muffs. All personnel including labourers working in dusty areas shall be provided with protective respiratory devices along with adequate training, awareness and information on safety and health aspects. The PP shall be held responsible in case it has been found that workers/ personals/ labourers are working without personal protective equipment.	COMPLIED	Noise monitoring regularly carried out, noise level is observed to be below 85dBA in the work zone area. PPE set (including helmet, safety shoe, safety jacket, ear muffs, and dust musk) has been issued to personnel including labourers working in dust zones. Workers are equipped with PPEs in the working zone.

<table>
<tr><td></td><td>V. Mining Plan</td><td></td><td></td></tr>
<tr><td>29</td><td>The Project Proponent shall adhere to the working parameters of mining plan which was submitted at the time of EC appraisal wherein year-wise plan was mentioned for total excavation i.e. quantum of mineral, waste, over burden, inter burden and top soil etc. No change in basic mining proposal like mining technology, total excavation, mineral & waste production,lease area and scope of working (viz. method of mining, overburden & dump management, O.B & dump mining, mineral transportation mode, ultimate depth of mining etc.) shall not be carried out without prior approval of the Ministry of Environment, Forest and Climate Change, which entail adverse environmental impacts, even if it is a part of approved mining plan modified after grant of EC or granted by State Govt. in the form to Short Term Permit (STP), Query license or any other name.</td><td>COMPLIED</td><td>There is no change in basic mining proposal like mining technology, total excavation, mineral & waste production, lease area and scope of working (viz. method of mining, overburden & dump management, O.B & dump mining, mineral transportation mode, ultimate depth of mining etc.

EC accorded for 6.0MTPA(ROM) of Iron ore and 0.036 MTPA Mn ore

PRODUCTION DETAILS as per Annually submitted IBM Returns

<table>
<tr><td>Year</td><td colspan="2">Production in Million Tonnes</td></tr>
<tr><td>Mineral</td><td>Fe</td><td>Mn</td></tr>
<tr><td>2020-21</td><td>4.48</td><td>0.0004</td></tr>
<tr><td>2021-22</td><td>5.44</td><td>0.0047</td></tr>
<tr><td>2022-23</td><td>5.3</td><td>0.0052</td></tr>
<tr><td>2023-24</td><td>5.63</td><td>0.0005</td></tr>
<tr><td>2024-25</td><td>5.84</td><td>0.00016</td></tr>
</table>
</td></tr>
<tr><td>30</td><td>The Project Proponent shall get the Final Mine Closure Plan along with Financial Assurance approved from Indian Bureau of Mines/Department of Mining & Geology as required under the Provision of the MMDR Act, 1957 and Rules/ Guidelines made there under. A copy of approved final mine closure plan shall be submitted within 2 months of the approval of the same from the competent authority to the concerned Regional Office of the Ministry of Environment, Forest and Climate Change for record and verification.</td><td>AGREED UPON</td><td>Agreed to abide by the condition.</td></tr>
</table>

31	The land-use of the mine lease area at various stages of mining scheme as well as at the end-of-life shall be governed as per the approved Mining Plan. The excavation vis-â-vis backfilling in the mine lease area and corresponding afforestation to be raised in the reclaimed area shall be governed as per approved mining plan. PP shall ensure the monitoring and management of rehabilitated areas until the vegetation becomes self-sustaining. The compliance status shall be submitted half- yearly to the MoEFCC and its concerned Regional Office.	COMPLIED	All the mining operations are being carried out as per approved Mine Plan including excavation and backfilling.
	VI. Land Reclamation		
32	The Overburden (O.B.) generated during the mining operations shall be stacked at earmarked OB dump site(s) only and it should not be kept active for a long period of time. The physical parameters of the OB dumps like height, width and angle of slope shall be governed as per the approved Mining Plan as per the guidelines/circulars issued by D.G.M.S w.r.t. safety in mining operations shall be strictly adhered to maintain the stability of top soil/OB dumps. The topsoil shall be used for land reclamation and plantation	COMPLIED	Over burden being stacked at earmarked site and after maturity same will be stabilized with plantation. Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. Height of the dump reported to be 20m, 27m,12m, width 240m, 170m, 150m and slope 31^{o}, 22^{0} and 18^{0} respectively. Coir matting of 8500 m2 (in 1st phase) and 7800 m2 (in 2nd phase) and 2040 (3rd phase) has already been completed, followed by plantation with native species. Photos of the same are attached as **ANNEXURE – XXII.**
33	The reject/waste generated during the mining operations shall be stacked at earmarked waste dump site(s) only. The physical parameters of the waste dumps like height, width and angle of slope shall be governed as per the approved Mining Plan as per the guidelines/circulars issued by DGMS w.r.t. safety in mining operations shall be strictly adhered to maintain the stability of waste dumps.	COMPLIED	Over burden being stacked at earmarked site and after maturity same will be stabilized with plantation. Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. Height of the dump reported to be 20m, 27m,12m, width 240m, 170m, 150m and slope 31^{o}, 22^{0} and 18^{0} respectively. Coir matting of 8500 m2 (in 1st phase) and 7800 m2 (in 2nd phase) and 2040 (3rd phase) has already been completed, followed by plantation with native species.

			Photos of the same are attached as **ANNEXURE – XXII**
34	The reclamation of waste dump sites shall be done in scientific manner as per the Approved Mining Plan cum Progressive Mine Closure Plan.	COMPLIED	Reclamation will be done as per approved mine plan
35	The slope of dumps shall be vegetated in scientific manner with suitable native species to maintain the slope stability, prevent erosion and surface run off. The selection of local species regulates local climatic parameters and help in adaptation of plant species to the microclimate. The gullies formed on slopes should be adequately taken care of as it impacts the overall stability of dumps. The dump mass should be consolidated with the help of dozer/ compactors thereby ensuring proper filling/ levelling of dump mass. In critical areas, use of geo textiles/ geo-membranes / clay liners / Bentonite etc. shall be undertaken for stabilization of the dump.	COMPLIED	Dump site is protected by providing geotextile mats along with plantation, seed broadcasting, vetiver grassing over the dumps. The dump mass should be consolidated with the help of dozer/ compactors thereby ensuring proper filling/ levelling of dump mass Photos of coir matting and vetiver grassing over dump is attached as **ANNEXURE – XXII and ANNEXURE XXX respectively.**
36	The Project Proponent shall carry out slope stability study in case the dump height is more than 30 meters. The slope stability report shall be submitted to concerned regional office of MoEF&CC.	COMPLIED	Slope stability study has been conducted as per DGMS guidelines. Copy of the report is attached as **ANNEXURE – XXVI.**
37	Catch drains, settling tanks and siltation ponds of appropriate size shall be constructed around the mine working, mineral yards and Top Soil/OB/Waste dumps to prevent run off of water and flow of sediments directly into the water bodies (Nallah/ River/ Pond etc.). The collected water should be utilized for watering the mine area, roads, green belt development, plantation etc. The drains/ sedimentation sumps etc. shall be de-silted regularly, particularly after monsoon season, and maintained properly	COMPLIED	Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. Settling ponds and check dams are constructed with adequate sump capacity designed with appropriate safety margin based on long term rainfall data to arrest silt and sediment flows from mine operation, soil, OB and mineral dumps, thus collected water is used for dust suppression and green belt development. The drains and settling ponds are de-silted on a regular basis. Photographs of the same are attached as **ANNEXURE XXIII** and **ANNEXURE XXIV.**

38	Check dams of appropriate size, gradient and length shall be constructed around mine pit and OB dumps to prevent storm run-off and sediment flow into adjoining water bodies. A safety margin of 50% shall be kept for designing of sump structures over and above peak rainfall (based on 50 years' data) and maximum discharge in the mine and its adjoining area which shall also help in providing adequate retention time period thereby allowing propersettling of sediments/ silt material. The sedimentation pits/ sumps shall be constructed at the corners of the garland drains	COMPLIED	Garland drains, retaining walls are provided at the foot of the dumps to arrest silt. Adequate check dams are constructed. The drains and settling ponds are de-silted on a regular basis. Photographs of the same are attached as **ANNEXURE XXIII**.
39	The top soil, if any, shall temporarily be stored at earmarked site(s) within the mine lease only and should not be kept unutilized for long. The physical parameters of the top soil dumps like height, width and angle of slope shall be governed as per the approved Mining Plan and as per the guidelines framed by DGMS w.r.t. safety in mining operations shall be strictly adhered to maintain the stability of dumps. The topsoil shall be used for land reclamation and plantation purpose.	COMPLIED	No top soil is generated as it is a working mines
	VII. Transportation		
40	No Transportation of the minerals shall be allowed in case of roads passing through villages/ habitations. In such cases, PP shall construct a 'bypass' road for the purpose of transportation of the minerals leaving an adequate gap (say at least 200 meters) so that the adverse impact of soundand dust along with chances of accidents could be mitigated. All costs resulting from widening and strengthening of existing public road network shall be borneby the PP in consultation with nodal State Govt. Department.	COMPLIED	No transportation of the minerals is allowed through the roads passing through villages/ habitations. Dispatch is done only through NH. Parking plaza of capacity 200 trucks is being provided to reduce traffic on the NH. Photograph is attached as **ANNEXURE VII.** Vacuum road sweeping machine is operational on Mineral transportation road. Necessary sprinkling is done through 16 KL mobile water sprinkler.

	Transportation of minerals through road movement in case ofexisting village/ rural roads shall be allowed in consultation with nodal State Govt. Department only after required strengthening such that the carrying capacity of roads is increased to handle the traffic load. The pollution due to transportation load on the environment will be effectively controlled and water sprinkling will also be done regularly. Vehicular emissions shall be kept under control and regularly monitored. Project should obtain Pollution Under Control (PUC) certificate for all the vehicles from authorized pollution testing centres		Photograph of the operational Road Sweeping Machine is attached as **ANNEXURE IV.** PUC check are being done on regular basis. All vehicles entering the mine premises are checked for emission of the vehicle (PUC) to ascertain emission limits as per the pollution norms.
41	The Main haulage road within the mine lease should be provided with a permanent water sprinkling arrangement for dust suppression. Other roads within the mine lease should be wetted regularly with tanker-mounted water sprinkling system. The other areas of dust generation like crushing zone, material transfer points, material yards etc. should invariably be provided with dust suppression arrangements. The air pollution control equipment's like bag filters, vacuum suction hoods, dry fogging system etc. shall be installed at Crushers, belt- conveyors and other areas prone to air pollution. The belt conveyor should be fully covered to avoid generation of dust while transportation. PP shall take necessary measures to avoid generation of fugitive dust emissions	COMPLIED	Fixed water sprinkler of around 1.2 Km has been provided in part of the haul road. Water sprinkling are being doone along the haul road by two number of truck mounted tanker of reported capacity 50Kl and 16KL Dust Suppression System (Dry fog system) has been provided at crusher and screening plant. Generation of fugitive dust emissions are controlled by regular water sprinkling on haul roads and mechanical road sweepers on concrete road, paved areas. Water sprinkling are being done on the haul road and vacuum sweeping on the national Highway to control fugitive dust. Photographs of the same are attached as **ANNEXURE XIII.**
	VIII. Green Belt		
42	The Project Proponent shall develop greenbelt in 7.5m wide safety zone all along the mine lease boundary as per the guidelines of CPCB in order to arrest pollution emanating from mining operations within the lease. The whole Green belt shall be developed within first 5 years starting from	COMPLIED	A total of 21352 saplings were planted by the end of 2024-25, which included safety zone plantation, dump plantation, nearby NH plantation etc. It covers about 8.5 Ha of area. Photographs of the same are attached as **ANNEXURE XLII.**

	windward side of the active mining area. The development of greenbelt shall be governed as per the EC granted by the Ministry irrespective of the stipulation made in approved mine plan.		
43	The Project Proponent shall carryout plantation/ afforestation in backfilled and reclaimed area of mining lease, around water body, along the roadsides, in community areas etc. by planting the native species in consultation with the State Forest Department/ Agriculture Department/ Rural development department/ Tribal Welfare Department/ Gram Panchayat such that only those species be selected which are of use to the local people. The CPCB guidelines in this respect shall also be adhered. The density of the trees should be around 2500 saplingsper Hectare. Adequate budgetary provision shall be made for protection and care of trees	COMPLIED	A total of 21352 saplings were planted by the end of 2023-24, which included safety zone plantation, dump plantation, nearby NH plantation etc. It covers about 7 Ha of area. Photographs of the same are attached as **ANNEXURE XLII.**
44	The Project Proponent shall make necessary alternative arrangements for livestock feed by developing grazing land with a view to compensate those areas which are coming within the mine lease. The development of such grazing land shall be done in consultation with the State Government. In this regard, Project Proponent should essentially implement the directions of the Hon'ble Supreme Court with regard to acquisition of grazing land. The sparse trees on such grazing ground, which provide mid-day shelter from the scorching sun, should be scrupulously guarded/ protected against felling and plantation of such trees should be promoted.	COMPLIED	Fodder plots have been developed in the non-mineralized area of the Mining lease. Photographs of the same is enclosed as **ANNEXURE – XXV.**
45	The Project Proponent shall undertake all precautionary measures for conservation and protection of endangered flora and fauna and Schedule-I species during mining operation. A Wildlife Conservation Plan shall be prepared for the same clearly delineating action to be taken for		The State Forest Department implements the Wild Life Conservation Plan as approved by PCCF (Wildlife) & Chief Wildlife Warden, Bhubaneswar. Letter with detail cost breakup is enclosed as **ANNEXURE-XLIII.** Compensatory afforestation is being carried out by State Forest department. Financial outlay for activities in project area given Rs.

	conservation of flora and fauna. The Plan shall be approved by Chief Wild Life Warden of the State Govt.		27,43,000 for Compensatory afforestation and expenditure detail with its implementation certificate is requested to DFO, Bonai vide letter no- JSW/SSWCP/2023/457 dt. 3.8.2023 for obtaining the same. The letter copy is enclosed as **ANNEXURE XXXII.**
46	And implemented in consultation with the State Forest and Wild Life Department. A copy of Wildlife Conservation Plan and its implementation status (annual) shall be submitted to the Regional Office of the Ministry.		The State Forest Department implements the Wild Life Conservation Plan as approved by PCCF (Wildlife) & Chief Wildlife Warden, Bhubaneswar. Letter with detail cost breakup is enclosed as **ANNEXURE-XLIII** Compensatory afforestation is being carried out by State Forest department. Financial outlay for activities in project area given Rs. 27,43,000 for Compensatory afforestation and expenditure detail with its implementation certificate is requested to DFO, Bonai vide letter no- JSW/SSWCP/2023/457 dt. 3.8.2023 for obtaining the same. The letter copy is enclosed as **ANNEXURE XXXII.**
	IX. Public hearing and human health issues		
47	The Project Proponent shall appoint an Occupational Health Specialist for Regular as well as Periodical medical examination of the workers engaged in the mining activities, as per the DGMS guidelines. The records shall be maintained properly. PP shall also carryout Occupational health check-ups in respect of Workers which are having ailments like BP, diabetes, habitual smoking, etc. The check-ups shall be undertaken once in six months and necessary remedial/ preventive measures be taken. A status report on the same may be sent to MoEFCC Regional Office and DGMS on half-yearly basis.	COMPLIED	Occupational health specialist for regular as well as periodical examination is appointed as per DGMS guidelines. Check-ups in respect of Workers which are having ailments like BP, diabetes, habitual smoking, etc are undertaken once in six months.
48	The Project Proponent must demonstrate commitment to work towards 'Zero Harm' from their mining activities and carry out Health Risk Assessment (HRA) for identification workplace hazards and assess their potential risks to health anddetermine appropriate control measures to protect the health and wellbeing of workersand nearby community. The proponent shall maintain	COMPLIED	Health Risk Assessment (HRA) for identification workplace hazards has been carried out.

	accurate and systematic records of the HRA. The HRA for neighbourhood has to focus on Public Health Problems like Malaria, Tuberculosis, HIV, Anaemia, Diarrhoea in children under five, respiratory infections due to bio mass cooking. The proponent shall also create awareness and educate the nearby community and workers for Sanitation, Personal Hygiene, Hand washing, not to defecate in open, Women Health and Hygiene (Providing Sanitary Napkins), hazard of tobacco and alcohol use. The Proponent shall carryout base line HRA for all the category of workers and thereafter every five years.		
49	The Proponent shall carry out Occupational health surveillance which be a part of HRA and include Biological Monitoring where practical and feasible, and the tests and investigations relevant to the exposure (e.g. for Dust a X-Ray chest; For Noise Audiometric; for Lead Exposure Blood Lead, For Welders Full Ophthalmologic Assessment; for Manganese Miners a complete Neurological Assessment by a Certified Neurologist, and Manganese (Pin) Estimation in Blood; For Inorganic Chromium- Fortnightly skin inspection of hands and forearms by a responsible person. Except routine tests all tests would be carried out in a Lab accredited by NABH. Records of Health Surveillance must be kept for 30 years, including the results of and the records of Physical examination and tests. The record of exposure due to materials like Asbestos, Hard Rock mining, Silica, Gold, Kaolin, Aluminium, Iron, Manganese, Chromium, Lead, Uranium need to be handed over to the Mining Department of the State in casethe life of the mine is less than 30 years. It would be obligatory for the		IME has been conducted for Narayanposhi Iron and Mn Ore mines. The X-ray test, audiometry test , neurological test are being conducted. Only 12 employees are exposed to the manganese, whose records are being maintained.

	State Mines Departments to make arrangements for the safe and secure storage of the records including X- Ray. Only conventional X- Ray will be accepted for record purposes and not the digital one). X-Ray must meet ILO criteria (17 x14 inches and of good quality).		
50	The Proponent shall maintained a record of performance indicators for workers which includes (a) there should not be a significant decline in their Body Mass Index and it should stay between 18.5 - 24.9, (b) the Final Chest X-Ray compared with the base line X-Ray should not show any capacities ,(c) At the end of their leaving job there should be no Diminution in their Lung Functions Forced Expiratory Volume in one second (FEVI),Forced Vital Capacity (FVC), and the ratio) unless they are smokers which has to be adjusted, and the effect of age, (d) their hearing should not be affected. As a proof an Audiogram (first and last need to be presented), (e) they should not have developed any Persistent Back Pain, Neck Pain, and the movement of their Hip, Knee and other joints should have normal range of movement, (f) they should not have suffered loss of any body part. The record of the same should be submitted to the Regional Office, MoEFCC annually along with details of the relief and compensation paid to workers having above indications.		The X-ray test, audiometry test, neurological test are being conducted. The employees have not developed any Persistent Back Pain, Neck Pain, and the movement of their Hip, Knee and other joints. Doctor's undertaking is attached as **ANNEXURE XLIV.**
51	The Projects Proponent shall ensure that 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.		Personnel working in dusty areas are provided with nose mask, safety glass and ear plug with proper safety training. Vocational training is being provided to all the employees and associates through Group VTC of JSW.

52	Project Proponent shall make provision for the housing for workers/labours or shall construct labour camps within/outside (company owned land) with necessary basic infrastructure/ facilities like fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche for kids etc. The housing may be provided in the form of temporary structures which can be removed after the completion of the project related infrastructure. The domestic waste water should be treated with STP in order to avoid contamination of underground water.		Provision of Toilets, drinking water, health care facilities has been developed for the workers and truck drivers. associated in mining operation. Labour camp has been provided with all basic amenities including 30 KL STP.
53	The activities proposed in Action plan prepared for addressing the issues raised during the Public Hearing shall be completed as per the budgetary provisions mentioned in the Action Plan and within the stipulated time frame. The Status Report on implementation of Action Plan shall be submitted to the concerned Regional Office of the Ministry along with District Administration.		Details of implementation of action plan prepared for addressing the issues raised during the Public Hearing has been attached as **ANNEXURE XLV**.
	X. Corporate Environment Responsibility (CER)		
54	The activities and budget earmarked for Corporate Environmental Responsibility (CER) as per Ministry's 0. M No 22-65/20 17-IA. II (M) dated 01.05.2018 or as proposed by EAC should be kept in a separate bank account. The activities proposed for CER shall be implemented in a time bound manner and annual report of implementation of the same along with documentary proof viz. photographs, purchase documents, latitude & longitude of infrastructure developed & road constructed needs to be submitted to Regional Office, MoEF&CC annually along with audited statement.	Being Complied	Details of expenditure on Corporate Environmental Responsibility is attached as **ANNEXURE XLVI.**

55	Project Proponent shall keep the funds earmarked for environmental protection measures in a separate account and refrain from diverting the same for other purposes. The Year wise expenditure of such funds should be reported to the MoEF&CC and its concerned Regional Office.	COMPLIED	An expenditure of Rs 2.28 Cr during the period of April 2024 to March 2025 has been incurred on dust suppression, fixed water sprinkling, online monitoring, water sprinkling on NH, OB Dump management etc
	XI. Miscellaneous		
56	The Project Proponent shall prepare digital map (land use & land cover) of the entire lease area once in five Years purpose of monitoring land use pattern and submit a report to concerned Regional Office of the MoEF&CC.	COMPLIED	Digital Map (land use and land cover) of the entire lease area is furnished on 21/09/2021. This map is to be submitted once in five years as per given condition. The Map is Attached as **ANNEXURE XLVII.**
57	The Project Authorities should inform to the Regional Office regarding date of financial closures and final approval of the project by the concerned authorities and the date of start of land development work.	Agreed to comply	Since Narayanposhi Iron & Manganese Ore Mines is a brown field project as JSW Steel Limited has got the lease during May 2020 through auction process and the EC granted to ex-lessee vide MoEF&CC (GoI) letter no. J-11015/288 /2008-IA-II(M), dated 18.06.2019 which is vested to JSW Steel Limited vide extant rules. At the time of vesting, the project was in operation at the permitted capacity. Accordingly financial closure and start of land development work was started by erstwhile lessee prior to our acquisition.
58	The Project Proponent shall submit six monthly compliance reports on the status of the implementation of the stipulated environmental safeguards to the MOEFCC & its concerned Regional Office, Central Pollution Control Board and State Pollution Control Board.	COMPLIED	Six monthly EC Compliance report is submitted to the MOEFCC & its concerned Regional Office, Central Pollution Control Board and State Pollution Control Board vide No. JSW/S/CO/2024/671 dated 15/11/2024 for the period April 2024 – September 2024.
59	A separate Environmental Management Cell' with suitable qualified manpower should be set-up under the control of a Senior Executive. The Senior Executive shall directly report to Head of the Organization. Adequate number of qualified Environmental Scientists and Mining Engineers shall be appointed and submit a report to RO, MoEF&CC.	Complied	Environment Management Cell (EMC) structure has been attached as **ANNEXURE XLVIII.**

60	The concerned Regional Office of the MoEF&CC shall randomly monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the MoEF& CC officer(s) by furnishing the requisite data / information /monitoring reports.	Agreed Upon	Agreed to comply

ANNEXURE I



R.R Sl. No. 12314
Date 04-08-2023

AFFIDAVIT

I Biswaranjan Kumar Padhi, working as Vice-President (Operation) of JSW Steel Ltd having its registered office JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai – 400051 and Mining Office Singhania Tower, Bhusugaon, Bhadrasahi, PO-Barbil, Dist-Keonjhar, Odisha do solemnly affirm and declare as under:

1. That, I am Vice-President and Agent of Narayanposhi Iron & Mn. Mines of JSW Steel Ltd and hence, competent to swear this affidavit.

2. That, I undertake to comply with all the conditions as prescribed in Environment Clearance accorded to Narayanposhi Iron and Manganese Ore Mine of M/s. JSW Steel Ltd. vide EC No. J-11015/288/2008-IA. II (M).

3. That the facts stated in the accompanying information sheet with annexures are based on available records and true to the best of my knowledge and belief.

DEPONENT

The above named deponent solemnly affirmed and declared before me.

04-08-2023

Narayanananda Tripathy
ADVOCATE & NOTARY
Regd. No. ON/03/2013
Barbil, Dist. Keonjhar (Odisha)

NOTARY
Narayanananda Tripathy
Regd. No. ON/03/2013
Expiry Date 28-01-2027
BARBIL
GOVT. OF ODISHA

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ANNEXURE II

Steel Limited

Regd. Office: JSW CentreBandra
Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925Phone :
+91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2025/227 Date: 22/05/2025

To,
The Member Secretary
State Pollution Control Board, Odisha,
Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-8,
BHUBANESWAR- 751012

Sub: - Submission of 9 Points NEERI Compliance Status Report of FY 2024-25 for **Narayanposhilron & Manganese Ore Mine of M/s JSW Steel Ltd.**

Ref: - 1. Vested Consent Order No 1008 vide letter no 6785/IND-I-CON-2258, dated 08.07.2019
2. New Consent Order No 2944 vide letter no 4651/IND-I-CON-2258 dated 30.03.2024.

Dear Sir,

With reference to aforesaid subject, please find enclosed herewith the 9 Points NEERI Compliance Status Report of FY 2024-25 for **Narayanposhi Iron & Manganese Ore Mine ofM/s JSW Steel Ltd**.

Seeking your co-operation as always.

Thanking you, Yours

Faithfully
For JSW Steel Ltd

Vijay Kumar 22/05/25

Vijay Kumar
(Authorized Signatory)

Encl: As above

Copy to- The Regional Officer, Regional Office, Rourkela, Office of the State Pollution ControlBoard, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha.

NEERI REPORT COMPLIANCE STATUS – GONUA MINE

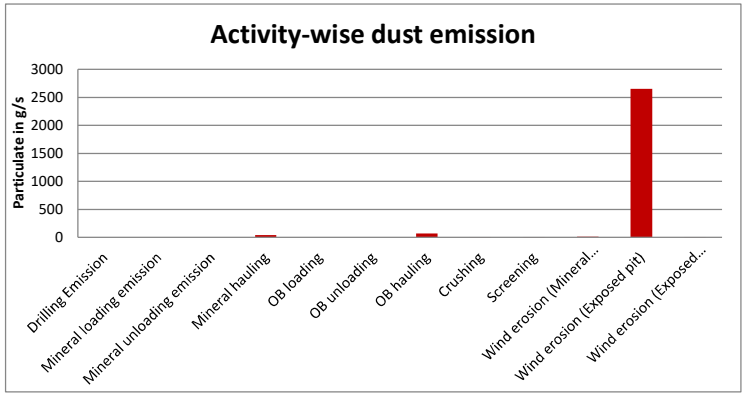
Sl. No.	Recommendation by CSIR-NEERI	Action Taken
1	The individual lease **holders shall make assessment and quantification of emission load generation (in terms of air pollution, noise, wastewater and** solid waste) from each of the mining activity (including transportation) forthe period starting from 1st April to 31st March and submit report by June of every year. Efforts should be made to further eliminate/ minimize generation of air pollution/ dust, noise, wastewater,solid waste generation in successive years through use of better technology.Necessary guidance many be sought from Regional Officer, SPCB on load calculation.	The project has already been practicing different environmental safeguard measures for pollution prevention The measures are- Mobile water sprinkling arrangement has been provided for the haul roads, processing area and loading / unloading points tominimize dispersion of air borne dust particles. Fixed water sprinkling beingmaintained and operated. Wet drilling arrangement with acoustic enclosure is in practice to control dust right at the source. Dust Suppression System (Dry fog system) being provided at all appropriate places of mineral handling plants (crusher & screeningplant) and other areas. Same are being maintained for proper dust control. No process water being discharged from the mine. Noise producing equipment's are covered as far as practicable. Workers engaged in Operations are provided with ear plugs / muffs. Besides this, acoustic enclosures are provided for all machines operating within themines. The overburden generated as solid waste is stacked at the earmarked areas and are covered by Coir matting followed by tree plantation. The vehicles carrying the loaded materials are being covered with tarpaulin. Annual Assessment and quantification of emission load generation is enclosed as Annexure I.
2	Monitoring of ambient air and fugitive emission in core zone shall be carried out on daily basis. Minimum four ambient air quality monitoring stationsshall be installed in the core zone. Out of four, at least one on-line monitoring station shall be installed in case of mines having EC capacity of 3 MTPA of more. Moreover, one station should be located near the ore carrying truck entry and exit gate of mine. A letter in this regard has already been communicated to individual leaseholder of capacity 3 MTPA and above vide Board's Letter no-7807, dt. 30.06.2018.	Three Continuous Ambient AirQuality Monitoring Stations (CAAQMS) are installed at the site in consultation with Regional Officer, Rourkela. All 3 CAAQMS are equipped with data transfer facility to OSPCB. In addition, regular environmental monitoring is conducted through a third-party NABL-accredited laboratory, Ecomen Mining Pvt. Ltd.

3	Monitoring in buffer zone shall be carried out by through NABET accredited agency preferably, at locations of nearest human habitation including schools and other public amenities located nearest to source of dust generation as applicable. Themonitoring station shall be installed in core and buffer zone in consultation with Regional Officer, SPCB.	Monitoring in buffer zone (in consultation with RO, SPCB) is also carried out by M/s Ecomen Mining Pvt Ltd (NABL Accredited Laboratory).
4	Monitoring stations shall be facilated for measurement of CO as an additionalparameter to the other parameters SPM,PM10, PM2.5, SO_2 and NO_2. The monitoring result shall be compiled and submitted to Board on annual basis.	CO is also measured along with PM10, PM2.5, SO_2 and NO_2. Consolidated monitoring report for FY 2024-25 is submitted to the Regional Officer, SPCB.
5	All the vehicles engaged in mining and transporting activity in the mine shall have Pollution under Control (PUC) certificate. A record of the same shall be maintained for verification of inspecting agency.	Transportation vehicles without a valid PUC is not permitted inside the mines. Mineral carrying trucks are not allowed to leave the lease area without tarpaulin cover and is being monitored by security personnel at the exitgate.
6	Noise level should be monitored near the major sources of noise generationwithin the core zone once in week and submit the report annually. Further, date, time and distance of measurementshall also be indicated with the noise levels in the report. The data shall be used to map the noise generation from different activities and efforts should bemade to maintain the noise levels with the acceptable limits of CPCB. The monitoring schedule shall be informed to Regional Officer, SPCB in order to ensure his presence 25% of the monitoring program.	Noise level is monitored weekly near the major sources like the crushing and screening unit, loading and unloading areas, haul roads, drilling units, excavator, dumper etc. It is carried out through M/s Ecomen Mining Pvt Ltd (NABL Accredited Laboratory). Consolidated monitoring report for FY 2024-25 is submitted to the Regional Officer, SPCB.
7	Measurement of flow rate of the springsand perennial nallah passing throughthe mining lease area shall be done on monthly basis. Identification of the perennial streams to be brought under the monitoring program and the location the flow measurement shall be determined in consultation withRegional Officer, SPCB. The consolidated report shall be submitted to Board on annual basis.	Flowrate of nearby surface water bodies are monitored on a monthly basis. Consolidated monitoring report for FY 2024-25 is submitted to the Regional Officer.
8	Effort shall be made to recycle or reusethe treated wastewater from ETP of work shop and STP of residential colony instead of discharging to outside.	A 50 KLD STP is installed in the colony to treat domestic wastewater. The treated water is reused for plantation. An ETP with an Oil & Grease trap is also provided to treat wastewater from washing machineries, and the

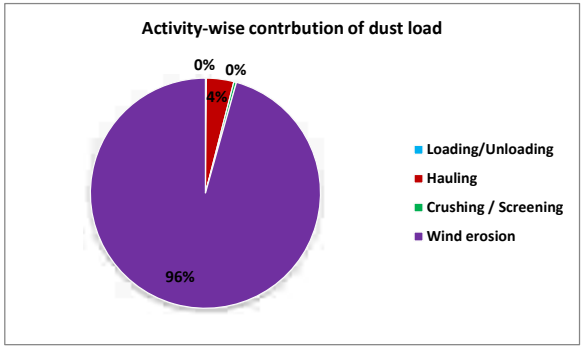
		treated water is recirculated and is used for washing.
9	Annual environmental sustainabilityreport (ESR) shall be made highlightingthe efforts made towards environmentalprotection with respect to different environmental components vis-à-visproduction performance of the mine on monthly basis. The data collected as perEC and CTE/CTO conditions should beutilized to prepare the annualsustainability report. The report shall be submitted to SPCB and RO, MoEF&CC by June of every year.	Annual environmental sustainability report(ESR) is enclosed as **Annexure II.**

RESULTS OF DUST LOAD CALCULATIONS

	Particulate matter in (g/s)	Particulate matter in (kg/d)	Particulate matter (kg per ton of ore)
Drilling Emission	0.06679882	5.771418206	0.000360308
Mineral loading emission	1.75785308	151.8785065	0.00948174
Mineral unloading emission	0.43629357	37.6957648	0.002353338
Mineral hauling	40.7383368	3519.792301	0.219739812
OB loading	0.70290758	60.73121467	0.003791436
OB unloading	0.46745375	40.38800417	0.002521414
OB hauling	66.4912397	5744.843109	0.358649214
Crushing	4.07407407	352	0.021975278
Screening	6.66666667	576	0.035959546
Wind erosion (Mineral stack)	11.024325	952.5016825	0.059464458
Wind erosion (Exposed pit)	2652.00024	229132.8205	14.30470848
Wind erosion (Exposed OB dump)	6.68964046	577.9849357	0.036083465
Total	**2791.116**	**241152.41**	**15.055088**



Major Activity	Dust load (kg/day)
Loading/Unloading	290.69349
Hauling	9264.63541
Crushing / Screening	928
Wind erosion	230663.307



GO TO MAIN PAGE

GO TO DATA ENTRY PAGE

GASEOUS LOAD CALCULATIONS FOR NARAYANPOSHI IRON & MANGANESE ORE MINES

During the field study, it was observed that dust is the major source of emission from various surface mining activities, whereas emission of SO_2 and NOx were negligible in comparison to the NAAQS protocol. Therefore, SO_2 and NOx emissions were measured considering mine as a whole and not for each activity of the mine. And the CO emission measured is insignificant to calculate the load in the iron ore mines.

Formulae for SO_2 and NO_x emission rates of overall mine

Activity	Parameter			Equation
	Symbol	Name	Unit	
Overall mine	u	Wind speed	$m\ s^{-1}$	For SO_2
	c	Iron ore production	$Mt\ year^{-1}$	$E = a^{0.7}[u/(11 + 4.4u)][c/(0.9 + 1.6c)] + [b/(3.3 + 19.9b)]$
	b	Waste handling	$Mm^3\ year^{-1}$	
	a	Leasehold area	km^2	For NO_x
	E	Emission rate	$g\ s^{-1}$	$E = 0.01ab[c/(1.38 + 0.26c)] + b^{1.1}]$

Source: S.K. Chaulya / Emission rate formulae for surface iron ore mining activities

Input data

1. u = wind-speed = 2.5 m/s
2. c = Iron ore production = 5.63 Mt/year
3. b = Waste handling = 2.1 Mm^3/year
4. a = leasehold area = 3.47 km^2
5. E = Emission rate = g/s

Results of gaseous load

S. No.	Parameter	Value	Kg/Day	Ton/Year
1.	SO_2	0.04 g/s	3.456	1.261
2.	NOx	0.38 g/s	32.832	11.984

Annual Environmental Sustainability Report (ESR) for Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd.

Introduction-

The Narayanposhi Iron and Manganese Ore mine (erstwhile lessee M/s Aryan Mining & Trading Corporation Pvt. Limited) was one of the mines whose lease expired on 31.03.2020. The lease area is located in villages Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF villages under Koira tehsil of Sundergarh district, Odisha state.

In pursuant to the Mines and Minerals (Development and Regulation) Act, 1957 and the Mineral (Auction) Rules, 2015, Govt. of Odisha issued the notice inviting tender dated December, 2019 for commencement of the auction process to grant the mining lease in respectof Narayanposhi Iron & Manganese Ore Block over an area of 349.254 Ha as per ROR (347.008 Ha as per DGPS computation) in villages Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF of Sundargarh District, Odisha for a resource size of about 186.05 Million tonnes (Mt). The e-auction process was conducted in accordance with the tender document and the mineral auction rule, 2015 for the said mineral block and M/s JSW Steel Limited was declared as the preferred bidder under Rule 9(9)(iii) of Mineral (Auction) Rules 2015.

Without prejudice to the generality of the provisions of section 8B(2) of the MMDR Act, 1957, the details of the valid rights, approvals, clearances, licenses and the like held by the previous lessee are vested in favor of M/S JSW Steel Ltd by the Govt. of Odisha for a period of 2 years from the date of execution of lease deed or till the date of getting fresh approvals, clearances, licenses, permits, and the like, whichever is earlier vide order No-4212/SM, dated **30.05.2020**. M/s JSW Steel Limited being successful bidder upon execution of mining lease deed, the successful bidder shall immediately, but not later than one hundred twenty days from the dateof execution of mining lease, apply afresh for all necessary rights, approvals, clearances, licenses and the like under the applicable statutes, rules or regulations, as the case may be, forobtaining the necessary clearances to enable further continuance of the mining operations beyond two years and vesting order shall be valid for a period of two years from the date of execution of new lease deed or till the date of getting all fresh approvals, clearances, licenses, permits, and the like, whichever is earlier.

On 10.06.2020, JSW has deposited INR 19,30,88,250/- towards the Advance Net Present Value [NPV] in CAMPA against the demand note raised by DFO, Bonai, Sundargarh District. The Mining Lease was granted in favor of M/s JSW Steel Limited for a period of 50 years w.e.f 26.06.2020. Subsequent to signing of the MDPA with the Collector, Sundargarh**, M/s JSW Steel Limited** has made payment of the third installment being the eighty percent of the upfrontvalue and executed and registered the mining lease with the Government of Odisha on 27.06.2020.

Indicative Coordinates Range of the Narayanposhi Iron & Manganese Ore Mine

Latitudes : 21°54’46.07” N - 21°56’23.13” N
Longitudes : 85°13’41.16” E - 85°14’56.56” E

Fully mechanized open cast method of mining by drilling and blasting and by deploying HEMM equipment’s like hydraulic drills and excavators, wheel loaders, dumpers, will be undertaken. The height and width of the benches for iron ore will be kept at 9 m and 15 m

respectively. The working of benches will be commenced from top and extended to bottom benches. The excavated ROM ore is proposed to be processed in the crushing and screening plants to obtain the lump and fine ore as product mix. The iron ore lumps and iron ore fines extracted from the mine will be transported through railway/port/road to JSW Steel Plants.

Production in FY 2024-25

Narayanposhi mining operations started from 01.07.2020 based on the vested approvals. During the financial year of 2024-25 (April 2024 to March 2025), Narayanposhi Mine has produced 5846458 MT Iron Ore (ROM)& 1610 Tonnes Manganese Ore and same are dispatched to steel plants.

Environment Management in Narayanposhi Mine

Air Management-

Blasting Operation

- Controlled blasting method is in practice by restriction of explosive charge in the holes.
- Well-designed blast by effective stemming and use of milli second delay detonators,Proper blasting designing to see that the optimum breakage occurs.
- To control ground vibrations and arrest fly rocks, advanced initiation system is beingused for blasting
- Ground vibrations are also being monitored and the results are well within limits.

Excavation, Hauling and Crushing & Screening

- Dry fog system for crusher & screen plants are provided.
- Proper maintenance of HEMM
- Using sharp teeth for shovels and other soil excavation equipment, and their periodicalreplacements.
- Acoustic enclosures for operator cabin.
- Avoiding overloading of dumpers
- Provision of dust filters / masks to workers working at highly dust prone and affectedareas
- Imparting sufficient training to operators on safety and Environmental parameters.

Transportation

- Regular water sprinkling is being carried out by engaging mobile water tankers on the mine benches, mine haul, loading and unloading points and transfer points for dust suppressions.
- Maintenance of haul road by regular grading is carried out through grader, dozer.
- Ensuring that all mineral trucks are covered by tarpaulin.
- Vehicular emissions controlled through regular and proper preventive maintenanceschedules.
- It is ensured that there is no overloading of trucks by having Quick Dispatch system atthe weigh bridge near the dispatch gate.
- Regular water sprinkling arrangements have been made on the transportation roads/public road through mobile water tankers.





Wet Drilling and Dust Extractor System in Drilling Operation





Quick Dispatch System

Existing Fixed Sprinkling System





16 KL and 50 KL Water Tanker Arrangement or Haul Road Dust Suppression





Dry Fog System in Mineral Handling Plants

CONSOLIDATED AIR QUALITY MONITORING DATA OF FY 2024-2025										
NARAYAN POSHI IRON & Mn ORE MINES										
AAQ DATA FOR THE PERIOD APRIL 2024 TO MARCH 2025										
	PM10(µg/m³)		PM2.5(µg/m³)		SO2(µg/m³)		NO2(µg/m³)		CO(µg/m³)	
	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM
CORE ZONE										
Near mines office	69.3	52.16	31.7	29.2	17.1	14.52	27.7	21.29	0.66	0.52
Gate No-02	74.1	56.21	35.1	31.4	16.9	12.3	24.5	20.7	0.63	0.49
Gate No-01	71.5	56.1	33.1	29.42	18.9	15.3	26.8	21.3	0.61	0.45
Rest Shelter	65.1	60.2	33.1	30.2	18.3	15.1	20.7	17.2	0.55	0.49
BUFFER ZONE										
Kasira Basti	56.2	50.1	35.1	26.1	17.2	14.3	20.01	15.2	0.65	0.5
Koira basti	57.3	49.1	28.1	20.78	15.2	13.9	18.5	15.2	0.6	0.45
Segasahi Village	56.1	51.2	35.2	25.2	16.5	14.4	17.2	13.4	0.55	0.36
Bhanjpali Village	55.3	48.2	30.5	24.1	17.2	14.4	18.2	13.6	0.41	0.32
NAAQ standard for Industrial ,residental,rural and other areas(24 hour)	**100(µg/m³)**		**60(µg/m³)**		**80(µg/m³)**		**80(µg/m³)**		**60(mg/m³) hourly**	

Water & OB Dump Management

- Garland drains maintained of suitable size around mine area and dump with propergradients to prevent rain water descent into active mine area.
- Settling ponds maintained to prevent flow of fine particles from OB / Waste dumps,check dams, parapet / retaining walls & garland drains.
- Usage of stored water in the settling ponds for watering of haul roads, vehicle washingand green belt development etc.
- De- silting of garland drains & settling ponds are being carried out at regular intervals.
- Maintenance of all the runoff management structures



Retaining Wall



Settling Pond





Dump Plantation

CONSOLIDATED GROUND WATER QUALITY MONITORING DATA OF FY 2024-2025					
NARAYAN POSHI IRON & Mn ORE MINES					
Dug well at Koira Basti					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
Ph		7.2	6.1	**6.5-8.5**	**No Relaxation**
Total Hardness	**mg/l**	65.3	45.2	**200**	**600**
Iron	**mg/l**	0.65	0.33	**1**	**No Relaxation**
Chloride	**mg/l**	26.5	22.3	**250**	**1000**
Total Dissolved Solids	**PPM**	120.1	115.3	**500**	**2000**
Sulphates	**mg/l**	8.6	5.6	**200**	**400**
Floride	**mg/l**	0.26	0.23	**1**	**1.5**
Dug well at Kasira Basti					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
Ph		7.1	6.02	**6.5-8.5**	**No Relaxation**
Total Hardness	**mg/l**	55.8	30.7	**200**	**600**
Iron	**mg/l**	0.45	0.33	**1**	**No Relaxation**
Chloride	**mg/l**	25.3	20.2	**250**	**1000**
Total Dissolved Solids	**PPM**	146.3	100.4	**500**	**2000**

Sulphates	**mg/l**	8.6	5.6	**200**	**400**
Floride	**mg/l**	0.22	0.18	**1**	**1.5**
Borewell Quarry 4					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
Ph		7.5	6	**6.5-8.5**	**No Relaxation**
Total Hardness	**mg/l**	54.6	35.6	**200**	**600**
Iron	**mg/l**	0.61	0.52	**1**	**No Relaxation**
Chloride	**mg/l**	30.4	20.6	**250**	**1000**
Total Dissolved Solids	**PPM**	130.5	80.5	**500**	**2000**
Sulphates	**mg/l**	7.5	5.3	**200**	**400**
Floride	**mg/l**	0.25	0.18	**1**	**1.5**
Borewell Near Gate-01					
Parameter	**Units**	**Max**	**Min**	**Acceptable Limits**	**Permissible Limits**
Ph		7.2	6.3	**6.5-8.5**	**No Relaxation**
Total Hardness	**mg/l**	54.2	45.2	**200**	**600**
Iron	**mg/l**	0.65	0.3	**1**	**No Relaxation**
Chloride	**mg/l**	24.5	17.5	**250**	**1000**
Total Dissolved Solids	**PPM**	140.2	115.3	**500**	**2000**
Sulphates	**mg/l**	7.6	4.5	**200**	**400**
Floride	**mg/l**	0.26	0.21	**1**	**1.5**

CONSOLIDATED SURFACE WATER QUALITY MONITORING DATA OF 2024-2025				
NARAYANPOSHI IRON & Mn ORE MINES				
Orahari Nala Up-stream				
Parameters	**Units**	**Max**	**Min**	**Limits For Stream Water Standards**
Ph		7.2	6.3	6.5-8.5

Total Dissolve Solid (TDS)	**PPM**	180.2	130.1	1500
Choloride	**mg/l**	25.3	15.4	600
Iron	**mg/l**	1	0.89	50
Floride	**mg/l**	0.56	0.12	1.5
BOD	**mg/l**	4.5	3.5	3
Dissolve Oxygen	**mg/l**	7.2	4.1	4
Orahari Nala Down-stream				
Parameters	**Units**	**Max**	**Min**	**Limits For Stream Water Standards**
Ph		7.5	6.1	6.5-8.5
Total Dissolve Solid (TDS)	**PPM**	155	102.3	1500
Choloride	**mg/l**	24.1	18.5	600
Iron	**mg/l**	1	0.71	50
Floride	**mg/l**	0.44	0.25	1.5
BOD	**mg/l**	3.1	3	3
Dissolve Oxygen	**mg/l**	3.9	2.5	4
Karo River Up-stream				
Parameters	**Units**	**Max**	**Min**	**Limits For Stream Water Standards**
Ph		7.5	6.05	6.5-8.5
Total Dissolve Solid (TDS)	**PPM**	170.1	110.5	1500
Choloride	**mg/l**	35.4	18.5	600
Iron	**mg/l**	1	0.89	50
Floride	**mg/l**	0.56	0.12	1.5
BOD	**mg/l**	3	2.1	3
Dissolve Oxygen	**mg/l**	3.8	2.1	4
Karo River Down-stream				
Parameters	**Units**	**Max**	**Min**	**Limits For Stream Water Standards**
Ph		7.6	6.1	6.5-8.5
Total Dissolve Solid (TDS)	**PPM**	180.2	121.3	1500
Choloride	**mg/l**	30.2	19.5	600
Iron	**mg/l**	1	0.87	50
Floride	**mg/l**	0.56	0.24	1.5
BOD	**mg/l**	4.5	3.5	3

Dissolve Oxygen	**mg/l**	3.7	2.3	4
Kasira Nala Up-stream				
Parameters	**Units**	**Max**	**Min**	**Limits For Stream Water Standards**
Ph		7.5	6.2	6.5-8.5
Total Dissolve Solid (TDS)	**PPM**	195.2	90.01	1500
Choloride	**mg/l**	21.3	19.5	600
Iron	**mg/l**	1	0.89	50
Floride	**mg/l**	0.56	0.12	1.5
BOD	**mg/l**	4.5	3.1	3
Dissolve Oxygen	**mg/l**	3.9	2.1	4
Kasira Down-stream				
Parameters	**Units**	**Max**	**Min**	**Limits For Stream Water Standards**
Ph		7.2	6.2	6.5-8.5
Total Dissolve Solid (TDS)	**PPM**	210	102.3	1500
Choloride	**mg/l**	25.4	18.2	600
Iron	**mg/l**	1	0.89	50
Floride	**mg/l**	0.56	0.15	1.5
BOD	**mg/l**	4.5	3.4	3
Dissolve Oxygen	**mg/l**	3.5	2.2	4

Noise Management

- Providing sound proof operator's cabin for equipment like dumpers, shovel, tippers, etc.
- Planting trees at various places within the lease area to act as acoustic barriers.
- Proper and regular maintenance of vehicles, machinery and other equipment. All HEMMs are monitored for any abnormal sound and rectified with due precaution by maintenance personnel.
- Providing workers with ear muffs & earplugs against high noise levels.
- Conducting regular health check-ups of workers including Audiometry test
- Controlling the time of exposure of workers towards high noise areas.

Consolidated Noise Quality Monitoring Data FY 2024-2025			
CORE ZONE	**MAXIMUM**	**MINIMUM**	**STANDARDS**
Mines Face Bench	73.1	42.1	**85 db**
Haulage Road	72.1	54	

Crusher Plant	74.8	54.1	
Screen Plant	75.5	43.2	
Ore Storage & Loading Point	77.1	52.1	
Waste Dump	74.5	49.3	

BUFFER ZONE	**Leq Day**		**Leq Night**		**Standard**	
	Max	**Min**	**Max**	**Min**	**Max**	**Min**
Koira Basti	50.1	42.3	45	37.4	**55db**	**45db**
Kasira Basti	52.1	44.2	44.2	35.1		
East Boundary	74.2	70.1	50.1	35.4	**75db**	**70db**
West Boundary	73.5	70.5	50.2	38.4		
North Boundary	72.1	70.4	49.5	37.4		
South Boundary	73.2	71.8	47.6	36.5		

Electronic Digital Display Board at Narayanposhi Mine Gate



Narayanposhi Environmental Protection Measures Expenditure (head wise breakup)incurred from April 2024 to March 2025

Expenditure Incurred on Environmental Protection Measures for the Financial Year 2024-25		
Sl No	Expenditure head -Particulars	Cost incurred in INR
		Narayanposhi
1	Construction of Retaining walls	540000
2	Construction of Garland drains, desiltation of settling ponds	272160
3	Geotextile works for dump stabilization	795000
5	Greenbelt development- Pit digging, plantation and maintenance	2040920
6	Operation of Road sweeping machines	2040000
7	Operation of fixed sprinklers	50000
8	Operation of mobile sprinklers	11521418
9	Use of chemical dust suppresants in sprinkling	472000
10	Online air quality monitoring	493065.36
11	Environment monitoring through NABL Accredited third party	1069111
12	Installation of Sewage treatment Plant	1975000
13	Study conducted on hydrogeology from CGWA Accredited Agency	410000
14	Nursery Development	-
15	Landscape development	606000
16	Environmental Awareness Programmes	400000
17	Flowmeter calibration and stamping	105000
18	Drip irrigation for plantation	45600
Total		22835274.36

ANNEXURE III

Concrete Road near Gate 2





Photograph of concrete road from the NH to Manganese pit









Google earth map depicting existing concrete road to Manganese pit

ANNEXURE IV

ROAD SWEEPING MACHINE



ANNEXURE V

SUMMARY

OF

ENVIRONMENTAL MONITORING REPORT

(October 2024 TO March 2025)

FOR

NARAYANPOSHI IRON & MANGANESE ORE MINE

DISTRICT—SUNDARGARD, ODISHA

OF

M/S JSW STEEL LIMITED, ODISHA

ENV MONITORING CARRIED OUT

BY

ECOMEN LABORATORIES PVT.LTD

Ecomen Laboratories Pvt. Ltd.
(An approved Laboratory from MoEF & CC & NABL)
B-1/8, Sector-H, Aliganj, Lucknow 246 024 (U.P.)
Phone No.: (91-524) 2746282; Fax No.: (91-524) 2745726
E-mail: contactus@ecomen.in

Environmental Monitoring Report- Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Limited, Odisha during the period (October 2024 to March 2025)

1. Ambient Air Quality Lease Area

Si. No.	Location	Month	Concentration	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³
1.	Gate No-1	October'24	Maximum	72.9	24.6	19	18.9	0.64
			Minimum	65.1	18.3	16.1	15.1	0.55
			Average	68.4	21.9	17.3	16.9	0.6
		November'24	Maximum	76.9	26.8	19.8	19.2	0.64
			Minimum	70.9	20.4	16	15.1	0.55
			Average	73.7	23.6	17.7	16.8	0.6
		December'24	Maximum	75.8	25.7	19.2	18.8	0.64
			Minimum	68.2	18.5	16.1	15.1	0.55
			Average	72.4	21.4	17.8	16.9	0.6
		January'25	Maximum	76	26.8	20.8	19	0.64
			Minimum	70	20.3	16	15.2	0.55
			Average	73.1	23.8	18.3	17.3	0.6
		February'25	Maximum	79	27	20.8	18.6	0.64
			Minimum	70.1	20	16.1	15.3	0.55
			Average	75.1	24.1	18.2	16.8	0.6
		March'25	Maximum	65.6	36.1	20.6	24.9	0.72
			Minimum	58.8	29.6	15.1	19.2	0.59
			Average	60.9	33.7	17.6	22.4	0.7
		Oct'24	Maximum	72.9	25.0	19.0	19.0	0.6
			Minimum	65.2	18.5	16	15	0.56
			Average	68.5	21.3	17.7	16.5	0.6

Si. No.	Location	Month	Concentration	PIlio µg/m³	PM2.5 µg/m³	SO2 µg/m³	NO2 µg/m³	CO mg/m³
2.	Near Babamath Area	Nov'24	Maximum	76.8	27.0	20.7	18.9	0.6
			Minimum	70.2	20.1	16	15.1	0.55
			Average	73.6	23.1	17.9	17.0	0.6
		Dec'24	Maximum	75.9	26.8	18.9	19.0	0.6
			Minimum	68.1	18.6	16.1	15.3	0.55
			Average	72.0	22.9	17.3	17.2	0.6
		Jan'24	Maximum	76.5	26.8	20.9	18.8	0.6
			Minimum	70.7	20.2	16	15.2	0.56
			Average	73.5	23.1	17.7	17.1	0.6
		Feb'24	Maximum	78.7	26.7	20.9	18.9	0.6
			Minimum	70.3	20	16	15	0.55
			Average	73.7	23.3	18.0	17.1	0.6
		Mar'24	Maximum	67.9	36.1	18.7	24.7	0.7
			Minimum	58.1	31.2	15	19.8	0.59
			Average	62.1	33.9	17.1	22.7	0.7
3.	Near Mines office	Oct'24	Maximum	72.7	24.9	18.7	18.9	0.6
			Minimum	65	18.1	16.4	15.1	0.55
			Average	67.9	21.9	17.6	16.7	0.6
		Nov'24	Maximum	76.9	26.6	20.4	18.9	0.6
			Minimum	70.1	20.3	16	15.4	0.55
			Average	73.6	23.0	17.8	17.5	0.6
		Dec'24	Maximum	75.7	25.5	19.0	18.9	0.6
			Minimum	68.5	18.6	16.1	15.1	0.55
			Average	72.6	22.0	17.7	16.7	0.6
		Jan'25	Maximum	76.9	26.8	20.2	19.0	0.6
			Minimum	70.1	20.2	16.1	15.1	0.55
			Average	73.3	24.0	17.9	16.9	0.6

Sl. No.	Location	Month	Concentration	PM_{10} µg/m^3	$PM_{2.5}$ µg/m^3	SO_2 µg/m^3	NO_2 µg/m^3	CO mg/m^3
		Feb'25	Maximum	78.8	26.8	21.0	19.0	0.6
			Minimum	70.1	20.1	16.1	15.1	0.56
			Average	74.2	23.2	18.0	17.1	0.6
		Mar'25	Maximum	67.4	36.9	20.4	24.0	0.7
			Minimum	58	28.1	17.3	19.7	0.6
			Average	62.7	32.6	19.2	22.0	0.7
4.	Rest Shelter	Oct'24	Maximum	72.3	24.4	18.9	18.9	0.6
			Minimum	65.1	18	16.2	15.3	0.55
			Average	68.6	21.2	17.5	17.1	0.6
		Nov'24	Maximum	76.8	26.7	20.2	19.9	0.6
			Minimum	70.4	20.3	16.1	15	0.55
			Average	73.1	23.5	18.2	16.9	0.6
		Dec'24	Maximum	75.6	26.6	20.7	18.9	0.6
			Minimum	68	18	16.1	15.3	0.55
			Average	71.7	21.5	17.7	16.8	0.6
		Jan'25	Maximum	74.8 68.1	24.3 18	20.7 16.1	18.2 15.3	0.6 0.55
			Minimum	71.8	21.1	17.6	16.7	0.6
			Average	74.8	24.3	20.7	18.2	0.6
		Feb'25	Maximum	78.0	26.5	20.9	19.0	0.6
			Minimum	70.7	20	16.1	15.1	0.55
			Average	74.2	23.7	17.8	16.9	0.6
		Mar'25	Maximum	65.4	36.3	20.9	24.8	0.7
			Minimum	58.1	28.3	15.5	19.5	0.62
			Average	62.5	32.1	18.8	22.5	0.7
CPCB Standard			**24 Hrly**	**100**	**60**	**80**	**80**	**4 (1Hrly)**
			Annual Average	**60**	**40**	**40**	**50**	**--**

2. Ambient Air Quality Buffer Area

Si. No.	Location	Month	Concentration	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³
1.	Koira Basti	Oct'24	Maximum	43.1	14.2	12.2	12.9	0.41
			Minimum	35	10.5	9.3	11.4	0.32
			Average	39.0	12.5	10.6	12.1	0.36
		Nov'24	Maximum	44.4	20.4	11.8	12.1	0.42
			Minimum	40.2	14.6	9	10.6	0.3
			Average	41.7	18.2	10.3	11.2	0.37
		Dec'24	Maximum	39.8	14.7	12.6	12.8	0.43
			Minimum	34.8	10.2	9.6	10.2	0.31
			Average	37.6	11.7	11.4	11.3	0.37
		Jan'25	Maximum	44.7	22	12.5	12.6	0.41
			Minimum	40.6	15	9.6	10.2	0.32
			Average	43.4	17.8	11.3	11.7	0.35
		Feb'25	Maximum	41.8	21.8	12.5	12.6	0.42
			Minimum	38.4	15	9.1	10.5	0.33
			Average	39.8	17.9	11.3	11.8	0.37
		Mar'25	Maximum	42.4	26.6	17.9	23.9	0.42
			Minimum	35.5	22.5	15.2	18.3	0.39
			Average	39.3	24.8	16.6	22.2	0.41
		Oct'24	Maximum	43.5	14.8	12.9	13.6	0.43
			Minimum	34.3	10.7	9.9	10.2	0.32
			Average	39.6	13.5	11.7	11.5	0.40

NARAYANPOSHI IRON & MANGANESE ORE MINE

Si. No.	Location	Month	Concentration	PM10 µg/m³	PM2.5 µg/m³	SO2 µg/m³	NO2 µg/m³	CO µg/m³
2.	Kashira Basti	Nov'24	Maximum	44.3	21	12.4	13	0.39
			Minimum	40.4	14.3	9.5	10.4	0.32
			Average	42.9	17.5	10.9	11.6	0.35
		Dec'24	Maximum	39	14	12.7	12.4	0.43
			Minimum	34.2	10.2	9.1	10.2	0.32
			Average	37.2	11.8	10.6	11.3	0.36
		Jan'25	Maximum	44.1	21.3	12.3	12.8	0.4
			Minimum	40.3	14.3	9	10.1	0.33
			Average	41.7	18.7	11.0	11.6	0.37
		Feb'25	Maximum	41	20.1	12.8	13	0.42
			Minimum	38.1	14.2	9.8	10	0.3
			Average	39.7	17.9	11.7	11.6	0.36
		Mar'25	Maximum	39	26.4	17.8	22.4	0.42
			Minimum	36.6	22.8	15	15.4	0.39
			Average	37.7	24.3	16.5	19.4	0.41
3.	Bhanjpali Village	Oct'24	Maximum	41.4	16.5	12.8	13.8	0.36
			Minimum	34.1	12.3	9.6	10.1	0.3
			Average	37.0	14.1	10.6	11.5	0.33
		Nov'24	Maximum	44.5	21.2	13	12.4	0.42
			Minimum	40.4	15.1	9.2	10.2	0.31
			Average	42.8	18.1	11.5	11.1	0.36
		Dec'24	Maximum	41.6	14.8	13	12.9	0.43
			Minimum	36	11.3	9.9	10.8	0.34
			Average	39.5	13.7	11.9	12.0	0.40
		Jan'25	Maximum	44.1	21	12.6	12.9	0.42
			Minimum	40.3	14	9.5	10.3	0.32
			Average	42.5	17.8	10.9	12.1	0.35

Sl. No.	Location	Month	Concentration	PM_{10} µg/m³	$PM_{2.5}$ µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³
		Feb'25	Maximum	42	21.3	12.2	12.7	0.41
			Minimum	39.2	14.5	9.2	10.4	0.31
			Average	40.7	17.2	10.7	11.5	0.36
		Mar'25	Maximum	43	26.7	17.3	22.9	0.41
			Minimum	37.6	22.9	14.3	20.8	0.38
			Average	40.1	24.3	16.2	21.9	0.40
4.	Segasahi village	Oct'24	Maximum	43.8	15.8	14	13.4	0.42
			Minimum	37.5	10.9	9.7	10.3	0.31
			Average	41.1	12.6	11.4	11.6	0.4
		Nov'24	Maximum	44.9	21.8	12.9	11.8	0.4
			Minimum	40.5	15.4	9.2	10.2	0.32
			Average	42.8	18.7	11.0	10.9	0.36
		Dec'24	Maximum	40.9	14.8	12.3	12.4	0.43
			Minimum	34.4	11.1	9.7	10.3	0.3
			Average	38.3	13.1	10.5	11.4	0.36
		Jan'25	Maximum	44.8 41.5	19.3 14.9	12.5 10.3	12.5 10.1	0.41 0.31
			Minimum	43.6	16.7	11.3	11.5	0.37
			Average	44.8	19.3	12.5	12.5	0.41
		Feb'25	Maximum	41.5	21.5	12.5	12.8	0.42
			Minimum	38.2	14.8	9.4	10.3	0.31
			Average	40.0	17.8	11.1	11.6	0.37
		Mar'25	Maximum	44.9	26.3	15.8	22.8	0.41
			Minimum	35.8	23.2	13.1	20	0.39
			Average	40.8	25.3	14.8	21.8	0.40
CPCB Standard			**24 Hrly**	**100**	**60**	**80**	**80**	**4 (1Hrly)**
			Annual Average	**60**	**40**	**40**	**50**	**--**

3. Fugitive Emission Monitoring (µg/m³)

Sl. No.	Month	Screen Plant		Crusher Plant		Ore Storage & Loading Point	
		Max	Min	Max	Min	Max	Min
1.	Oct'24	731.5	641.9	732.2	673.9	724.1	659.4
2.	Nov'24	729.7	652.6	709.5	654.5	731.8	670.6
3.	Dec'24	723.7	654.4	713.5	643.4	706.5	654.3
4.	Jan'25	716.7	651.3	723.4	654.8	728.2	658.5
5.	Feb'25	733.3	658.5	736.3	657.1	727.3	657.1
6.	Mar'25	691.1	648.4	705.9	659.4	712.2	645.7
Six Month Average		**721.0**	**651.2**	**720.1**	**657.2**	**721.7**	**657.6**

Sl. No.	Month	Mines Haulage Road		Mines Face Bench		Waste Dump	
		Max	Min	Max	Min	Max	Min
1.	Oct'24	732.8	642.2	725.4	644.7	724.1	669.9
2.	Nov'24	716.5	652.1	734.6	651.6	715.5	662.3

3.	Dec'24	717.3	642.3	725	660.3	721.9	643
4.	Jan'25	709.2	660.2	734.5	654.7	717	659.9
5.	Feb'25	737.1	669.4	737.2	674	732.7	664.3
6.	Mar'25	722.5	709.2	711.4	649.9	714.8	651.1
Six Month Average		**722.6**	**662.6**	**728.0**	**655.9**	**721.0**	**658.4**

4. ILLUMINATION MONITORING (Lux)

	OCT 24		NOV 24		DEC 24	
LOCATION	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**
Workshop Area	152.0	132.0	142.0	92.0	101.0	98.0
Screen Plant	116.0	133.0	88.0	123.0	106.0	123.0
Haul Road	88.0	59.0	64.0	59.0	68.0	79.0
Loading Point	98.0	89.0	82.0	89.0	78.0	59.0
Crusher Plant	67.0	75.0	83.0	55.0	95.0	85.0
Parking Yard	85.0	69.0	98.0	97.0	78.0	89.0
Permanent Path	96.0	102.0	94.0	132.0	96.0	102.0
Electric Substation	164.0	89.0	185.0	89.0	145.0	89.0
Rest Shelter	44.0	57.0	54.0	47.0	74.0	47.0
Mines Bench Foot Path	58.0	79.0	58.0	69.0	88.0	79.0
	JAN 25		**FEB 25**		**MARCH 25**	
LOCATION	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**
Workshop Area	118.0	95.0	119.0	96.0	125.0	72.0
Screen Plant	102.0	124.0	105.0	125.0	56.0	143.0
Haul Road	67.0	75.0	68.0	76.0	54.0	39.0
Loading Point	75.0	57.0	78.0	67.0	58.0	79.0
Crusher Plant	105.0	85.0	115.0	95.0	83.0	55.0
Parking Yard	78.0	87.0	76.0	83.0	58.0	47.0
Permanent Path	98.0	105.0	96.0	108.0	94.0	122.0
Electric Substation	142.0	87.0	143.0	82.0	115.0	59.0
Rest Shelter	78.0	47.0	76.0	47.0	52.0	47.0
Mines Bench Foot Path	85.0	78.0	85.0	79.0	38.0	29.0

						29.0

5. Noise Level {dB(A)}

A. Ambient Noise Monitoring

Location	OCT 24		NOV 24		DEC 24		Standards	
	Leq Day	Leq Night	Leq Day	Leq Night	Leq Day	Leq Night	Leq Day	Leq Night
KASHIRA BASTI	52.8	41.8	53.8	41.8	52.9	43.8	55 dB(A)	45 dB(A)
KOIRA BASTI	46.9	40.9	47.9	40.9	54.3	40.3	55 dB(A)	45 dB(A)
EAST BOUNDARY	67.4	54.5	67.3	60.7	54.1	44.1	75 dB(A)	70 dB(A)
WEST BOUNDARY	65.5	51.2	70.9	60.9	51.0	41.3	75 dB(A)	70 dB(A)
NORTH BOUNDARY	68.8	55.4	67.3	65.6	54.1	41.6	75 dB(A)	70 dB(A)
SOUTH BOUNDARY	65.2	51.2	68.7	61.1	57.0	42.1	75 dB(A)	70 dB(A)
Location	**JAN-25**		**FEB-25**		**MARCH-25**		**Standards**	
	Leq Day	**Leq Night**	**Leq Day**	**Leq Night**	**Leq Day**	**Leq Night**	**Leq Day**	**Leq Night**
KASHIRA BASTI	52.2	42.8	52.2	42.5			55 dB(A)	45 dB(A)
KOIRA BASTI	50.3	40.4	51.3	41.5	45.4	36.8	55 dB(A)	45 dB(A)
EAST BOUNDARY	68.4	65.6	61.7	60.9	69.4	58.8	75 dB(A)	70 dB(A)
WEST BOUNDARY	68.1	60.9	65.2	61.4	64.8	50.3	75 dB(A)	70 dB(A)
NORTH BOUNDARY	68.1	62.5	66.3	61.3	68.5	60.2	75 dB(A)	70 dB(A)
SOUTH BOUNDARY	68.2	67.6	69.4	60.5	67.1	60.7	75 dB(A)	70 dB(A)

B. Source Noise Monitoring

CORE ZONE	OCT-24				NOV-24			
	Week-1	Week-2	Week-3	Week-4	Week-1	Week-2	Week-3	Week-4
	Leq				Leq			
Magazine Area	72.8	71.7	73.2	70.3	72.8	67.8	73.4	72.9
ML Boundary Pillar No.1	69.0	71.8	73.4	74.5	70.4	73.9	68.4	72.9
Mile Face / Bench	67.8	67.5	69.8	74.7	69.3	70.3	68.2	71.2
Haulage Road	73.5	70.0	70.9	69.8	73.6	67.4	72.4	69.1
Crusher Plant	69.9	73.7	71.3	74.9	69.6	71.0	73.9	72.9
Screen Plant	67.2	69.1	72.4	69.9	73.2	69.0	68.9	71.4
Ore Storage & Loading Point	67.6	72.9	69.5	73.4	71.2	72.4	69.8	70.2
Waste Dump	70.3	67.5	69.4	67.1	72.9	68.2	68.6	69.4

CORE ZONE	DEC-24				JAN-25			
	Week-1	Week-2	Week-3	Week-4	Week-1	Week-2	Week-3	Week-4
	Leq				Leq			
Magazine Area	71.4	71.0	71.3	68.9	68.7	69.7	74.0	73.3
ML Boundary Pillar No.1	73.4	73.6	73.9	67.4	70.5	69.1	69.5	68.2
Mile Face / Bench	73.7	71.8	68.7	68.5	70.3	72.8	67.7	67.7
Haulage Road	72.4	70.9	73.8	72.6	71.6	72.8	71.8	71.7
Crusher Plant	71.3	67.0	72.8	69.9	72.2	71.2	70.1	71.9
Screen Plant	69.6	71.5	69.1	67.9	69.7	68.1	73.4	67.0
Ore Storage & Loading Point	72.4	73.2	71.8	69.8	72.1	71.6	69.8	72.6
Waste Dump	73.4	73.4	73.8	72.6	67.0	67.8	69.9	71.3
CORE ZONE	FEB-25				MARCH-25			
	Week-1	Week-2	Week-3	Week-4	Week-1	Week-2	Week-3	Week-4
	Leq				Leq			
Magazine Area	69.5	73.3	73.6	71.6	62.4	58.9		
ML Boundary Pillar No.1	73.5	69.9	72.6	72.2	59.4	59.1		
Mile Face / Bench	73.7	67.2	70.4	71.3	62.7	61.0		
Haulage Road	70.4	67.8	73.1	69.6	58.6	59.9		
Crusher Plant	73.9	67.9	69.5	70.5	61.3	62.3		
Screen Plant	73.1	71.2	72.5	69.1	60.4	60.7		
Ore Storage & Loading Point	71.1	71.2	68.8	73.5	62.8	61.4		
Waste Dump	67.3	70.7	73.2	67.8	62.4	60.4		

6. Surface Water Quality

NARAYANPOSHI IRON ORE MINE								
Karo River UpStream								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream Water Standards**
PH	-	6.90	6.83	6.98	6.84	6.86	7.22	6.5-8.5
Total Dissolved Solids	**mg/l**	224.0	232.0	236.0	244.0	246.0	102.2	1500
BOD	**mg/l**	14.5	15.0	15.0	16.0	15.0	3.2	3
DO	**mg/l**	5.8	5.9	6.0	6.3	6.32	6.3	4
Chlorides	**mg/l**	24.0	26.0	20.0	24.0	26.0	9.0	600
Fluorides	**mg/l**	0.38	0.35	0.35	0.38	0.38	0.22	1.5
Iron	**mg/l**	0.22	0.24	0.21	0.18	0.17	1.42	50
Karo River DownStream								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream**

								Water Standards
PH	**-**	7.36	7.25	6.98	7.56	7.57	7.16	6.5-8.5
Total Dissolved Solids	**mg/l**	256.0	264.0	236.0	276.0	278.0	662.4	1500
BOD	**mg/l**	19.0	18.0	15.0	19.5	19.7	3.0	3
DO	**mg/l**	5.2	5.5	6.0	5.7	5.8	6.2	4
Chlorides	**mg/l**	32.0	28.0	20.0	32.0	34.0	8.0	600
Fluorides	**mg/l**	0.29	0.25	0.35	0.36	0.38	0.22	1.5
Iron	**mg/l**	0.26	0.22	0.21	0.22	0.21	1.22	50
Orhari Nala Upstream								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream Water Standards**
PH	**-**	7.56	7.48	7.65	7.75	7.85	7.12	6.5-8.5
Total Dissolved Solids	**mg/l**	210.0	228.0	226.0	232.0	242.0	96.0	1500
BOD	**mg/l**	2.9	3.1	3.0	3.5	3.6	2.7	3
DO	**mg/l**	6.5	6.8	6.7	6.9	6.8	6.2	4
Chlorides	**mg/l**	20.0	22.0	24.0	28.0	28.0	12.0	600
Fluorides	**mg/l**	0.17	0.15	0.19	0.22	0.25	0.18	1.5
Iron	**mg/l**	0.10	0.11	0.12	0.10	0.11	0.98	50
Orhari Nala Downstream								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream Water Standards**
PH	**-**	7.44	7.60	7.65	7.54	7.64	7.02	6.5-8.5
Total Dissolved Solids	**mg/l**	272.0	280.0	280.0	296.0	298.0	110.0	1500
BOD	**mg/l**	3.9	4.0	3.7	3.4	3.6	2.9	3
DO	**mg/l**	6.2	6.4	6.4	6.2	6.5	5.8	4
Chlorides	**mg/l**	34.0	28.0	36.0	40.0	40.7	14.4	600
Fluorides	**mg/l**	0.24	0.26	0.27	0.31	0.35	0.16	1.5
Iron	**mg/l**	0.05	0.07	0.07	0.09	0.10	1.20	50
Manganese Quarry								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream Water Standards**
PH	**-**	7.10	7.05	7.29	7.38	7.48	7.26	6.5-8.5
Total Dissolved Solids	**mg/l**	140.0	148.0	152.0	160.0	167.0	128.0	1500
BOD	**mg/l**	5.0	5.2	5.5	5.7	5.8	2.8	3
DO	**mg/l**	6.4	6.2	6.6	6.8	6.4	5.4	4
Chlorides	**mg/l**	34.0	32.0	38.0	40.0	42.0	10.0	600
Fluorides	**mg/l**	0.26	0.24	0.24	0.27	0.21	0.18	1.5

Iron	**mg/l**	0.16	0.15	0.11	0.15	0.16	1.82	50
Kashira Nala upstream								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream Water Standards**
PH	**-**	6.98	6.86	6.78	6.65	6.75	7.20	6.5-8.5
Total Dissolved Solids	**mg/l**	244.0	256.0	256.0	264.0	268.0	92.0	1500
BOD	**mg/l**	9.0	9.5	10.0	10.5	10.6	2.7	3
DO	**mg/l**	5.2	5.5	5.6	5.8	5.4	5.4	4
Chlorides	**mg/l**	36.0	32.0	39.0	42.0	43.0	14.0	600
Fluorides	**mg/l**	0.37	0.39	0.35	0.38	0.39	0.28	1.5
Iron	**mg/l**	0.15	0.16	0.12	0.14	0.15	1.12	50
Kashira Nala downStream								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream Water Standards**
PH	**-**	7.20	7.38	7.36	7.45	7.52	7.08	6.5-8.5
Total Dissolved Solids	**mg/l**	280.0	292.0	292.0	284.0	286.0	177.0	1500
BOD	**mg/l**	10.0	10.2	9.5	10.2	10.4	6.0	3
DO	**mg/l**	5.8	5.9	6.2	6.5	6.7	6.1	4
Chlorides	**mg/l**	22.0	24.0	20.0	24.0	23.0	26.0	600
Fluorides	**mg/l**	0.35	0.33	0.38	0.34	0.37	0.35	1.5
Iron	**mg/l**	0.14	0.15	0.10	0.15	0.14	0.16	50
Nrayanposhi Nala								
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Limits for Stream Water Standards**
PH	**-**	7.56	7.65	7.45	7.59	7.69	7.22	6.5-8.5
Total Dissolved Solids	**mg/l**	280.0	296.0	298.0	287.0	285.0	102.0	1500
BOD	**mg/l**	18.5	17.0	20.5	19.0	19.4	2.4	3
DO	**mg/l**	4.9	4.7	4.7	4.9	4.6	5.5	4
Chlorides	**mg/l**	38.0	36.0	44.0	48.0	48.1	12.0	600
Fluorides	**mg/l**	0.38	0.34	0.35	0.36	0.37	0.30	1.5
Iron	**mg/l**	0.24	0.25	0.21	0.18	0.16	1.14	50

7.Surface Water Flow Rate

LOCATION NAME	OCT-24	NOV-24	DEC-24	JAN-25	FEB-25	MARCH-25
Karo River Upstream	0.56	0.64	0.48	0.58	0.65	0.79
Karo River Downstream	0.56	0.64	0.48	0.58	0.65	0.80
Orahari Nala Upstream	0.64	0.72	0.64	0.75	0.78	0.82
Orahari Nala Downstream	0.64	0.72	0.64	0.75	0.78	0.82
Kashira Nala Upstream	0.72	0.85	0.72	0.76	0.86	0.89
Kashira Nala Downstream	0.72	0.85	0.72	0.76	0.86	0.89

8.Ground Water Quality

Location		Bore well Near Gate No.1	Quarry-4	Kashira Village	Koira Basti	Near workshop
Parameter	Units	NOV-24				
PH	-	6.95	6.95	6.95	6.78	6.95
Total Dissolved Solids	mg/l	224.0	224.0	224.0	232.0	224.0
Total Hardness	mg/l	80.0	80.0	80.0	92.0	80.0
Sulphates	mg/l	7.60	7.60	7.60	9.45	7.60
Chlorides	mg/l	22.0	22.0	22.0	24.0	22.0
Fluoride	mg/l	0.21	0.21	0.21	0.15	0.21
Iron	mg/l	0.09	0.09	0.09	0.06	0.09
Location		Bore well Near Gate No.1	Quarry-4	Kashira Village	Koira Basti	Near workshop
Parameter	Units	JAN-25				
PH	-	6.86	6.98	6.98	6.78	6.98
Total Dissolved Solids	mg/l	226.0	218.0	218.0	224.0	218.0
Total Hardness	mg/l	80.0	82.0	82.0	97.0	80.0
Sulphates	mg/l	7.74	7.52	7.86	9.52	7.42
Chlorides	mg/l	22.2	23.0	24.0	26.0	22.0
Fluoride	mg/l	0.22	0.22	0.26	0.16	0.20
Iron	mg/l	0.08	0.10	0.10	0.08	0.10

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9.Drinking Water Quality

Near Mines Office									
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Acceptable Limits**	**Permissible Limits**
PH	-	6.70	6.85	6.80	6.96	7.46	6.98	**6.5-8.5**	**No Relaxation**
Total Dissolved Solids	mg/l	196.0	216.0	208.0	220.0	38.0	236.0	**500**	**2000**
Total Hardness	mg/l	80.0	88.0	76.0	80.0	613.0	71.0	**200**	**600**
Sulphates	mg/l	9.50	8.84	10.50	9.50	18.0	9.8	**200**	**400**
Chlorides	mg/l	16.0	20.0	20.0	24.0	123.0	18.0	**250**	**1000**
Fluoride	mg/l	0.16	0.18	0.18	0.21	BDL	0.17	**1**	**1.5**
Iron	mg/l	0.08	0.07	0.09	0.11	6.98	0.09	**1**	**No Relaxation**
Rest Shelter									
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Acceptable Limits**	**Permissible Limits**
PH	-	6.65	6.72	6.75	6.88	6.89	7.15	**6.5-8.5**	**No Relaxation**
Total Dissolved Solids	mg/l	172.0	180.0	184.0	196.0	197.0	196.0	**500**	**2000**
Total Hardness	mg/l	64.0	68.0	68.0	72.0	73.0	51.0	**200**	**600**
Sulphates	mg/l	7.20	8.15	6.70	6.80	6.85	8.68	**200**	**400**
Chlorides	mg/l	10.0	12.0	14.0	16.0	16.0	12.0	**250**	**1000**
Fluoride	mg/l	0.10	0.08	0.12	0.16	0.17	0.14	**1**	**1.5**
Iron	mg/l	0.09	0.07	0.10	0.06	0.06	0.10	**1**	**No Relaxation**
Near Gate No.1									
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Acceptable Limits**	**Permissible Limits**
PH	-	6.84	6.92	6.95	6.75	6.79	7.18	**6.5-8.5**	**No Relaxation**
Total Dissolved Solids	mg/l	188.0	196.0	196.0	184.0	189.0	229.0	**500**	**2000**
Total Hardness	mg/l	72.0	76.0	76.0	78.0	76.0	68.0	**200**	**600**
Sulphates	mg/l	6.90	6.40	7.10	6.90	6.90	10.7	**200**	**400**
Chlorides	mg/l	14.0	10.0	18.0	20.0	20.0	18.0	**250**	**1000**
Fluoride	mg/l	0.11	0.13	0.10	0.13	0.15	0.14	**1**	**1.5**
Iron	mg/l	0.07	0.05	0.09	0.10	0.10	0.10	**1**	**No Relaxation**

10. ETP Monitoring (Inlet & Outlet)

Parameter	Units	OCT-24	NOV-24	DEC-24	JAN-25	FEB-25	MARCH-25	Acceptable Limits
ETP Inlet								
pH	-	6.76	6.70	6.72	6.85	6.95	6.56	**6.5-9.0**
Total Suspended Solid as TSS	mg/l	85.6	66.2	84.6	87.2	89.2	78.4	**100.0**
Total Dissolved Solids as TDS	mg/l	598.0	468.0	588.0	596.0	595.0	614.0	-
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	33.9	32.0	34.0	36.5	36.4	43.0	**30.0**
Chemical Oxygen Demand as COD	mg/l	286.0	192.0	296.0	286.0	276.0	246.0	**250.0**
Oil & Grease as O & G	mg/l	8.52	7.22	8.50	7.80	7.95	7.70	**10.0**
Parameter	**Units**	**OCT-24**	**NOV-24**	**DEC-24**	**JAN-25**	**FEB-25**	**MARCH-25**	**Acceptable Limits**
ETP Outlet								
pH	-	7.56	7.04	7.55	7.56	7.46	7.19	**6.5-9.0**
Total Suspended Solid as TSS	mg/l	26.5	30.2	27.8	30.0	33.0	38.3	**100.0**
Total Dissolved Solids as TDS	mg/l	268.0	487.0	652.0	680.0	686.0	557.0	-
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	15.8	24.0	14.0	16.0	17.0	17.0	**30.0**
Chemical Oxygen Demand as COD	mg/l	124.8	140.0	114.0	116.0	123.0	164.0	**250.0**
Oil & Grease as O & G	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	**10.0**

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11.STP Monitoring (Inlet&Outlet)

Parameter	Units	Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	March-25	Detection Range
STP Inlet								
pH	-	6.94	6.85	6.85	6.92	6.96	6.78	2.0 -12
Total Suspended Solid as TSS	mg/l	68.0	60.0	78.0	84.0	86.0	123.0	5 - 5000
Total Dissolved Solids as TDS	mg/l	640.0	658.0	670.0	688.0	692.0	785.0	10-10000
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	36.0	34.0	38.0	42.0	46.0	35.0	5-10000
Chemical Oxygen Demand as COD	mg/l	260.0	272.0	276.0	284.0	286.0	286.0	5-50000
Oil & Grease as O & G	mg/l	6.90	6.40	7.25	7.60	7.67	8.23	5-600
Parameter	**Units**	**Oct-24**	**Nov-24**	**Dec-24**	**Jan-25**	**Feb-25**	**March-25**	**Acceptable Limits**
STP Outlet								
pH	-	7.25	7.18	7.40	7.40	7.46	7.10	6.5-9.0
Total Suspended Solid as TSS	mg/l	34.0	26.0	36.0	36.0	38.0	38.0	100.0
Total Dissolved Solids as TDS	mg/l	590.0	585.0	610.0	610.0	613.0	763.0	-
Biochemical Oxygen Demand as BOD 3days at 27^0C	mg/l	16.0	14.5	17.0	17.0	18.0	24.0	30.0
Chemical Oxygen Demand as COD	mg/l	108.0	104.0	120.0	120.0	123.0	78.0	250.0
Oil & Grease as O & G	mg/l	BDL	BDL	BDL	BDL	BDL	5.14	10.0

12. Soil Monitoring

Sl. No.	Parameters	Unit	Koira	kashira	Babamath Nursury	Narayanposhi Village	dump 2/ magazine area	Orahari Village	Tukutala Village	Manganese Quarry
1.	pH	-	6.45	6.45	5.79	6.55	7.51	6.47	6.80	7.45
2.	Electrical Conductivity	µmhos/cm	168.0	124.0	98.0	114.0	144.0	134.0	98.0	140.0
3.	Total Soluble Solid	mg/kg	130.0	128.0	116.0	127.0	172.0	127.0	104.0	176.0
4.	Nitrogen (N)	mg/kg	138.0	152.0	132.0	153.0	168.0	157.0	126.0	180.0
5.	Av. Phosphorous (P_2O_5)	kg/ha	48.0	56.0	38.0	54.0	28.0	66.0	28.0	30.0
6.	Av. Potassium (K_2O)	mg/kg	137.0	108.0	144.0	101.0	87.5	118.0	114.0	98.0
7.	Av. Sodium (Na_2O)	mg/kg	210.0	220.0	264.0	223.0	176.0	210.0	256.0	204.0
8.	Av. Calcium as Ca	mg/kg	810.0	845.0	1246.0	845.0	892.0	845.0	790.0	972.0
9.	Av .Magnesium as Mg	mg/kg	232.0	248.0	352.0	278.0	388.0	218.0	244.0	480.0
10.	Chloride (Cl)	mg/kg	27.90	31.5	56.0	33.5	40.0	31.6	34.0	44.0
11.	Copper (Cu)	mg/kg	0.18	0.18	2.95	0.18	0.51	0.14	0.16	0.59
12.	Zinc (Zn)	mg/kg	1.76	2.17	1.44	2.15	11.20	2.17	1.80	9.45
13.	Iron (Fe)	mg/kg	5.45	3.80	76.0	3.81	21.79	3.81	5.10	24.8
14.	Manganese (Mn)	mg/kg	2.97	3.70	51.0	3.70	0.19	3.72	4.16	0.19
15.	Organic Carbon	%	0.30	0.30	0.54	0.32	0.35	0.30	0.32	0.36
16.	Sodium Absorption ratio (SAR)	-	0.71	0.68	0.71	0.68	0.51	0.64	0.68	0.51
17.	Grain Size Distribution									
a	Textural Class	-	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
b	Sand	%	55.0	51.0	52.0	51.0	56.0	52.0	57.0	57.0
c	Silt	%	33.0	37.0	26.0	37.0	34.0	37.0	29.0	29.0
d	Clay	%	12.0	12.0	22.0	12.0	10.0	13.0	14.0	14.0

13.Vibration Monitoring

Sl no.	Station Name	Instrument location	Season (Summer/Winter/ Monsoon/post monsoon	Peak particle velocity	Air Over pressure	Frequency	Remark
1	RF Quarry	Mines view point	**post monsoon**	2.25mm/s	109.9 dBL @ 7.8Hz / .0062kPa	30.1Hz	Permisible limit
2	RF Quarry(RL-621)	Mines view point	**post monsoon**	0.0mm/s	134.0 dBL @ 6.9Hz / .1003kPa	2.5Hz	Permisible limit
3	Quarry-4	Rest shelter	**Winter**	3.12mm/s	110.9 dBL @ 16Hz / .007kPa	5.3Hz	Permisible limit
4	RF Quarry	Mines rest shelter	**Winter**	2.85mm/s	111.2 dBL @ 3.6Hz / .0072kPa	6.4Hz	Permisible limit

Verified By

Technical Manager

Authorized By

Quality Manager

ANNEXURE VI

Narayanposhi Mines Avenue Plantation near NH





Gate 1 road side

ANNEXURE VII

PARKING PLAZA WITH SEPARATE ENTRY AND EXIT ALONG WITH BASIC AMENITIES





ANNEXURE VIII

Annexure-V

Avenue plantation in road side of NH-215













ANNEXURE IX

Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines

Submitted to

M/s. JSW Steel Ltd.
Mines Division
Odisha

Prepared by

Mineral Processing Dept.
CSIR-Institute of Minerals & Materials Technology
Bhubaneswar-751013

Foreword

I am happy to forward the report on "Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines" prepared for M/s. JSW Steel Ltd., Mines Division, Odisha. This report includes the mineralogical, physical and chemical characteristics of two iron ore samples as well as physical beneficiation, settling and filtration studies of finer size range of particles to generate the concentrate as sinter and pellet feed material. Mineralogical, physical and chemical studies provide the valuable information to develop the conceptual process flowsheet. Suitable washing and desliming process flowsheet was developed to utilize this low grade iron ores with predominant association with clay minerals. It is possible to get concentrate having more than 62.5% Fe with around more than 82% yield and less than 2.5% alumina in combination of scrubbing, classification and beneficiation of fine range particles using high intensity magnetic separator.

I wish that these findings can be utilised by M/s. JSW Steel Ltd., Mines Division, Odisha for utilization of low grade iron ore fines.

Director
CSIR-Institute of Minerals and Materials Technology
Bhubaneswar

प्रस्तावना

मैसर्स जे.एस.डब्ल्यू.स्टील लिमिटेड, खान प्रभाग, ओडिशा के लिए तैयार "नुआगांव और नारायणपोशी खानों के लौह अयस्क फाइन्स की धुलाई और डीस्लिमिंग" पर रिपोर्ट को अग्रेषित करते हुए मुझे खुशी हो रही है। । इस रिपोर्ट में दो लौह अयस्क नमूनों की खनिज, भौतिक और रासायनिक विशेषताओं के साथ-साथ भौतिक लाभकारी, कणों के महीन आकार की सीमा के निपटान और निस्पंदन अध्ययन शामिल हैं ताकि सिंटर और पेलेट फीड सामग्री के रूप में ध्यान केंद्रित किया जा सके। खनिज, भौतिक और रासायनिक अध्ययन वैचारिक प्रक्रिया फ्लोशीट विकसित करने के लिए बहुमूल्य जानकारी प्रदान करते हैं। क्ले मिनरल्स खनिजों के साथ प्रमुख सहयोग के निम्न श्रेणी के लौह अयस्कों का उपयोग करने के लिए उपयुक्त धुलाई और डीस्लिमिंग प्रक्रिया फ्लोशीट विकसित की गई। उच्च तीव्रता वाले चुंबकीय विभाजक का उपयोग करके महीन श्रेणी के कणों के स्क्रबिंग, वर्गीकरण और लाभकारी के संयोजन में लगभग 82% से अधिक उत्पादकता और 2.5% से कम एल्यूमिना के साथ 62.5% Fe से अधिक सांद्रता प्राप्त करना संभव हो पाया।

मेरी इच्छा है कि इन निष्कर्षों का उपयोग मैसर्स जेएसडब्ल्यू स्टील लिमिटेड, खान प्रभाग, ओडिशा द्वारा निम्न ग्रेड लौह अयस्क फाइन के उपयोग के लिए किया जा सकता है। ।

निदेशक

सीएसआईआर-खनिज और पदार्थ प्रौद्योगिकी संस्थान, भुवनेश्वर

Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines

Submitted to

M/s. JSW Steel Ltd.
Mines Division
Odisha

Prepared by

CSIR-Institute of Minerals and Materials Technology
Bhubaneswar-751013, India

Foreword

I am happy to forward the report on "Washing and Desliming of Iron Ore Fines of Nuagaon and Narayanposhi Mines" prepared for M/s. JSW Steel Ltd., Mines Division, Odisha. This report includes the mineralogical, physical and chemical characteristics of two iron ore samples as well as physical beneficiation, settling and filtration studies of finer size range of particles to generate the concentrate as sinter and pellet feed material. Mineralogical, physical and chemical studies provide the valuable information to develop the conceptual process flowsheet. Suitable washing and desliming process flowsheet was developed to utilize this low grade iron ores with predominant association with clay minerals. It is possible to get concentrate having more than 62.5% Fe with around more than 82% yield and less than 2.5% alumina in combination of scrubbing, classification and beneficiation of fine range particles using high intensity magnetic separator.

I wish that these findings can be utilised by M/s. JSW Steel Ltd., Mines Division, Odisha for utilization of low grade iron ore fines.

Director
CSIR-Institute of Minerals and Materials Technology
Bhubaneswar

Executive Summary

As per the recent National Steel Policy of Govt. of India, steel production will be enhanced to 300 MTPA in 2030 from current production of 115 MTPA to increase per capita consumption from 65kg to 160kg against the world average 218kg. For the production of 300 MTPA, the country needs high-quality ore around 450 MTPA in form of calibrated ore, sinter and pellet to meet the requisite demand. To catering 450 MPTA, around 750-800 MPTA ores are to be mined.

M/s. JSW Steel Ltd. Mines Division, Odisha was interested to carry out the beneficiation studies of iron ores from their captive mines i.e., Nuagaon and Narayanposhi. CSIR-IMMT, Bhubaneswar has taken the responsibility to carry out characteristics and beneficiation studies to achieve the concentrate as sinter and pellet feed material.

The mineralogical and chemical analysis of Nuagaon iron ore mines was carried out. The Fe content in the bulk sample is 60.27%. The alumina, silica and LOI of the sample are 4.46%, 3.36% and 5.31% respectively. The Bond work index was carried out as per the standard procedure. The Bond work index of the bulk sample is 9.7 kWh/tonne. After desliming by using screw scrubber, the Bond work index was enhanced to 11.00 kWh/tonne. The desliming study of ore was carried out using screw scrubber to classify 100 micron particles as screw scrubber overflow. The water and solid ratio was maintained around 7:3. The overflow percentage with respect to feed was 40%. The Fe content of underflow of screw scrubber could be enhanced to 63.61%. The underflow of screw scrubber was also treated in gravity separation process using jig and spiral concentrator to enhance the Fe content. As grinding system is not available in this circuit, the jig and spiral concentrator tailings cannot be rejected due to high Fe content. Hence the screw scrubber underflow product was considered as one of the products. The Fe content in overflow of screw scrubber is 55.31%. The overflow was treated in magnetic separator to recover iron values from slimes. The Fe content in magnetic concentrate is 61.99%. This is the second product of the process. The overall yield of the process is 82.65% with 63.17% Fe, 1.73% Al_2O_3, 2.59% SiO_2 and 4.57% LOI.

The mineralogical and chemical analysis of Narayanposhi iron ore mines was carried out. The Fe content in the bulk sample is 60.76%. The alumina, silica and LOI of the sample are 4.16%, 2.75% and 6.18% respectively. The Bond work index was carried out as per the standard procedure. The Bond work index of the bulk sample is 11.5 kWh/tonne. After desliming by using screw scrubber, the Bond work index was enhanced to 12.40 kWh/tonne. The desliming study of ore was carried out using screw scrubber to classify 100 micron particles as screw scrubber overflow. The water and solid ratio were maintained around 7:3. The overflow percentage with respect to feed was 19.10%. The Fe content of underflow of screw scrubber could be enhanced to 62.47%. Hence it was considered as one of the products. The Fe content in overflow of screw scrubber is 53.61%. The overflow was treated in rougher and scavenger magnetic separators to recover iron values from slimes. The Fe content in rougher magnetic concentrate is 62.15% and 58.66 % Fe in scavenger magnetic concentrate. Magnetic concentrate is the second product of the process. The overall yield of the process is 91.93% with 62.32% Fe, 2.92% Al_2O_3, 1.81% SiO_2 and 5.86% LOI.

In overall study of beneficiation of screw scrubber overflow was done by magnetic separation process but in commercial plant, the hydrocyclone provision should be there to make further classification before magnetic separator in case of the low grade ore contains less than 58% Fe.

The concentrate and tailings of Nuagaon iron ore sample were taken for the settling study to provide the basic data for design of thickeners. A commercial anionic flocculent was used for settling of fine particles in the present study. The settling study of the concentrate was carried out at different solid concentration from 20 to 35% at 5% interval. The settling study of the tailings were carried out at the solid concentration of 5-10%. The pressure filtration of concentrates and the tailings were carried out using pilot scale filter press. During filter press operation, the cycle time was 22 minutes for filtration of concentrate and 35 minutes for the tailings. It is possible to achieve around 16% moisture in the filter cake for the concentrate and around 21-22% moisture for the tailings. Similarly, the settling and filtration studies of Narayanposhi iron ore sample was carried out.

Acknowledgements

Institute of Minerals and Materials Technology (IMMT), Bhubaneswar, has promoted a vision of Mineral Processing in India and abroad that lowers energy cost, reduces economic risk through improved processing, conserves resources and protects the environment. With this vision we took up to carry out research to carry out the beneficiation study of BMQ sample from M/s. JSW Steel Ltd., Mines Division, Odisha. We would like to express our sincere thanks to Mr. Ranjan Kumar Nayak, COO; Mr. James John, AVP; Mr. Swatantra Kumar, Sr. Manager; and Mr. Puneeth Rao Pawar, Manager; and also the Management of M/s. JSW Steel Ltd., Mines Division, Odisha for providing an opportunity to work on this project specially. We thank all the scientists and staff members in MP Dept. of CSIR-IMMT who have supported directly/indirectly to complete this project.

Investigators

Investigators

1. Dr. S. K. Biswal, Head & Chief Scientist, MP Department
2. Dr. A. K. Sahu, Chief Scientist
3. Dr. P. C. Beuria, Senior Principal Scientist
4. Dr. S. P. Das, Senior Principal Scientist
5. Dr. Alok Tripathy, Senior Scientist
6. Mr. S. N. Sahu, Senior Scientist & PL

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Chapter 1
Introduction

1.1 Background

Iron ores are valuable natural resources being finite and non-renewable. Iron ore is one of the basic raw materials for iron and steel industries. The production of iron and steel has significantly expanded in recent years, particularly in China and India. It is predicted that the steel production may reach more than 2600 million tonnes in 2030. The recycle in form of iron scrap may meet around 650 million tonnes per annum. The remaining more than 3200 million tonnes per annum will be met through fresh iron ore. This has resulted in a large increase in the demand for iron ore. The quality of iron ore deposits, however, has deteriorated worldwide because of long-term mining, and the existing mines are having increasing difficulty in producing ore with a high grade of iron ore by simple crushing and screening. It is great concern for steel industries to either receive suitable quality iron ore in form of lumpy or sinter/pellet.

Australia and Brazil are among the world's largest iron ore producers and hold a large portion of the world's iron ore reserves. India is the 4th largest iron ore producer next to Australia, Brazil and China. India produced 209 million tonne during 2019-20 financial years. As per the recent National Steel Policy of Govt. of India, steel production will be enhanced to 300 MTPA in 2030 from current production of 115 MTPA to increase per capita consumption from 65kg to 160kg against the world average 218kg. For the production of 300 MTPA, the country needs high-quality ore around 450 MTPA in form of calibrated ore, sinter and pellet to meet the requisite demand. To catering 450 MPTA, around 750-800 MPTA ores are to be mined as shown in Fig.1.1.

1.2 Status of Iron Ore in India

India has 33 billion tonnes of primary iron ore resources like hematite and magnetite based minerals. Out of this, around 10.5 billion tonnes BMQ is available in India as on 1.4.2015 as per Mineral Year Book 2018 published by IBM, Nagpur. Remaining resources comes under hematite category. India's 98% magnetite reserves/resources in form of magnetite or BMQ are located in five States, namely, Karnataka (7,802 million tonnes or 72%) followed by Andhra Pradesh (1,392 million tonnes or 13%), Rajasthan (617 million tonnes or 6%),

Tamil Nadu (507 million tonnes or 5%) and Goa (226 million tonnes or 2%). Similarly, the total reserves/resources of haematitic ore as on 1.4.2015 have been estimated at 22.5 billion tonnes. Major reserves/resources of hematitic ore are located in Odisha (7,559 million tonnes or 34%), Jharkhand (5,286 million tonnes or 23%), Chhattisgarh (4,858 million tonnes or 22%), Karnataka (2,467 million tonnes or 11%) and Goa (1,189 million tonnes or 5%). The threshold value of hematite iron ore is 45% Fe whereas 35% for siliceous hematite ore available in State of Goa.

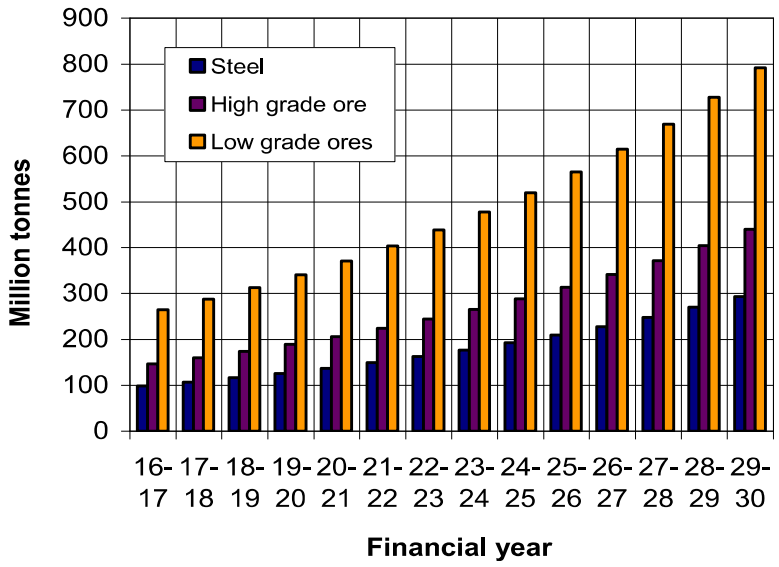


Fig. 1.1 Production of steel, high grade ores and low grade ores for beneficiation

1.3 Characteristics of Indian Ore

Indian hematitic iron ore deposits are soft and friable in nature because it is associated with goethite. During mining, it has been reported that the ratio between fines and lump ores is 2:1. Additionally, generation of fines happens due to mechanised mining and also preparation of sized ores by crushing and screening. Hence 50-70% fines (both high and low grades) are generated during mining and preparation of ore activities. The country is not endowed with high-grade requisite iron ore resources. It is, therefore, imperative to achieve the best use of available low-grade iron ore resources through scientific methods of beneficiation and pelletisation. Challenges and solutions are needed to be focussed for upgradation of Indian low-grade hematite iron ore in association of goethite, kaolinite and gibbsite minerals. The recovery of micro fines of iron phase minerals from slimes/tailings

from iron ore washing/beneficiation plants should be taken seriously to maximize the utilization of these resources for long-term sustainability. Nature of iron phase minerals and associated gangue minerals decide the process flowsheet of iron ore beneficiation to be adopted. Utilization of low-grade iron ores through beneficiation and pelletisation is closely interlinked with the environmental impact on the surrounding of the mines. Both aspects have to be properly coordinated to facilitate and ensure a sustainable development of beneficiation and pelletisation processes for utilization of iron ores in harmony with the environment.

1.4 Problems and Challenges of the Indian Iron Ore

In general, Indian hematite ore contains a good amount of clay minerals, which affects the process fluid dynamics due to their swelling properties. It increases the viscosity of the slurry; hence it affects the grinding as well as separation units. These ores are more fragile in nature due to presence of goethite phase. As a result, the ultra fine generation in the grinding circuit is more and ultimately it increases the Blaine number which has negative impact in the pelletisation plant. Percentage of goethite increases when Fe content of the ore decreases and other gangues minerals increases simultaneously. As per commercial plant observation, below 55% Fe content of ore does not respond well to the conventional beneficiation process.

1.5 Present Practice

At present practice in India, the ROM ore is crushed and classified into different size fractions either in dry or wet process. Most of the mines are operated in a dry process using hard ore by selective mining to cater the calibrated iron ore need of iron and steel industries. It is crushed to below 40/30 mm or 18mm size and classified at 10 mm/5mm size to provide the suitable size of calibrated ore (40/30+10 mm) or (-18+5 mm) to blast furnace/DRI operation respectively if the ore meets requisite metallurgical, physical and chemical properties. Whatever fine ore is generated due to crushing and classification processes, it may be utilized in sintering plant of integrated steel plants if it meets the required specification. The low grade ore is subjected to the physical beneficiation to recover the iron values, otherwise, it is dumped in mine site as rom fine dumps as shown in Fig.1.2. In the same time, percentage of low-grade fines increases day-by-day due to depletion of high-

grade iron ore. It also creates environmental impact in air and water body in the surrounding of the mine. Utilization of these fines is the need of hour to maximize the iron recovery through suitable beneficiation process which should hold up the economic feasibility and environmental sustainability. Some of the iron ore mining industries are still making the washing of coarse particles and putting the slimes in the pond as shown in Fig. 1.3. These slimes also contain good amount of Fe values.



Fig. 1.2 Iron ore low grade dump fines



Fig. 1.3 Iron ore slimes pond

1.6 Appropriate Approach for Iron Ore Beneficiation

- Percentage of goethite increases when Fe content of the ore decreases and simultaneously other gangues minerals increases. When the ore contains less than 55% Fe, it has been noted that goethite percentage is more than 50%. Hence this ore does not respond well to the conventional beneficiation process using gravity and magnetic separation techniques using physical properties. As the Indian hematite ore contains good amount of clay, it should be removed at the beginning of the process

using scrubbing equipment like screw scrubber/screw classifier, reflux classifier or drum scrubber. Hence the effect of slimes in the grinding and separation units in the process can be minimised.

- During grinding of the ore, proper classification unit with closed circuit grinding is very indispensable to reduce the generation of ultra-fine.
- Grinding product and desliming product should be treated separately to avoid the selectivity of the particles during separation process.
- If more goethite presents in the ore or liberated goethite is more, reduction roasting process may be adopted to maximise the recovery of the iron values.

1.7 Objective of the Project

M/s. JSW Steel Ltd., Mines Division, Odisha is planning to set up Washing and Desliming Iron Ore Plant to generate concentrates for sinter and pellet feed material from 58-60% Fe from Nuagaon and Narayanposhi mines.

The scopes of the work involved in this study:

(i) Sample preparation
(ii) Size analysis of as received sample
(iii) Detail chemical analysis of as received sample
(iv) Fe analysis of each size fractions
(v) Washing study by screw scrubber
(vi) Desliming study by hydrocyclone
(vii) Detail chemical analysis of screw scrubber product, hydrocyclone underflow and overflow
(viii) Settling study of cyclone overflow and underflow
(ix) Filtration study of hydrocyclone underflow
(x) Material (solid and water) balance of process
(xi) Report preparation

****

Chapter 3
Characterization, Beneficiation and Dewatering Studies of Narayanposhi Sample

3.1 Introduction

Around 1 tonnes of Iron ore below 10 mm sample was received from Narayanposhi Iron ore mines, Barbil, Odisha to carry out the desliming and beneficiation study to develop the suitable process flowsheet for production of high-grade iron ore concentrate. Around 100 kg representative sample was taken by standard coning and quartering method for size analysis, chemical analysis, bond work index, mineralogical studies and bulk density of bulk sample. The remaining sample was processed for desliming and beneficiation studies.

3.2 Characterisation Study

3.2.1 Size & Fe Analysis of Bulk Sample

The total sample of around 1 tonnes was thoroughly mixed and representative sample was drawn by coning and quartering method for size analysis. Then the size analysis with respective Fe analysis of bulk sample was carried out and the result is given in Table 3.1. The remaining sample was subjected to beneficiation studies.

Table 3.1
Size and Fe analysis of bulk sample

Size, mm	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
+10	9.48	9.48	63.05	63.05
+6	20.03	29.51	62.83	62.90
+3	17.30	46.81	61.70	62.46
+2	7.09	53.90	61.51	62.33
+1	13.20	67.09	61.13	62.10
+0.850	5.68	72.77	60.03	61.93
+0.500	3.84	76.62	61.64	61.92
+0.300	3.03	79.65	61.43	61.90
+0.210	2.93	82.58	60.14	61.84
+0.150	1.79	84.37	60.24	61.80
+0.100	1.24	85.61	60.34	61.78
+0.075	0.45	86.06	60.56	61.78
+0.045	0.98	87.04	60.22	61.76
-0.045	12.96	100.00	54.21	60.78
Total	100.00		60.78	
Bulk			60.76	

3.2.2 Detail Chemical Analysis

The detailed chemical analysis, LOI along with the trace elements of the bulk sample was carried out. The result is given in the Table 3.2. The major impurity is quartzite and aluminum oxide. The hematite percent in the ore is about 86.88 %.

Table 3.2
Detail chemical analysis of the bulk sample

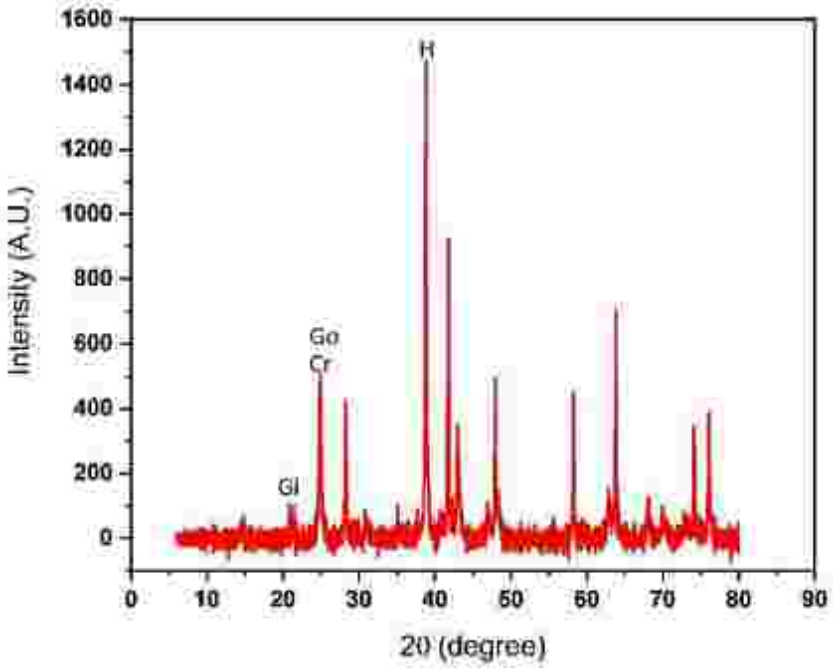
Details	Percentage
Fe (T)	60.76
Fe_2O_3	86.88
SiO_2	2.75
Al_2O_3	4.16
CaO	0.014
Cr_2O_3	0.020
CuO	0.006
K_2O	0.057
MgO	0.048
MnO_2	0.072
Na_2O	0.015
NiO	0.004
P_2O_5	0.004
PbO	0.006
TiO_2	0.004
V_2O_5	0.013
ZnO	0.014
LOI	6.18

3.3 Mineralogical Study

Mineralogical study of the bulk sample was carried out by using X-ray diffraction study. This study gives the qualitative mineralogical identification of different phases present with their textures.

3.3.1 XRD Study

XRD study was carried out on the representative bulk sample to determine the major minerals present in the sample. The XRD result is shown in Fig. 3.1 It indicates that the bulk sample have hematite as the major mineral phase and other minerals are goethite, gibbsite and chromite.



H: Hematite, Go: Goethite, Gi: Gibbsite, Cr: Chromite

Fig. 3.1 XRD study of bulk sample

3.4 Sequential Heating Analysis of Bulk Sample

The sequential heating at different temperature was carried out using muffle furnace for bulk sample to determine the association of minerals like goethite, gibbsite, kaolinite and overall LOI content. The result of sequential heating is given in Table 3.3. Based on weight loss at different temperatures, percentage of goethite, gibbsite and kaolinite were calculated. The percentage of water loss during 108°C to 450°C is used to calculate the percentage of goethite and gibbsite mineral. The percentage of water loss during 450°C 850°C is used to calculate the percentage of kaolinite mineral. The percentage of water loss during 850°C 950°C is used to calculate the percentage of carbonate minerals. Mineralogical characteristion study carried out by using both heating cycle and chemical analysis is given Table 3.4.

Table 3.3
LOI at different temperature by sequential heating cycle of bulk sample

400°C	850°C	950°C	Total LOI, %
5.42	0.71	0.05	6.18

Table 3.4
Mineralogical characteristics study by using heating cycle and chemical analysis

Heating Cycle Analysis	Hematite, %	Goethite, %	Kaolinite, %	Gibbsite, %
	48.16	43.32	5.12	2.97
Chemical Analysis	Fe(T), %	LOI, %	Al_2O_3, %	SiO_2, %
	60.76	6.18	4.16	2.75

3.5. Estimation of Bond Work Index

3.5.1 Sample Preparation

Around 30 kg of representative bulk sample was taken and screened at 4.36 mm size. The +3.36 mm size was crushed to below 3.36 mm size by using roll crusher. Then, it was thoroughly mixed and the representative sample was drawn for grindiability study for determination of Bond Work Index (BWI).

3.5.2 Ball Mill Grindiability Process

Grindiability study was carried out as per the standard procedure described by Bond. The Bond ball mill work index determination is carried out in a standard test mill and under standard conditions. The test mill has an internal diameter of 12 inch and length is also 12 inch. It has a smooth lining with rounded corners, no lifters except for a 4" X 8" hand hole lid for charging.

It has a revolution counter and runs at 70 rpm. The grinding charge consists of 285 iron balls weighing 20.125 kg. It consists of about 43 numbers of 1.45" balls, 67 numbers of 1.17" balls, 10 numbers of 1" balls, 71 numbers of 0.75" balls and 94 numbers 0.61" balls with a calculated surface area of 842 sq inch.

The standard feed was prepared by passing all through 3.36 mm size. It was packed by shaking in a 1000 cc graduated cylinder, and the weight of 700 cc was placed in the mill

and ground dry at 250 percent circulating load. After the first grinding period of 100 revolutions, the mill was dumped; the ball charge was screened out and 700 cc of material was screened on 150 mesh (100 micron) with coarser protecting sieves if necessary. The undersize was weighed and fresh unsorted feed was added to oversize to bring its weight back to that of original charge. Then it was returned on to the balls in the mill and ground for the number of revolutions calculated from the results of the previous period to produce sieve undersize equal to 1/3.5 of the total charge in the mill. The grinding period cycles were continued until the net grams of sieve undersize produced per mill revolution reaches equilibrium and reverses its direction of increase or decrease. Then the undersize product and circulating load were screen analyzed, and the average of the last three net grams per revolution (G_{bp}) was the mill grindiability. When F is the size in microns which 80 percent of the new ball mill feed passes, P is the microns which 80 percent of the last cycle sieve undersize product passes, and P_1 is the opening in microns of sieve size tested (100 micron), then the ball mill work index W_i is calculated from the following revised equation;

$$W.\ I.\ = 44.5\ /\{\ (\ P_i)^{0.23}\ X\ (\ G_{bp})^{0.82}\ X\ 10\ (1\ /\ \sqrt{}\ P\ -\ 1/\sqrt{}F)\} \qquad \textbf{(3.1)}$$

3.5.3 Bond Work Index of Bulk Sample

The representative iron ore bulk sample was taken for grindability study as per Bond's method. The size analysis of the crushed product for grindability study was carried and the results are given in the Table 3.5. It was found that d_{80} of the feed material was 2100 micron. The grindability study was carried for 100 micron test sieve. The weight of the 700 cc of material was 1610 gm. For 250 percent circulating load, 460 gm of -100 micron particles are to be produced at equilibrium revolution. To reach the equilibrium revolution a number of tests were carried out. At the equilibrium stage, G_{bp} was 1.867.

The size analysis of -100 micron product was carried out. The size analysis of product is given in the Table 3.6. The overall grindability result of bulk Sample is given in Table 3.7. The particle size distribution of feed and product is depicted in Fig. 3.2 and 3.3 respectively. The d_{80} of the ball mill product was 79.5 micron. Then according to Equation, W.I. was calculated and it was found 10.2 kWh/short ton. It was converted to normal tonne and WI value is 11.3 kWh/tonne.

$Wi = (44.5)/((P_1)^{0.23} \text{ X } (Gbp)^{0.82} (10/\sqrt{P} - 10/\sqrt{F}))$

$=(44.5)/((100)^{0.23} \text{ X } (1.867)^{0.82} (10/\sqrt{79.5} - 10/\sqrt{2100}))$

= 10.2 kWh/short ton

= 10.2 X 1.1 = **11.5 kWh/tonne**

The bond work index of the sample is determined to be 11.5 kWh/tonne.

Table 3.5
Feed size analysis

Size, micron	Cum. Wt., % Passing
3360	100.00
2000	77.76
1000	52.80
850	40.25
500	31.68
300	25.09
212	17.27
150	12.80
100	9.69

Table 3.6
Size analysis of ground product

Size, micron	Cum Wt., % Passing
100	100.00
75	75.00
63	53.00
45	35.75
38	24.25

Table 3.7
Results of gram per revolution

No. of revolutions	100micron produced (g)	100micron in the feed (g)	Net -100micron produced (g)	Grindability (g/rev.)
100	398	156	242	2.420
174	410	38.6	371	2.130
197	420	39.7	380	1.926
218	448	40.7	407	1.868
223	460	43.4	417	1.866
223	461	44.6	416	1.869
222	460	44.7	415	1.867
223	460	44.6	415	1.865

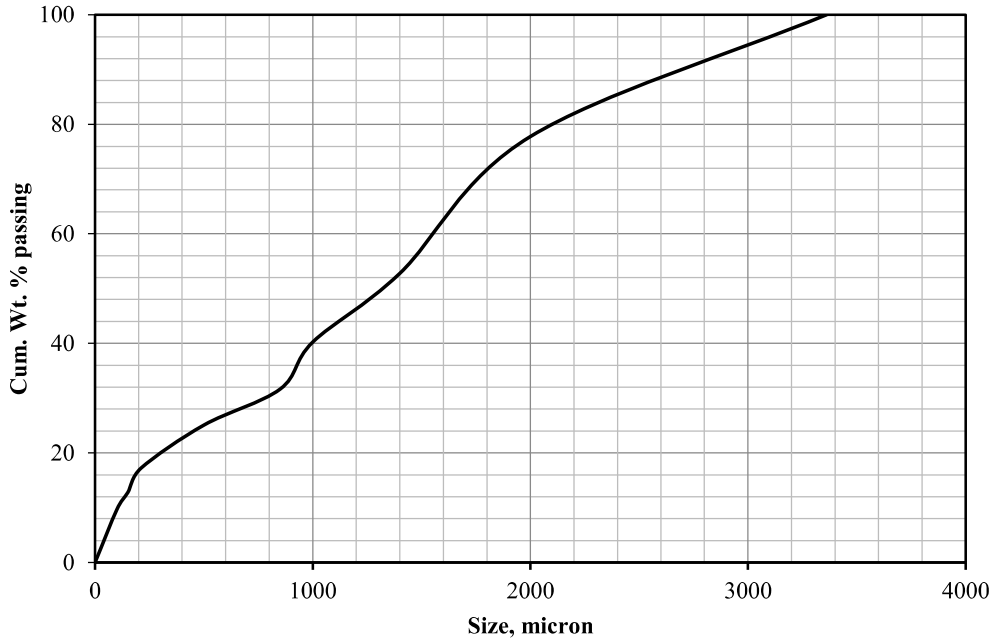


Fig. 3.2 Particle size distribution of feed

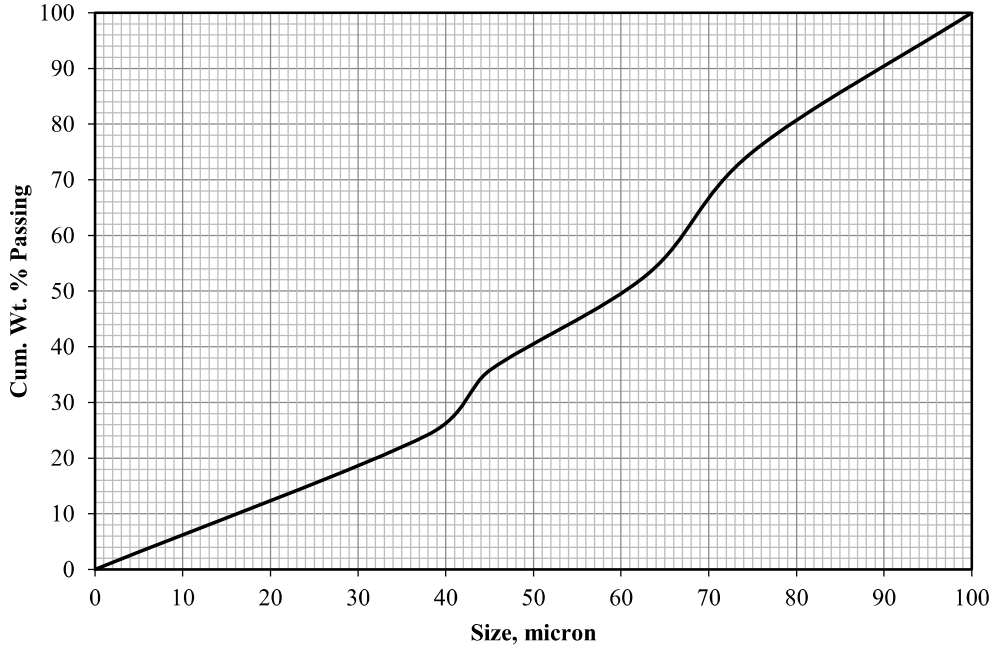


Fig. 3.3 Particle size distribution of product

3.5.4 Bond Work Index of Screw Scrubber Underflow Sample

The representative screw scrubber underflow sample was taken for grindability study as per Bond's method. The size analysis of the crushed product for grindability study was carried and the result is given in the Table 3.8. It was found that d_{80} of the feed material was 2030 micron. The grindability study was carried for 100 micron test sieve. The weight of the 700 cc of material was 1580 gm. For 250 percent circulating load, 452 gm of below 100 micron particles are to be produced at equilibrium revolution. To reach the equilibrium revolution a number of tests were carried out. At the equilibrium stage, G_{bp} was 1.647.

The size analysis of below 100 micron product was carried out. The size analysis of product is given in the Table 3.9. The overall grindability result of screw scrubber underflow is given in Table 3.10. The particle size description of feed and product is depicted in Fig. 3.4 and 3.5 respectively. The d_{80} of the ball mill product was 78.5 micron. Then according to equation, W.I. was calculated and it was found 11.3 kWh/short ton. It was converted to normal tonne and WI value is 12.4 kWh/tonne.

$$Wi = (44.5)/((P_1)^{0.23} \text{ X } (Gbp)^{0.82} (10/\sqrt{P} - 10/\sqrt{F}))$$

$$=(44.5)/((100)^{0.23} \text{ X } (1.647)^{0.82} (10/\sqrt{78.5} - 10/\sqrt{2030}))$$

= 11.3 kWh/short ton = 11.3 X 1.1 = **12.4 kWh/tonne**

The bond work index of the sample is determined to be 12.4 kWh/tonne.

Table 3.8
Feed size analysis

Size, micron	Cum. Wt., % Passing
3360	100.00
2000	79.24
1400	47.59
1000	32.15
850	21.90
500	15.32
212	8.86
150	5.95
100	4.18

Table 3.9
Size analysis of ground product

Size, micron	Cum Wt., % Passing
100	100.00
75	76.00
63	55.50
45	41.00
38	29.50

Table 3.10
Results of gram per revolution

No. of revolutions	100micron produced (g)	100micron in the feed (g)	Net -100micron produced (g)	Grindability (g/rev.)
100	268	66	202	2.020
218	604	11.2	593	2.717
157	488	25.2	463	2.947
146	316	20.4	296	2.019
217	396	13.2	383	1.762
247	428	16.6	411	1.665
261	450	17.9	432	1.658
261	450	18.8	431	1.651
262	451	18.8	432	1.647
263	451	18.9	432	1.644

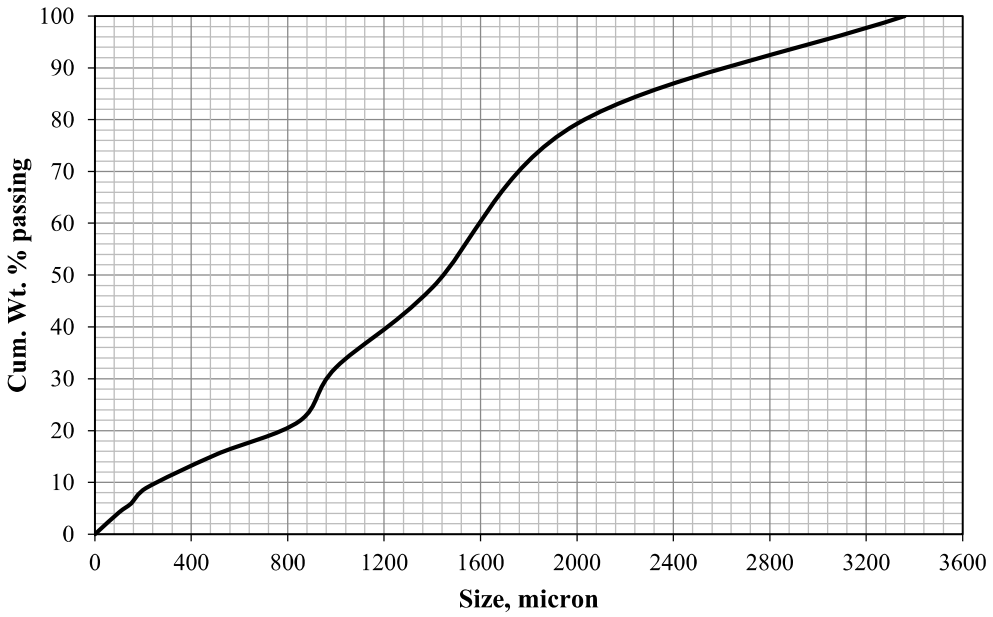


Fig. 3.4 Particle size distribution of feed

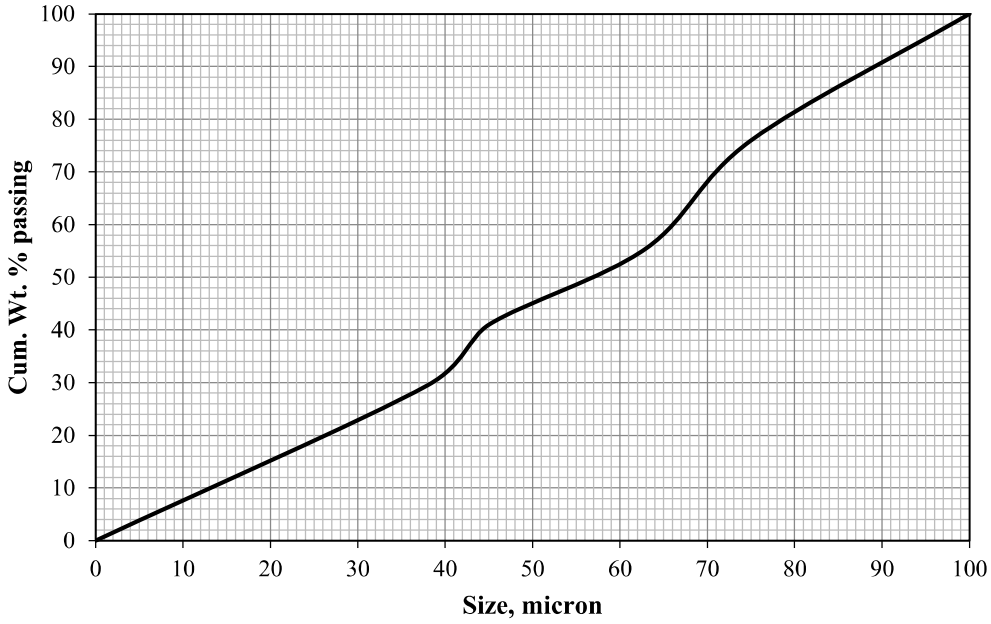


Fig. 3.5 Particle size distribution of product

3.6 Bulk Density

Bulk density is the weight of material in air per unit volume. It is measured by the help of a square sized metal container having length of each side 300 mm. Bulk density is evaluated by weighing a precisely measured known volume of ore sample. Natural moisture content is determined as per IS: 2720 (part 2) -1973. The bulk density of -10 mm sized sample is 1.982 kg/m^3 and its bulk density after being tapped is 3.178 kg/m^3.

3.7 Beneficiation Studies

The beneficiation study of the iron ore sample was carried out based on their mineralogy. According to size analysis studies, it contains good number of fine particles which may be iron phase minerals along with clay particles. In general, the fine clay particles are coated on the surface of the coarse particles. These clay minerals are responsible to increase the viscosity of slurry due to their swelling characteristics during the beneficiation process. Hence, it is essential to remove at the beginning of the process by scrubbing technique and discard as the reject. Hence the remaining materials can be processes smoothly for up-gradation of iron values by physical beneficiation. As it contains 12.96% of below 45

microns and the top size is below 10mm, hence for attrition of particles, screw scrubber process is most suitable. This equipment also classifies simultaneously the fine particles in a single stage. The laboratory screw scrubber was used for desliming the slime particles at the feed rate of 200 kg/hr using water to solid ratio of 70:30. The screw scrubber gives two products i.e., overflow (slimes) and underflow (coarse particles). The sample was fed to the screw scrubber. The Fe content of scrubber underflow could be achieved to 62.47% with overall yield of 80.90% and overflow fraction contained 53.61% Fe with overall yield of 19.10%. The result of screw scrubber is given in the Table 3.11. The result shows that screw scrubber underflow is one of the final product and overflow need to be further processed. Attempt was made to enhance the grade of scrubber underflow by further process.

Table 3.11
Screw scrubber study of bulk sample

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Underflow	80.90	80.90	62.47	62.47
Overflow	19.10	100.00	53.61	60.78
Total	100.00		60.78	

The underflow of screw scrubber was further classified into two different size fractions viz. (-10+1mm, and -1mm). The Fe content of -10+1 mm size could be achieved to 62.64% with overall yield of 59.42%. The Fe content of -1 mm size could be achieved to 62.01% with overall yield of 21.48%. The result of classified sample is given in Table 3.12. The result shows -10+1 mm is having slightly more higher Fe value compared to -1mm size fraction.

Table 3.12
Size classification of screw scrubber underflow

Size, mm	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
-10+1	59.42	59.42	62.64	62.64
-1	21.48	80.90	62.01	62.47
Total	80.90		62.47	

The -10+1 mm size fraction of sample was processed in the batch type laboratory jig (Supplied by All Minerals, Germany). In each batch around 50kg sample was taken during experiment. It is a hydraulic jig operated with pneumatic control pulsating system. The pulse frequency was kept 60 cycle per minute and air flow rate 0.3 to 0.4 bar. The screen

aperture used for bed was 1 mm size. After 30 minutes the material was collected from the chamber in layer by layer from top to bottom at particular thickness. The concentrate (Layer 1, Layer 2 and Layer 3) obtained by jigging of -10+1 mm fraction contains 63.19% Fe with yield of 65.79% and tailings contains 55.40% Fe with yield of 4.94 %. The jigging study of -10+1 mm sample is given in the Table 3.13.

Table 3.13
Jigging study on -10+1 mm size fraction material

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Layer 1	51.93	51.93	64.14	64.14
Layer 2	7.49	59.42	60.23	63.65
Layer 3	6.37	65.79	58.89	63.19
Layer 4	4.94	70.73	55.40	62.64
Total	59.42		62.44	

The -1 mm size samples was processed in the spiral concentrator. Roughing and cleaning operations were carried out to enrich the concentrate grade. In both operations of roughing and scavenging, 30% solid concentration was maintained. The capacity of spiral concentrator is 1 tonne per hour. The Fe content of rougher concentrate could be achieved to 63.22% with overall yield of 18.13%. The Fe contains of scavenging concentrate, scavenging tailings and tailing fines could achieved 60.18%, 59.17% and 52.33% with overall yield of 3.36 %, 2.53 % 0.90% respectively. The result of spiral concentrator is given in the Table 3.14.

Table 3.14
Spiral study of -1mm size fraction material

Details	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
Rougher Concentrate	18.13	18.13	63.22	63.22
Scavenging Concentrate	3.36	21.48	60.18	62.75
Scavenging Tailings	2.53	24.01	59.17	62.37
Tailing Fines	0.90	24.91	52.33	62.01
Total	21.48		62.01	

The -10+1 mm size was further classified in two different size fractions viz. (-10+5 mm, and -5+1mm). The Fe content of -10+5 mm size could be achieved to 63.12% with overall yield of 30.17%. The Fe content of -5+1 mm size could be achieved to 62.14% with overall yield of 29.25 %. The result of classified sample is given in Table 3.15.

Table 3.15
Size classification of -10+1 mm fraction

Size, mm	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
-10+5	30.17	30.17	63.12	63.12
-5+1	29.25	59.42	62.14	62.64
Total	59.42		62.64	

The -10+5 mm and -5+1 mm size fraction of samples were processed in the batch type laboratory jig. In each batch around 50kg sample was taken for experiment. The pulse frequency was kept 60 cycle per minute and air flow rate 0.3 to 0.4 bar. The screen aperture used for bed was 1 mm size. After 30 minute the material was collected from the chamber in layers from top to bottom at particular thickness. The concentrate (Layer 1, Layer 2 and Layer 3) obtained by jigging of -10+5 mm fraction contains 62.74% Fe with yield of 28.06% and tailings contains 53.23% Fe with yield of 2.11%. The jigging study of -10+5 mm sample is given in Table 3.16. The concentrates (Layer 1, Layer 2 and Layer 3) obtained by jigging of -5+1 mm fraction contains 62.74 % Fe with yield of 27.41 % and tailings contains 53.23% Fe with yield of 1.84%. The jigging study of -5+1 mm sample is given in Table 3.17.

Table 3.16
Jigging study on -10+5 mm size fraction material

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Layer 1	22.15	22.15	64.12	64.12
Layer 2	3.19	25.35	60.08	63.26
Layer 3	2.72	28.06	59.07	62.74
Layer 4	2.11	30.17	53.23	62.14
Total	30.17		62.14	

Table 3.17
Jigging study on -5+1 mm size fraction material

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Layer 1	18.89	18.89	64.12	64.12
Layer 2	5.09	23.98	60.08	63.26
Layer 3	3.43	27.41	59.07	62.74
Layer 4	1.84	29.25	53.23	62.14
Total	29.25		62.14	

The overflow of screw scrubber is to be deslimed by hydrocyclone to remove the ultrafine gangue minerals directly. The screw scrubber overflow sample was fed to the rougher hydrocyclone. The hydrocyclone gives two products i.e., overflow (very ultrafine slimes particle) and underflow (fine coarse particles). The Fe content of hydrocyclone underflow could be achieved to 57.52% Fe with overall yield of 11.33% and overflow fraction contained 47.90% Fe with overall yield of 7.77%. The rougher hydrocyclone overflow sample was fed to the scavenging hydrocyclone at the density 1040 kg/m^3. The Fe content of scavenger hydrocyclone underflow could be achieved to 54.45% Fe with overall yield of 1.26% and overflow fraction contained 46.63% Fe with overall yield of 6.51%. The rougher and scavenging hydrocyclone study are given in Table 3.18 and 3.19.

Table 3.18
Rougher hydrocyclone study of screw scrubber overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Underflow	11.33	11.33	57.52	57.52
Overflow	7.77	19.10	47.90	53.61
Total	19.10		53.61	

Table 3.19
Scavenging hydrocyclone study

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Underflow	1.26	1.26	54.45	54.45
Overflow	6.51	7.77	46.63	47.90
Total	7.77		47.90	

If the overflow of hydrocyclone contains ultrafine hematite particles and are not the discardable, then the screw scrubber overflow will be beneficiated directly using WHIMS/HGMS.

The rougher and scavenging hydrocyclone underflow were blended together and given in Table 3.20. The blended material fed to LONGI. The intensity of magnetic separator (Longi) having 12000 gauss in pilot scale. The result of rougher LONGI study is given in the Table 3.21. The Fe content of the rougher magnetic fraction could be enhanced to 62.15% Fe with overall yield of 8.22%. The rougher middling could be achieved 57.44% Fe with overall Yield of 1.00 % and non-magnetic fraction from rougher tailings contains 45.10% Fe with overall yield of 3.37%. The rougher tailings of LONGI was further fed to scavenger stage of LONGI. The Fe content of the scavenging magnetic fraction could be

enhanced to 56.39% Fe with overall yield of 1.00%. The scavenging middling contains 44.79% Fe with overall Yield of 0.26% and non-magnetic fraction from scavenging tailings contains 39.79%Fe with overall yield of 2.11%. The result of scavenger LONGI is given in the Table 3.22.

Table 3.20
Blending of hydrocyclone underflows

Details	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
Rougher hydrocyclone underflow	11.33	11.33	57.52	57.52
Scavenging hydrocyclone underflow	1.26	12.59	54.45	57.21
Total	12.59		57.21	

Table 3.21
LONGI study of blended product

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	8.22	8.22	62.15	62.15
Middling	1.00	9.22	57.44	61.64
Non-Mag	3.37	12.59	45.10	57.21
Total	12.59		57.21	

Table 3.22
LONGI scavenging study

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	1.00	1.00	56.39	56.39
Middling	0.26	1.26	44.79	54.00
Non-Mag	2.11	3.37	39.79	45.10
Total	3.37		45.10	

The overflow of hydrocyclone was fed to HGMS (supplied by LONGI). The magnetic intensity of LONGI is 12000 gauss. The feed density was kept at 1.06 kg/m^3. The Fe content of the rougher magnetic fraction of LONGI could be achieved to 57.78 % Fe with overall yield of 1.81% whereas non-magnetic fraction contains 41.58% Fe with overall yield of 4.24 %. The rougher non-magnetic fraction was fed to the scavenging LONGI. The Fe content of the scavenging magnetic fraction of LONGI could be achieved to 43.21% Fe with overall yield of 0.82% and non-magnetic fraction contains 41.12% Fe with overall yield of 3.06%. The rougher and scavenging magnetic separation results are given in Table 3.23 and 3.24.

Table 3.23
LONGI study of hydrocyclone overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	1.81	1.81	57.78	57.78
Middling	0.46	2.27	49.28	56.06
Non-Mag	4.24	6.51	41.58	46.63
Total	6.51		46.63	

Table 3.24
LONGI scavenging study

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	0.82	0.82	43.21	43.21
Middling	0.35	1.18	41.76	42.78
Non-Mag	3.06	4.24	41.12	41.58
Total	4.24		41.58	

Based on the above study and considering on the quality and quantity on the final product, following process were carried out. The beneficiation study was carried out by using screw scrubbing of the ROM sample followed by the Magnetic separation of the screw scrubber overflow and scavenging magnetic separation of rougher non-magnetic fraction. The results are given in the Table 3.25 to Table 3.27. The overall product is given in the Table 3.28 and the overall reject is given in the Table 3.29. The process flowsheet is shown in Figure 3.7. The chemical analysis of the product and reject are given in Table 3.30 and 3.31 respectively.

Table 3.25
Scrubbing study of bulk sample

Details	Wt., %	Cum Wt., %	Fe, %	Cum. Fe, %
Underflow	80.90	80.90	62.47	62.47
Overflow	19.10	100.00	53.61	60.78
Total	100.00		60.78	

Table 3.26
Rougher magnetic separation study of screw scrubber overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	10.03	10.03	61.36	61.36
Middling	1.46	11.49	54.87	60.54
Non-Mag	7.61	19.10	43.14	53.60
Total	19.10		53.61	

Table 3.26
Rougher magnetic separation study of screw scrubber overflow

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	8.22	8.22	62.15	62.15
Middling	1.46	9.68	55.87	61.18
Non-Mag	9.42	19.10	45.80	53.61
Total	19.10		53.61	

Table 3.27
Scavenging magnetic separation study of rougher non-magnetic fraction

Details	Wt., %	Cum. Wt., %	Fe, %	Cum. Fe, %
Mag	2.81	2.81	58.66	58.66
Middling	0.61	3.42	45.66	56.34
Non-Mag	7.46	10.88	42.94	47.15
Total	10.88		47.15	

Table 3.28
Overall products

Details	Wt., %	Fe, %
Screw Scrubber underflow	80.90	62.47
Rougher MS Conc.	8.22	62.15
Scavenger MS Conc.	2.81	58.66
Total	91.93	62.32

Table 3.29
Overall rejects

Details	Wt., %	Fe, %
Scavenger Middling	0.61	45.66
Scavenger Tailings	7.46	42.94
Total	8.07	43.15

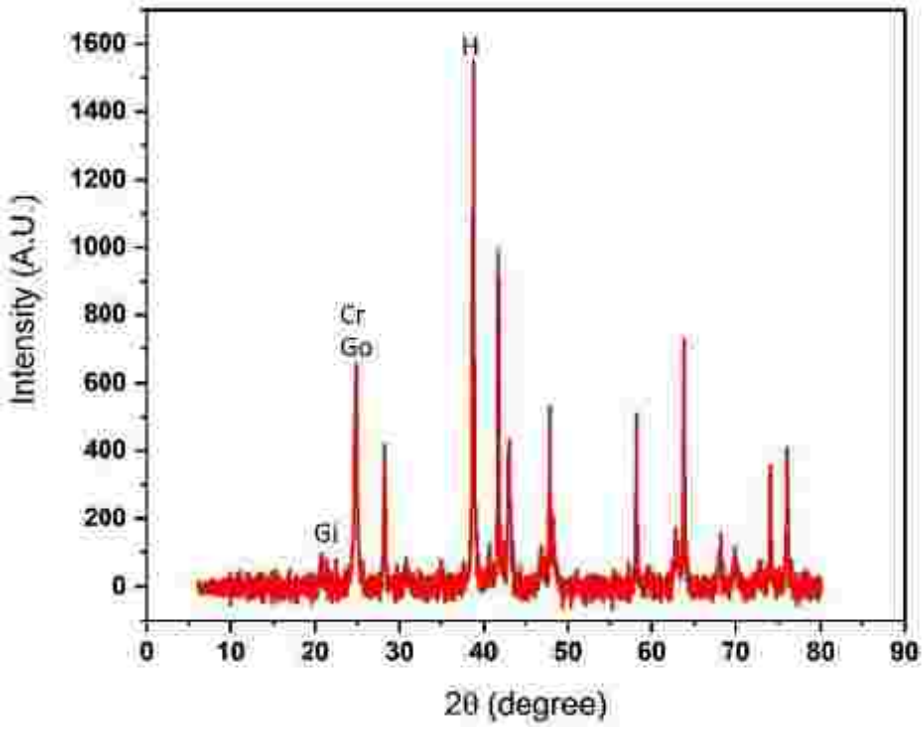
Table 3.30
Chemical analysis of the product

Details	Scrubber Underflow	Rougher Mag.	Scavenger Mag.	Overall Product
Fe (T)	62.47	62.15	58.66	62.32
Fe_2O_3	89.33	88.87	83.88	89.12
SiO_2	1.75	1.9	3.29	1.81
Al_2O_3	2.74	3.41	6.58	2.92
LOI	5.85	5.79	6.23	5.86

Table 3.31
Chemical analysis of the reject

Details	Percentage
Fe (T)	43.00
Fe_2O_3	61.49
SiO_2	13.72
Al_2O_3	17.70
LOI	7.01

XRD study was carried out on the product sample to determine the major minerals present in the samples. The XRD results is shown in Fig. 3.6. It indicates that the product sample have hematite as the major mineral phase and other minor minerals are quartz, goethite, cristobilite and quartz.



H: Hematite, Go: Goethite, Gi: Gibbsite, Cr: Cristobilite

Fig. 3.6 XRD study of product sample

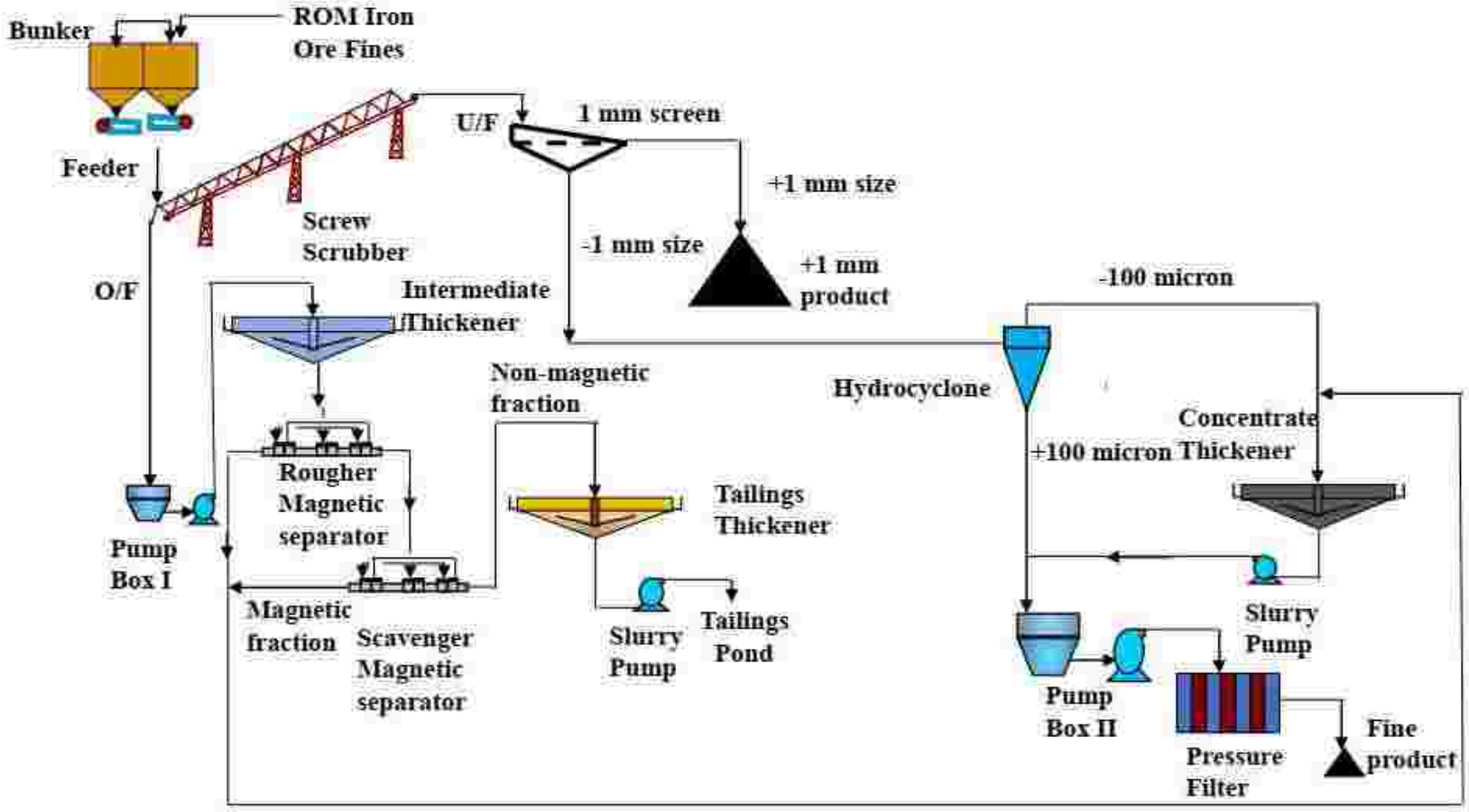


Fig. 3.7 Process flowsheet for washing of low-grade iron ore of Narayanposhi

3.8 Pressure Filtration Study

The pressure filtration study of magnetic separation concentrate and tailings were carried out by using Diemme Filter press and the results are given in Table 3.32 and 3.33. The pressure filter used for experiment is shown in Fig. 3.8.



Fig. 3.8 Pilot scale pressure filter set up

Table 3.32
Pressure filtration result of magnetic separation concentrate

Parameters	Exp. 1
Solid % in feed	60
Feeding time, min	15
Feeding pressure, bar	6
Air purging time, min	7.5
Air purging pressure, bar	8
Squeezing time, min	7.5
Squeezing pressure, bar	11
Total filtration time, min	30
Weight of cake (Wet), Kg	45.5
Cake Thickness, mm	20
Filtrate (water)	30
Cake moisture, %	17.2

Table 3.33
Pressure filtration result of magnetic separation tailings

Parameters	Exp. 1
Solid % in feed	32
Feeding time, min	15
Feeding pressure, bar	7
Air purging time, min	10
Air purging pressure, bar	8
Squeezing time, min	10
Squeezing pressure, bar	13
Total filtration time, min	35
Cake Thickness, mm	18.0
Cake moisture, %	21.8

3.9 Settling Studies

3.9.1 Materials Preparation

After processing of the iron ore, the tailing and concentrate samples were taken for the settling study to provide the basic data for design of thickeners for tailings and concentrate.

3.9.2 Experimental Method

The settling study was carried out in a graduated measuring cylinder of 1 liter capacity. Different solid concentration like 20% to 30% in increment of 5% of concentrate and 5% to 10% in the increment of 2.5% tailing samples are prepared. The pH of the concentrate sample was maintained at 6.5 and the pH of tailing is also 6.5. This is due to pH as the received in the process. The interface height was observed against the time intervals. The interface level with respect to time was recorded in each case.

3.9.3 Results and Discussion

The settling study was carried out on concentrate sample at different solids concentration of 20%, 25% and 30%. The pH of the sample was kept at 6.5 as the sample was received from the process at the same pH. The results of experiments were shown in Figures 3.9 to 3.12. It has been observed that the settling rate decreases with increasing of solid percentage. In case of 20% of solid concentration, the settling rate is 1.5 m/hr. Different dosses of flocculent was used to enhance the settling rate of solid. Very low doses of

flocculent is required at lower solid concentration to get satisfactory results to design the conventional thickener. At higher solid concentration, the flocculent dosage requirement is little high.

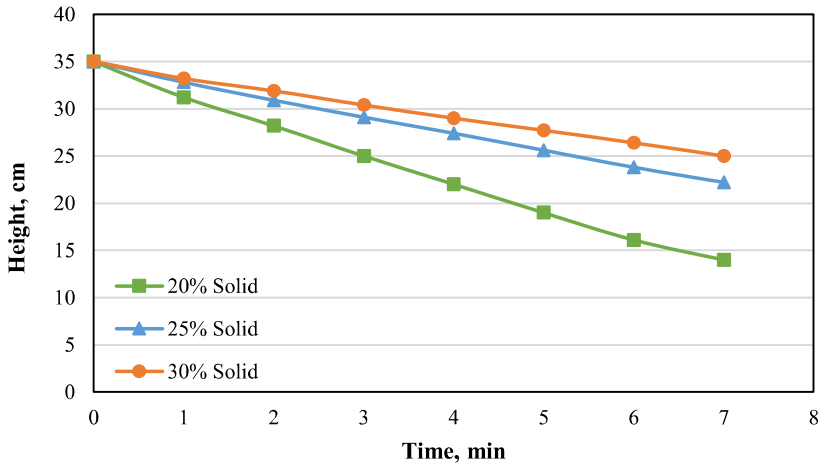


Fig. 3.9 Settling study of iron ore concentrate at different solid concentration

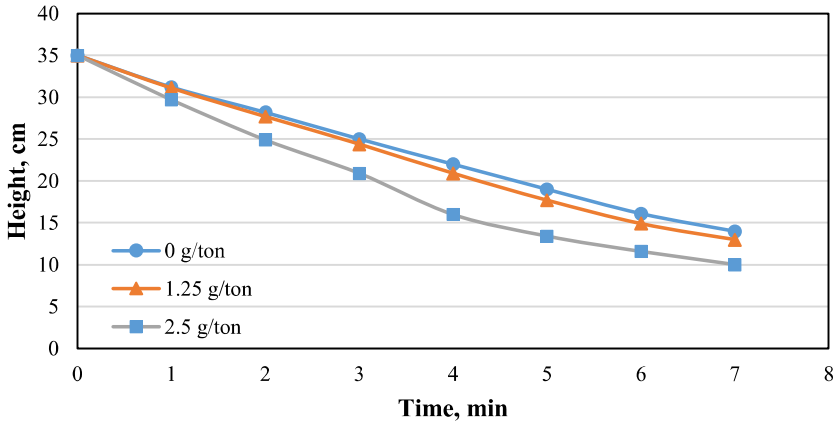


Fig. 3.10 Iron ore concentrate settling study at 20% solid concentration with different doses of flocculent

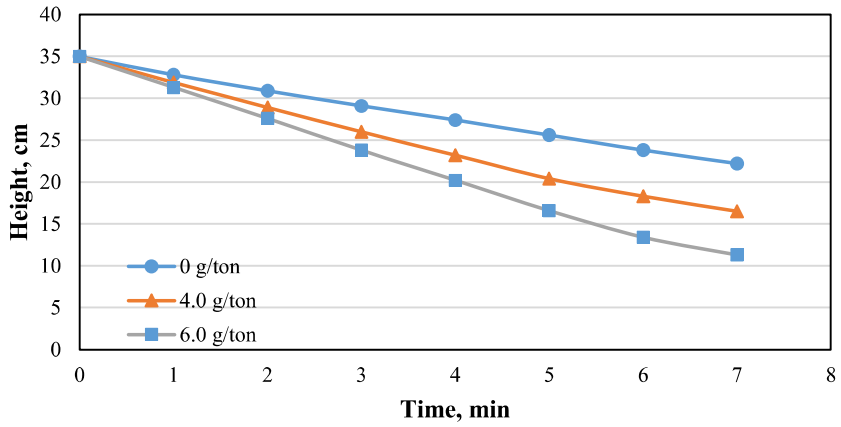


Fig. 3.11 Iron ore concentrate settling study of 25% solid concentration with different doses of flocculent.

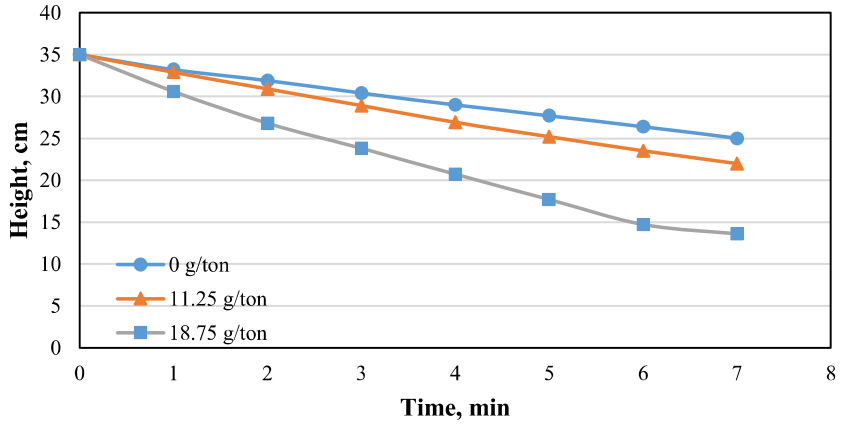


Fig. 3.12 Iron ore concentrate settling study of 30% solid concentration with different doses of flocculent.

Similarly settling studies of iron ore tailings were carried out at different concentration of 5%, 7.5% and 10%. The tests were carried out without and with addition of flocculent. The tests results are shown in Figure 3.13 to 3.16. It has been observed that the settling rate decreases with increasing of solid percentage. In case of 5% of solid concentration, the settling rate is 2 m/hr whereas in case 15 %, the settling rate is 0.8 m/hr. The flocculent rate was varied from 6.52 gm/tonne to 30 gm/tonne of solid. The settling rate with flocculent is very high at lower solid concentration. It indicates that after 5% solid concentration, the

flocculent may require at lower dosage to enhance the settling rate. At higher solid concentration, the flocculent dosage requirement is high. At 10% solid concentration, the settling rate is very poor even after adding the flocculent.

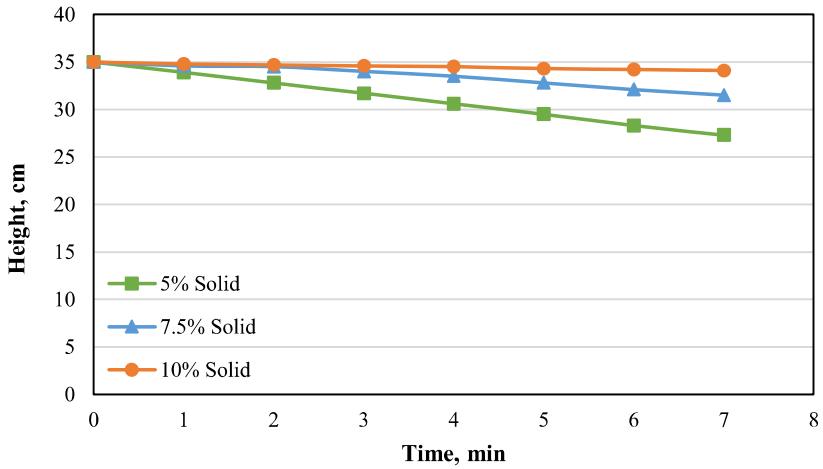


Fig. 3.13 Iron ore tailings settling study of different solid concentration

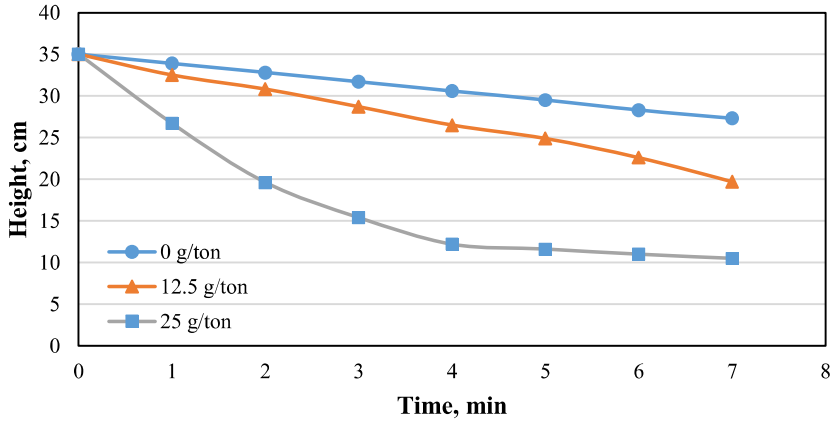


Fig. 3.14 Iron ore tailings settling study at 5% solid concentration with different doses of flocculent

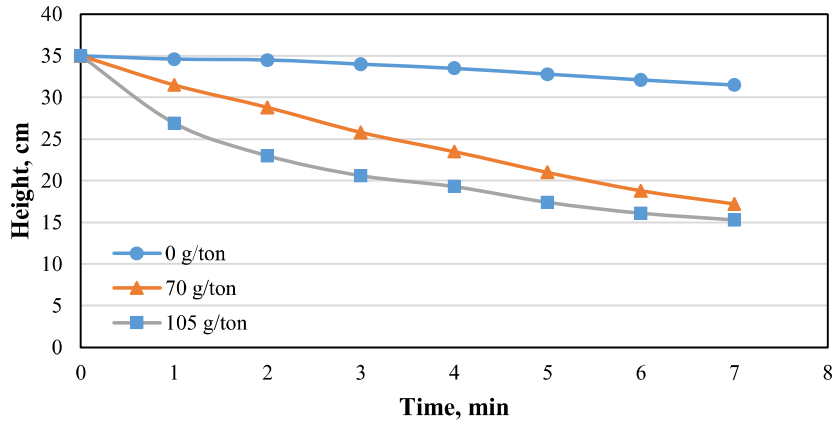


Fig. 3.15 Iron ore tailings settling study at 7.5% solid concentration with different doses of flocculent

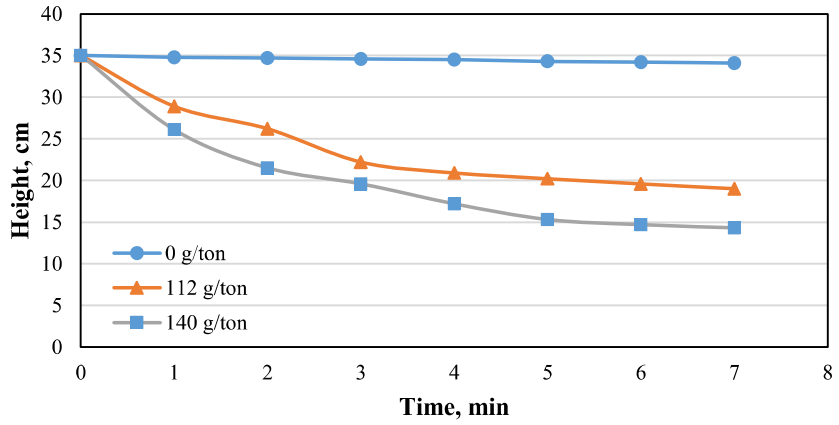


Fig. 3.16 Iron ore tailings settling study at 10% solid concentration with different doses of flocculent

3.10 Conclusions

The results of settling studies indicate the following observations;

1. The settling rate in case of tailings sample is very slow due to presence of ultra-fine clay minerals. Because of its surface charge, those try to remain in dispersion mode. The flocculent helps to neutralize the surface charge and make agglomerates the ultra-fine particles, as a result, the settling rate enhances.

2. The settling rate for conventional thickener design is required around 20 cm within 5-6 minutes. The above results are matching these phenomena.
3. For concentrate sample, small dose of flocculants was required to be added as there was less clay mineral compared to the tailings.

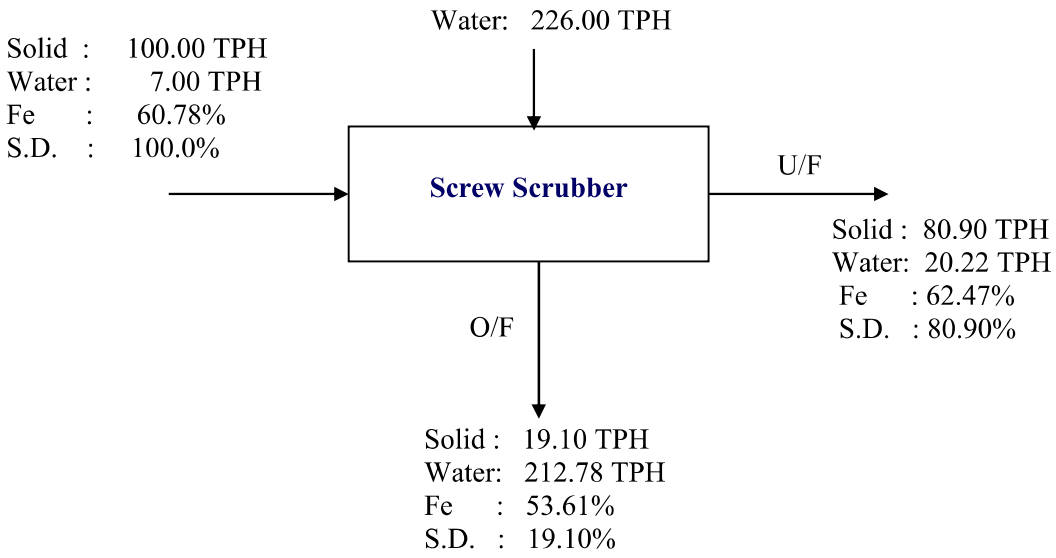
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Annexure II.A

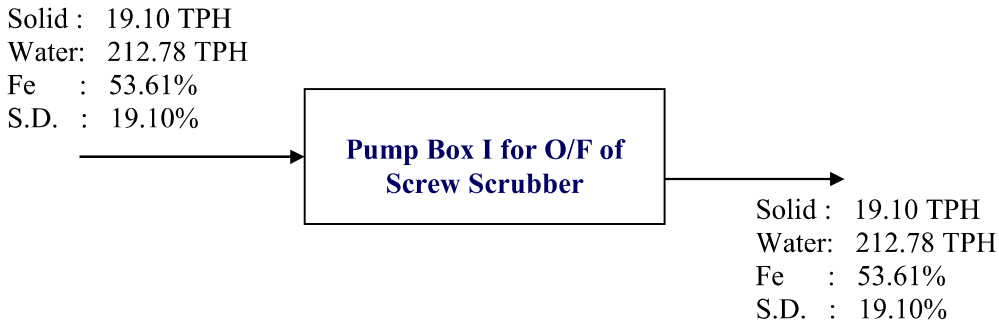
Material Balance of Process (Narayanposhi Iron ore)

Basis: 100 TPH

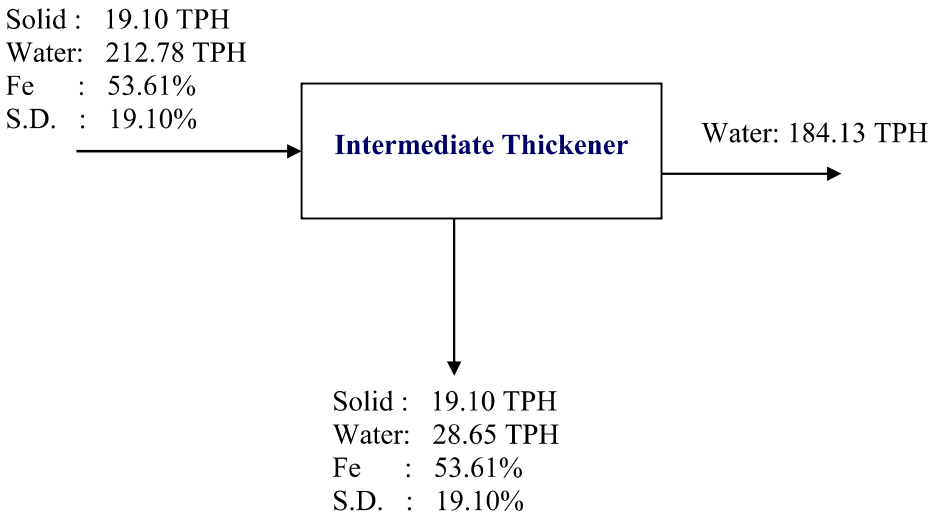
1. Screw Scrubber



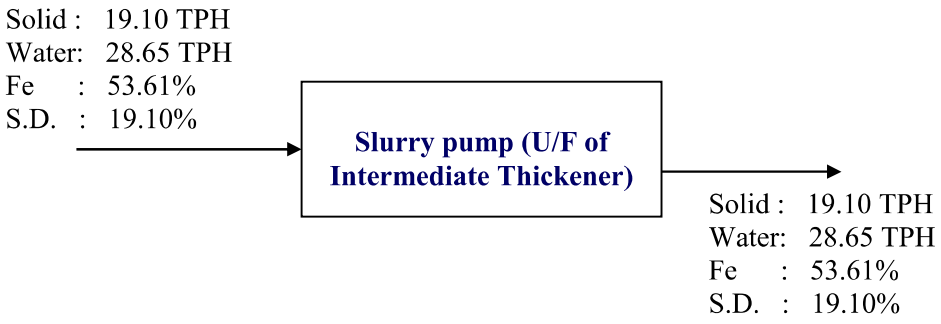
2. Pump Box I (O/F of Screw Scrubber)



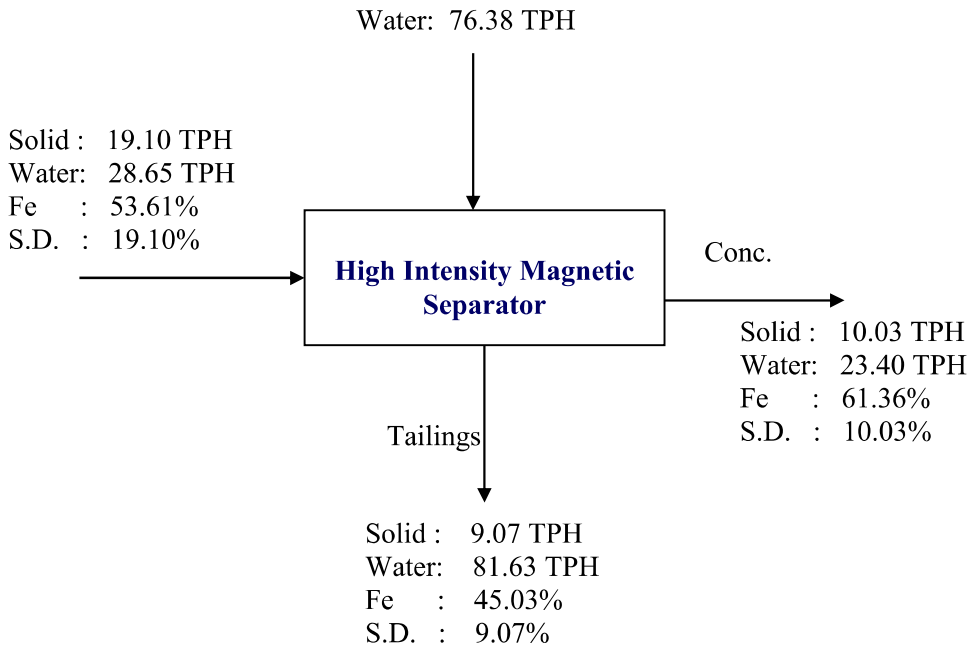
3. Intermediate Thickener



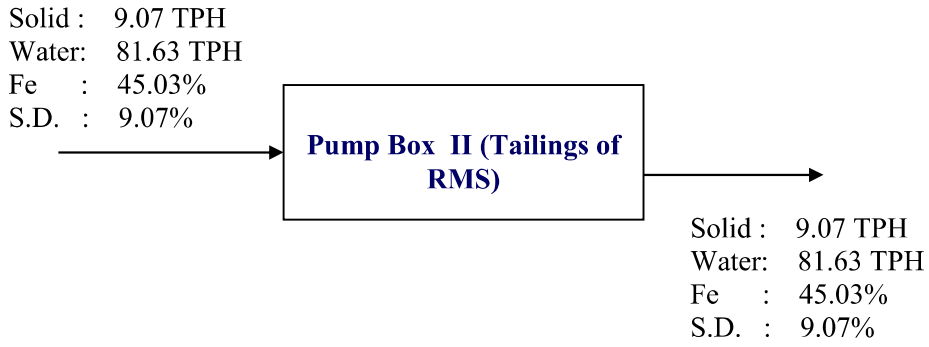
4. Slurry Pump I (U/F of intermediate thickener)



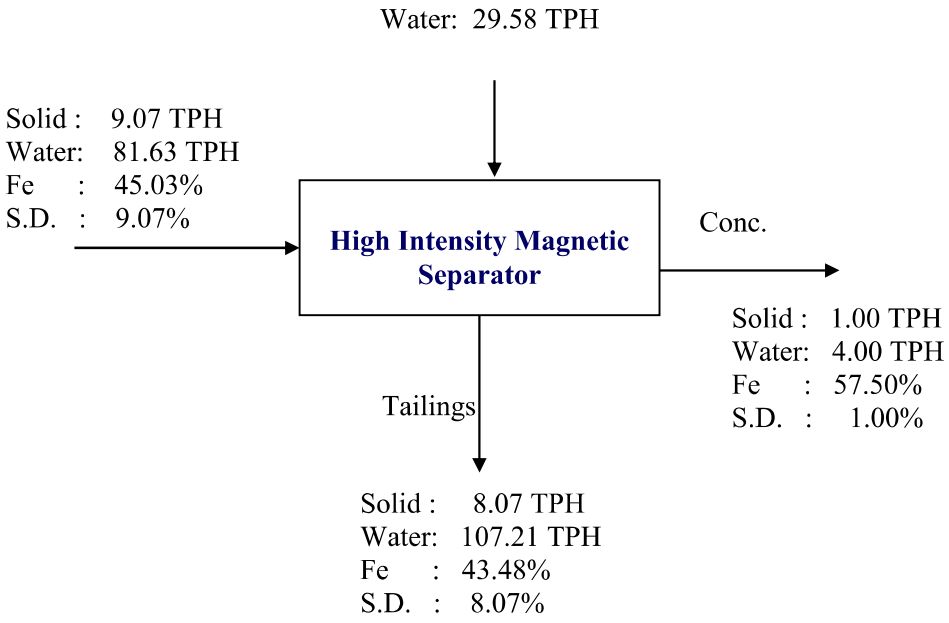
5. High Intensity Rougher Magnetic Separator



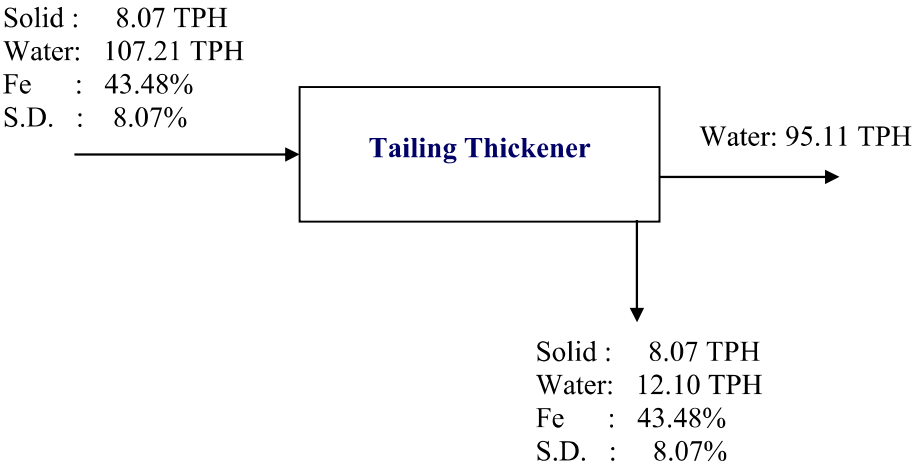
6. Pump Box II (Tailings of RMS)



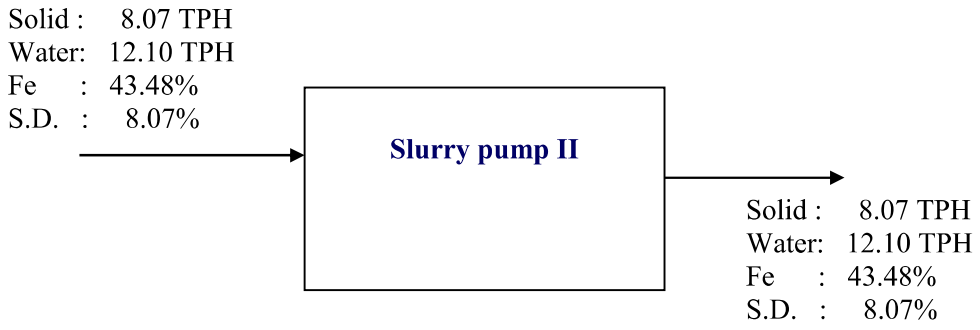
7. High Intensity Scavenging Magnetic Separator



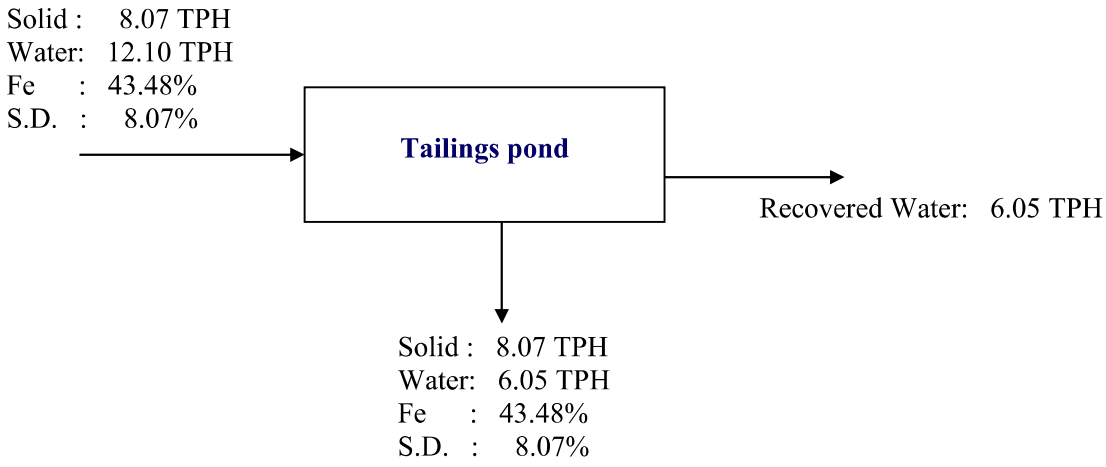
8. Tailing Thickener



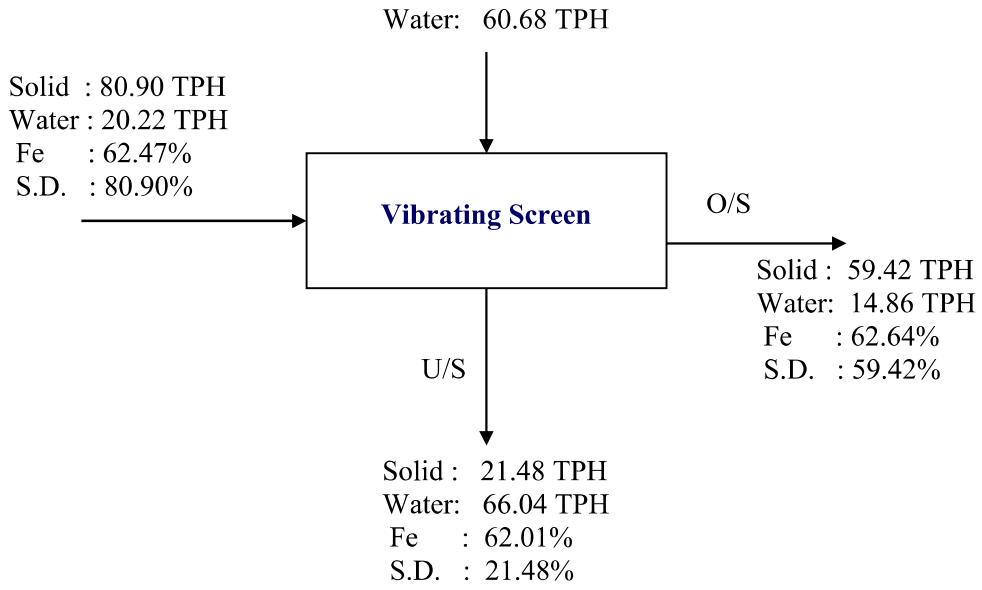
9. Slurry Pump II



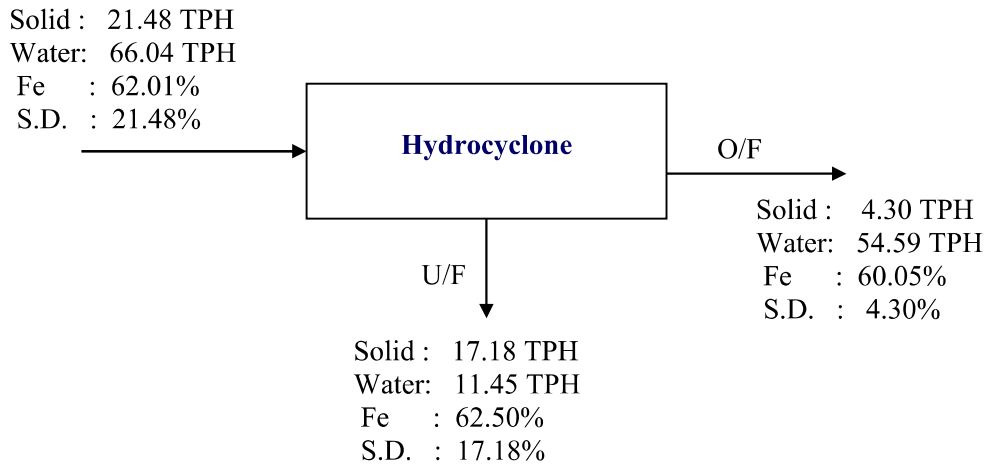
10. Tailings Pond



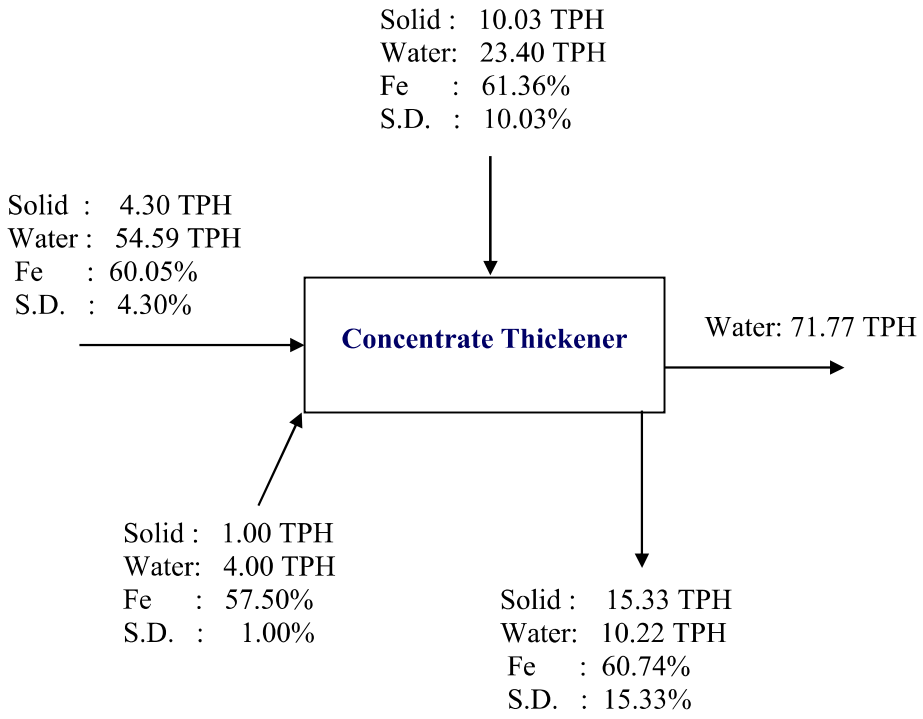
11. Vibrating Screen (1 mm size)



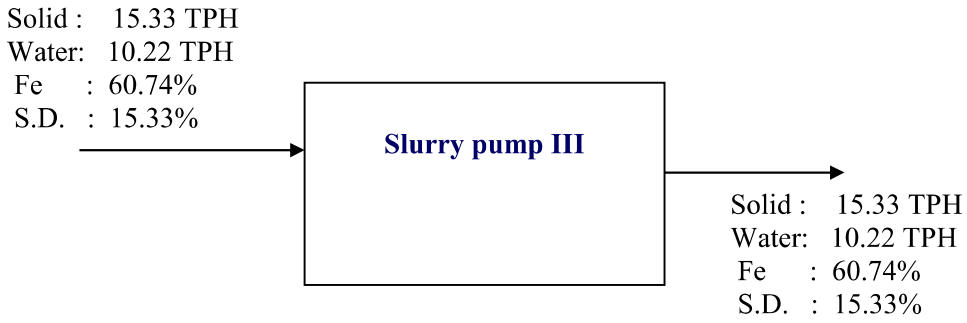
12. Hydrocyclone



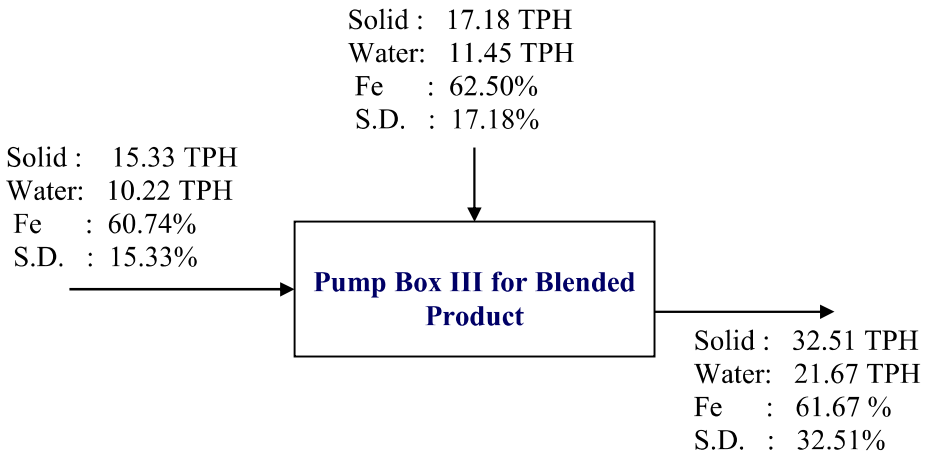
13. Concentrate Thickener



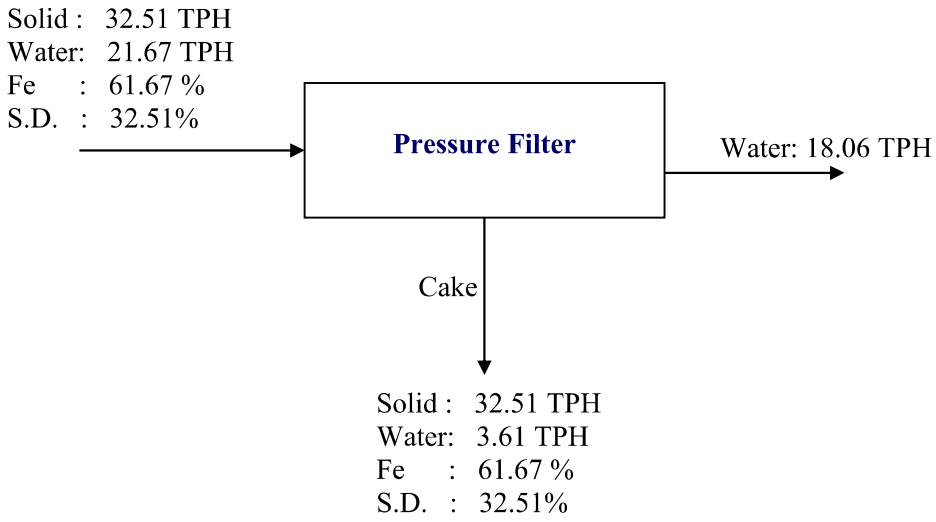
14. Slurry Pump III (Underflow of CT)



15. Pump Box III (Blended Product)



16. Pressure Filter



Water Balance

A. Water Handling

Sl. No.	List of Equipment	Water Addition, TPH
1	Bulk Sample	7.00
2	Screw Scrubber	226.00
3	Vibrating Screen	60.68
4	Rougher Magnetic Separator	76.38
5	Scavenger Magnetic Separator	29.58
Total		**399.64**

B. Water Recovered

Sl. No.	List of Equipment	Water recovered, TPH
1	Intermediate Thickener	184.13
2	Concentrate Thickener	71.77
3	Pressure Filter	18.06
4	Tailings Thickener	95.11
5	Tailing Pond	6.05
Total		**375.12**

C. Water Contains in Products

Sl. No.	Name of the Product	Water Contain, TPH
1	Pressure Filter	3.61
2	Vibrating screen	14.86
3	Tailing pond	6.05
Total		**24.52**

D. Make up water

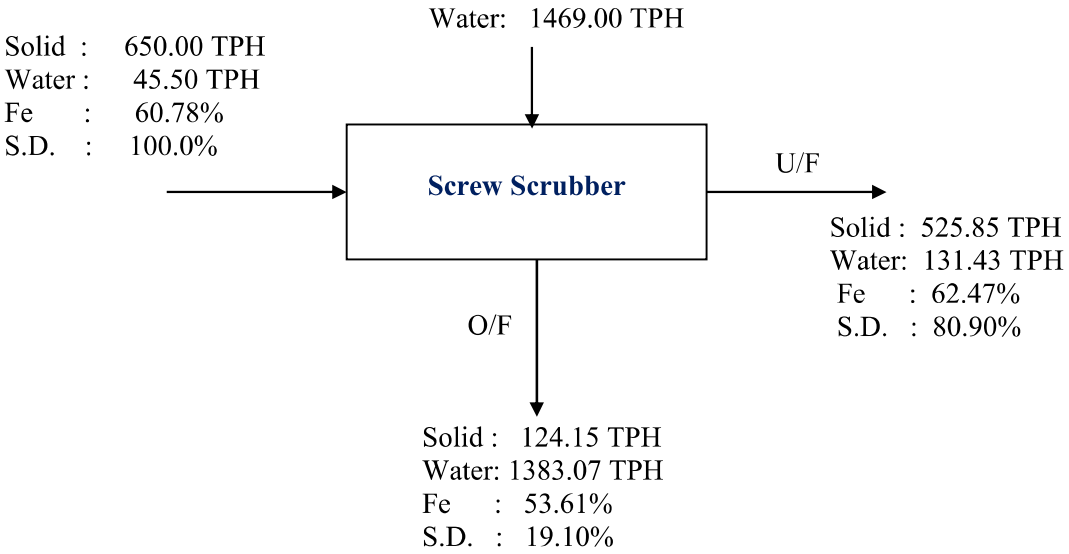
Sl. No.	Name of the Product	Water Contain, TPH
1	Water content in products	18.47
2	Water content in tailings	6.05
3	1% of handling loss	4.00
Total		**28.52**

Annexure II.B

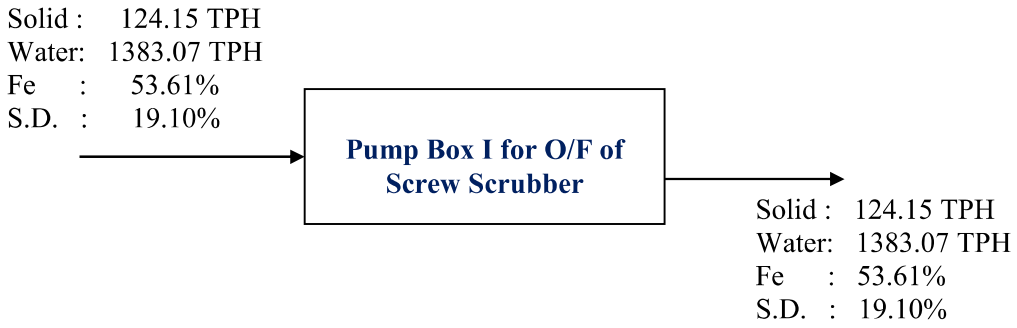
Material Balance of Process (Narayanposhi Iron ore)

Basis: 650 TPH

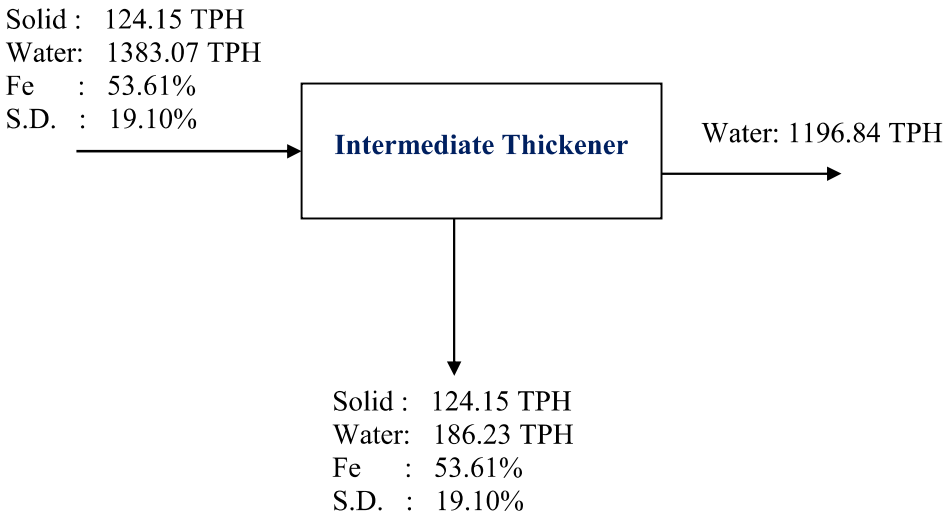
1. Screw Scrubber



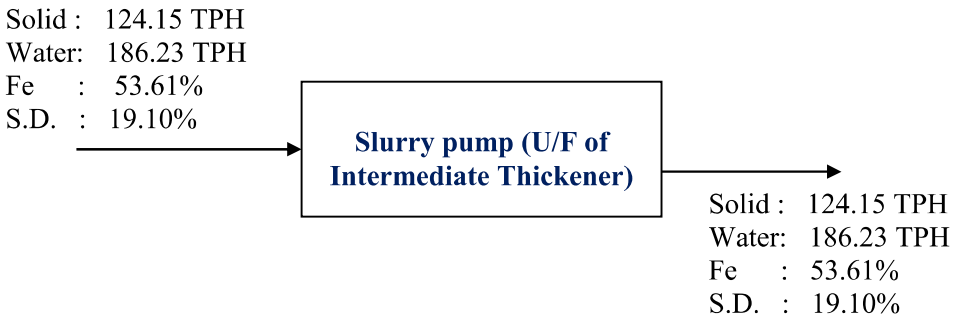
2. Pump Box I (O/F of Screw Scrubber)



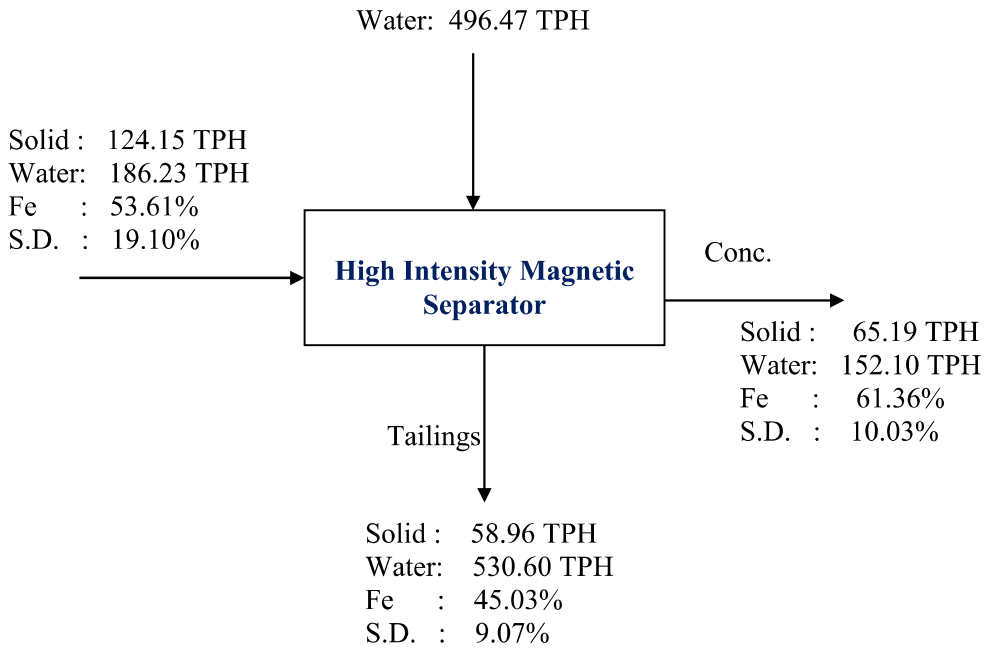
3. Intermediate Thickener



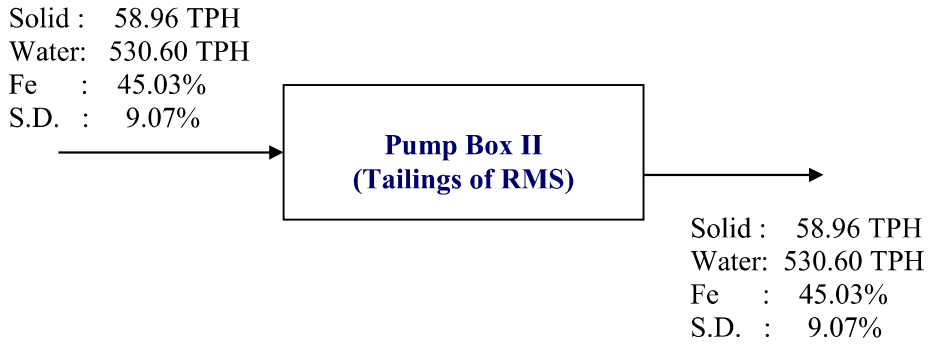
4. Slurry Pump I (U/F of intermediate thickener)



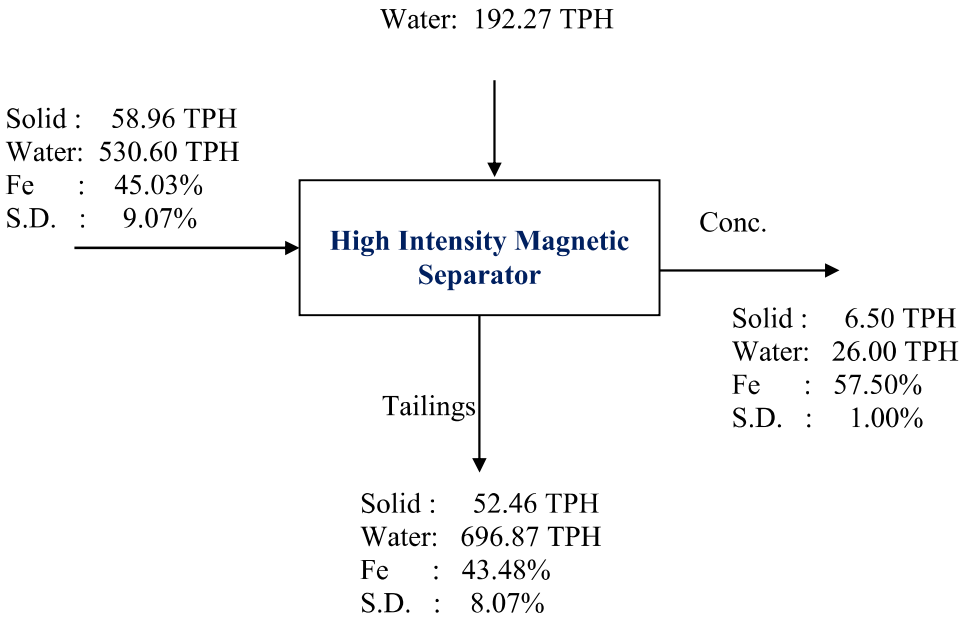
5. High Intensity Rougher Magnetic Separator



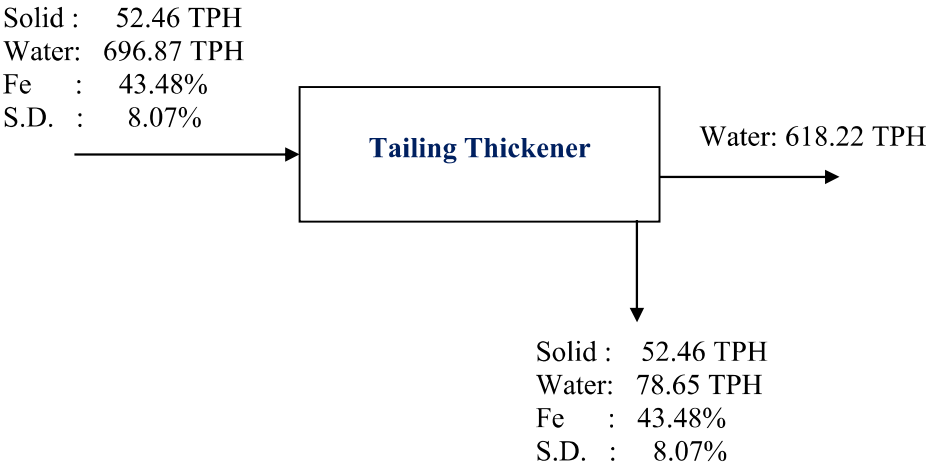
6. Pump Box II (Tailings of RMS)



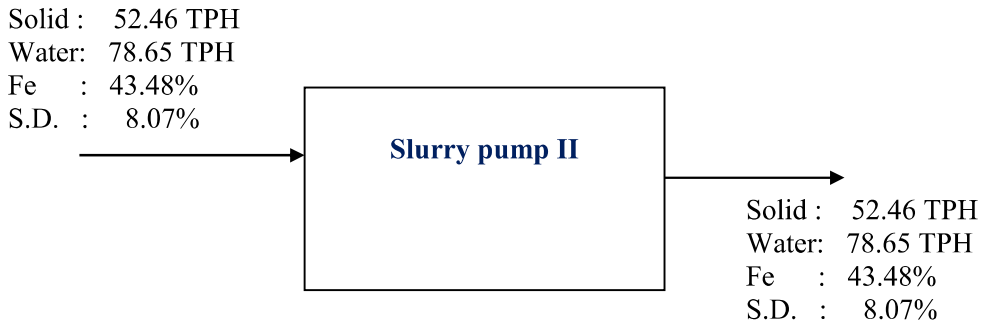
7. High Intensity Scavenging Magnetic Separator



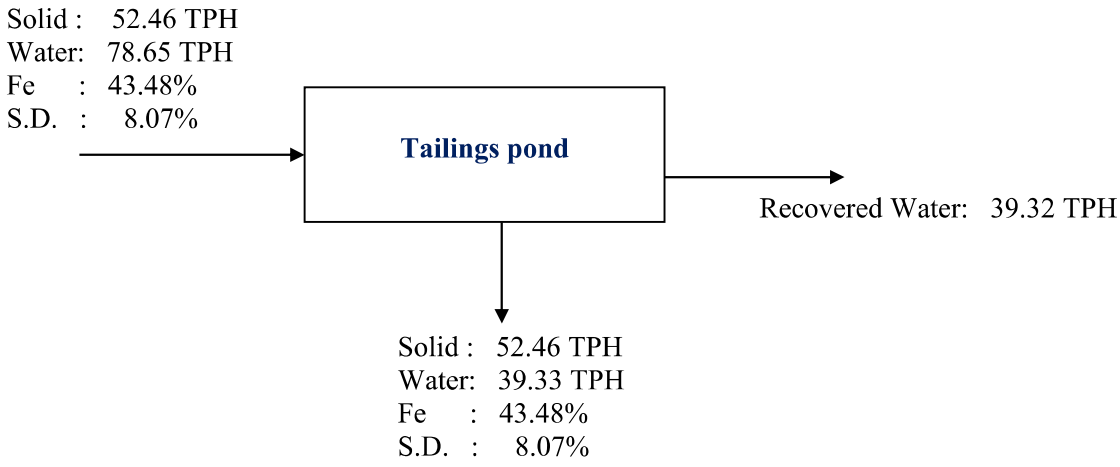
8. Tailing Thickener



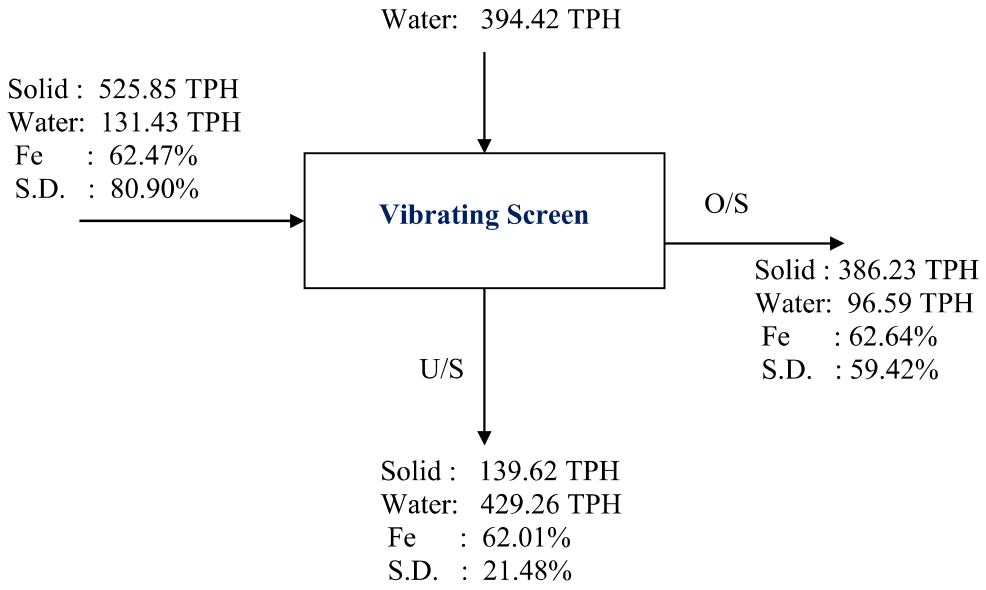
9. Slurry Pump II



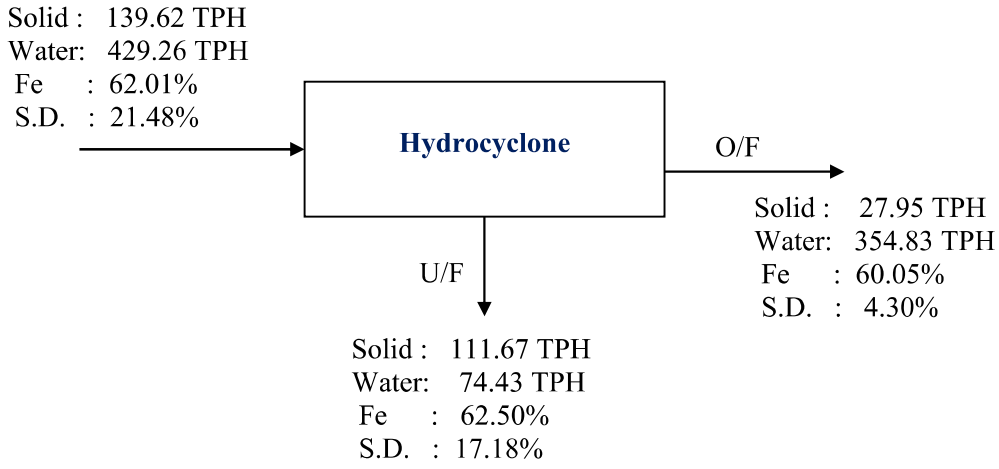
10. Tailings Pond



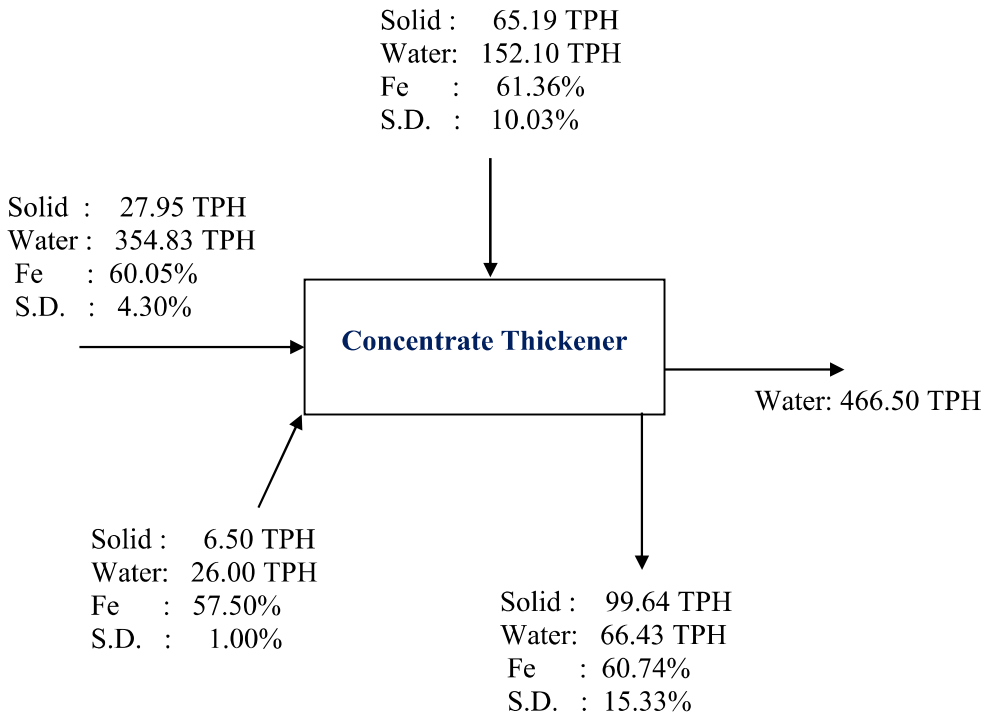
11. Vibrating Screen (1 mm size)



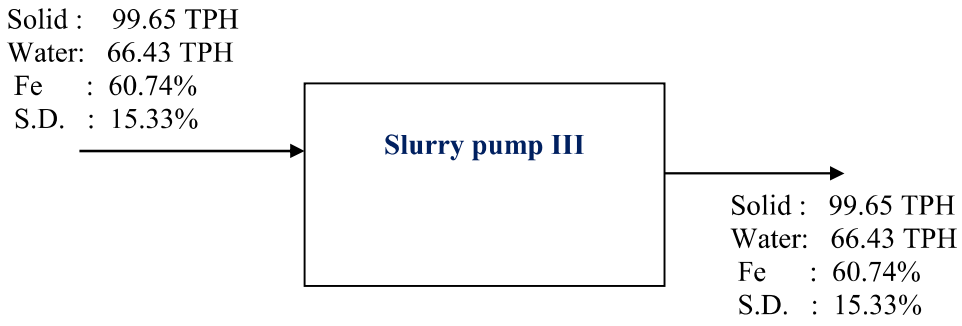
12. Hydrocyclone



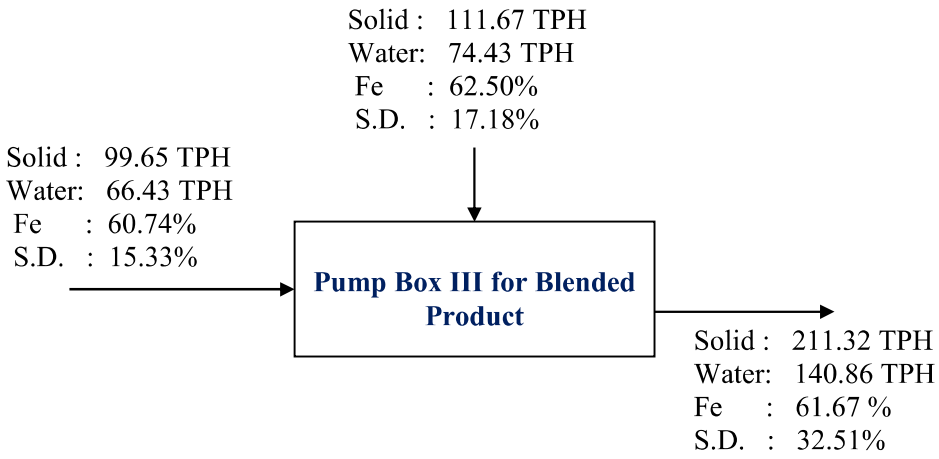
13. Concentrate Thickener



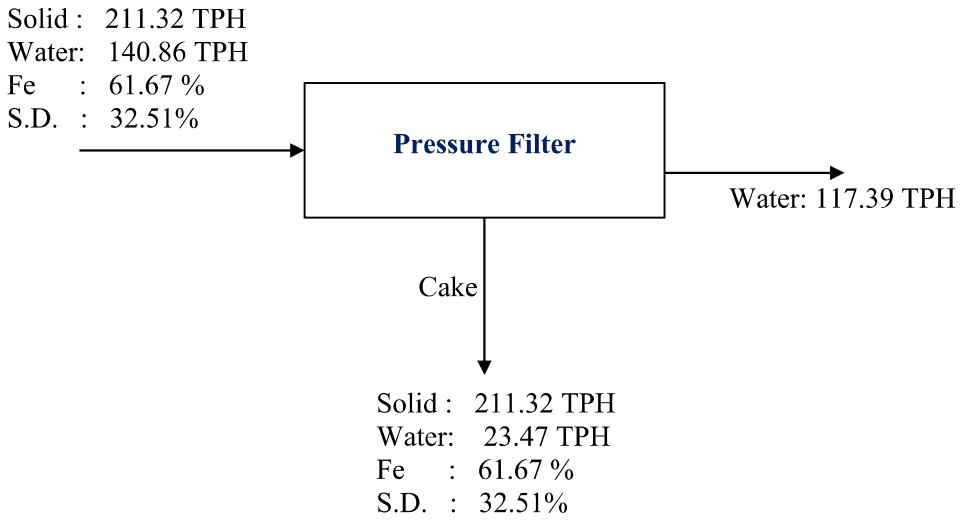
14. Slurry Pump III (Underflow of CT)



15. Pump Box III (Blended Product)



16. Pressure Filter



Water Balance

A. Water Handling

Sl. No.	List of Equipment	Water addition, TPH
1	Bulk Sample	45.50
2	Screw Scrubber	1469.00
3	Vibrating Screen	394.42
4	Rougher Magnetic Separator	496.47
5	Scavenger Magnetic Separator	192.27
Total		**2597.66**

B. Water Recovered

Sl. No.	List of Equipment	Water recovered, TPH
1	Intermediate Thickener	1196.84
2	Concentrate Thickener	466.50
3	Pressure Filter	117.39
4	Tailings Thickener	618.22
5	Tailing Pond	39.32
Total		**2438.27**

C. Water Contains in Products

Sl. No.	Name of the Product	Water contain, TPH
1	Pressure Filter	23.47
2	Vibrating screen	96.59
3	Tailing pond	39.33
Total		**159.39**

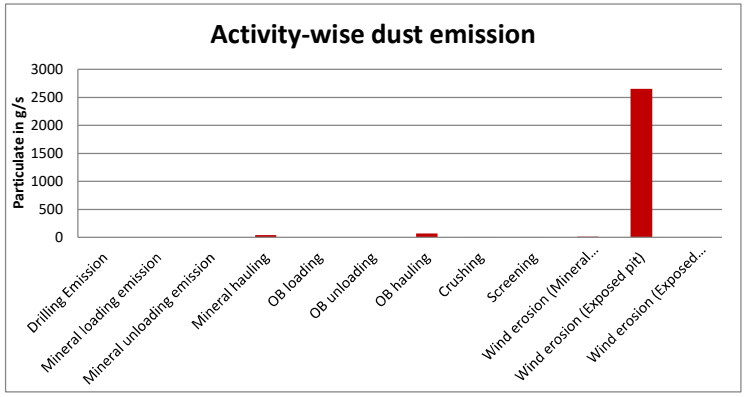
D. Make up water

Sl. No.	Name of the Product	Water contain, TPH
1	Water content in products	120.06
2	Water content in tailings	39.33
3	1% of handling loss	26.00
Total		**185.39**

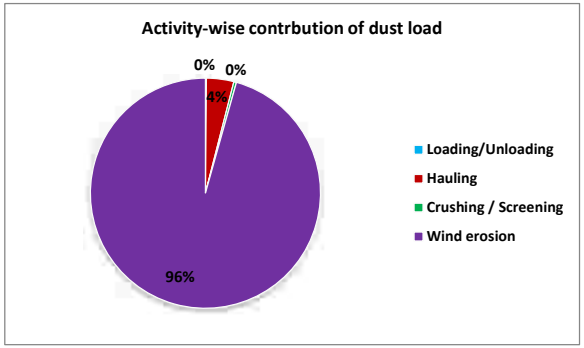
ANNEXURE X

RESULTS OF DUST LOAD CALCULATIONS

	Particulate matter in (g/s)	Particulate matter in (kg/d)	Particulate matter (kg per ton of ore)
Drilling Emission	0.06679882	5.771418206	0.000360308
Mineral loading emission	1.75785308	151.8785065	0.00948174
Mineral unloading emission	0.43629357	37.6957648	0.002353338
Mineral hauling	40.7383368	3519.792301	0.219739812
OB loading	0.70290758	60.73121467	0.003791436
OB unloading	0.46745375	40.38800417	0.002521414
OB hauling	66.4912397	5744.843109	0.358649214
Crushing	4.07407407	352	0.021975278
Screening	6.66666667	576	0.035959546
Wind erosion (Mineral stack)	11.024325	952.5016825	0.059464458
Wind erosion (Exposed pit)	2652.00024	229132.8205	14.30470848
Wind erosion (Exposed OB dump)	6.68964046	577.9849357	0.036083465
Total	**2791.116**	**241152.41**	**15.055088**



Major Activity	Dust load (kg/day)
Loading/Unloading	290.69349
Hauling	9264.63541
Crushing / Screening	928
Wind erosion	230663.307



GO TO MAIN PAGE

GO TO DATA ENTRY PAGE

GASEOUS LOAD CALCULATIONS FOR NARAYANPOSHI IRON & MANGANESE ORE MINES

During the field study, it was observed that dust is the major source of emission from various surface mining activities, whereas emission of SO_2 and NOx were negligible in comparison to the NAAQS protocol. Therefore, SO_2 and NOx emissions were measured considering mine as a whole and not for each activity of the mine. And the CO emission measured is insignificant to calculate the load in the iron ore mines.

Formulae for SO_2 and NO_x emission rates of overall mine

Activity	Parameter			Equation
	Symbol	Name	Unit	
Overall mine	u	Wind speed	$m\ s^{-1}$	For SO_2
	c	Iron ore production	$Mt\ year^{-1}$	$E = a^{0.7}[u/(11 + 4.4u)][c/(0.9 + 1.6c)] + [b/(3.3 + 19.9b)]$
	b	Waste handling	$Mm^3\ year^{-1}$	
	a	Leasehold area	km^2	For NO_x
	E	Emission rate	$g\ s^{-1}$	$E = 0.01ab[c/(1.38 + 0.26c)] + b^{1.1}]$

Source: S.K. Chaulya / Emission rate formulae for surface iron ore mining activities

Input data

1. u = wind-speed = 2.5 m/s
2. c = Iron ore production = 5.63 Mt/year
3. b = Waste handling = 2.1 Mm^3/year
4. a = leasehold area = 3.47 km^2
5. E = Emission rate = g/s

Results of gaseous load

S. No.	Parameter	Value	Kg/Day	Ton/Year
1.	SO_2	0.04 g/s	3.456	1.261
2.	NOx	0.38 g/s	32.832	11.984

ANNEXURE XI

Online Monitoring Stations

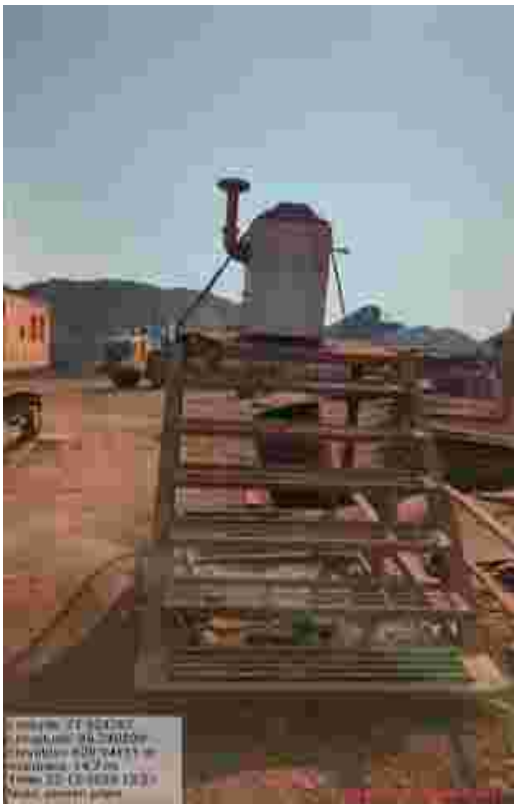






FUGITIVE TEST MONITORING STATIONS











AMBIENT AIR QUALITY MONITORING STATIONS






National Highway 520
Sundargarh
Northern Division
Odisha


National Highway 520
Sundargarh
Northern Division
Odisha

ANNEXURE XII

QUALITY COUNCIL OF INDIA

Creating an Ecosystem for Quality

National Accreditation Board for Education and Training

Certificate of Accreditation

Ecomen Laboratories Pvt. Ltd., Lucknow

Flat No. 5-8, 2nd Floor, Arif Chamber-V, Sector-H, Aliganj, Lucknow

The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	Mining of minerals including opencast / underground mining	1	1 (a) (i)	A
2.	Thermal power plants	4	1 (d)	B
3.	Mineral beneficiation	7	2 (b)	A
4.	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
5.	Cement plants	9	3 (b)	A
6.	Coke Oven Plants	11	4 (b)	A
7.	Asbestos milling and asbestos based products	12	4 (c)	A
8.	Synthetic organic chemicals industry	21	5 (f)	A
9.	Distilleries	22	5 (g)	A
10.	Sugar Industry	25	5 (j)	B
11.	Isolated storage & handling of hazardous chemicals	28	-	B
12.	Industrial estates/ parks/ complexes/areas, export processing Zones (EPZs), Special Economic Zones(SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
13.	Common hazardous waste treatment, storage and disposal facilities (TSDFs),	32	7 (d)	A
14.	Ports, harbours, break waters and dredging	33	7 (e)	A
15.	Highways	34	7 (f)	A
16.	Common Municipal Solid Waste Management Facility	37	7 (i)	B
17.	Building and construction projects	38	8 (a)	B
18.	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC MoM dated March 19, 2021 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACD/21/1711 dated April 20, 2021. The accreditation needs to be renewed before the expiry Ecomen Laboratories Pvt. Ltd., Lucknow, following due process of assessment.

Sr. Director, NABET
Dated: April 20, 2021

Certificate No.
NABET/EIA/2023/RA 0203 (Rev 02)

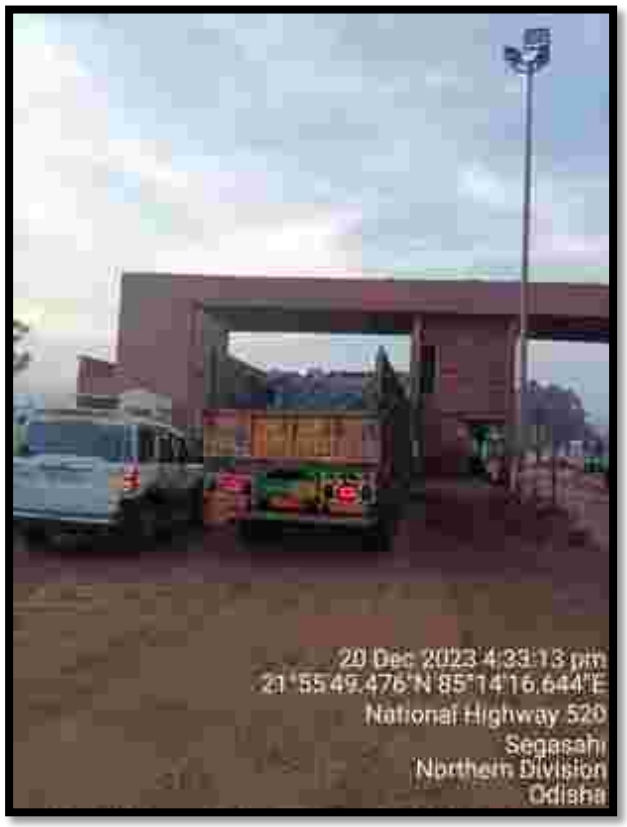
Valid till
March 22, 2025

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website

ANNEXURE XIII

Tarpaulin covered trucks





Road Sweeping Machine



Fixed Sprinkler System



50 KL Mobile Sprinkler



16 KL Mobile Sprinkler



Dry Fog System



Wheel Washing System



ANNEXURE XIV

Comprehensive Hydrogeological Report

on

Ground water conditions in core and buffer zones

For

Narayanposhi Iron and Manganese Ore Mine

of

M/S JSW Steel Limited



Address

Narayanposhi Iron and Manganese Ore Mines
Village: Kasira, Block/Taluka: Koira,
Distt.: Sundargarh,
Odisha-770048

Prepared By

Geo Climate Risk Solutions Pvt. Ltd.
Accredited by CGWA and ISO 9001:2015 Certified Company
APIS, Sunrise Incubation Tower, Hill No.3, Madhurawada, Visakhapatnam, 530048.
Website: www.gcrs.co.in
Email: business@gcrs.co.in

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GEO CLIMATE RISK SOLUTIONS PVT LTD
....for sustainability

June 2023

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1 SALIENT FEATURES OF THE PROPOSAL

S. No.	Particulars	Information
1.	Application No.	CGWA/NOC/MIN/ORIG/2017/2415
2.	Submission Date	30.06.2022
3.	Fresh or Renewal	Renewal
4.	Existing or New/ Proposed	Existing
5.	If Renewal, date of validity of existing/ last NOC	18.01.2022
6.	CTE Issue Date	21-12-2016
7.	Name of Project with Address	JSW steel ltd.- Narayanposhi Iron and Manganese Ore Mines.Village: Kasira, Block/Taluka: Koira, Distt.: Sundargarh, Odisha, 770048
8.	State	Odisha
9.	District	Sundargarh
10.	Block/ Taluka	Koira
11.	Category of Block/ Taluka (as per prevailing GWRE)	Koira in Safe category
12.	Quantum of GW applied (KLD)	2039 KLD for NOC period 2022 to 2024 2082 KLD for NOC period 2024 to 2026
13.	Quantum of GW applied (m3/Year)	625975 m3/year
14.	Alluvium/ Non-alluvium	Non-alluvium
15.	GW Modelling Required (Yes/ No)	Yes
16.	Name of Authorized Signatory of Project & Designation	 Baswaraj M Dalgade
17.	Consultant Details with Name of Authorized Signatory (If Institution)	 Mr. G. Prasad Basu
18.	In case report is prepared jointly by accredited institute and individual consultant, name details of chapters prepared by the individual consultant	NA
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)	CGWA/RGI/005 Date- 15.02.2021 Validity upto-14.02.2026

2 ABOUT THE PROJECT

Narayanposhi Iron and Manganese Ore Mine of M/s JSW Steel Ltd for production of 10 M TPA (ROM) of Iron ore with total excavation of 10.815 million TPA (ROM 10 MTPA + OB 0.815 MTPA) and 0.036 million TPA of Manganese ore (ROM) with total excavation of 0.3059 million TPA (ROM 0.036 MTPA + OB 0.269 MTPA) along with screening, crushing and 6 MTPA beneficiation plant in lease area of 347.008 ha (As per DGPS) /349.254 ha (As per ROR) in Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF villages under Koira tehsil of Sundergarh district, Odisha state.

JSW Steel Limited proposes to produce 10.0 million TPA of Iron ore (ROM) and 0.036 million TPA of Manganese Ore (ROM) with total excavation of 10.815 million TPA and 0.3059 million TPA and Beneficiation Plant of 6 million TPA by fully mechanized method in villages Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF under Koira tehsil of Sundergarh District, Odisha State. The mineable reserve of Narayanposhi mine is about 186.05 million tonnes (Mt) out of which the mineable iron ore reserve is about 185.51 Mt and mineable manganese ore reserve is about 0.538 Mt as on 01.04.2020 as per Approved Mining Plan in the name of M/s JSW Steel Limited vide letter no. MP/A/14-ORI/BHU/2020-21 dated: 08.09.2020.

The allotted mining block has an area of 349.254 Ha as per ROR (347.008 Ha as per DGPS computation). The area falls under Survey of India Topo Sheet No. 73 F/4, F/8, G/1 and G/5. The indicative coordinates of the Narayanposhi Iron & Manganese Ore Mine are given below:

Latitudes : 21°54’46.07” N - 21°56’23.13” N

Longitudes : 85°13’41.16” E - 85°14’56.56” E

The proposed mining of Narayanposhi Iron & Manganese Ore Deposit will employ about 997 people including skilled, semi-skilled, unskilled, and clerical manpower apart from managerial staff.

The present comprehensive report on ground water conditions of both core & buffer zone is prepared for 2nd renewal of the permission with NOC No. CGWA/NOC/MIN/ORIG/2017/2415 dated 15/02/2017 for groundwater abstraction of 980 m^3/day from 7 tubewells and 735 m^3/day from dewatering pumps. The first renewal of permission has taken place with NOC no. CGWA/NOC/MIN/REN/1/2019/5586.

Table 2.1: Salient Feature.

Name of the Lease holder	M/S. JSW Steel Limited
Rule 45 Registration No.	IBM/432/2011
Address	JSW Centre, Bandra Kurla Complex, Bandra East, Mumbai - 400051
DGPS coordinates of boundary pillars	Lat: $21^0$54'46.07" to $21^0$56'23.13" N Long: $85^0$13'41.16" to $85^0$14'56.56" E
Status of applicant/Lessee	Private Limited Company
Mineral(s) which is/are included in the letter of intent/lease deed	Hematite (IRON ORE) & Manganese
Mineral(s) which is/are the applicant/lessee intends to mine.	Iron & Manganese
Lease Details (Existing Mine)	27.06.2020 -26.06.2070
Name of Mine	Narayanposhi Iron and Mangnese Ore Mine
Date of grant of lease	27.06.2020
Period / Expiry date	26.06.2070
Name of Lease holder	M/S. JSW Steel Limited
District & State	Sundergarh &Odisha
Taluka	Koira
Villages	Koira, Kashira and Kathamala R. F
Weather the area falls under (CRZ),if yes details there of	NO

(Source- Approved mine plan)

OBJECTIVE

The overall objective of the study is to provide a coherent statement of the potential impacts of ground water withdrawal and seepage from mining activities in and around the ground water regime and suggest appropriate measures that can be taken to mitigate them.

This report is prepared to fulfil the following objectives:

• To understand the ground water dynamics of the area through detailed primary and secondary hydro-geological datasets.

• Assessment of likely impacts of ground water withdrawal on ground water regime, water quality, and surface water bodies of the study area (10 km buffer area).

• Understanding and evaluation of optimum utilization of the groundwater abstracted for different mining activities. The break-up of total water requirement is explained in detail.

• The field monitoring was carried out for the preparation of comprehensive hydrogeological reports of core and buffer zones in the radius of 2 and 10 km respectively as per the CGWA new guidelines notified on 24.09.2020 and the report was updated as per the revised SOP issued on 14th Feb, 2022 for obtaining approval from the Central Ground Water Authority.

a. A greater understanding of the aquifer geometry of the area is understood by conducting geophysical study (VES) and provided lithological data of exploration/development wells

GENERALISED SCOPE OF WORK

Preparation of Comprehensive Hydrogeological Report along with Ground Water Modelling Study.

- Generation of baseline data, establishing a network of observation wells, conducting aquifer performance test.
- To carry out Hydrogeological studies viz. general topography, drainage analysis, and geology,
- Aquifer characteristics, quality of water; Ground water resources estimation and categorization, seepage calculations of ground water in mine workings;
- Mining impact on surface and ground water environment and remedial measures**.**
- Detailed mathematical modelling of computed data.
- Suggested mitigation measures on impact of mining.
- Obtaining 'statutory approval/NOC' from Central Ground Water Board/Authority to carryout mining operations.

APPROACH AND METHODOLOGY

In the order to achieve the objectives and scope of work outlined above, a multidisciplinary approach has been adopted dovetailing the domain skill of hydro-geological and ground water modelling giving equal opportunities so as arrive at optimal strategy addressing the issues holistically. The methodology encompasses detailed hydro-geological investigation in and

around the lease area, establishing aquifer extent and an optimal ground water monitoring network for the surveillance of changes in water quantity and quality. Estimation of mine seepage in time and space has been attempted along with evaluating the influence on ground water in terms of space and quantification of contribution from ground water. Further, an attempt has been made to arrive at technically viable engineering interventions for water harvesting and ground water recharge following standard norms and guidelines within the statutory frame work of various regulatory authorities.

LOCATION AND ACCESSIBILITY

The Narayanposhi mine is located at the national highway no. 520 which is passing within the lease area. The village road of Kasira village exists in the M.L area. Lease area is accessible from Koira (2.0km) on NH-520 from Bhadrasahi (31km) to Rajamunda (58 km) long. The nearest railhead is at Barsuan at 30 Km from the lease area via Tensa. The area falls in survey of India Toposheet no. 73 G/1 & 73 G/5. The toposheet map of the study area showing lease area is given in **Figure 2.2** and Google map in **Figure 2.3**. The buffer area is bounded by coordinates $85^0$25'32.28303" to $85^0$26'40.67115"E. longitudes and from $22^0$06'16.72057" to $22^0$07'41.65495"N latitudes. The area wise coverage is given **Table 2.2.**

Table 2.2: District wise and Block wise area coverage in buffer zone.

STATE	DISTRICT	Block name	Block area	Percentages
Odisha	Keonjhar	Champua	550.8827798	1.274226472
Odisha	Keonjhar	Jhumpura	2373.229619	5.489429179
Odisha	Keonjhar	Joda	37826.18968	87.4943527
Odisha	Sundargarh	Koira	2482.419249	5.74199165

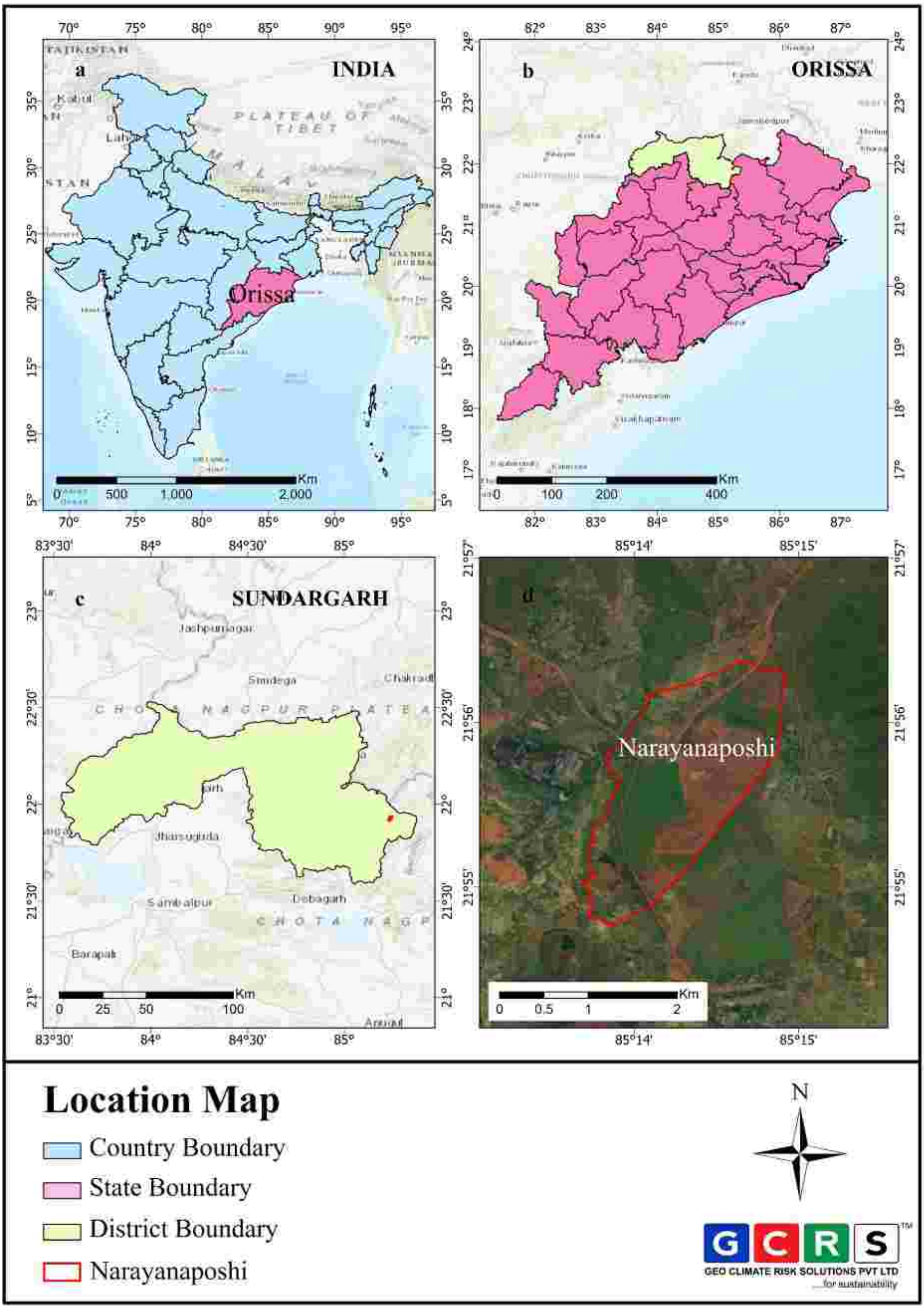


Figure 2.1: Location map of the Study Area.

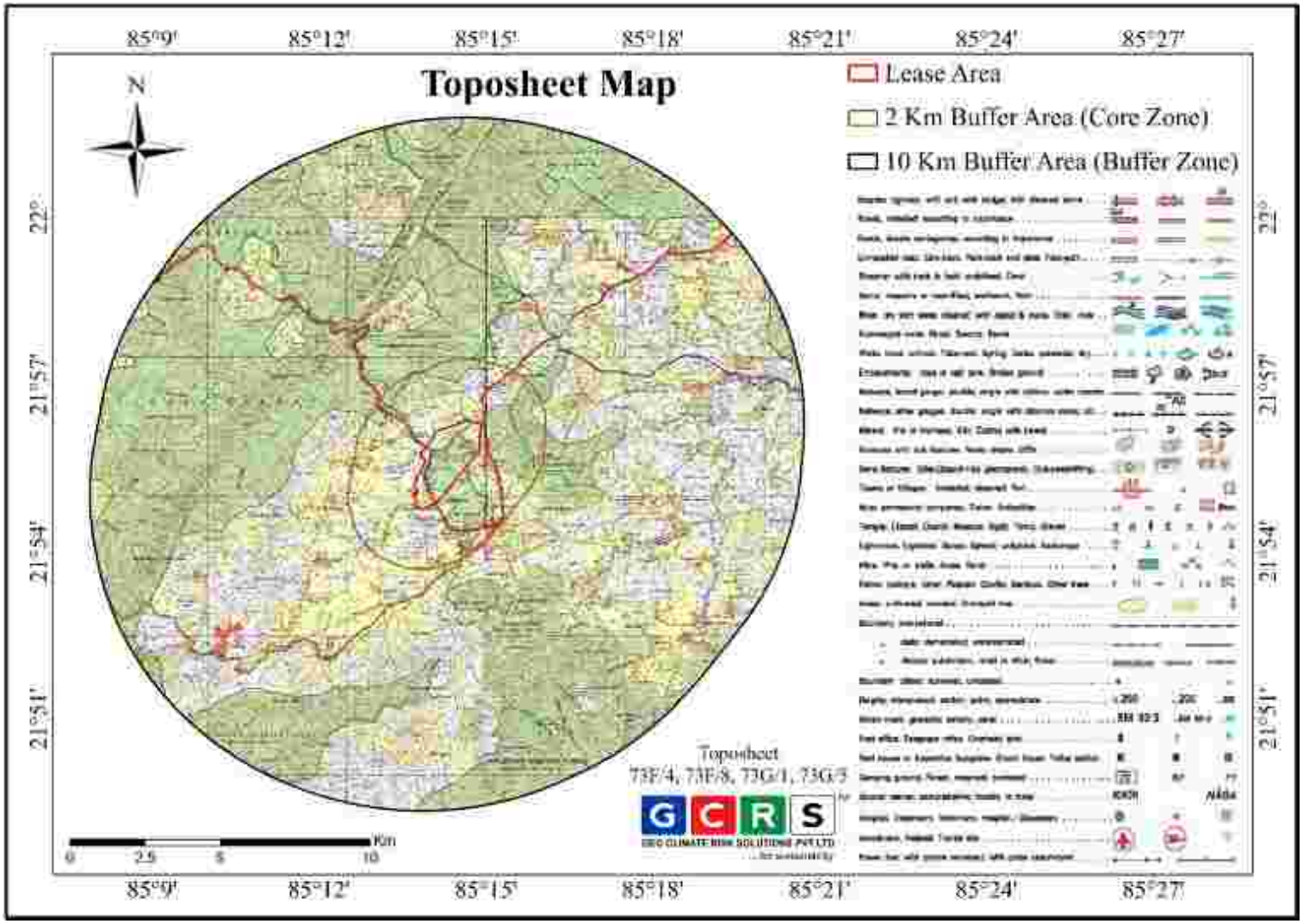


Figure 2.2: Toposheet of the Study and Project Area (Source: Survey of India).

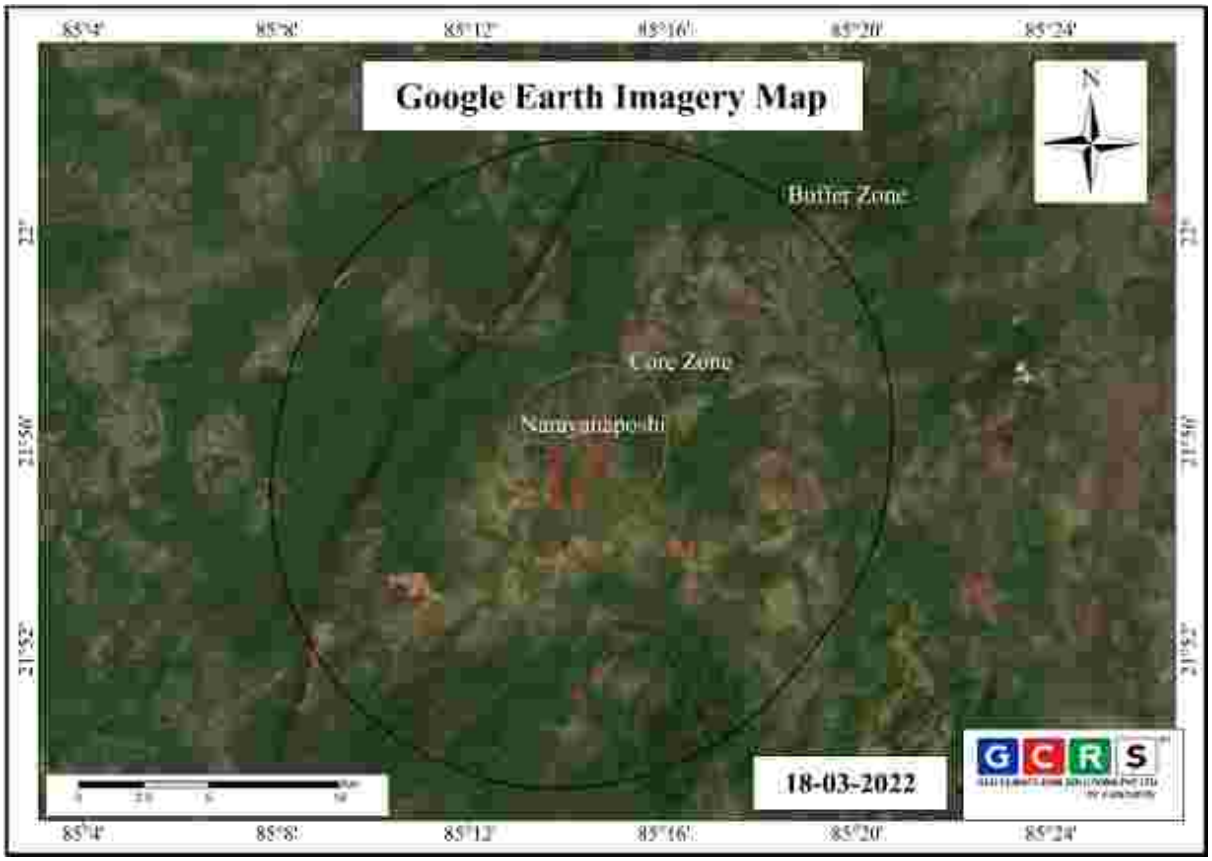


Figure 2.3: Google Image of the Study Area (18.06.2022).

2.1 LANDUSE / LAND COVER OF THE SURROUNDING AREA

The land use and landcover (LULC) maps are the fundamental data source for land management and planning. The accurate mapping of LULC classes is a valuable tool for understanding the relationship between humans and the environment (Pratico et al., 2021; Schulz et al., 2021; Viana et al., 2019; Qian and Zhang, 2022). The LULC maps for the present study were prepared using Sentinel-2 data on Google Earth Engine (GEE) platform. The GEE platform is widely used to shorten the processing time, which helps the user store decades of data and removes the need to download the satellite imagery one by one. The spatial resolution of LULC classes in the present study is mainly related to the topographic factors/conditions. According to the LULC maps prepared for pre-monsoon, 2022, the predominant land use is green area with 85.2% followed by agriculture 9.3%, barren land 4.3%, built up 0.62% and

water body 0.5%. The LULC maps for pre monsoon 2022 is presented in **Figure 2.4.** The land use pattern of the study area as deciphered from satellite imagery is given in **Table 2.3.**

Table 2.3: Land Use Pattern of the study area.

LULC CLASSES	**Area (%)**
Water	0.5
Agriculture	9.3
Green area	85.2
Barren	4.3
Built-up	0.62
TOTAL	100.0

Table 2.4: Existing Land Use Pattern of the mine lease area.

Land Use Category	**Pre mining stage (Ha)**	**Existing stage (Ha)**
Forest	188.72	142.73
Settlement	11.14	11.14
Agriculture	130.74	130.74
Waste land Stony / Scrubby land	42.50	40.26
	0.00	48.23
Road	7.30	7.30
TOTAL	380.40	380.40

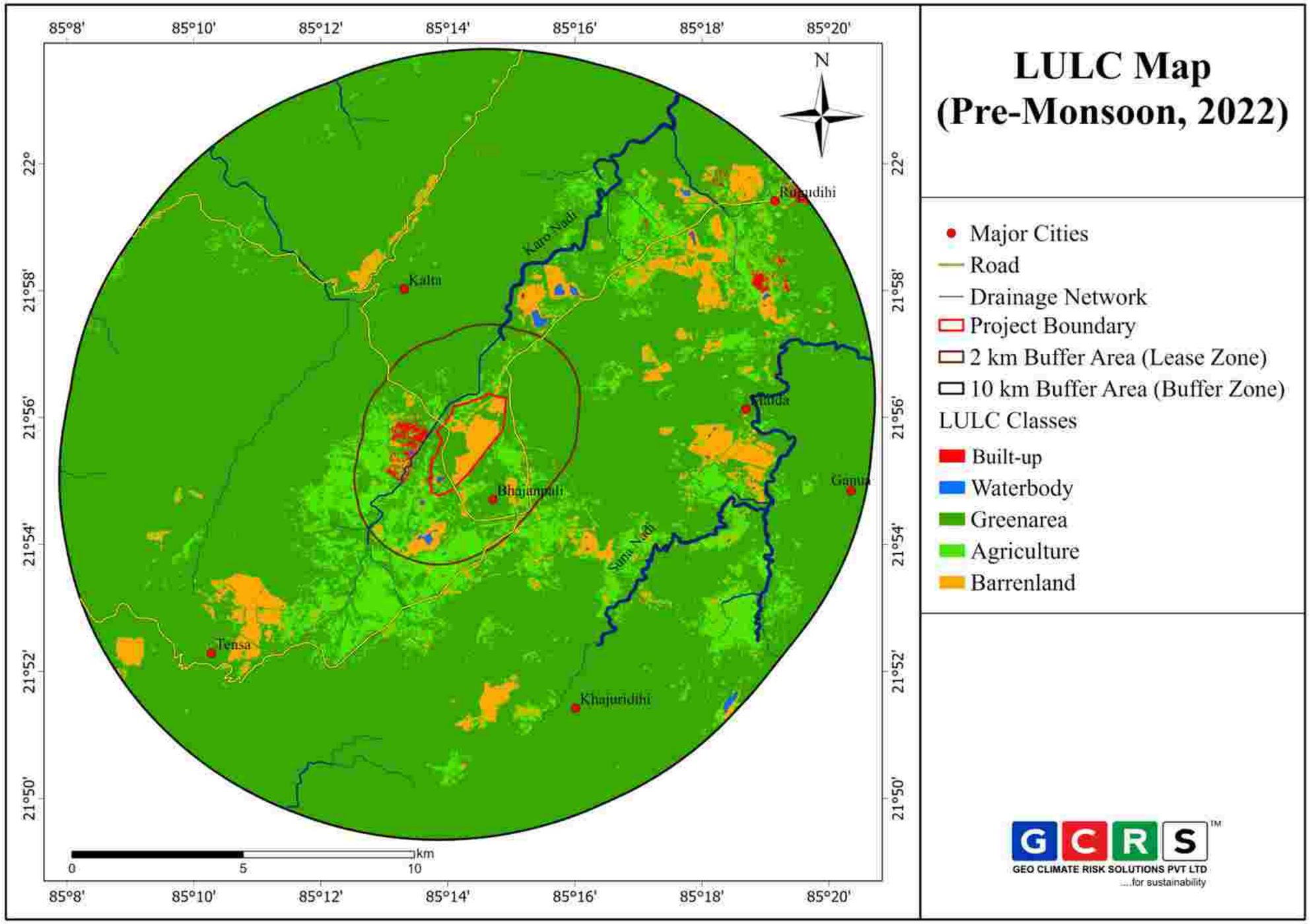


Figure 2.4: LULC map of Pre-monsoon, 2022 (Source: Sentinel-2).

2.2 DEM / TOPOGRAHY

Topography:

The surface topography/DEM map is prepared from SRTM-DEM of 30 m spatial resolution using ArcGIS Pro software. The area is marked by undulating hills with altitudes varying from 545m to 640m above MSL. General slope of the area is towards north on an average. Three prominent mounds having their highest points at 630m, 620m and 595m are in the lease area from south to north. Few spurs are developed in the central portion of the lease area. Another insignificant mound having peak point of RL 605m occur near Quarry-6. All the above peak points relate to each other in different trends with intervening valleys where from several seasonal nalas emerge. The topography map of the study area is given in **Figure 2.5.**

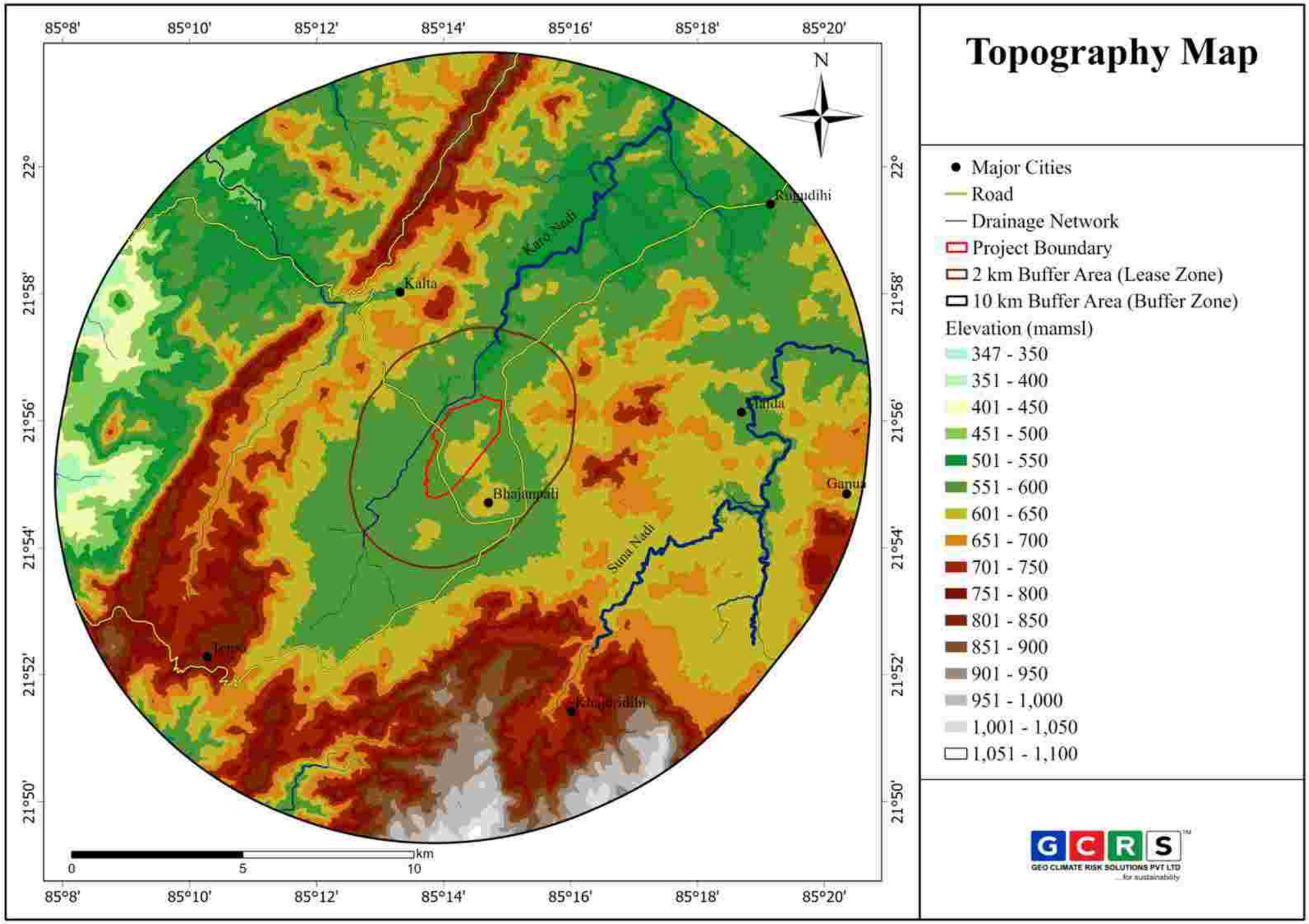


Figure 2.5: Topography map of the study area (Source: SRTM-DEM).

2.3 GEOMORPHOLOGY AND DRAINAGE

Geomorphology:

The undulating terrain stretching from north to the southeast is reversed by numerous isolated hillocks and granitic domes. The height varies from 100m to 602 m. Alluvial tract: Flat alluvial tract made up of late Pleistocene to recent sediments and occurs in the flood plain of the river tributaries in the southeastern part of the district and is located at a height of about 20-35 meters above msl. The geomorphological map is shown in **Figure 2.7** (Bukosh, GSI, 2022).

Drainage:

The drainage network of the study area is extracted from SRTM-DEM of 30 m spatial resolution by utilizing the Hydrology tool of ArcGIS software. Drainage system is dendritic type. Two prominent seasonal nalas divide the whole lease area into three parts from NE to SW which flow due north. River Karo flowing due north close to the western boundary outside the lease area constitutes the principal drainage system of the locality and collects surface run-off water through the seasonal nalas. Karo nala with many seasonal streams and tributaries of the different order constitutes the main dendritic pattern of drainage system in the area. Two seasonal nalas flow along south-north dividing the lease hold into three parts. These seasonal nalas carry the surface run-off water and discharge finally into the Karo nala which constitutes the nearest source of water for the mine lease area. Drainage map of the area has been shown as drainage map in **Figure 2.6.**

Areal coverage of these hydrogeomorphic units is shown in following **Table 2.5**.

Table 2.5: Areal coverage of geomorphic features in buffer zone.

S. No	Geomorphological units	Area (Ha)	Area (%)
1	**Structural Hills**	36411.3176	76.78
2	**Pediment**	9740.66	20.54
3	**Water Body**	441.03	0.93
4	**Pediplain**	331.96	0.70
5	**Residual Hill**	322.4758	0.68
6	**Plateau**	175.4648	0.37
	TOTAL	47422.9195	100

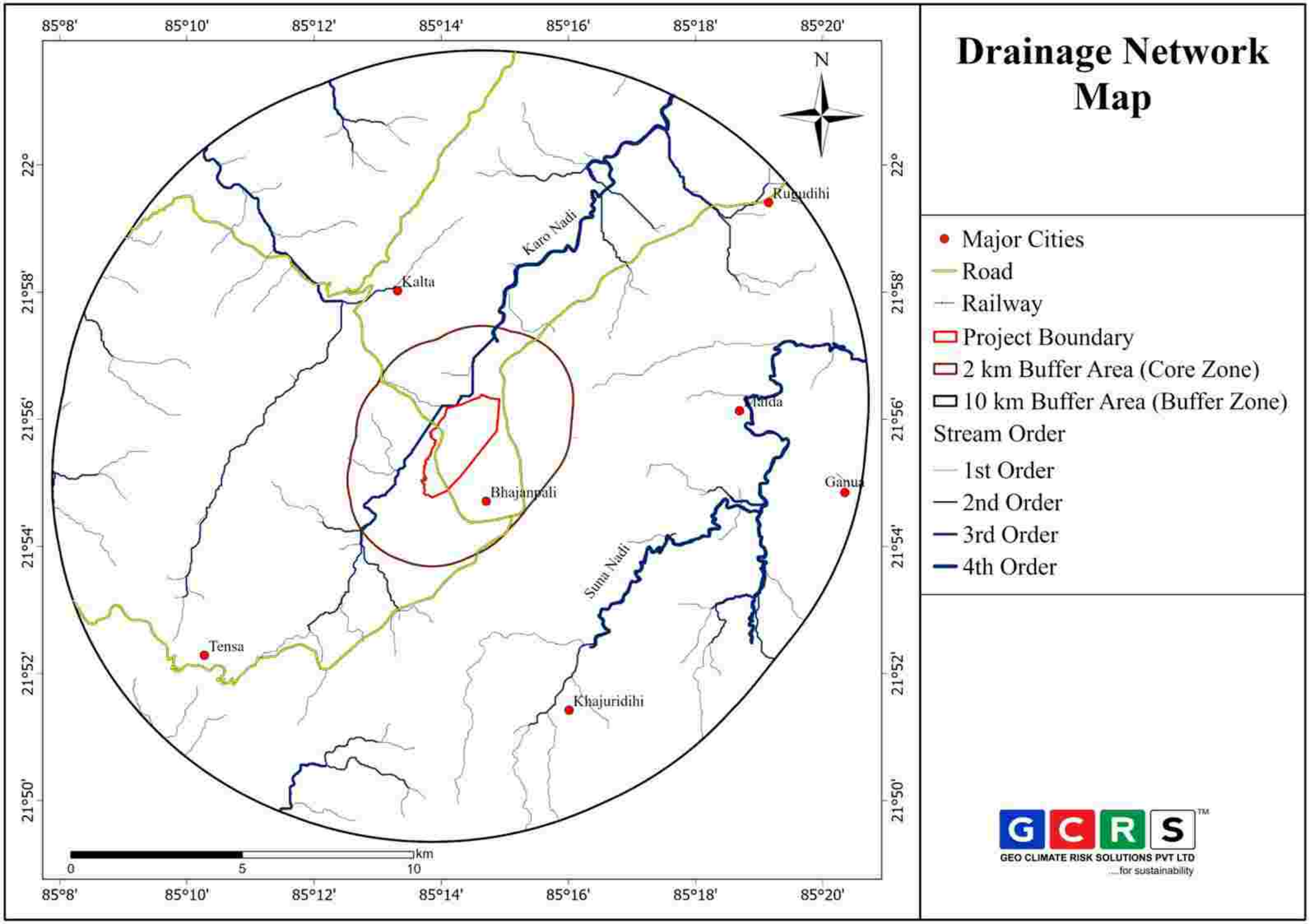


Figure 2.6: Drainage map of the study area (Source: SRTM-DEM).

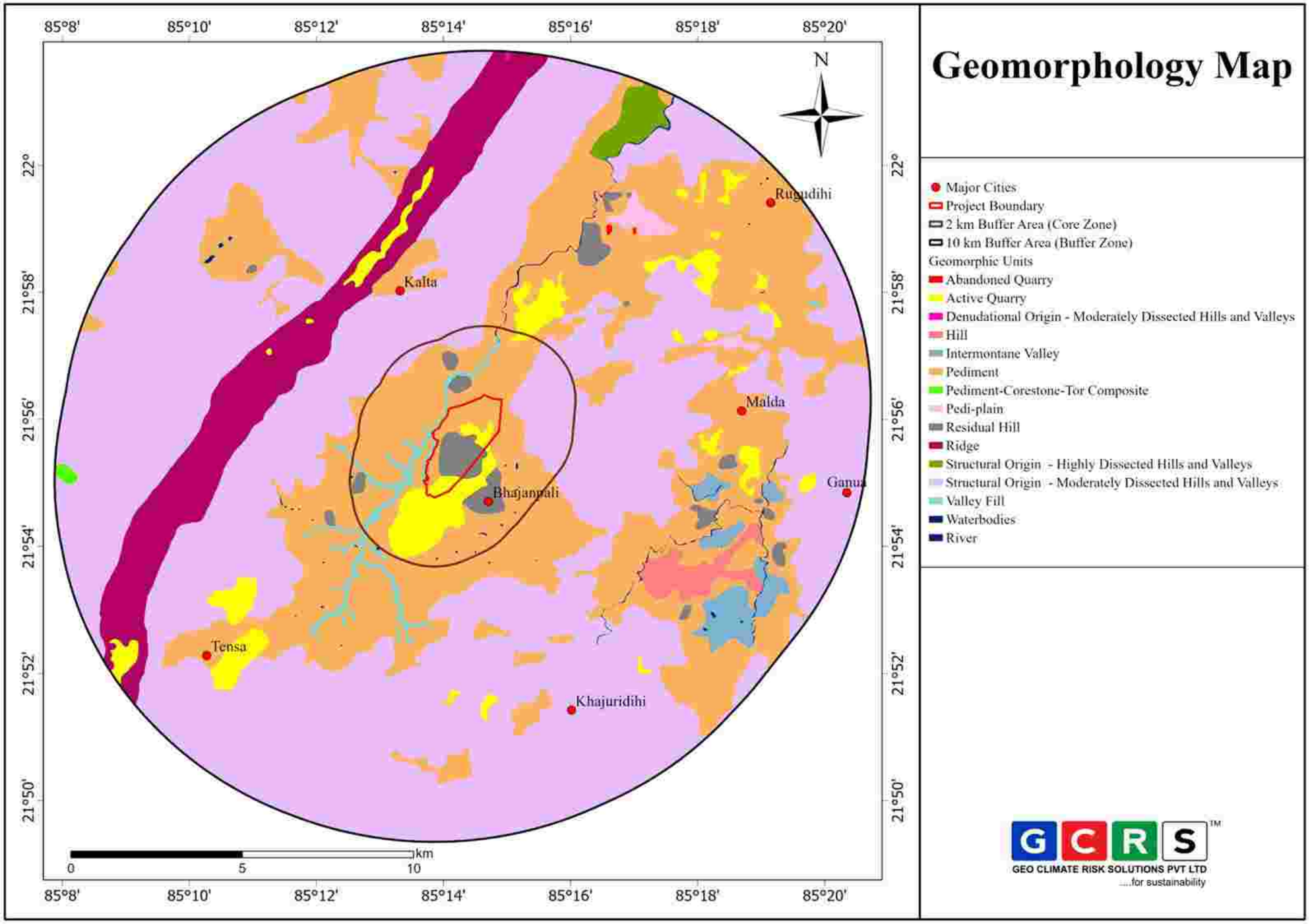


Figure 2.7: Geomorphological map of the Study area (https://bhukosh.gsi.gov.in/).

2.4 DETAILS OF WETLANDS / MAJOR WATER BODIES

A wetland is a distinct ecosystem that is flooded by water, either permanently or seasonally, where oxygen-free processes prevail. The primary factor that distinguishes wetlands from other landforms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique hydric soil. Any wetland site which has been listed under the Ramsar Convention that aims to conserve it and promote sustainable use of its natural resources is called a Ramsar Site. As per the Ramsar Site, there is no Wetlands in study area **(Figure 2.8).**

No Ramsar wetland site is present in the vicinity of 500 m from the project boundary. The Ramsar Wetland site nearest is Bhitarakanika Mangroves (Figure **2.9**), situated at an aerial distance of about 225 km from the project site. Hence, a Certificate regarding the same is not applicable for the proposal.

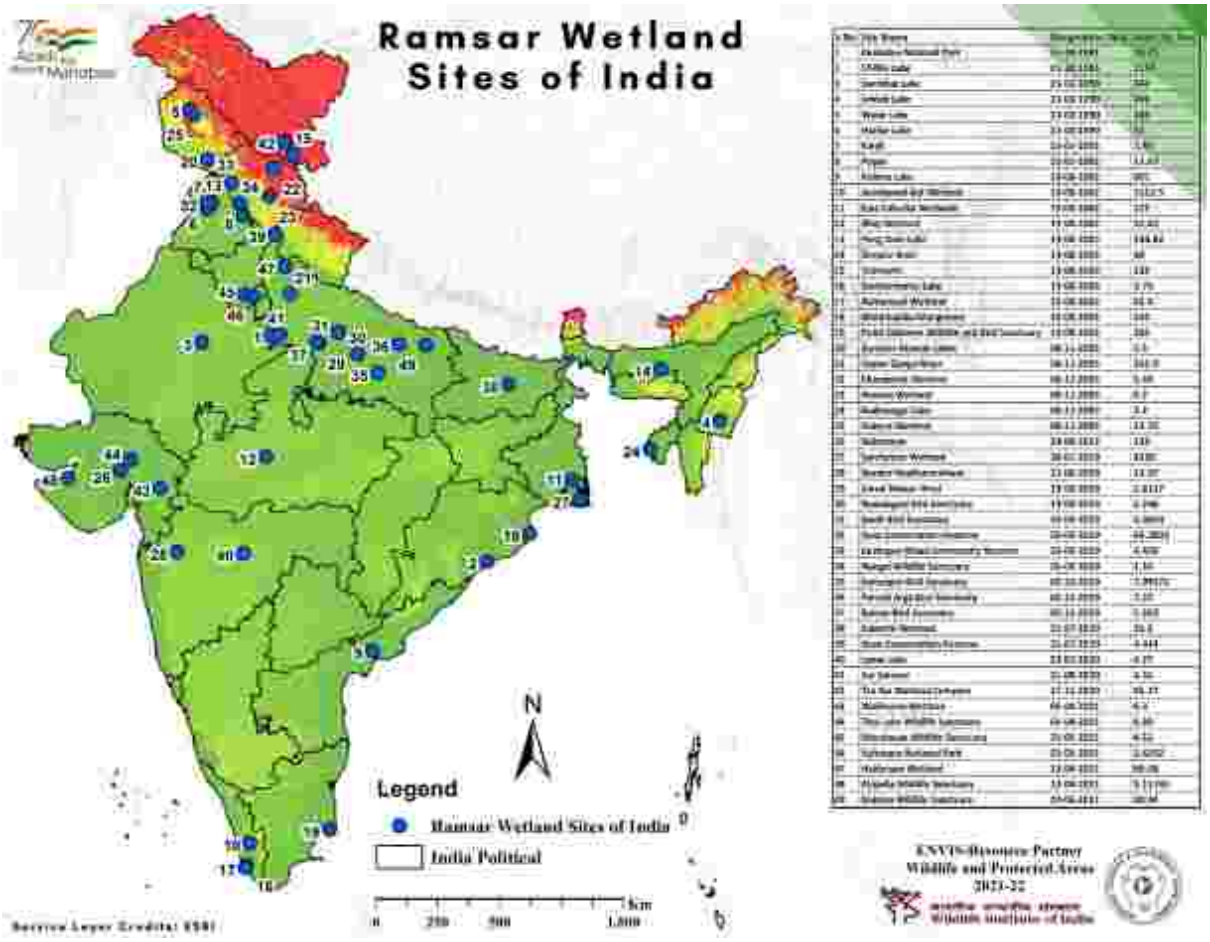


Figure 2.8: Wetland sites of India (Source: https://blog.forumias.com/wetlands/).

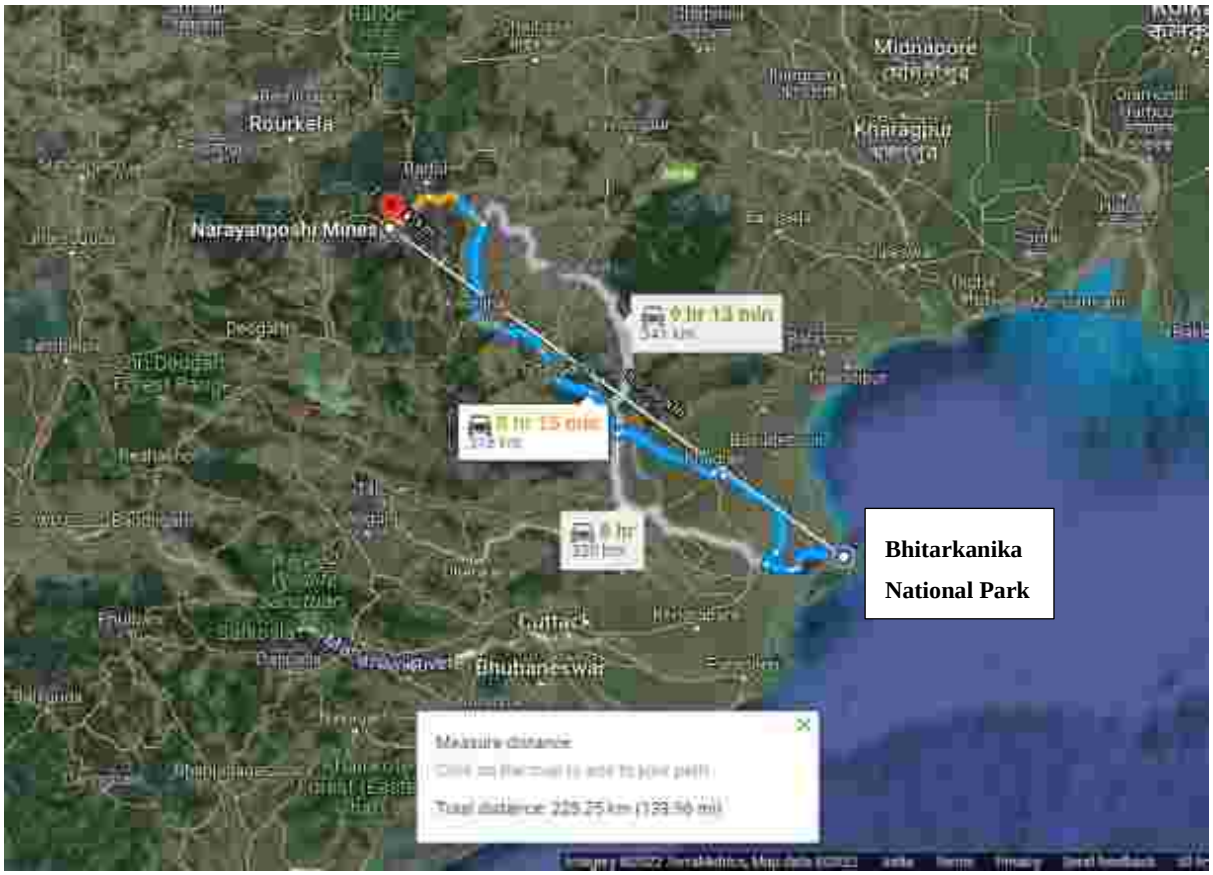


Figure 2.9: Nearest Ramsar site to the project site.

3 HYDROGEOLOGY

Details pertaining to the ground water scenario in the core and buffer zones of the study area, brief of the regional and local geology, hydrogeological set up, water level trends, fluctuations and quality data including relative maps have been discussed in the underlying sections.

3.1 GEOLOGICAL SET UP

The ML area is a part of the Bonai - Kendujhar belt falling in Sundargarh districts. The feebly metamorphosed Precambrian volcano-sedimentary rocks exposed in this belt between the Singhbhum granite on the east and Bonai granite on the west and are classified as 'Iron ore Group' (Sarkar & Saha, 1962) or 'Koira Group' (Murty and Acharya, 1975). These rocks are disposed in form of a low northerly plunging 'Horse-shoe' shaped synclinorium (Jones, 1934). The litho-stratigraphic succession of this area, as worked out by earlier workers, based on regional field studies is shown below in **Table 3.1**

The base of the Koira Group is marked by a pronounced unconformity over the Singhbhum granite in the eastern side and has a sheared inter-fingering contact relationship with Bonai granite on the western side. The basal formation comprises of gritty sandstone, which ranges from orthoquartzite on one hand to pebbly sandstone and conglomerate on the other, this arenaceous unit is followed by mafic volcanic Which is found all along the outer periphery of the horseshoe synclinorium. The volcanic formation comprises predominantly of Lower volcanic flows dominantly of mafic composition and an upper tuffaceous zone. The lava is pillowed at the bottom part and amygdaloidal at the top indicating its sub-aqueous and subsequent sub-aerial character. The lava grades into purple color tuffaceous shale conformably towards the upper part and described as lower shale formation' (Murty and Acharya, op. cit.). By the appearance of jasper and banded jasper inter banded with the greenish and black shale towards the top, the lower shale passes into the 'Banded Iron Formation'.

The 'Banded iron Formation' is represented by Banded hematite jasper (BHJ)/ Banded hematite quartzite (BHQ)/ Banded magnetite quartzite (BMQ), inter-bedded black or green shale and banded ferruginous chert. Due to high resistance to erosion these litho-units form high ridges conspicuously marking the outline of the 'horse-shoe' synclinorium and depict the major structural pattern of the belt.

The 'Banded Iron Formation' is overlain by the 'Upper Shale Formation' comprising of thick sequence of tuffaceous purple, white and buff coloured shale, black shale, banded ferruginous shale with inter-bedded chert and Banded hematite jasper (BHJ)/ Banded hematite quartzite (BHQ)/ Banded magnetite quartzite (BMQ) bands and spreading over the entire core of the synclinorium. The 'Upper Shale Formation' can be divided into two horizons/ zones (Patel, et.al. 2005) namely, lower manganiferous shale horizon/ zone and upper ferruginous shale horizon/ zone. These two horizons/zones exhibit conformable relationship.

Regional geology: Iron ore deposit of the M.L area forms a part of the eastern limb of the Singhbhum Keonjhar-Bonai belt, also known as the Jamda-Koira valley and is represented by a narrow NNE-SSW trending synclinorium of 60 km length and 25 km width. The Precambrian horseshoe shaped belt is well known for its large reserves of iron and manganese ore.

The strike is north-east to north, and dips are moderate to steep. The western limb of the synclinorium is slightly overturned at some places.

The belt was first reported by Jones in 1934 and has been studied in detail by several eminent geo-scientists, since then. The major litho types are metamorphosed sandstone, lithic wacke mostly in the east, BIF, and iron ore fragments. Shale, lavas, volcanic, pyroclastic tuffs, phyllite and Banded Iron Formation (BIF) including Banded Hematite Quartzite (BHQ) and the Kolhan Group of rocks are exposed.

The Precambrian rocks of this region comprising of basic lava, tuffs, banded iron formation (BIF), shales, conglomerates and sandstones etc. were mapped for the first time by Jones (1934). The stratigraphic succession established by Jones has largely been modified later by Dunn (1940) based on detailed mapping in the northern parts of the belt. Dunn recognized a new group lying unconformably over the Iron Ore Group which he named as the “Kolhan Group”. The rock types of the area belonging to the Kolhan group lies to the north of the Noamundi in Bihar.

The most acceptable litho-stratigraphic succession for the belt was proposed by Murthy and Acharaya (1975). They identified different depositional facies and proposed a more detailed stratigraphic succession. They also proposed a new name the “Kolhan Group” to the rocks of Bonai-Keonjhar belt. The stratigraphic succession suggested by Murthy and Acharya (1975) is given in **Table 3.1**.

Table 3.1:The stratigraphic succession of the region.

KOLHAN GROUP	Sandstone, Conglomerate, Breccias
Unconformity	
Mixed Facies Formation	• Basic Lava, tuffs and tuffites of volcanic facies. • Iron, Manganese, Lenses of Iron formation, Chert, small dolomite patches of chemical facies. • Minor lenses of sandy and silty shale of clastic facies.
Banded Shale Formation	• Banded shale member • Black shale member • Black shale – chert member
Banded Iron formation	• Finally, banded Jaspilite Member • Coarsely banded jaspilite member
Volcanic Formation	• Tuffaceous shale • Basic Lava
Basal Sandstone	Gritty Sandstone, Quartzite, Conglomeratic at places with interbedded Lava at top
Unconformity	
Singhbhum Granite with enclaves of older meta-basic and meta-sedimentary rocks.	

Acharya and his co-workers, in their recent studies, have indicated occurrence of manganese mineralization in lower shales below BIF, possibly of syngenetic origin. However, genesis of most of the manganese ore occurrences in this belt is attributed to secondary enrichment of manganiferous shales and phyllites.

Local geology:

The lease area forms a part of the famous Horse-Shoe shaped Singhbhum-Bonai-Keonjhar iron ore belt. Geologically, the terrain forms a part of oldest meta-sedimentary formations representing the Pre-Cambrian Iron Ore Group.

The Major Litho units identified in the region are schists, tuffs, phylites, shale and Banded Iron Formations comprising of Banded Hematite Jasper (BHJ) and Banded Hematite Quartzite (BHQ). At many places these units are covered by laterite.

The Precambrian rocks of this region were first mapped by Jones in 1936 and then were subsequently modified by Dunn in 1940. Later, extensive work has been done in this region by a host of workers. The geological Map is shown in **Figure 3.1.**

Local stratigraphy:

Narayanposhi Iron and Manganese Ore Mine are in the southern end of the western limb of the Horse-shoe shaped Iron Ore Range of West Singhbhum-Keonjhar-Sundargarh district of Jharkhand & Odisha. The rock types found within the leasehold belong to Banded Iron Formation of Koira Group. The main litho units mapped in this area are laterite, Banded Hematite Jasper, shale of different nature and cherty phyllite. Alluvium occupies especially the low-lying areas. This is a meta-sedimentary deposit of Bonai synclinorium.

Soil & Alluvium: Traverses along and across the leasehold, however, show that alluvial soil covers a sizeable portion of the area. The alluvium occupies especially the low-lying area. These areas are appeared to be barren where village site and low yielding agricultural fields are seen.

Ferruginous Laterite: Ferruginous laterites occur as intermediate waste and capping at places on the in-situ Iron ore horizons having Fe content or less than 55% and contain both hematite and goethite**.**

Float Iron Ore: The float iron ore zones may be considered of two types. The ores are mostly of massive type with big lumps and occur along with lateritic horizons. Float zone continues up to 5-7 m from surface level which is seen in quarry 5 & 6. The second variety of float ore over (+) 10 to (-)40mm size with laterite, which is observed in Quarry-1.

Conga Zone: In the northeastern corner and western part of the area, conga zones are exposed consisting of boulders, cobbles and pebbles of iron ores re-cemented by lateritic materials. These materials are seen in and around Quarry-4 (old) & Quarry-5.

In-situ Iron Ore: Below the float ore zone, in-situ ore exists and proved up to a depth of 60m from surface level. Because of its boulder nature, it is sometimes mistaken as float ore. An in-situ ore zone is delineated covering all in-situ ore working quarries like Q-1, 3, 4, 7 etc. However, based on depth persistence, in-situ ore zone is delineated around the Q-1, 2, 3, 4, 6 & 7.

Manganiferous Shale: Most of the workable manganese ore deposits occur within this formation. The shale is mostly ferruginous, grey, pink in colour with white streaks. These coloured members do not occur in conspicuous band rather than they are highly mixed up. Manganese bodies usually occur on the crest of the domes in the variegated shale formed due to the superposed folding.

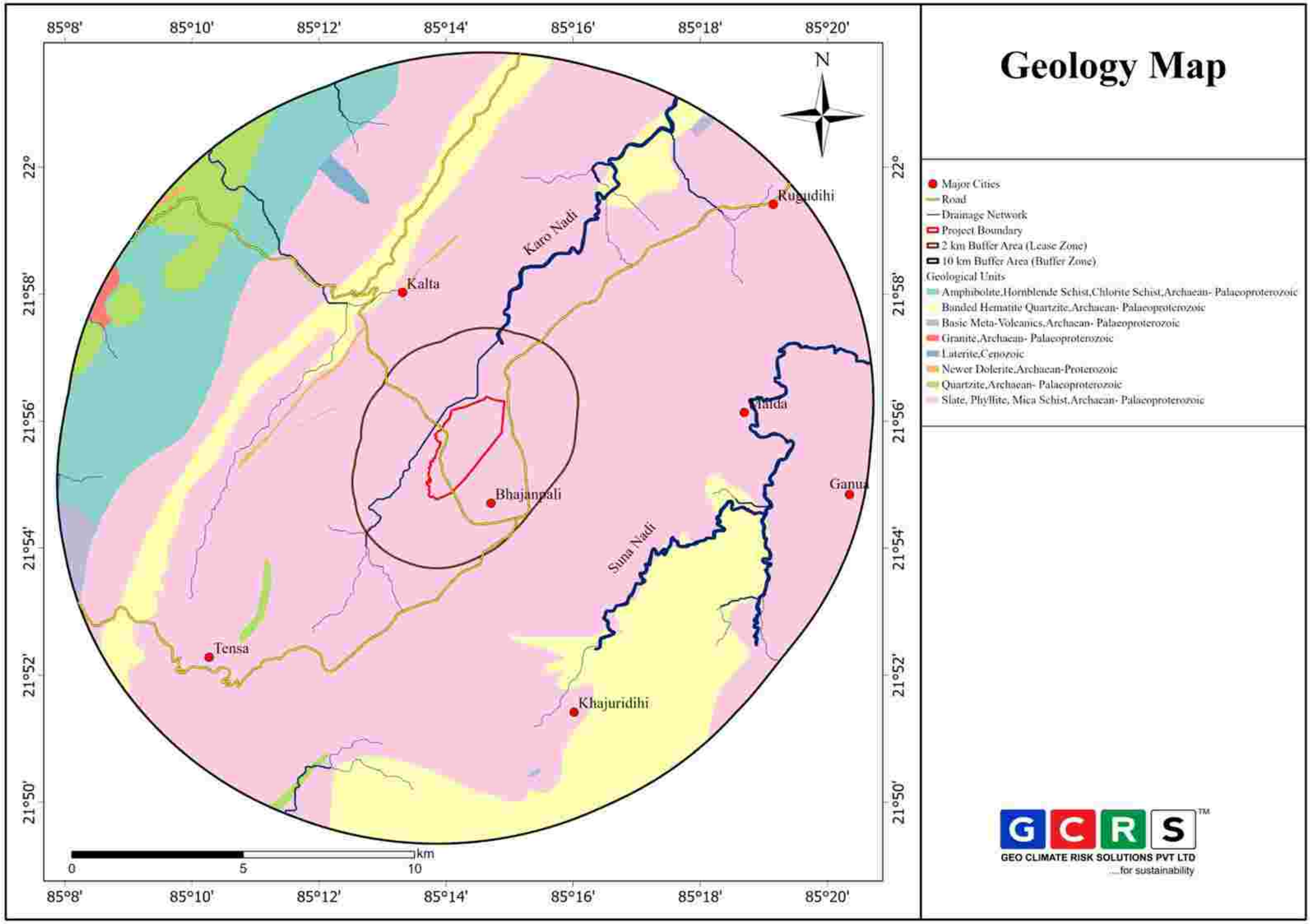


Figure 3.1: Geological Map of the Study Area (Source: https://bhukosh.gsi.gov.in).

3.2 GEOPHYSICAL STUDIES

Using Ohm's law electrical resistivity of sub-surface geologic formation is determined through artificially energizing the subsurface and carrying measurements on the ground surface. Contrast in resistivity value of an individual layer with the surrounding or effective presence (dependent of its relative resistivity and thickness) makes it detectable.

In the electrical resistivity method, a known amount of electrical current (I) is sent into the ground through a pair of electrodes (called current electrodes) and the potential (□V) developed because of the resistance offered by the subsurface due to the passage of this current is measured across another pair of electrodes (potential electrodes) planted into the ground. The ratio between the potential measured and the corresponding current sent into the ground yields the resistance 'R' of the ground to a depth depending upon the spacing between the two current electrodes. Through the multiplication of this value of `R' by a geometric factor a parameter called the apparent resistivity "□a" is computed. Both the parameters, apparent resistivity '□a' and the resistance 'R' contain the information on the geo-electric characteristics of the subsurface. In practice, there exist several configurations but most used are the Wenner and Schlumberger configurations.

In this survey microprocessor-based resistivity meter CRM-500 was used. For the present study Vertical Electrical Sounding (VES) have been carried out using Schlumberger configuration. Maximum spreads were 300 m (AB) for sounding.

VERTICAL ELECTRICAL SOUNDING (VES)

VES is a process by which the depth investigation is made. In this, the centre is fixed, and the measurements are made by successively increasing the electrode spacing. The apparent resistivity values obtained with increasing values of electrode separations are used to estimate the thickness and resistivity's of the subsurface formations. In Schlumberger sounding arrangement (**Figure 3.2**) all the four electrodes are kept in a line symmetrically over a point '0', with inner (Potential) electrodes kept closer. For increasing the depth of investigation, the current electrodes C1 and C2 are moved apart symmetrically from the center point `0' keeping the potential electrodes fixed. The separation between the potential electrodes is changed only when the potential between them drops to allow value during sounding. The apparent resistivity for each electrode separation is calculated by multiplying the resistance `R' with

Schlumberger configuration factor 'K' (which is called as geometrical factor). We have the formula is

$\rho a = \pi R \{(C1C2/2)2 - (P1P2/2) 2\} / P1P2$ or $\rho a = KR$

Where 'K' is the geometric factor for Schlumberger configuration,

C1C2 is current electrode spacing

P1P2 is potential electrode spacing

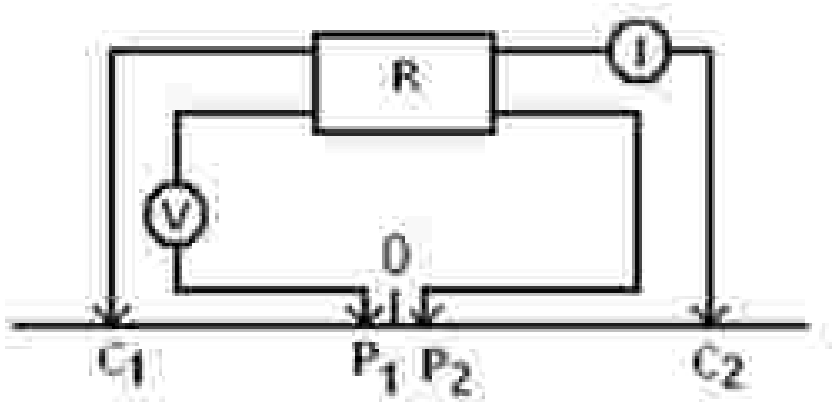


Figure 3.2: Schlumberger electrode configuration.

DATA ANALYSIS AND INTERPRETATION

Surface geophysical survey comprised of seven Vertical Electrical Sounding (VES) have been conducted at two different locations in the lease area to identify the subsurface condition. The observed resistance values from the instrument have been multiplied with geometric factor (K) to get the apparent resistivity values for each electrode spacing. The apparent resistivity values for different potential dipole were brought to single common potential dipole. The field apparent resistivity data were plotted on log-log graph paper against the half current electrode separation to get the VES curves (X axis-$C_1C_2/2$ value and Y axis apparent resistivity value).

These data of $C_1C_2/2$ and apparent resistivity were interpreted with the help of two layer master curve by curve matching technique and further checked with the help of IPI2WIN software. The final results were corroborated with the known hydrogeological conditions existing in the area. The geoelectric layer parameters (layer resistivity and layer thickness) were obtained for each VES. The interpreted results are given in the Table 7..

Table 3.2: Results of VES survey.

VES1				VES2			
SI. No.	AB/2in mtr (C.E.)	MN in mtr.(P.E.)	Resistivity (ohm - mt.)	SI. No.	AB/2in mtr (C.E.)	MN in mtr.(P.E.)	Resistivity (ohm - mt.)
1	2	2	210	1	2	2	257
2	5	2	310	2	5	2	297
3	10	2	300	3	10	2	271
4	20	20	234	4	20	20	157
5	30	20	137	5	30	20	125
6	40	20	101	6	40	20	121
7	50	20	94	7	50	20	123
8	60	20	84	8	60	20	124
9	70	20	97	9	70	20	119
10	80	20	105	10	80	20	125
11	90	20	114	11	90	20	125
12	100	20	120	12	100	20	131
13	120	40	132	13	120	40	136
14	140	40	150	14	140	40	146
15	150	40	159	15	150	40	156

DISCUSSION OF RESULT

A total 02 numbers of VES has been carried out at different points. Aquameter CRM 500 Resistivity meter has been used for conducting the VES. Schlumberger and half Schlumberger configurations have been used for conducting the VES survey. The maximum current electrode spread for conducting VES was 300 m (AB). The data is plotted on double logarithmic graph paper and matched with standard curves to know the true resistivity and thickness of various layers. The data is also interpreted by Computer using IPI2WIN software to verify the results of partial curve matching. From interpreted results of VES the resistivity and thickness of different layers are given in VES 1 and VES 2.

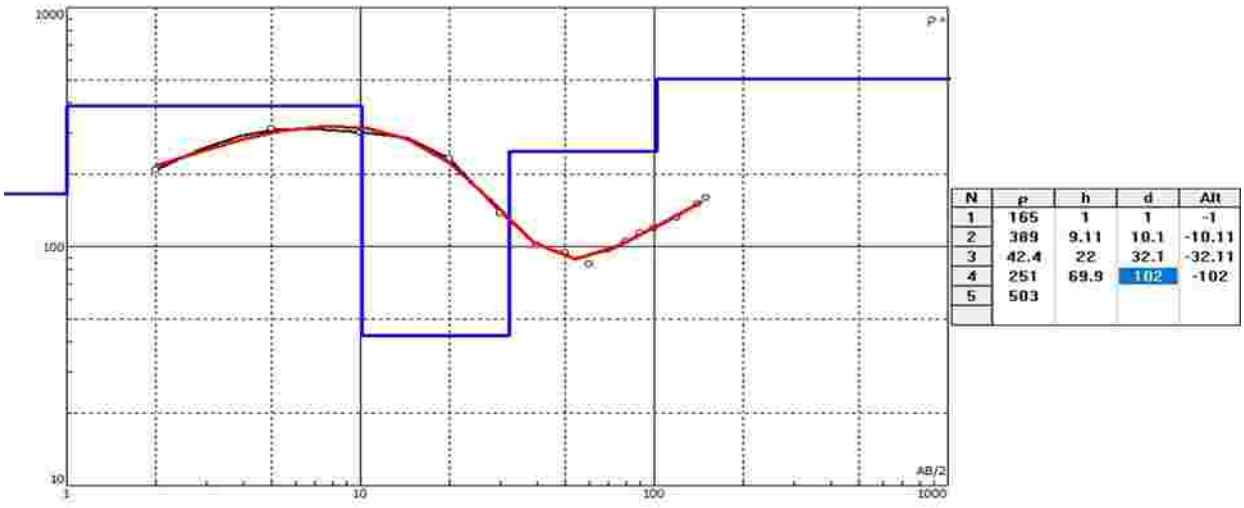


Figure 3.3: Electrode spacing (AB/2) vs resistivity for VES1.

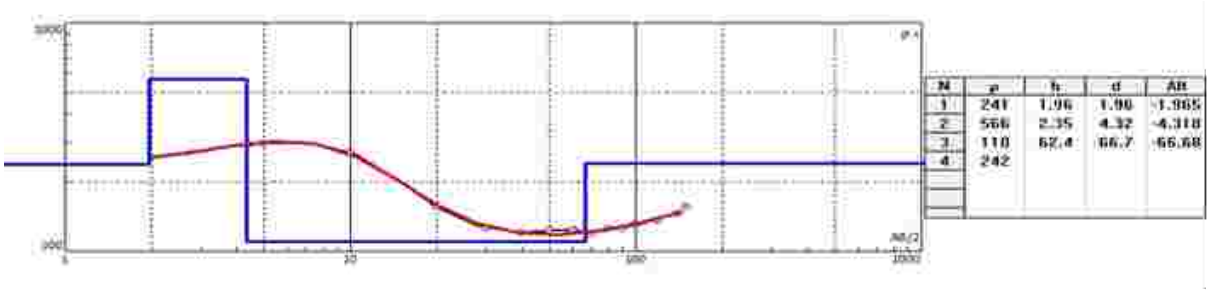


Figure 3.4: Electrode spacing (AB/2) vs resistivity for VES2.

VES	Layer	Depth in	Probable Litho-	Topography	Expected Geology
VES-1	1 2 3 4 5	1 10.1 32.1 102 inf.	Top Soil Weathered Zone Highly Fractured Fractured Rock Hard Rock	Plain	Precambrian (Singhbhum
VES-2	1 2 3 4	1.96 4.32 66.7 inf.	Top Soil Weathered Zone Fractured Rock Hard Rock	Plain	Precambrian (Singhbhum

3.3 HYDROGEOLOGICAL SET UP

The hydrogeological framework of the area is entirely controlled by geological set up, intensity and distribution pattern of rain fall and the degree of primary and secondary porosities in the prevailing geological formations for storage and movement of ground water. Since the whole area is covered by the hard rock formations of diverse lithological composition and structure, the water bearing properties of the formations also vary. The area has undergone several phases of intense tectonic deformations, which are responsible for deep seated fracture systems. It has been brought out during hydrogeological study of the area that how the lithology and tectonic deformations control the occurrence and distribution of ground water reservoirs and their water bearing and water yielding properties. The occurrence of linear dykes and faults and other structural elements i.e. lineaments form due to tensile deformations have been found main factors responsible for occurrence and movement of ground water in this crystalline rock dominating area. The major strike pattern i.e., N to NNE, low plunging syncline in ESE direction, of the crystalline formations and subsequent development of cleavage and faults play an important role in the movement and flow pattern of water in the area. Based on water bearing and water yielding properties, the rock formations can say as dominated by duly consolidated formations in almost whole of the area. In the rest there are semi consolidated and unconsolidated such as laterites occur as wrapping over crystalline formations and recent alluvium along river and nala courses respectively. In accordance with prevalence the rocks can be divided into following subgroups –

- Consolidated formation
- Semi Consolidated formation.
- Unconsolidated formations.

3.3.1 Aquifer Characteristics

Consolidated formations:

The entire area is dominated by underlying consolidated formations of Precambrian meta-sedimentary of Iron Ore Super Group of rocks. It consists of several rock formations such as quartzites, volcanics, shales, phyllites, mica-schists and Iron Ore formations such as Banded Haematite Quartzite (BHQ) and Banded Haematite Jasper (BHJ) etc. Each litho units have its

own ground water bearing properties. These rocks are very hard and compact and lack primary porosity. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. The aquifer materials are highly heterogeneous in character showing both vertical and lateral variations. The weathered residuum forms the main repository of ground water, which occurs under water table conditions and circulates through deeper fractures and fissures. Ground Water occurs under unconfined condition in phreatic aquifers and in semi confined to confined conditions in the deeper fracture zones. The water yielding capacity of fractured rocks largely depends on the extent of fracturing, openness and size of fractures and extent of their interconnection into the near surface weathered zone. These interconnected joints and fractures in the underlying hard rocks facilitate circulation of ground water and in turn form deeper aquifers.

Semi consolidated formations:

Semi-consolidated formation occurs only in the form of laterites which was found as capping over the Iron Ore Super Group of rocks with very limited thickness except in very isolated pockets where thickness around 6 to 8 meters has been observed which constitute shallow dug well zones.

Un-Consolidated Formation:

Recent alluvial formations generally occupy the river courses and nalas and having very limited thickness. Hence these deposits do not play any significant role in the hydrogeological scenario of the area.

A) GROUND WATER OCCURRENCE AND AQUIFER SYSTEMS

Fissured formations:

Ground water in the fissured formations occurs under unconfined conditions within the weathered residuum and under semi confined to confined conditions in fractures at depth. The thickness of the weathered zone varies from negligible to 40 m. In general thickness of weathered zone is minimum in Singbhum granite and maximum in Proterozoic volcanics. The weathered zone forms the shallow unconfined aquifer. Among all rock types the weathered zone as well as fractured zone in granitic rocks forms better aquifer. In weathered formation the yield on an average varies from 20 to 22 m^3 /day. The fractured granitic rock can yield upto 15 lps whereas at Kanjipani Proterozoic volcanics yield 25 lps. The fractured

zone is mostly confined within 75 to100 m depth and within this depth 2 to 3 fractures are found.

Unconsolidated Alluvial formation:

Quaternary and upper Tertiary sediments: Sands, gravels and pebble form the main aquifer systems in quaternary alluvial deposits under lain by Tertiary sediments. Groundwater occurs under phreatic condition at shallow depth and semi confined to confined in deeper depth in these formations. The shallow near surface aquifers which are mainly exploited by dug wells yield fresh water in the entire district. The yield of the existing dug wells in the district varies from 12 to 25 lps. The average depth of these dug well is around 6 to 7 m. The thickness of the alluvium varies from 15 to 95 mbgl.

Laterites: It generally forms the shallow aquifer and ground water mostly tapped by shallow dug wells. On an average the yield from dug wells in laterites is around 25 to 30 m^3 /day with the maximum of 40 to 45 m3/day. The specific capacity and transmissivity of lateritic aquifers vary from 0.0016 m3 /min/m to 0.2214 m3 /min/m and 3.2 m^2 /day to 506.85 m2 /day.

The hydrogeological map is depicted in **Figure 3.5.**

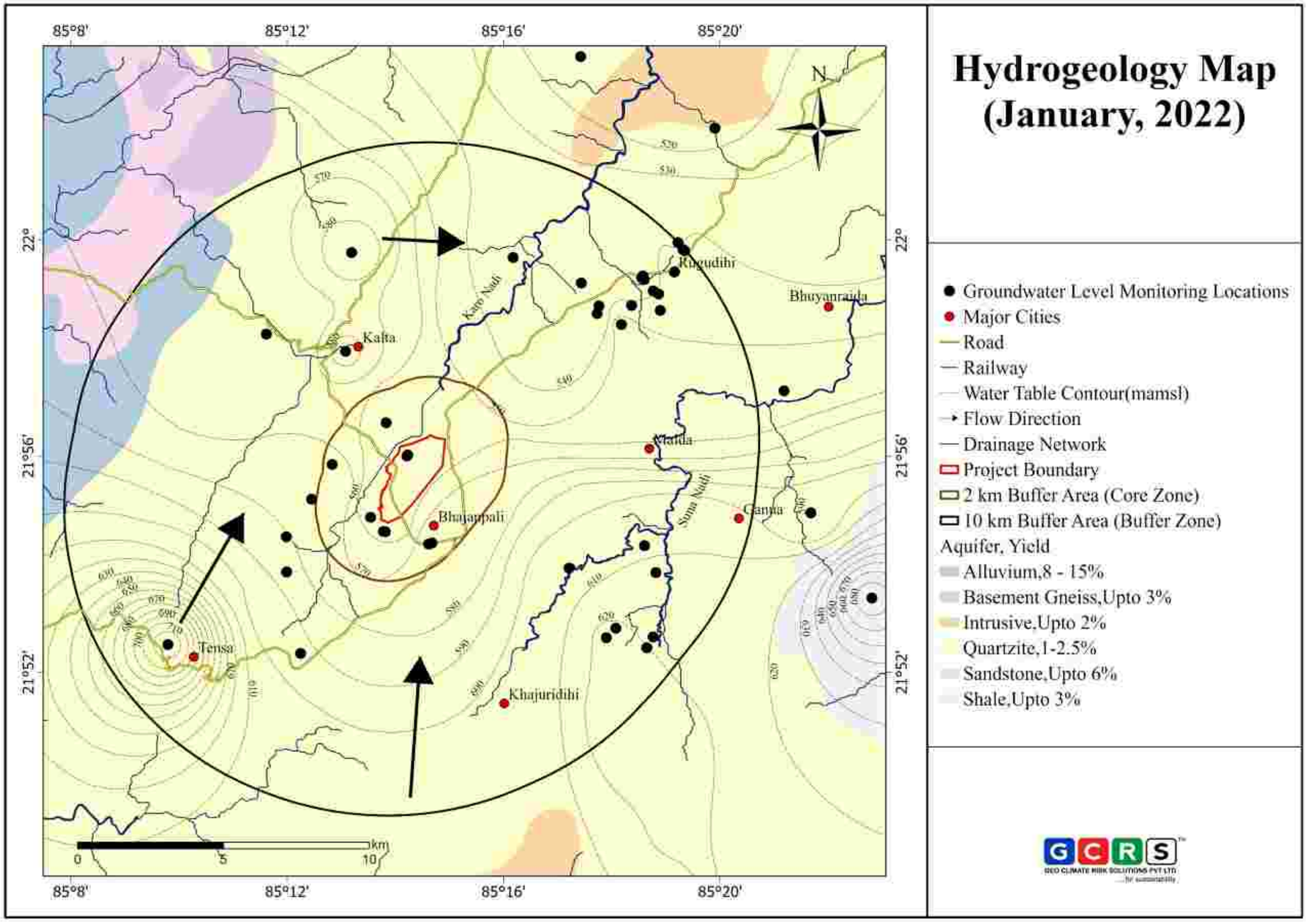


Figure 3.5: Hydrogeology map for January 2022 (Source: CGWB data and field data).

AQUIFER CHARECTERISTIC OF CONFINED AQUIFER

The shallow level formations of the area have water level variation from 5.15 m to 6.45 mbgl. Yield of the wells varies from 5.4 m^3/hr to 7.2 m^3/hr. Transmissivity value varies from 1.27 m^2 /day to 1.6 m^2/day. The values are tabulated in **Table 3.3.**

Table 3.3: Aquifer characteristics of the study area.

Principle Aquifer	**Quartzite**
Major Aquifer	Quartzite
Aquifer system	Single
Aquifer Type	Unconfined Semi-confined
Thickness of weathered zone	12 – 25
Decadal average-mbgl	5 - 1 0
Transmissivity m^2 /day	1-3
Yield	3-10
Specific yield	1 -2 .5
Quality (EC in Micromhos/cm)	5 0 0 -1 0 0 0

Source: CGWA reports

3.3.2 Ground water flow and aquifer interaction with surface water bodies

To know the ground water flow regime, present in the study area, water table contours have been drawn based on water level data of January, 2022. The maps show the elevation of water table in the core zone and in the buffer zone of the project site. The water table elevation in the region ranges from 502.05 to 716.38 mamsl (Figure 3.5)**.** In post-monsoon season, flow direction, water divide, elevation of water table prevailing in the area etc. have been evaluated & presented in **Figure 3.5** as Hydrogeological map which shows that the water table is higher in the south-west and north east portion of the buffer zone. The overall groundwater flow direction is noticed from south to north.

3.3.3 Depth to Water Level

The monitoring data will be of immense helpful in management of the water resources as well as protecting the ground water storage. Such study envisages regular monitoring of water level at selected locations to observe the variation of the ground water level and the changes in water quality with respect to ground water withdrawal over a period and space. It is pertinent to say that any ground water development of a particular area would bring changes in the immediate vicinity of the development area.

The objective is to identify the potential areas that have registered change in ground water levels and quality which in turn would help in identifying the appropriate measures for adoption of artificial recharge to neutralize the negative impact of the envisaged ground water development. In the present report, the monitored data has been presented and the overall picture of ground water storage behavior due to continuous abstraction of ground water has been analyzed for January 2022. To analyze the change in water level regimes one time monitoring is pursued by the field investigating team by the consultancy The water level depth ranges from 1-10 m bgl in the study area.

Distribution of Monitoring Stations

To study the change in ground water regime in and around study area, a total of 45 monitoring wells were selected at different locations for regular monitoring of ground water level. The monitoring schedule undertaken in and around the mine area has been bifurcated in core and buffer zone to have a better understating about the changes that is being observed in the ground water regime. The separate analysis of the long-term ground water behaviour in core and buffer zone would enable to demarcate the areas that bear direct impact of any ground water development that has triggered its impact in the surrounding areas has also been discussed in subsequent headings. The location maps of monitoring wells for core and buffer zones are presented in **Figure 3.6** and the basic details of these monitoring wells are presented in

Table 3.4.

Table 3.4: Basic details of established monitoring wells in the study area.

Well Id	Latitude	Longitude	Water Level (mbgl)	Water Table (mamsl)
WL01	21.93332	85.23689	5.84	553.16
WL02	21.93368	85.23715	5.75	554.25
WL03	21.91441	85.2257	7.2	555.8
WL04	21.91006	85.22964	5.1	563.9
WL05	21.91001	85.23026	5.82	554.18

WL06	21.94364	85.23048	10.4	551.6
WL07	21.90616	85.24357	1.65	576.35
WL08	21.90647	85.24454	3.5	573.5
WL09	21.93076	85.2139	5.73	573.27
WL10	21.92006	85.20756	5.27	575.73
WL11	21.90843	85.19976	1.25	586.75
WL12	21.89757	85.19985	6.37	592.63
WL13	21.96555	85.21798	0.62	584.38
WL14	21.97097	85.19357	5.93	522.07
WL15	21.89879	85.28677	9.71	613.29
WL16	21.87243	85.20415	4.09	596.91
WL17	21.9961	85.21985	1.75	589.25
WL18	21.99453	85.26961	9.7	526.3
WL19	21.98669	85.2906	6.34	529.66
WL20	21.97725	85.29546	9.79	536.21
WL21	21.97959	85.29601	6.19	538.81
WL22	21.97382	85.30295	6.4	557.6
WL23	21.97981	85.30611	4.2	539.8
WL24	21.97821	85.31493	5.1	543.9
WL25	21.98322	85.31441	0.5	545.5
WL26	21.98423	85.31274	2.36	536.64
WL27	21.98774	85.30999	2.84	538.16
WL28	21.98829	85.30915	5.47	535.53
WL29	21.98887	85.30956	6.34	533.66
WL30	21.90567	85.3101	5.66	597.34
WL31	21.8974	85.31359	10.36	605.64
WL32	21.88025	85.30126	6.05	620.95
WL33	21.87735	85.2983	3.65	624.35
WL34	21.87755	85.31271	4.05	617.95
WL35	21.87426	85.31084	3.58	623.42
WL36	21.87523	85.16331	3.62	716.38
WL37	21.99009	85.31931	2.82	547.18
WL38	21.99662	85.32243	5.85	540.15
WL39	21.99706	85.32194	5.05	541.95
WL40	21.99917	85.32039	4.47	538.53
WL41	21.95341	85.35306	5.62	554.38
WL42	21.91581	85.36132	3.24	589.76
WL43	21.8896	85.38006	0.5	685.5
WL44	22.034391	85.33168	4.95	502.05
WL45	22.05648	85.29034	5.9	516.1

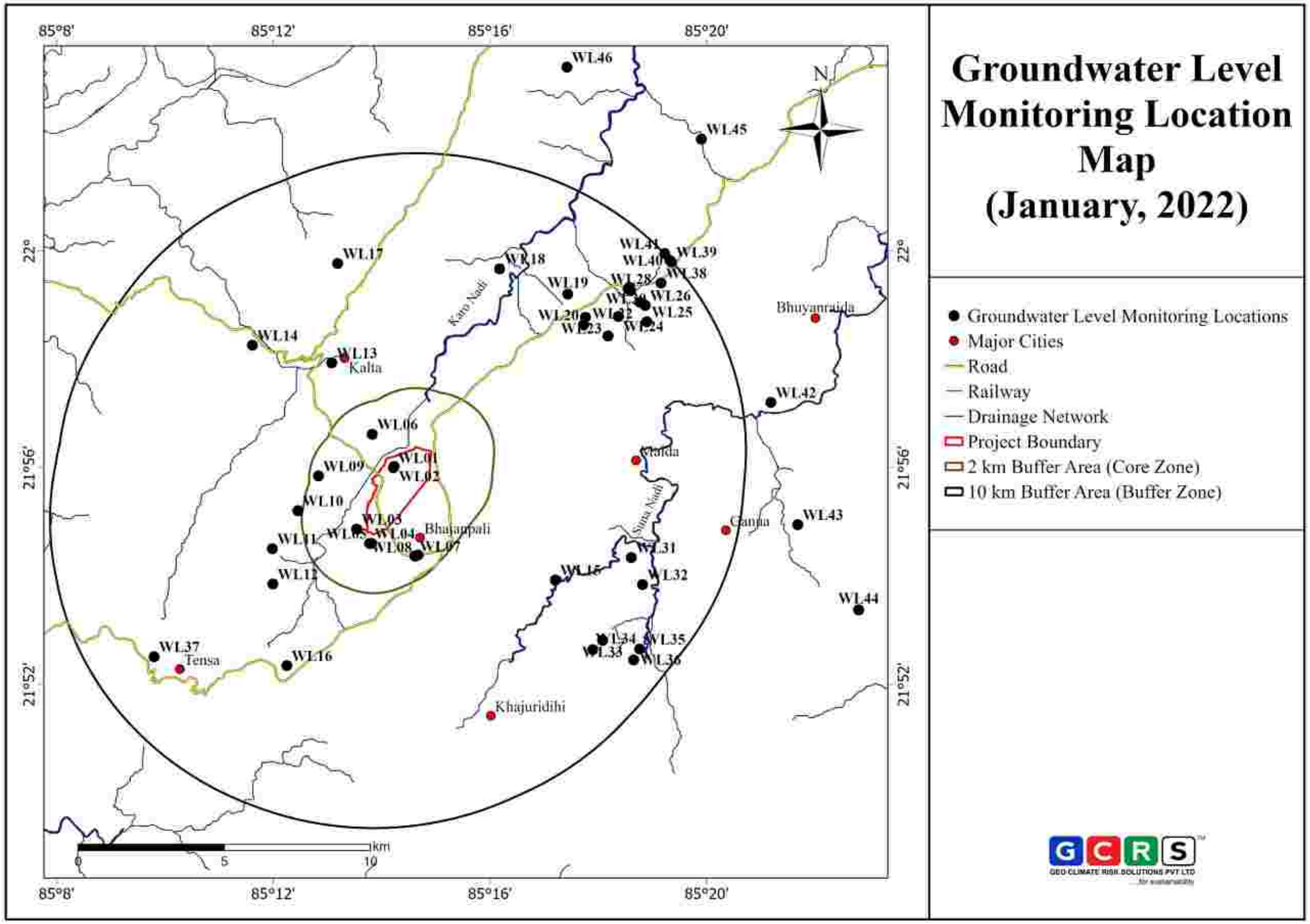


Figure 3.6: Distribution of Monitoring Network.

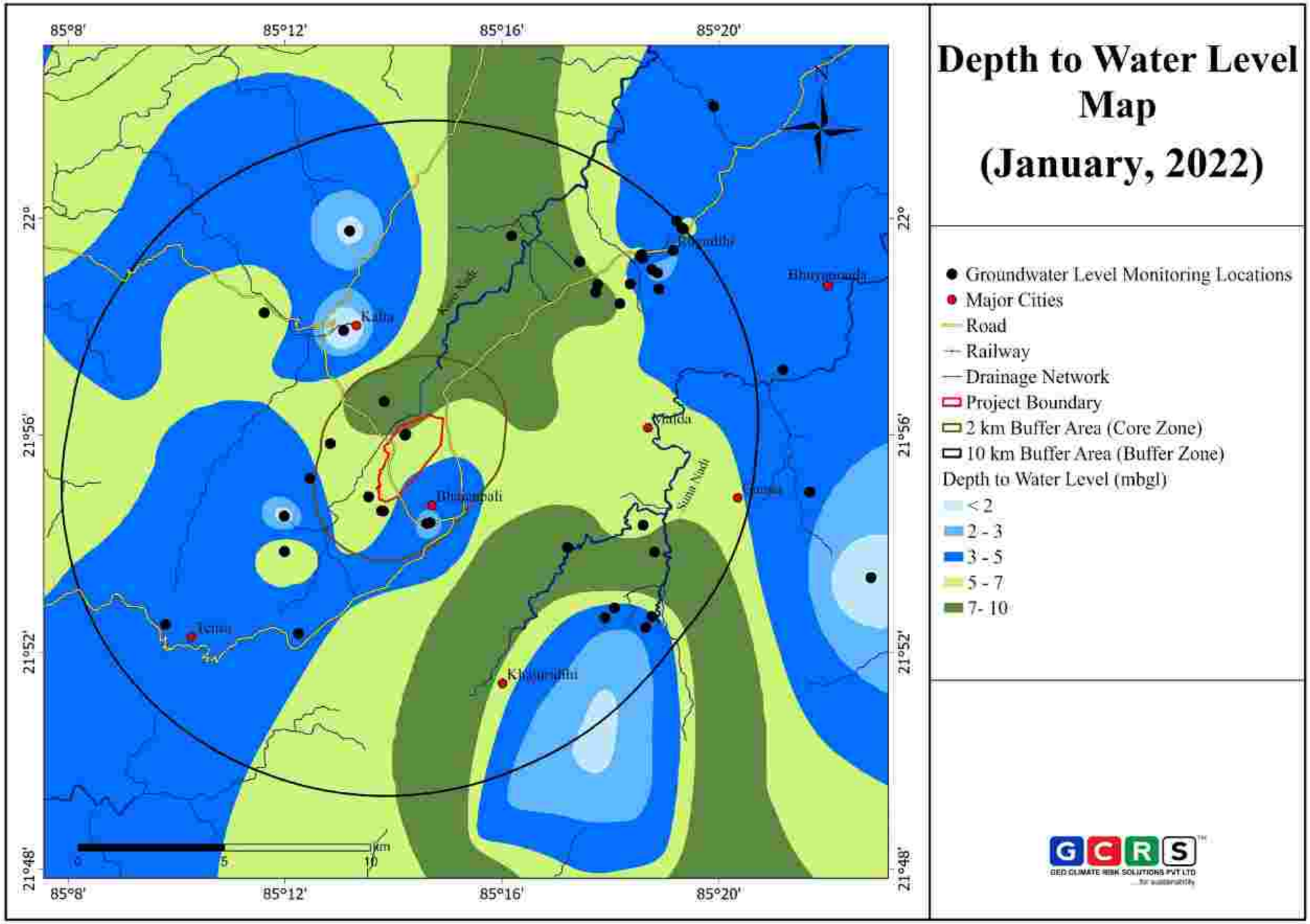


Figure 3.7: Depth to water level map (Source: Field data).

The water level monitoring data for the March, 2024 is given in the Table 3.5 and location map is shown in Figure 3.8. The water level in the study area is varied from 1.54 to 6.37 mbgl (Figure 3.9). Similarly, water table is varied from 315.55 to 875.23 mamsl in the study area (Figure 3.10).

Table 3.5: Water level monitoring data for the March, 2024.

Well Id	Village Name	Longitude	Latitude	Elevation (m)	Water Level (mbgl)	Water Table (mamsl)
N4	Mithirda	85.3397	21.8395	877	1.77	875.23
N5	Tensa CT	85.16331	21.87523	722	3.19	718.81
N12	Badpatuli	85.31084	21.87426	627	3.58	623.42
N6	Tentulidihi	85.203006	21.868969	613	5.64	607.36
N7	Bandal	85.19985	21.89757	597	6.37	590.63
N9	Jhirpani	85.21985	21.9964	590	4.44	585.56
N8	Kalta	85.21798	21.96555	584	1.54	582.46
N16	Kashira	85.254058	21.91755	583	6.21	576.79
N13	Kamanda	85.21485	21.931194	575	5.69	569.31
N14	Koida CT	85.22964	21.91006	569	5.10	563.90
N11	Kalmanga	85.31977	21.95253	565	5.20	559.80
N3	Chormalda	85.35306	21.95341	560	5.62	554.38
N15	Kasira	85.23715	21.93368	560	5.75	554.25
N2	Camp of Tisco	85.32085	22.0051	541	5.89	535.11
N10	Paduliposi	85.2906	21.98669	536	6.34	529.66
N1	Mutuhanuman	85.117222	21.999722	319	3.45	315.55

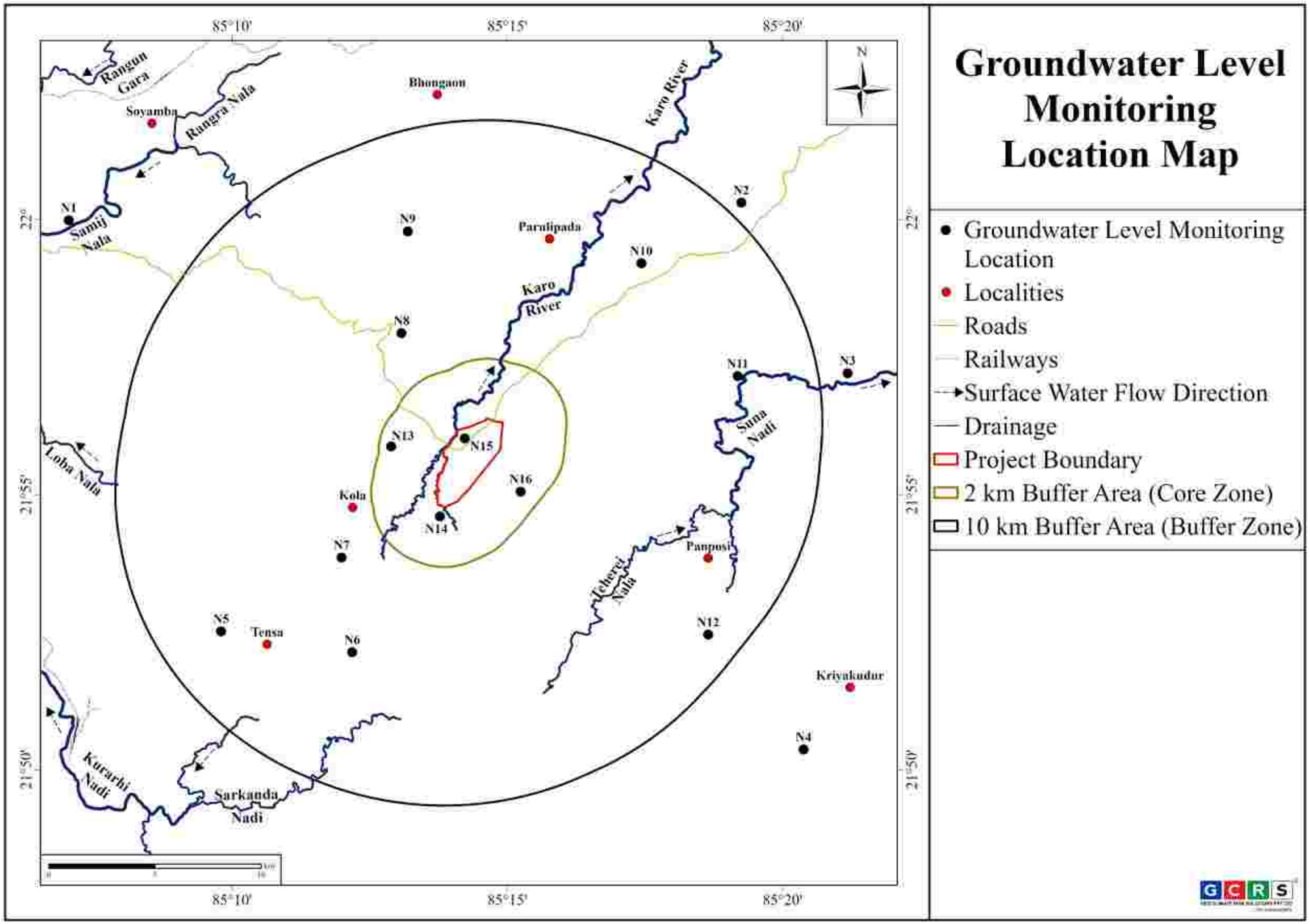


Figure 3.8 : Water level monitoring location map for March, 2024.

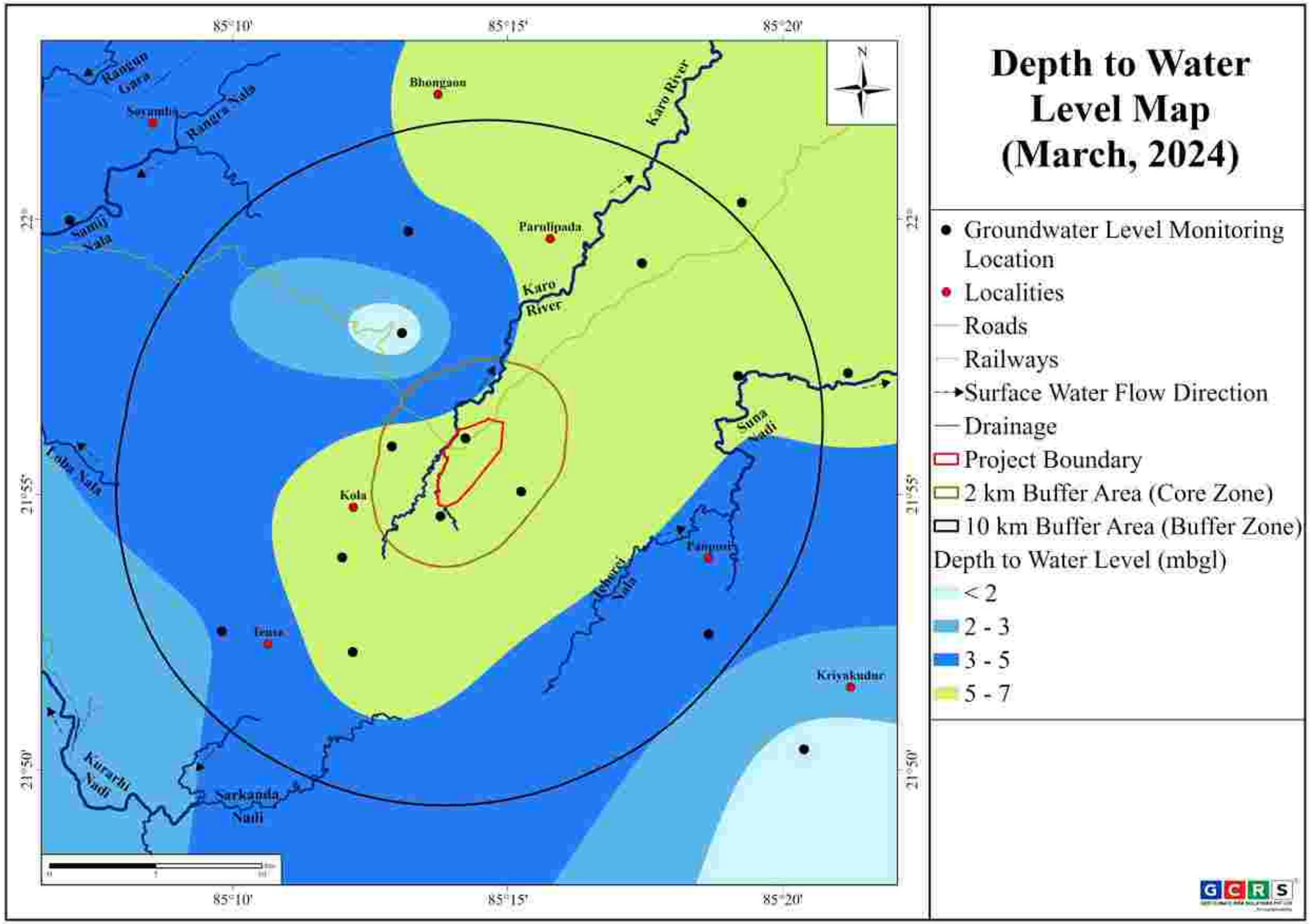


Figure 3.9: Depth to water level map for March, 2024 (Source: Field data).

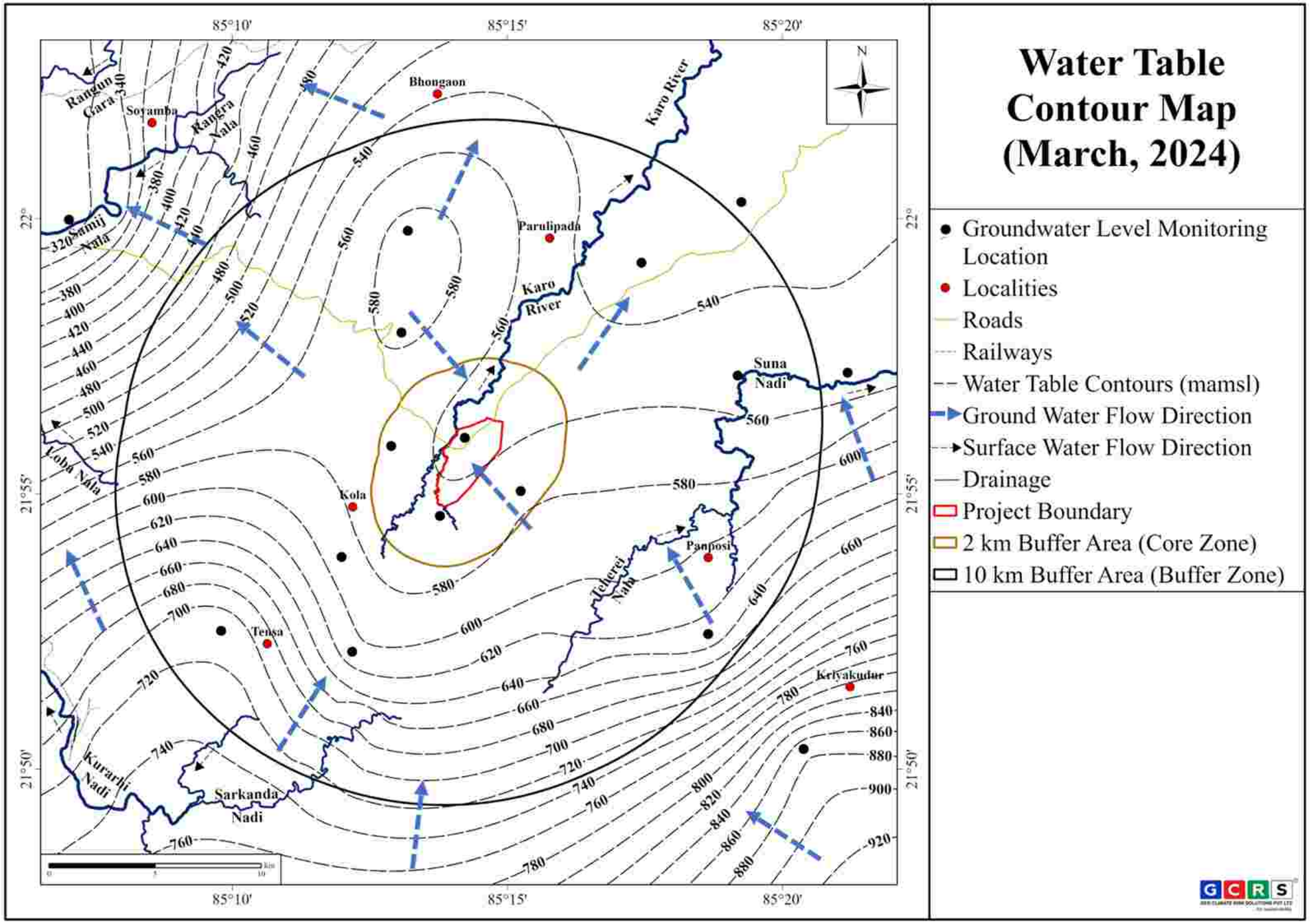


Figure 3.10: Water table map for March, 2024 (Source: Field data)

3.3.4 Long term water level data analysis

The ground water levels collected from CGWB (https://indiawris.gov.in/wris/) in the area has been monitored 4 times in a year as mentioned earlier. Mean water level (2014-2019) has been compared with water levels of year 2020, for pre-monsoon and post-monsoon period, separately in core and buffer zones, to assess the change in ground water levels over the years. The water level data for last six years have been analyzed to assess the seasonal fluctuation in the ground water level within the study area.

HYDROGRAPHS

To study the changes in ground water level with respect to time, time series analysis through analysis of hydrographs has been attempted. The variation in ground water level recorded systematically for a longer period is plotted in the form of graph (hydrograph). Some representative hydrographs are given below for core and buffer zone for the period of 2014 to 2021 in Figure 3.11**.** The monitoring wells that are considered to plot the hydrographs are represented below. The Guali station is a 2.54 km away from site boundary, Bhadrasahi station lies at 20.4 km NE from thr site. The Rugudi station lies 7 km away from the site boundary in Northeast direction and falls inside 10 km buffer area. The Joda stations lies at 20 kms away from the site boundary. These representative hydrographs presented here also shows the fluctuations in water levels over the period of observation.

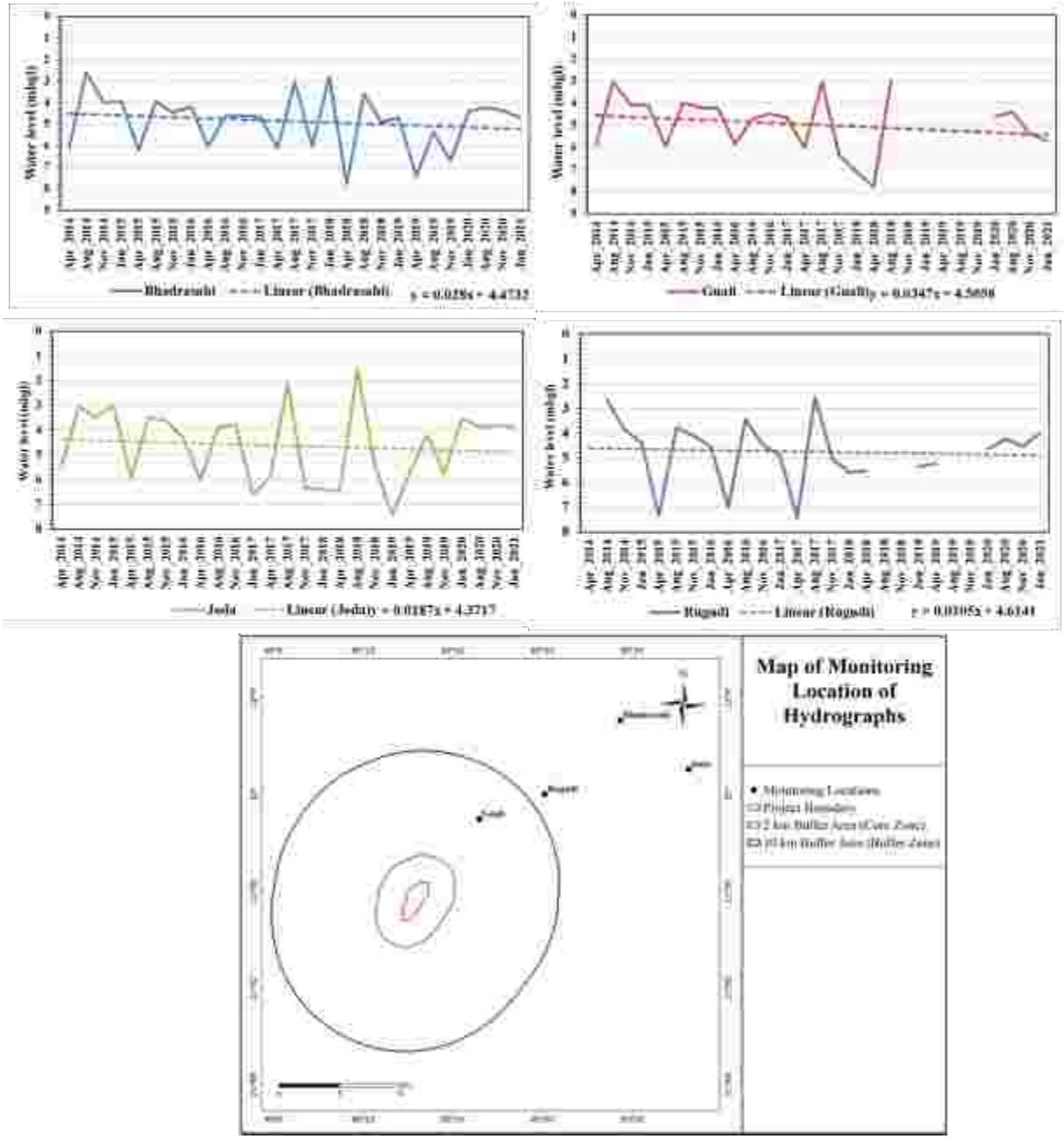


Figure 3.11: Long-term hydrographs of CGWB groundwater monitoring wells.

3.3.5 Ground water quality

The suitability of ground water for drinking/irrigation/industrial purposes is determined keeping in view the effects of various chemical constituents present in water on the growth of human being, animals, and various plants and on industrial requirement. However, many ions are very essential for the growth of plants and human body but when present in excess, have

an adverse effect on health and growth. The ground water samples were analysed for major as well as heavy chemical constituents. The ranges of different chemical constituents present in ground water are given in The iso-conductivity map of ground water has been prepared and presented as Figure 3.13. On perusal of the iso-conductivity, it is observed that the electrical conductivity for shallow Aquifer in study district ranges from 167-319 ms/cm. The electrical conductivity for shallow aquifer is within Permissible Limit (750-2250 μMhos/cm @ 25°C). The Figure 3.14 represents the chloride ion distribution in the core zone and in buffer zone of the project site. As per the analysis the chloride ion concentration in groundwater and in surface water samples range from 14-20 mg/l and are within the range of maximum permissible limit (250 mg/l). The nitrate distribution in the study area ranges from 1 to 8.2 mg/l and presented in Figure 3.15. The Figure 3.16 reflects fluoride concentration in the study area that ranges from 0.1 to 0.27 mg/l. All the parameters are within the range of maximum permissible limit, hence, it is inferred that the groundwater is safe for drinking and domestic purposes.

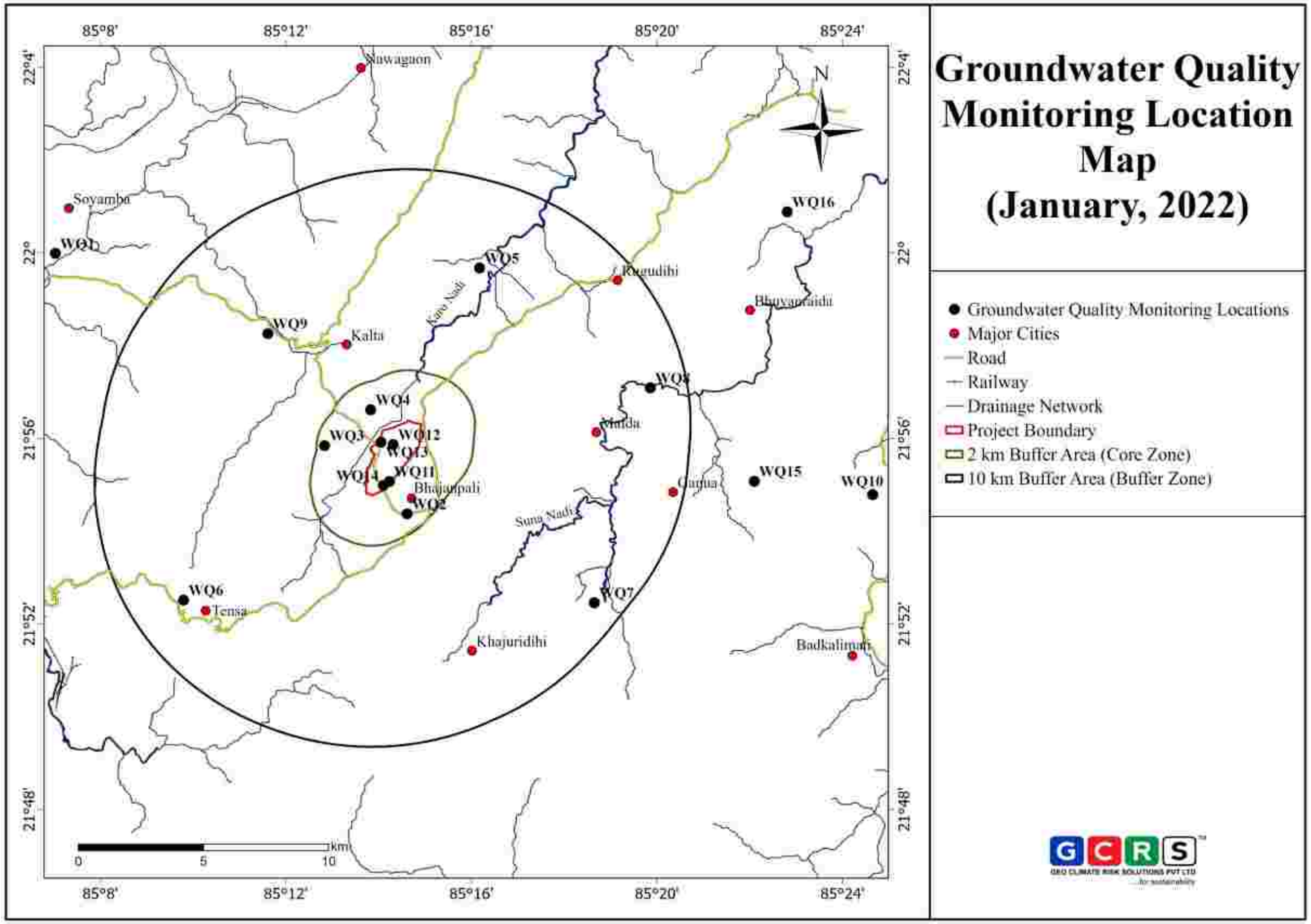


Figure 3.12: Water quality monitoring location map for January, 2022.

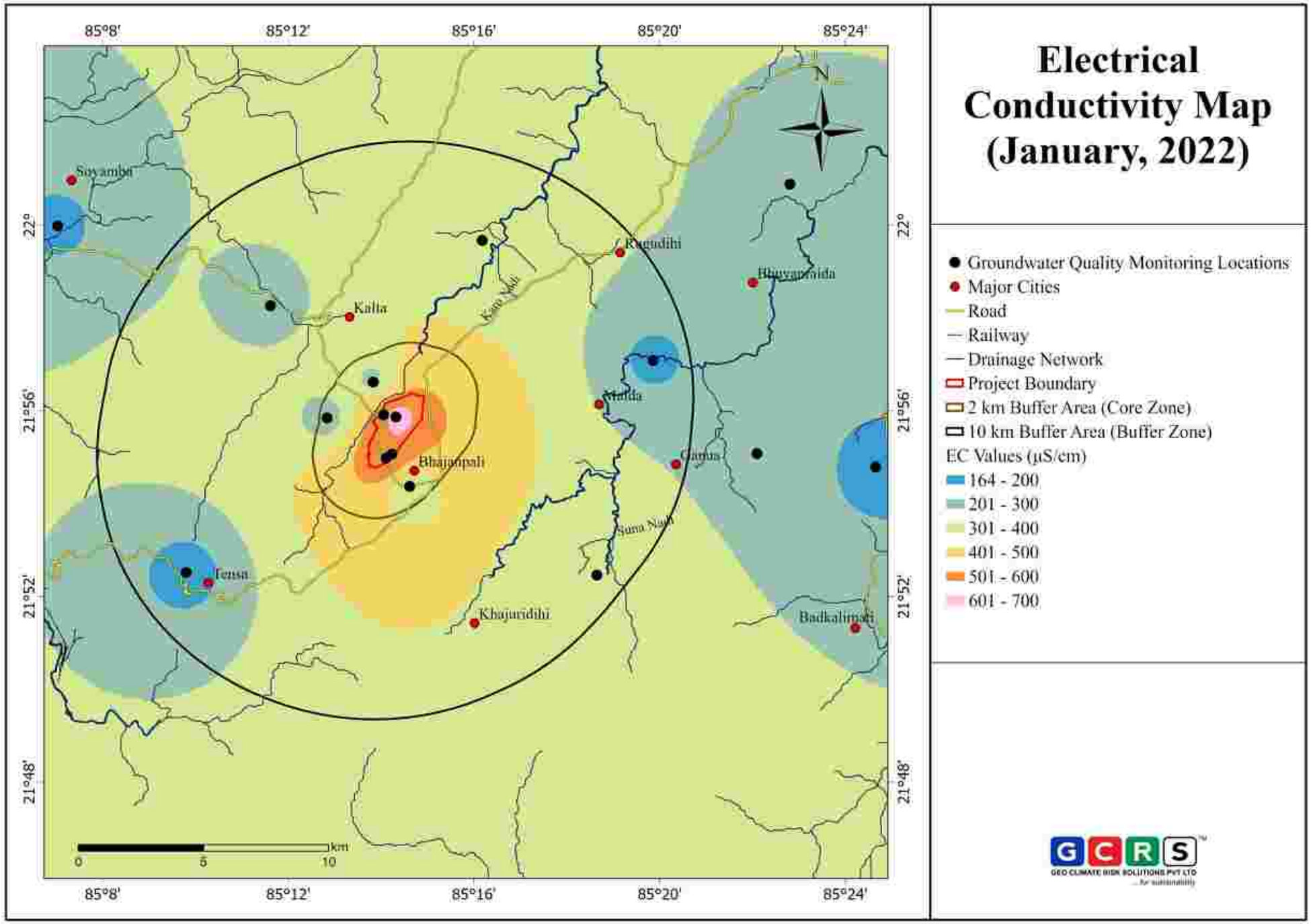


Figure 3.13:Contour map showing electrical conductivity in the buffer zone (Source: Field data).

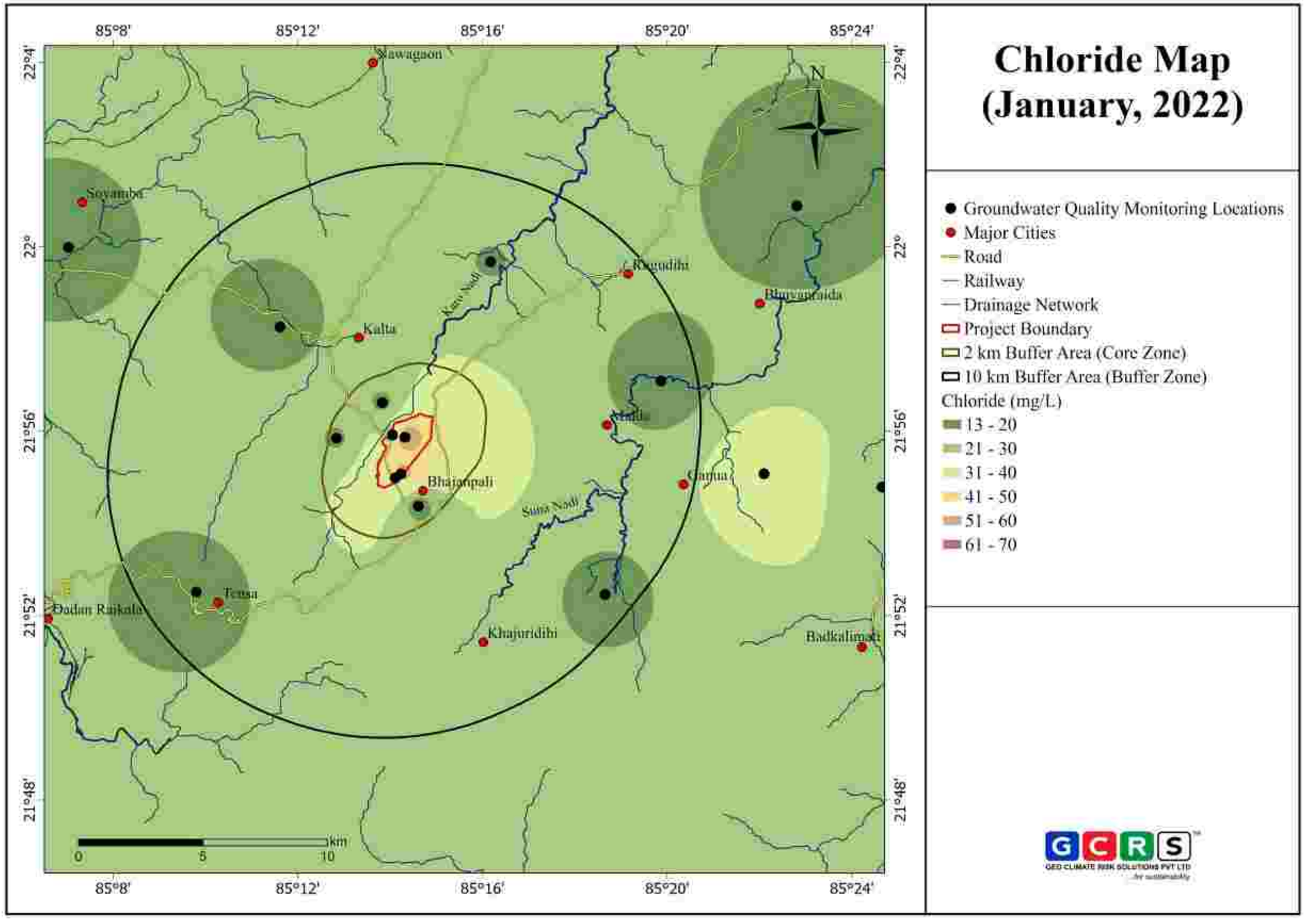


Figure 3.14: Chloride distribution map (Field data).

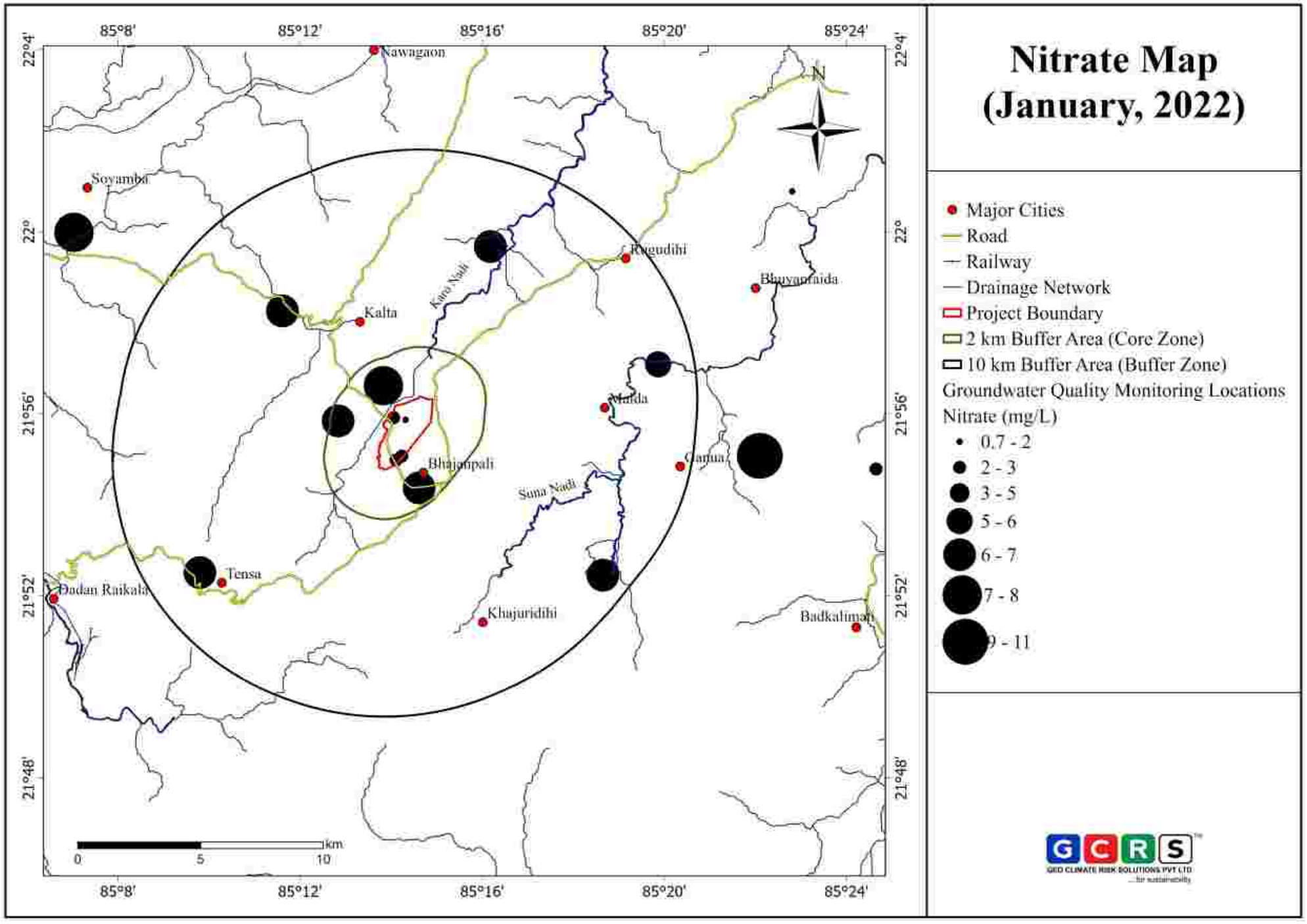


Figure 3.15: Nitrate distribution map (Source: Field data).

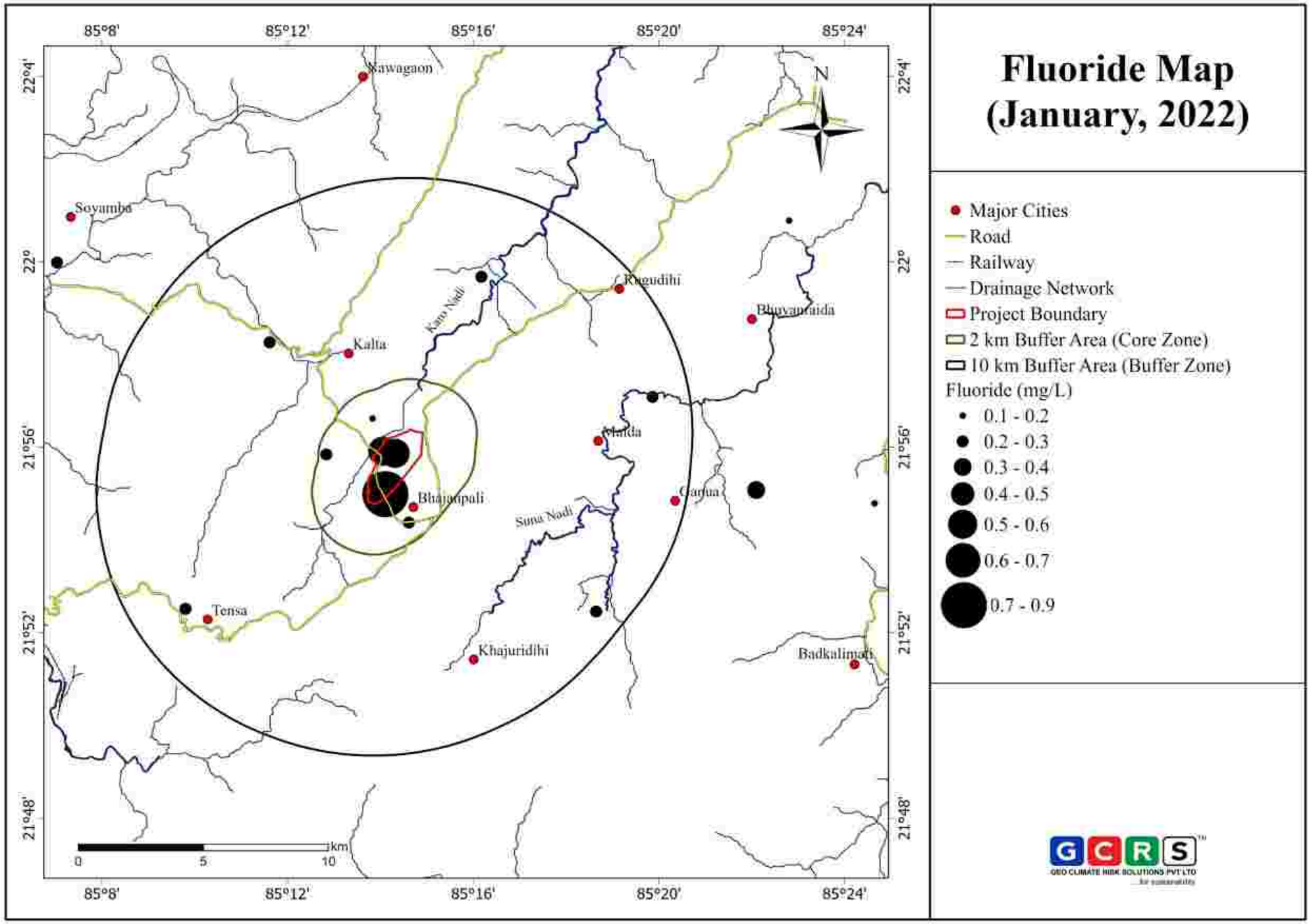


Figure 3.16: Fluoride distribution map (Source: Field data).

The water quality analysis was done based on samples collected from the dug wells present in the buffer area. The samples were collected from 16 locations for pre-monsoon season (May, 2022). The results of water analysis when compared with water quality standards specified in IS 10500 shows that all the parameters are within desirable range. The water quality meets Class A, B and C norm specified by CPCB. Water quality test reports are attached in annexure 9. The iso-conductivity map of ground water has been prepared and presented as Figure 3.13. On perusal of the iso-conductivity, it is observed that the electrical conductivity for shallow Aquifer in study district ranges from 167-319 ms/cm. The electrical conductivity for shallow aquifer is within Permissible Limit (750-2250 μMhos/cm @ 25°C). The Figure 3.14 represents the chloride ion distribution in the core zone and in buffer zone of the project site. As per the analysis the chloride ion concentration in groundwater and in surface water samples range from 14-20 mg/l and are within the range of maximum permissible limit (250 mg/l). The nitrate distribution in the study area ranges from 1 to 8.2 mg/l and presented in Figure 3.15. The Figure 3.16 reflects fluoride concentration in the study area that ranges from 0.1 to 0.27 mg/l. All the parameters are within the range of maximum permissible limit, hence, it is inferred that the groundwater is safe for drinking and domestic purposes.

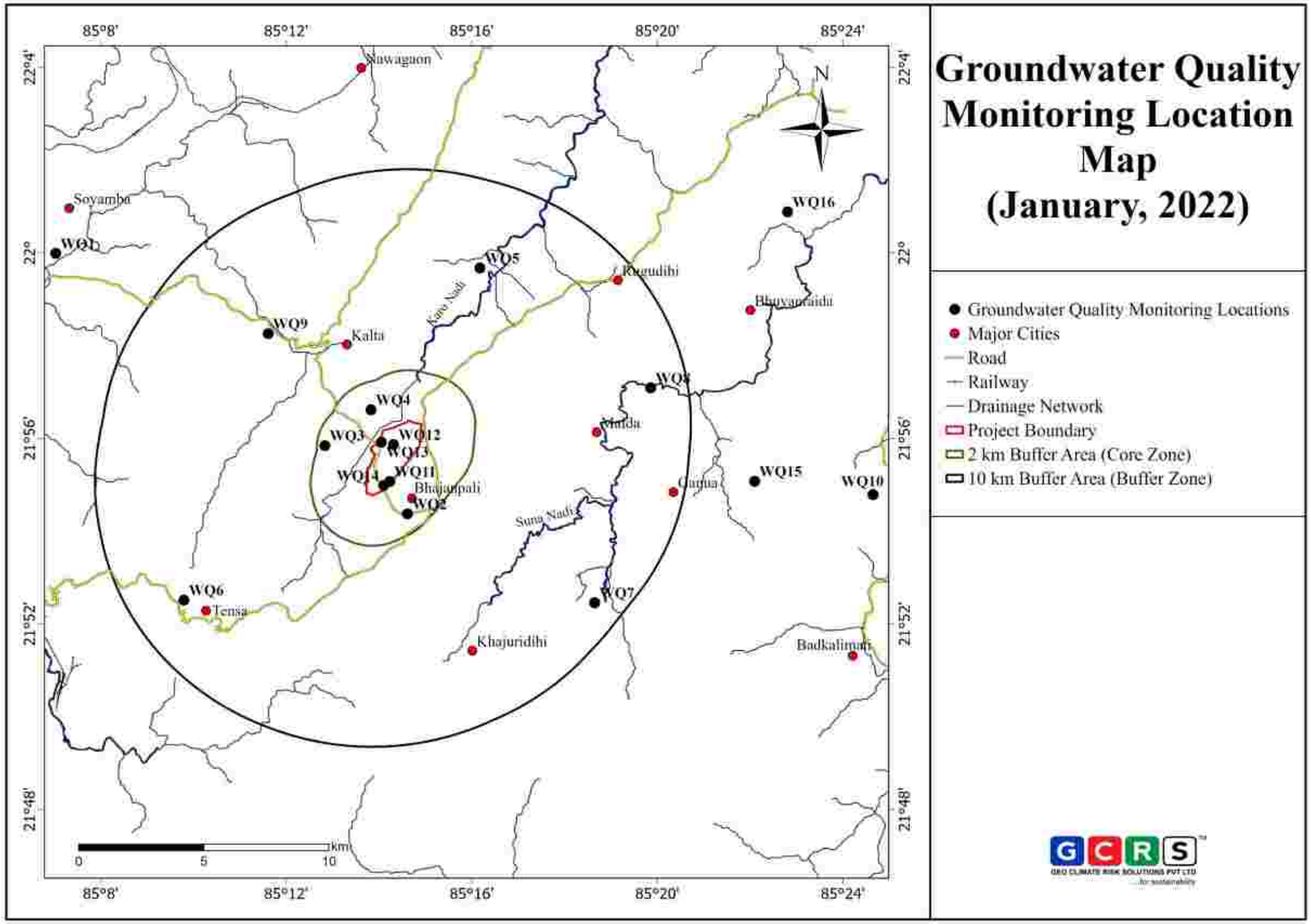


Figure 3.12: Water quality monitoring location map for January, 2022.

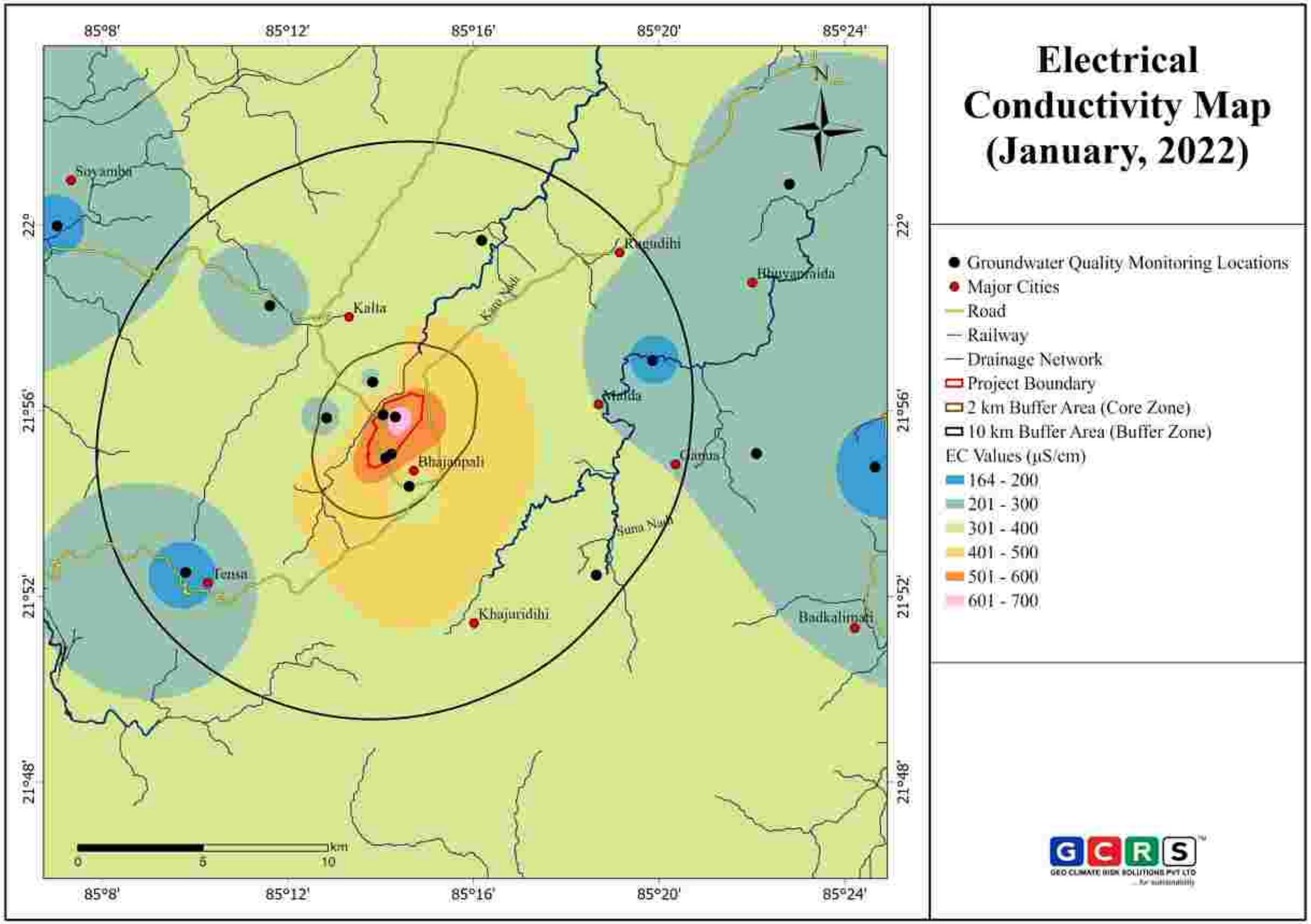


Figure 3.13:Contour map showing electrical conductivity in the buffer zone (Source: Field data).

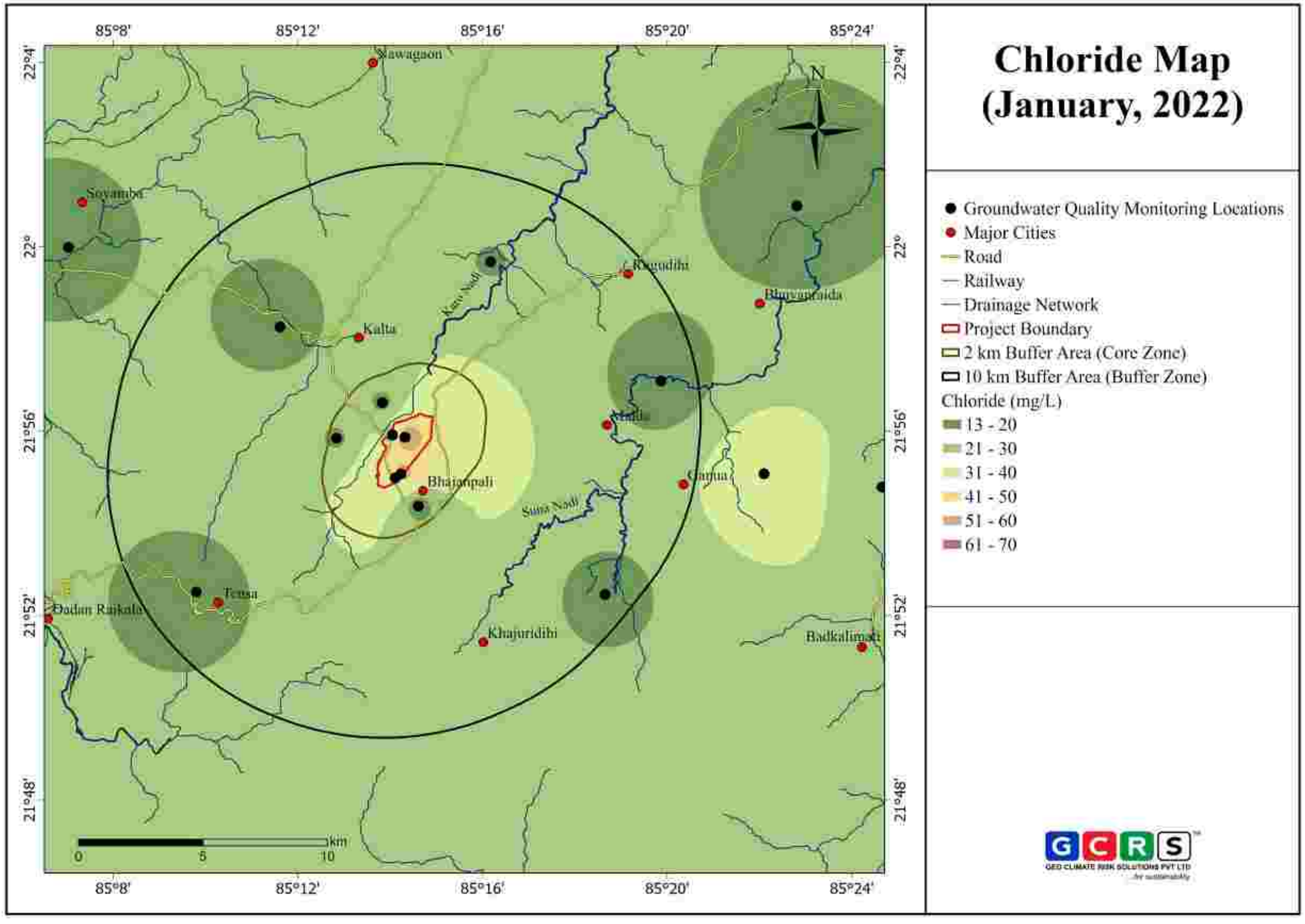


Figure 3.14: Chloride distribution map (Field data).

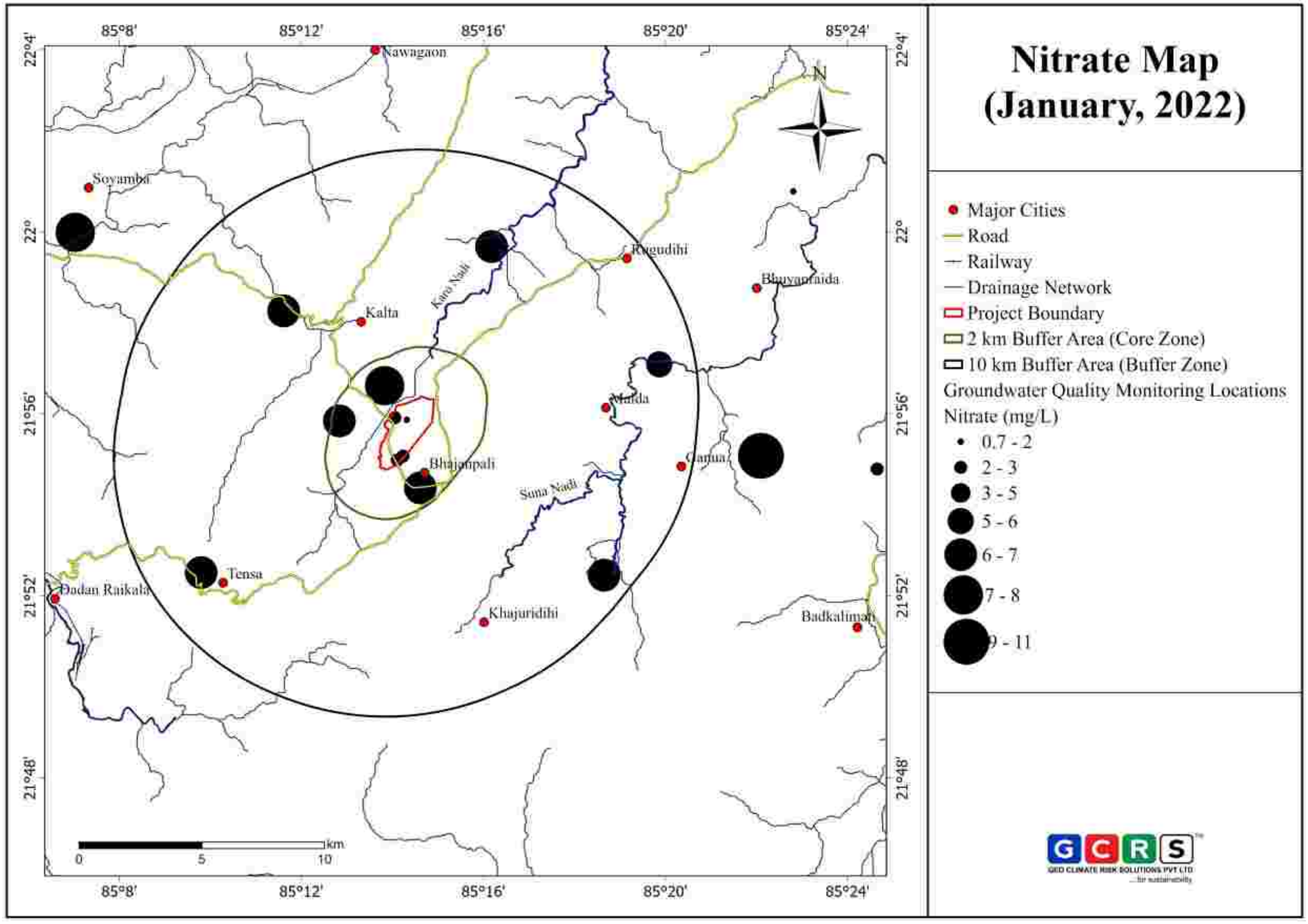


Figure 3.15: Nitrate distribution map (Source: Field data).

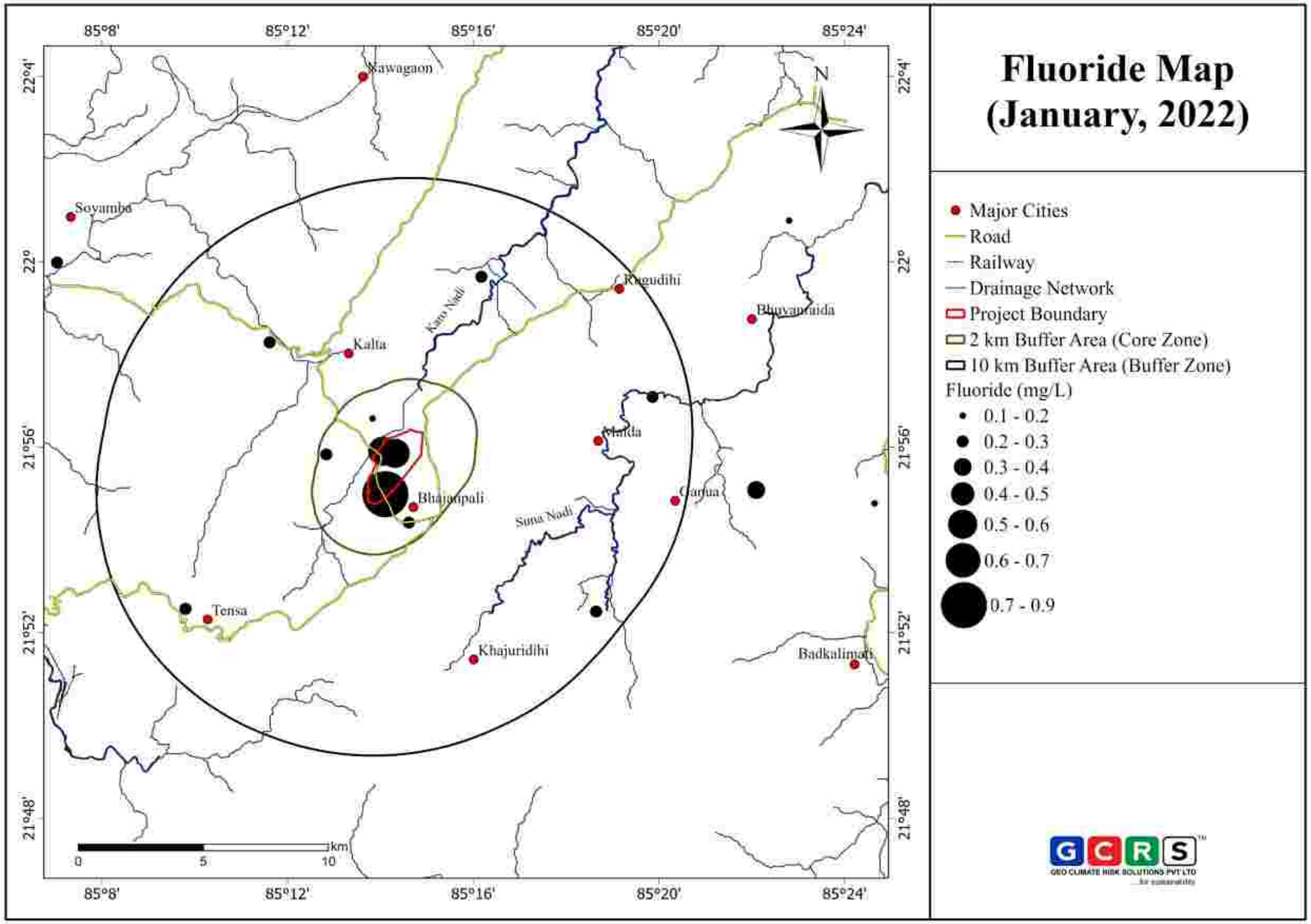


Figure 3.16: Fluoride distribution map (Source: Field data).

The water quality monitoring data for March, 2024 is given in Table 3.6 and the monitoring location maps is shown in Figure 3.17. The analysis results shown that all the parameters are within the permissible limit. The EC, Cl, F and NO_3 concentration contour maps are shown in Figure 3.18 to Figure 3.21.

Table 3.6: Water quality analysis details for March, 2024.

S.no	Well id	Village Name	Longitude	Latitude	pH	EC	Total Alkalinity	Hardness	Ca	Mg	Na	K	Fe	HCO3	Cl	SO4	NO3	F	Mn
1	N1	Mutuhanuman	85.11722222	21.99972222	7.03	146.4	29.5	120	20.2	16.9	4.2	0.96	0.77	29.5	25.2	10.3	3.9	0.11	<0.05
2	N2	Camp of Tisco	85.32085	22.0051	7.15	182.2	30.1	114	18.6	16.4	3.6	1.12	0.69	30.1	23.1	7.2	4.2	0.16	<0.05
3	N3	Chormalda	85.35306	21.95341	7.21	167.9	27.5	132	23.4	17.9	3.1	1.04	0.61	27.5	22.4	8.0	4.6	0.14	<0.05
4	N4	Mithirda	85.3397	21.8395	7.05	180.2	28.6	114	22.9	13.8	4.0	0.88	0.81	28.6	24.5	6.6	5.1	0.12	<0.05
5	N5	Tensa CT	85.16331	21.87523	6.88	176.3	27.9	126	21.5	17.6	2.9	0.76	0.66	27.9	23.9	10.8	4.8	0.13	<0.05
6	N6	Tentulidihi	85.20300556	21.86896944	7.02	146.9	29.4	120	19.6	17.3	2.7	1.03	0.79	29.4	25.1	10.3	4.3	0.16	<0.05
7	N7	Bandal	85.19985	21.89757	7.18	158.2	30.3	102	20.7	12.2	3.3	1.15	1.12	30.3	23.6	6.7	5.1	0.12	<0.05
8	N8	Kalta	85.21798	21.96555	7.01	150.4	26.5	125	23.5	16.1	3.1	0.82	1.03	26.5	24.7	10.9	3.6	0.15	<0.05
9	N9	Jhirpani	85.21985	21.9964	6.83	146.9	32.7	106	22.9	11.9	2.3	1.24	0.96	32.7	22.9	6.6	4.1	0.14	<0.05
10	N10	Paduliposi	85.2906	21.98669	7.21	160.5	28.9	118	21.4	15.7	2.8	1.03	1.13	28.9	24.5	10.1	4.8	0.13	<0.05
11	N11	Kalmanga	85.31977	21.95253	7.06	150.3	31.6	127	16.8	20.7	3.0	1.42	1.16	31.6	26.8	9.2	5.2	0.12	<0.05
12	N12	Badpatuli	85.31084	21.87426	7.19	158.7	30.7	121	23.5	15.1	2.1	0.68	1.01	30.7	24.1	10.2	4.9	0.16	<0.05
13	N13	Kamanda	85.21485	21.93119444	7.11	166.9	26.5	130	25.1	16.4	2.2	0.92	0.98	26.5	22.6	8.4	4.2	0.14	<0.05
14	N14	Koida CT	85.22964	21.91006	7.07	164.2	29.8	132	23.9	17.6	2.4	1.14	0.76	29.8	21.9	7.6	3.6	0.11	<0.05
15	N15	Kasira	85.23715	21.93368	7.16	156.4	30.4	116	22.5	14.5	1.6	1.06	1.12	30.4	20.7	6.8	5.0	0.13	<0.05
16	N16	Kashira	85.25405833	21.91755	7.20	134.2	31.2	108	20.1	14.0	2.0	0.85	1.06	31.2	24.8	7.2	4.4	0.14	<0.05

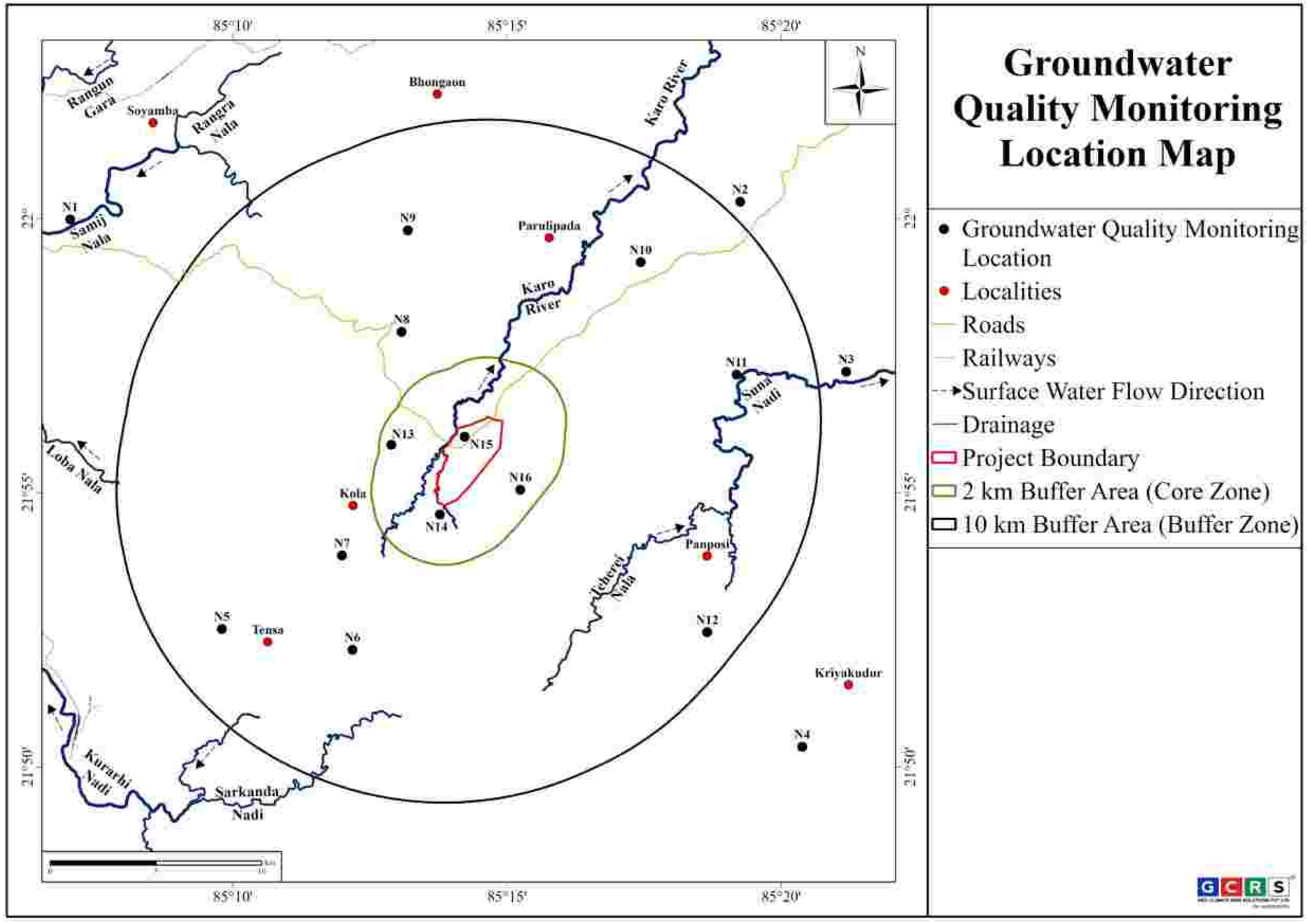


Figure 3.17: Water quality monitoring location map for March, 2024.

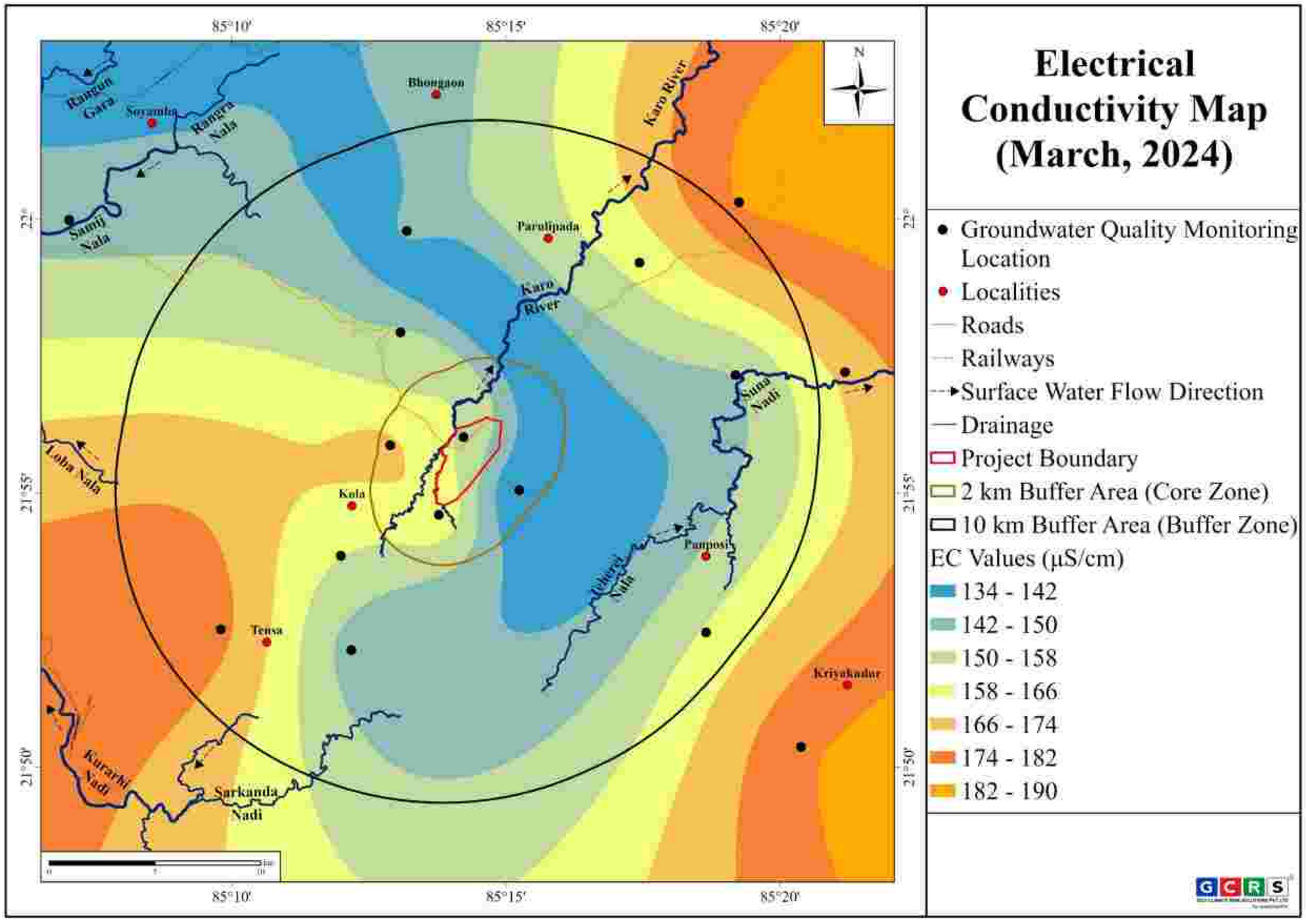


Figure 3.18: EC concentration contour map for March, 2024 (Source: Field Data).

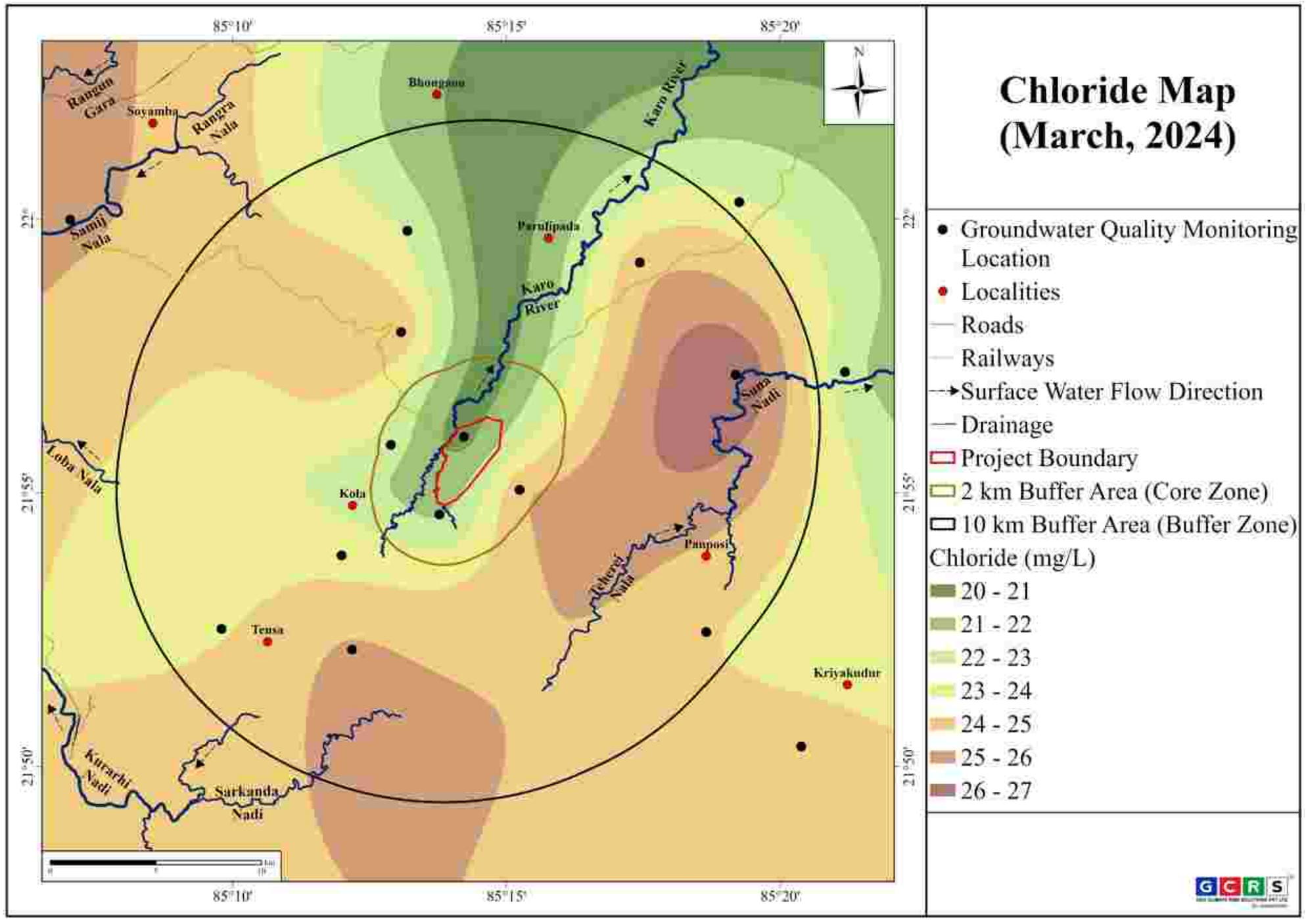


Figure 3.19: Cl concentration contour map for March, 2024 (Source: Field Data).

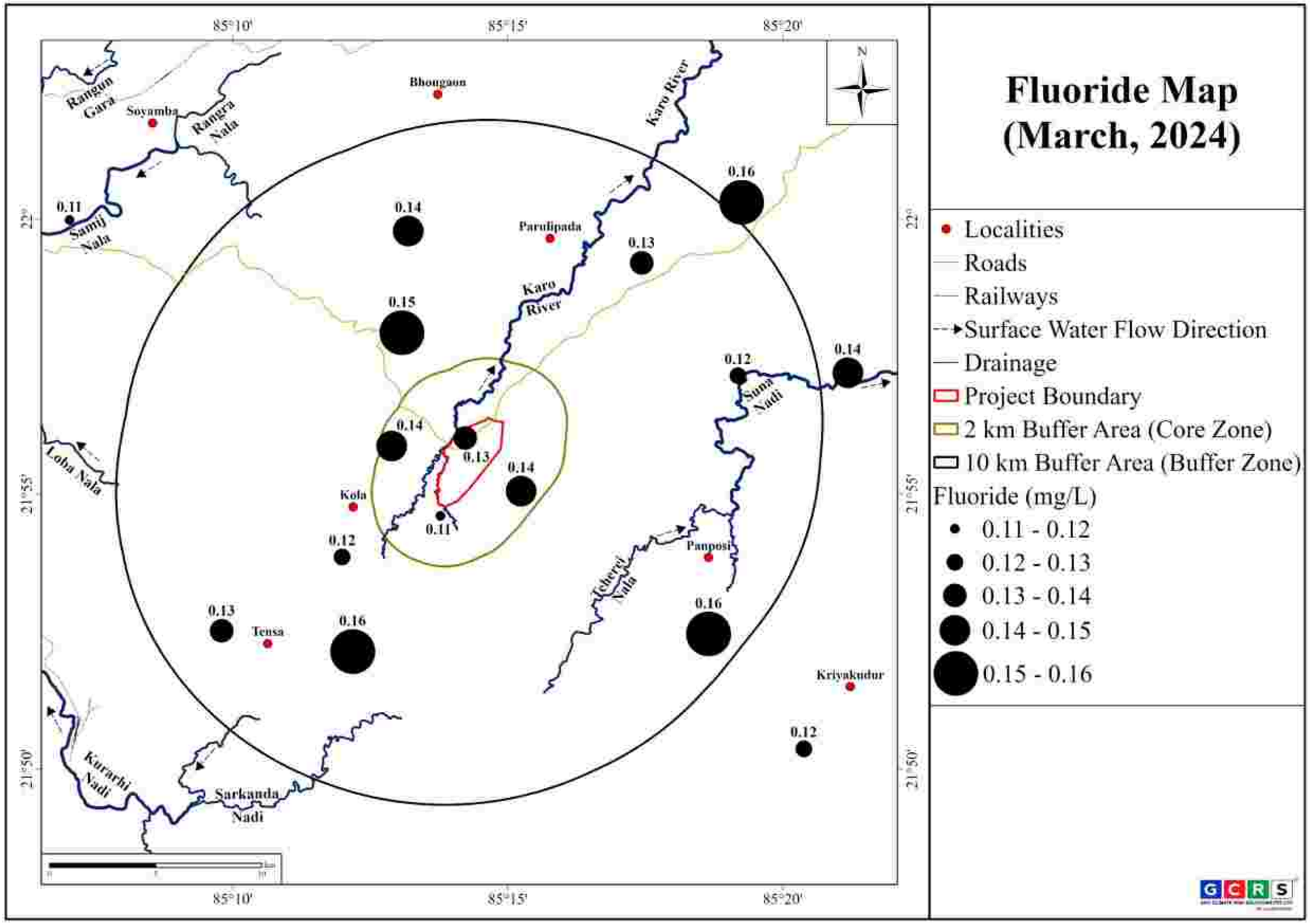


Figure 3.20: Fluoride concentration contour map for March, 2024 (Source: Field Data).

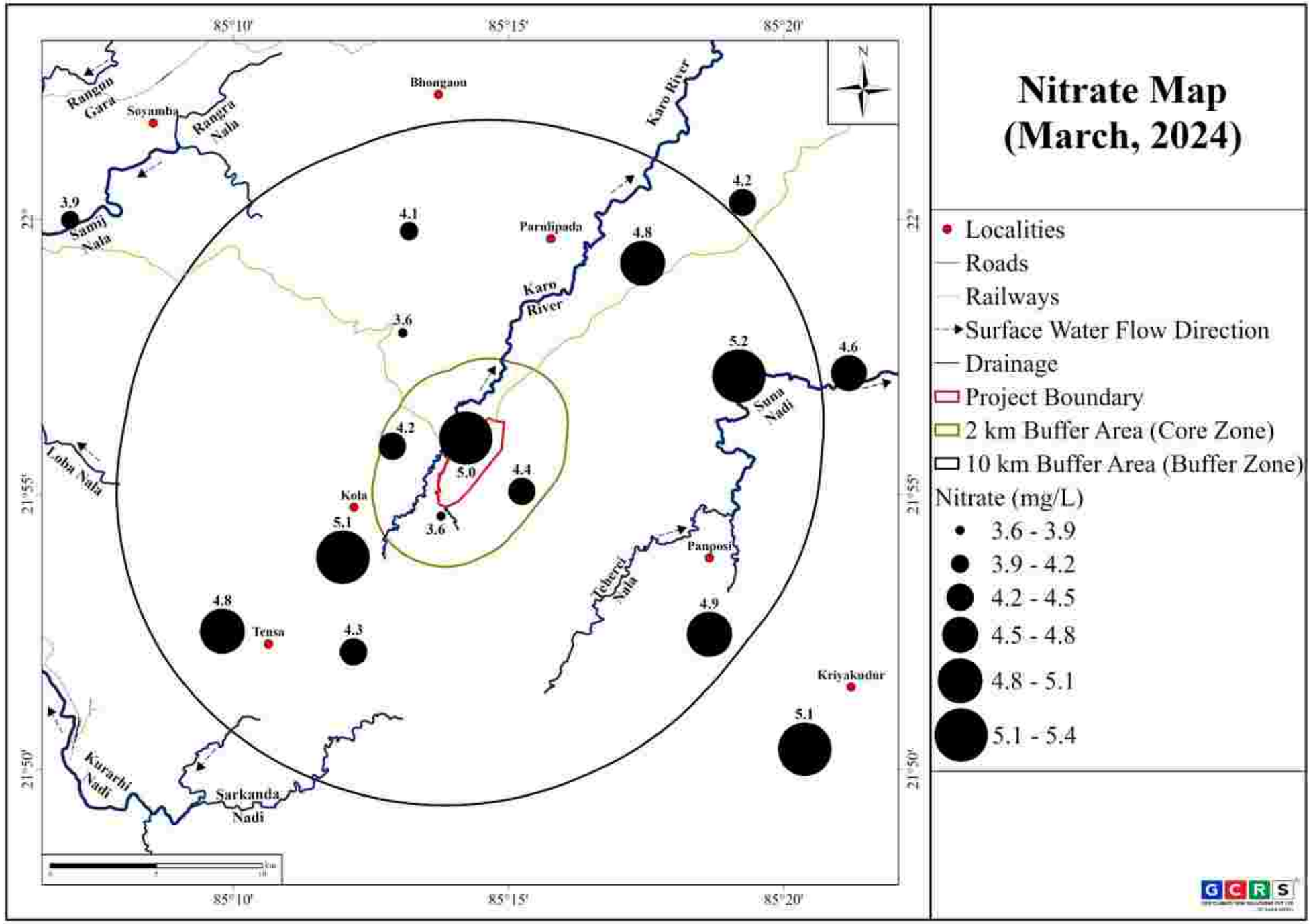


Figure 3.21: Nitrate concentration contour map for March, 2024 (Source: Field Data).

3.3.6 Water quality of nearby bodies:

The suitability of ground water for drinking/irrigation/industrial purposes is determined keeping in view the effects of various chemical constituents present in water on the growth of human being, animals, and various plants and on industrial requirement. However, many ions are very essential for the growth of plants and human body but when present in excess, have an adverse effect on health and growth. For estimation of the quality of ground water, 5 surface water samples have been collected in study area. The ground water samples were analysed for major as well as heavy chemical constituents. The ranges of different chemical constituents present in ground water are given in **Table 3.7.**

The Surface water quality samples were collected from five (5) locations for post monsoon season (Nov.2021). The results of water analysis when compared with water quality standards specified in IS 10500 shows that all the selected water samples are within the range of maximum permissible limit.

Table 3.7: Summarized results of chemical quality of surface water in the study area for the post-monsoon season (2021).

S. No	1	2	3	4	5
Location	Oraharinala upstream	Oraharinala downstream	Karo river upstream	Karo river downstream	Kasira Nala (Near between Quarry No. 3 & 4
Source	Surface water	Surface water	Surface water	Surface water	Surface water
Elevation	600	538	544	567	553
Colour	10	20	5	10	10
pH	6.72	6.87	6.62	6.75	6.74
Total Suspended Solids	34	58	48	66	54
Total Dissolved Solids	148	182	154	184	168
Chloride (as CI)	20	30	25	40	20
Iron (as Fe)	0.12	0.19	0.19	0.23	0.13
Sulphates (as SO4)	9.5	12.4	12	17	12
Fluoride (as F)	0.15	0.21	0.15	0.19	0.16
Nitrates (as NO3)	5.8	7.6	5.3	6.2	5.6
Copper (as Cu)	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese as Mn	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Selenium (as Se)	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (as Zn)	0.02	0.05	0.02	0.03	< 0.02

Cadmium (as Cd)	<0.003	<0.003	<0.003	<0.003	<0.003
Lead (as Pb)	<0.01	< 0.10	< 0.10	<0.01	<0.01
Arsenic (as As)	<0.01	< 0.02	< 0.02	<0.01	<0.01
Cyanide (as CN)	<0.02	< 0.02	< 0.02	<0.02	<0.02
Chromium (as Cr 6)	<0.02	< 0.02	< 0.02	<0.02	<0.02
Anionic Detergents (as MBAS)	<0.1	<0.1	<0.1	<0.1	<0.1
Phenolic Compounds (as C6HSOH)	<0.001	<0.001	<0.001	<0.001	<0.001
COD	52	76	48	68	40
BOD (as 02)	6	9	6	9	7
Dissolved Oxygen (as 02)	5.2	5.1	5.2	4.9	5.2
Oil & Grease	< 1	< 1	< 1	< 1	< 1
Total Coliforms	70	80	90	130	50

4 APPROVED MINE PLAN

As per guidelines of IBM threshold value of iron ore is considered as 45%Fe and calculation of reserves is done under different range of Fe% i.e. 45 to 55%Fe and 55% Fe above. While above 55%Fe ore is termed as saleable/usable iron ore, below that up to 45% Fe is termed as mineral reject. Similarly, threshold value of Manganese ore has been considered as 10%Mn and cut-off grade has been considered as 20%Mn. Considering these factors, the grade – wise calculation of updated iron ore and Mn ore resources in the ML area in all the deposits are done.

Considering the geological plan, twenty-four numbers of cross sections are prepared in 1: 2000 scale covering the total area and from lease boundary to boundary. Position of holes are well shown on the cross sections and the lithology as encountered in each of the bore holes were plotted indicating the run wise grade of ore encountered in the hole. The ore zones are plotted in each of the bore holes of respective cross sections and are connected to arriving sectional area of different grade of the ore zone for that section.

Category wise updated reserve and resources as per UNFC:

The Reserve & Resource has been updated category wise classified and estimated as per UNFC guidelines. It is a three-digit code-based system. It represents the economic viability axis (E)

as the first digit, the feasibility axis (F) as the second digit and the geological axis (G) as the third digit. The highest category of reserves under UNFC system will have the Code 111 and the lowest category of the Code will have 334. Reserve & Grade as per United Nations Framework Classification, Geological Reserve (in Million Tonnes and as on 01.04.2014) is. It is represented in **Table 4.1** .

Table 4.1: Reserves as per UNFC classification.

	CATEGORY	UNFC CODE	Iron Ore Quantity (Tonnes)			Grade	Mn Ore Quantity (Tonnes)			Grade
			+45 - 55 Fe%	+55 Fe%	Total		+10 - 20	+20 Mn%	Total	
Reserves	A. Total Mineral Reserves		41199904	123599712	164799616	+45% Fe	50803	457227	508030	+10% Mn
	Proved Mineral Reserve	111	0	0	0		0	0	0	
	Probable Mineral Reserve	121	2702759	8108276	10811035		0	0	0	
		122	38497145	115491436	153988581		50803	457227	508030	
	B.Total Remaining		4059012	12177036	16236048		2990	26914	29905	
Resources	Feasibility Mineral	211	0	0	0		0	0	0	
	Pre-Feasibility Mineral resources	221	685492	2056477	2741969		0	0	0	
		222	3373520	10120559	13494079		2990	26914	29905	
	Measured Mineral	331	-	-	-		-	-	-	
	Indicated Mineral	332	-	-	-		-	-	-	
	Inferred Mineral	333	-	-	-		-	-	-	
	Reconnaissance Mineral	334	-	-	-		-	-	-	
Total Reserves + Resources (A+B) as on 01.04.2021			45258916	135776748	181035664		53793	484141	537934	

Based on proved mineral reserve and production of 1.0 Mt/yr, the life of mine is estimated to be 8 years.

OPENCAST MINING (WITH JUSTIFICATION)

For any given ore body, relative economy of mining is generally the consideration for choosing the method of mining between the underground mining and opencast mining. However, there does arise rigid situation where opencast mining becomes virtually impossible. Natural obstacles like hill or mountain or river or fragile ecological set up or archeological excavation or National Sanctuary or similar such situation just cannot be overcome (irrespective of economy or no economy) and underground mining must be resorted. While natural barrier may not exist, still economy of opencast mining of ore may become higher than market value or relatively higher than underground cost of production for the same scale of production like excessive ore to overburden ratio on account of opencast depth, flat slope of quarry (because of very soft ground), thin ore body compared to overburden or side burden, excessive haul distance where cost of hauling forms a big component in overburden cost or similar such situation. In certain situation, information may not be available on the Geo-technical / Hydrological / Mineralogical front and is likely to take few years before information can be obtained and assessment is possible on the economy of mining by underground method at depth from the surface.

SEQUENCE OF MINING AND PROPOSED MINING METHOD

Sequence of Mining Operations under the existing/present mining method is given as follows:

A) Existing Mining Method

- Narayanposhi Iron & Manganese Ore Mine is an "A" category mine and mining operation is fully mechanized & opencast, using shovel-dumper combination and various processes involved are drilling, blasting, excavation, quality control, ore processing (crushing & screening), loading of finished products and waste disposal.
- Production capacity of the mine is 6 MTPA of iron ore and 0.036 MTPA of manganese ore.
- Currently the well-developed quarries/pit are Quarry 3/4, RF Pit and Manganese Quarry-5 (**Table 4.2)**

Table 4.2: Details of the Existing Quarry, Ore Plot, Waste Dump & Processed Ore etc.

Sl. No	Name of the ore	Name of the Quarry	Dimension		Status	Top R.L	Bottom R.L
			Length (m)	Breadth (m)			
1	Fe-Ore	Q-3/4	575	322	Active	582	551
2	Fe-Ore	Q-5	280	50	Inactive	542	553
3	Fe-Ore	RF Block	590	390	Active	630	573
4	Mn-Ore	Q-1	98	40	Inactive	540	538.50
6	Mn-Ore	Q-2	70	45	Inactive	541	539
7	Mn-Ore	Q-3	50	40	Inactive	568	547
8	Mn-Ore	Q-4	82	79	Inactive	551	543
9	Mn-Ore	Q-5	210	208	Active	558	542

B) Proposed Mining Method: -

The mining is proposed to be carried out by open cast fully mechanized method with the deployment of drills, associated compressors, dumpers/tippers, excavators and other equipment's for development, production, processing and undertaking all the precautions for protection of the environment. During the ensuing plan period, it has been envisaged to ramp up the production of iron ore from the current capacity 6 MTPA to 10MTPA after obtaining all the statutory clearances from the competent authorities. The quantity of manganese ore shall remain 0.036 MTPA.

The ROM production of 10 MTPA of iron ore is proposed to be undertaken in Quarry3/4 and RF Pit. Manganese ore production of 0.036 MTPA shall be from Mn Quarry-4. Both, lateral and depth wise extension is proposed to be undertaken to achieve the proposed target

Dimensions of the ore body

The shape and size of the ore deposit has been arrived by considering the data/information of existing quarry and drilled bore holes. The lessee has undertaken drilling of 170 DTH/RC/Core bore holes within the lease area. These boreholes along with existing quarry gives valuable information about the ore body configuration i.e. shape & size of the mineral deposit. Based on the results of bore holes it can be observed that maximum depth of iron ore occurrence is 165.95m (BH – DH-096) and the minimum depth of the bore hole in which iron ore body is encountering is 22.35m (DH-018). The average thickness of the ore body has been assumed as 30m. Considering the information of geology and bore holes data, the shape and size of these iron ore is1800m x 800m x 51.486m and that for Mn ore is 350mx 300m x 46.11m.

The size and shape of different ore zone are furnished below in **Table 4.3**

Table 4.3: Dimensions of different zones.

Potentially	**Co-ordinates**	**Configuration (Lx W x D)**
Iron Ore zone	Easting – 317400 to 319065	1800m x800m x 51.486m
Manganese Ore	Easting – 317105 to 317465	350m x 300m x46.11m

Table 4.4: The summary of the ore exploration.

SL. No	**Year of Exploration**	**Number of Bore Holes**	**Type of BH**	**Meterage of drilling (M)**	**Spacing/Grid Interval**	**Scale of Exploration G1/G2/G3**
1	2003-04	19	RC	594.00	100m x 200m	G2
2	2009-10	26	Core	1151.65	100m x 200m	G2
3	2010-11	7	Core	299.05	50m x 50m	G1
4	2011-12	95	Core	5129.45	100m x 200m/100m x 100m/ 50m x 50m	G1&G2
5	2015-16	05	DTH	153.50	100m x 100m	G1
6	2016-17	14	Core	845.55	100m x 100m/ 100m x 200m	G1&G2
7	2018-19	4	Core	263.10	--	--
Total		170		8436.30		G1/ G2

Based on the exploratory evidence, the ultimate working depth will be 405mRL. Height and width of the benches will be kept at 9m each for iron ore and 6m each for manganese ore.

The individual bench slope would be kept nearly vertical, height and width of the benches would be kept at 9m each for iron ore and 6m each for Mn ore. The individual bench slope will be kept at 850 with the horizontal whereas the overall quarry slope angle would be maintained at 37.50 to the horizontal during plan period as well as at the end of the life of the mine. The dimensions of the existing pit are given in **Table 4.5**.

Table 4.5: Dimension of existing pit.

	Iron (Fe) ore	**Manganese (Mn) ore**
Quarry bench height	9 m	6 m
Quarry bench width	10-12 m	10 m
Bank slope angle	85^0	85^0

Overall slope	37.5^0	31.5^0

The year wise excavation details are given in **Table 4.6** and **Table 4.7**

Table 4.6:Year wise excavation details (Iron ore).

Year	Name of Quarry	Total Exacavation (in Cum)	Topsoil (in Cum)	OB/SB/IB (in Cum)	ROM		Total ROM (in Cum)	ROM/Waste Ratio (Cum/cum)
					Ore (in Cum)	Mineral reject (in Cum)		
2021-22	Quarry 3/4	1144456	-	217534	695192	231731	926922	1:0.24
	RF	1834709	-	761631	804808	268269	1073078	1:0.71
	Sub-Total	2979165	0	979165	1500000	500000	2000000	1:0.49
2022-23	Quarry 3/4	1918332	-	591782	994913	331638	1326550	1:0.45
	RF	2046018	-	705901	1005087	335029	1340116	1:0.53
	Sub-Total	3964350	0	1297683	2000000	666667	2666667	1:0.49
2023-24	Quarry 3/4	2744518	-	886385	1393600	464533	1858133	1:0.48
	RF	2696775	-	1221575	1106400	368800	1475200	1:0.83
	Sub-Total	5441293	0	2107960	2500000	833333	3333333	1:0.64
2024-25	Quarry 3/4	2964598	-	1294060	1252903	417634	1670538	1:0.78
	RF	2465217	-	802421	1247097	415699	1662796	1:0.49
	Sub-Total	5429814	0	2096481	2500000	833333	3333333	1:0.63
Grand Total		17814622-	0	6481289	8500000	2833333	11333333	1:0.58

Table 4.7:Year wise excavation details (Manganese ore).

Year	Name of Quarry	Total Exacavation (in Cum)	Topsoil (in Cum)	OB/SB/IB (in Cum)	ROM		Total ROM (in Cum)	ROM/Waste Ratio (Cum/cum)
					Ore (in Cum)	Mineral reject (in Cum)		
2021-22	Quarry 5	125521	0	109868	14087	1565	15652	1: 7.02
2022-23		125270	0	109618	14087	1565	15652	1: 7.01
2023-24		127269	0	111617	14087	1565	15652	1: 7.14
2024-25		126520	0	110868	14087	1565	15652	1: 7.09
Grand Total		504581	0	441972	56348	6261	62609	1: 7.06

The surface plan, geological plan, geological sections are given in Annexure 1, Annexure 2 and Annexure 3 respectively. The development plans are given in Annexure 4 to 7 and the conceptual plan is given in Annexure 8.

5 ESTIMATION OF MINE SEEPAGE AND ADVANCED DEWATERING PLAN

5.3 ESTIMATION OF MINE SEEPAGE

The mine area is occupied by thin layer of alluvium underlain predominantly by sandstone, shale and coal seams in general. In the mining lease area, the ground water table levels varies with an average of 544 mamsl. Hence any mining depth below 544 mamsl will activate ground water seepage to the mine pit and eventually require pumping the ground water to allow mining activity. Throughout the operational phase of the open-cut and underground mines, the excavations are expected to intersect the upper unconfined aquifer and will result in discharge of groundwater into the pits/mine workings. As per the normal mining procedure, the sump pumps will be employed at the base of pits/underground workings to remove the groundwater, which will be used for other purposes (i.e., dust suppression and water supply) at the mine sites. Groundwater discharge into the pits and underground workings will cause drawdown around the mining operations that in turn causes regional groundwater levels to lower. Following the cessation of mining, groundwater will continue to discharge to the rehabilitated final voids until water levels within the surrounding aquifers recover to a new equilibrium.

Accurate estimation of ground water inflow to mine excavation is important for mine management/ operations and generally accomplished through analytical approach adopting the equivalent flow approach (Figure 5.1). Numerical modeling offers better and relatively accurate approximation, the complexities and in- homogeneity can be better approximated in numerical modeling but it requires huge data and skill, very often such facilities are not present and analytical methods are resorted.

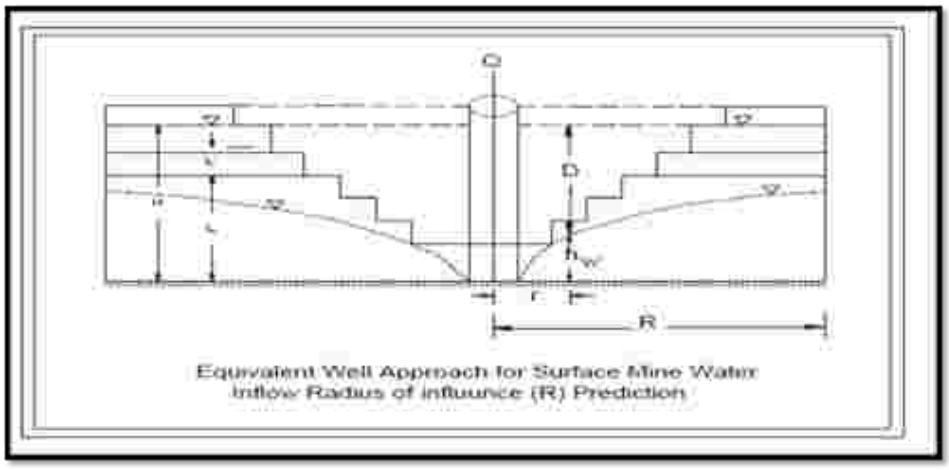


Figure 5.1: Impact of mining on ground water.

In the present context an attempt has been made to assess the mine seepage adopting analytical approach, as per mine plan both with depth and time and quantification of computation of mine water inflow. Effort has also been made to plan the details of utilization of water being pumped out along with quantification of its various uses. Further, with the help of analytical techniques and statistical analysis of water level observations attempt has been made to study the impact of mining on ground water regime, both with depth and time as well as on surface water sources in the surrounding areas and suggest mitigation measures.

In open cast mining as soon as the water table is encountered in the mine pit the ground water seepages start. The quantum of water which accumulates in the mine sump is quite large and varies with time. During the 1st and 2nd year of plan period, ultimate pit limit is 544 mamsl. So, there will be no seepage during these periods. The seepage will be started from the 3rd year onwards as the ultimate pit limit is lower than the water table. The evaluated mine seepage in mine pit for the 3rd year to 4th year plan period is given in Table **5.1**.

Table 5.1: Year wise and bench wise Mine seepage.

Year	Quarry name	RL of the Quarry	dh/dl	Thickness of Saturated Quarry Face (b) (m)	Quarry Dimension (m)	Perimeter (m)	Seepage (m3/day)	Total Seepage (m3/year)
2021-2022	Quarry-3/4	580-544	0.08	0	477 x 260	1474	0	0
	RF Pit	615-552	0.1	0	475 x 260	1470	0	0
	Mn Quarry-5	555-531	0.9	20	230 x 194	848	625.824	228425.76
Total							**625.824**	**228425.76**
2022-2023	Quarry-3/4	580-526	0.08	8	590 x 360	1900	49.856	18197.44
	RF Pit	615-543	0.1	0	505 x 300	1610	0	0
	Mn Quarry-5	555-531	0.9	20	227 x 208	870	642.06	234351.9
Total							**691.916**	**252549.34**
2023-2024	Quarry-3/4	580-508	0.08	3	650 x 406	2112	20.78208	7585.4592
	RF Pit	615-516	0.1	2.8	604 x 325	1858	21.32984	7785.3916
	Mn Quarry-5	555-531	0.9	20	227 x 208	870	642.06	234351.9
Total							**684.17192**	**249722.7508**
2024-2025	Quarry-3/4	562-499	0.08	4	655 x 406	2122	27.84064	10161.8336
	RF Pit	615-516	0.1	2.8	650 x 435	2170	24.9116	9092.734
	Mn Quarry-5	555-525	0.9	20	230 x 232	924	681.912	248897.88
Total							**734.66424**	**268152.4476**

K for that area about 0.41 m/day, which is taken from the CGWB published literature

Water table gradient is based on the surface slope

Average water level calculated from monitoring well of core zone.

Note: With the spatial variation in aquifer parameters and recharge, the observed inflow may slightly deviate from that estimated.

5.4 ESTIMATION OF RAINWATER QUANTUM DEWATERED

For the estimation of the rainwater quantum (runoff quantum) accumulate in the mine pit, the total working pit area is taken from the surface plan. The rainfall data (average of last 10 years) for the area is taken from the IMD data. The runoff coefficient for the mine pit area is taken as 0.2 based on Manual of Artificial Recharge of Groundwater, (CGWB, 2007). The details of pit area, rainfall, and runoff coefficient are given in Table 1.

Table 5.2: Estimation of rainwater quantum available for dewatering.

Catchment area (Pit Boundary) (m2)	**Average Rainfall (m)**	**Runoff Coefficient**	**Runoff Quantum (m3/year)**	**Average Per day (m3/day)**
5,07,416	1.32	0.2	133958	367

Runoff quantum = Pit area × Rainfall × Runoff Coefficient

The total quantum of rainwater that will accumulate in the mine pit will be about 1,33,958 m3/year. So, the average dewatering quantity will be about 367 m^3/day.

5.5 ADVANCED DEWATERING PLAN IN CASE OF COAL/LIGNITE MINES

NA

5.6 GROUND WATER MODELLING

GW modelling detail is be provided as a separate document.

6 MINE WATER MANAGEMENT

The groundwater abstraction for this project is about 2039 KLD/ 744235 KLY for the NOC period 2022 to 2024 and 2082 KLD/759930 KLY for NOC period 2024 to 2026. The details of sources of water are given in Table 6.1.

Table 6.1: Details of sources of water.

Year	**Mine seepage (m3/day)**	**Rainwater (m3/day)**	**Borewell (m3/day)**	**Total (m3/day)**
2022-24	692	367	980	2039
2024-26	735	367	980	2082

The total make-up water requirement for the proposed mining, central processing unit, grinding, desliming and beneficiation plant is about 965 m^3 /day out of which 230 m^3/day will be met through borewells and 735 will be met from dewatering water. The total ground water abstraction from borewells is 980 m3/day and mine seepage are 735 m3/day and 692 and 735 for the period 2022-24 and 2024-26, respectively Similarly, rainwater quantum will be about 367 m3/day. The total Water requirement for domestic, dust suppression and vehicle washing, environment requirements, and mine requirements of the project as tabulated in Table 6.2.

Though the beneficiation plant is proposed by the client, the proponent wants to obtain NOC for total water requirement of 1715 m^3/day.

Table 6.2: Water requirements.

Activities	**Requirement (m3/day)**
Water sprinkling in mining areas (haul road) and dust suppression measure provided at ore fines stockpile, Vehicle washing etc.	625 (Borewell)
Drinking, domestic and Sanitation (Mine and Proposed Operator Colony)	120 (Borewell)
Environmental Requirements	05 (Borewell)
Beneficiation Plant	965 (230 from Borewell +735 from dewatering water)
Total	**1715**

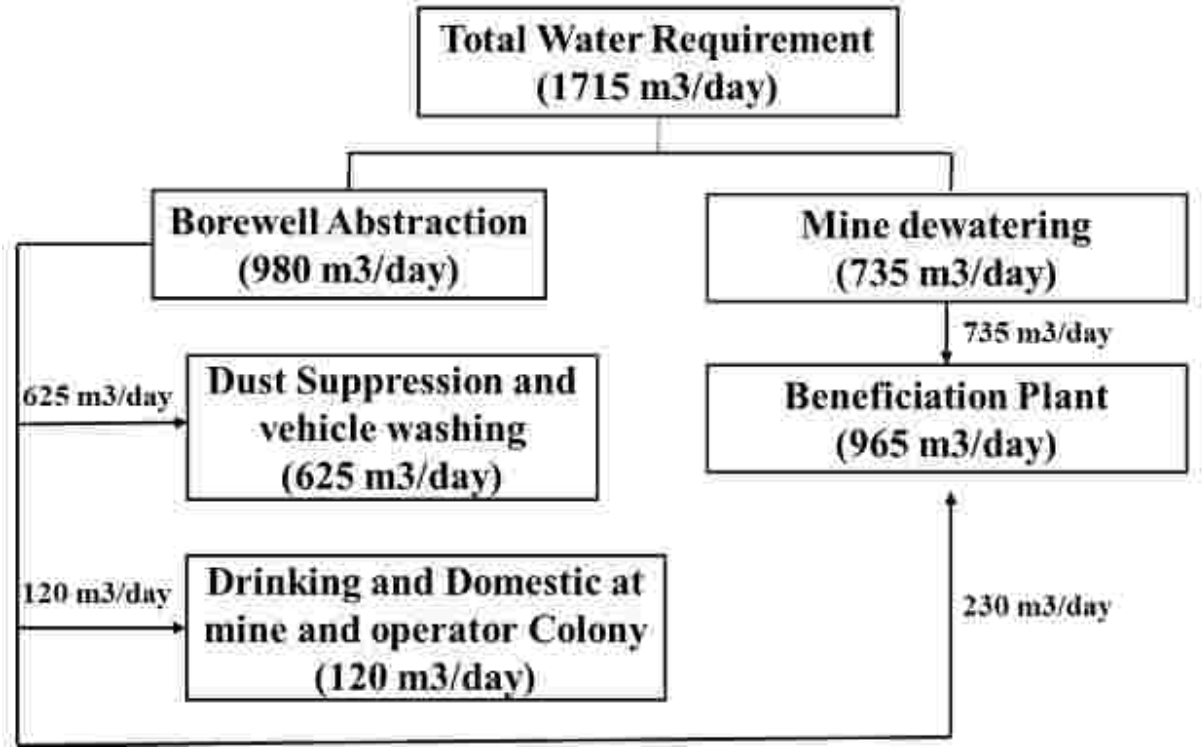


Figure 6.1: Water balance chart.

7 IMPACT OF MINE DEWATERING / ABSTRACTION AND MITIGATION MEASURES

7.3 IMPACT ON THE GROUND WATER REGIME

Ground water resources of buffer zone:

Ground water being a dynamic and replenishable resource is generally estimated based on the component of annual recharge, which could be subjected to development by means of suitable ground water structures. Present area comprises its major part as hills, undulating plains and geological formations comprising hard rock formations of Precambrian period. Though rainfall is the primary source of ground water recharge but due consideration has also been paid to other factors such as seepage from major rivers and other drainage and also from ponds and water bodies. Though there are various methodologies available for computation of Ground Water Resources, but each one has its own ifs & buts. Keeping all the parameters into consideration Government Agencies (State Ground Water Departments of Orissa and Central Ground Water Board (South Eastern Region at Bhubaneswar had computed block-wise ground water resources. Here an effort has been made to compute the ground water resource of present area on pro- rata basis. The ground water resources in the study area are tabulated as below in Table 7.1.

Table 7.1: Ground Water Resources in Joda Block Dist- Keonjhar.

S. No	Block	Area (Ha)	Rechargeable Area of Block falling in Buffer zone (Ha)	Net Annual Ground Water Availability (Ham)	Existing Gross Ground Water Draft for all Uses (Ham)
1	Joda	28908	6020	817.58	530.20
2	Jhumpura	48657	32.3	3.29	1.05
3	Koira	64916	291	32.25	3.59
	Total			853.12	534.84

Stage of Ground Water Development =

(Existing Gross Ground Water Draft / Net Annual Ground Water Availability) X100

= (534.84/853.12) X100) = 62.69 %

So, Stage of Ground Water Development in the area is 63 %

Thus, the stage of G W development is 63 %. As per the criteria for categorization of area made by Central Ground Water Authority for the development point of view, the present study area falls under 'Safe Category'. Ample scope exists for withdrawal of required amount (980 m^3/ day) of ground water. It will not have any appreciable impact on ground water resources in the area.

It is envisaged that no significant impacts will occur due to the groundwater abstraction by this project.

7.4 IMPACT ON SURFACE WATER SOURCES

Karo River flows along the eastern side of the lease area whereas the massive mining operation is carried out in the western side of the lease area. Therefore, there is no chance of flows of sediments towards Karo River to cause sedimentation. The surface run-off water during rain follows the seasonal nala and natural drainage system. However, check dam will be created across the nala course to arrest the wash-offs and to release clean water. Hence, there will not be any impact on surface water bodies due to mining activities.

7.5 IMPACT ON WATER QUALITY

The downward movement of the toxic substances from the stack, dump, and exposed quarry faces during seepage and percolation of groundwater typically affects the groundwater quality adversely in the mining area.

The waste generated from the Narayanposhi iron and manganese ore mine is proposed to be utilized for internal haul road maintenance and balance, if any, will be dumped at the earmarked waste dump location and will be used for backfilling of quarry.

No Effluent will be generated due to mining. Sewage generated from toilet blocks would be collected by means of suitable sewer system for treatment in Sewage Treatment Plant (STP). Biological solid waste generated from STP would be used as manure for development of greenery. There is also no occurrence of toxic materials which can pollute the water & jeopardize human health.

Conforming to the same, the water quality analysis carried out for the water samples collected from the study area, presented in section 3.3.5, reveals that all the water quality parameters concerned are within the desired and/or permissible limits. Stipulated by statutory authorities.

7.6 MITIGATION MEASURES

Water conservation practices such as rainwater harvesting, and artificial recharge should be taken as a part of the project. To maintain the ground water regime unaffected in the area different settling cum percolation ponds have been constructed which work as rainwater harvesting cum groundwater water recharge structures **(Table 7.2**). The images of recharge structures are presented in **Figure 7.1**.

Table 7.2: Settling cum percolation pond details.

Sl. No.	Location	Latitude	Longitude	Area (m2)	Capacity (m^3)
1	Pond 1	21.929597	85.232664	3853	2478.7
2	Pond 2	21.915503	85.229861	1652	5779.5
3	Pond 3	21.937316	85.244672	4526.54	6789.7
	Total				15,047.99

The mine site has three recharge ponds with 5779.5 m^3 capacity for pond 1, 2478.7 m^3 capacity for pond 2 and 6789.7 m3 for pond 3, making it total 15,047.99 m3. Out of which only 60% of the total capacity can be used to estimate recharge volume. The calculations are given below:

Total storage capacity of the pond 1 = 5779.5 m^3

Rainfall during monsoon = 1324 mm.

No of rainy days: 63

Average rainfall per day: 21 mm

It is presumed that after every 30 rainy days pond will be filled with rain water, and further water will remain for another 30 days. Thus, number of fillings will be 3 in a year considering 2 fillings in monsoon and 1 filling in non-monsoon.

Thus, storage capacity of pond 1 will be 5779.5 *3= 17,338.5 m^3

Total storage capacity of the pond 2will be 2478.7 *3 = 7,436.1 m^3

Total storage capacity of the pond 3 will be 6789.7*3 = 20,369 m^3

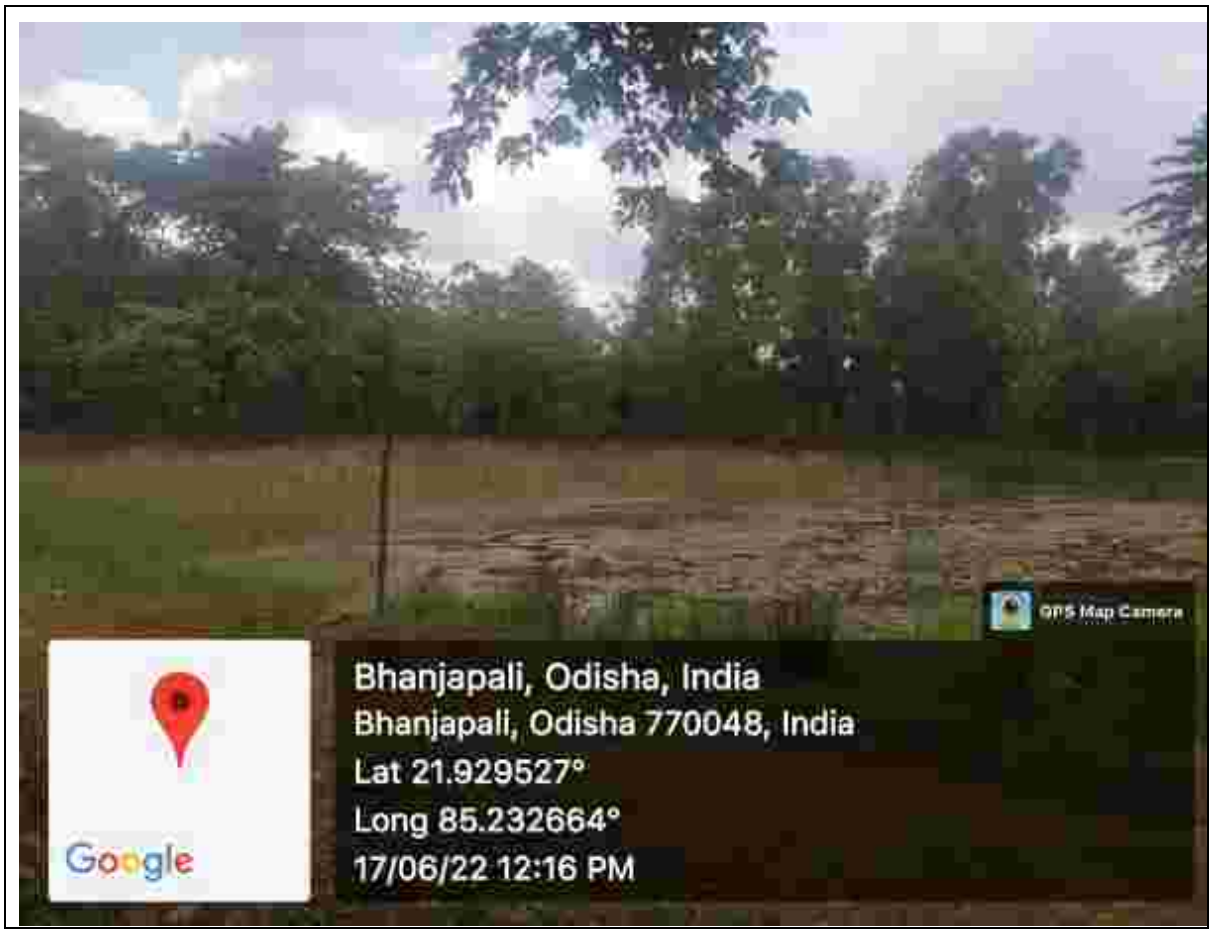
Out of gross storage capacity 45,143.6 m^3 of pond 1, pond 2, and pond 3 the recharge estimated in a year is 60% of Harvested rain water.

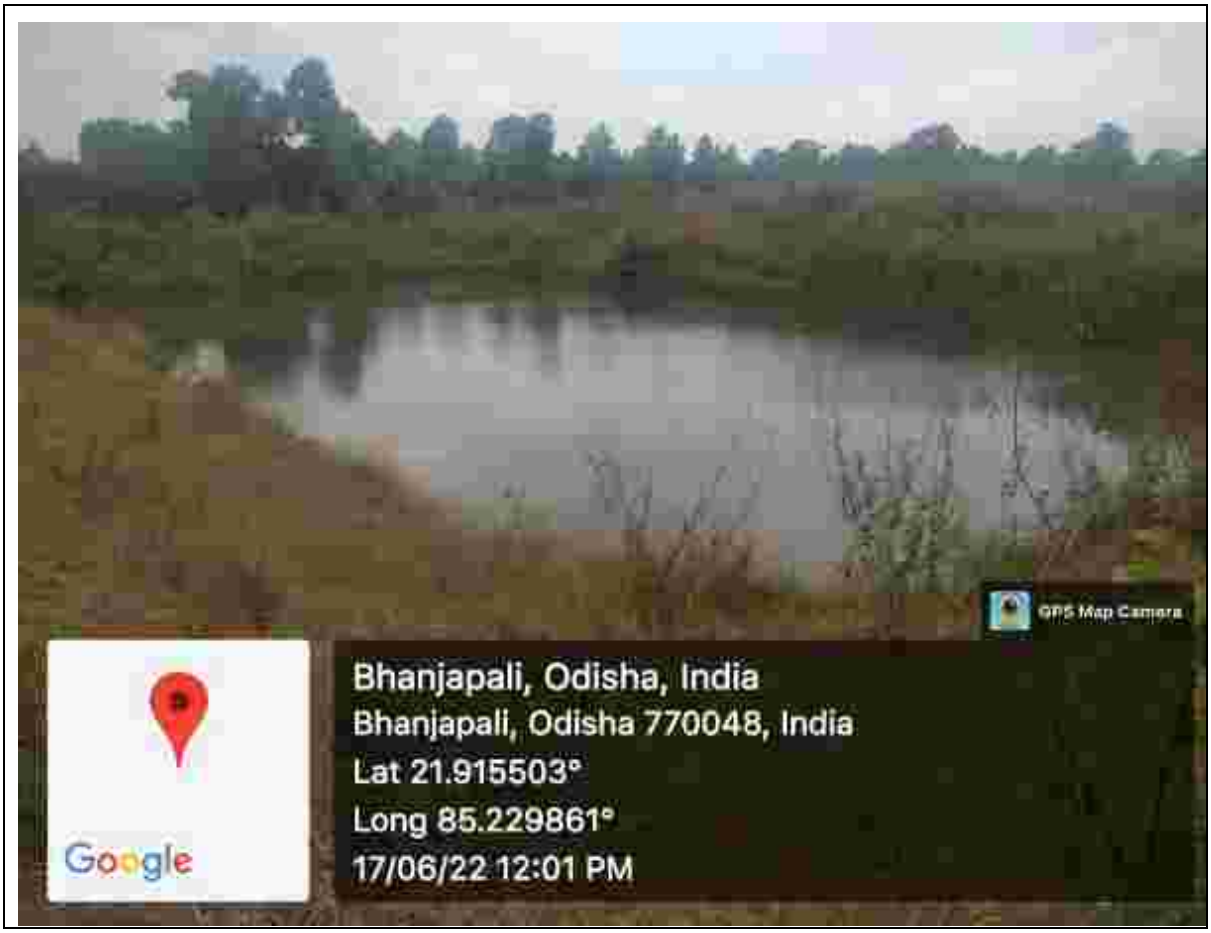
It is presumed that number of fillings will be 3 times in a year thus taking no. of days water available in water conservation strcutures is 120 days

So, total estimated recharge from **three ponds**

= Total Storage capacity x No. of filings x recharge rate *(CGWB, GEC, 2015)*

= 45,143.6 x 3 x 0.60 = **81,258.5 m^3 /year** will be done by water conservation structures. This amount will be




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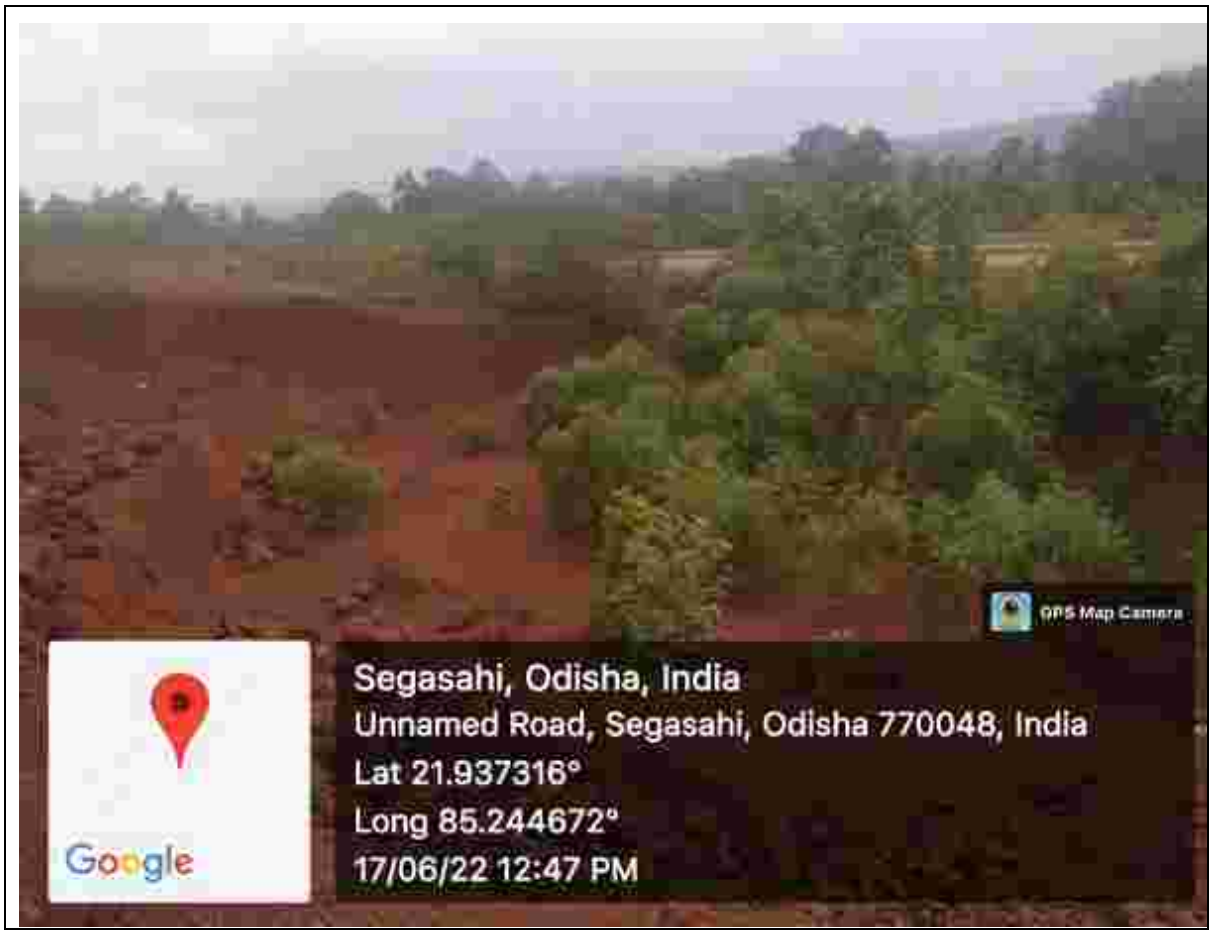


Figure 7.1: Images of recharge ponds.

7.7 SALINE WATER DISPOSAL STRATEGIES

NA

8 OTHER DETAILS PERTAINING TO THE PROJECT

The total groundwater requirement through borewells for the project is 735 m^3/day which can be extracted from seven (7) no. of bore wells as per NOC permission. The mine site has three (3) existing borewells which are in working condition and installed with flowmeters as per NOC (Figure **8.1**). Other than those, four (4) borewells are in proposed condition to fulfil the groundwater requirement. The site has two piezometers in the lease area. Hydrograph of one piezometer which is installed with telemetry system is given in **Figure 8.2** and the images of piezometers are shown in Figure **8.3**. At the time of transfer of the mine lease to JSW steel in June 2020, the proponent could find only 3 borewells in the mine lease area.

The Flow meter readings and piezometer data is given in **Annexure 10**.

Table 8.1: Details of Existing Tubewells/pumps inside the site for domestic and other uses.

S. No.	Type of Structure	Location	Lat	Long	Pump capacity (HP)	Whether fitted with Water Meter	Working condition
1	Tubewell	Canteen Area	21.931027	85.238715	5	Yes	Yes
2	Tubewell	Gate-02	21.936373	85.234982	NA	Yes	Yes
3	Tubewell	Geology lab	21.932305	85.246457	NA	Yes	Yes


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Figure 8.1: Images of flow meters installed.

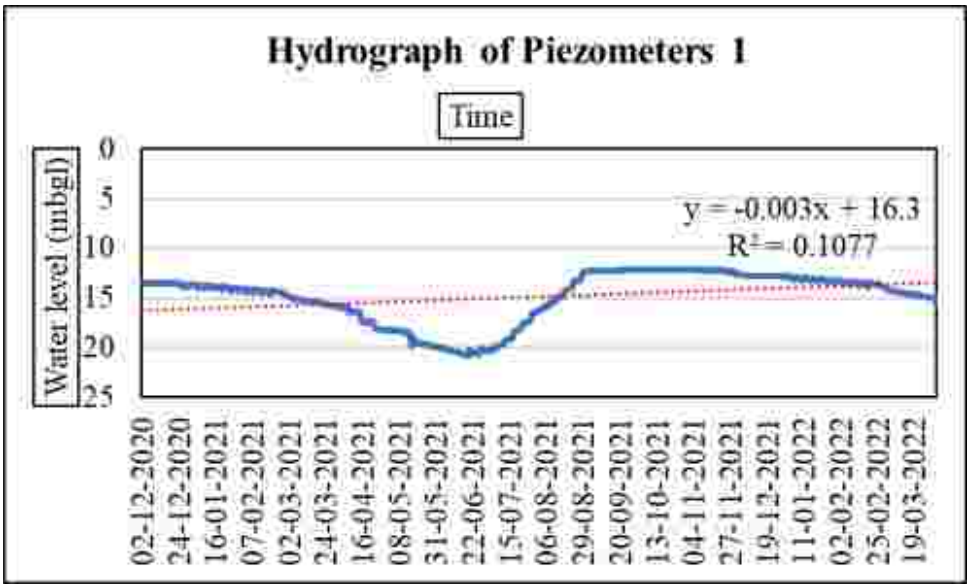


Figure 8.2: Hydrograph of piezometer 1.





Figure 8.3: Images of Piezometers.

9 SUMMARY AND CONCLUSION

Narayanposhi Iron and Manganese Ore Mine of M/s JSW Steel Ltd for production of 10 M TPA (ROM) of Iron ore with total excavation of 10.815 million TPA (ROM 10 MTPA + OB 0.815 MTPA) and 0.036 million TPA of Manganese ore (ROM) with total excavation of 0.3059 million TPA (ROM 0.036 MTPA + OB 0.269 MTPA) along with screening, crushing and 6 MTPA beneficiation plant in lease area of 347.008 ha (As per DGPS) /349.254 ha (As per ROR) in Harischandrapur, Koira, Kashira, Kusumdihi and Kathamala RF villages under Koira tehsil of Sundergarh district, Odisha state. The mining block has an area of 349.254 Ha as per ROR (347.008 Ha as per DGPS computation). The area falls under Survey of India Topo Sheet No. 73 F/4, F/8, G/1 and G/5. The indicative coordinates of the mine site are ; Latitudes 21°54'46.07" N - 21°56'23.13" N and Longitudes: 85°13'41.16" E - 85°14'56.56" E

The Lease area is accessible from Koira (2.0km) on NH-520 from Bhadrasahi (31km) to Rajamunda (58 km) long. The nearest railhead is at Barsuan at 30 Km from the lease area via Tensa. The predominant land use (pre monsoon 2022) is green area with 85.2% followed by agriculture 9.3%, barren land 4.3%, built up 0.62% and water body 0.5%. The area is a semi-rugged terrain with elongated hills trending in NW-SE direction, low mounds, and wide valleys. The highest elevation is 594 m above MSL, and the lowest elevation is 548 m above MSL forms the valley floor in this block. Two prominent seasonal nalas divide the whole lease area into three parts from NE to SW which flow due north. River Karo flowing due north close to the western boundary outside the lease area constitutes the principal drainage system of the locality and collects surface run-off water through the seasonal nalas. The entire area is dominated by underlying consolidated formations of Precambrian meta- sedimentary of Iron Ore Super Group of rocks. It consists of several rock formations such as quartzites, volcanics, shales, phyllites, mica-schists and Iron Ore formations such as Banded Haematite.

Quartzite (BHQ) and Banded Haematite Jasper (BHJ) etc. Since the whole area is covered by the hard rock formations of diverse lithological composition and structure, the water bearing properties of the formations also vary. The aquifer system of the region is encompassed with primary and secondary porosity and groundwater occurs under shallow and deeper aquifers. The study area is encompassed with deep semi-confined to confined aquifers with a discharge rate of 11.76 to 21.56 (m3/min/m) and transmissivity of 3.4 to 8.6 m2/day. The water level of the buffer area ranges from 1.65 to 7.2 m bgl. The groundwater flow direction is from south towards north in the buffer zone. To analyse the water level fluctuation in the area, CGWA wells are

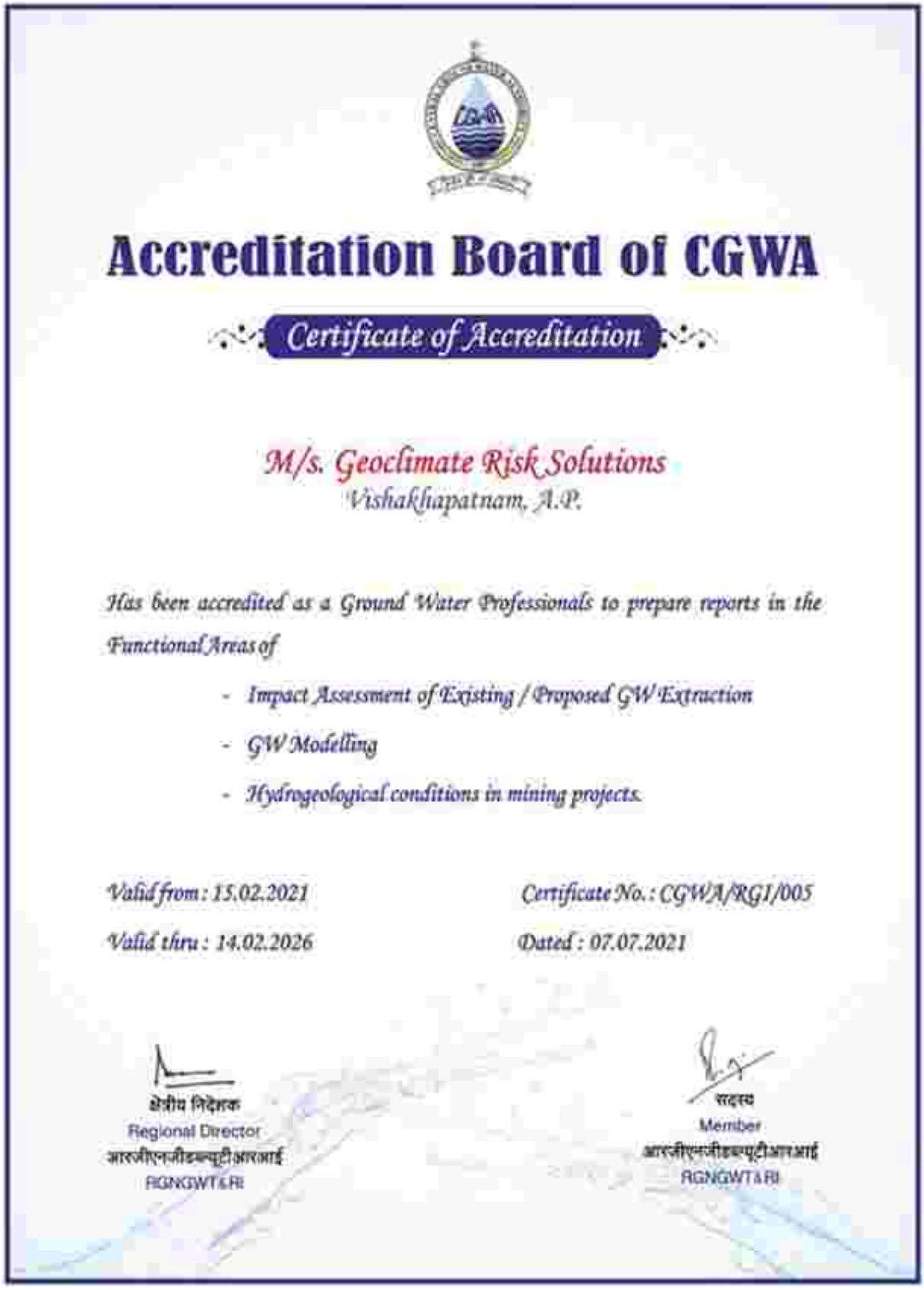
taken into consideration and hydrographs are analysed for 6 monitoring station from 2014 to 2019. In general, the hydrograph indicates cyclic and sinusoidal changes representing the recharge and discharge of ground water which represents seasonal fluctuations in the water level of the region.

The project site has two (3) recharge ponds which collects total **45,143.6 m^3/year** of water which will be used for mine use, plantation etc. and the rest will be drained through the Karo river after proper treatment.

The total ground water abstraction from borewells is 980 m3/day and mine seepage are 735 m3/day and 692 and 735 for the period 2022-24 and 2024-26, respectively Similarly, rainwater quantum will be about 367 m3/day. The groundwater abstraction from this project is about 2039 KLD/ 744235 KLY for the NOC period 2022 to 2024 and 2082 KLD/759930 KLY for NOC period 2024 to 2026. The total make-up water requirement for the proposed mining, central processing unit, grinding, desliming and beneficiation plant is about 965 m^3 /day out of which 230 m^3/day will be met through borewells and 735 will be met from dewatering water.

As per the criteria for categorization of area made by Central Ground Water Authority for the development point of view (GWRA, 2022) the present study area falls under ‘safe’ category. So, it is envisaged that there will be no significant impacts on ground water resources in the area by the abstraction of 2082 m^3/day of groundwater by this project.

10 ACCREDITATION CERTIFICATE



Accreditation Board of CGWA

Certificate of Accreditation

M/s. Geoclimate Risk Solutions
Vishakhapatnam, A.P.

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/005*

Valid thru : 14.02.2026 *Dated : 07.07.2021*

क्षेत्रीय निदेशक
Regional Director
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT&RI

सदस्य
Member
आरजीएनजीडब्ल्यूटीआरआई
RGNGWT&RI

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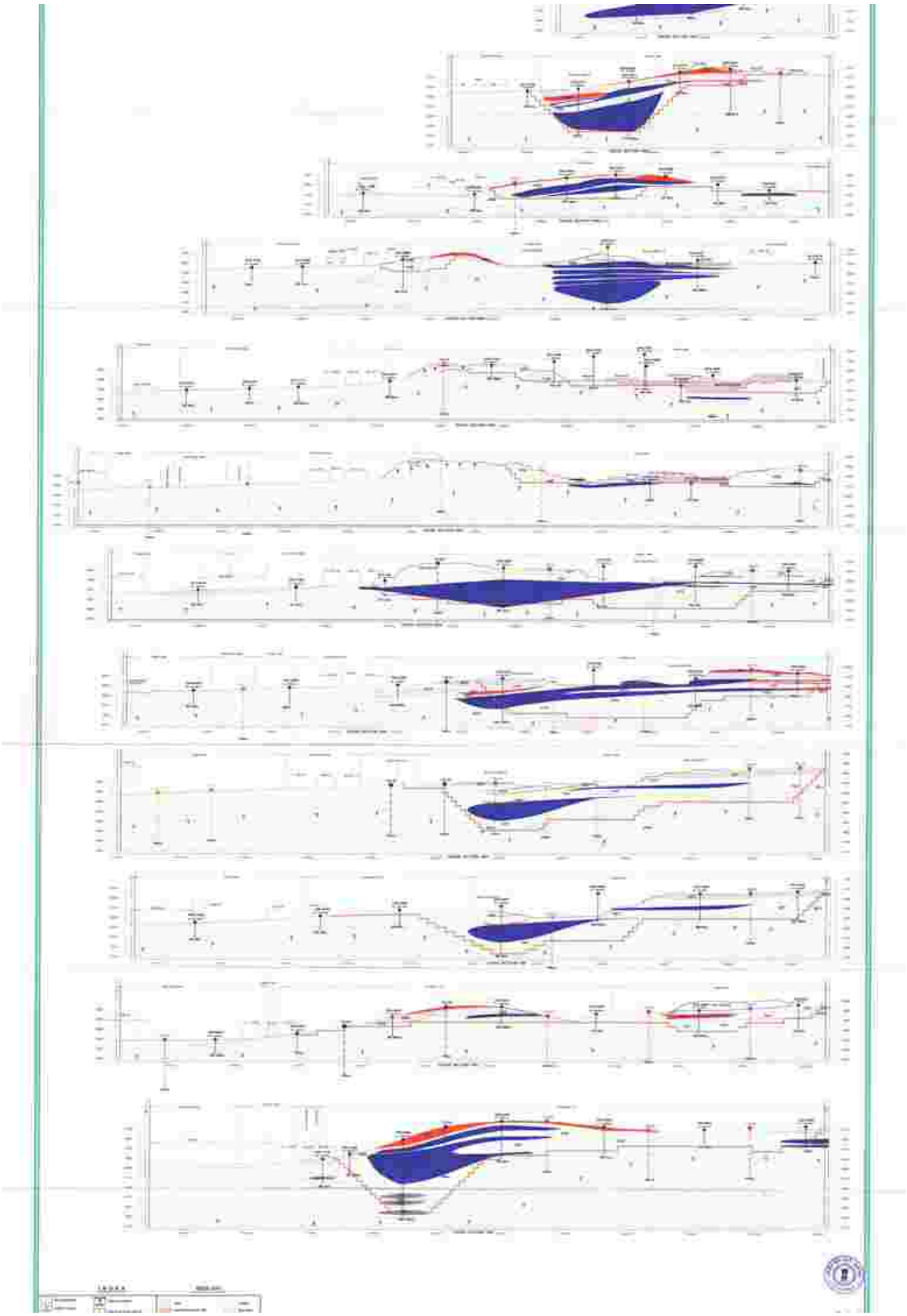
Annexure 1: Surface plan.



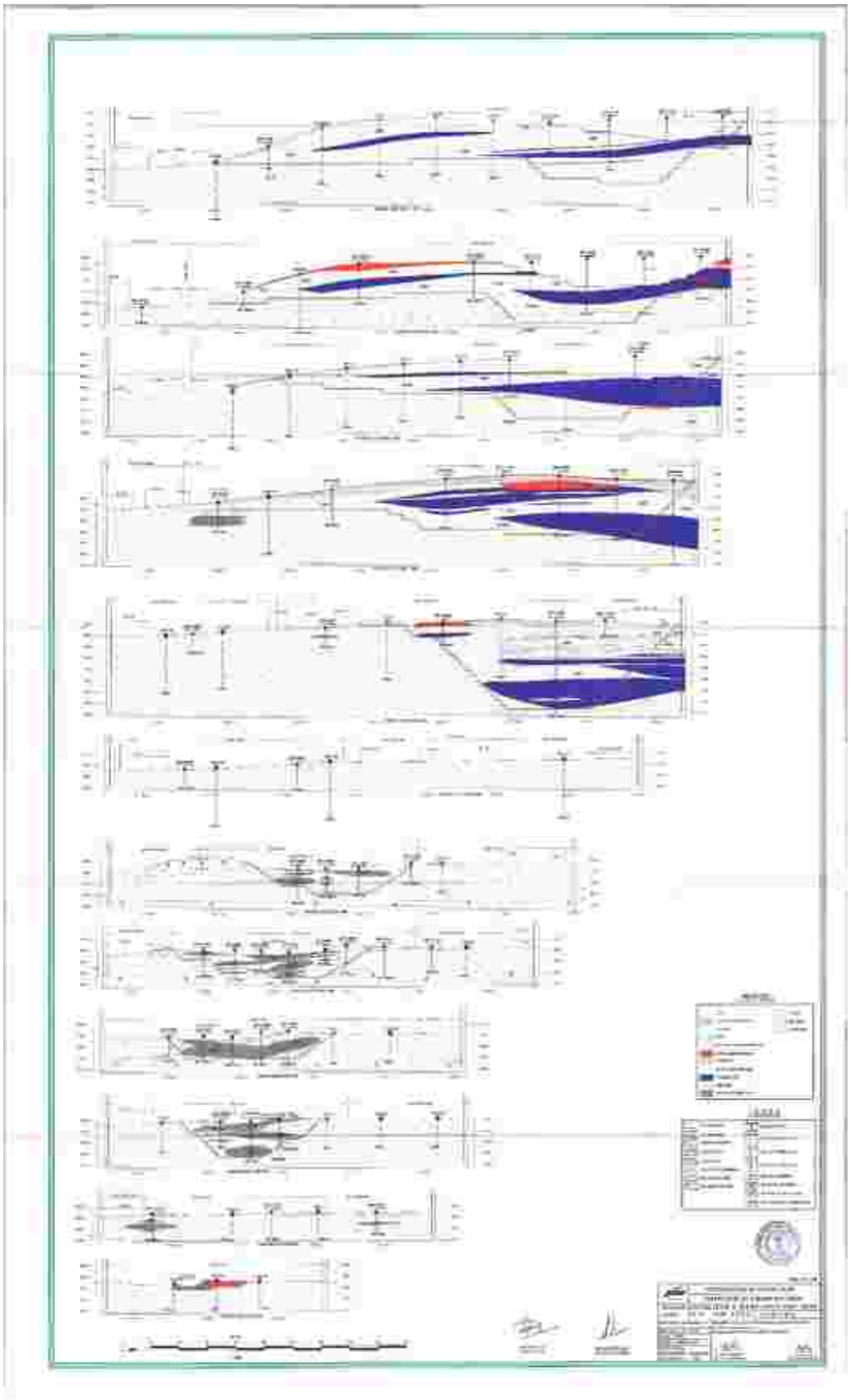
Annexure 2: Geological plan.



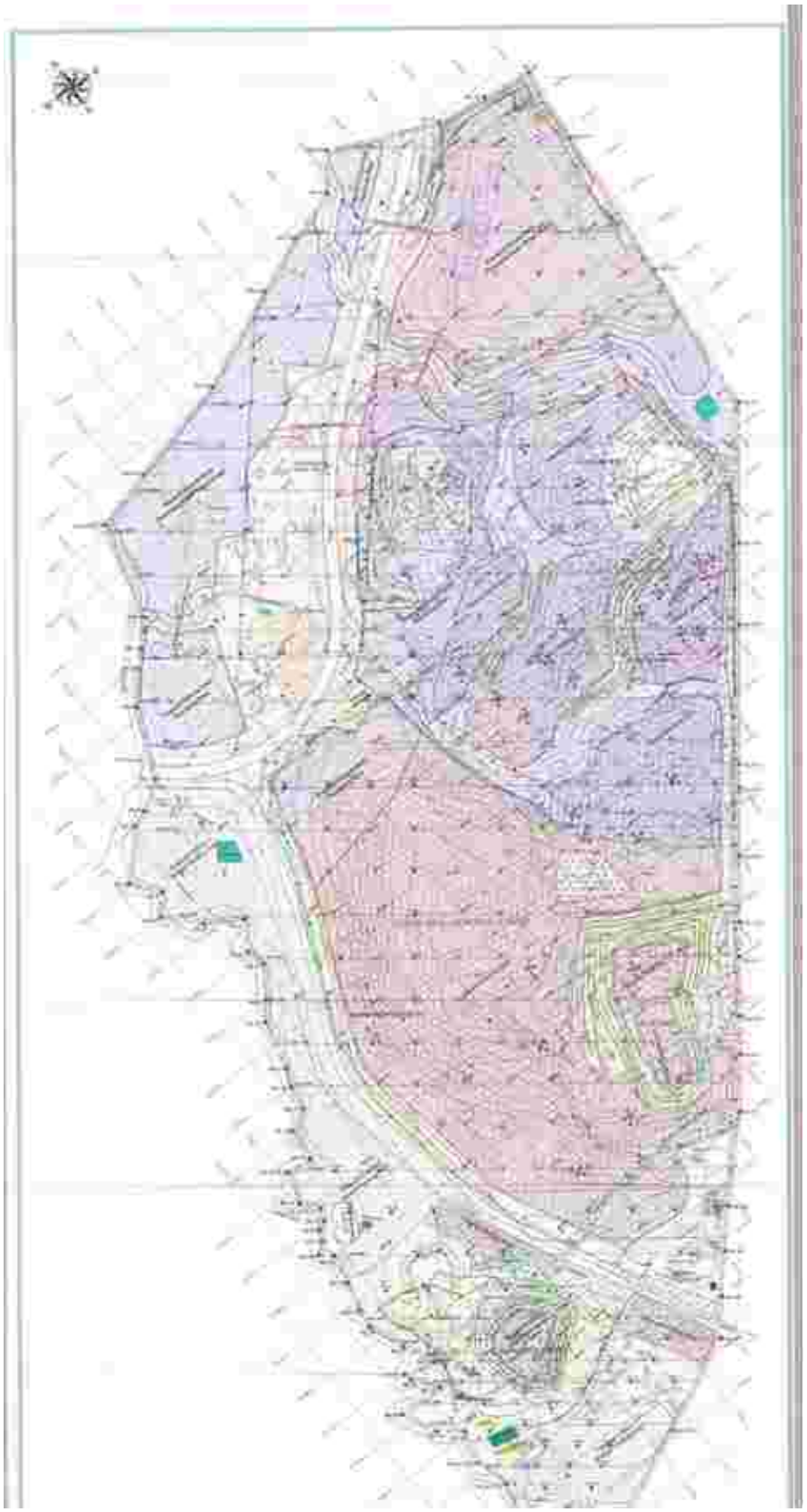
Annexure 3A: Geological Sections.



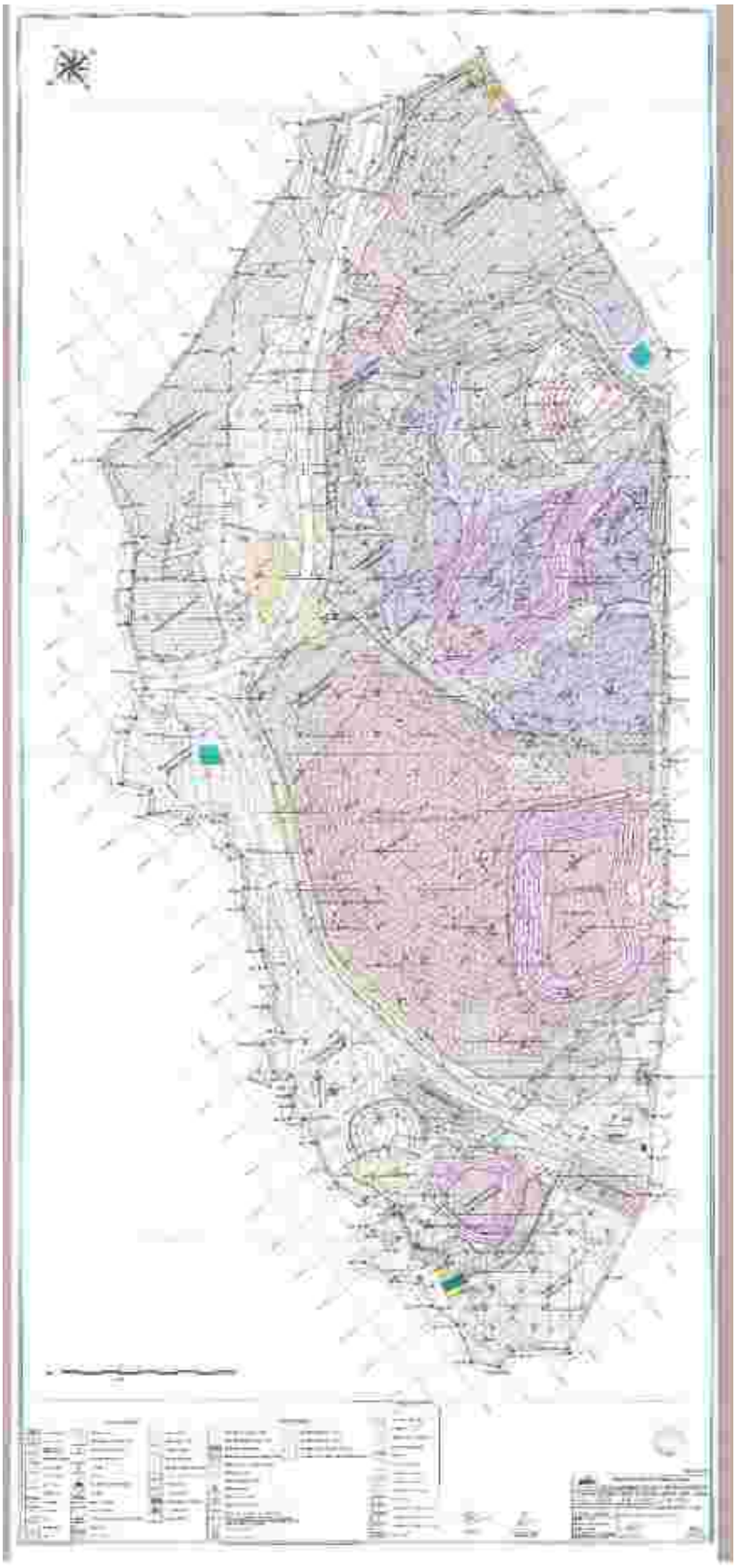
Annexure 3B: Geological sections.



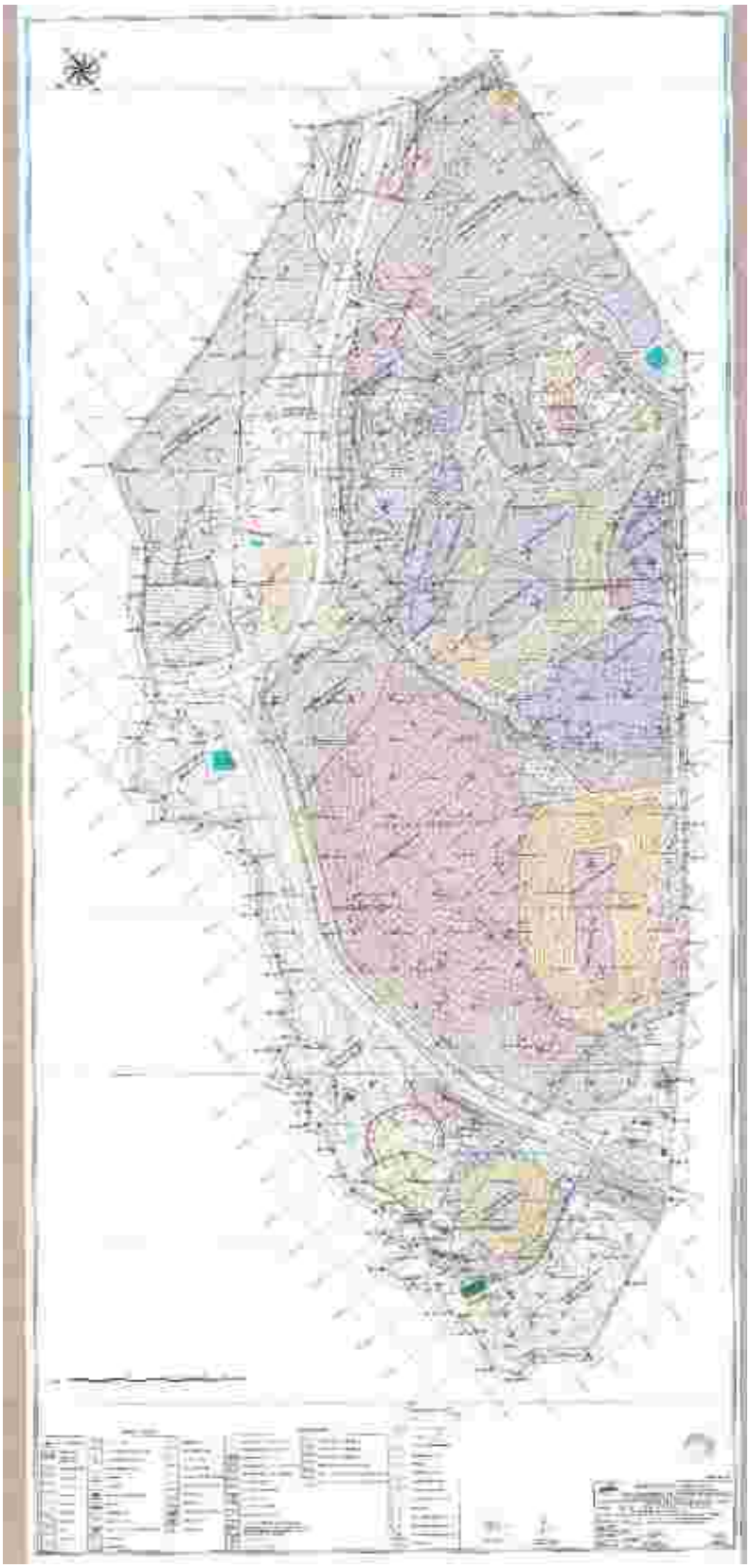
Annexure 4: Development plan (2021-2022).



Annexure 5: Development plan (2022-2023).



Annexure 6: Development plan (2023-2024).



Annexure 7: Development plan (2024-2025).



Annexure 8: Conceptual plan.



Annexure 9: Water quality test results

Second Floor Hall, House No. B-138, Sector H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4070031/2740262
E-mail : ecomen@ecomen.in, Website : www.ecomen.in, CIN - U74210UP2008PTC035811, GSTIN : 09AAACE6078R1ZL
An approved Laboratory from Ministry of Environment, Forest and Climate Change, Govt. of India, New Delhi

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/DW/000/0140/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Jamdihi** Longitude: 85.1172222 Latitude: 21.999722
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	-
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:20 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-72 % RH	**Sample ID Code**	ECO/LAB/0140/06/2022

Sl. No.	Unit	Unit	Protocol	Result	Detection Range	IMRAN STANDARDS as per IS 10500:2012 (Reaff.2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130-A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	6.79	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	168.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	56.0	5-1500	200	600
8.	Total Hardness as CaCO3	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	65.60	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	16.0	5 - 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	6.20	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	10.0	1.0 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed. 2017, 4500-NO_3^- B	7.40	5.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	17.00	5-1000	250.0	1000.0
14.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.23	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.14	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.05	0.02-50	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax.
25.	Aluminium as Al	mg/l	APHA, 23rd Ed. : 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. : 2017, 3112 A+B	BDL	0.001-5	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. : 2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
30.	Cyanide as CN	mg/l	APHA, 23rd Ed. 2017, 4500 CN A+D	BDL	0.005-5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Class -b	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. : 2017, 9221 A+E	Absent	1.8	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By
Technical Manager

Authorized By
Quality Manager

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-138
Sector-H, Aliganj, Lucknow

---End of Report---

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ECOMEN LABORATORIES PVT. LTD.

TEST REPORT

NAME & ADDRESS OF CUSTOMER		Test Report No.	
		Issue Date of Test Report	
Type of Sample			
Sample Registration No.		Name of Location	
Sampling Method		Sample Collected By	
Date of Sample Collection		Time of Sample Collection	
Date of Sample Received		Time of Sample Received	
Start Date of Analysis		End Date of Analysis	
Laboratory Environmental Condition		Sample Quantity	
		Sample ID Code	

Sl. No.	Test Parameter	Unit	Test Method	Result	Acceptable Limits	Permissible Limits
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5 Hazen	15 Hazen
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Agreeable	Agreeable
3.	Turbidity	NTU	APHA, 23rd Ed. 2017, 2130 A/B	BDL	1	5
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A/B	6.85	6.5 - 8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540C	BDL	1 - 5000	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540C	240.0	5 - 2000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A + B	64.0	5 - 600	200	600
8.	Total Hardness as CaCO3	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	20.0	5 - 600	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A/B	16.00	5 - 200	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A/B	0.69	5 - 100	30.0	100.0
11.	Sulfate as SO4	mg/l	APHA, 23rd Ed. 2017, 4500 SO4 E	14.6	5 - 200	100.0	400.0
12.	Nitrate Nitrogen as NO3	mg/l	APHA, 23rd Ed. 2017, 4500 NO3- B	4.25	5.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl- A/B	14.00	5 - 600	250.0	1000.0
14.	Fluoride as F	mg/l	APHA, 23rd Ed. 2017, 4500 F-	0.22	0.05 - 1.0	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A/B	BDL	0.05	0.45	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.14	0.02 - 0.30	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A/B	BDL	0.1	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A/B	0.07	0.05 - 5.0	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111 A/B	BDL	0.05 - 50	0.05	No Relax.
21.	Phenolic Compounds as C6H5OH	mg/l	APHA, 23rd Ed. 2017, 5530 B & C	BDL	0.001	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500Cl B	BDL	0.1 - 0.5	0.25	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, 2160	Agreeable	Agreeable	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. - 2017, 3500 Se A/C	BDL	0.01 - 10	0.01	No Relax.
25.	Aluminium as Al	mg/l	APHA, 23rd Ed. - 2017, 3500 Al A/B	BDL	0.1 - 100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. - 2017, 3112 A/B	BDL	0.001 - 1	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. - 2017, 3111 A/B	BDL	0.01 - 5	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. - 2017, 3111 A/B	BDL	0.002 - 5	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. - 2017, 4500B A+C	0.29	0.5 - 10	0.5	1.0
30.	Cyanide as CN-	mg/l	APHA 23rd Ed 2017, 4500 CN- A/D	BDL	0.005 - 5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Clause 8	BDL	0.5 - 10	0.5	No Relax.
32.	Anionic Detergent as MBAS	mg/l	APHA, 23rd Ed. 2017, 5540 C	BDL	0.01 - 5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A/D	BDL	0.0001 - 1	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. - 2017, 9221 A/E	Absent	1.0	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS 10500:2012 (Reaff. 2018) limits for above tested parameters and the results are relevant to the sample tested.

Note: • BDL- Below Detection Limit

Verified By
Technical Manager

Authorized By
Quality Manager

—End of Report—

Ecomen Laboratories Pvt. Ltd.
Second Floor, House No. B-38, Sector-H, Aliganj, Lucknow-226024

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An approved Laboratory from Ministry of Environment, Forest and Climate Change, Govt. of India, New Delhi

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECO/LAB/DW/0004/0142/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Kasira** Longitude: 85.2139 Latitude: 21.93076
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	-
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:15 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-72 % RH	**Sample ID Code**	ECO/LAB/0142/06/2022

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	DRINKING STANDARDS as per IS 10500:2012 (Reaff. 2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130-A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	7.10	2.0-12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	198.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	70.0	5-1500	200	600
8.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	86.00	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	22.8	5 - 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	7.40	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	14.0	1.0 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed. 2017, 4500-NO_3^- E	6.80	2.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	18.20	5-1000	250.0	1000.0
14.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.27	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.44	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.05	0.02-50	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax
25.	Aluminum as Al	mg/l	APHA, 23rd Ed. : 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. : 2017, 3112 A+B	BDL	0.001-1	0.001	No Relax
27.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.01	No Relax
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.005-2	0.003	No Relax
29.	Boron as B	mg/l	APHA, 23rd Ed. : 2017, 4500 B A+C	0.22	0.2-10	0.5	1.0
30.	Cyanide as CN	mg/l	APHA, 23rd Ed 2017, 4500 CN A+D	BDL	0.005-5	0.03	No Relax
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Clause 4	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. : 2017, 9221 A+E	Absent	1.0	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS:10500:2012 (Reaff. 2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By
Technical Manager

Authorized By
Quality Manager

—End of Report—

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-118,
Sector-H, Aliganj, Lucknow-226024

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ECOMEN LABORATORIES PVT. LTD.

Second Floor Hall, House No. B-19B, Sector-H, Aliganj, Lucknow - 226024

Phone No. : 0522 - 4079001/2748282

E-mail : ecomenlabs@ecomen.in, Website : www.ecomen.in, CIN : U74120UP2018PTC103401, GSTIN : 09AAICE6078H1ZP

An environment Laboratory from Ministry of Environment, Forest and Climate Change, Govt. of India, New Delhi

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/DW/0004/0143/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Rengalbeda** Longitude: 85.25048 Latitude: 21.94364
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	--
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:10 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-72 % RH	**Sample ID Code**	ECO/LAB/0143/06/2022

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012 (Reaff.2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-300	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130-A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	6.91	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	220.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	76.0	5-1500	200	600
8.	Total Hardness as CaCO3	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	80.42	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	19.80	5 - 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	7.60	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	18.0	10 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed. 2017, 4500-NO_3^- B	8.20	5.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	17.26	5-1000	250.0	1000.0
14.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.20	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.03-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.14	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.06	0.02-50	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax.
25.	Aluminium as Al	mg/l	APHA, 23rd Ed. : 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. : 2017, 3112 A+B	BDL	0.001-1	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. : 2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
30.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 CN A+B	BDL	0.005-5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Class -b	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E-Coli	cfu/100 ml	APHA, 23rd Ed. : 2017, 9221 A+E	Absent	1.0	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By

Technical Manager

Authorized By

Quality Manager

---End of Report---

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-19B,
Sector-H, Aliganj, Lucknow-226024

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TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/DW/0004/0144/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Kulhapunjuli** Longitude: 85.29963 Latitude: 21.99453
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	-
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:05 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C Humidity: 30-72 % RH	**Sample Quantity**	As per Requirement
		Sample ID Code	ECO/LAB/0144/06/2022

Sl. No.	TESTS	Unit	PROTOCOL	RESULTS	Detection Range	IS:10500:2012 (Reaff:2018) Desirable	IS:10500:2012 (Reaff:2018) Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130 A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	7.38	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540 C	BDL	5 - 9000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540 C	266.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	84.0	5-1500	200	600
8.	Total Hardness as CaCO3	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	110.0	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	26.42	5 – 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	10.48	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	22.00	1.0 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed. 2017, 4500-NO_3^- B	6.80	5.0 – 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl- A+B	19.00	5-1000	250.0	1000.0
14.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.22	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.15	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.06	0.02-50	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. – 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax.
25.	Aluminum as Al	mg/l	APHA, 23rd Ed. – 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. – 2017, 3112 A+B	BDL	0.001-1	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. – 2017, 3111 A+B	BDL	0.01-1	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. – 2017, 3111 A+B	BDL	0.002-2	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. – 2017, 4500 B A+C	0.24	0.2-10	0.5	1.0
30.	Cyanide as CN	mg/l	APHA 23rd Ed 2017, 4500 -CN- A+D	BDL	0.005-5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Class -6	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. – 2017, 9221 A+E	Absent	1.8	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff -2018) limits for above tested parameters and the results are related to the sample tested.

Note: * BDL - Below Detection Limit

Verified By

Technical Manager

—End of Report—

Authorized By

Quality Manager

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-108,
Sector-H, Aliganj, Lucknow-226024

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ECOMEN LABORATORIES PVT. LTD.

Second Floor Hall, House No. B-118, Sector-H, Aliganj, Lucknow - 226 024

Phone No.: 0522 - 4059011/2749282

E-mail: ecomen@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1999PTC051001, GSTIN : 09AACEE0278H1ZI

An approved Laboratory from Ministry of Environment, Forest and Climate Change, Govt. of India, New Delhi

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/DW/0004/0145/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Raikela** Longitude: 85.16331 Latitude: 21.87523
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	-
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:00 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-72 % RH	**Sample ID Code**	ECO/LAB/0145/06/2022

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	IS 10500:2012 (Reaff. 2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130 A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	7.33	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	148.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	56.0	5-1500	200	600
8.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	74.0	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	16.8	5 - 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	7.80	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	16.0	1.0 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed. 2017, 4500-NO_3^- B	6.08	5.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	14.80	5-1000	250.0	1000.0
14.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.24	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.15	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.07	0.02-50	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.26	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax.
25.	Aluminum as Al	mg/l	APHA, 23rd Ed. : 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. : 2017, 3112 A+B	BDL	0.001-1	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.005-2	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. : 2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
30.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 CN^- A+D	BDL	0.005-5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Clause 6	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. : 2017, 9221 A+E	Absent	1.0	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS- 10500:2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By

Technical Manager

Authorized By

Quality Manager

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-118

---End of Report---

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ECOMEN LABORATORIES PVT. LTD.

Second Floor Hall, House No. B-158, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4070913/2745852
E-mail : contactus@ecomen.in, Website : www.ecomen.in CIN : U74210UP1999PTC023991, GSTIN: 09AAACE8078H1ZP
An approved Laboratory from Ministry of Environment, Forest and Climate Change, Govt. of India, New Delhi

TEST REPORT

FORMAT NO: ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/DW/0006/0146/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Basuda** Longitude: 85.31084 Latitude: 21.87426
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	-
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:10 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-72 % RH	**Sample ID Code**	ECO/LAB/0146/06/2022

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012(Reaff.2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130-A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	6.85	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	284.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	74.90	5-1500	200	600
8.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	96.0	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	23.80	5 – 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	8.60	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	17.20	10 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed. 2017, 4500-NO_3^- B	6.40	5.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	16.0	5-1000	250.0	1000.0
14.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.22	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.13	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.06	0.02-50	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax.
25.	Aluminium as Al	mg/l	APHA, 23rd Ed. : 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. : 2017, 3112 A+B	BDL	0.001-1	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. : 2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
30.	Cyanide as CN	mg/l	APHA 23rd Ed.2017, 4500 -CN A+D	BDL	0.005-5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Class -6	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MAHS	mg/l	APHA. 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. : 2017, 9221 A+E	Absent	1.0	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff. 2018) limits for above tested parameters and the results are related to the sample tested.

Note: = BDL- Below Detection Limit

Verified By

Technical Manager

Authorized By

Quality Manager

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-158
Sector-H, Aliganj, Lucknow-226024

---End of Report---

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ECOMEN LABORATORIES PVT. LTD.

An approved Laboratory from Ministry of Environment, Forest and Climate Change, Govt. of India, New Delhi

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/DW/0004/0147/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Katenahi** Longitude: 85.33102 Latitude: 21.95142
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	-
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:15 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-72 % RH	**Sample ID Code**	ECO/LAB/0147/06/2022

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012(Reaff:2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130-A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	6.76	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2340-C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2340-C	160.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	54.0	5-1500	200	600
8.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	64.0	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	15.8	5 – 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	5.8	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	14.0	1.0 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed. 2017, 4500-NO_3^- B	5.90	5.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl- A+B	13.60	5-1000	250.0	1000.0
14.	Fluoride as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.23	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.14	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.015
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.06	0.02-20	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax.
25.	Aluminium as Al	mg/l	APHA, 23rd Ed. : 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. : 2017, 3112 A+B	BDL	0.001-1	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. : 2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
30.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 CN A+D	BDL	0.005-5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Class -A	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. : 2017, 9221 A+E	Absent	1.0	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff. 2018) limits for above tested parameters and the results are related to the sample tested.

Note: * BDL- Below Detection Limit

Verified By

Technical Manager

Authorised By

Quality Manager

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-148

---End of Report---

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An approved Laboratory from Ministry of Environment, Forest and Climate Change, Govt. of India, New Delhi

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/DW/0004/0148/06/2022**
		Issue Date of Test Report	**10.06.2022**
Type of Sample	Ground Water		
Sample Registration No.	004	**Name of Location**	**Kalta** Longitude : 85.19957 Latitude : 21.97097
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Team
Date of Sample Collection	04.06.2022	**Time of Sample Collection**	-
Date of Sample Received	04.06.2022	**Time of Sample Received**	5:20 PM
Start Date of Analysis	05.06.2022	**End Date of Analysis**	08.06.2022
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-72 % RH	**Sample ID Code**	ECO/LAB/0148/06/2022

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012 (Reaff.2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed. 2017, 2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as	NTU	APHA, 23rd Ed. 2017, 2130 A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	6.80	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540 C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540 C	218.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed. 2017, 2320 A+ B	48.0	5-1500	200	600
8.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed. 2017, 2340 A+C	82.0	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed. 2017, 3500 Ca A+B	18.2	5 - 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed. 2017, 3500 Mg A+B	5.6	5-1000	30.0	100.0
11.	Sulfate as SO_4	mg/l	APHA, 23rd Ed. 2017, 4500-SO_4^{2-} E	14.20	1.0 -250	200.0	400.0
12.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed.2017, 4500-NO_3^- B	6.20	5.0 - 100	45.0	No Relax.
13.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	13.40	5-1000	250.0	1000.0
14.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.26	0.05-10	1.0	1.5
15.	Copper as Cu	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.05-5	0.05	1.5
16.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.14	0.02-50	0.3	No Relax.
17.	Manganese as Mn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	BDL	0.1-5	0.10	0.30
18.	Arsenic as As	mg/l	APHA, 23rd Ed. 2017, 3114 C	BDL	0.01-2	0.01	0.05
19.	Zinc as Zn	mg/l	APHA, 23rd Ed. 2017, 3111 A+B	0.04	0.02-50	5.0	15
20.	Total Chromium as Cr	mg/l	APHA, 23rd Ed. 2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
21.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed. 2017, 5530 A+C	BDL	1-10	0.001	0.002
22.	Free Residual Chlorine	mg/l	APHA, 23rd Ed. 2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
23.	Taste	-	APHA, 23rd Ed. 2017, A+B	Agreeable	Qualitative	Agreeable	Agreeable
24.	Selenium as Se	mg/l	APHA, 23rd Ed. - 2017, 3500 Se A+C	BDL	0.02-10	0.01	No Relax.
25.	Aluminium as Al	mg/l	APHA, 23rd Ed. - 2017, 3500 Al A+B	BDL	0.2-100	0.03	0.2
26.	Mercury as Hg	mg/l	APHA, 23rd Ed. - 2017, 3112 A+B	BDL	0.001-1	0.001	No Relax.
27.	Lead as Pb	mg/l	APHA, 23rd Ed. - 2017, 3111 A+B	BDL	0.01-2	0.01	No Relax.
28.	Cadmium as Cd	mg/l	APHA, 23rd Ed. - 2017, 3111 A+B	BDL	0.002-2	0.003	No Relax.
29.	Boron as B	mg/l	APHA, 23rd Ed. - 2017, 4500 B A+C	0.21	0.2-20	0.5	1.0
30.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 ,CN A+D	BDL	0.002-5	0.05	No Relax.
31.	Mineral Oil	mg/l	IS 3025 (Part 39) Clause 6	BDL	0.01-10	0.5	No Relax.
32.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	0.2	1.0
33.	Polynuclear aromatic hydrocarbon as PAH	mg/l	APHA, 23rd Ed. 2017, 6440 A+B	BDL	0.0001-2	0.0001	No Relax.
34.	E. Coli	cfu/100 ml	APHA, 23rd Ed. - 2017, 9221 A+E	Absent	1.8	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By

Technical Manager

—End of Report—

Authorized By

Quality Manager

Ecomen Laboratories Pvt. Ltd.
Second Floor Hall, House No. B-118,
Sector-H, Aliganj, Lucknow-226024

Annexure 10

Readings of Flow meters

Date	Flow meter 1(m^3)	Flow meter 2 (m^3)	Flow meter 3 (m^3)
01/10/2021	56.65	48.82	65.30
02/10/2021	54.78	26.25	49.47
03/10/2021	45.54	53.73	15.24
04/10/2021	46.76	60.72	43.56
05/10/2021	36.65	45.10	54.67
06/10/2021	32.43	68.76	43.87
07/10/2021	65.56	58.67	32.65
08/10/2021	43.56	40.75	76.54
09/10/2021	54.67	52.49	65.43
10/10/2021	43.87	38.92	43.78
11/10/2021	32.65	32.65	54.34
12/10/2021	76.54	76.54	65.43
13/10/2021	65.43	65.43	43.76
14/10/2021	43.78	43.78	87.65
15/10/2021	54.34	54.34	34.87
16/10/2021	65.43	65.43	45.65
17/10/2021	43.76	43.76	54.65
18/10/2021	87.65	87.65	43.76
19/10/2021	34.87	34.87	76.45
20/10/2021	91.30	45.65	34.78
21/10/2021	32.43	54.65	54.56
22/10/2021	65.56	43.76	43.78
23/10/2021	43.56	76.45	56.65
24/10/2021	54.67	34.78	54.78
25/10/2021	43.87	54.56	45.54
26/10/2021	32.65	43.78	46.76
27/10/2021	76.54	56.65	36.65
28/10/2021	65.43	54.78	65.45

29/10/2021	43.78	45.54	54.78
30/10/2021	54.34	46.76	54.67
31/10/2021	65.43	36.65	54.65
01/11/2021	43.76	65.45	45.78
02/11/2021	87.65	54.78	45.76
03/11/2021	34.87	54.67	45.87
04/11/2021	45.65	54.65	43.56
05/11/2021	54.65	45.78	54.67
06/11/2021	43.76	45.76	43.87
07/11/2021	76.45	45.87	32.65
08/11/2021	34.78	43.56	76.54
09/11/2021	54.56	54.67	65.43
10/11/2021	43.78	43.87	43.78
11/11/2021	56.65	32.65	54.34
12/11/2021	54.78	76.54	65.43
13/11/2021	45.54	65.43	43.76
14/11/2021	46.76	43.78	87.65
15/11/2021	36.65	54.34	34.87
16/11/2021	32.43	65.43	45.65
17/11/2021	65.56	43.76	34.87
18/11/2021	43.56	87.65	54.65
19/11/2021	54.67	48.08	78.65
20/11/2021	43.87	44.54	54.78
21/11/2021	32.65	69.42	56.54
22/11/2021	76.54	52.09	45.67
23/11/2021	65.43	36.62	65.54
24/11/2021	43.78	17.91	34.87
25/11/2021	54.34	48.82	56.56
26/11/2021	65.43	26.25	45.43
27/11/2021	43.76	53.73	76.45
28/11/2021	87.65	60.72	54.78
29/11/2021	34.87	45.10	45.87
30/11/2021	91.30	68.76	65.43

01/12/2021	32.43	58.67	43.76
02/12/2021	65.56	40.75	87.65
03/12/2021	43.56	52.49	34.87
04/12/2021	54.67	38.92	45.65
05/12/2021	43.87	32.65	54.65
06/12/2021	32.65	76.54	43.76
07/12/2021	76.54	65.43	76.45
08/12/2021	65.43	43.78	34.87
09/12/2021	43.78	54.34	45.65
10/12/2021	54.34	65.43	54.65
11/12/2021	65.43	43.76	43.76
12/12/2021	43.76	87.65	76.45
13/12/2021	87.65	34.87	54.56
14/12/2021	34.87	45.65	43.78
15/12/2021	45.65	54.65	56.65
16/12/2021	54.65	43.76	54.78
17/12/2021	43.76	76.45	45.54
18/12/2021	76.45	34.78	46.76
19/12/2021	34.78	54.56	36.65
20/12/2021	54.56	43.78	65.45
21/12/2021	43.78	56.65	54.78
22/12/2021	56.65	54.78	34.45
23/12/2021	54.78	45.54	56.65
24/12/2021	45.54	54.67	54.56
25/12/2021	46.76	54.65	54.67
26/12/2021	36.65	45.78	54.76
27/12/2021	32.43	45.76	45.87
28/12/2021	65.56	45.87	56.65
29/12/2021	43.56	43.56	54.67
30/12/2021	54.67	54.67	65.54
31/12/2021	43.87	43.87	65.54
01/01/2022	32.65	32.65	87.65
02/01/2022	76.54	76.54	65.67

03/01/2022	65.43	65.43	45.76
04/01/2022	43.78	43.78	56.54
05/01/2022	54.34	54.34	34.67
06/01/2022	65.43	65.43	54.53
07/01/2022	43.76	43.76	65.30
08/01/2022	87.65	87.65	49.47
09/01/2022	34.87	48.08	15.24
10/01/2022	54.65	44.54	43.56
11/01/2022	78.65	69.42	54.67
12/01/2022	54.78	52.09	43.87
13/01/2022	56.54	36.62	32.65
14/01/2022	45.67	17.91	76.54
15/01/2022	65.54	48.82	65.43
16/01/2022	34.87	26.25	43.78
17/01/2022	56.56	53.73	54.34
18/01/2022	45.43	60.72	65.43
19/01/2022	43.76	45.10	43.76
20/01/2022	87.65	68.76	32.65
21/01/2022	34.87	58.67	76.54
22/01/2022	45.65	40.75	65.43
23/01/2022	54.65	52.49	43.78
24/01/2022	43.76	38.92	54.34
25/01/2022	76.45	32.65	65.43
26/01/2022	34.78	76.54	43.76
27/01/2022	54.56	65.43	87.65
28/01/2022	43.78	43.78	34.87
29/01/2022	56.65	54.34	45.65
30/01/2022	54.78	65.43	34.87
31/01/2022	45.54	43.76	54.65
01/02/2022	46.76	87.65	78.65
02/02/2022	36.65	34.87	54.78
03/02/2022	65.45	58.67	56.54
04/02/2022	54.78	40.75	45.67

05/02/2022	34.45	52.49	65.54
06/02/2022	56.65	38.92	34.87
07/02/2022	54.56	32.65	56.56
08/02/2022	49.49	76.54	45.43
09/02/2022	82.97	65.43	43.76
10/02/2022	68.25	43.78	87.65
11/02/2022	0.00	54.34	34.87
12/02/2022	83.26	65.43	45.65
13/02/2022	103.73	43.76	54.65
14/02/2022	17.85	87.65	43.76
15/02/2022	37.17	34.87	76.45
16/02/2022	105.21	45.65	34.78
17/02/2022	91.30	54.65	54.56
18/02/2022	32.43	43.76	43.78
19/02/2022	65.56	76.45	56.65
20/02/2022	43.56	54.65	54.78
21/02/2022	54.67	43.76	45.54
22/02/2022	43.87	76.45	46.76
23/02/2022	32.65	34.78	36.65
24/02/2022	76.54	54.56	65.45
25/02/2022	65.43	43.78	54.78
26/02/2022	43.78	56.65	34.45
27/02/2022	54.34	54.78	34.67
28/02/2022	65.43	45.54	54.53
01/03/2022	43.76	54.67	65.30
02/03/2022	87.65	54.65	49.47
03/03/2022	34.87	45.78	15.24
04/03/2022	45.65	45.76	43.56
05/03/2022	54.65	45.87	54.67
06/03/2022	43.76	43.56	43.87
07/03/2022	76.45	54.67	32.65
08/03/2022	34.78	43.87	76.54
09/03/2022	54.56	32.65	65.43

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11/03/2022	56.65	65.43	54.34
12/03/2022	54.78	43.78	65.43
13/03/2022	45.54	54.34	43.76
14/03/2022	46.76	65.43	32.65
15/03/2022	36.65	43.76	76.54
16/03/2022	65.43	87.65	65.43
17/03/2022	43.67	48.08	43.78
18/03/2022	43.65	44.54	54.34
19/03/2022	68.25	69.42	65.43
20/03/2022	0.00	52.09	43.76
21/03/2022	83.26	36.62	87.65
22/03/2022	103.73	17.91	34.87
23/03/2022	17.85	48.82	45.65
24/03/2022	37.17	26.25	34.87
25/03/2022	105.21	53.73	54.65
26/03/2022	91.30	60.72	78.65
27/03/2022	32.43	45.10	54.78
28/03/2022	65.56	68.76	56.54
29/03/2022	43.56	58.67	45.67
30/03/2022	54.67	40.75	65.54
31/03/2022	43.87	52.49	34.87
01/04/2022	32.65	38.92	56.56
02/04/2022	76.54	32.65	45.43
03/04/2022	65.43	76.54	43.76
04/04/2022	43.78	65.43	87.65
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06/04/2022	65.43	54.34	45.65
07/04/2022	43.76	65.43	54.65
08/04/2022	87.65	43.76	43.76
09/04/2022	34.87	87.65	76.45
10/04/2022	45.65	34.87	34.78
11/04/2022	54.65	58.67	54.56

12/04/2022	43.76	40.75	43.78
13/04/2022	76.45	52.49	56.65
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17-09-2021	12.22
18-09-2021	12.23
18-09-2021	12.22
19-09-2021	12.23
19-09-2021	12.22
20-09-2021	12.23
20-09-2021	12.22
21-09-2021	12.18
21-09-2021	12.12

22-09-2021	12.18
22-09-2021	12.12
23-09-2021	12.18
23-09-2021	12.12
24-09-2021	12.18
24-09-2021	12.12
25-09-2021	12.18
25-09-2021	12.12
26-09-2021	12.18
26-09-2021	12.12
27-09-2021	12.18
27-09-2021	12.12
28-09-2021	12.18
28-09-2021	12.12
29-09-2021	12.18
29-09-2021	12.12
30-09-2021	12.17
30-09-2021	12.11
01-10-2021	12.17
01-10-2021	12.11
02-10-2021	12.18
02-10-2021	12.12
03-10-2021	12.18
03-10-2021	12.12
04-10-2021	12.18
04-10-2021	12.12
05-10-2021	12.18
05-10-2021	12.12
06-10-2021	12.18
06-10-2021	12.12
07-10-2021	12.18
07-10-2021	12.12
08-10-2021	12.17

08-10-2021	12.11
09-10-2021	12.17
09-10-2021	12.11
10-10-2021	12.18
10-10-2021	12.12
11-10-2021	12.18
11-10-2021	12.12
12-10-2021	12.18
12-10-2021	12.12
13-10-2021	12.18
13-10-2021	12.12
14-10-2021	12.18
14-10-2021	12.12
15-10-2021	12.18
15-10-2021	12.12
16-10-2021	12.17
16-10-2021	12.11
17-10-2021	12.17
17-10-2021	12.11
18-10-2021	12.17
18-10-2021	12.11
19-10-2021	12.17
19-10-2021	12.11
20-10-2021	12.17
20-10-2021	12.11
21-10-2021	12.17
21-10-2021	12.11
22-10-2021	12.17
22-10-2021	12.11
23-10-2021	12.17
23-10-2021	12.11
24-10-2021	12.17
24-10-2021	12.11

25-10-2021	12.17
25-10-2021	12.11
26-10-2021	12.17
26-10-2021	12.11
27-10-2021	12.17
27-10-2021	12.11
28-10-2021	12.18
28-10-2021	12.11
29-10-2021	12.18
29-10-2021	12.11
30-10-2021	12.18
30-10-2021	12.11
31-10-2021	12.18
31-10-2021	12.11
01-11-2021	12.18
01-11-2021	12.11
02-11-2021	12.18
02-11-2021	12.11
03-11-2021	12.18
03-11-2021	12.11
04-11-2021	12.18
04-11-2021	12.11
05-11-2021	12.2
05-11-2021	12.15
06-11-2021	12.2
06-11-2021	12.15
07-11-2021	12.2
07-11-2021	12.15
08-11-2021	12.22
08-11-2021	12.17
09-11-2021	12.22
09-11-2021	12.17
10-11-2021	12.22

10-11-2021	12.17
11-11-2021	12.22
11-11-2021	12.17
12-11-2021	12.22
12-11-2021	12.17
13-11-2021	12.22
13-11-2021	12.17
14-11-2021	12.22
14-11-2021	12.17
15-11-2021	12.22
15-11-2021	12.17
16-11-2021	12.22
16-11-2021	12.17
17-11-2021	12.22
17-11-2021	12.17
18-11-2021	12.22
18-11-2021	12.17
19-11-2021	12.22
19-11-2021	12.17
20-11-2021	12.23
20-11-2021	12.19
21-11-2021	12.23
21-11-2021	12.19
22-11-2021	12.23
22-11-2021	12.25
23-11-2021	12.32
23-11-2021	12.26
24-11-2021	12.35
24-11-2021	12.27
25-11-2021	12.37
25-11-2021	12.28
26-11-2021	12.37
26-11-2021	12.29

27-11-2021	12.38
27-11-2021	12.3
28-11-2021	12.38
28-11-2021	12.3
29-11-2021	12.38
29-11-2021	12.5
30-11-2021	12.45
30-11-2021	12.65
01-12-2021	12.6
01-12-2021	12.64
02-12-2021	12.6
02-12-2021	12.69
03-12-2021	12.64
03-12-2021	12.69
04-12-2021	12.64
04-12-2021	12.7
05-12-2021	12.66
05-12-2021	12.7
06-12-2021	12.66
06-12-2021	12.7
07-12-2021	12.72
07-12-2021	12.79
08-12-2021	12.73
08-12-2021	12.75
09-12-2021	12.73
09-12-2021	12.75
10-12-2021	12.73
10-12-2021	12.75
11-12-2021	12.73
11-12-2021	12.75
12-12-2021	12.73
12-12-2021	12.75
13-12-2021	12.73

13-12-2021	12.75
14-12-2021	12.73
14-12-2021	12.75
15-12-2021	12.73
15-12-2021	12.75
16-12-2021	12.74
16-12-2021	12.78
17-12-2021	12.74
17-12-2021	12.78
18-12-2021	12.74
18-12-2021	12.78
19-12-2021	12.76
19-12-2021	12.8
20-12-2021	12.76
20-12-2021	12.8
21-12-2021	12.76
21-12-2021	12.8
22-12-2021	12.77
22-12-2021	12.83
23-12-2021	12.77
23-12-2021	12.83
24-12-2021	12.77
24-12-2021	12.83
25-12-2021	12.77
25-12-2021	12.83
26-12-2021	12.78
26-12-2021	12.84
27-12-2021	12.78
27-12-2021	12.84
28-12-2021	12.81
28-12-2021	12.86
29-12-2021	12.81
29-12-2021	12.86

30-12-2021	12.83
30-12-2021	12.89
31-12-2021	12.83
31-12-2021	12.89
01-01-2022	12.83
01-01-2022	12.89
02-01-2022	12.9
02-01-2022	12.88
03-01-2022	12.91
03-01-2022	12.9
04-01-2022	12.92
04-01-2022	13.12
05-01-2022	13.22
05-01-2022	12.89
06-01-2022	12.99
06-01-2022	12.94
07-01-2022	13.02
07-01-2022	13
08-01-2022	13.03
08-01-2022	13.02
09-01-2022	13.04
09-01-2022	13.24
10-01-2022	13.09
10-01-2022	12.88
11-01-2022	12.98
11-01-2022	12.93
12-01-2022	13.01
12-01-2022	12.99
13-01-2022	13.02
13-01-2022	13.01
14-01-2022	13.03
14-01-2022	13.23
15-01-2022	13.33

15-01-2022	13
16-01-2022	13.1
16-01-2022	13.05
17-01-2022	13.13
17-01-2022	13.11
18-01-2022	13.14
18-01-2022	13.13
19-01-2022	13.15
19-01-2022	13.35
20-01-2022	13.2
20-01-2022	13.02
21-01-2022	13.12
21-01-2022	13.07
22-01-2022	13.15
22-01-2022	13.13
23-01-2022	13.16
23-01-2022	13.15
24-01-2022	13.17
24-01-2022	13.37
25-01-2022	13.47
25-01-2022	13.14
26-01-2022	13.24
26-01-2022	13.19
27-01-2022	13.27
27-01-2022	13.25
28-01-2022	13.28
28-01-2022	13.27
29-01-2022	13.29
29-01-2022	13.49
30-01-2022	13.16
30-01-2022	13.26
31-01-2022	13.21
31-01-2022	13.29

01-02-2022	13.27
01-02-2022	13.3
02-02-2022	13.29
02-02-2022	13.31
03-02-2022	13.51
03-02-2022	13.61
04-02-2022	13.28
04-02-2022	13.38
05-02-2022	13.33
05-02-2022	13.41
06-02-2022	13.39
06-02-2022	13.42
07-02-2022	13.41
07-02-2022	13.43
08-02-2022	13.63
08-02-2022	13.73
09-02-2022	13.31
09-02-2022	13.41
10-02-2022	13.36
10-02-2022	13.44
11-02-2022	13.42
11-02-2022	13.45
12-02-2022	13.44
12-02-2022	13.46
13-02-2022	13.66
13-02-2022	13.76
14-02-2022	13.43
14-02-2022	13.53
15-02-2022	13.48
15-02-2022	13.56
16-02-2022	13.54
16-02-2022	13.57
17-02-2022	13.56

17-02-2022	13.58
18-02-2022	13.78
18-02-2022	13.88
19-02-2022	13.39
19-02-2022	13.49
20-02-2022	13.44
20-02-2022	13.52
21-02-2022	13.5
21-02-2022	13.53
22-02-2022	13.52
22-02-2022	13.54
23-02-2022	13.51
23-02-2022	13.61
24-02-2022	13.56
24-02-2022	13.64
25-02-2022	13.62
25-02-2022	13.65
26-02-2022	13.64
26-02-2022	13.66
27-02-2022	13.86
27-02-2022	13.96
28-02-2022	13.91
28-02-2022	13.99
01-03-2022	13.97
01-03-2022	14
02-03-2022	13.99
02-03-2022	14.01
03-03-2022	14.13
03-03-2022	14.23
04-03-2022	14.18
04-03-2022	14.26
05-03-2022	14.24
05-03-2022	14.27

06-03-2022	14.26
06-03-2022	14.28
07-03-2022	14.27
07-03-2022	14.31
08-03-2022	14.29
08-03-2022	14.41
09-03-2022	14.35
09-03-2022	14.45
10-03-2022	14.4
10-03-2022	14.48
11-03-2022	14.46
11-03-2022	14.49
12-03-2022	14.48
12-03-2022	14.5
13-03-2022	14.49
13-03-2022	14.53
14-03-2022	14.51
14-03-2022	14.56
15-03-2022	14.54
15-03-2022	14.59
16-03-2022	14.56
16-03-2022	14.6
17-03-2022	14.57
17-03-2022	14.62
18-03-2022	14.57
18-03-2022	14.68
19-03-2022	14.59
19-03-2022	14.7
20-03-2022	14.6
20-03-2022	14.75
21-03-2022	14.65
21-03-2022	14.81
22-03-2022	14.7

22-03-2022	14.85
23-03-2022	14.75
23-03-2022	14.82
24-03-2022	14.79
24-03-2022	14.85
25-03-2022	14.82
25-03-2022	14.9
26-03-2022	14.85
26-03-2022	14.96
27-03-2022	14.92
27-03-2022	14.97
28-03-2022	14.94
28-03-2022	14.99
29-03-2022	14.95
29-03-2022	15.01
30-03-2022	14.96
30-03-2022	15.02
31-03-2022	14.97
31-03-2022	15.03
31-03-2022	14.99
31-03-2022	15.5

Visiontek Consultancy Services Pvt. Ltd.
(Committed For Better Environment)
Certified for : ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 (OH&S), ISO/IEC 17025:2017
Accredited by : NABET-A Grade, MOEF & CC/CPCB & SPCB-A Grade
Laboratory Services: Environment Lab, Food Lab, Material Lab, Soil Lab, Mineral Lab, & Microbiology Lab
• Infrastructure Engineering • Surface & Sub-Surface Investigation • Agricultural Development • Mine Planning & Design
• Water Resource Management • Quality Control & Project Management • Information Technology • Mineral Sub-Soil Exploration
• Environmental & Social Study • Renewable Energy • Public Health Engineering • Waste Management Services

Test Report No: Envlab/23-24/TR-14632 Date: 07.03.2024

WATER QUALITY ANALYSIS REPORT

Costomer Name & Address	:	Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundargarh	
SAMPLE DETAILS			
Sample Description	Water Sample	Sampling Procedure	APHA 1060
Sample Condition	Sealed Plastic & Sterilized Glass Bottle	Sample Received on	24.02.2024
Sampling Date	23.02.2024	Test Completed on	24.02.2024 TO 29.02.2024

Sate	Well Id	Village Name	Longitude	Latitude	pH	EC	Total Alkalinity	Hardness	Ca	Mg	Na	K
1	N1	Murukumman	85.11722222	21.99972222	7.03	146.4	29.5	120	20.2	16.9	4.2	0.96
2	N2	Camp of Tisco	85.32083	22.0061	7.15	182.2	30.1	114	18.6	16.4	3.6	1.32
3	N3	Chernakda	85.35306	21.95141	7.21	167.9	27.5	132	23.4	17.9	3.1	1.04
4	N4	Mirhirdi	85.3397	21.8395	7.05	180.2	28.6	114	22.9	13.8	4.0	0.88
5	N5	Tensa CT	85.36331	21.87523	6.88	176.3	27.9	126	21.5	17.6	2.9	0.76
6	N6	Tentulidihi	85.20360556	21.86896944	7.02	146.9	29.4	120	19.6	17.3	2.7	1.08
7	N7	Bandal	85.19985	21.89787	7.18	158.2	30.3	102	20.7	12.2	3.3	1.18
8	N8	Kalta	85.21739	21.94855	7.01	198.4	26.5	125	23.5	16.1	3.1	0.82
9	N9	Jhirpani	85.23987	21.9964	6.83	146.9	32.7	106	22.9	11.9	2.8	1.24
10	N10	Pudulipoti	85.2906	21.98669	7.21	160.5	28.9	118	21.4	15.7	2.8	1.03
11	N11	Kalmanga	85.31977	21.95253	7.06	150.3	31.6	127	16.8	20.7	3.0	1.42
12	N12	Badpatali	85.31084	21.87426	7.19	158.7	30.7	121	23.5	15.1	2.1	0.68
13	N13	Kasmanda	85.24485	21.93119444	7.11	166.9	26.5	130	25.1	16.4	2.2	0.92
14	N14	Kolda CT	85.27964	21.91006	7.07	184.2	29.8	132	23.9	17.6	2.4	1.14
15	N15	Kasira	85.23715	21.93368	7.16	156.4	30.4	116	22.5	14.5	1.6	1.06
16	N16	Kashira	85.2540833	21.91759	7.20	134.2	31.2	108	20.1	14.8	2.0	0.88

(Note: The above mentioned analyzed parameters follows IS 10500 Specification)

Reviewed By: Approved By:

Plot No.- M-22 & 23, Chandaka Industrial Estate, Patia, Bhubaneswar, Khurda, Odisha-751024, India Tel.: 0674-3511721
E-mail: visiontek@visiontek.org,visiontekin@gmail.com
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Visiontek Consultancy Services Pvt. Ltd.
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Accredited by : NABET-A Grade, MOEF & CC/CPCB & SPCB-A Grade
• Infrastructure Engineering • Surface & Sub-Surface Investigation • Agricultural Development • Mine Planning & Design
• Water Resource Management • Quality Control & Project Management • Information Technology • Mineral Sub-Soil Exploration
• Environmental & Social Study • Renewable Energy • Public Health Engineering • Waste Management Services
Laboratory Services: Environment Lab, Food Lab, Material Lab, Soil Lab, Mineral Lab & Microbiology Lab

Test Report No: Enviab/23-24/TR- 14634 Date: 07.03.2024

WATER QUALITY ANALYSIS REPORT

Customer Name & Address	:	Narayanposhi Iron Ore Mines of M/s JSW Steel Ltd, Sundargarh	
SAMPLE DETAILS			
Sample Description	Water Sample	Sampling Procedure	APHA 1060
Sample Condition	Sealed Plastic & Sterilized Glass Bottle	Sample Received on	24.02.2024
Sampling Date	23.02.2024	Test Completed on	24.02.2024 TO 29.02.2024

S.no	Well id	Village Name	Longitude	Latitude	Fe	HCO3	Cl	SO4	NO3	F	Mn
1	N1	Matiduamunda	85.11722222	21.99972222	0.77	29.5	25.2	10.3	3.9	0.11	<0.05
2	N2	Camp of Thete	85.52085	22.0051	0.69	30.1	24.1	7.2	4.2	0.16	<0.05
3	N3	Chuemolda	85.55306	21.95341	0.61	27.5	22.4	8.0	4.6	0.14	<0.05
4	N4	Mithurda	85.3397	21.8395	0.81	28.6	24.9	6.6	5.1	0.12	<0.05
5	N5	Tuisa CT	85.16331	21.87923	0.66	27.9	23.9	10.8	4.8	0.13	<0.05
6	N6	Tentulsili	85.2030056	21.8680944	0.79	29.4	25.1	10.3	4.3	0.16	<0.05
7	N7	Rundal	85.19085	21.88757	1.12	30.3	23.6	6.7	5.1	0.12	<0.05
8	N8	Kalia	85.21708	21.96555	2.01	26.5	24.7	10.9	3.6	0.15	<0.05
9	N9	Jhirpani	85.21085	21.9064	0.96	32.7	23.9	6.8	4.1	0.12	<0.05
10	N10	Paduljoni	85.2906	21.98669	1.23	28.9	24.5	10.1	4.8	0.13	<0.05
11	N11	Kalamuga	85.31977	21.95283	1.16	31.6	30.8	9.2	5.2	0.12	<0.05
12	N12	Badpatali	85.31094	21.87429	1.01	30.7	24.1	10.2	4.9	0.16	<0.05
13	N13	Kumsida	85.21405	21.931119444	0.98	26.5	22.6	8.4	4.2	0.14	<0.05
14	N14	Kuida CT	85.27964	21.91906	0.76	29.8	23.9	7.6	3.6	0.11	<0.05
15	N15	Kasira	85.37735	21.93368	1.32	30.4	28.7	6.8	5.0	0.13	<0.05
16	N16	Kasira	85.25405833	21.91755	1.06	31.2	24.8	7.2	4.4	0.14	<0.05

(Note: The above mentioned analyzed parameters follows IS 10500 Specification)

Reviewed By: Approved By:

Plot No.- M-22 & 23, Chandaka Industrial Estate, Patia, Bhubaneswar, Khurda, Odisha-751024, India Tel.: 0674-3511721
E-mail: visiontek@visiontek.org,visiontekin@gmail.com
Visit us at: www.visiontek.org

ANNEXURE XV

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
केन्द्रीय भूमि जल प्राधिकरण
Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Authority

(भूजल निकासी हेतु अनापत्ति प्रमाण पत्र)
NO OBJECTION CERTIFICATE (NOC) FOR GROUND WATER ABSTRACTION

Project Name:	Jsw Steel Ltd.-narayanposhi Iron And Manganese Ore Mines		
Project Address:	At/po- Koira, Dist- Sundargarh, Odisha-770048		
Village:	Kasira	Block:	Koida
District:	Sundargarh	State:	Odisha
Pin Code:			
Communication Address:	M/s Jsw Steel Limited, Narayanposhi Iron And Manganese Ore Mines, Village: Kasira, Block/taluka: Koida, Distt.: Sundargarh, Odisha, Koida, Sundargarh, Odisha - 770048		
Address of CGWB Regional Office :	Central Ground Water Board South Eastern Region, Bhujal Bhawan, Khandagiri Square, Nh-5, Bhubaneshwar, Khordha, Odisha - 751030		

1.	**NOC No.:**	CGWA/NOC/MIN/REN/2/2024/10057	2.	**Date of Issuence**	17/10/2024
3.	Application No.:	21-4/859/OR/MIN/2016	4.	Category: (GWRE 2023)	Safe
5.	Project Status:	Existing Ground Water	6.	NOC Type:	Renewal
7.	**Valid from:**	19/01/2022	8.	**Valid up to:**	18/01/2026(Extended Validity)

9. Ground Water Abstraction Permitted:

Fresh Water		Saline Water		Dewatering		Total	
m³/day	m³/year	m³/day	m³/year	m³/day	m³/year	m³/day	m³/year
980.00	35770.00			1102.00	402230.00	2082.00	438000.00

10. Details of ground water abstraction /Dewatering structures

	Total Existing No.:4						Total Proposed No.:4					
	DW	DCB	BW	TW	MP	MPu	DW	DCB	BW	TW	MP	MPu
Abstraction Structure*	0	0	3	0	0	0	0	0	4	0	0	0
Dewatering Structure*	0	0	0	0	1	0	0	0	0	0	0	0

*DW- Dug Well; DCB-Dug-cum-Bore Well; BW-Bore Well; TW-Tube Well; MP-Mine Pit;MPu-Mine Pumps

11.	Ground Water Abstraction/Restoration Charges paid (Rs.):	9587400.00
12.	Environment Compensation (if applicable) paid (Rs.):	0.00

13.	Number of Piezometers(Observation wells) to be constructed/ monitored & Monitoring mechanism.	No. of Piezometers	Monitoring Mechanism		
			Manual	DWLR**	DWLR With Telemetry
	**DWLR - Digital Water Level Recorder	2	0	1	1

(Compliance Conditions given overleaf)

This is an auto generated document & need not to be signed.

CENTRAL GROUND WATER AUTHORITY

18/11, जामनगर हाउस, मानसिंह रोड, नई दिल्ली - 110011 / 18/11, Jamnagar House, Mansingh Road, New Delhi-110011
Phone: (011) 23383561 Fax: 23382051, 23386743
Website: cgwa-noc.gov.in

Validity of this NOC shall be subject to compliance of the following conditions:

Mandatory conditions:

1) Installation of tamper proof digital water flow meter with telemetry on all the abstraction structure(s) shall be mandatory for all users seeking No Objection Certificate and intimation regarding their installation shall be communicated to the CGWA within 30 days of grant of No Objection Certificate.

2) Proponents shall mandatorily get water flow meter calibrated from an authorized agency once in a year.

3) Construction of purpose-built observation wells (piezometers) for ground water level monitoring shall be mandatory as per Section 14 of Guidelines. Water level data shall be made available to CGWA through web portal. Detailed guidelines for construction of piezometers are given in Annexure-II of the guidelines.

4) Proponents shall monitor quality of ground water from the abstraction structure(s) once in a year. Water samples from bore wells/ tube wells / dug wells shall be collected during April/May every year and analysed in NABL accredited laboratories for basic parameters (cations and anions), heavy metals, pesticides/ organic compounds etc. Water quality data shall be made available to CGWA through the web portal.

5) In case of mining projects, additional key wells shall be established in consultation with the Regional Director, CGWB for ground water level monitoring four (4) times a year (January, May, August and November) in core as well as buffer zones of the mine.

6) In case of mining project the firm shall submit water quality report of mine discharge/ seepage from Govt. approved/ NABL accredited lab.

7) The firm shall report compliance of the NOC conditions online in the website (www.cgwa-noc.gov.in) within one year from the date of issue of this NOC.

8) Industries abstracting ground water in excess of 100 m 3 /d shall undertake annual water audit through certified auditors and submit audit reports within three months of completion of the same to CGWA. All such industries shall be required to reduce their ground water use by at least 20% over the next three years through appropriate means.

9) Application for renewal can be submitted online from 90 days before the expiry of NOC. Ground water withdrawal, if any, after expiry of NOC shall be illegal & liable for legal action as per provisions of Environment (Protection) Act, 1986.

10) This NOC is subject to prevailing Central/State Government rules/laws/norms or Court orders related to construction of tube well/ground water abstraction structure / recharge or conservation structure/discharge of effluents or any such matter as applicable.

General conditions:

11) No additional ground water abstraction and/or de-watering structures shall be constructed for this purpose without prior approval of the Central Ground Water Authority (CGWA).

12) The proponent shall seek prior permission from CGWA for any increase in quantum of groundwater abstraction (more than that permitted in NOC for specific period).

13) Proponents shall install roof top rain water harvesting in the premise as per the existing building bye laws in the premise.

14) The project proponent shall take all necessary measures to prevent contamination of ground water in the premises failing which the firm shall be responsible for any consequences arising thereupon.

15) In case of industries that are likely to contaminate the ground water, no recharge measures shall be taken up by the firm inside the plant premises. The runoff generated from the rooftop shall be stored and put to beneficial use by the firm.

16) Wherever feasible, requirement of water for greenbelt (horticulture) shall be met from recycled / treated waste water.

17) Wherever the NOC is for abstraction of saline water and the existing wells (s) is /are yielding fresh water, the same shall be sealed and new tubewell(s) tapping saline water zone shall be constructed within 3 months of the issuance of NOC. The firm shall also ensure safe disposal of saline residue, if any.

18) Unexpected variations in inflow of ground water into the mine pit, if any, shall be reported to the concerned Regional Director, Central Ground Water Board.

19) In case of violation of any NOC conditions, the applicant shall be liable to pay the penalties as per Section 16 of Guidelines.

20) This NOC does not absolve the proponents of their obligation / requirement to obtain other statutory and administrative clearances from appropriate authorities.

21) The issue of this NOC does not imply that other statutory / administrative clearances shall be granted to the project by the concerned authorities. Such authorities would consider the project on merits and take decisions independently of the NOC.

22) In case of change of ownership, new owner of the industry will have to apply for incorporation of necessary changes in the No Objection Certificate with documentary proof within 60 days of taking over possession of the premises.

23) This NOC is being issued without any prejudice to the directions of the Hon'ble NGT/court orders in cases related to ground water or any other related matters.

24) Proponents, who have installed/constructed artificial recharge structures in compliance of the NOC granted to them previously and have availed rebate of upto 50% (fifty percent) in the ground water abstraction charges/ground water restoration charges, shall continue to regularly maintain artificial recharge structures.

25) Industries which are likely to cause ground water pollution e.g. Tanning, Slaughter Houses, Dye, Chemical/ Petrochemical, Coal washeries, pharmaceutical, other hazardous units etc. (as per CPCB list) need to undertake necessary well head protection measures to ensure prevention of ground water pollution as per Annexure III of the guidelines.

26) In case of new infrastructure projects having ground water abstraction of more than 20 m3/day, the firm/entity shall ensure implementation of dual water supply system in the projects.

27) In case of infrastructure projects, paved/parking area must be covered with interlocking/perforated tiles or other suitable measures to ensure groundwater infiltration/harvesting.

28) In case of coal and other base metal mining projects, the project proponent shall use the advance dewatering technology (by construction of series of dewatering abstraction structures) to avoid contamination of surface water.

29) The NOC issued is conditional subject to the conditions mentioned in the Public notice dated 27.01.2021 failing which penalty/EC/cancellation of NOC shall be imposed as the case may be.
30) This NOC is issued subject to the clearance of Expert Appraisal Committee (EAC) (if applicable).
31) In the self-compliance report, the PP shall submit details of Drilling Agency/ Agencies, which has/ have constructed BW(s)/ TW(s) along with undertaking to the effect that all necessary measures have been taken as per directions of Hon'ble Supreme Court provided in Annexure-VII of guidelines dated 24.09.2020 in respect of abandoned/ failed BW(s)/ TW(s)/Piezometer(s), if any. The PP is advised to engage registered drilling agency/ agencies. In the event of any mishap/ unfortunate incident due to negligence in taking measures for prevention of accident due to falling in Bore Well, both PP and concerned drilling agency shall jointly be held responsible and penal action as per extant Government rules shall be taken.

(Non-compliance of the conditions mentioned above is likely to result in the cancellation of NOC and legal action against the proponent.)

CENTRAL GROUND WATER AUTHORITY

Department of Water Resources, River Development and Ganga Rejuvenation
Ministry of Jal Shakti, Govt. of India

Receipt

(As per the guideline Gazette Notification S.O. 3281(E) regarding the New Guidelines dated 24.09.2020 of CGWA, MoJS, Govt. of India)
https://cgwa-noc.gov.in

Application No,:	21-4/859/OR/MIN/2016	Date of Issuence:17/10/2024
Name of Firm:	JSW Steel Ltd.-NARAYANPOSHI IRON AND MANGANESE ORE MINES	
AppType Category:	*Iron ore*	
Application Type:	*Mining*	
PAN/GSTIN No. of Firm/Individual:	/	

SN	Description	Amount (Rs.)
1.	Application Processing Fee	**5000.00**
2.	Ground Water Abstraction charges	**9587400.00**
3.	Ground Water Restoration charges	**0**
4.	Environmental Compensation Charges (ECRGW) *(Date From to) Days-*	
5.	Penalty for non-Compliance of NOC conditions *Condition to be mentioned*	**100000.00**
6.	Adjustment Charges	
7.	Rebate	
8.	Charges for correction/modification in the existing issued No Objection Certificate	

S.No.	Description	Rate
(i)	Change in User ID	Rs. 1000
(ii)	Change in firm Name	Rs. 5000
(iii)	Extension of No Objection Certificate	Rs. 5000
(iv)	Issuance of duplicate No Objection Certificate	Rs. 5000
(v)	Issuance of corrigendum to No Objection Certificate	Rs. 5000
(vi)	Any other items/correction etc.	Rs. 500

Rs. Rupees Ninty Six Lakh Ninty Two Thousand Four Hundred Only	**9692400.00**

This is an system generated invoice, hence, does not require ink signed.

18/11, जामनगर हाउस, मानसिंह रोड, नई दिल्ली - 110011 / 18/11, Jamnagar House, Mansingh Road, New Delhi-110011
Phone: (011) 23383561 Fax: 23382051, 23386743
Website: cgwa-noc.gov.in

पानी बचाये – जीवन बचाये
SAVE WATER - SAVE LIFE

Term and conditions:

i. All disputes are subject to Delhi Jurisdiction.
ii. Any complaint in regard to the rates will not be entertained.

Member-Secretary
CGWA, New Delhi

CENTRAL GROUND WATER AUTHORITY

ANNEXURE XVI

Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2025/97 Date: 28/02/2025

To,
The Member Secretary,
State Pollution Control Board,
Odisha, Paribesh Bhawan,
A/118, Nilakantha Nagar, Unit-8,
BHUBANESWAR- 751012

Sub: - Submission of Quarterly Ground Water Level and Quality Monitoring Reports in compliance of CTO and NEERI Conditions for **Narayanposhi Iron and Manganese Mine of M/s JSW Steel Ltd.**

Ref: - Consent Order No 2944 vide letter no 4651/IND-I-CON-2258 dated 30.03.2024.

Dear Sir,

With reference to aforesaid subject, please find enclosed herewith the Quarterly Ground Water Level and Quality Monitoring Reports for January 2025 in compliance of CTO and NEERI Conditions for **Narayanposhi Iron and Manganese Mine of M/s JSW Steel Ltd**.

Thanking you,

Yours Faithfully
For JSW Steel Ltd

Mrutyunjaya Mahapatra
(Authorized Signatory)

Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

Copy to-

i. Member Secretary, Central Ground Water Authority, Ministry of Jal Shakti, Govt. of India, 18/11, Jamnagar House, Mansingh Road, New Delhi-110011

ii. The Deputy Director General of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (Eastern Zone), A/3, Chandersekharpur, Bhubaneswar – 751023

iii. The Regional Officer, Regional Office, Rourkela, Office of the State Pollution Control Board, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha

JSW STEEL LIMITED

NAME OF THE MINE: **NARAYANPOSHI IRON AND MANGANESE ORE MINE**

MONTH: **JANUARY 2025**

DESCRIPTION OF WORK: **GROUND WATER TABLE**

ECOMEN MINING PVT. LTD.
LUCKNOW

ecoMen

ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746282
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI

TC-12751

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/09

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron & Manganese Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/GL/009/0449/01/2025**
		Issue Date of Test Report	**05.01.2025**
Type of Sample	Ground Water Level Monitoring		
Sample Registration No.	009		
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Lab Team
Date of Sample Monitoring	14.01.2025	**Time of Sample Collection**	12:30 PM
Laboratory Environmental Condition	Temperature: 25 ± 5 ℃	**Sample Quantity**	As per Requirement
	Humidity: 30-60 % RH	**Sample ID Code**	ECO/LAB/0449/01/2025

Ground Water Level Report

S. No.	Name of Location	Unit	Ground Water Level (in Meter)
1.	Gate no	Meter	11.85
2.	Operator colony	Meter	09.68
3.	Koira Village	Meter	10.57
4.	Quarry-4	Meter	09.35
5.	Kashira Village	Meter	10.45

Statement of Conformity: The above tested parameters results are related to the sample tested.

Verified By
Technical Manager

Authorized By
Quality Manager

ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746282
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12751

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron& Managnese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400001262F**
		Test Report No.	**ECO/LAB/GW/055/0388/01/2025**
		Issue Date of Test Report	**31.01.2025**
Type of Sample	Ground Water		
Sample Registration No.	055	**Name of Location**	Kashira Village
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	23.01.2025	**Time of Sample Collection**	-
Date of Sample Received	25.01.2025	**Time of Sample Received**	10:30 AM
Start Date of Analysis	25.01.2025	**End Date of Analysis**	31.01.2025
Laboratory Environmental Condition	Temperature: 27 ± 2 ℃	**Sample Quantity**	As Per Requirement
	Humidity: 56 %	**Sample ID Code**	ECO/LAB/0388/01/2025

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012(Reaff:2018)	
						Desirable	Permissible
1.	Colour	Hazen	APHA, 23rd Ed.2017, 2120 B	<5.0	5-100	5.00	15.0
2.	Odour	-	APHA, 23rd Ed.2017,2150 B	Agreeable	Qualitative	Agreeable	Agreeable
3.	Turbidity as Tb	NTU	APHA, 23rd Ed.2017, 2130-A+B	BDL	1 - 100	1.0	5.0
4.	pH	-	APHA, 23rd Ed.2017, 4500H+ A+B	6.98	2.0 -12	6.5-8.5	No Relax.
5.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed.2017,2540-C	BDL	5 - 5000	-	-
6.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed.2017, 2540-C	218.0	5 - 5000	500	2000
7.	Total Alkalinity	mg/l	APHA, 23rd Ed.2017,2320 A+ B	78.0	5-1500	200	600
8.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed.2017,2340 A+C	82.0	5-1500	200.0	600.0
9.	Calcium as Ca	mg/l	APHA, 23rd Ed.2017,3500 Ca A+B	19.25	5 – 1000	75.0	200.0
10.	Magnesium as Mg	mg/l	APHA, 23rd Ed.2017, 3500 Mg A+B	7.62	5-1000	30.0	100.0
11.	Sodium as Na	mg/l	APHA,23rd Ed. : 2017,3500 Na A+B	9.65	1-100	-	-
12.	Potassium as K	mg/l	APHA,23rd Ed. : 2017,3500 K A+B	1.08	1-100	-	-
13.	Sulfate as SO_4	mg/l	APHA, 23rd Ed.2017, 4500-SO_4^{2-} E	7.86	1.0 -250	200.0	400.0
14.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed.2017, 4500-NO_3^- B	5.96	5.0 - 100	45.0	No Relax.
15.	Chloride as Cl	mg/l	APHA, 23rd Ed.2017, 4500 Cl A+B	24.0	5-1000	250.0	1000.0
16.	Fluorides as F	mg/l	APHA, 23rd Ed.2017, 4500-C	0.26	0.05-10	1.0	1.5
17.	Copper as Cu	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.05-5	0.05	1.5
18.	Iron as Fe	mg/l	APHA, 23rd Ed.2017, 3500 Fe B	0.10	0.02-50	0.3	No Relax.
19.	Manganese as Mn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.1-5	0.10	0.30
20.	Arsenic as As	mg/l	APHA, 23rd Ed.2017, 3114 C	BDL	0.01-2	0.01	0.05
21.	Zinc as Zn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.02-50	5.0	15
22.	Total Chromium as Cr	mg/l	APHA, 23rd Ed.2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
23.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed.2017, 5530 A+C	BDL	1-10	0.001	0.002
24.	Free Residual Chlorine	mg/l	APHA, 23rd Ed.2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
25.	Mercury as Hg	mg/l	APHA, 23rd Ed.2017, 3112 A+B	BDL	0.001-1	0.001	No Relax
26.	Lead as Pb	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.01-1	0.01	No Relax
27.	Cadmium as Cd	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.002-2	0.003	No Relax
28.	Boron as B	mg/l	APHA, 23rd Ed.2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
29.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed.2017, 5540 A+C	BDL	0.01-5	0.2	1.0
30.	Sulphide as S2	mg/l	APHA,23rd Ed. : 2017,4500 S2- F	BDL	0.5-10	0.05	No Relax
31.	Nickel as Ni	mg/l	APHA,23rd Ed. : 2017,3111 A+B	BDL	0.02-5	0.02	No Relax
32.	Hexavalent Chromium as Cr6+	mg/l	APHA,23rd Ed. : 2017,3500 A+B	BDL	0.05-5	-	-
33.	Phosphate as PO4	mg/l	APHA,23rd Ed. : 2017,4500 PD	BDL	0.1-50	-	-
34.	Total coliform	Per 100 ml	IS15185:2016;RA:2021	Absent	<1	Absent	Absent
35.	E. Coli	Per 100 ml	IS-15185,2016 RA-2021	Absent	<1	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ecoMen
ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746282
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12751

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron& Managnese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400001263F**
		Test Report No.	**ECO/LAB/GW/055/0389/01/2025**
		Issue Date of Test Report	**31.01.2025**
Type of Sample	Ground Water		
Sample Registration No.	055	**Name of Location**	Koira Village
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	23.01.2025	**Time of Sample Collection**	-
Date of Sample Received	25.01.2025	**Time of Sample Received**	10:30 AM
Start Date of Analysis	25.01.2025	**End Date of Analysis**	31.01.2025
Laboratory Environmental Condition	Temperature: 27 ± 2 ℃	**Sample Quantity**	As Per Requirement
	Humidity: 56 %	**Sample ID Code**	ECO/LAB/0389/01/2025

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012(Reaff:2018)	
						Desirable	Permissible
36.	Colour	Hazen	APHA, 23rd Ed.2017, 2120 B	<5.0	5-100	5.00	15.0
37.	Odour	-	APHA, 23rd Ed.2017,2150 B	Agreeable	Qualitative	Agreeable	Agreeable
38.	Turbidity as Tb	NTU	APHA, 23rd Ed.2017, 2130-A+B	BDL	1 - 100	1.0	5.0
39.	pH	-	APHA, 23rd Ed.2017, 4500H+ A+B	6.78	2.0 -12	6.5-8.5	No Relax.
40.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed.2017,2540-C	BDL	5 - 5000	-	-
41.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed.2017, 2540-C	224.0	5 - 5000	500	2000
42.	Total Alkalinity	mg/l	APHA, 23rd Ed.2017,2320 A+ B	84.0	5-1500	200	600
43.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed.2017,2340 A+C	97.0	5-1500	200.0	600.0
44.	Calcium as Ca	mg/l	APHA, 23rd Ed.2017,3500 Ca A+B	20.4	5 – 1000	75.0	200.0
45.	Magnesium as Mg	mg/l	APHA, 23rd Ed.2017, 3500 Mg A+B	9.76	5-1000	30.0	100.0
46.	Sodium as Na	mg/l	APHA,23rd Ed. : 2017,3500 Na A+B	9.35	1-100	-	-
47.	Potassium as K	mg/l	APHA,23rd Ed. : 2017,3500 K A+B	BDL	1-100	-	-
48.	Sulfate as SO_4	mg/l	APHA, 23rd Ed.2017, 4500-SO_4^{2-} E	9.52	1.0 -250	200.0	400.0
49.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed.2017, 4500-NO_3^- B	6.35	5.0 - 100	45.0	No Relax.
50.	Chloride as Cl	mg/l	APHA, 23rd Ed.2017, 4500 Cl A+B	26.0	5-1000	250.0	1000.0
51.	Fluorides as F	mg/l	APHA, 23rd Ed.2017, 4500-C	0.16	0.05-10	1.0	1.5
52.	Copper as Cu	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.05-5	0.05	1.5
53.	Iron as Fe	mg/l	APHA, 23rd Ed.2017, 3500 Fe B	0.08	0.02-50	0.3	No Relax.
54.	Manganese as Mn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.1-5	0.10	0.30
55.	Arsenic as As	mg/l	APHA, 23rd Ed.2017, 3114 C	BDL	0.01-2	0.01	0.05
56.	Zinc as Zn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.02-50	5.0	15
57.	Total Chromium as Cr	mg/l	APHA, 23rd Ed.2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
58.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed.2017, 5530 A+C	BDL	1-10	0.001	0.002
59.	Free Residual Chlorine	mg/l	APHA, 23rd Ed.2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
60.	Mercury as Hg	mg/l	APHA, 23rd Ed.2017, 3112 A+B	BDL	0.001-1	0.001	No Relax
61.	Lead as Pb	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.01-1	0.01	No Relax
62.	Cadmium as Cd	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.002-2	0.003	No Relax
63.	Boron as B	mg/l	APHA, 23rd Ed.2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
64.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed.2017, 5540 A+C	BDL	0.01-5	0.2	1.0
65.	Sulphide as S2	mg/l	APHA,23rd Ed. : 2017,4500 S2- F	BDL	0.5-10	0.05	No Relax
66.	Nickel as Ni	mg/l	APHA,23rd Ed. : 2017,3111 A+B	BDL	0.02-5	0.02	No Relax
67.	Hexavalent Chromium as Cr6+	mg/l	APHA,23rd Ed. : 2017,3500 A+B	BDL	0.05-5	-	-
68.	Phosphate as PO4	mg/l	APHA,23rd Ed. : 2017,4500 PD	BDL	0.1-50	-	-
69.	Total coliform	Per 100 ml	IS15185:2016;RA:2021	Absent	<1	Absent	Absent
70.	E. Coli	Per 100 ml	IS-15185,2016 RA-2021	Absent	<1	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ecoMen
ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746282
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12751

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron& Managnese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400001264F**
		Test Report No.	**ECO/LAB/GW/055/0390/01/2025**
		Issue Date of Test Report	**31.01.2025**
Type of Sample	Ground Water		
Sample Registration No.	055	**Name of Location**	Near workshop
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	23.01.2025	**Time of Sample Collection**	-
Date of Sample Received	25.01.2025	**Time of Sample Received**	10:30 AM
Start Date of Analysis	25.01.2025	**End Date of Analysis**	31.01.2025
Laboratory Environmental Condition	Temperature: 27 ± 2 ℃	**Sample Quantity**	As Per Requirement
	Humidity: 56 %	**Sample ID Code**	ECO/LAB/0390/01/2025

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012(Reaff:2018)	
						Desirable	Permissible
71.	Colour	Hazen	APHA, 23rd Ed.2017, 2120 B	<5.0	5-100	5.00	15.0
72.	Odour	-	APHA, 23rd Ed.2017,2150 B	Agreeable	Qualitative	Agreeable	Agreeable
73.	Turbidity as Tb	NTU	APHA, 23rd Ed.2017, 2130-A+B	BDL	1 - 100	1.0	5.0
74.	pH	-	APHA, 23rd Ed.2017, 4500H+ A+B	6.98	2.0 -12	6.5-8.5	No Relax.
75.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed.2017,2540-C	BDL	5 - 5000	-	-
76.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed.2017, 2540-C	218.0	5 - 5000	500	2000
77.	Total Alkalinity	mg/l	APHA, 23rd Ed.2017,2320 A+ B	74.0	5-1500	200	600
78.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed.2017,2340 A+C	80.0	5-1500	200.0	600.0
79.	Calcium as Ca	mg/l	APHA, 23rd Ed.2017,3500 Ca A+B	18.20	5 – 1000	75.0	200.0
80.	Magnesium as Mg	mg/l	APHA, 23rd Ed.2017, 3500 Mg A+B	7.47	5-1000	30.0	100.0
81.	Sodium as Na	mg/l	APHA,23rd Ed. : 2017,3500 Na A+B	9.45	1-100	-	-
82.	Potassium as K	mg/l	APHA,23rd Ed. : 2017,3500 K A+B	1.06	1-100	-	-
83.	Sulfate as SO_4	mg/l	APHA, 23rd Ed.2017, 4500-SO_4^{2-} E	7.42	1.0 -250	200.0	400.0
84.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed.2017, 4500-NO_3^- B	5.42	5.0 - 100	45.0	No Relax.
85.	Chloride as Cl	mg/l	APHA, 23rd Ed.2017, 4500 Cl A+B	22.0	5-1000	250.0	1000.0
86.	Fluorides as F	mg/l	APHA, 23rd Ed.2017, 4500-C	0.20	0.05-10	1.0	1.5
87.	Copper as Cu	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.05-5	0.05	1.5
88.	Iron as Fe	mg/l	APHA, 23rd Ed.2017, 3500 Fe B	0.10	0.02-50	0.3	No Relax.
89.	Manganese as Mn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.1-5	0.10	0.30
90.	Arsenic as As	mg/l	APHA, 23rd Ed.2017, 3114 C	BDL	0.01-2	0.01	0.05
91.	Zinc as Zn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.02-50	5.0	15
92.	Total Chromium as Cr	mg/l	APHA, 23rd Ed.2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
93.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed.2017, 5530 A+C	BDL	1-10	0.001	0.002
94.	Free Residual Chlorine	mg/l	APHA, 23rd Ed.2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
95.	Mercury as Hg	mg/l	APHA, 23rd Ed.2017, 3112 A+B	BDL	0.001-1	0.001	No Relax
96.	Lead as Pb	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.01-1	0.01	No Relax
97.	Cadmium as Cd	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.002-2	0.003	No Relax
98.	Boron as B	mg/l	APHA, 23rd Ed.2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
99.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed.2017, 5540 A+C	BDL	0.01-5	0.2	1.0
100.	Sulphide as S2	mg/l	APHA,23rd Ed. : 2017,4500 S2- F	BDL	0.5-10	0.05	No Relax
101.	Nickel as Ni	mg/l	APHA,23rd Ed. : 2017,3111 A+B	BDL	0.02-5	0.02	No Relax
102.	Hexavalent Chromium as Cr6+	mg/l	APHA,23rd Ed. : 2017,3500 A+B	BDL	0.05-5	-	-
103.	Phosphate as PO4	mg/l	APHA,23rd Ed. : 2017,4500 PD	BDL	0.1-50	-	-
104.	Total coliform	Per 100 ml	IS15185:2016;RA:2021	Absent	<1	Absent	Absent
105.	E. Coli	Per 100 ml	IS-15185,2016 RA-2021	Absent	<1	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746282
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12751

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron& Managnese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400001265F**
		Test Report No.	**ECO/LAB/GW/055/12650391/01/2025**
		Issue Date of Test Report	**31.01.2025**
Type of Sample	Ground Water		
Sample Registration No.	055	**Name of Location**	Quarry-4
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	23.01.2025	**Time of Sample Collection**	-
Date of Sample Received	25.01.2025	**Time of Sample Received**	10:30 AM
Start Date of Analysis	25.01.2025	**End Date of Analysis**	31.01.2025
Laboratory Environmental Condition	Temperature: 27 ± 2 ℃	**Sample Quantity**	As Per Requirement
	Humidity: 56 %	**Sample ID Code**	ECO/LAB/0391/01/2025

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012(Reaff:2018)	
						Desirable	Permissible
106.	Colour	Hazen	APHA, 23rd Ed.2017, 2120 B	<5.0	5-100	5.00	15.0
107.	Odour	-	APHA, 23rd Ed.2017,2150 B	Agreeable	Qualitative	Agreeable	Agreeable
108.	Turbidity as Tb	NTU	APHA, 23rd Ed.2017, 2130-A+B	BDL	1 - 100	1.0	5.0
109.	pH	-	APHA, 23rd Ed.2017, 4500H+ A+B	6.98	2.0 -12	6.5-8.5	No Relax.
110.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed.2017,2540-C	BDL	5 - 5000	-	-
111.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed.2017, 2540-C	218.0	5 - 5000	500	2000
112.	Total Alkalinity	mg/l	APHA, 23rd Ed.2017,2320 A+ B	78.0	5-1500	200	600
113.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed.2017,2340 A+C	82.0	5-1500	200.0	600.0
114.	Calcium as Ca	mg/l	APHA, 23rd Ed.2017,3500 Ca A+B	19.21	5 – 1000	75.0	200.0
115.	Magnesium as Mg	mg/l	APHA, 23rd Ed.2017, 3500 Mg A+B	7.54	5-1000	30.0	100.0
116.	Sodium as Na	mg/l	APHA,23rd Ed. : 2017,3500 Na A+B	9.32	1-100	-	-
117.	Potassium as K	mg/l	APHA,23rd Ed. : 2017,3500 K A+B	1.12	1-100	-	-
118.	Sulfate as SO_4	mg/l	APHA, 23rd Ed.2017, 4500-SO_4^{2-} E	7.52	1.0 -250	200.0	400.0
119.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed.2017, 4500-NO_3^- B	5.62	5.0 - 100	45.0	No Relax.
120.	Chloride as Cl	mg/l	APHA, 23rd Ed.2017, 4500 Cl A+B	23.0	5-1000	250.0	1000.0
121.	Fluorides as F	mg/l	APHA, 23rd Ed.2017, 4500-C	0.22	0.05-10	1.0	1.5
122.	Copper as Cu	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.05-5	0.05	1.5
123.	Iron as Fe	mg/l	APHA, 23rd Ed.2017, 3500 Fe B	0.10	0.02-50	0.3	No Relax.
124.	Manganese as Mn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.1-5	0.10	0.30
125.	Arsenic as As	mg/l	APHA, 23rd Ed.2017, 3114 C	BDL	0.01-2	0.01	0.05
126.	Zinc as Zn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.02-50	5.0	15
127.	Total Chromium as Cr	mg/l	APHA, 23rd Ed.2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
128.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed.2017, 5530 A+C	BDL	1-10	0.001	0.002
129.	Free Residual Chlorine	mg/l	APHA, 23rd Ed.2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
130.	Mercury as Hg	mg/l	APHA, 23rd Ed.2017, 3112 A+B	BDL	0.001-1	0.001	No Relax
131.	Lead as Pb	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.01-1	0.01	No Relax
132.	Cadmium as Cd	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.002-2	0.003	No Relax
133.	Boron as B	mg/l	APHA, 23rd Ed.2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
134.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed.2017, 5540 A+C	BDL	0.01-5	0.2	1.0
135.	Sulphide as S2	mg/l	APHA,23rd Ed. : 2017,4500 S2- F	BDL	0.5-10	0.05	No Relax
136.	Nickel as Ni	mg/l	APHA,23rd Ed. : 2017,3111 A+B	BDL	0.02-5	0.02	No Relax
137.	Hexavalent Chromium as Cr6+	mg/l	APHA,23rd Ed. : 2017,3500 A+B	BDL	0.05-5	-	-
138.	Phosphate as PO4	mg/l	APHA,23rd Ed. : 2017,4500 PD	BDL	0.1-50	-	-
139.	Total coliform	Per 100 ml	IS15185:2016;RA:2021	Absent	<1	Absent	Absent
140.	E. Coli	Per 100 ml	IS-15185,2016 RA-2021	Absent	<1	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ecoMen
ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746282
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12751

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron& Managnese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400001266F**
		Test Report No.	**ECO/LAB/GW/055/0392/01/2025**
		Issue Date of Test Report	**31.01.2025**
Type of Sample	Ground Water		
Sample Registration No.	055	**Name of Location**	Bor well gate no 1
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	23.01.2025	**Time of Sample Collection**	-
Date of Sample Received	25.01.2025	**Time of Sample Received**	10:30 AM
Start Date of Analysis	25.01.2025	**End Date of Analysis**	31.01.2025
Laboratory Environmental Condition	Temperature: 27 ± 2 ℃	**Sample Quantity**	As Per Requirement
	Humidity: 56 %	**Sample ID Code**	ECO/LAB/0392/01/2025

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as per IS 10500:2012(Reaff:2018)	
						Desirable	Permissible
141.	Colour	Hazen	APHA, 23rd Ed.2017, 2120 B	<5.0	5-100	5.00	15.0
142.	Odour	-	APHA, 23rd Ed.2017,2150 B	Agreeable	Qualitative	Agreeable	Agreeable
143.	Turbidity as Tb	NTU	APHA, 23rd Ed.2017, 2130-A+B	BDL	1 - 100	1.0	5.0
144.	pH	-	APHA, 23rd Ed.2017, 4500H+ A+B	6.86	2.0 -12	6.5-8.5	No Relax.
145.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed.2017,2540-C	BDL	5 - 5000	-	-
146.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed.2017, 2540-C	226.0	5 - 5000	500	2000
147.	Total Alkalinity	mg/l	APHA, 23rd Ed.2017,2320 A+ B	78.0	5-1500	200	600
148.	Total Hardness as $CaCO_3$	mg/l	APHA, 23rd Ed.2017,2340 A+C	80.0	5-1500	200.0	600.0
149.	Calcium as Ca	mg/l	APHA, 23rd Ed.2017,3500 Ca A+B	19.32	5 – 1000	75.0	200.0
150.	Magnesium as Mg	mg/l	APHA, 23rd Ed.2017, 3500 Mg A+B	7.54	5-1000	30.0	100.0
151.	Sodium as Na	mg/l	APHA,23rd Ed. : 2017,3500 Na A+B	9.35	1-100	-	-
152.	Potassium as K	mg/l	APHA,23rd Ed. : 2017,3500 K A+B	1.08	1-100	-	-
153.	Sulfate as SO_4	mg/l	APHA, 23rd Ed.2017, 4500-SO_4^{2-} E	7.74	1.0 -250	200.0	400.0
154.	Nitrate Nitrogen as NO_3	mg/l	APHA, 23rd Ed.2017, 4500-NO_3^- B	5.86	5.0 - 100	45.0	No Relax.
155.	Chloride as Cl	mg/l	APHA, 23rd Ed.2017, 4500 Cl A+B	22.2	5-1000	250.0	1000.0
156.	Fluorides as F	mg/l	APHA, 23rd Ed.2017, 4500-C	0.22	0.05-10	1.0	1.5
157.	Copper as Cu	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.05-5	0.05	1.5
158.	Iron as Fe	mg/l	APHA, 23rd Ed.2017, 3500 Fe B	0.08	0.02-50	0.3	No Relax.
159.	Manganese as Mn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.1-5	0.10	0.30
160.	Arsenic as As	mg/l	APHA, 23rd Ed.2017, 3114 C	BDL	0.01-2	0.01	0.05
161.	Zinc as Zn	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.02-50	5.0	15
162.	Total Chromium as Cr	mg/l	APHA, 23rd Ed.2017, 3111A+B	BDL	0.05-20	0.05	No Relax.
163.	Phenolic Compounds as C_6H_5OH	mg/l	APHA, 23rd Ed.2017, 5530 A+C	BDL	1-10	0.001	0.002
164.	Free Residual Chlorine	mg/l	APHA, 23rd Ed.2017, 4500-Cl B	BDL	0.5-10	0.20	1.0
165.	Mercury as Hg	mg/l	APHA, 23rd Ed.2017, 3112 A+B	BDL	0.001-1	0.001	No Relax
166.	Lead as Pb	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.01-1	0.01	No Relax
167.	Cadmium as Cd	mg/l	APHA, 23rd Ed.2017, 3111 A+B	BDL	0.002-2	0.003	No Relax
168.	Boron as B	mg/l	APHA, 23rd Ed.2017, 4500 B A+C	BDL	0.2-10	0.5	1.0
169.	Anionic detergent as MABS	mg/l	APHA, 23rd Ed.2017, 5540 A+C	BDL	0.01-5	0.2	1.0
170.	Sulphide as S2	mg/l	APHA,23rd Ed. : 2017,4500 S2- F	BDL	0.5-10	0.05	No Relax
171.	Nickel as Ni	mg/l	APHA,23rd Ed. : 2017,3111 A+B	BDL	0.02-5	0.02	No Relax
172.	Hexavalent Chromium as Cr6+	mg/l	APHA,23rd Ed. : 2017,3500 A+B	BDL	0.05-5	-	-
173.	Phosphate as PO4	mg/l	APHA,23rd Ed. : 2017,4500 PD	BDL	0.1-50	-	-
174.	Total coliform	Per 100 ml	IS15185:2016;RA:2021	Absent	<1	Absent	Absent
175.	E. Coli	Per 100 ml	IS-15185,2016 RA-2021	Absent	<1	Absent	Absent

Statement of Conformity: The above tested parameters confirm as per IS-10500-2012 (Reaff.-2018) limits for above tested parameters and the results are related to the sample tested.

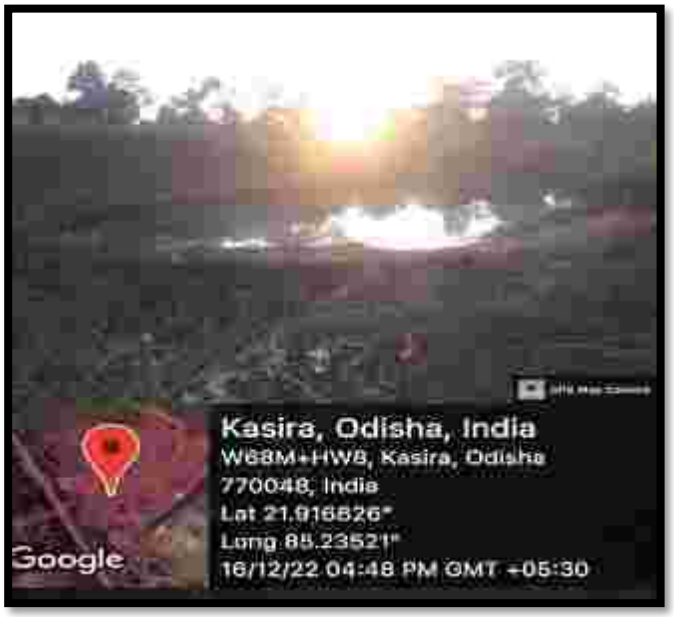
Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ANNEXURE XVII

RECHARGE PITS



Water Harvesting Pond Near Manganese quarry



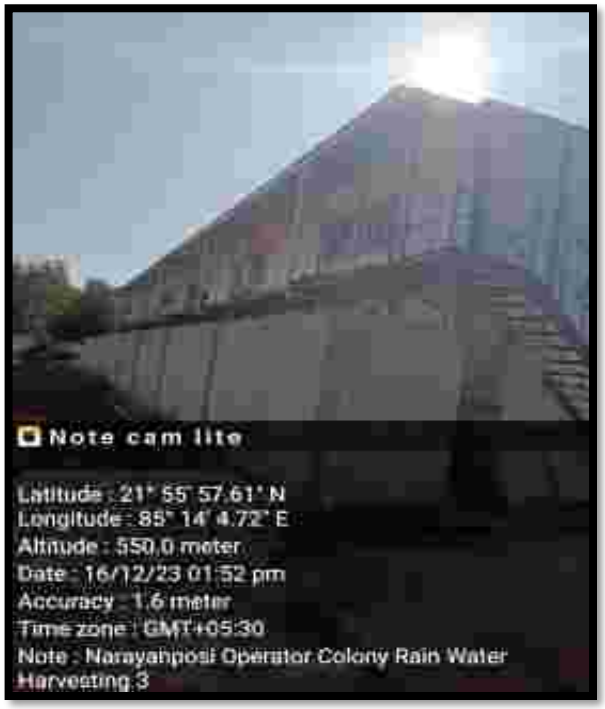
Ground Water Recharge Pit near Gate 2



Recharge pit in Baba Math

ROOF TOP RAINWATER HARVESTING SYSTEM









ANNEXURE XVIII

National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

ECOMEN LABORATORIES PVT. LTD.

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

SECOND FLOOR HALL, HOUSE NO. B-1/8, SECTOR-H, ALIGANJ, LUCKNOW, UTTAR PRADESH, INDIA

in the field of

TESTING

Certificate Number: TC-9539

Issue Date: 21/05/2023 **Valid Until:** 20/05/2025

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: ECOMEN LABORATORIES PRIVATE LIMITED

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

ANNEXURE XIX

Effluent Treatment Plant (ETP) with Oil & Grease Separation System





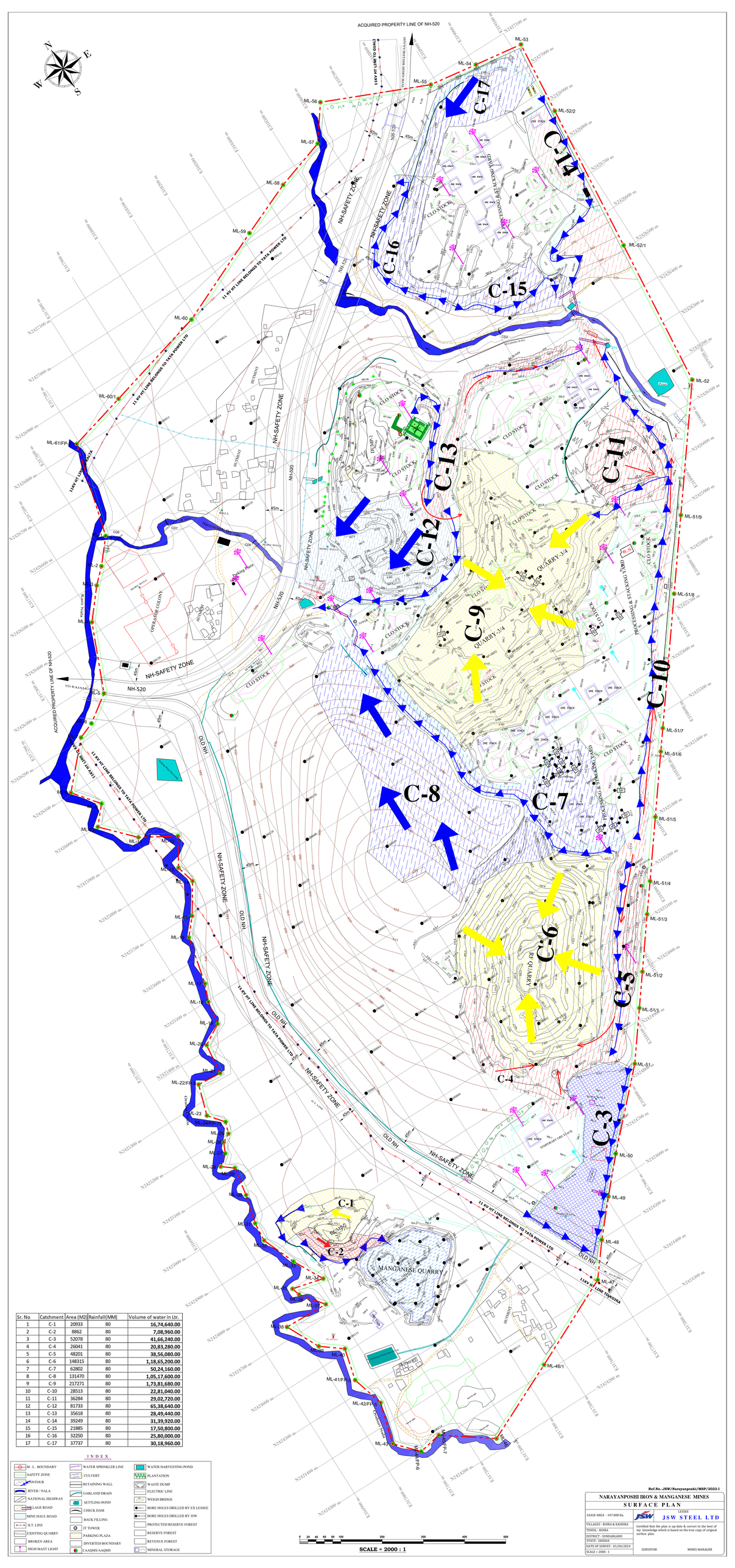
ANNEXURE XX

Sewage treatment plant





ANNEXURE XXI



Sr. No	Catchment	Area (M2)	Rainfall(MM)	Volume of water in Ltr.
1	C-1	20933	80	16,74,640.00
2	C-2	8862	80	7,08,960.00
3	C-3	52078	80	41,66,240.00
4	C-4	26041	80	20,83,280.00
5	C-5	48201	80	38,56,080.00
6	C-6	148315	80	1,18,65,200.00
7	C-7	62802	80	50,24,160.00
8	C-8	131470	80	1,05,17,600.00
9	C-9	217271	80	1,73,81,680.00
10	C-10	28513	80	22,81,040.00
11	C-11	36284	80	29,02,720.00
12	C-12	81733	80	65,38,640.00
13	C-13	35618	80	28,49,440.00
14	C-14	39249	80	31,39,920.00
15	C-15	21885	80	17,50,800.00
16	C-16	32250	80	25,80,000.00
17	C-17	37737	80	30,18,960.00

INDEX

- M. L. BOUNDARY
- SAFETY ZONE
- CONTOUR
- RIVER / NALA
- NATIONAL HIGHWAY
- LAGE ROAD
- MINE HAUL ROAD
- H.T. LINE
- EXISTING QUARRY
- BROKEN AREA
- HIGH MAST LIGHT
- WATER SPRINKLER LINE
- CULVERT
- RETAINING WALL
- GARLAND DRAIN
- SETTLING POND
- CHECK DAM
- BACK FILLING
- IT TOWER
- PARKING PLAZA
- DIVERTED BOUNDARY
- CA/QMS/AA/MS
- WATER HARVESTING POND
- PLANTATION
- WASTE DUMP
- ELECTRIC LINE
- WEIGH BRIDGE
- BORE HOLES DRILLED BY EX LESSEE
- BORE HOLES DRILLED BY JSW
- PROTECTED RESERVE FOREST
- RESERVE FOREST
- REVENUE FOREST
- MINERAL STORAGE

Ref.No.-JSW/Narayanposhi/MSP/2023-1

NARAYANPOSHI IRON & MANGANESE MINES

SURFACE PLAN

LEASE AREA - 347.000 Hs

VILLAGES - KOIRA & KASHIRA

TEHSIL - KOIRA

DISTRICT - SUNDARGARH

STATE - ODISHA

DATE OF SURVEY - 01/04/2024

SCALE - 2000 : 1

LESSEE

JSW STEEL LTD

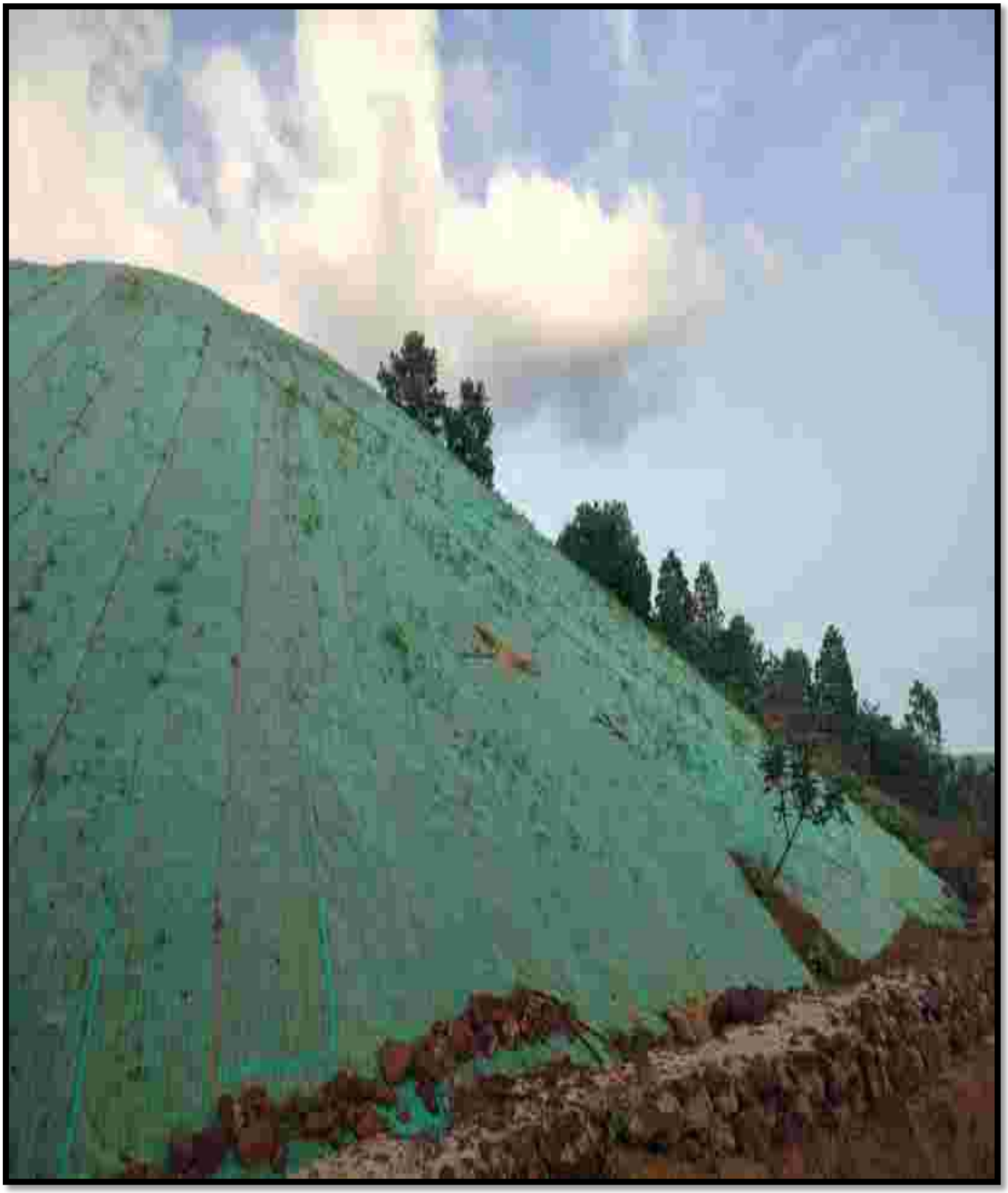
Certified that the plan is up-date & correct to the best of my knowledge which is based on the true copy of original surface plan.

SURVEYOR

MINES MANAGER

ANNEXURE XXII

COIR MATTING






realme
Shot on realme 8 5G

VETIVER GRASS PLANTATION





ANNEXURE XXIII

WASTE DUMP

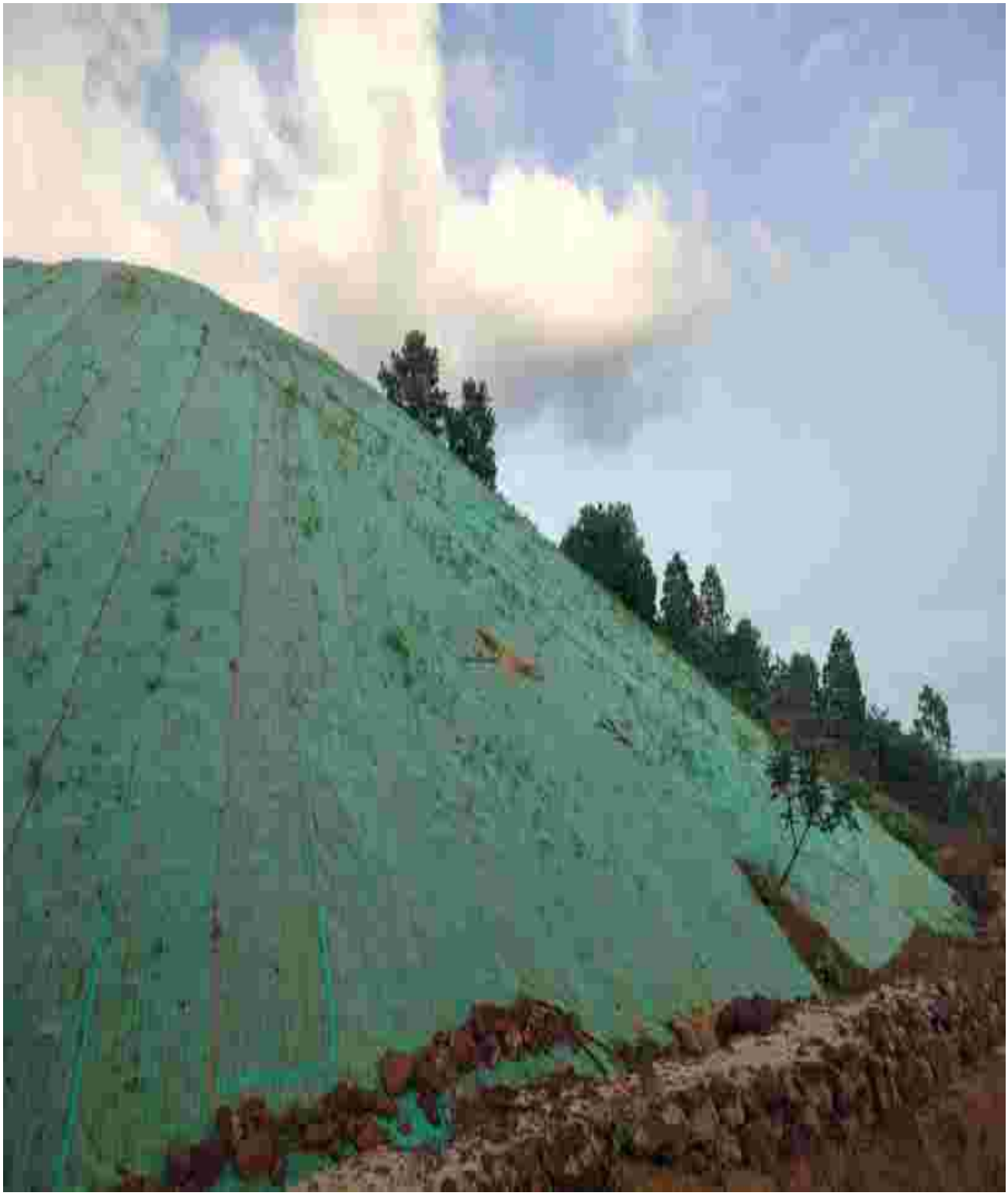




OB Dump

Manganese Dump







Manganeses Dump


GPS Map Camera
Bhanjapali, Odisha, India
Unnamed Road, Bhanjapali, Odisha 770048, India
Lat 21.917281°
Long 85.23008°
21/12/23 03:47 PM GMT +05:30
Google

Low grade stack





ANNEXURE XXIV

Water stored in pits used for dust suppression





ANNEXURE XXV

Fodder plots/grazing land in non-mineralized area









ANNEXURE XXVI

SCIENTIFIC STUDY OF THE STABILITY OF PIT SLOPE and DUMP SLOPE IN IRON ORE MINES OF ODISHA

(Narayanposhi Iron and Manganese Mines, JSW Steel Ltd.)



(Source: https://earth.google.com/web)

Dept. of Mining Engineering
National Institute of Technology, Rourkela

June - 2023

Scientific Study of the Stability of Pit Slope and Dump Slope in Iron Ore Mines of Odisha

(Narayanposhi Iron and Manganese Mines, JSW Steel Ltd.)

(Work order no. Odisha Mines/118402/SER/4500141067 date. 16-04-2022)





AN INVESTIGATION REPORT

Submitted by

Prof Manoj Kumar Mishra, PhD

Dept. of Mining Engineering
National Institute of Technology, Rourkela

June - 2023

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Acknowledgment…

We take this opportunity to express our deep sense of gratitude to M/S *JSW Steel Ltd, NARAYANPOSHI* for awarding the investigation project titled *"Scientific study on Slope Stability of iron and manganese ore mines in Odisha (Location: NARAYANPOSHI Iron and Manganese Mines)"* to National Institute of Technology. Rourkela.

We appreciate the opportunity, confidence and help extended by Mr. B. R. K. Padhi, VP(Mines), Mr. Vijay Kumar (Health & Safety), Mr.I. K. Saha, Mine Manager, Mr. Atmaranjan Pradhan, Safety officer (Mine) to address one of the technical issues in the mine and in the subsequent investigations. The quantum of the work involved right from the first field visit to the preparation of the project report has been a great sense of inspiration and challenge. We are obliged to each officer for their continuous help and inputs during the progress of the work. Their warm hospitality to each member of the team is also thankfully acknowledged.

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(Prof. M. K. Mishra)
Principal Investigator

Date: 07-09-2023

Disclaimer

This report is a classified document and meant for the internal use of the organization JSW Steel Ltd, Narayanposhi Iron and Manganese Mines, Odisha. This report, in full or part can neither be quoted, nor published anywhere by anybody other than the investigators or the organization. It can however be communicated to Government agencies only on demand.

There is little scope for control of day-to-day activities at the NARAYANPOSHI IRON AND MANGANESE MINES site by NIT Rourkela, nor it is possible to have any such control, and hence NIT Rourkela not responsible for proper implementation of the recommendations.

This investigation on the " Scientific study on Slope Stability of iron and manganese ore mines in Odisha (Location: NARAYANPOSHI Iron and Manganese Mines) was carried out by a team led by Dr. Manoj K. Mishra of N.I.T, Rourkela. Neither Dr. M. K. Mishra, any member of the investigating teams, nor NIT, Rourkela assumes any liabilities with respect to the use of or for damages resulting from the use of, any information, method or process disclosed in this report.

1.0 Introduction

Surface mining operation is a major and popular process to excavate earth materials. Though this approach is relatively simple and fast, yet it often endangers the men and machines, and thus its profitability, unless scientifically planned. Bench mining or slope system is a major part of the surface excavation system. Correct slope design and its stability has been a major challenge to mine operation. The slope design involves knowledge of geotechnical parameters, geological influences, correct slope height, slope angle and overall angle. Government regulation also warrants carrying out slope design as a part of the statutory requirement.

1.1 Brief Background of the Project

NIT Rourkela received a work order vide purchase order no Odisha Mines/118402/SER/4500141067 dated 16-04-2022 from JSW Steel Ltd., Barbil, Odisha for scientific study of the stability of pit slope and dump slope in its Narayanposhi Iron and Manganese Mines, Odisha. This is an assignment that originated in 01-09-2020 from JSW Steel Ltd, Dolvi (Maharastra). NIT Rourkela accepted the order on 2nd June 2022 and initiated investigation. As a part of the investigation, the team initiated the investigation in June-2022 and made many visits to the mine. The team discussed with mine officials, inspected the area, carried out geological study, and identified a few sample location of the iron and manganese ore deposit at the Narayanposhi Iron and Manganese Mines.

1.2 Scope of work

The aim of the investigation was to carry out scientific study of the stability of pit slope and dump slope in iron and manganese ore mines in Odisha, JSW Steel Ltd., Barbil. The scope of work as outlined in the work order was.

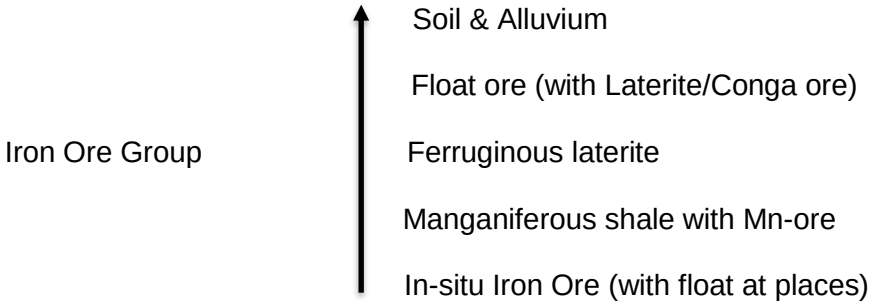
i. To undertake the study of slope stability to arrive ultimate pit slope and dump slope for long term safety.
ii. Suggest methods for dump slope monitoring.
iii. Suggest best practices for slope maintenance and its stabilization.
iv. Optimization of dump slope parameters for capacity maximization.
v. Recommendation for following, considering geotechnical characteristics of deposit:
    a) Slope angle for working and final pit
    b) Dump design parameters (Dump height and slope; bench height and slope angle)
    c) Monitoring method of PIT and dump slope stability

1.3 Geology of the area

Narayanposhi Iron and Manganese Ore Mine are in the southern end of the western limb of the Horse-shoe shaped Iron Ore Range of West Singhbhum-Keonjhar-Sundargarh district of Jharkhand & Odisha. The rock types found within the leasehold belong to Banded Iron Formation of Koira Group. The main litho units mapped in this area are laterite, Banded Hematite Jasper, shale of different nature and cherty phyllite. Alluvium occupies especially the low-lying areas. This is a meta-sedimentary deposit of Bonaisynclinorium.

1.3.1 Geological Setting

Based on the field studies, the stratigraphic sequence of different litho assemblages of the area is interpreted as follows:



Soil & Alluvium: Traverses along and across the leasehold, however, show that alluvial soil covers a sizeable portion of the area. The alluvium occupies especially the low lying area. These areas are appeared to be barren where village site and low yielding agricultural fields are seen.

Ferruginous Laterite: Ferruginous laterites occur as intermediate waste and capping at places on the in-situ Iron ore horizons having Fe content or less than 55% and contain both hematite and goethite.

Float Iron Ore: The float iron ore zones may be considered of two types. The ores are mostly of massive type with big lumps and occur along with lateritic horizons. Float zone continues up to 5-7 m from surface level which is seen in quarry 5 & 6. The second variety of float ore over (+) 10 to (-)40mm size with laterite, which is observed in Quarry-1.

Conga Zone: In the north eastern corner and western part of the area, conga zones are exposed consisting of boulders, cobbles and pebbles of iron ores re-cemented by lateritic materials. These materials are seen in and around Quarry-4 (old) and Quarry-5.

In-situ Iron Ore: Below the float ore zone, in-situ ore exists and proved up to a depth of 60m from surface level. Because of its boulder nature, it is sometimes mistaken as float ore. An in-situ ore zone is delineated covering all in-situ ore working quarries like Q-1, 3, 4, 7 etc.

However, on the basis of depth persistence, in-situ ore zone is delineated around the Q-1, 2, 3, 4, 6 & 7.

Manganiferous Shale: Most of the workable manganese ore deposits occur within this formation. The shale is mostly ferruginous, grey, pink in colour with white streaks. These coloured members do not occur in conspicuous band rather than they are highly mixed up. Manganese bodies usually occur on the crest of the domes in the variegated shale formed due to the superposed folding.

1.3.2 Structure (Dip and Strike)

The litho units of BIF usually trend in a NE-SW to NNE-SSW direction with westerly dips varying from 20˚ to 70˚.



Fig I: Narayanposhi Iron Mine

1.4 Mining Methodology

The mine is operated by opencast fully mechanized method. There are 2 major well-developed mechanized iron-ore and manganese quarries as Quarry-3 and 4 and RF Quarry. In all quarries, bench height is maintained up to 9 m and width up to 18 m, adhering to the MMR-1961 guidelines. During the proposed period of mining operation, excavation for iron ore is done in both of the quarries. Production capacity per annum of the mine is envisaged 6 million tons per year from the in-situ reserve.

Drilling was carried out using 115mm diameter drills with 10% subgrade drilling to avoid toe formation. Blasting was by SME (Site Mixed Emulsion Explosives) and accessories (NONEL) manufactured and supplied by Solar Industries India Ltd., Nagpur, Maharashtra. Its VOD ranges is 4000±500 m/sec, and the final density ranges 1.15±0.005 g/cc. The mines used 17 and 25 milliseconds for the Trunk-Line-Delay and 250 milliseconds for the Down-The-Hole delay. Series pattern was adopted to reduce the maximum charge per delay. Controlled blasting along with a shock tube initiation system/NONEL system was practiced to get optimum blast results and minimize hazards. Boulders generated during blasting were broken

into smaller pieces mainly by using a rock breaker. The design parameters of the mine are in table 1.

Table1: Design Features

Sl. No.	Salient Feature	Description
1	Method of Mining	Fully mechanized
2	Production	6 Mt/yr Iron ore (ROM)
3	Means of Raising	Drilling, blasting, excavation, processing, etc
4	Bench Height	upto 9 m
5	Bench Width	Upto 18 m
6	Bench Angle	85^0
7	Overall Slope	33^0
8	Transportation of ore	Through dumpers and tippers
9	Blasting Practice	Deep hole blasting to the rock mass

1.5 Safety Factor Analysis

The stability of rock slopes depends on behaviour of the shear strength created along the sliding surfaces. In general rock or rock material, is assumed to follow the Mohr Coulomb criteria and the strength is expressed in terms of cohesion 'c' and friction angle $'\emptyset'$and is expressed mathematically as $\tau = c + \sigma' tan\emptyset$ [τ = shear strength, c = cohesion, σ' = effective normal stress, and $\emptyset$ = friction angle]

The effective normal stress is the difference between the stress due to the weight of the rock lying above the sliding plane and the uplift due to any water pressure acting on this surface.

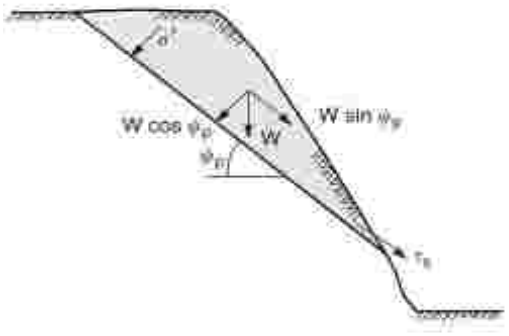


Figure II: Slope Block Analysis

The stability of the block can be quantified by the ratio of the resisting and driving forces, which is termed the factor of safety (FOS). And is given by

$$FOS = \frac{\text{Resisting Forces}}{\text{Driving Forces}}, or$$

$$FOS = \frac{cA + W\cos\psi_p \tan\emptyset}{W\sin\psi_p}$$

The resisting strength is more than the displacing stress for stability of the slope. The FOS equation at equilibrium is

$$FOS = \frac{\cos\psi_p \tan\emptyset}{\sin\psi_p} \text{or,} FOS = 1 \text{ When } \psi_p = \emptyset$$

It shows that when there are no in-filling materials, the block of rock will slide when the dip angle of the sliding surface equals the friction angle of this surface, and the stability is independent of the size of the sliding block. The block is at a condition of “limiting equilibrium” when the driving forces are exactly equal to the resisting forces and the factor of safety is equal to 1.0. Therefore, the method of slope stability analysis is termed limit equilibrium analysis. For the investigation of stability of the existing slopes, the minimum factor of safety is from 1.3 to 1.5 [3]

The Limit Equilibrium Method (LEM) is a well-known computational methodology for evaluating the Factor of Safety (FOS) and stability degree of slopes (Duncan, 1996; Krahn 2003). Limit equilibrium is the method where limit state conditions are assumed. The limited equilibrium methods (LEMs) are popular to assess the slope stability of mine geological sections.

In this slope stability investigation project, a dedicated software for LEM code Slide2D (RocScience Inc., Canada) used. Slide 2 is a two-dimensional limit equilibrium slope stability analysis program for evaluating the probability of failure of geological transverse and geological sections by identifying circular or non-circular failure-prone surfaces in soil or rock slopes. It analyzes the stability of slip surfaces using vertical slice or non-vertical slice limit equilibrium methods. This code has extensive probabilistic analysis capabilities that can carry out statistical distributions to many parameters, including material properties, support properties, loads, and water table location. The probability of failure/reliability index is determined, providing a measure of the risk factor associated with a slope design.

The evaluation needs geotechnical data were obtained from laboratory testing with the samples available.

1.6 Geotechnical Investigation

It is important that the reaction of the rocks to the changes in stresses due to the proposed excavation should be such that the resultant strain is within the tolerable limit of the engineering design. Typically, the behavior of rocks is determined from unbroken rock pieces, i.e., intact rock or rock core though rocks are heterogenous, anisotropic and inelastic. The geotechnical investigation of core specimen includes the laboratory determination of the pertinent parameters.

1.6.1 Location of sample collection points

Slope stability analysis involves understanding and dealing with the behavior of earth materials at specific locations e.g. face, bench, strata, etc. The behavior of materials are scientifically represented by its geotechnical properties as cohesion, density, angle of internal friction, compressive strength, etc. These needs sample collection and testing by established processes. The locations of samples were collected were carefully chosen depending upon site characteristics. It was made sure that the samples were collected from the bench faces. Fresh samples were collected freshly exposed faces. In absence of regular core logs, boulders of adequate sizes of about 900cm^3 each were collected and transported to the laboratory. NX core samples were prepared from those boulders. Soft material as alluvium, laterite and ochre were collected in air tight bags and processed for shear testing. The following sections discuss the procedure adopted for testing. The test specimens were obtained by cutting the core samples perpendicular to the cylindrical axis with the help of a rock cutting machine fitted (make: AIM 202, AIMIL, India). The length to diameter ratio was kept between 2.0 to 2.5 for the samples for determination of Compressive Strength. The loading surfaces of the test specimen were made flat within ± 0. 01mm.The following photographs are provided below shown are sample collection and prepared test specimens.



Figure III: Sample collection

1.6.2 Testing Procedures:

The determination of different physical and mechanical properties were carried out by IS guidelines as mentioned against each type of test and described below.

a. Density	IS: 13030-1991 (Reaffirmed 1996)
b. Compressive Strength	IS: 9143-1979 (Reaffirmed 1996)
c. Triaxial Strength	IS: 13047-1991 (Reaffirmed 2001)
d. Shear Strength	IS: 2720-part13-1986 (Reaffirmed 2002)



Figure IV: Coring operation and cored specimen

1.6.2.1 Density

Density reflects the information about the mineralogical or grain constituents. For determination of density Indian Standard 13030:1991 has been followed. Each specimen was machined to conform closely to the geometry of a right cylinder. The mass of each specimen was typically more than 600g. Each sample was put in an oven maintained at a temperature of $105^0 \pm 3^0$C for 24 hours. The samples were removed from the oven after 24 hrs and placed in desiccators for cooling. Each sample was brushed to remove loose material sticking to it. The external dimension of each specimen was determined using a digital caliper (make: Mitutoyo, Japan) with an accuracy of 0.01mm. Average of three readings each for the length and diameter were taken for calculation of volume (V). The mass (M) of each specimen was determined using a digital balance (make: Contech, India) with an accuracy of 0.001g. The density (ρ) was determined using the formula $\rho = M/V$ where M and V are Mass and volume of the sample respectively.

1.6.2.2 Uniaxial Compressive Strength

In most of the engineering design the compressive strength (UCS) of rock is one of the most important input parameters. It reflects the ultimate bearing capacity before the rock fails i.e. the total loss of integrity in the sample. The compressive strength of the test specimen was determined following IS:9143-1979. The selected specimen of length to diameter ratio between 2 to 2.5 was wiped clean and the dimensions were measured with the help a digital calliper. The measurement of diameter was carried out by taking the average of four reading obtained at about upper height, two mid-heights and lower height. The cross-sectional area was calculated from this measurement.



Figure V: Determining UCS of rock sample

The surfaces of the two bearing discs and the test specimen were wiped clean. The specimen was placed between the two platens. The upper disc was then gradually lowered onto the specimen. Care was taken to see that the axis of the specimen was properly aligned with the discs. The loading machine was operated at a stress level, typically between 0.5 to 1 MPa/sec so that the sample fails within 5 to 10 minutes of test. Load was then continuously applied at a constant rate till failure occurred and the maximum load on the specimen was recorded. The compressive strength is determined from the relation as given by the equation $\sigma_c = \frac{F}{A}$ where

σ_c is UCS; F is Failure load; and A is the cross-sectional area of the sample.

1.6.2.3 Triaxial Compression Test

Rock exhibits higher bearing capacity when the same is confined. The failure load varies with confinement pressure. Triaxial compression refers to a test with simultaneous compression of a rock sample and application of axisymmetric confining pressure. The triaxial Compressive Strength of rock samples was determined following IS 13047:1991. The result shows the cohesion and friction angle. The test sample was wiped clean and its diameter was measured

at upper, two-mid and lower heights respectively. The average value was used to calculate the cross-sectional area of the test sample. The sample was then put in the triaxial cell (make: AIMIL, India).



Fig VI: Triaxial Setup and Fractured Sample

The specimen, the platens and the spherical seat were accurately aligned to ensure that they are coaxial with others. The cell was then filled up with hydraulic oil, allowing the air to escape through an air bleeder valve. The air bleeder valve was then closed. The cell was then placed into the axial loading device. The axial load and the confining pressure were increased simultaneously in such a way that axial stress and confining pressure were approximately equal and until the predetermined test level for the confining pressure reached. The axial load was then increased continuously without shock to produce an approximately constant rate of load for deformation. The maximum axial load and the corresponding confining pressure were recorded. Then the confining pressure and corresponding longitudinal failure strength were plotted in the same scale to plot Mohr analysis for the determination of cohesion and angle of internal friction. The lateral confinement was provided between 0.98 and 3.92 MPa.

1.6.2.4 Shear Strength Test

The top layers of the strata consist of different varieties of soil as yellow, yellow loamy, brown, of varying grain sizes, etc. These materials as well as laterite, broken shales also constitute the overburden. The parameters that govern its engineering behaviour are cohesion and the angle of internal friction apart from the unit weight. Those are typically determined from the direct shear strength test. Samples from different locations of the overburden dump area were collected as per standard practice in the air tight bags. All the samples were mixed thoroughly discarding pebbles and gravels as per IS: 2770 requirement. Specimen sizes 60x60x25 cm^3

were made and cured as both dry state as well as 95±5% humidity to represent extreme conditions. The test involves applying horizontal load on the soil specimen so as to undergo sharing with a constant the vertical normal load. The relationship between normal stress and shear stress at failure provide the shear strength parameters (cohesion and internal friction angle). The specimen and testing of shear strength parameters was carried out as per IS:2720 (Part # 13, 1986 (Reaffirmed 2002).



Fig VII: Direct Shear test

The joint in rock cores didn't exhibit any regular pattern, thickness, and presence. Hence the shear strength tests of the rock cores have not been performed to know the characteristics of joint filling material.

1.6.2.5 Test Results:

The results of the different tests carried out on the rock cores are reported in following pages. Density values represent the average values of the particular rock type. The photographs of testing arrangement, some typical failure profiles obtained during the testing have been given for the rock in compression, shear, and triaxial testing.

1.6.3 Rock Mass Classification

Cylindrical rock cores or samples of intact rocks are tested in the laboratory to determine their properties. However, such experimentations only reveal the strength of the intact rock masses and the data exhibited in the field often do not confirm to that in the laboratory tests. This is mainly due to the presence of discontinuities that causes instability to the rocks in the form of planes of weaknesses. One such approach by which the strengths of the rocks are reduced by visibly observing the discontinuities present in them is the Geological Strength Index (GSI), wherein the strength parameters of the rocks are considerably reduced to confirm to that of the rock masses exhibited in the field.

1.6.4 GEOLOGICAL STRENGTH INDEX (GSI)

A new rock mass classification scheme was introduced by Hoek and Brown (1997) based on visual observations of geological conditions making it simple, fast and reliable. It is called the Geological Strength Index (GSI). It reflects the property of a discontinuous or jointed rock mass which influences its strength and deformability. GSI considers the shapes of contact rock pieces as represented by its boundaries and degree of interlocking as well as the conditions on the surface separating those. The surface conditions vary from very good to very poor with GSI values between 100 and 0 respectively. The interlocking blocks vary between intact or massive to laminated or sheared. The mine area is constituted of multiple strata types. The upper layer at places exhibits soft laminated ore band but interspersed with laterite. Iron ore +55% is also observed in the outcrop (as in 200N). The observed material consists of majorly laterite with loose shale among others and the overburden is soft, a GSI value corresponding to blocky or many intersecting discontinuities sets with mixture of angular and rounded particles was taken as 40. Similarly, for other ore types – BHJ/BHQ, Iron ore 45-55%, shale, and Iron ore +55%, the GSI values were considered from the chart (*Figure VIII*). Those values are shown in Table 1 to 3.







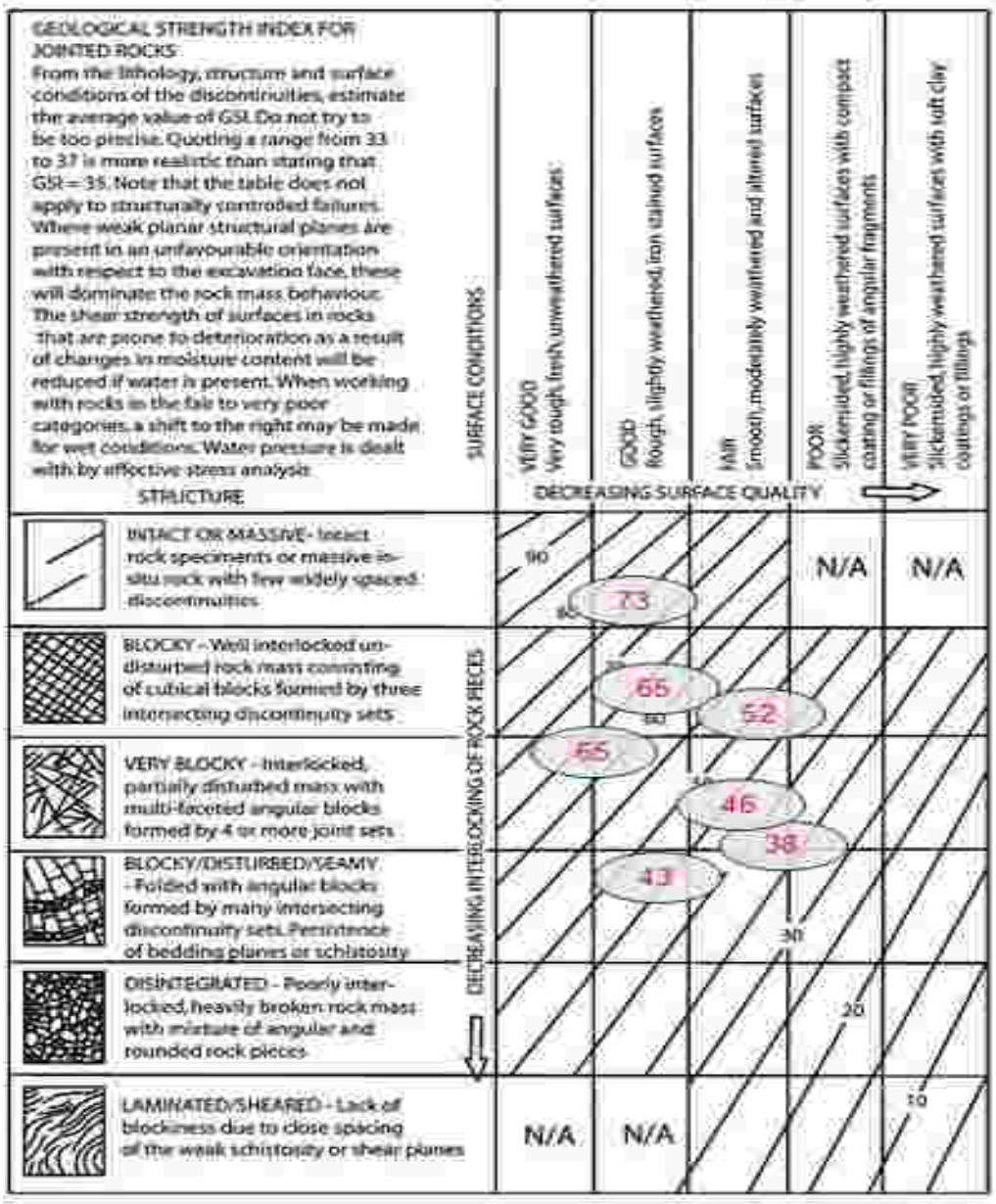


Fig VIII: The Geological Strength Index (GSI) chart used for rock mass

1.7 Slope Design, Modelling and Boundary Conditions

The shear strength of the rock mass including that of the joints and discontinuities typically influence stability of slopes. The determination of the rock behavior subjected to deformation including that of the joint and joint filling materials is a complex phenomenon. Hence, those are determined indirectly involving both laboratory data and test data. A number of such approaches exist for the determination of slope stability, however, intact rock criteria, Mohr-Coulomb (MC) and Hoek-Brown are the most popular approaches that are evaluated here. MC considers a linear relationship between shear strength and gravitational loading whereas HB considers a non-linear relationship. A few of those approaches for slope design are

discussed below are used to find the shear strength as cohesion 'c' and angle of internal friction 'φ'.

I. Mohr-Coulomb Approach:

It used the intact rock strength parameters i.e., cohesion and friction angle to find the factor of safety. It overestimates the rock mass strength or behavior in field conditions.

II. Generalized Hoek-Brown Approach:

It considers rock mass parameters like mineralogy, composition, grain size influence, degree of fracture, site influence, disturbance expected due to blasting and stress relief as well as visual observation data. The following are some of the empirical equations used to predict the rock mass parameters:

$$m_b = m_i \exp\left(\frac{GSI - 100}{28 - 14D}\right)$$

$$s = \exp\left(\frac{GSI - 100}{9 - 3D}\right)$$

$$a = \frac{1}{2} + \frac{1}{6}\left(e^{-\frac{GSI}{15}} - e^{-\frac{20}{3}}\right)$$

$$\sigma_{cm} = \frac{2c'cos\varphi'}{1 - sin\varphi'}$$

$$\sigma_{tm} = \frac{2c'cos\varphi'}{1 + sin\varphi'}$$

$$\sigma_{tm} = -\frac{s.\sigma_{ci}}{m_m}$$

Where, σ_{cm}, σ_{tm}, σ_{ci}, c' and φ' are uniaxial compressive strength of rock mass, tensile strength of rock mass, uniaxial compressive strength of intact rock, cohesion and angle of internal friction of rock mass respectively. The other parameter *D* is a factor for near surface blast damage and stress reduction, m_m, and m_i are Hoek and Brown parameter for rock mass and intact rock respectively depending on mineralogy, composition and grain size influence, *s* is a rock mass characteristic, i.e., how fractured the rock mass is with typical values in the range of 0.001 to 1 and *a* is a site constant for quality of rock, about 0.5. in this investigation. The surface mine would require blasting for excavation process. Therefore, the value of *D* is considered to be 1 for such conditions where production blasting is carried out, and 0.7 where the rock mass can be extracted by mechanical excavations. The compressive and tensile strength values exhibited at the field are much less than that obtained in the laboratory testing. The effective uniaxial compressive strength value of the rock mass is determined from the empirical equation proposed by Marinos and Hoek (2001) as below:

$$\sigma_{cm} = 0.0034 m_i^{0.8} \sigma_{ci} (1.029 + 0.025 e^{-0.1 m_i})^{GSI}$$

III. Mohr-Coulomb Rock Mass Parameter Approach:

Mohr-Coulomb approach is quite popular and the various rock mass parameters such as cohesion, c' and angle of internal friction, φ' have been developed from the Hoek-Brown approach using the following relations (Hoek et al, 2002).

$$sin\varphi' = \frac{6am_m(s + m_m\sigma'_{3n})^{a-1}}{2(1+a)(2+a) + 6am_m(s + m_m\sigma'_{3n})^{a-1}}$$

$$\frac{c'}{\sigma_{ci}} = \frac{[(1+2a)s + (1-a)m_m\sigma'_{3n}](s + m_m\sigma'_{3n})^{a-1}}{(1+a)(2+a)\frac{\sqrt{1 + \left(6am_m\left(s + m_m{\sigma'_{3n}}^{a-1}\right)\right)}}{(1+a)(2+a)}}$$

$$\sigma'_{3n} = \sigma'_{3,\max}/\sigma'_{ci}$$

Where, $\sigma'_{3,\max}$ is maximum value of lateral stress. It is related to slope height H and unit weight γ of the rocks. The effective maximum lateral stress of the rock is given by the relation as below:

$$\frac{\sigma'_{3,\max}}{\sigma'_{cm}} = 0.72\left(\frac{\sigma'_{cm}}{\gamma H}\right)^{-0.91}$$

The design has considered the average values of the geotechnical parameters as determined from various approaches each with respective factor of safety with the application of gravitational force on the models created for analysis. The failure plane has been analyzed for wide variations in its locations and safety factors associated with the most critical plane is determined.

1.8 Failure consideration of the Ore Body slope

Slope failures in surface operations involving hard rocks primarily depend on the characteristics of the rocks and the behavior of the geological features as well as the interaction between the geology and the rock characteristics. Soil or heavily fractured earth materials typically fail by circular failure whereas rock geometry fails by circular failures if there is any intrusion of weak layers incorporated into the rock mass or typically rock geometry fails by plane, wedge, or toppling modes. The stability of the slope is generally controlled by the shear strength parameters along with others. Stability analysis typically follows the limit equilibrium method. In limit equilibrium method, failure or sliding occurs when a limit equilibrium condition is reached i.e., when the resisting forces balance the driving forces such that any disturbances in the balance between them causes the slope to undergo failure. These design methods are widely accepted and are also commonly used and enable moderation of the slope performances with the variations in the parameters involved in slope design. The

primary idea behind the limit equilibrium approach is to determine a state of stress along the surface which is likely to fail such that the free body, along with the slip surface and the free ground surface remains in static equilibrium. The state of stress is then compared with the available strength, which is the stress required to cause failure along the slip surface.

Thus, the analysis involves determination of the factor of safety against sliding for an unstable block of rock mass. The analysis involves developing the model, assigning rock properties, specifying the boundary conditions followed by analyzing the whole of slope geometry to determine the location that would exhibit the lowest factor of safety.

1.8.1 Metal Mines Regulations, 1961 (reproduced verbatim)

Mine follows MMR-1961 as prescribed by the Directorate General of Mines Safety (DGMS) including the guidelines it received vide letter no 330234|SEZ|Chaibasa Region|Perm|2021|195681 date 31-01-2022.

2.0. OPENCAST WORKINGS:

(a) The height of the benches in alluvium and soft rock formation shall not be more than 3m and in overburden, ore or other hard rock formation shall not be more than the digging height of the machine used for digging, excavation or removal and in any case, it shall not be more than 9m.

(b) The width of any bench shall not be less than:

(i) The width of the widest machine plying on the bench plus two meters, or

(ii) If dumpers ply on the bench three times the width of the dumper, or

(iii) The height of the bench, whichever is more.

(c) If tippers or similar transport vehicles are deployed for transportation of ore, separate roads for such tipping trucks or similar vehicles shall be provided and safe loading practices shall be adopted avoiding plying of trucks on the same bench where men are to work, travel or rest.

(d) No manual workers shall be employed where HEMM is deployed in the mine.

4.0. SPOIL OVERBURDEN OR DEBRIS BANKS:

I (a) Spoils, overburden or debris shall be deposited at places belonging to the mine and duly approved by the manager in writing.

b) Spoils, overburden or debris shall not be deposited, beneath transmission, telephone, or power lines or near any public structure.

(c) The slope of a spoil bank face shall be determined by the natural angle of repose of the material being deposited but shall in no case exceed 37.5 degrees from the horizontal. The

spoil bank face shall not be retained by artificial means at an angle in excess of its natural angle of repose.

(d) Any spoil bank exceeding 30m in height shall be kept benched so that no such bench exceeds 30m in height and the general slope does not exceed 1 vertical to 1.5 horizontal. In no case, the height of any spoil bank shall be allowed to exceed 60m unless a scientific study on its stability has been done and separate permission is obtained from this Directorate.

(e) The spoil bank face shall not be retained by an artificial means at an angle above its natural angle of slope.

(f) The spoils overburden or debris shall not be deposited within 45m of a railway or other structures and it shall not be permitted to approach any of the above said structures closer than a distance equal to 1.5 times the vertical height of its face.

(g) The toe of a spoil-bank shall not be extended to any point within 100m of a mine opening, railway or other public works, public road or building or other permanent structure not belonging to the owner.

(h) A suitable fence shall be erected between any railways of public works or road or building or structures and the toe of an active spoil bank to prevent unauthorized persons from approaching the spoil bank.

(i) The backfilled area shall be kept benched and the distance of any active mine workings (faces) from the toe of the bottom-most backfilled face (bench) shall not be less than 100m.

II. No person shall or shall be permitted to approach the toe of an active spoil bank where he may be endangered from material rolling down the face. Suitable signs for warning the persons at conspicuous places shall also be displayed.

1.8.2 Safety Analysis of Slope Profiles

The geological transverse sections for mine provided by JSW Steel Ltd were considered and those slope profiles were analysed. Each material present have been assigned suitable strength characteristics as obtained from laboratory testing and field observations and the factor of critical safety value is computed. A number of such sections have been analysed that are represented below. Ground water table is present well below the slope forming materials and hence is assumed to have no effect on the stability of the slopes that have been considered for stability analysis.

For Rock samples, the cores were used to determine its representative UCS values and for the loose rock mass the samples, their cohesion and internal friction were calculated by direct shear test. However, these values are much higher and it’s not a reliable demonstration of the field condition. Therefore, the GSI value is incorporated in the determination of cohesion and

friction angle which is a much better representation of the field situation. Here, The GSI values were obtained from the on-site survey of the undisturbed exposed mineral outcrop. The m_i values were determined from the predefined values which best represents the rock strength. The Disturbance factor is considered 1 or 0.7 as per the mine practice.

The dump profile analyses were carried using the shear strength for overburden specimen. Limit equilibrium analysis involves density, cohesion and internal friction angle values. Intact ores were tested to determine the *c* and φ of those. The slope height considered was 10m. Intact values are always much higher than that available in the field. Mohr-Coulomb is a popular approach. So, its equivalent rock mass approach is adopted with suitable modifications (Sec. III). Accordingly, the slope profiles were analysed with parametric values (Table. 1-3). The following images show the safety factor analyses done for both dry and saturated conditions for respective sections (Figure 1 to 74).

Table 1: Geotechnical parameters of rock mass

ORE TYPE	GSI	UCS (MPa)	Intact Lab Test Results		MC Rock Mass Parameters		Average Density (g/cc
			Cohesion (MPa)	Friction Angle (Degree)	Cohesion (MPa)	Friction Angle (Degree)	
BHJ/BHQ	65	179	8.54	65	1.080	63	2.77
Lateritic Ore	52	32	4.93	56	0.095	51	1.75
Hard Laminated Ore	73	85	8.86	67	1.033	62	3.17

Table 2: Dry Rock Mass parameters

ORE TYPE	GSI	MC Rock Mass Parameters		Average Density (g/cc)
		Cohesion (MPa)	Friction Angle (Degree)	
Iron Ore 45 to 55 **%**	46	0.075	40	3.28
Laterite etc.	43	0.036	41	2.78
Iron Ore > 55 **%**	38	0.045	29	3.13
Shale	65	0.021	37	1.95
Overburden (Iron & Mn)	-	0.032	39	2.74

Table 3: Saturated Rock Mass parameters

ORE TYPE	GSI	MC Rock Mass Parameters		Average Density (g/cc)
		Cohesion (MPa)	Friction Angle (Degree)	
Iron Ore 45 to 55 **%**	46	0.071	39	2.98
Laterite etc.	43	0.033	40	2.55
Iron Ore > 55 **%**	38	0.043	28	2.82
Shale	65	0.016	34	1.74
Overburden (Iron & Mn)	-	0.027	32	2.47

PIT ANALYSIS

QUARRY 3 & 4

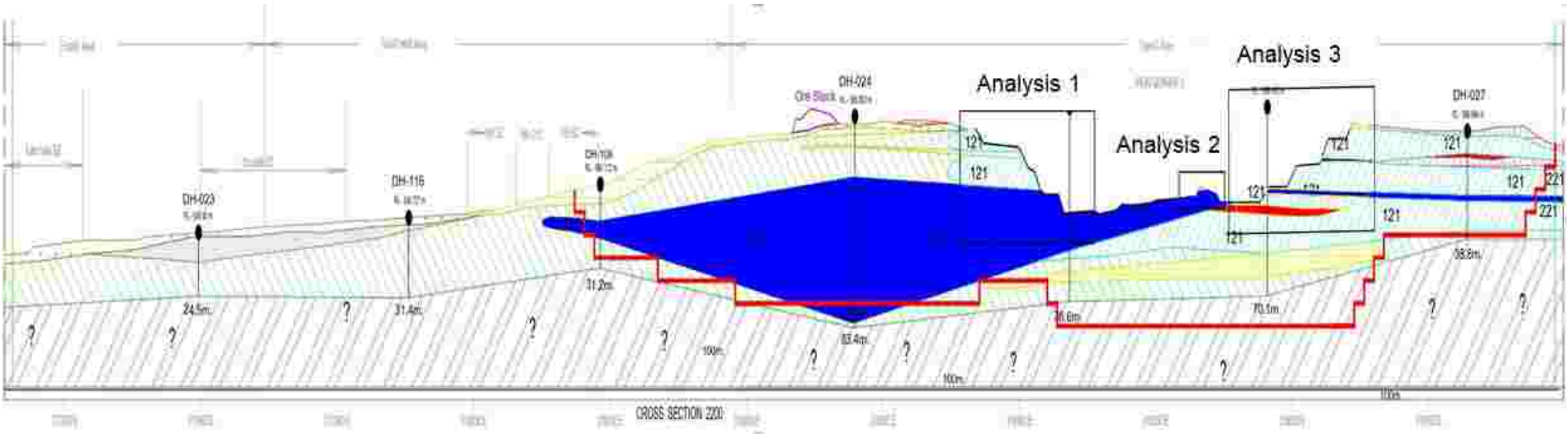


Figure 1: Narayanposhi section 2200N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1- 318400E (CROSS SECTION 2200)

1.1 Dry condition

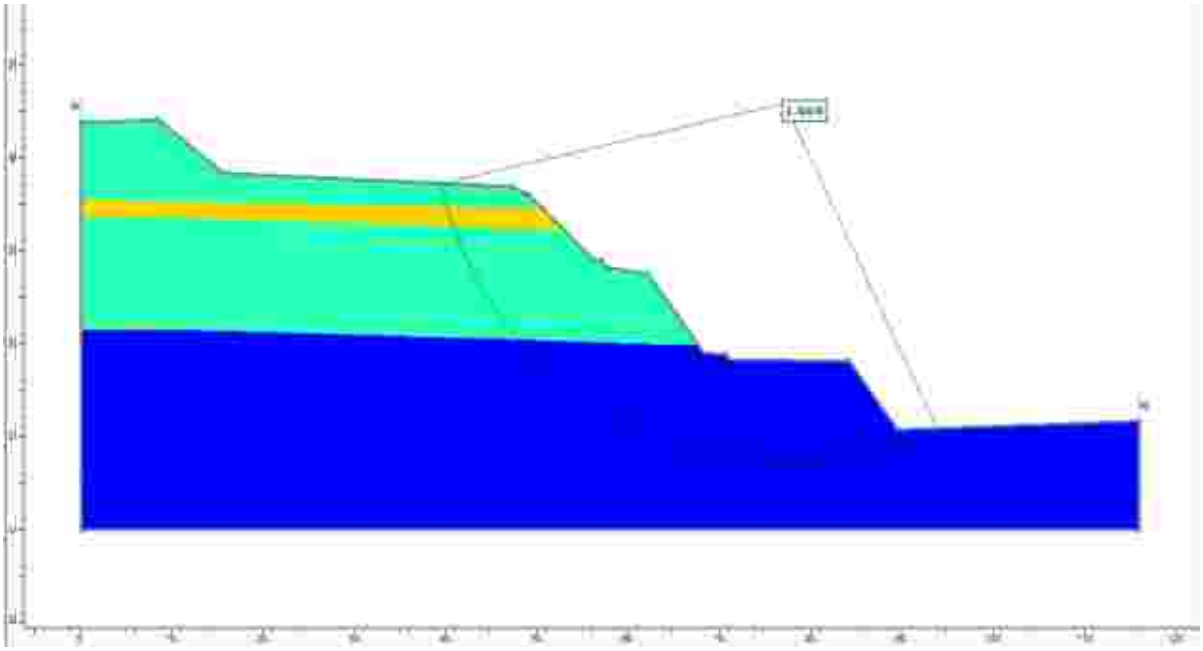


Figure 2: Slope stability analysis of a shale, laterite and Iron ore +55% slope with FOS of 1.669

1.2 Saturated condition

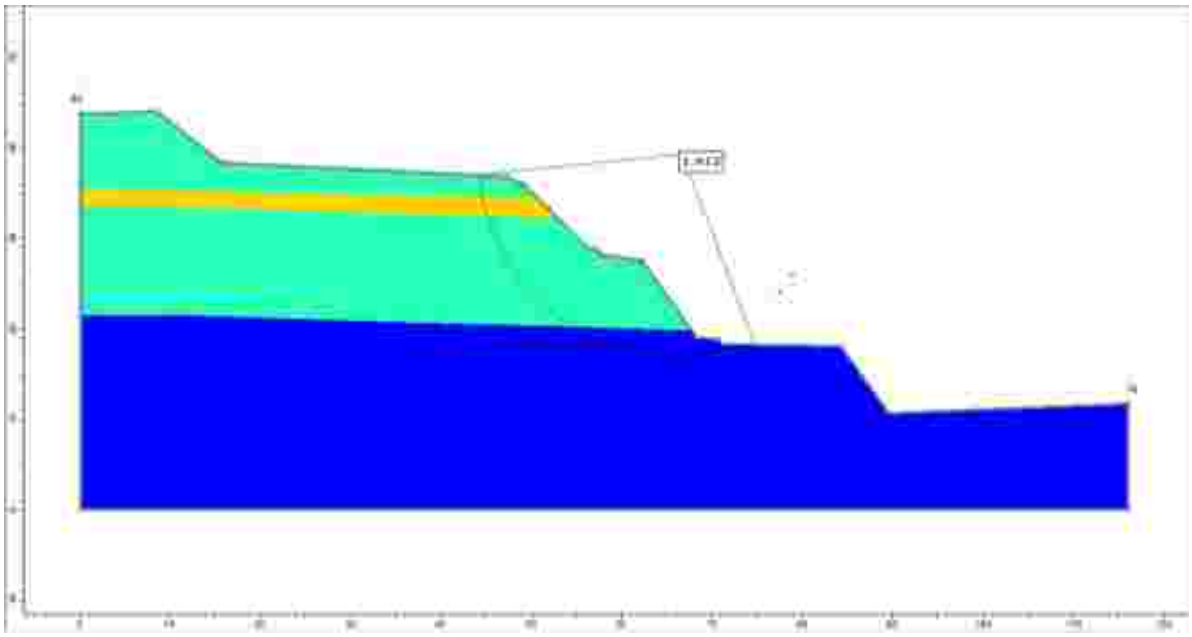


Figure 3: Slope Stability Analysis of shale, laterite and BHJ with FOS 1.413

Analysis 2- 318500E

2.1 Dry condition

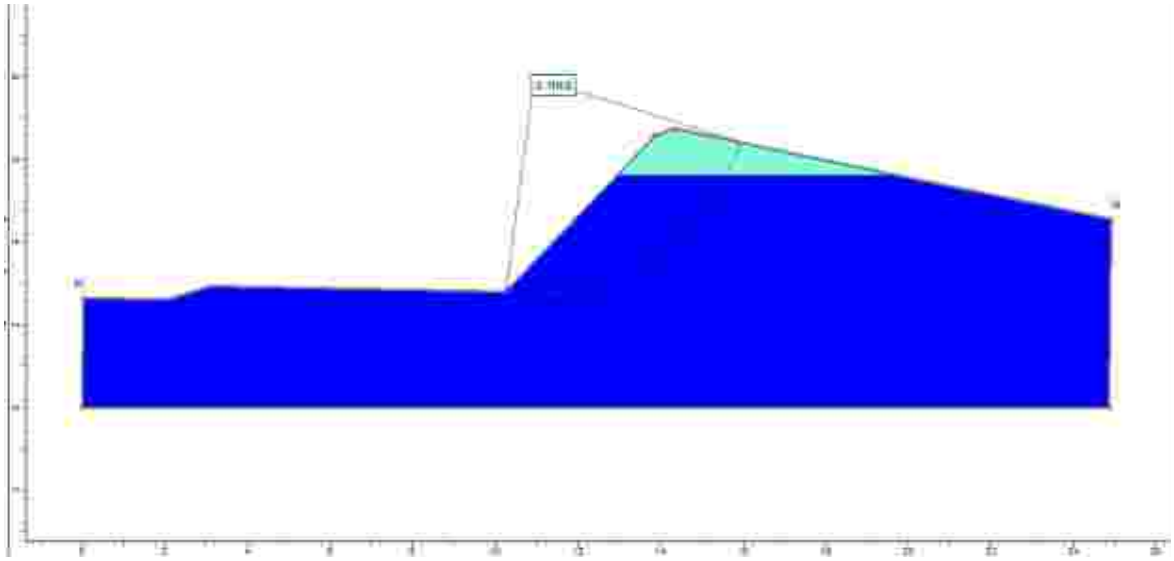


Figure 4: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 2.982

2.2 Saturated condition

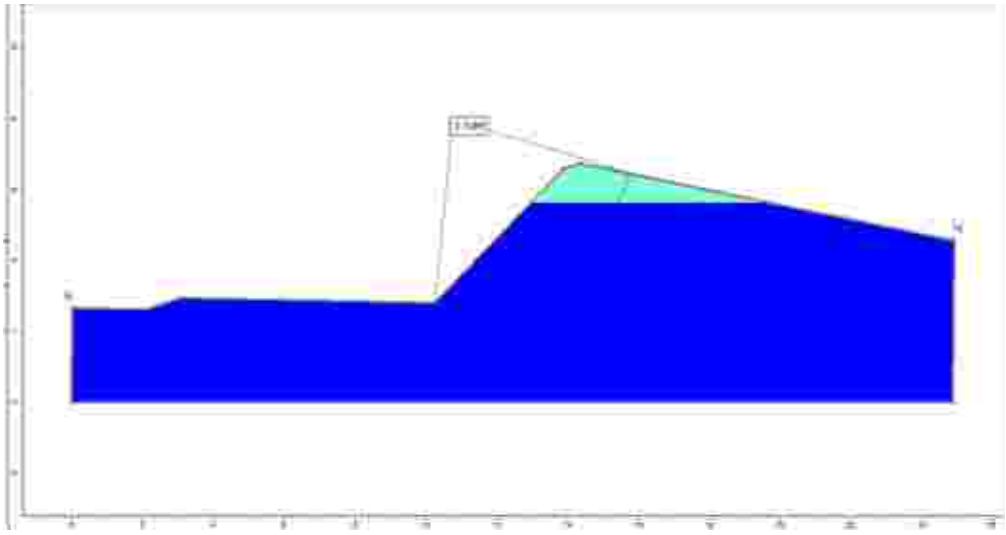


Figure 5: Slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 2.589

Analysis 3-318600E

3.1 Dry condition

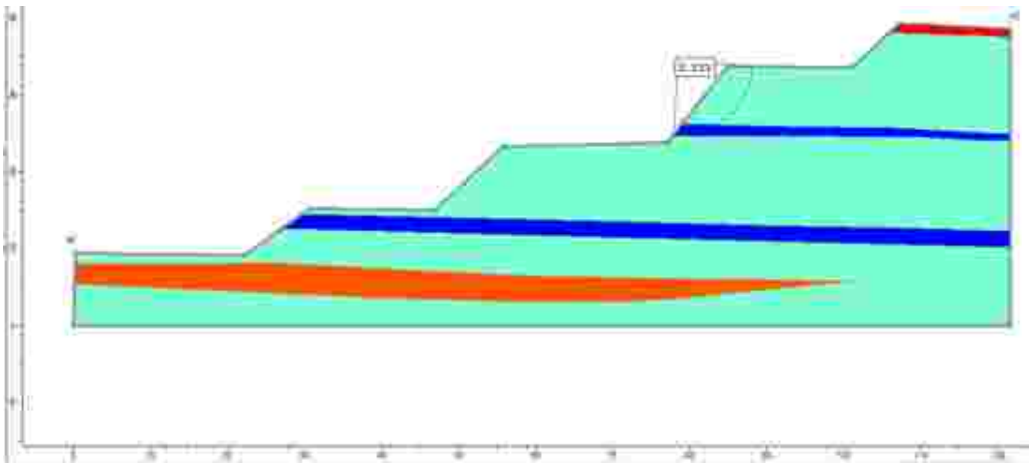


Figure 6: slope stability analysis of Iron ore 45-55% and Iron ore +55% Iron ore 45-55%pe with FOS of 2.251

3.2 Saturated condition

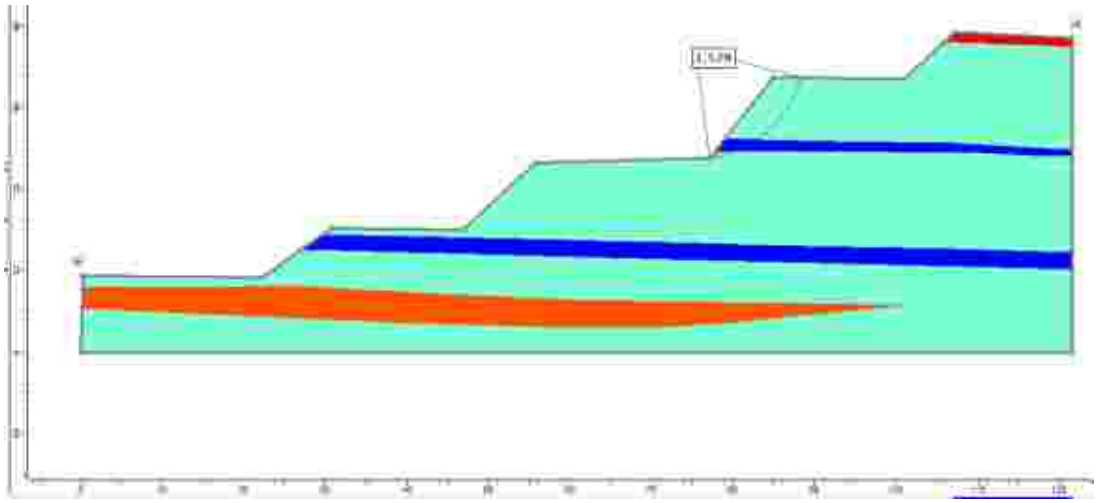


Figure 7: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.579

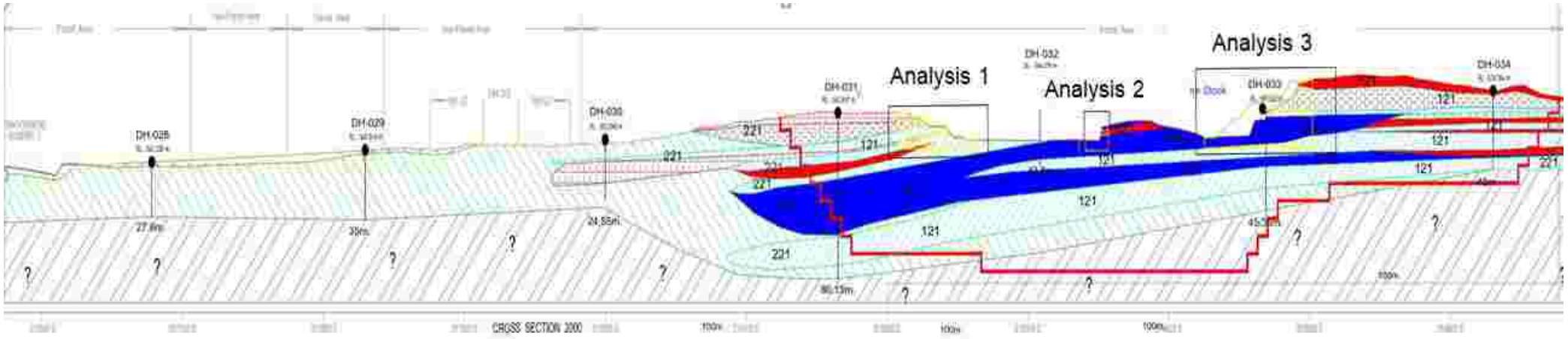
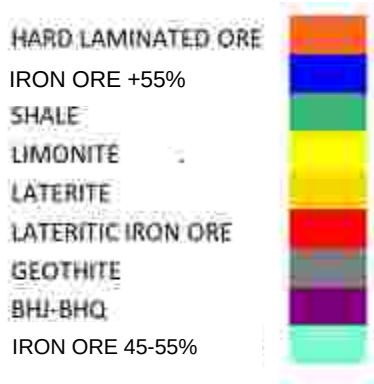


Figure 8: Narayanposhi section 2000N



Analysis 1 - 318250E (CROSS SECTION 2000)

1.1 Dry conditions

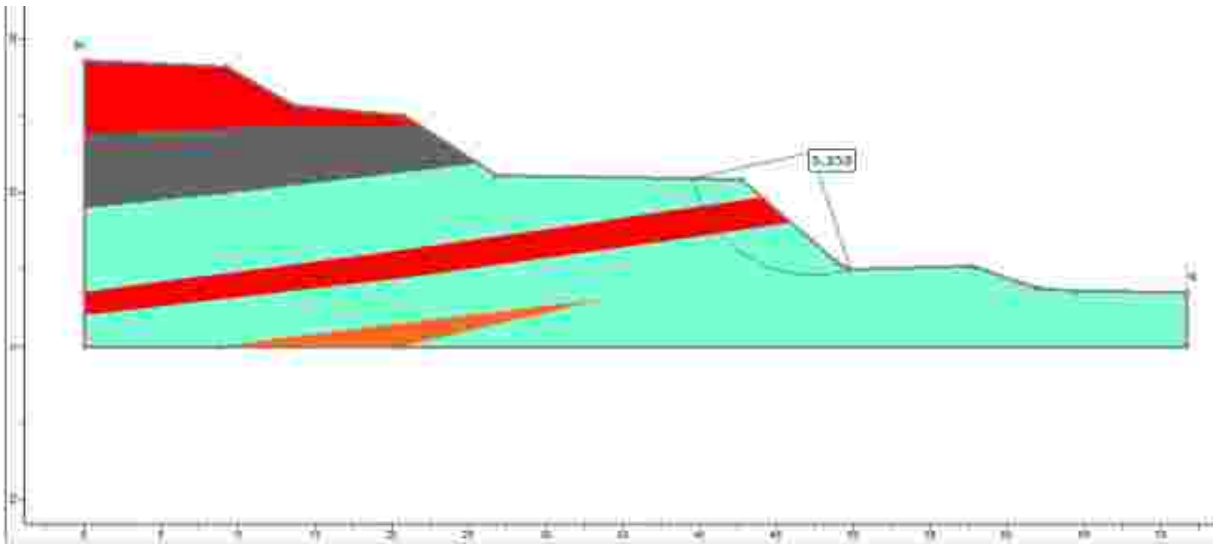


Figure 9: slope stability analysis of a SLO and lateritic ore slope with FOS of 5.252

1.2 Saturated condition

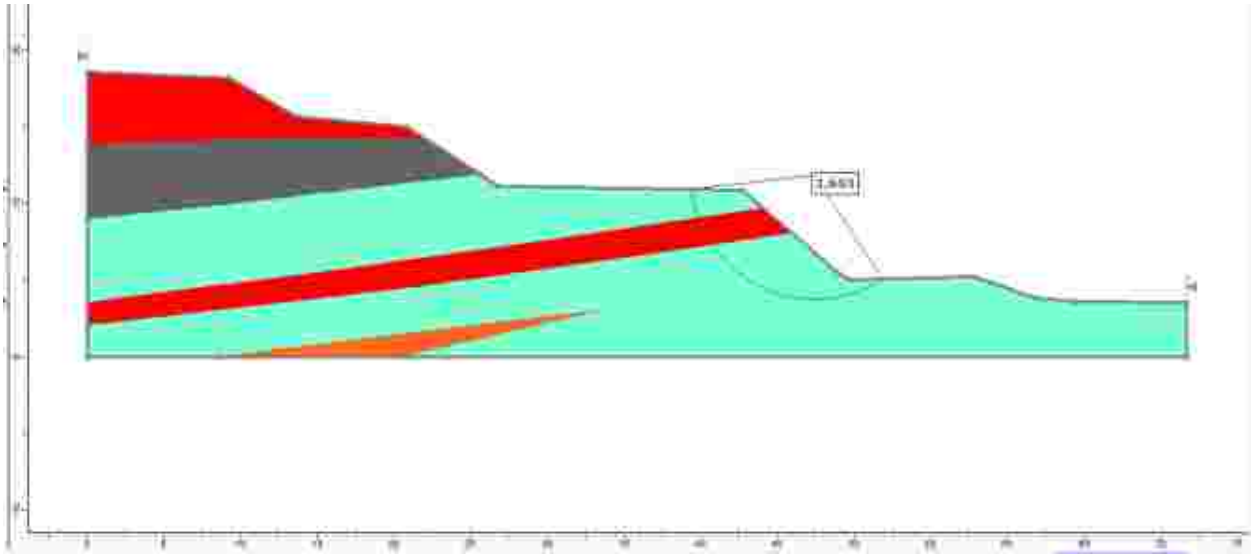


Figure 10: slope stability analysis of a Iron ore 45-55% and lateritic ore slope with FOS of 3.683

Analysis 2 - 318350E

2.1 Dry conditions

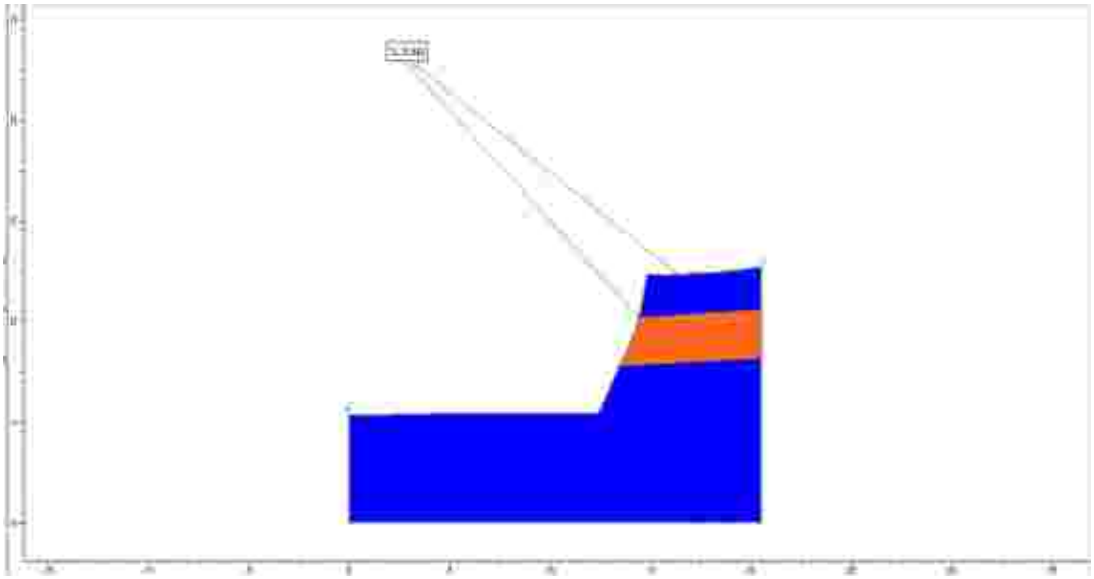


Figure 11: slope stability analysis of a Iron ore +55% slope with FOS of 3.320

2.2 Saturated conditions

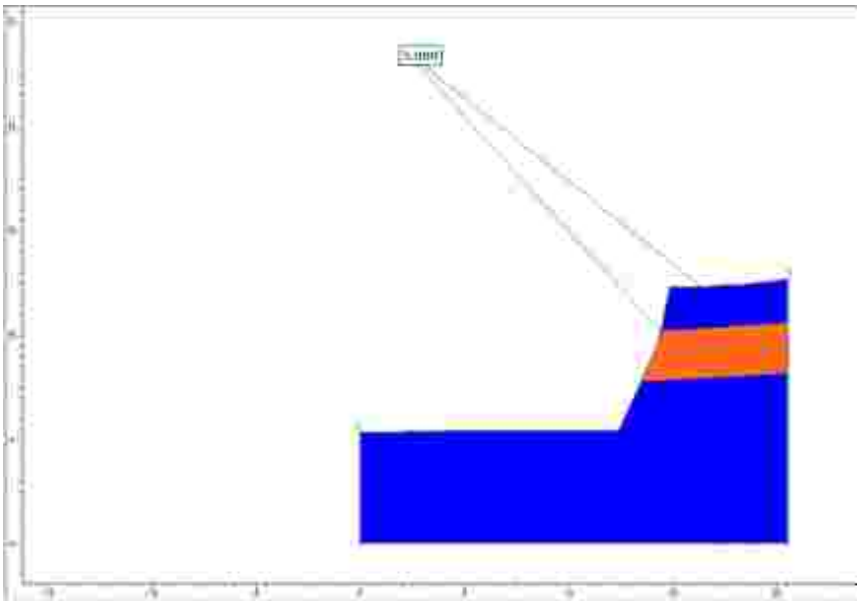


Figure 12: slope stability analysis of a Iron ore +55% slope with FOS of 3.090

Analysis 3 - 318500E

3.1 Dry conditions

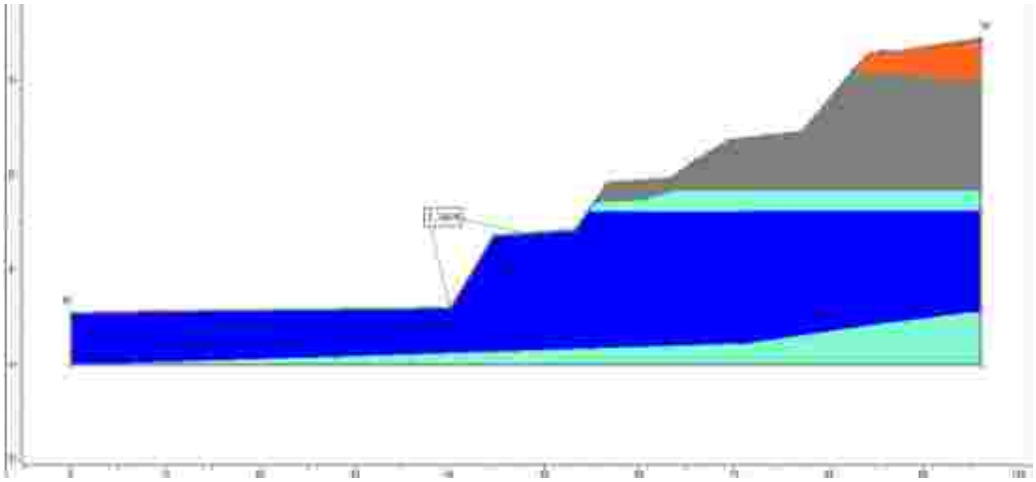


Figure 13: slope stability analysis of a Iron ore +55% slope with FOS of 1.564

3.2 Saturated conditions

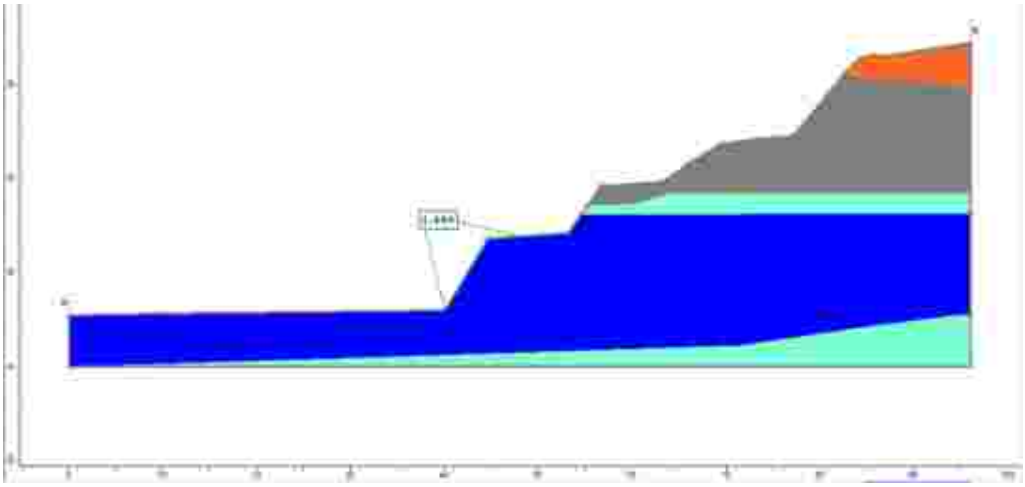


Figure 14: slope stability analysis of a Iron ore +55% slope with FOS of 1.449

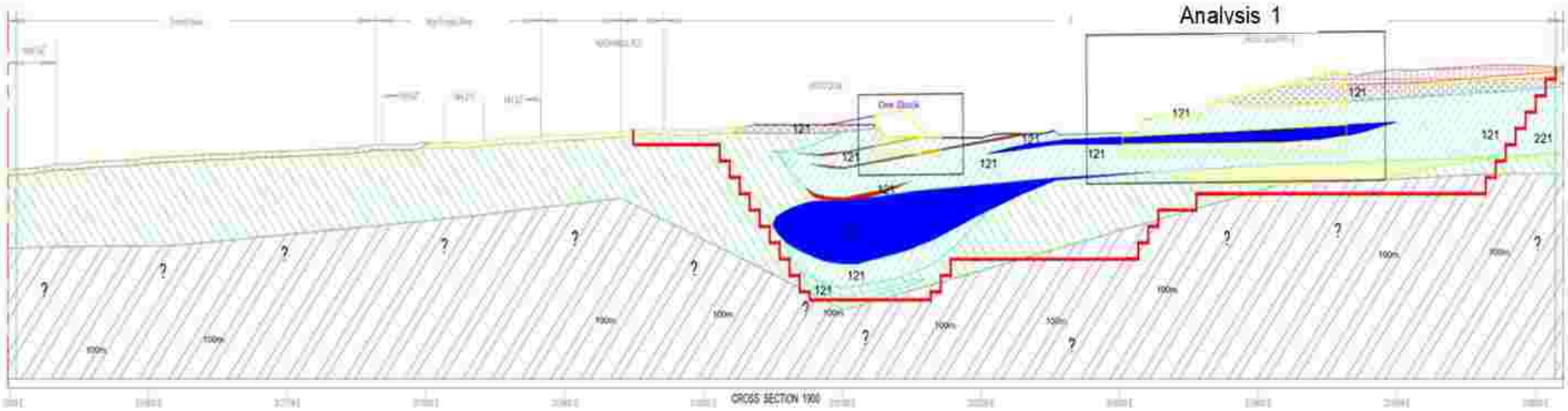
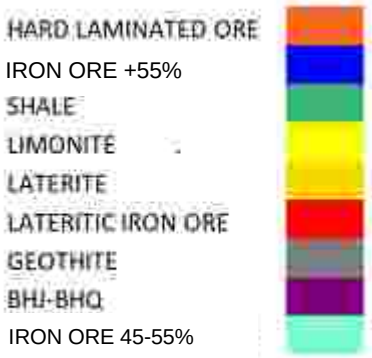


Figure 15: Narayanposhi section 1900N



Analysis 1 - 318400E (CROSS SECTION 1900)

1.1 Dry condition

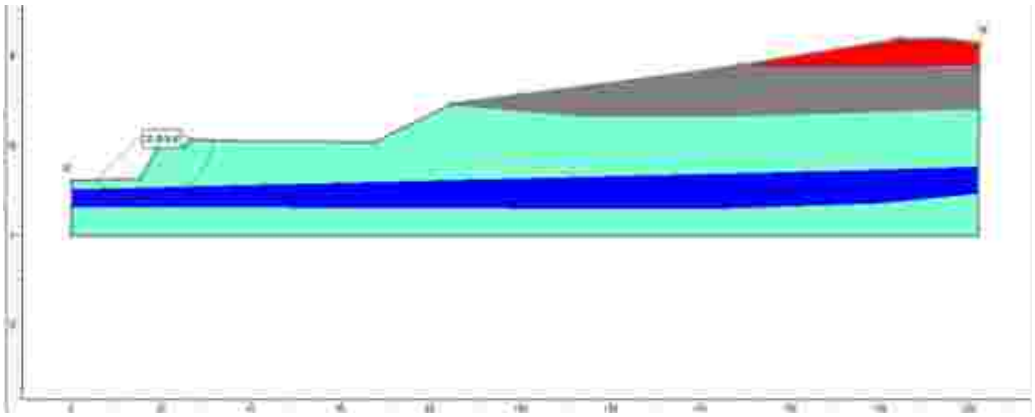


Figure 16: slope stability analysis of a Iron ore 45-55% slope with FOS of 2.854

1.2 Saturated condition

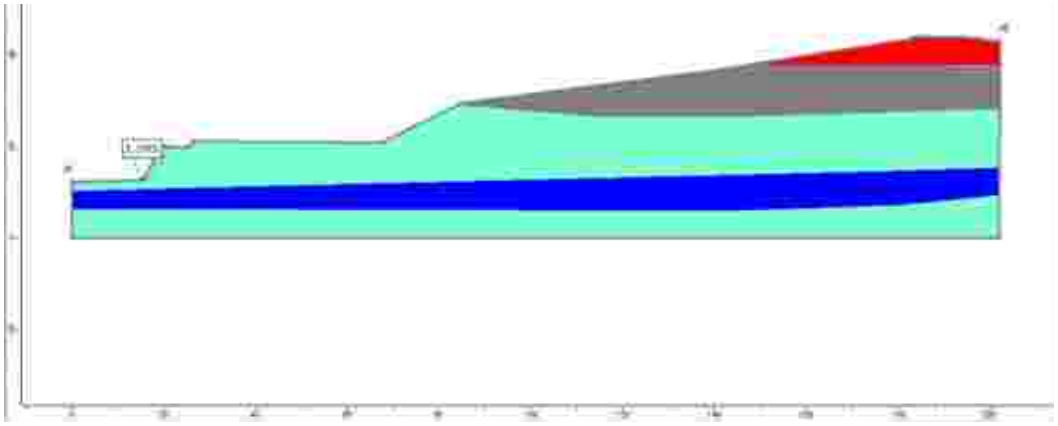


Figure 17: slope stability analysis of a Iron ore 45-55% slope with FOS of 1.395

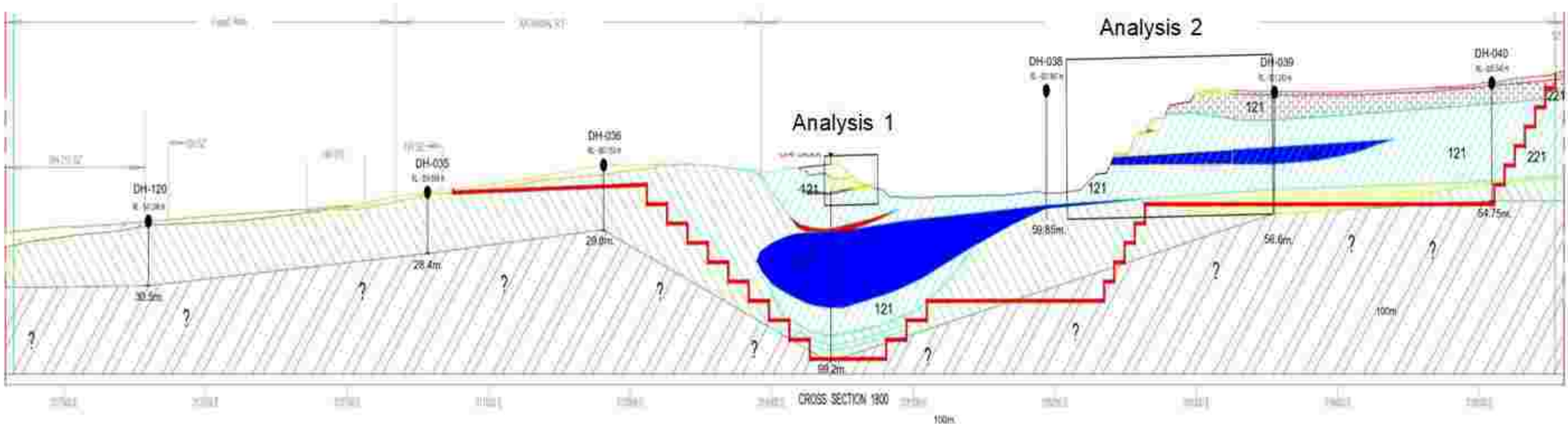
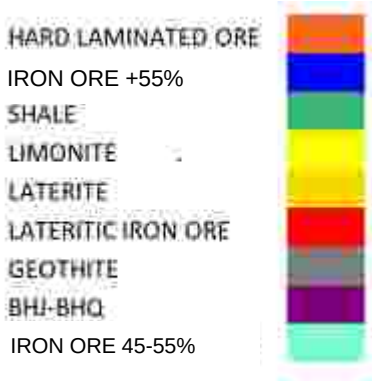


Figure 18: Narayanposhi section 1800N



Analysis 1 - 318050(CROSS SECTION 1800)

1.1 Dry condition

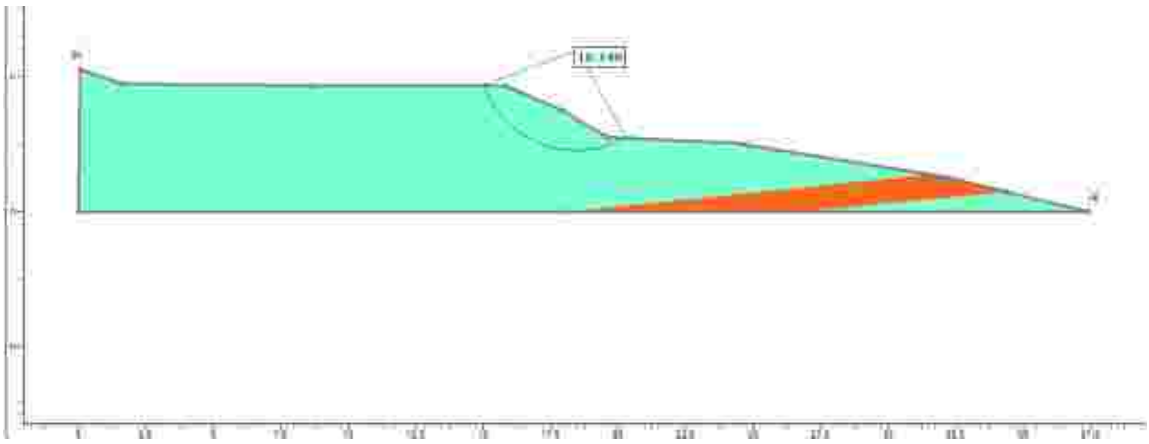


Figure 19 slope stability analysis of Iron ore 45-55% slope with FOS 10.140

1.2 Saturated condition

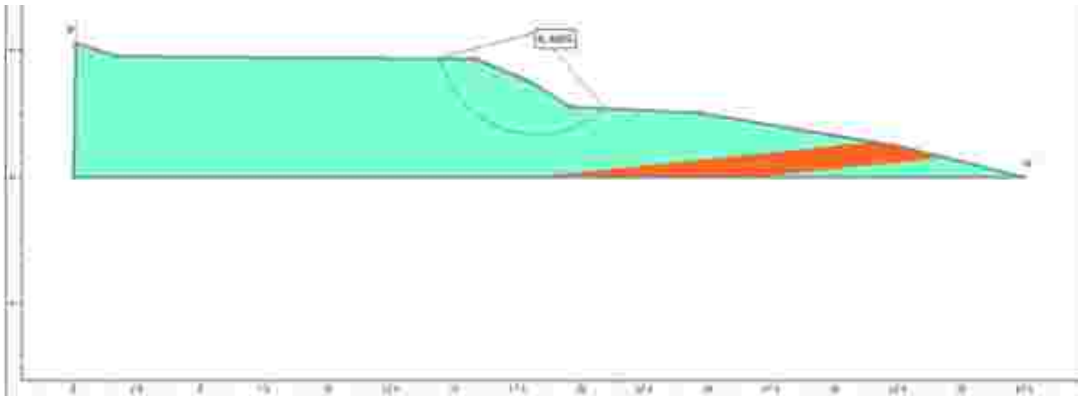


Figure 20: slope stability analysis of a Iron ore 45-55% slope with FOS 6.605

Analysis 2- 318300E

2.1 Dry conditions

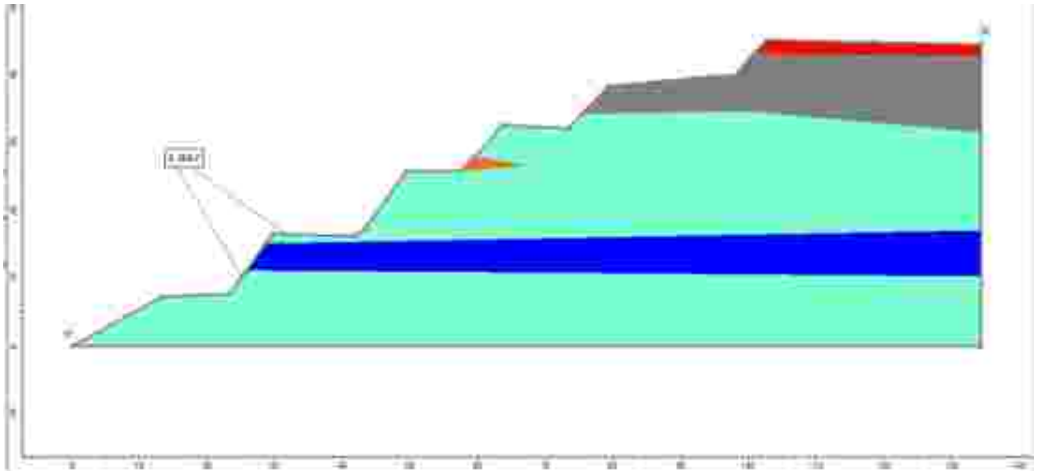


Figure 21: slope stability analysis of a Iron ore +55% and Iron ore 45-55% slope with FOS 1.887

2.2 saturated conditions

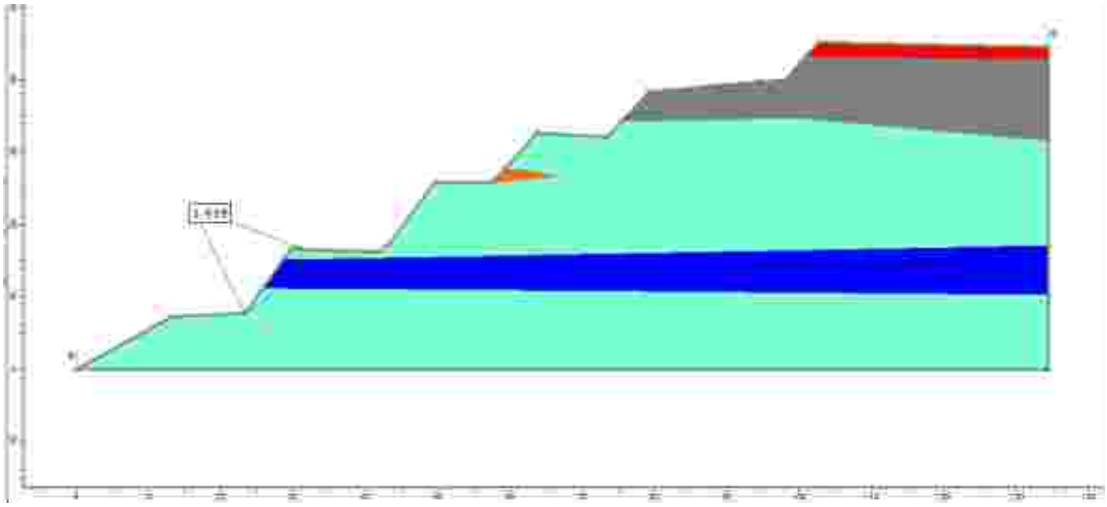


Figure 22: slope stability analysis of a Iron ore +55% and Iron ore 45-55% slope with FOS 1.419

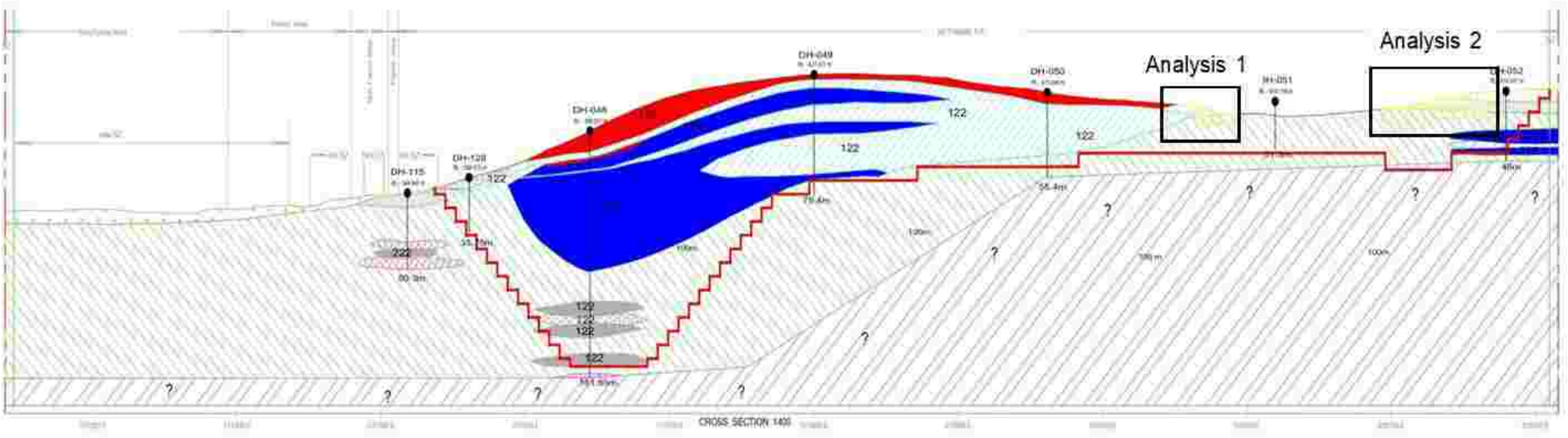


Figure 23: Narayanposhi section 1400N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1 - 318100E (CROSS SECTION 1400)

1.1 Dry conditions

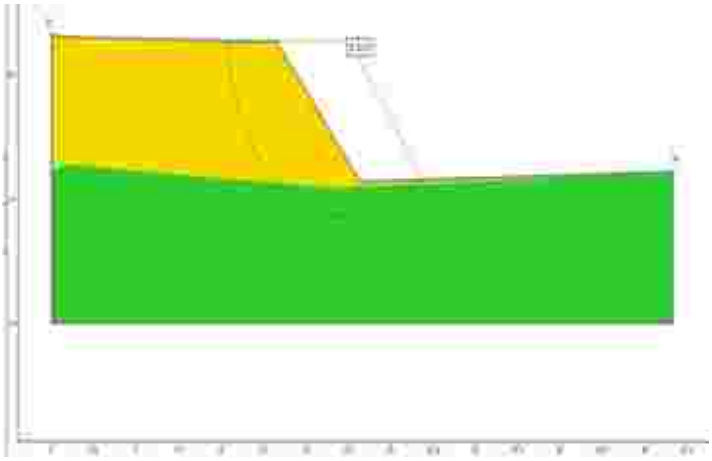


Figure 24: slope stability analysis of a laterite and shale slope with FOS of 2.527

1.2 Saturated conditions

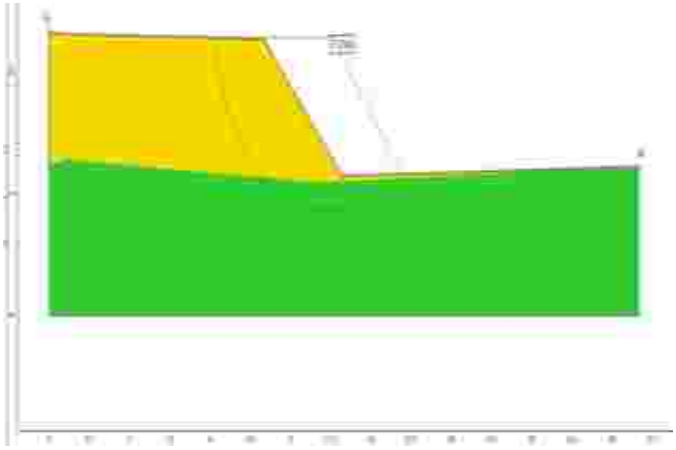


Figure 25: slope stability analysis of a laterite and shale slope with FOS of 2.236

Analysis 2 - 318250E

2.1 Dry conditions

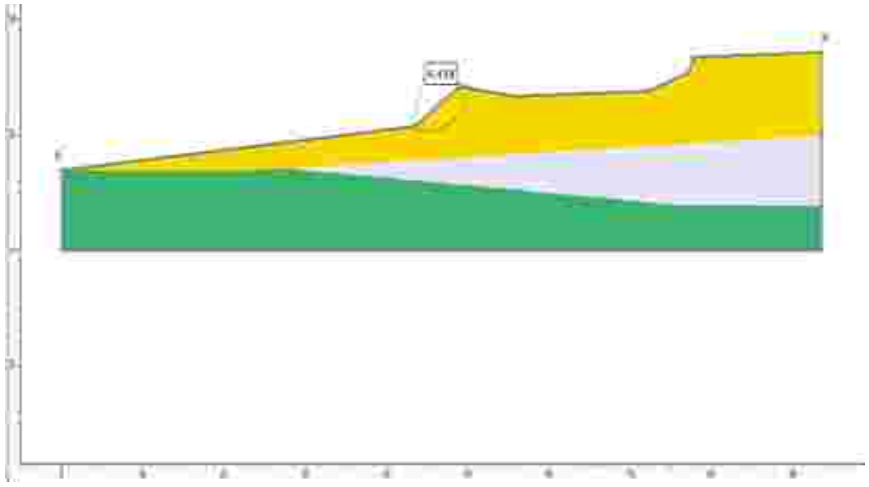


Figure 26: slope stability analysis of a laterite slope with FOS of 4.418

2.2 Saturated conditions

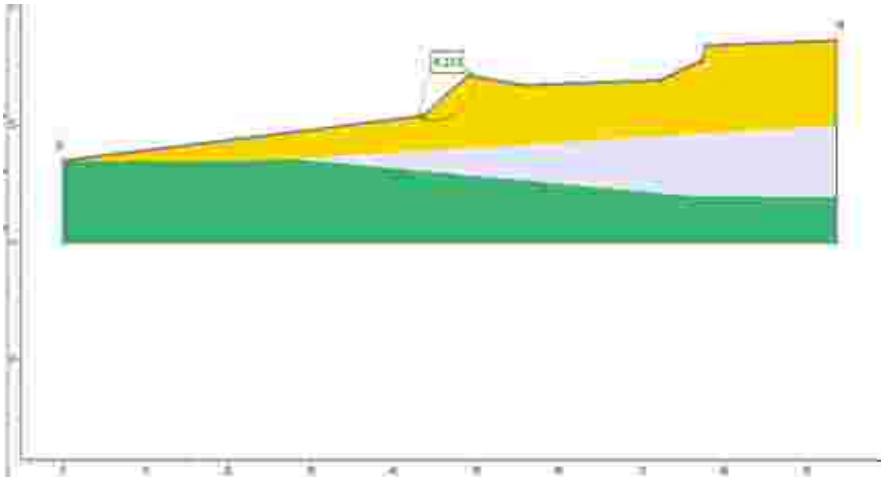


Figure 27: slope stability analysis of a laterite slope with FOS of 4.272

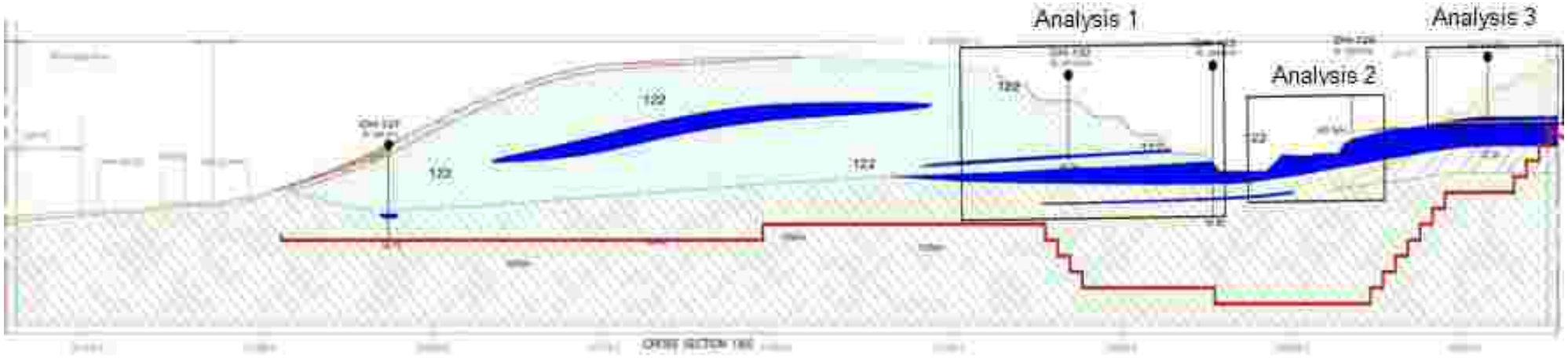
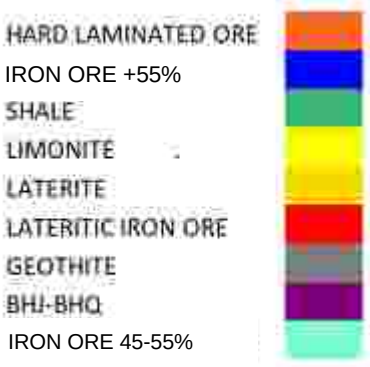


Figure 28: Narayanposhi section 1300N



Analysis 1 - 318000E CROSS SECTION 1300

1.1 Dry condition

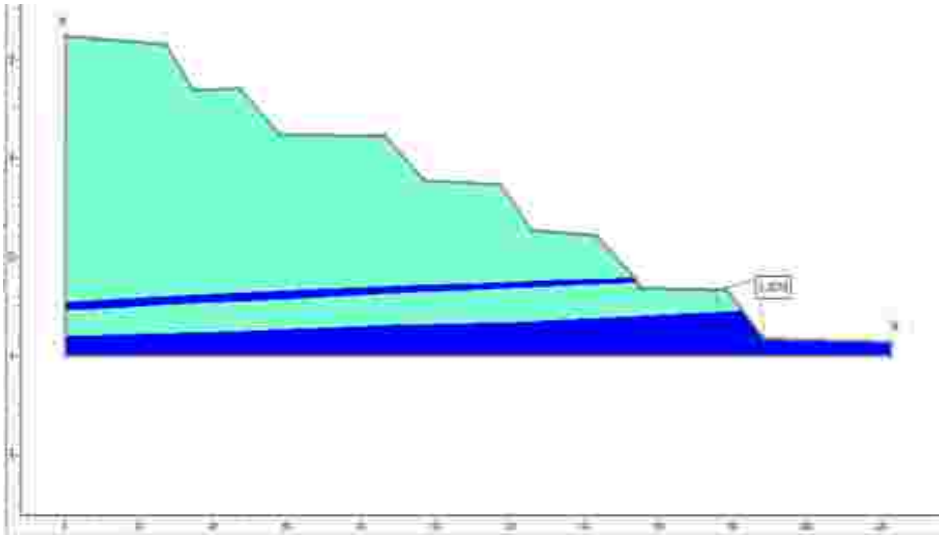


Figure 29: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.870

1.2 Saturated condition

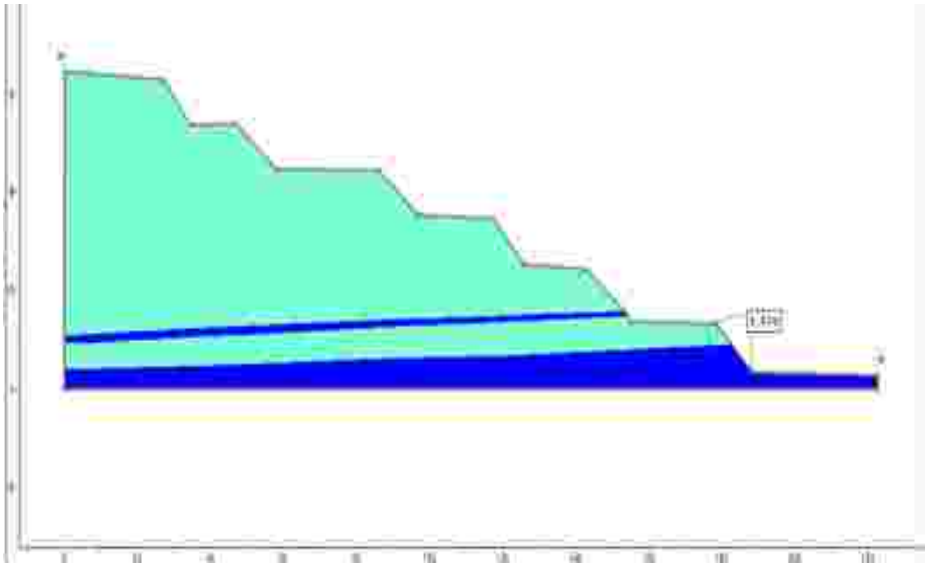


Figure 30: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.476

Analysis 2 - 318100E

2.1 Dry condition

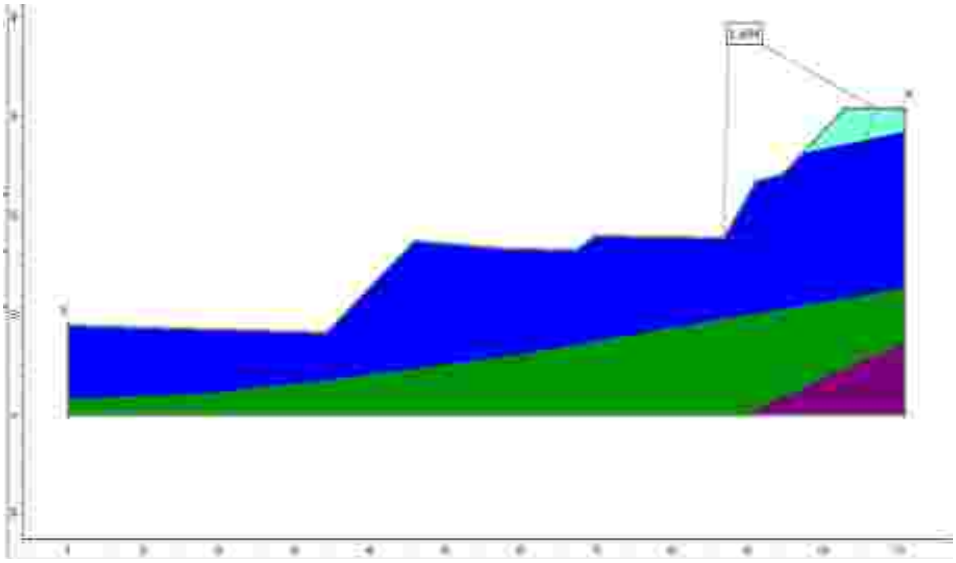


Figure 31: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.694

2.2 Saturated condition

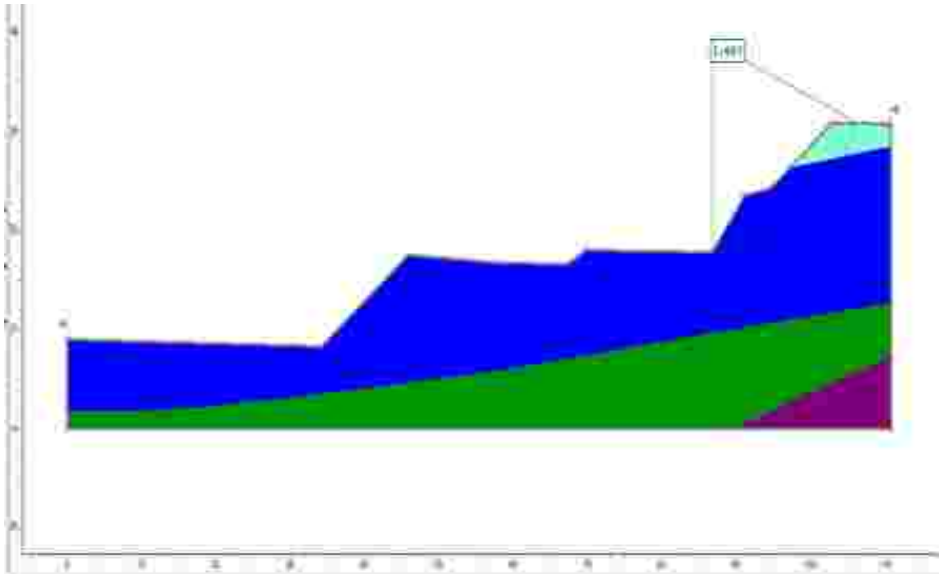


Figure 32: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.487

Analysis 3 - 318200E

3.1 Dry condition

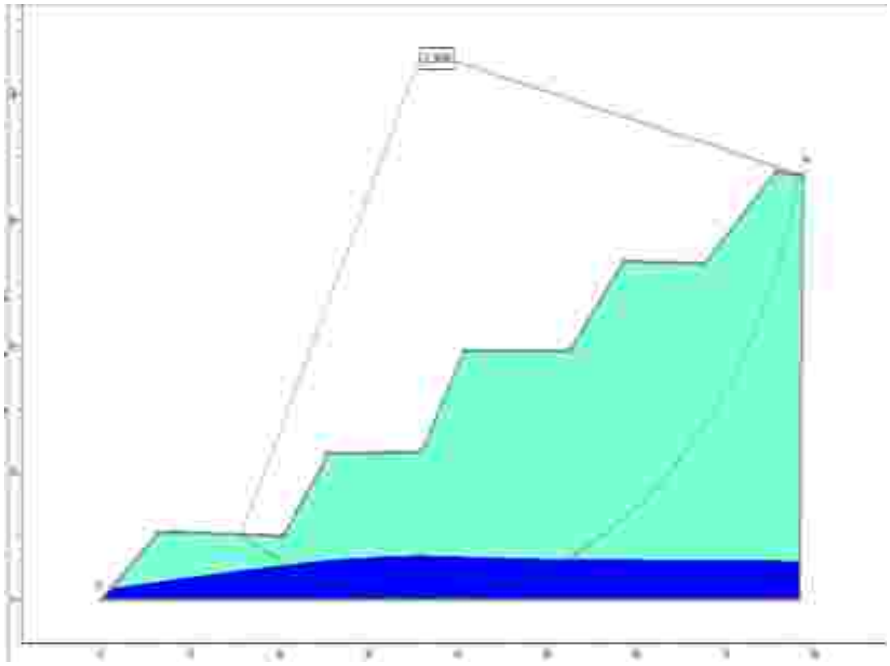


Figure 33: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 2.309

3.2 Saturated condition

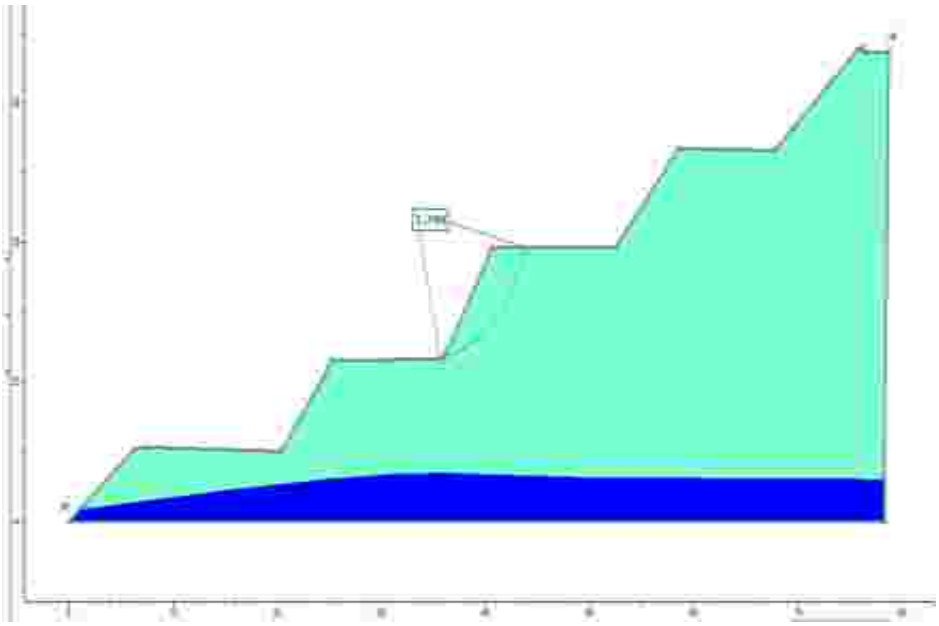


Figure 34: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.740

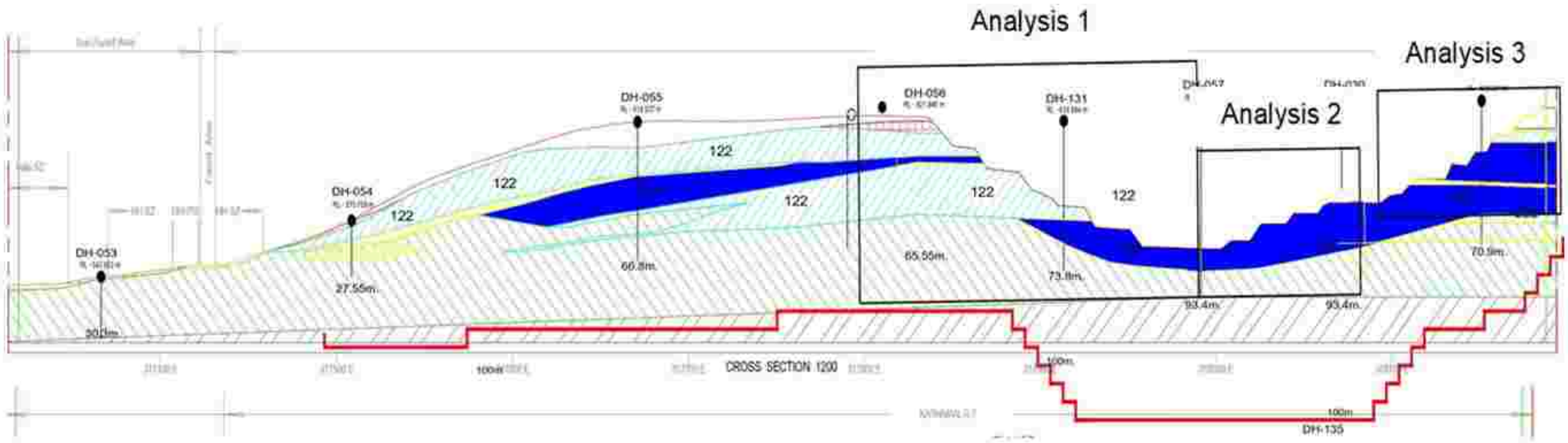


Figure 35: Narayanposhi section 1200N

HARD LAMINATED ORE
IRON ORE +55%
SHALE
LIMONITE
LATERITE
LATERITIC IRON ORE
GEOTHITE
BHJ-BHQ
IRON ORE 45-55%

Analysis 1- 317900E CROSS SECTION 1200

1.1 Dry condition

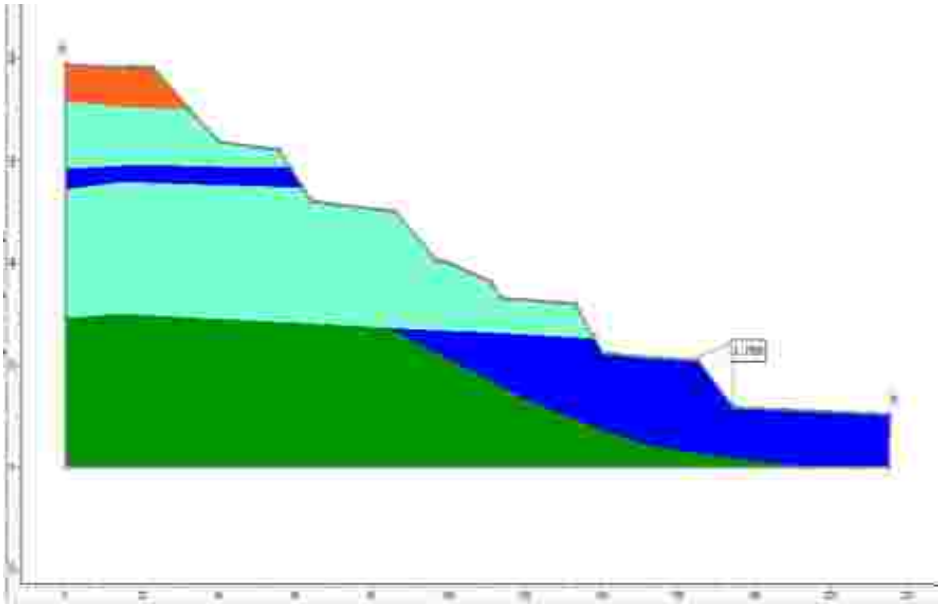


Figure 36: slope stability analysis of a Iron ore +55% slope with FOS of 1.708

1.2 Saturated condition

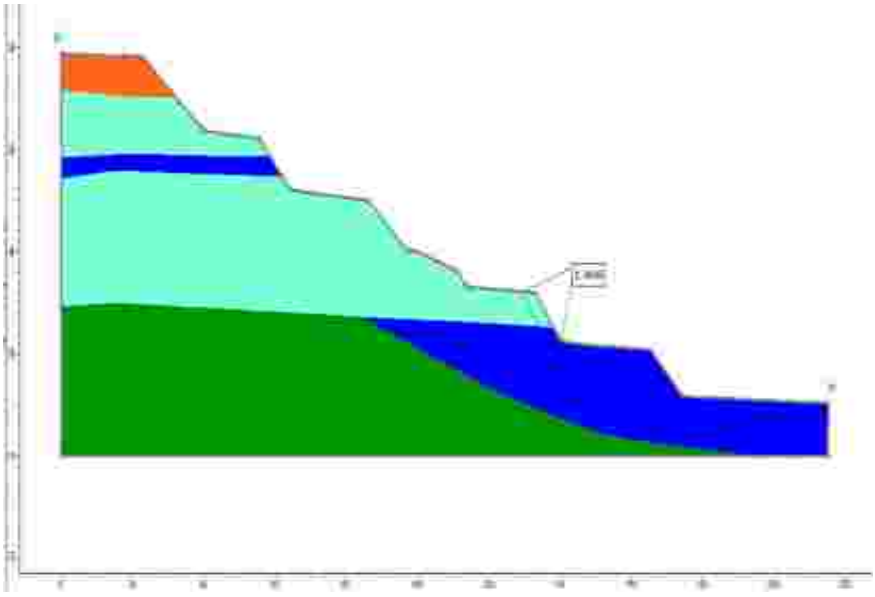


Figure 37: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 1.496

Analysis 2 - 318000E

2.1 Dry condition

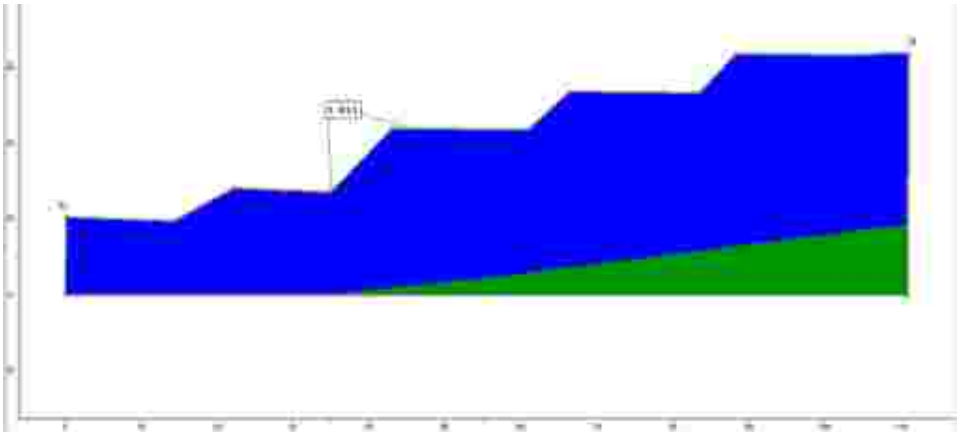


Figure 38: slope stability analysis of a Iron ore +55% slope with FOS of 1.821

2.2 Saturated condition

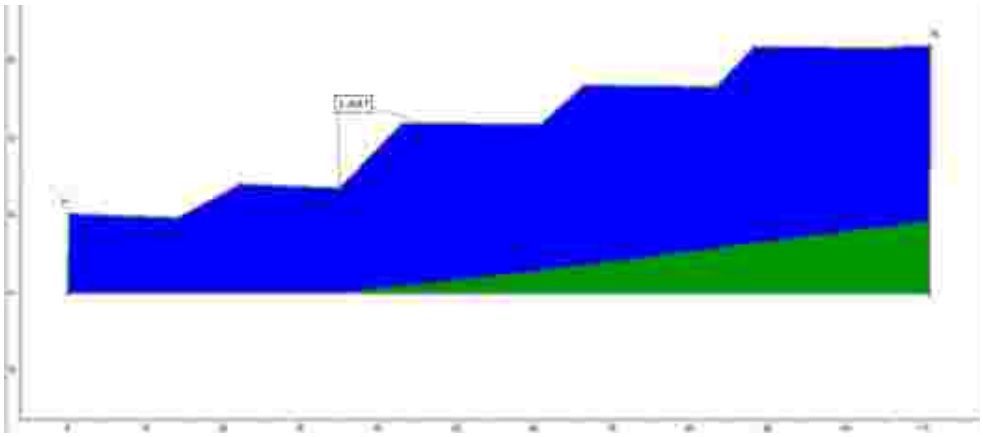


Figure 39: slope stability analysis of a Iron ore +55% slope with FOS of 1.687

Analysis 3 - 318100E

3.1 Dry condition

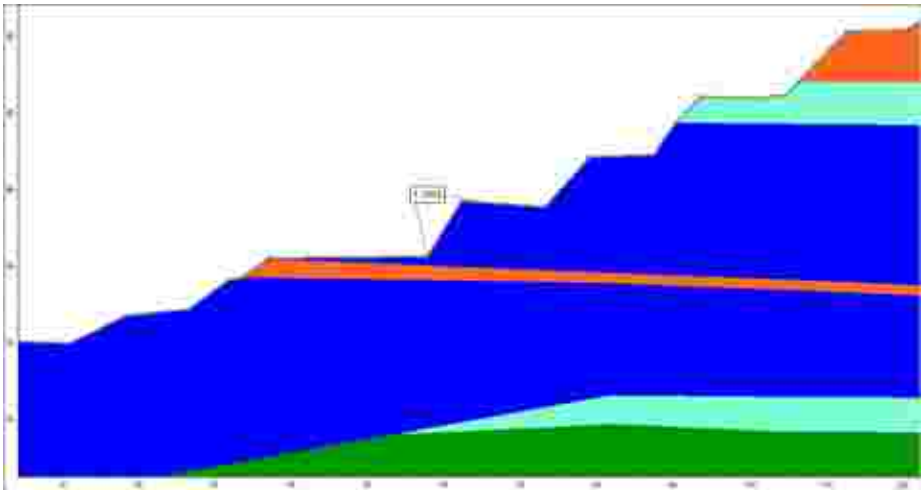


Figure 40: slope stability analysis of a Iron ore +55% slope with FOS of 1.491

1.2 Saturated condition

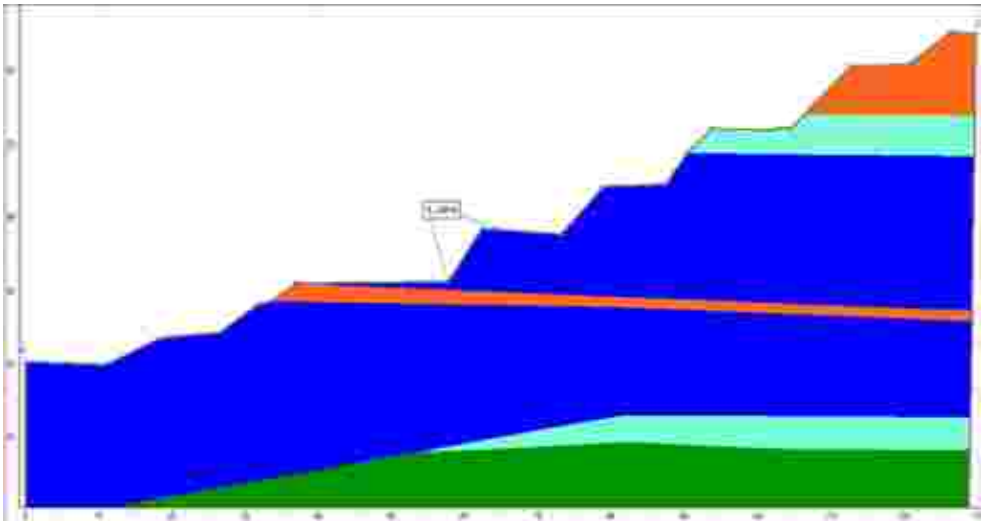


Figure 41: slope stability analysis of a Iron ore +55% slope with FOS of 1.384

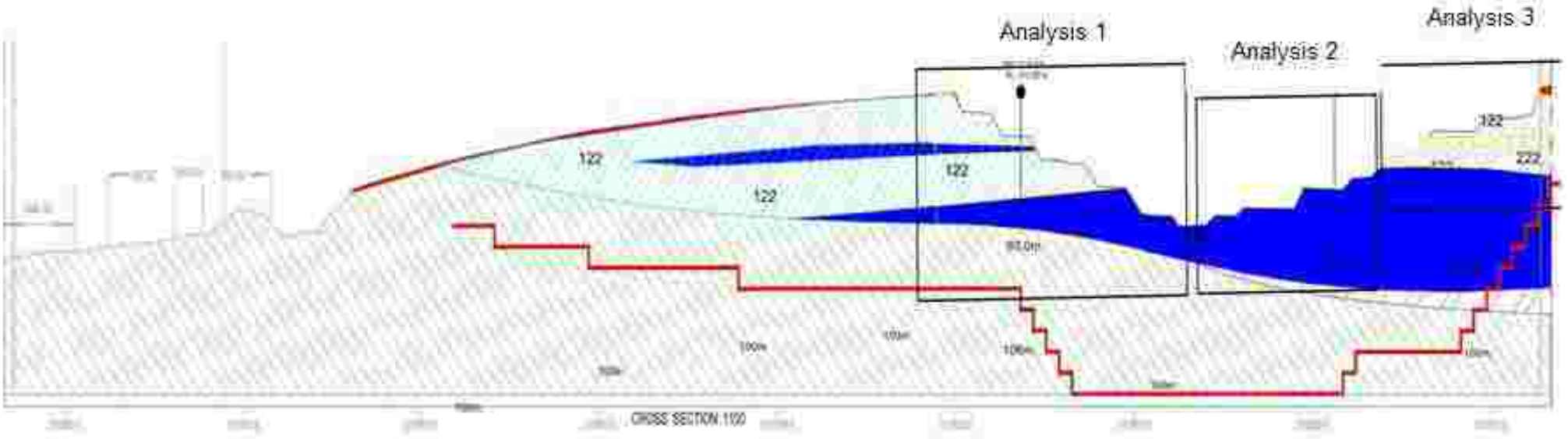
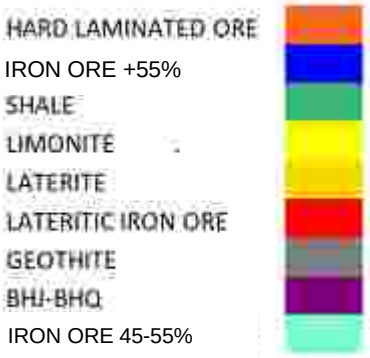


Figure 42: Narayanposhi section 1100N



Analysis 1 - 317850E CROSS SECTION 1100

1.1 Dry condition

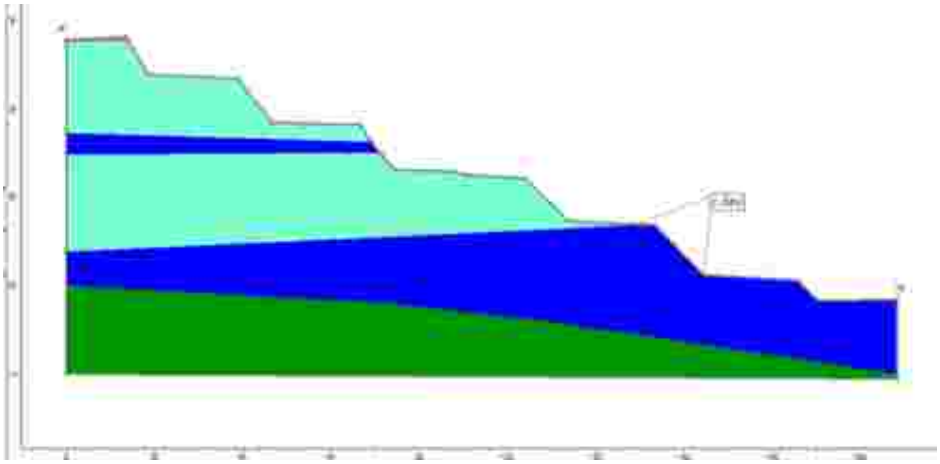


Figure 43: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.582

1.2 Saturated condition

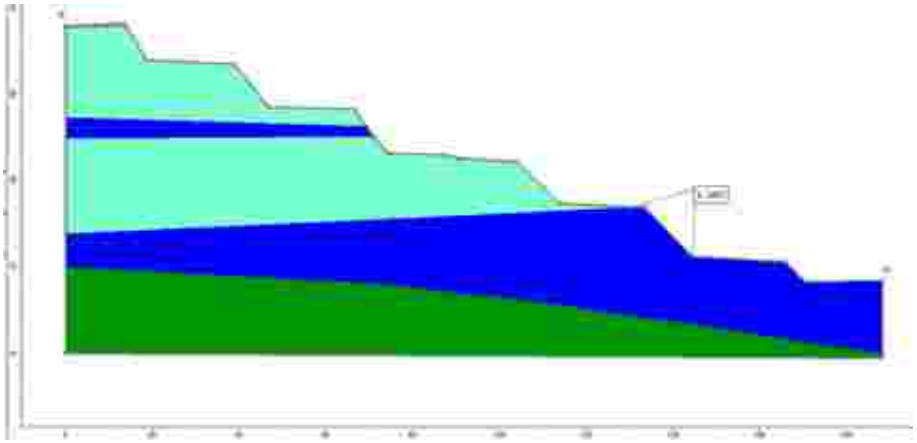


Figure 44: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS of 1.385

Analysis 2- 318000E

2.1 Dry condition

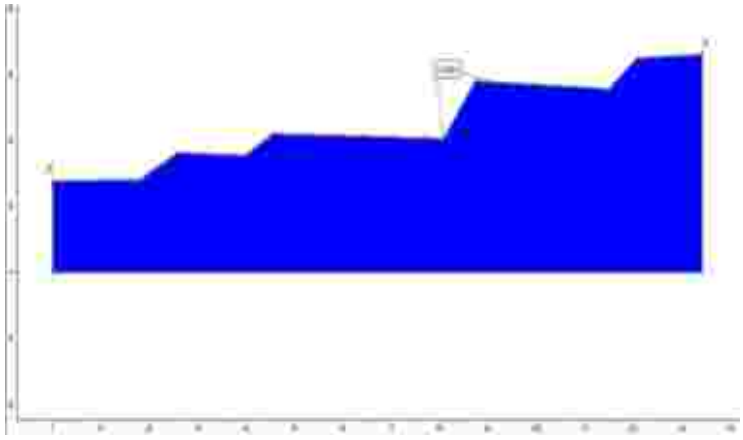


Figure 45: slope stability analysis of a Iron ore +55% slope with FOS of 1.561

2.2 Saturated condition

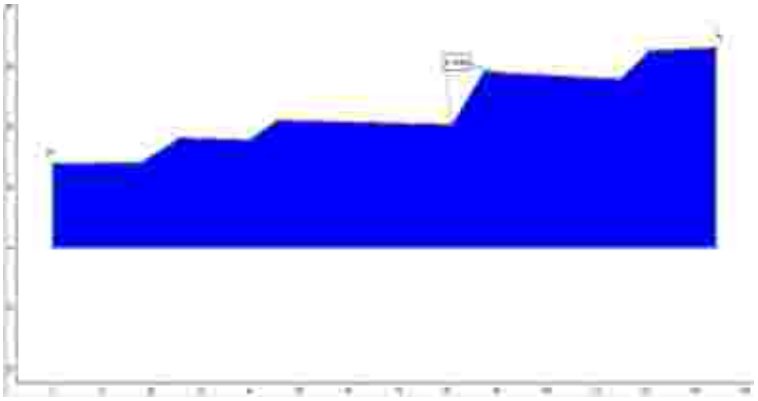


Figure 46: slope stability analysis of a Iron ore +55% slope with FOS of 1.446

Analysis 3 - 318100E

3.1 Dry condition

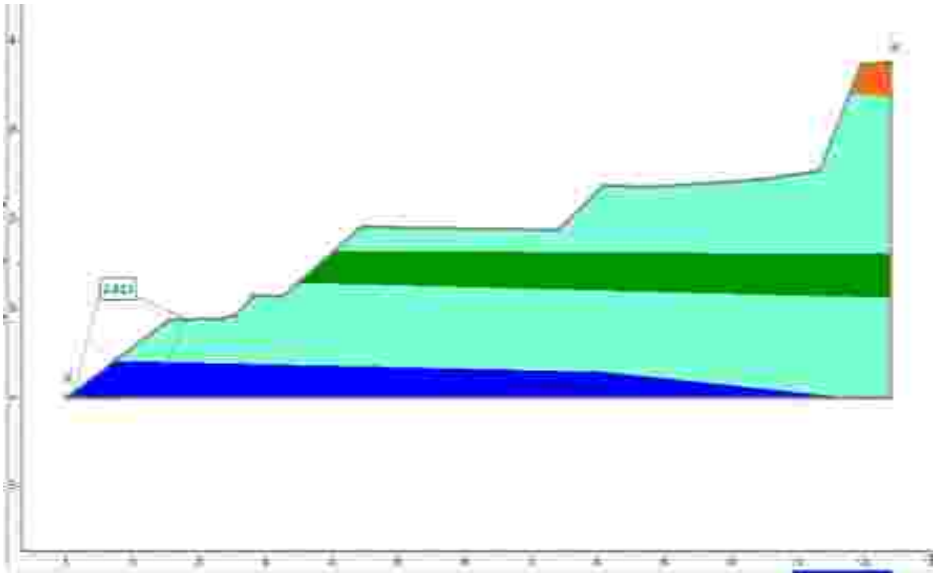


Figure 47: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 2.613

3.2 Saturated condition

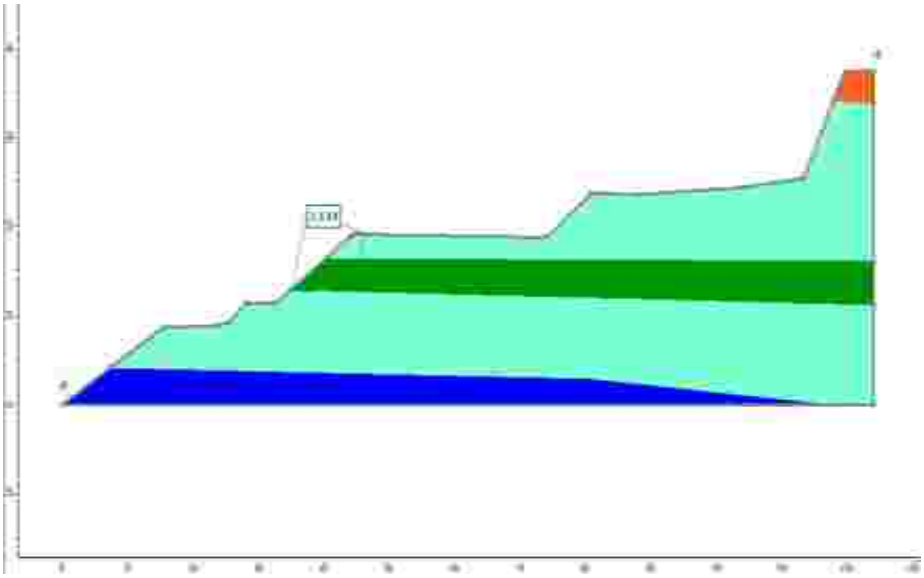


Figure 48: slope stability analysis of a Iron ore 45-55% and Iron ore +55% slope with FOS 2.124

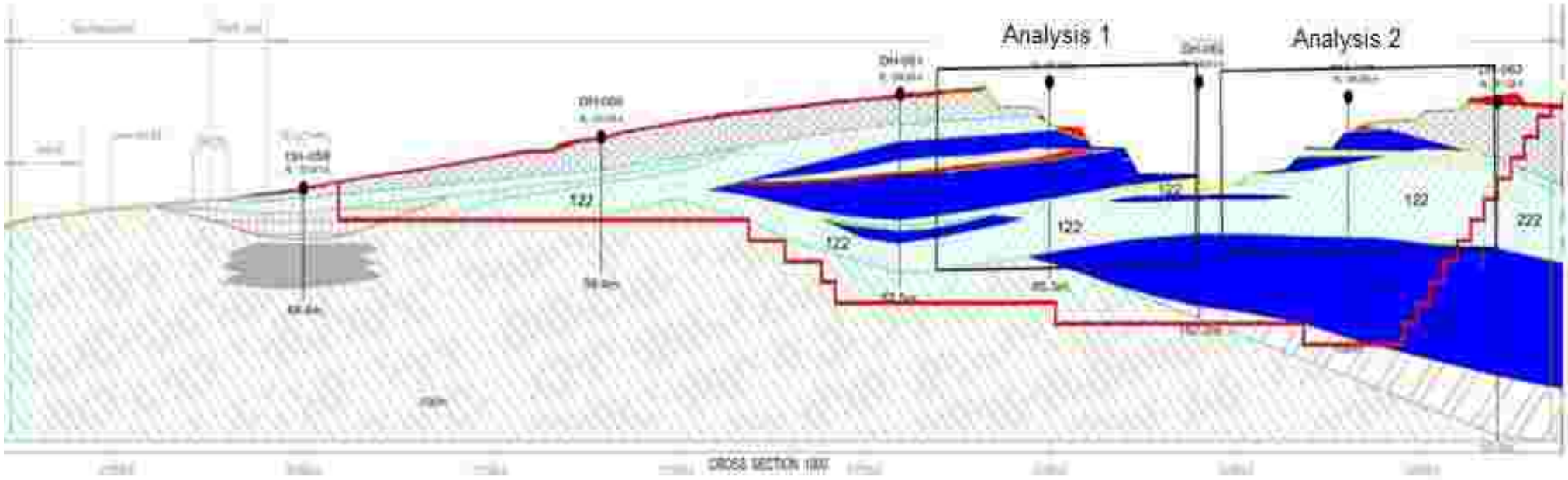
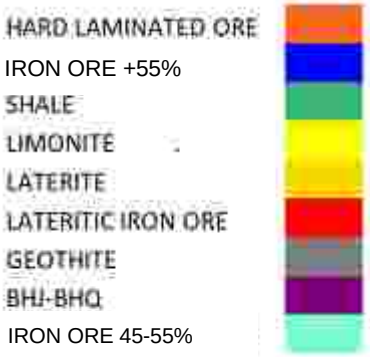


Figure 49: Narayanposhi section 1000N



Analysis 1 - 317800E CROSS SECTION 1000

1.1 Dry condition

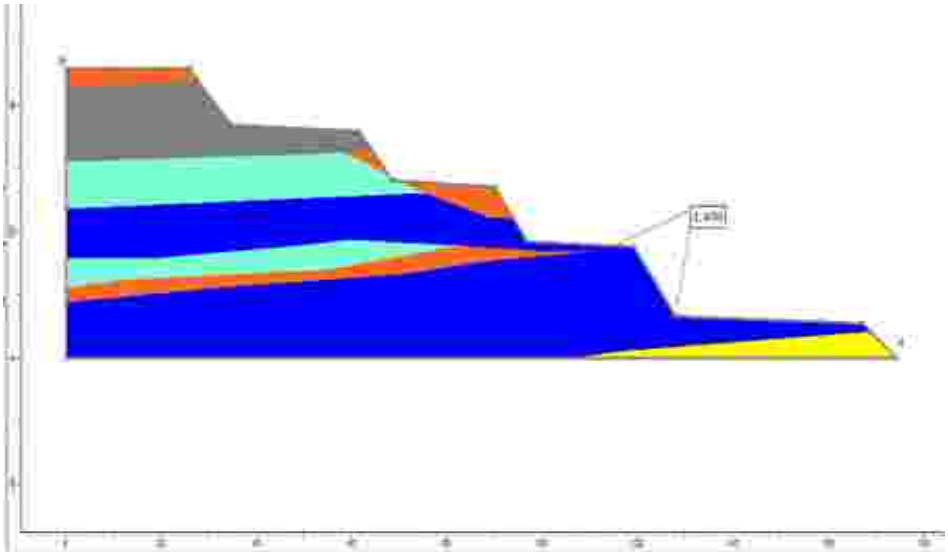


Figure 50: slope stability analysis of Iron ore +55% slope with FOS of 1.470

1.2 Saturated condition

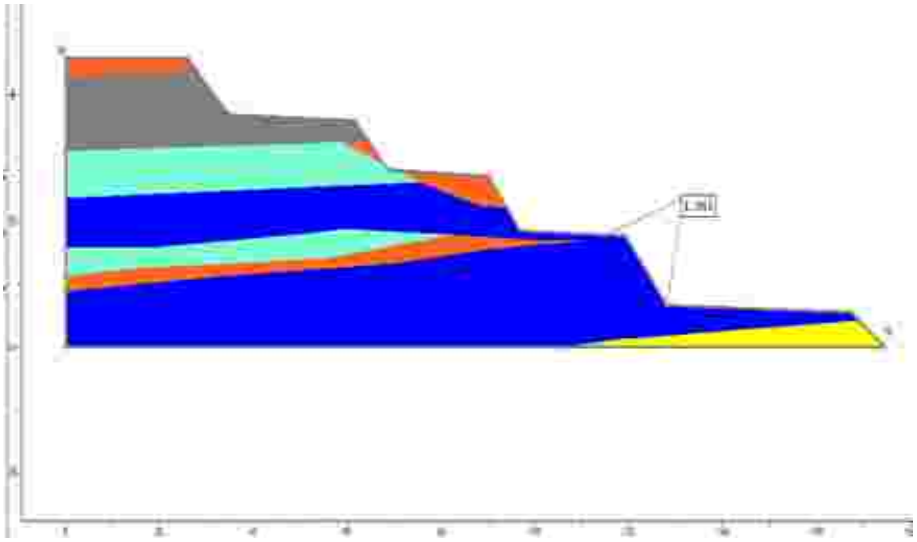


Figure 51: slope stability analysis of Iron ore +55% slope with FOS 1.362

Analysis 2-318000E CROSS SECTION 1000

2.1 Dry condition

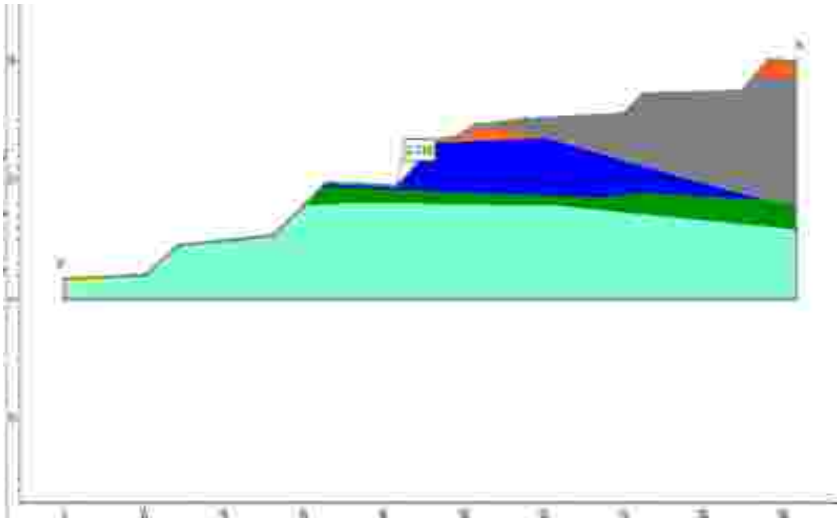


Figure 52: slope stability analysis of a Shale and Iron ore +55% slope with FOS of 2.720

2.2 Saturated condition

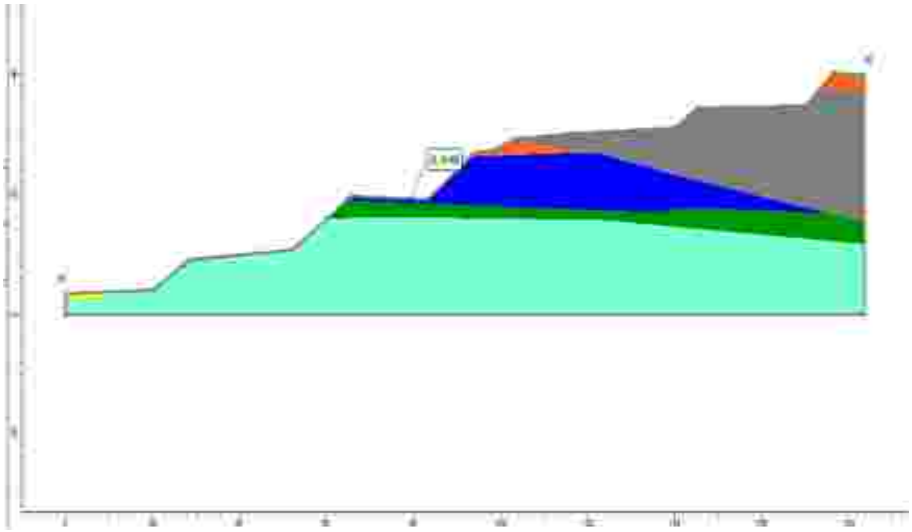


Figure 53: slope stability analysis of a Shale and Iron ore +55% slope with FOS of 2.440

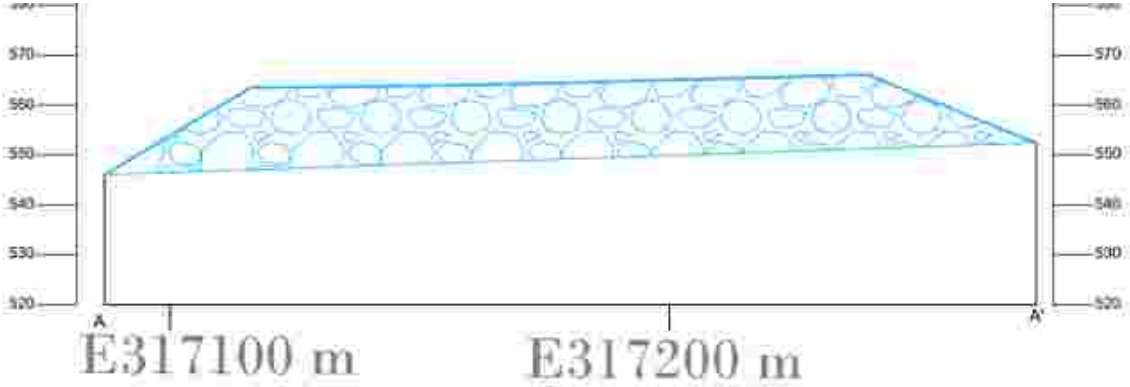


Figure 54: Manganese quarry dump section along A-A'

1.1 ANALYSIS 1

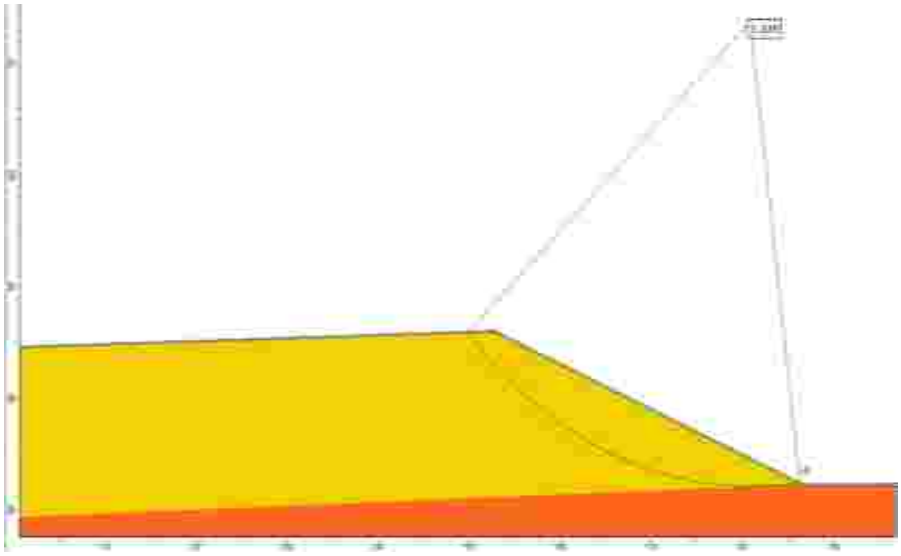


Figure 55: Slope stability analysis with FOS 3.226

1.2 ANALYSIS 2

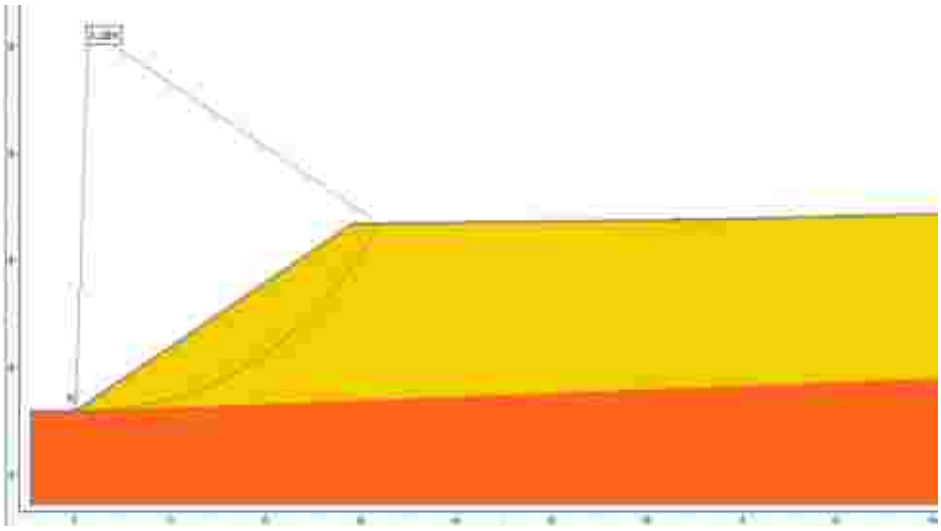


Figure 56: Slope stability analysis of the dump with FOS of 2.289

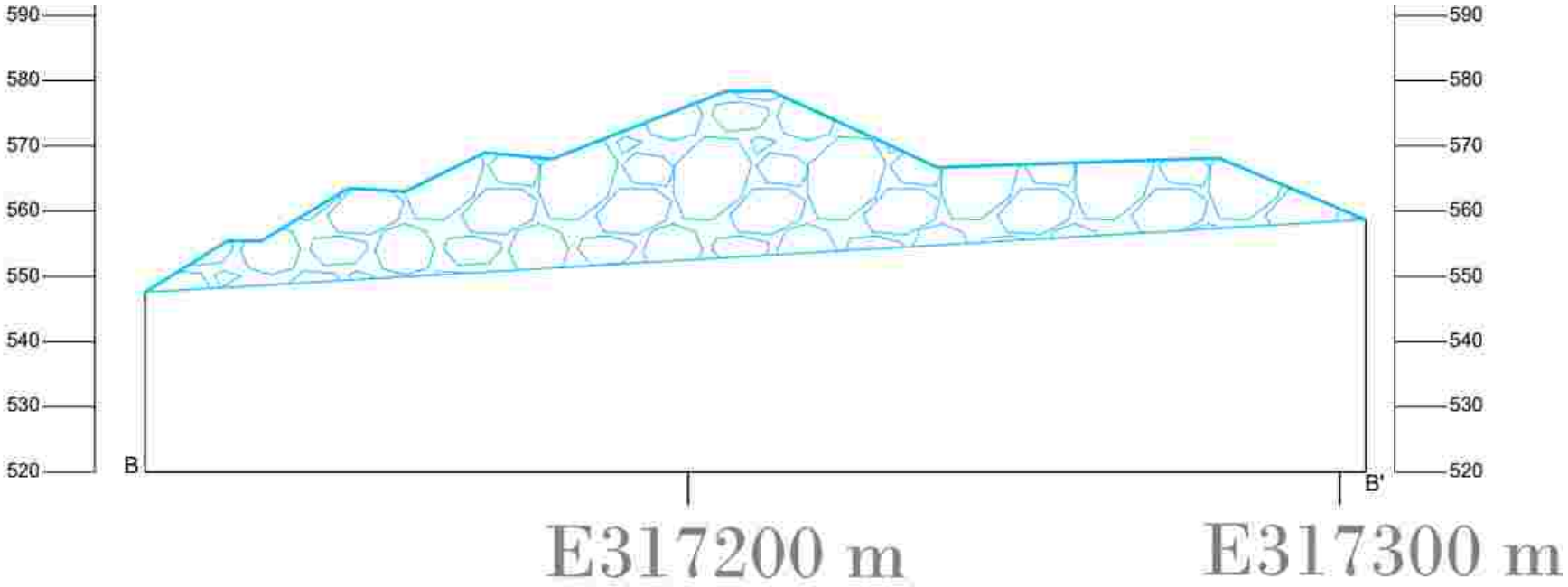


Figure 57: Manganese quarry dump section along B-B'

1.1 ANALYSIS 1

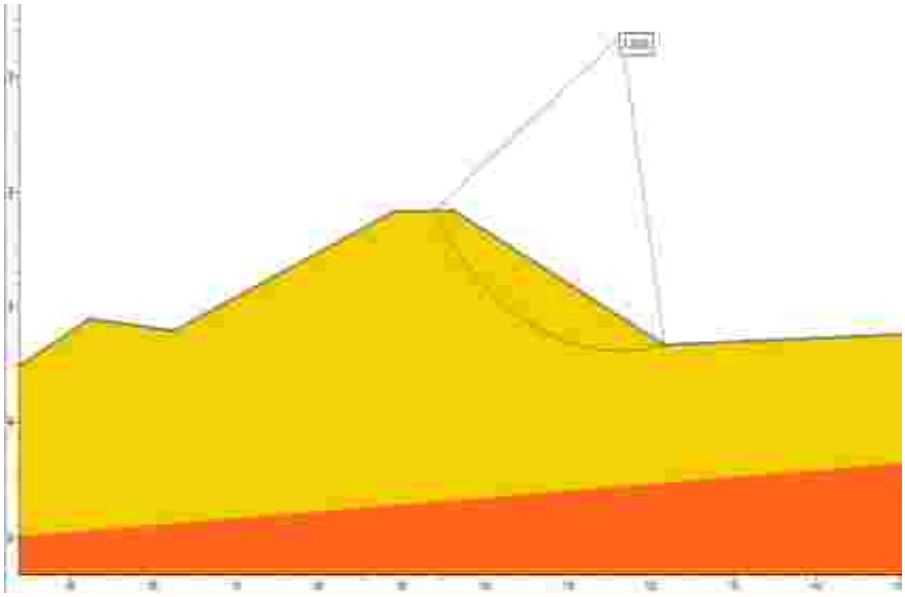


Figure 58: Slope stability analysis of the dump with FOS of 3.071

1.2 ANALYSIS 2

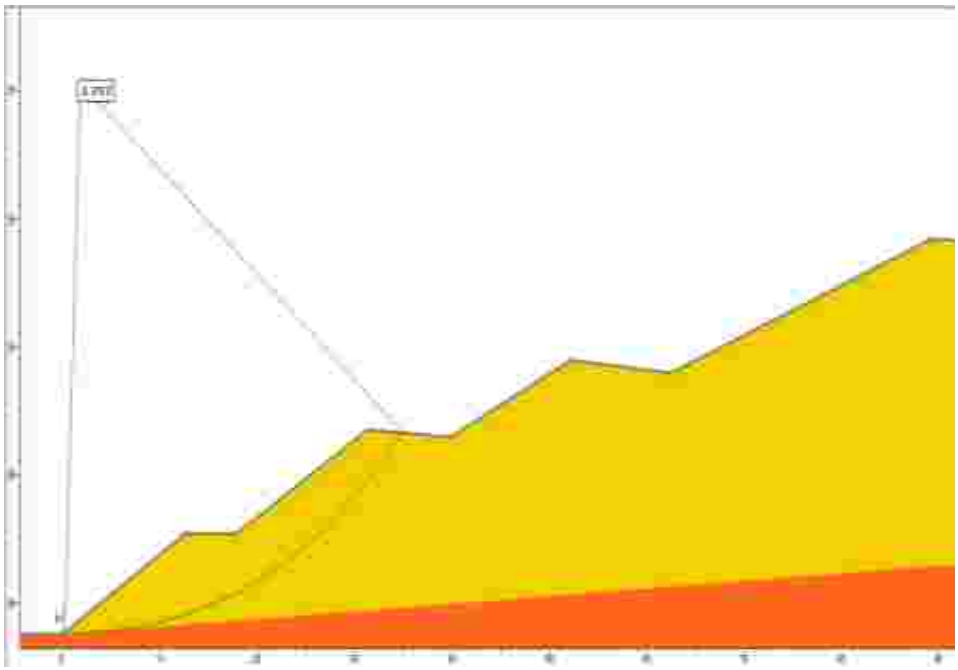


Figure 59: Slope stability analysis of the dump with FOS of 2.792

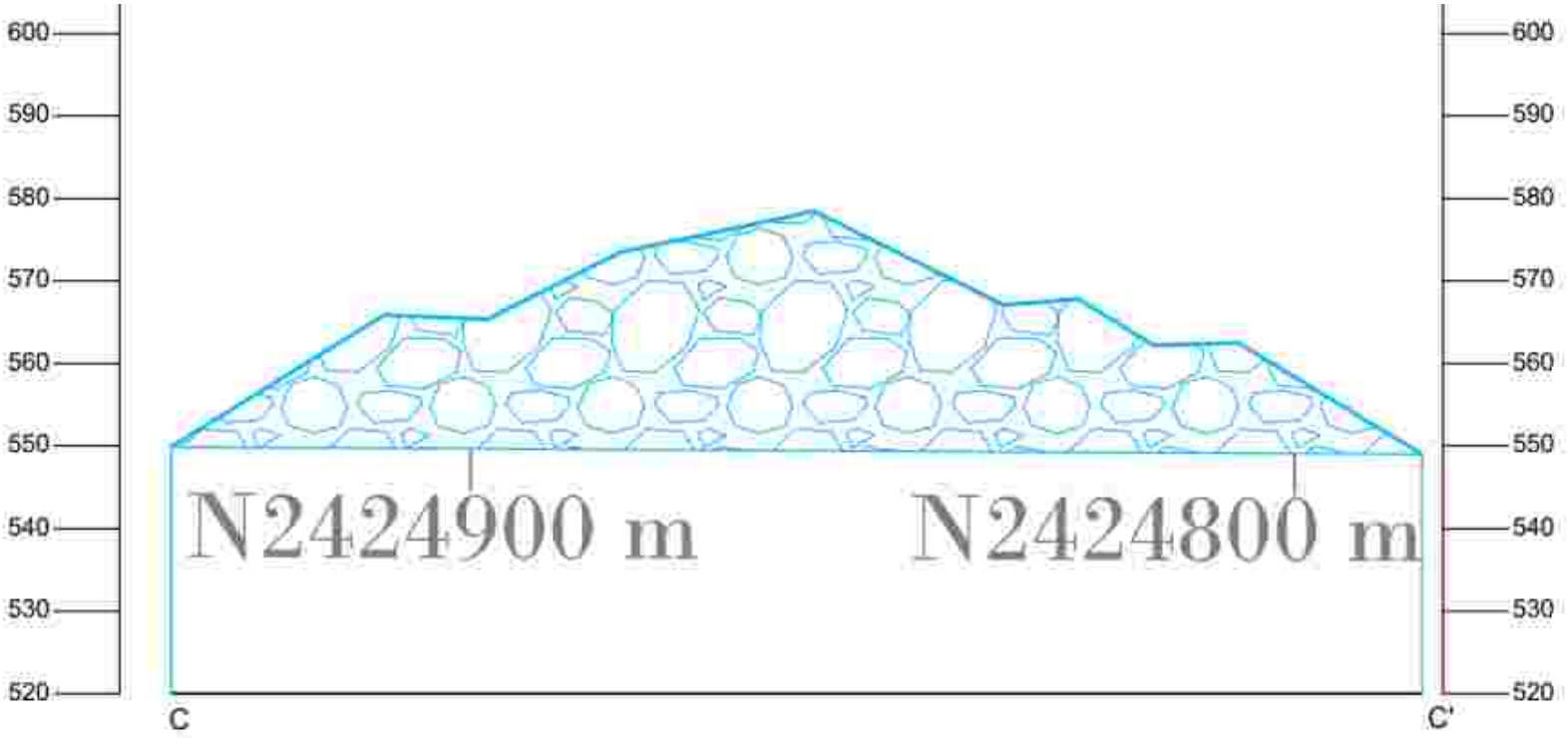


Figure 60: Manganese quarry dump section along C-C'

1.1 ANALYSIS 1



Figure 61: Slope stability analysis of the dump with FOS of 2.447

1.2 ANALYSIS 2

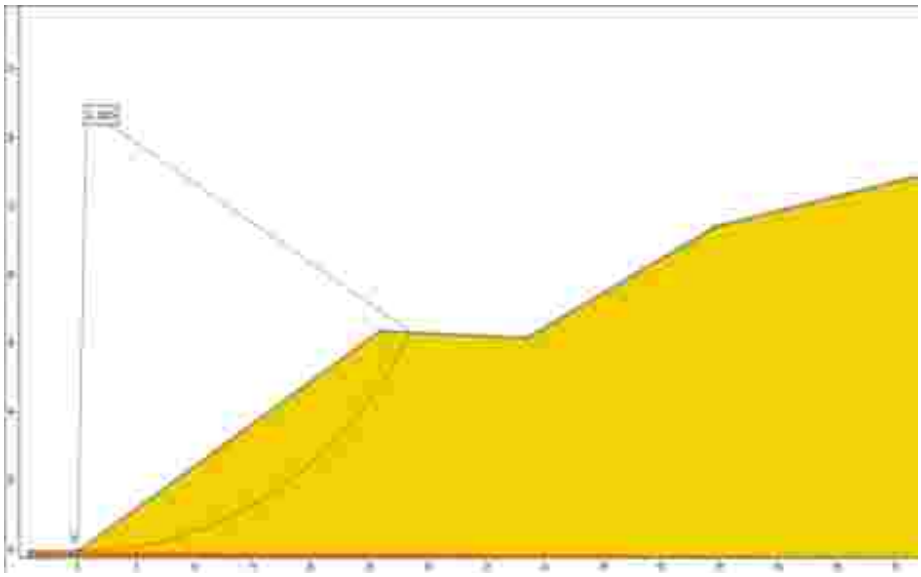


Figure 62: Slope stability analysis of the dump with FOS of 2.285

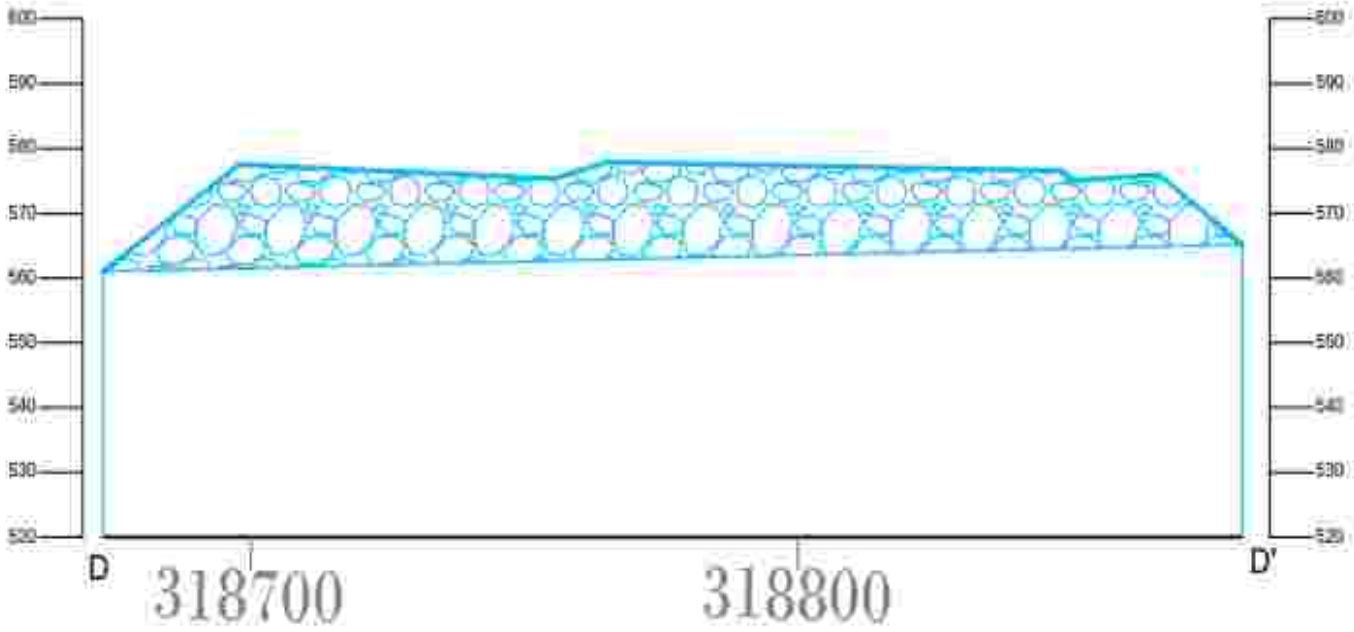


Figure 63: Quarry 3 dump section along D-D'

1.1 ANALYSIS 1

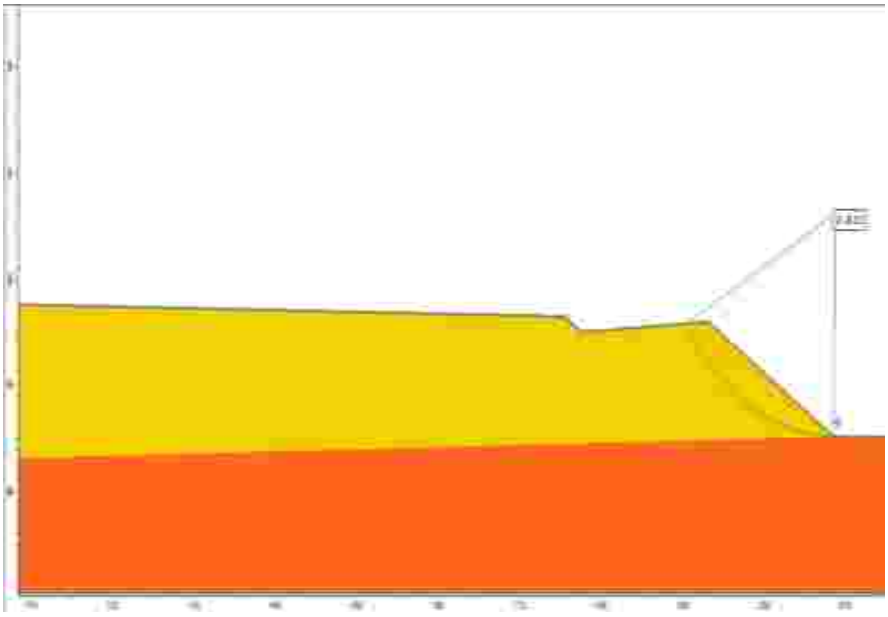


Figure 64: Slope stability analysis of the dump with FOS of 2.411

1.2 ANALYSIS 2

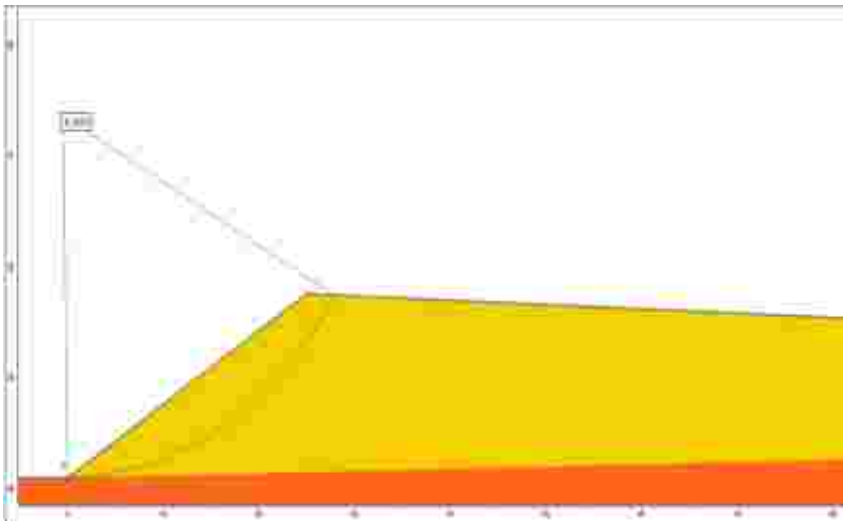


Figure 65: Slope stability analysis of the dump with FOS of 2.168

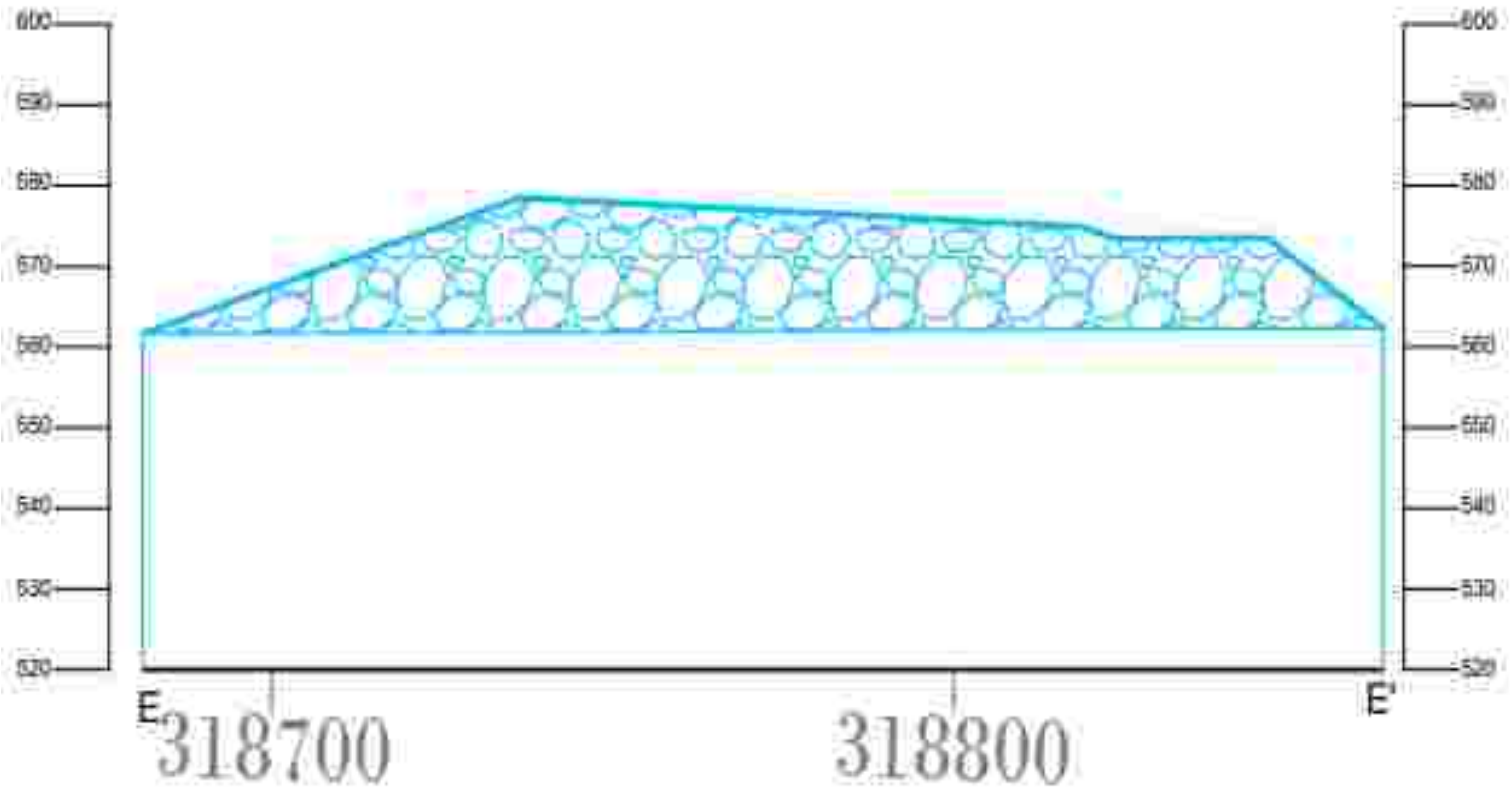


Figure 66: Quarry 3 dump section along E-E'

1.1 ANALYSIS 1



Figure 67: Slope stability analysis of the dump with FOS 2.460

1.2 ANALYSIS 2

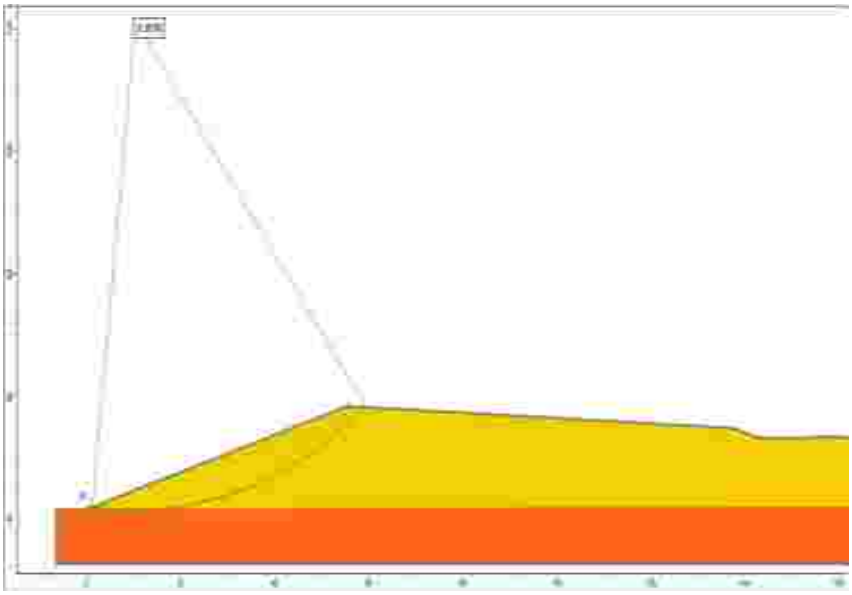


Figure 68: Slope stability analysis of the dump with FOS of 3.850

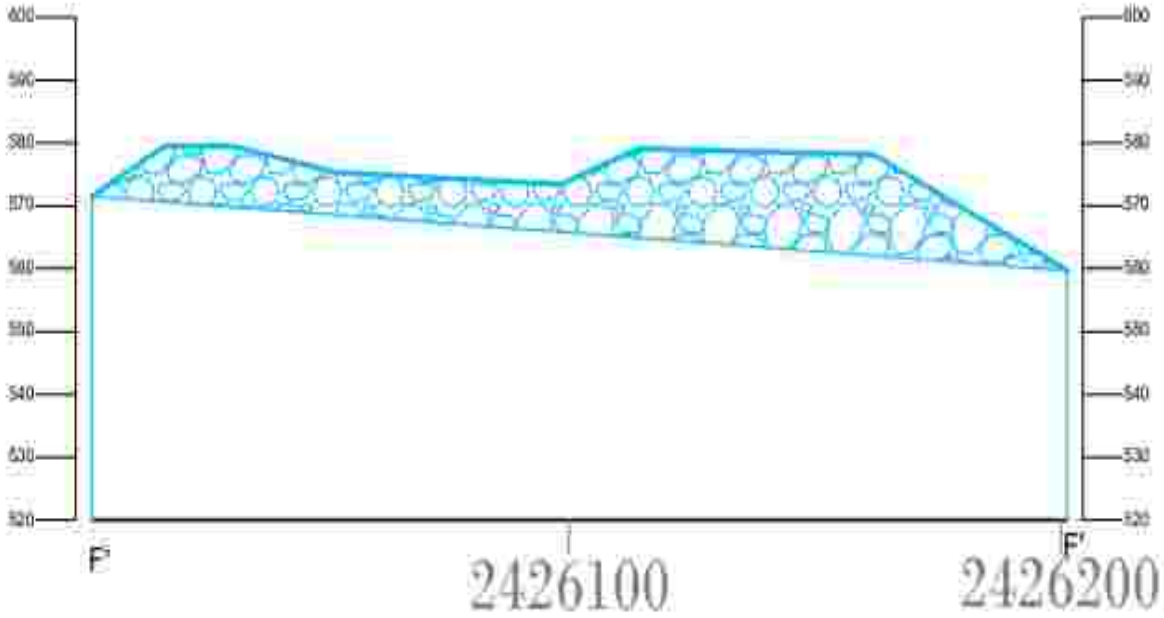


Figure 69: Quarry 3 dump section along F-F'

1.1 ANALYSIS 1

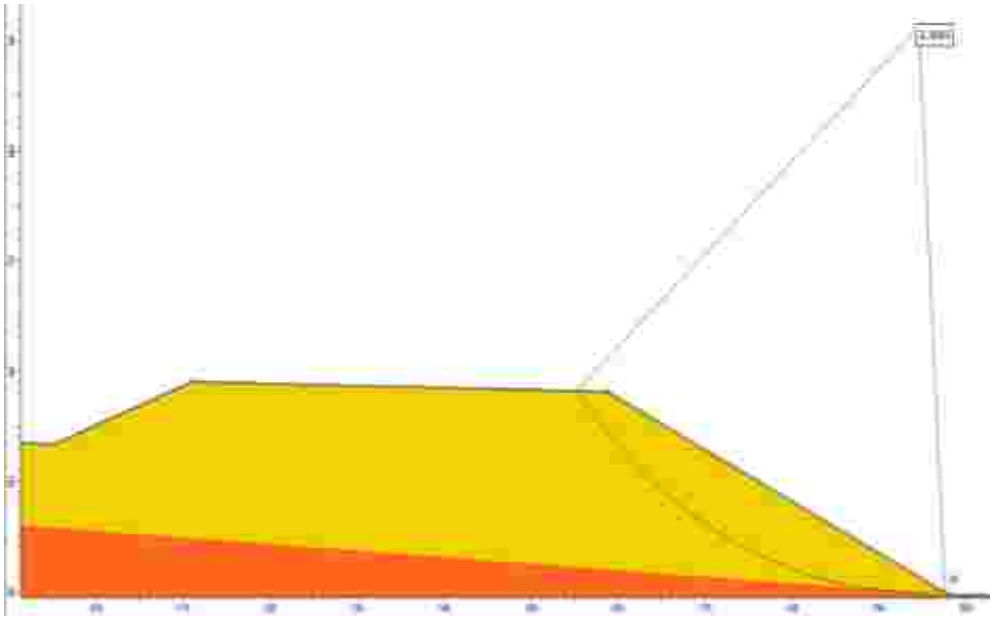


Figure 70: Slope stability analysis of the dump with FOS of 2.685

1.2 ANALYSIS 2

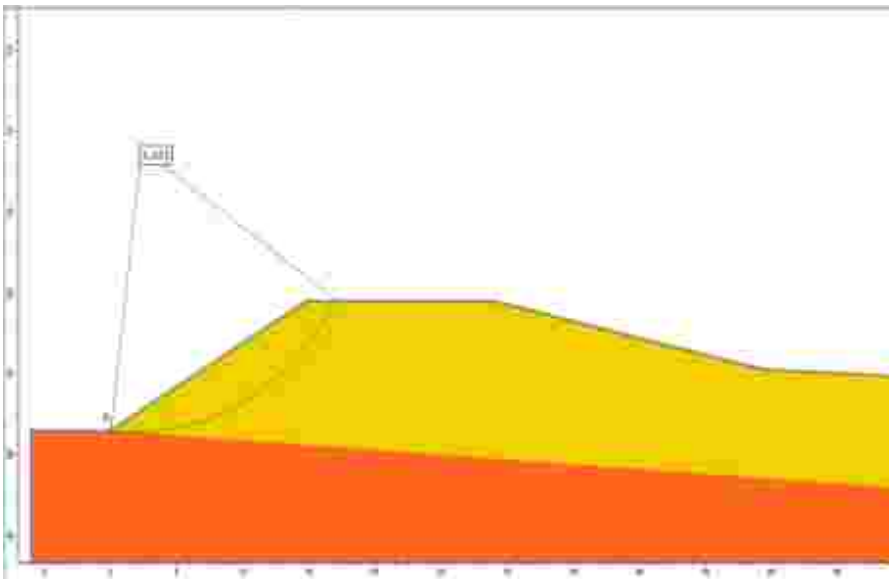


Figure 71: Slope stability analysis of the dump with FOS of 3.155

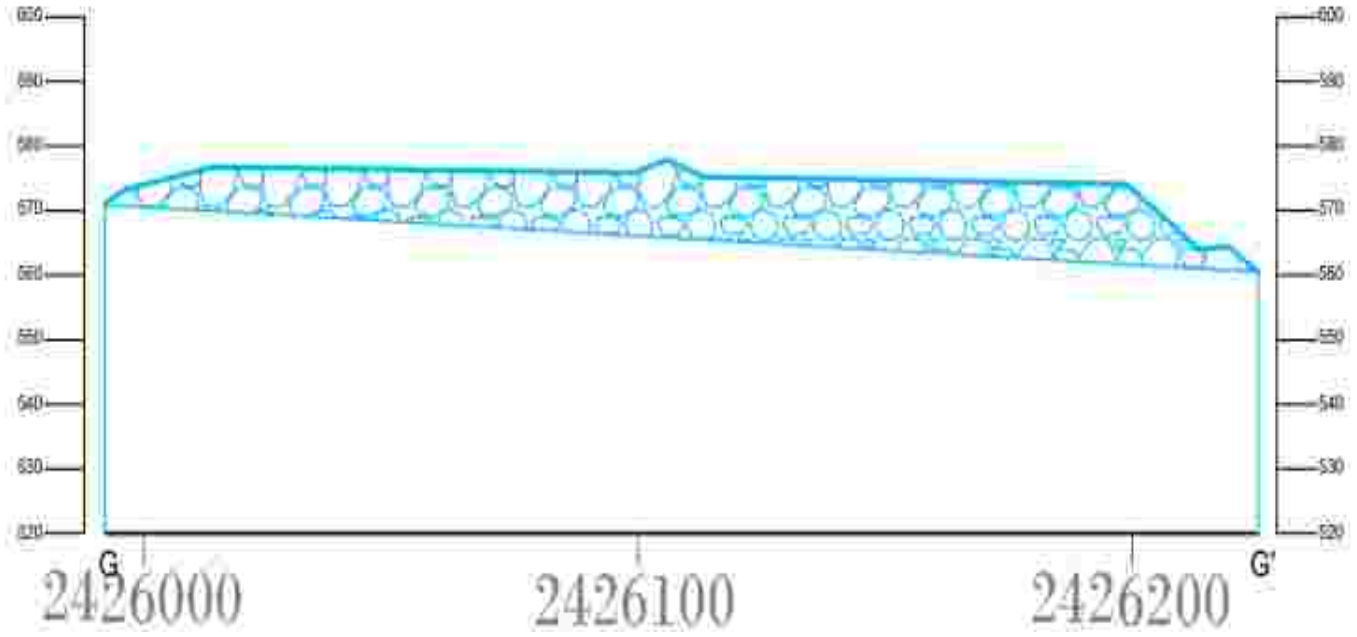


Figure 72: Quarry 3 dump section along G-G'

1.1 ANALYSIS 1



Figure 73: Slope stability analysis of the dump with FOS of 2.518

1.2 ANALYSIS 2

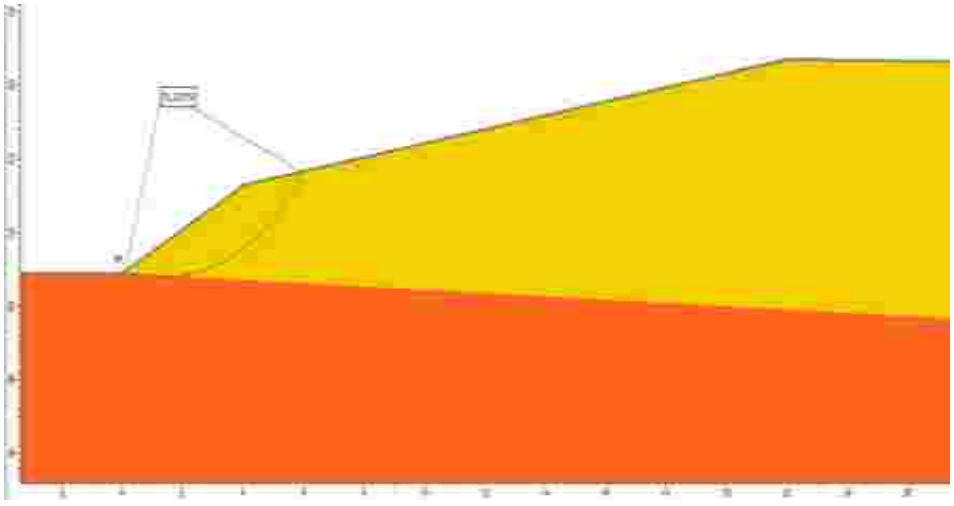


Figure 74: Slope stability analysis of the dump with FOS of 5.375

PIT ANALYSIS FOS TABLE

Section		FOS			
Northing	Easting	dry	figure	saturated	figure
2200	318400	1.669	2	1.413	3
	318500	2.982	4	2.589	5
	318600	2.251	6	1.579	7
2000	318250	5.252	9	3.683	10
	318350	3.320	11	3.090	12
	318500	1.564	13	1.449	14
1900	318400	2.854	16	1.395	17
1800	318050	10.140	19	6.605	20
	318300	1.887	21	1.419	22
RF quarry					
1400	318100	2.527	24	2.236	25
	318250	4.418	26	4.272	27
1300	318000	1.870	29	1.476	30
	318100	1.694	31	1.487	32
	318200	2.309	33	1.740	34
1200	317900	1.708	36	1.496	37
	318000	1.821	38	1.687	39
	318100	1.491	40	1.384	41
1100	317850	1.582	43	1.385	44
	318000	1.561	45	1.446	46
	318100	2.613	47	2.124	48
1000	317800	1.470	50	1.362	51
	318000	2.720	52	2.440	53

DUMP ANALYSIS FOS TABLE

Dump sections were analysed for both dry and saturated conditions. As observed in dump, safety factor in dry condition is more than that in saturated condition. Hence, for the dump the images of analysis with dry condition are not shown.

DUMP ANALYSIS				
Section	Analysis	Profile	FOS	Figure
MANGANESE QUARRY A-A'	1.1	Profile close to 317200	3.226	55
	1.2	Profile close to 317100	2.289	56
MANGANESE QUARRY B-B'	1.1	Profile close to 317300	3.071	58
	1.2	Profile close to 317200	2.792	59
MANGANESE QUARRY C-C'	1.1	Profile close to 2424800	2.447	61
	1.2	Profile close to 2424900	2.285	62
QUARRY 3 DUMP D-D'	1.1	Profile close to 318800	2.411	64
	1.2	Profile close to 318700	2.168	65
QUARRY 3 DUMP E-E'	1.1	Profile close to 318800	2.460	67
	1.2	Profile close to 318700	3.850	68
QUARRY 3 DUMP F-F'	1.1	Profile close to 2426200	2.685	70
	1.2	Profile close to 2426100	3.155	71
QUARRY 3 DUMP G-G'	1.1	Profile close to 2426200	2.518	73
	1.2	Profile close to 2426000	5.375	74

2.0 CONCLUSIONS AND RECOMMENDATIONS

A few analyses were carried out for singular strata type of soft material such as laterite, Iron ore +55% (Blue Dust), shale and Iron ore 45-55% (SLO) to estimate the bench height and bench slope for safety factor 1.3. The graphs show respective bench slopes at the corresponding bench heights. Analyses show all the quarry benches as well as dumps have safety factor more than 1.3 and hence are considered stable. The dump benches have slope angle less than the recommended angle of 37.5^0.

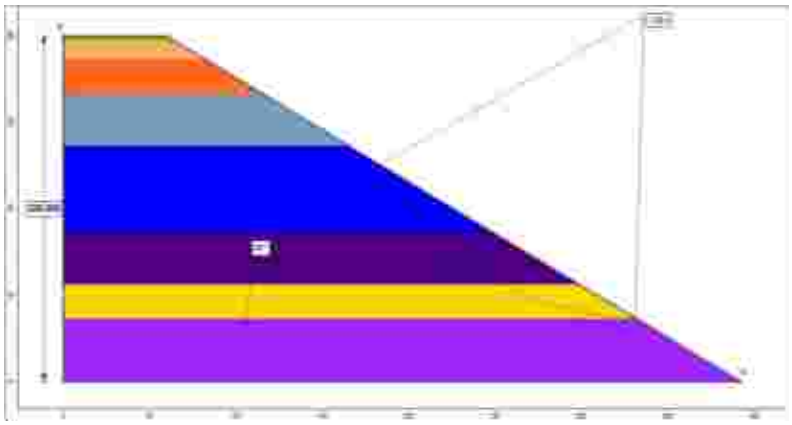
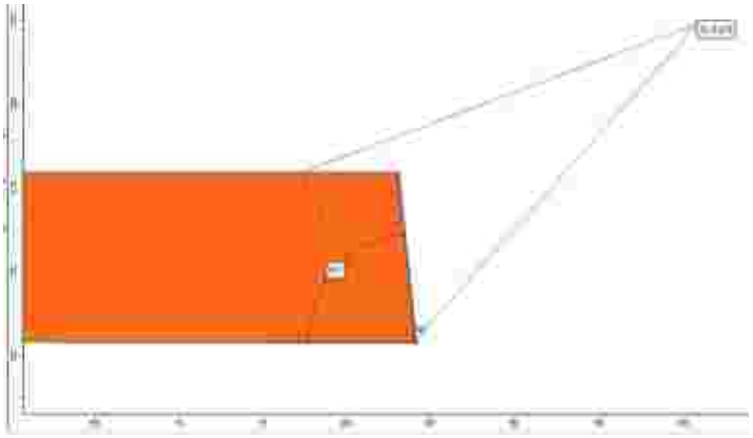
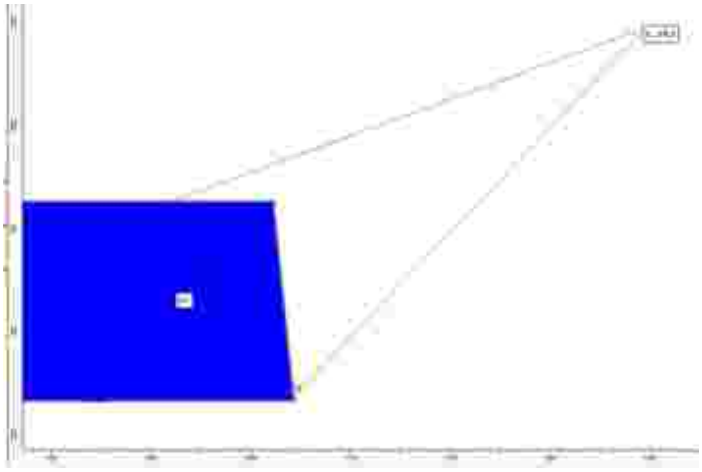


Figure: Overall Pit slope angle of 31^0 with FoS 1.301

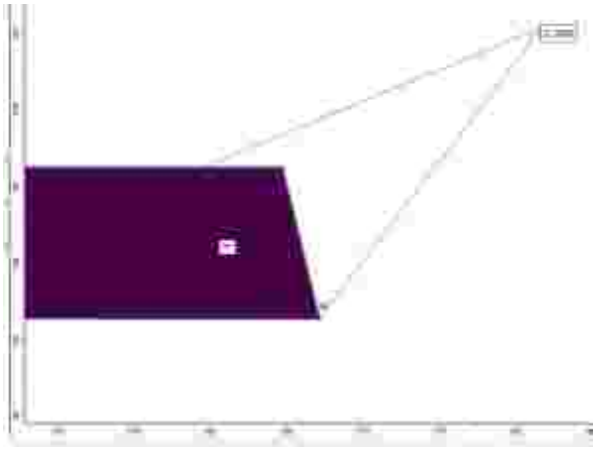
LATERITE



SLO



Blue dust



Shale

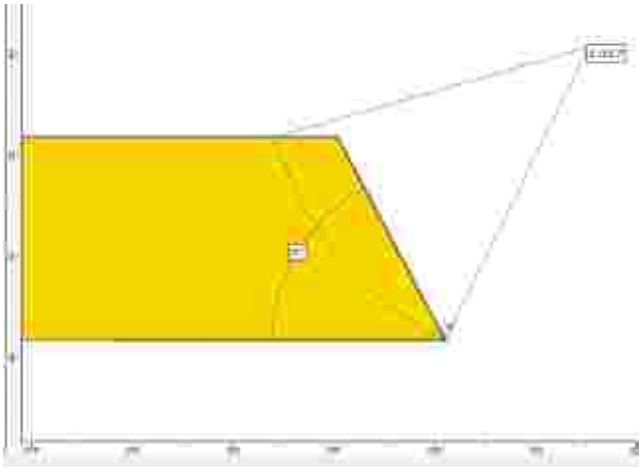


Table: Slope Angles for different heights and materials

Sl. No.	*Material Type*	*10 meters*	*9 meters*	*8 meters*
1	Laterite	84^0	$>84^0$	$>84^0$
2	SLO	84^0	$>84^0$	$>84^0$
3	Blue Dust	76^0	$>80^0$	$>80^0$
4	Shale	62^0	64^0	68^0
5	BHQ	$>80^0$	$>80^0$	$>80^0$
6	Lateritic Ore	$>80^0$	$>80^0$	$>80^0$
7	Hard Laminated Ore	$>80^0$	$>80^0$	$>80^0$

Analysis for Overburden Dump

The geotechnical parameters for dump materials for both the iron and manganese pits were very close and hence the average values were taken to predict the FoS of the overall layout and individual bench layout. DGMS guideline restricts the maximum over all height to 90m with maximum slope angle 37.5^0. The analysis shows that the FOS is 1.347. the corresponding FOS for 30m single bench is 1.371 (figures below).

90m Overall OB Section

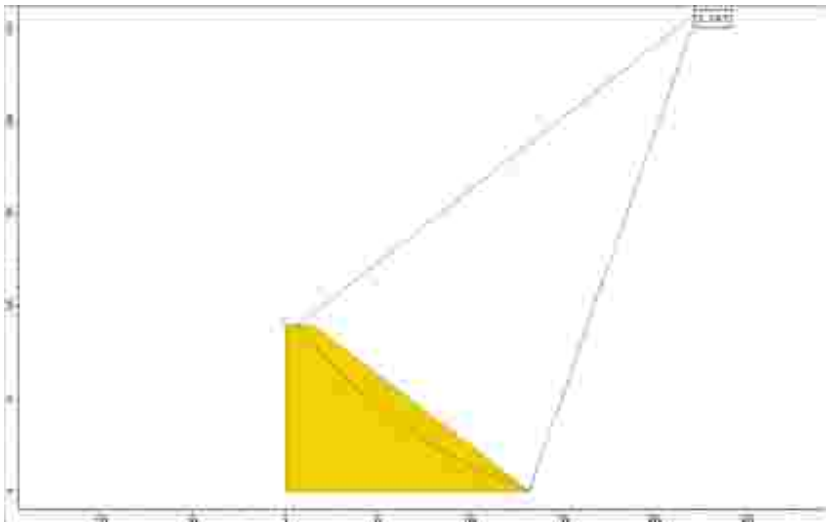


Figure 75: Total height 90m OB for angle 37.5^0 with FOS 1.347.

Single bench



Figure 76: OB slope with 30m bench at angle 37.5^0 with FOS 1.371.

Precautionary Measures

Unanticipated movement on the ground can pose hazardous condition that may harm lives, equipment and properties. There are several ways to reduce chances of surface ground failure as (a) safe geotechnical design, (b) secondary support or rock fall catchment system, and (c) maintaining devices for advance warning of impending failure. Proper bench design can minimize rock fall hazards. Certain support system may enhance overall rock mass strength. The analysis shows that no large-scale failure is possible though localised bench failure cannot be ruled out. Those should be arrested by lower benches and hence access of machineries should be maintained.

Drainage and Water Management

Rainwater plays a adverse role in mine slope stability. So, care should be made to avoid entry of rainwater in the slope. So, suitable drainage facility should be made in and around the mine and waste dump. Drains should be properly maintained. Drain channels should be inspected regularly to keep the path free from debruises. Effectiveness of drainage may be maintained by piezometers and other instruments to check the functioning.

Rainwater should not be allowed to accumulate or left unattended. Effective garland drain should be provided around pit and waste dumps. Maintaining a proper gradient should help in quick run off of water. Surface run off and sub surface water adds to instability. Grasses have very high binding capacity and help in long term stabilisation. It also helps in reducing the water pressure due to evapo-transmission.

Water management

Rainwater of the adjacent areas should not be allowed to enter the mine pit. It would cause erosion and deep gullies. So, rainwater catchment area should be channelled away to other areas. The upper surface of the mine and dump should be adequately graded to divert he run off of rainwater away. Therefore, proper levelling and grading of surface should be carried out. Regular and continuous maintaining should be done to check the flow path of rainwater and to

take immediate remedial measures. Rainwater in the dump should be channel down effectively through effective toe drain arrangement. Subsurface drainage system or sub drains should remove subsurface water directly from an unstable slope, to redirect adjacent ground water sources away and to reduce hydrostatic pressure.

Stability of Benches

Pit walls often experience vibration due to poor blasting operations. Uncontrolled blasting results in over brakes, widening of existing cracks/joints, creation of fresh cracks etc. Those become critical to the stability of pit slopes. Therefore, a properly designed and controlled blasting should be carried out. Controlled blasting with closely spaced or carefully designed drill holes, properly selected explosives, and sequential detonation should be adopted. The control blasting can be achieved by broadly by (i) using an explosive with a relatively low detonation velocity, and (ii) maintaining air gap between the explosive and the wall of drill hole. The mine authority is recommended to go for scientific study for this.

Slope Monitoring

Three general principles of slope geo-mechanics that govern slope stability are (Kliché, 1999)

a. Slope failures do not occur spontaneously.
b. Most slope failures tend towards equilibrium.
c. A slope failure does not occur without warning.

The slope should be regularly monitored to observe any instability in advance to avoid any damage to men and machineries. The instability if detected at early stage can be addressed by adopting suitable remedial measure. In general, slope stabilisation involves continuous monitoring of the slopes to detect any movement. The guidelines given in the gazette of Indian extraordinary part –II, section 3, Subsection-1, New Delhi Feb 21, 2020 for mine workings should be followed. There should be a team of dedicated skilled persons with proper training for slope

monitoring exercises. Slope stabilisation schemes as grading, serrating, benching, arresting rock falls, and other measures should be adopted. Slope monitoring mechanism varies widely from a simple visual observation of signs of instability to use of state of art instrumentation. Regular surveying of other benches and their movement both horizontal and vertical can be carried out to determine potential instability. Determination of simple displacement by tension cracks mapping, extensometers and survey points are some of the cost-effective monitoring methods. Typically, all these methods should be adopted as no single method represent the whole behaviour accurately. Systematic mapping of tension cracks shows geometry of the failure more effectively. All cracks should be mapped regardless of apparent cause. The end of the cracks should be flagged or marked so that new cracks or extensions of existing cracks can be identified. Portable wire extensometers provide monitoring in areas of active instability across tension cracks. The extensometers should be positioned on stable ground behind the last visible tension crack and the wire should extend to the unstable area. Anyone working in the area can check on slope movement by inspecting the instruments. The monitoring of prism targets with the total station provides detailed movement history for displacement and rates in the unstable areas.

Monitoring Schedule

A well designed and developed monitoring schedule should be established. Frequency of monitoring depends on precision, rate of movement and how critical the area is. If there is heavy rain or a large blast in the area, additional measurement should be made. Mines should attempt to establish measurement of surface movement through survey network. The network should consist of target areas/locations/sections (e.g. prism shape) placed on and around area of anticipated instability on slopes and one or more non-moving contact points for survey stations. The angles and distances from the survey stations to the locations/areas/sections should be measured on regular basis to establish history of movement on slope. The permanent control points for the survey stations should be placed on stable ground.

Tension Cracks

The formation of cracks at the top of a slope, specifically on dump sections exhibits the sign of instability. The measurement and monitoring of the changes to crack width and its direction of propagation establish the extent of the unstable area. Existing cracks may be identified with clear identification so that new cracks can be easily identified.

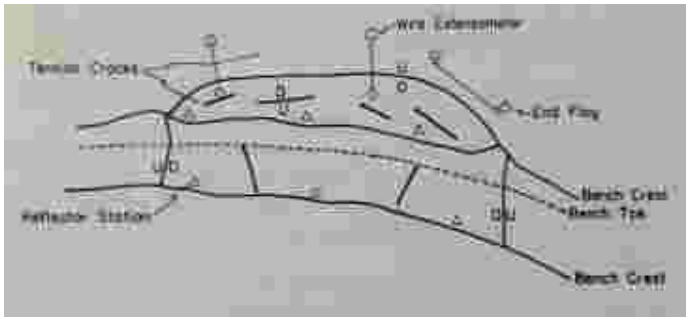


Figure 75: Methodology to measure tension crack (after Call, 1982)

Measurements of tension cracks can be carried out simply by driving two stakes or either side of it and measuring its separation over time. Portable wireline extensometer is another method of monitoring tension crack behaviour.

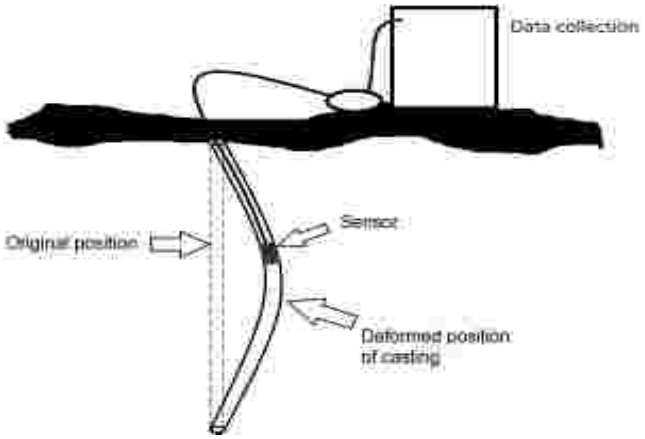


Figure 76: Cross-sectional schematic of typical traverse-probe inclinometer system

Inclinometer is another equipment to monitor ground movement specifically in horizontal direction (fig 16, pp). The end of the casing is fixed to a stable part. The groves has sensing units and the deflection of casing reflects the movement of rock mass. Inclinometers provide information on

- Location of shear zones
- Natures of shear along the zone plan rotational.

- Measurement along shear zones and predict its rate i.e. constant, accelerating or decelerating

Borehole extensometer is another technique to monitor slope movement. It consists of tensioned rods anchored at varying points in the borehole (Fig 18). Changes in the distance between the anchor and the rod head give the movement information for rock mass.

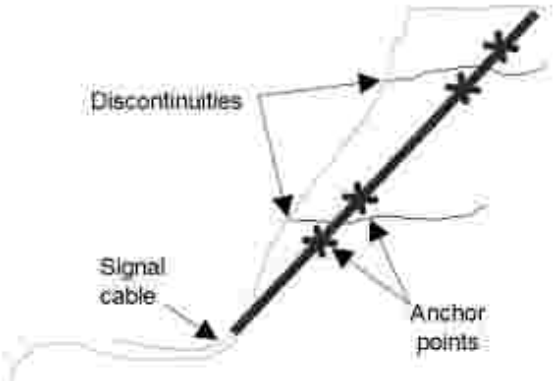


Figure 77: Multi-point borehole extensometer

TDR (Time Domain Reflectometry) is a recent approach that uses electronic pulses through coaxial cable. Signal at the deformation or break in cable position gives information on the subsurface rock mass behaviour.

Piezometers

The effectiveness of mine dewatering schemes and the effects of seasonal variations can be determined by piezometers. Excessive pore pressure, water infiltration in particular at geological boundaries cause slope failures. So, data on water pressure development should be maintained regularly. Highwalls and other potential faces should be examined regularly for new seeps or changes in water flow rate.

Stress, gravity loading, rock mass strength, geology, pore pressure as well as many other factors contribute to slope failure. Complete attention to monitor each and every potential failure block is neither feasible not economical and often not attainable with conventional point displacement monitoring techniques. As mining activities progress, it becomes important to monitor different

sections of the pit walls. So, frequent relocation of survey devices can be challenging. A recent advancement that is being experimented with success is synthetic aperture radar (SAR). It can generate high quality digital elevation maps (DEMs) and detect disturbances of earth's surfaces. There are a few variations of the same that are being developed that can take continuous images in almost all weather and time conditions. Those may be explored by the mine management.

3.0 Additional Recommendations

The following additional recommendations are made with reference to the slope stability investigation carried for Narayanposhi iron and manganese ore mine.

1. There is no challenge due to ground water at the mine. However, steps are recommended to have an effective garland drain/bund all around to collect/divert run off rainwater of the catchment area before it reaches the mine slopes. The drains should be kept clear of silt and debris.

2. There should be regular mapping of the weak zones, faults, and bedding planes of the pit by geologist and data should be used for further analysis of slope stability for different geo-mining condition. It will facilitate to detect any unfavorable conditions at different stages of mining.

3. Mining and excavation activities change the physical dimension of the system. So regular scientific study should be carried out for safety factor analysis of the pit as well as dump sections, say every 5 to 6 years or if significant alteration of system happens, or change in geological structural features is observed.

4. Mine management should make a dedicated team of trained and competent persons for slope monitoring with clearly defined duties and responsibilities. The monitoring should be done periodically at least once a month and the results of the monitoring should be recorded. The monitoring data should be regularly analyzed to predict the slope movement or instability well in advance. In case of need, help/advice may be sought from expert agencies in the field of slope stability and slope monitoring.

5. During rainy season, an officer should be deputed for regular visual observation in and around the mine and dump to see that rain water is not accumulating at any point except sump. The

effectiveness of drains should also be visually ascertained. If any blockage is observed, immediately steps should be taken to make it effective. If any tension crack is detected in the pit/dump, the entry of water inside the crack should be checked.

6. Mine management should explore construction of a dedicated barricades of adequate strength and dimensions between the lease boundary and nearby settlements so that the debris or rolling fragments are arrested by the barricades.

References

1. Hoek, E and Brown, E.T., 1997, Practical Estimate of Rock Mass Strength, Int. Journal of Rock Mechanics and Mining Sciences, Vol 34, No 2, pp 203-215
2. Hoek, E., Carranza-Torres, C.T., and Corkum, B., 2002, Hoek-brown Failure Criterion-2002 Edition, Proceedings, 5th North American Rock Mechanics Symposium, Toronto, Canada, Vol 1, pp 267-273
3. Shivakugan, N, S K Shukla and B M Das; 2013; "Rock Mechanics: An Introduction", Taylor and Francis Group, CRC Press, ISBN 978-0-415-80923-8; pp 115-241
4. Hoek, E. and J.W. Bray, 1977, Rock Slope Engineering, Institution of Mining and Metallurgy, London, pp 309
5. The Metalliferous Mines Regulations [MMR] 2019, vide The Gazette of India, CG-DL-E-27022020-216432, Extraordinary, PART II—Section 3—Sub-section (i), pp 180-184
6. Indian Standard Method for Determination of Tensile Strength by Indirect Tests on Rock Specimen, IS 10082-1981, pp 12
7. Indian Standard Method of Test for laboratory Determination of Water Content, Porosity, Density and related properties of Rock Material, IS 13030-1991
8. Indian Standard Method of Test for the determination of Unconfined Compressive Strength of Rock Material, IS 9143-1979
9. Indian Standard Method of Test for the determination of Strength of Rock Materials in Triaxial Compression, IS 13047-1991
10. Call, R.D., 1982, "Monitoring Pit Slope behaviour", Proceedings 3rd International Conference on Stability in Surface Mining, SME-AIME, New York, pp 229-248
11. Kliche, C. A., 1999, Rock Slope Stability, Publ: SMME Inc., CO, USA, pp 252
12. Wyllie, D. C., and Mah, C. W., (2004). Rock Slope Engineering. Spon Press, London and New York

Ref No 3: As per the aforementioned recommended FOS criteria (p192)

where F_r is the total force available to resist the sliding of the rock block and F_i is the total force tending to induce sliding. For a slope on the point of failure, a condition of limiting equilibrium exists in which $F_i = F_r$, and thus FS = 1. For stable slopes, $F_r > F_i$, and therefore FS > 1. In practice, rock slopes with FS = 1.3 to 1.5 are considered to be stable; the lower value is taken for temporary slopes such as mine slopes, whereas the higher value is considered for permanent slopes such as slopes adjacent to road pavements and railway tracks.

6.3.2 Plane failure

Figure 6.3 shows a rock slope of height H inclined to the horizontal at an angle i. The sliding rock block $A_1A_2A_3$ is separated by the joint/bedding/failure plane A_2A_3, which is inclined to the horizontal at an angle θ. A_1A_3 $(= B)$ is the top width of the sliding rock block, and W is its weight. The stability of the rock block $A_1A_2A_3$ is analysed as a two-dimensional limit equilibrium problem, considering a slice of unit thickness through the slope. Only the force equilibrium is considered, neglecting any resistance to sliding at the lateral boundaries of the sliding block. The joint/bedding plane material is assumed to be a c–ϕ soil material, with c and ϕ as cohesion and angle of internal friction (also called angle of shearing resistance), respectively, obeying the Mohr–Coulomb failure criterion.

The total force available to resist the sliding block is

$$F_r = sA \tag{6.2}$$

where s is the shear strength of the sliding failure plane, and A is the area of the base A_2A_3 of the sliding rock block. It is given as

$$A = \frac{H}{\sin\theta} \tag{6.3}$$

The top width B is calculated as

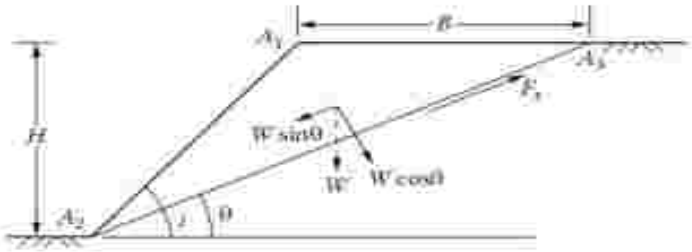


Figure 6.3 A rock slope in plane failure.

ANNEXURE XXVII

Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

No. JSW/S/CO/2024/478 Date: 29/06/2024

To,
The Member Secretary
State Pollution Control Board, Odisha,
Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-8,
BHUBANESWAR- 751012

Sub: - Submission of Annual Return copy submitted to IBM in compliance of CTO Special Condition S. No. 42 dated 30.03.2024 for **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd.**

Ref: - Consent Order No 2944 vide letter no 4651/IND-I-CON-2258 dated 30.03.2024.

Dear Sir,

With reference to aforesaid subject, please find enclosed herewith the Annual Return copy submitted to IBM in compliance of CTO Special Condition S. No. 42 dated 30.03.2024 for **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd**.

Seeking your co-operation as always.

Thanking you,

Yours Faithfully
For JSW Steel Ltd

Mrutyunjaya Mahapatra
(Authorized Signatory)

Encl: As above

Copy to- The Regional Officer, Regional Office, Rourkela, Office of the State Pollution Control Board, At- Near Panposh Hockey Chowk, AT/PO. - Panposh, Rourkela – 769 004, Dist – Sundargarh, Odisha

FORM G-1

[See rule 45(5)(c)(i)]

For the financial Year 1st April, 2023 to 31st March, 2024

ANNUAL RETURN

[To be used for minerals other than Copper, Gold, Lead, Pyrites, Tin, Tungsten, Zinc and precious and semi-precious stones]

Final Submitted

To

(i) The Regional Controller of Mines
Indian Bureau of Mines
Bhubaneshwar Region,
PIN:
(Please address to Regional Controller of Mines in whose territorial jurisdiction the mines falls as notified from time to time by the Controller General, Indian Bureau of Mines under rule 66 of the Mineral Conservation and Development Rules, 2017)

(ii) The State Government of Odisha

PART - I (General)

1. Details of Mine:	
(a) Registration number allotted by Indian Bureau of Mines *(to give registration number of the Lessee-Owner)*	IBM/432/2011
(b) Mine Code (allotted by Indian Bureau of Mines)	30ORI13068
(c) Name of the Mineral	IRON ORE
(d) Name of Mine	NARAYANPOSHI IRON AND MANGANESE MINE
(e) Name(s) of other mineral(s), if any, produced from the same mine	MANGANESE ORE
2. Location of the Mine :	
Village	NARAYANPOSHI
Post Office	Koira
Tahsil-Taluk	Koira
District	SUNDARGARH
State	ODISHA
PIN Code	770048
Fax No. :	02242863000
Phone No. :	02242861000
E-mail:	tapankumar.behera@jsw.in
Mobile:	9437811282

3. Name and address of Lessee-Owner (along with fax no. and e-mail):	
Name of Lessee-Owner	M/s. JSW STEEL LIMITED
Address	JSW CENTREBANDRA KURLA COMPLEX, BANDRA (EAST)
District	MUMBAI SUBURBAN
State	MAHARASHTRA
PIN Code	400051
Fax No. :	2242863000
Phone No. :	9437811282
E-mail:	tapankumar.behera@jsw.in
Mobile:	9437811282
4. Registered Office of the Lessee:	MUMBAI
5. Director in charge :	Gajraj Singh Rathore
6. Agent :	RAM Shanker Sharma
7. Manager :	Indrakant Saha
8. Mining Engineer in charge:	Indrakant Saha
9. Geologist in charge :	Shubhendu Shekhar
10. Transferor (previous owner), if any, and date of transfer:	NOT APPLICABLE 27/06/2020

Uploaded Document	
Upload PMCP Table in Excel:	PMCP_report_Narayanposhi_2023-24.xlsx
Upload UAV Survey (KML/KMZ File) :	Narayanposhi_PMCP.kmz

Final Submitted

11. Particulars of area operated-Lease

(Furnish information on items (i) to (vi) lease-wise in case mine workings cover more than one lease)

Lease - 1	
(i) Lease number allotted by the State Government	093056569401
(ii) Area under lease (hectares):	
Under Forest	257.451 hectares
Outside Forest	89.557 hectares
Total	347.008 hectares
(iii) Date of execution of mining lease deed	27/06/2020
(iv) Period of lease	50
(v) Area for which surface rights are held (hectares)	
Under Forest	250.205 hectares
Outside Forest	74.595 hectares
Total	324.800 hectares
(vi) Date and period of renewal (if applicable)	0

(vii) In case there is more than one mine in the same lease area, indicate name of mine and mineral produced	<table><tr><th>Mine Name</th><th>Mine Code</th><th>Mineral Name</th></tr><tr><td>--</td><td>--</td><td>--</td></tr></table>

12. Lease area (surface area) utilisation as at the end of year (hectares):	Under forest	Outside forest	Total
(i) Already exploited and abandoned by opencast (O-C) mining	0.000	0.000	0.000
(ii) Covered under current (O-C) Workings	78.618	0.389	79.007
(iii) Reclaimed-rehabilitated	0.000	0.000	0.000
(iv) Used for waste disposal	5.416	0.901	6.317
(v) Occupied by plant, buildings, residential, welfare buildings and roads	15.088	8.134	23.222
(vi) Used for any other purpose (specify) Mineral Storage	34.692	6.820	41.512
(vii) Work done under progressive mine closure plan during the year	4.150	0.000	4.150
13. Ownership-exploiting Agency of the mine: (Public Sector-Private Sector-Joint Sector)	Private Sector		

Final Submitted

PART-II (Employment and Wages)

1.Number of supervisory staff employed at the mine		
Description	Wholly employed	Partly employed
(i) Graduate Mining Engineer	3	0
(ii) Diploma Mining Engineer	8	0
(iii) Geologist	7	0
(iv) Surveyor	1	0
(v) Other administrative and technical supervisory staff	70	0
Total:	89	0
2. (i) Number of days the mine worked:	366	
(ii) No. of shifts per day:	3	
(iii) Indicate reasons for work stoppage in the mine during the year (due to strike, lockout, heavy rain, non-availability of labour, transport bottleneck, lack of demand, uneconomic operations, etc.) and the number of days of work stoppage for each of the factors separately .	Reasons: Others; No. of days:	

3. Employment and salary-wages paid #:

Maximum number of persons employed on any one day during the year:

(i) In workings below ground on *(date)* (a) *(number)* 0

(ii) In all in the mine on *(date)* 01/03/2024 (a) *(number)* 1010

Classification	Total number of man days worked during the year			No. of days worked during the year	Average daily number of persons employed			Total Wages - Salary for the year (₹)
	Direct	Contract	Total		Male	Female	Total	
(1)	2(A)	2(B)	2(C)	(3)	4(A)	4(B)	4(C)	(5)
Below Ground	0	0	0	0	0	0	0	0.00
Opencast	14190	86490	100680	366	267	8	275	101336448.00
Above Ground	15572	143826	159398	366	351	85	436	145663078.00
Total:	29762.0	230316.0	260078.0	366.000	618.0	93.0	711.0	246999526.00

To include all employees exclusive to the mine and attached factory, workshop or mineral dressing plant at the mine site

Final Submitted

PART-II A (Capital Structure)

1. Value of Fixed Assets* (₹ 4507295167)

(in respect of the mine, beneficiation plant, mine work-shop, power and water installation)

In case this information is furnished as combined information in another mine's return please specify Mine Code-Mine Name:

Mine Name	Mine Code	Mineral Name
--	--	--

Description	At the beginning of the year (₹)	Additions during the Year (₹)	Sold or discarded during the year (₹)	Depreciation during the year (₹)	Net closing Balance (₹) (2+3)-(4+5)	Estimated market value** (₹)
1	2	3	4	5	6	7
(i) Land***	0	0	0	0	0	0
(ii) Building:						
Industrial	47452007	14637454	0	11731309	50358152	0
Residential	0	3023509	0	248556	2774953	0
(iii) Plant and Machinery including transport equipment	0	0	0	0	0	0
(iv) Capitalised Expenditure such as pre-production exploration, development, major overhaul and repair to machinery etc. (As prescribed under Income Tax Act)	4479956779	215261189	0	241055906	4454162062	0
Total:	4527408786	232922152	0	253035771	4507295167	0

* In case the fixed assets are common to more than one mine, furnish combined information for all such mines together in any one of the mine's return. In the returns for other mines, give only a cross reference to the particular mine's return where-in the information is included.

** Optional and may be furnished in respect of items (i), (ii) and (iii) if the mine owner desires.

*** Including any non-recurring expenditure incurred on the acquisition of land.

2. Source of Finance (at the end of the year) :

(i) Paid up Share Capital (₹)	0
(ii)Own Capital (₹)	0
(iii)Reserve and Surplus (All Types)(₹)	0
(iv)Long Term loans outstanding (#)(₹)	0

Name of the Institution-Source	Amount of Loan (₹)	Rate of Interest
NA	0	0

(#) Indicate the names of the lending institutions such as State Finance Corporation, Industrial Development and other Public Corporations, Co-operative Banks, Nationalised Banks and other sources along with the amount of loan from each source and the rate of interest at which loan has been taken.

3. Interest and Rent (₹)

(i) Interest paid during the year	114897154
(ii) Rents (excluding surface rent) paid during the year	0

Final Submitted

PART-III (Consumption of Materials)

1. Quantity and cost of material consumed during the year			
Description	Unit	Quantity	Value (₹)
(i) Fuel			
(a) Coal	Tonnes	0	0
(b) Diesel Oil	Ltrs.	9098721	855279774
(c) Petrol	Ltrs.	0	0
(d) Kerosene	Ltrs.	0	0
(e) Gas	Cu.M	19152	1007760
(ii) Lubricant			
(a) Lubricant oil	Ltrs.	78461	8916303
(b) Grease	Kgs.	13773	2499357
(iii) Electricity			
(a) Consumed	Kwh	3803318	12780701
(b) Generated	Kwh	2027201	56103242
(c) Sold	Kwh	0	0
(iv) Explosives (furnish full details in Part IV)			42453630
(v) Tyres	Nos.	131	17996691
(vi) Timber and Supports			0
(vii) Drill rods and kits	Nos.	66	4664154
(viii) Other spares and stores			1308923

2. Royalty, Rents and Payments made to DMF and NMET (₹):		
	Paid for current year	Paid towards past arrears
(a) Royalty	3775526714	0
(b) Dead rent	694974	0
(c) Surface rent	0	0
(d) Payment made to DMF	371240412	0
(e) Payment made to NMET	75510999	0
3. Compensation paid for felling trees during the year (₹)		0
4. Depreciation on fixed assets (₹)		253035771

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5. Taxes and cesses		
	Amount in Rupees paid during the year to:	
	Central Govt.	State Govt.
(i) Sales Tax	2891822129	2861695389
(ii) Welfare cess	0	0
(iii) Other taxes and cesses:-		
(a) Mineral cess	0	0
(b) Cess on dead rent	0	0
(c) Others (please specify) NA	0	0
6. Other expenses (₹):		
(i) Overheads		513210980
(ii) Maintenance		5627774
(iii) Money value of other benefits paid to workmen		0
(iv) Payment made to professional agencies		0

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PART-IV (Consumption of Explosives)

Licensed capacity of magazine: (specify unit separately in kg-tonne, numbers, metres)	**Item**	**Unit**	**Capacity**
	Explosives	Kg.	0
	Detonators	No.s	0
	Fuses	Mts	0

Classification of Explosives	Unit	Quantity consumed during the year		Estimated requirement during the next year	
		Small dia. (upto 32 mm)	Large dia. (above 32 mm)	Small dia. (upto 32 mm)	Large dia. (above 32 mm)
1. Gun Powder	Kg.	0		0	
2. Nitrate Mixture					
a. Loose ammonium nitrate	Kg.	0	0	0	0
b. Ammonium nitrate in cartridged form	Kg.	0	36275	0	0
3. Nitro compound	Kg.	0	4183	0	0
4. Liquid Oxygen soaked cartridges	Kg.	0	0	0	0
5. Slurry explosives (Mention different trade names) SME	Kg.	0	820925	0	1525333
6. Detonators					
i) Ordinary	No.s	18589		0	
ii) Electrical					
(a) Ordinary	No.s	341		730	
(b) Delay	No.s	0		0	
7. Fuse					
(a) Safety Fuse	Mts	0		0	
(b) Detonating Fuse	Mts	2525		4000	
8. Plastic ignition cord	Mts	0		0	
9. Others (specify) NA		0		0	

Different sizes of soaked liquid oxygen cartridges to be reported in equivalent kg. as per manufacturer's instruction.

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PART-V (General Geology & Mining)

(Items 2 and 3 to be submitted separately for each mineral)

1. Exploration

1(i) Exploration activities during the year:

		At the beginning of the year	During the year	Cumulative	Grid spacing-Dimension
Drilling	No of holes	42	51	93	100*100
	Metrage	4118	5730	9848	0
Pitting	No of pits	0	0	0	0
	Excavation (in m^3)	0	0	0	0
Trenching	No of trenches	0	0	0	0
	Excavation (in m^3)	0	0	0	0
	Length covered (in metre)	0	0	0	0
Expenditure on exploration (₹)		27799649	48022533	75822182	0

1(ii). Any other exploration activity during the year: NA

2. Reserves and Resources estimated (in tonnes) (IRON ORE).

Classification	Code	At the beginning of the year 1.4.2023 as per latest approved mining plan- scheme	Assessed during the year	Depletion of reserves during the year	Balance resources as on 31.3.2024
(1)	(2)	(3)	(4)	(5)	(6)= (3+4-5)
A. Mineral Reserve					
1. Proved Mineral Reserve	111	0	0	0	0
2. Probable mineral Reserve	121	8041296	0	5627775	2413521
	122	146018150	0	0	146018150
3. Total Reserves		154,059,446.00	0.00	5,627,775.00	148,431,671.00
B. Remaining Resources					
1. Feasibility mineral Resource	211	0	0	0	0
2. Prefeasibility mineral resource	221	2741969	0	0	2741969
	222	13494079	0	0	13494079
3. Measured mineral resource	331	0	0	0	0
4. Indicated mineral resource	332	0	0	0	0
5. Inferred mineral resource	333	0	0	0	0
6. Reconnaissance mineral resource	334	0	0	0	0
7. Total remaining Resources		16,236,048.00	0.00	0.00	16,236,048.00
Total (A+B)		170,295,494.00	0.00	5,627,775.00	164,667,719.00

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2. Reserves and Resources estimated (in tonnes) (MANGANESE ORE).

Classification	Code	At the beginning of the year 1.4.2023 as per latest approved mining plan- scheme	Assessed during the year	Depletion of reserves during the year	Balance resources as on 31.3.2024
(1)	(2)	(3)	(4)	(5)	(6)= (3+4-5)
A. Mineral Reserve					
1. Proved Mineral Reserve	111	0	0	0	0
2. Probable mineral Reserve	121	0	0	0	0
	122	498087	0	554	497533
3. Total Reserves		498,087.00	0.00	554.00	497,533.00
B. Remaining Resources					
1. Feasibility mineral Resource	211	0	0	0	0
2. Prefeasibility mineral resource	221	0	0	0	0
	222	29904	0	0	29904
3. Measured mineral resource	331	0	0	0	0
4. Indicated mineral resource	332	0	0	0	0
5. Inferred mineral resource	333	0	0	0	0
6. Reconnaissance mineral resource	334	0	0	0	0
7. Total remaining Resources		29,904.00	0.00	0.00	29,904.00
Total (A+B)		527,991.00	0.00	554.00	527,437.00

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3. Subgrade-Mineral Reject (in tonnes) (IRON ORE)

(Information to be given in respect of mineral fractions generated and stacked- dumped below cut-off grade and above threshold value, if prescribed, having no immediate sale value)

Generation of subgrade-mineral reject (in tones)	At the beginning of the year	Generated during the year	Disposed during the year	Total stacked at the end of the year	Average grade of the mineral reject generated
from unprocessed ore	0	0	0	0	0
from processed ore	29966.01	564611	468031	126546.01	52.55

3. Subgrade-Mineral Reject (in tonnes) (MANGANESE ORE)

(Information to be given in respect of mineral fractions generated and stacked- dumped below cut-off grade and above threshold value, if prescribed, having no immediate sale value)

Generation of subgrade-mineral reject (in tones)	At the beginning of the year	Generated during the year	Disposed during the year	Total stacked at the end of the year	Average grade of the mineral reject generated
from unprocessed ore	0	0	0	0	0
from processed ore	0	0	0	0	0

4. Overburden and Waste (in m^3)

(Information to be given in respect of overburden- waste and mineral fractions generated below threshold value, if prescribed)

At the beginning of the year	Generated during the year	Disposed in dumps during the year	Backfilled during the year	Total at the end of the year
2056841.41	705343	158298	547045	2762183.91

5. Trees planted- survival rate

Description	Within lease area	Outside lease area
i) Number of trees planted during the year	6000	0
ii) Survival rate in percentage	80	0
iii) Total no. of trees at the end of the year	18600	0

6. Type of Machinery: Give the following information for the types of machinery in use such as hoist, fans, drills, loaders, excavators, dumpers, haulages, conveyors, pumps, etc.

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Type of machinery	Capacity of each type of machinery	Unit (in which capacity is reported)	No. of machinery	Electrical Non-electrical (specify)	Used in opencast underground (specify)
AIR COMPRESSOR	4.700	CUM/MN	1	Electrical	Opencast
BACK HOE	74.000	CUM	1	Non Electrical	Opencast
BLAST HOLE DRILL (ELEC.)	115.000	MM	2	Non Electrical	Opencast
CRANE	15.000	TONNE	1	Non Electrical	Opencast
CRUSHER	400.000	T/H	2	Non Electrical	Opencast
CRUSHER	200.000	T/H	1	Non Electrical	Opencast
DOZER	433.000	HP	1	Non Electrical	Opencast
DOZER	531.000	HP	1	Non Electrical	Opencast
DUMPER	100.000	TONNE	12	Non Electrical	Opencast
GENERATOR (DIESEL)	1010.000	KWH	1	Non Electrical	Opencast
GENERATOR (DIESEL)	250.000	KWH	1	Non Electrical	Opencast
GENERATOR (DIESEL)	25.000	KWH	2	Non Electrical	Opencast
GENERATOR (DIESEL)	20.000	KWH	2	Non Electrical	Opencast
JEEP/TRACTOR	45.000	HP	1	Non Electrical	Opencast
JEEP/TRACTOR	75.000	HP	1	Non Electrical	Opencast
MOTOR GRADER	280.000	HP	2	Non Electrical	Opencast
PUMPS (ELEC.)	270.000	L/MN	1	Non Electrical	Opencast
SHOVEL (HYDRAULIC)	5.200	CUM	4	Non Electrical	Opencast
TIPPER	31.000	CUM	18	Non Electrical	Opencast
WATER TANKER	50000.000	LITRE	1	Non Electrical	Opencast
WATER TANKER	16000.000	LITRE	1	Non Electrical	Opencast
WHEEL LOADER	9.000	CUM	1	Non Electrical	Opencast

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7**(i) Details of mineral Treatment Plant, if any**: Give a brief description of the process capacity of the machinery deployed and its availability. (Submit Flow Sheet and Material Balance of the Plant separately).

NA

(ii) Furnish following information:

Item		Tonnage	Average Grade
Feed:		0.000	0.000
Concentrates-processed products :	(mention name)	0.000	0.000
By-products-Co-products:	(mention name)	0.000	0.000
Tailings:		0.000	0.000

7**(i) Details of mineral Treatment Plant, if any**: Give a brief description of the process capacity of the machinery deployed and its availability. (Submit Flow Sheet and Material Balance of the Plant separately).

NA

(ii) Furnish following information:

Item		Tonnage	Average Grade
Feed:		0.000	0.000
Concentrates-processed products :	(mention name)	0.000	0.000
By-products-Co-products:	(mention name)	0.000	0.000
Tailings:		0.000	0.000

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PART-VI (PRODUCTION, DESPATCHES AND STOCKS) (IRON ORE (HEMATITE))

(To be submitted separately for each mineral)

(Unit of Quantity in Tonnes)

1. Type of ore produced:

(Applicable for Iron ore only; tick mark whichever is applicable)

(a) Hematite

2. Production and Stocks of ROM ore at Mine-head

Category	Opening stock	Production	Closing stock
(a) Open Cast workings	300730.379	5627775.000	180421.379
(b) Underground Workings	0.000	0.000	0.000
(c) Dump workings	0.000	0.000	0.000

3(i) Grade-wise ROM ore despatches from mine head ($):

Grade of ROM	Despatches from mine-head	Ex-mine Price (₹)
(a) 45% to below 51% Fe ROM	0.000	0.00
(b) 51% to below 55% Fe ROM	0.000	0.00
(c) 55% to below 58% Fe ROM	0.000	0.00
(d) 58% to below 60% Fe ROM	0.000	0.00
(e) 60% to below 62% Fe ROM	0.000	0.00
(f) 62% to below 65% Fe ROM	0.000	0.00
(g) 65% and above Fe ROM	0.000	0.00

($): Applicable for iron ore and chromite only. For other minerals data of dispatches to be reported in 3(ii)

3(ii) Grade-wise Production, Dispatches, Stocks and Ex-mine prices:

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Grades**	Opening stock at mine-head	Production	Despatches from mine-head	Closing stock at mine-head	Ex-mine price (₹-Tonne)
(i) Lumps					
(a) 45% to below 51% Fe	0.000	0.000	0.000	0.000	0.00
(b) 51% to below 55% Fe	0.000	0.000	0.000	0.000	0.00
(c) 55% to below 58% Fe	0.000	0.000	0.000	0.000	0.00
(d) 58% to below 60% Fe	0.000	0.000	0.000	0.000	0.00
(e) 60% to below 62% Fe	0.000	0.000	0.000	0.000	0.00
(f) 62% to below 65% Fe	0.000	0.000	0.000	0.000	0.00
(g) 65% and above Fe	0.000	0.000	0.000	0.000	0.00
(ii) Fines					
(a) 45% to below 51% Fe	0.000	0.000	0.000	0.000	0.00
(b) 51% to below 55% Fe	28934.573	620.000	0.000	29554.573	5953.40
(c) 55% to below 58% Fe	33.233	74585.000	74501.590	116.643	5953.40
(d) 58% to below 60% Fe	100625.445	491263.000	385373.590	206514.855	5953.40
(e) 60% to below 62% Fe	20824.083	1237927.000	1152035.050	106716.033	5953.40
(f) 62% to below 65% Fe	198035.772	2124938.000	1956086.590	366887.182	5953.40
(g) 65% and above Fe	3968.650	0.000	3948.120	20.530	5953.40
(a) CONCENTRATES	0.000	0.000	0.000	0.000	0.00
(iii) Calibrated Lump Ore (CLO)					
(a) Below 62% Fe (CLO any size)	528431.981	1383665.000	1626631.710	285465.271	5953.40
(b) 62% to below 65% Fe (5-18 mm size CLO)	102555.000	909.000	15607.770	87856.230	5953.40
(c) 62% to below 65% Fe (10-40 mm size CLO)	1728540.336	434177.000	318791.520	1843925.816	5953.40
(d) 62% to below 65% Fe (CLO others)	0.000	0.000	0.000	0.000	0.00
(e) 65% and above Fe (5-18 mm size CLO)	0.000	0.000	0.000	0.000	0.00
(f) 65% and above Fe (10-40 mm size CLO)	9977.000	0.000	0.000	9977.000	0.00
(g) 65% and above Fe (CLO others)	0.000	0.000	0.000	0.000	0.00

Note.--- Any kind of Hematite Iron Ore below 45% Fe but above threshold value shall be included in the grade slab of'45% to below 51% Fe'.

3(iii) In case the mineral is being pulverized in own factory, please give the following particulars (*):

Grade**	Total quantity of mineral Pulverized (in tonnes)	Total quantity of pulverized mineral produced (for each mesh size)		Total Quantity of pulverized mineral sold during the month		
		Mesh size	Quantity (tonne)	Mesh size	Quantity (tonne)	Ex-factory Sale value (₹)

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3(iv) Average cost of pulverization (*) : ₹ per tonne

(*): Not applicable for Iron ore, Manganese ore, Bauxite and Chromite

4. Details of deductions made from sale value for computation of Ex-mine price (₹- Tonne)

Deduction claimed #	Amount (in ₹- Tonne)	Remarks
(a) Cost of transportation (indicate loading station and distance from mine in remarks)	0.00	NA
(b) Loading and unloading charges	0.00	NA
(c) Railway freight, if applicable (indicate destination and distance)	0.00	NA
(d) Port Handling charges- export duty (indicate name of port)	0.00	NA
(e) Charges for sampling and analysis	0.00	NA
(f) Rent for the plot at Stocking yard	0.00	NA
(g) Other charges (specify clearly)	0.00	NA
Total (a) to (g)	0.00	

 # Not applicable for captive dispatches and ex-mine sales

5. Sales- Despatches effected for Domestic Purposes and for Exports:

Grade	Nature of Despatch *(indicate whether Domestic Sale or Domestic Transfer or Captive consumption or Export)*	For Domestic Purposes				For export		
		Registration number as allotted by the Indian Bureau of Mines to the buyer ##	Consignee name ##	Quantity	Sale value (₹)	Country	Quantity	F.O.B Value (₹)
55% to below 58% Fe,Fines	CAPTIVE CONSUMPTION	IBM/4185/2011	Bhushan Power & Steel Ltd.	19631.070	0.00			
55% to below 58% Fe,Fines	CAPTIVE CONSUMPTION	IBM/432/2011	JSW STEEL LIMITED	26785.750	0.00			
55% to below 58% Fe,Fines	DOMESTIC TRANSFER	IBM/1038/2011	JSW Ispat Special Products Limited	28084.770	102951096.57			
58% to below 60% Fe,Fines	CAPTIVE CONSUMPTION	IBM/1038/2011	JSW Ispat Special Products Limited	43843.680	0.00			
58% to below 60% Fe,Fines	CAPTIVE CONSUMPTION	IBM/4185/2011	Bhushan Power & Steel Ltd.	120959.830	0.00			
58% to below 60% Fe,Fines	CAPTIVE CONSUMPTION	IBM/432/2011	JSW STEEL LIMITED	185954.850	0.00			
58% to below 60% Fe,Fines	DOMESTIC TRANSFER	IBM/1038/2011	JSW Ispat Special Products Limited	34615.230	126878934.86			

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60% to below 62% Fe,Fines	CAPTIVE CONSUMPTION	IBM/1038/2011	JSW Ispat Special Products Limited	90836.310	0.00			
60% to below 62% Fe,Fines	CAPTIVE CONSUMPTION	IBM/4185/2011	Bhushan Power & Steel Ltd.	659296.550	0.00			
60% to below 62% Fe,Fines	CAPTIVE CONSUMPTION	IBM/432/2011	JSW STEEL LIMITED	383815.450	0.00			
60% to below 62% Fe,Fines	DOMESTIC TRANSFER	IBM/1038/2011	JSW Ispat Special Products Limited	18086.740	75059971.00			
62% to below 65% Fe,Fines	CAPTIVE CONSUMPTION	IBM/1038/2011	JSW Ispat Special Products Limited	211702.200	0.00			
62% to below 65% Fe,Fines	CAPTIVE CONSUMPTION	IBM/4185/2011	Bhushan Power & Steel Ltd.	1205938.740	0.00			
62% to below 65% Fe,Fines	CAPTIVE CONSUMPTION	IBM/432/2011	JSW STEEL LIMITED	538445.650	0.00			
65% and above Fe,Fines	CAPTIVE CONSUMPTION	IBM/4321/2011	JSW STEEL LIMITED	3948.120	0.00			
Below 62% Fe (CLO any size),Calibrated Lump Ore (CLO)	CAPTIVE CONSUMPTION	IBM/1038/2011	JSW Ispat Special Products Limited	132318.590	0.00			
Below 62% Fe (CLO any size),Calibrated Lump Ore (CLO)	CAPTIVE CONSUMPTION	IBM/4185/2011	Bhushan Power & Steel Ltd.	1038372.850	0.00			
Below 62% Fe (CLO any size),Calibrated Lump Ore (CLO)	CAPTIVE CONSUMPTION	IBM/432/2011	JSW STEEL LIMITED	455940.270	0.00			
62% to below 65% Fe (5-18 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/4166/2011	N.R. Ispat & Power Pvt. Ltd.	3782.580	27234576.00			
62% to below 65% Fe (5-18 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/538/2011	JAI BALAJI INDUSTRIES LIMITED	3930.050	28296360.00			
62% to below 65% Fe (5-18 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/5519/2011	NRVS STEELS LIMITED	3948.370	28428264.00			
62% to below 65% Fe (5-18 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/743/2011	JAI BALAJI JYOTI STEELS LIMITED	3946.770	28416744.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	CAPTIVE CONSUMPTION	IBM/432/2011	JSW STEEL LIMITED	157595.400	0.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/1085/2011	IND SYNERGY LTD.	7500.060	47700387.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/11655/2012	RAJGANGPUR ISPAT UDYOG	3947.970	25109089.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump	DOMESTIC SALE	IBM/13213/2012	SHYAM STEEL MANUFACTURING LIMITED	7776.680	54670061.73			

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Ore (CLO)								
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/22254/2018	SHREE RUPANADHAM STEEL PRIVATE LIMITED	3945.660	25133851.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/22940/2020	SEVEN HILLS MINERALS PRIVATE LIMITED	23635.790	149102795.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/23066/2020	PH ENTERPRISE	7890.270	52863103.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/23074/2020	KUSHAL MINERALS AND METALS PRIVATE LIMITED	10528.690	66962473.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/23300/2021	BR STEEL AND POWER PRIVATE LIMITED	3903.980	24829310.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/4135/2011	SREE METALIKS LIMITED	19505.690	124056184.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/4361/2011	OREAD METALICS PRIVATE LIMITED	7862.950	56613240.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/44779/2022	RANKINE ENGINEERING LLP	7299.170	51386159.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/45348/2023	ALPINE MINERALLS	3944.540	25087274.40			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/538/2011	JAI BALAJI INDUSTRIES LIMITED	18061.040	118883869.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/5774/2011	BAJRANGBALI SPONGE AND POWER LIMITED	7879.520	50113748.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/794/2011	MSP STEEL & POWER LIMITED	19750.390	139042749.00			
62% to below 65% Fe (10-40 mm size CLO),Calibrated Lump Ore (CLO)	DOMESTIC SALE	IBM/944/2011	SUPER SMELTERS LIMITED	7763.720	49377259.20			

To indicate separately if more than one buyer.

NOTE:- Mine owners are required to substantiate domestic sale value- FOB value for each grade of ore quoted above with copy of invoices (not to be submitted with the return; to be produced whenever required)

6. Give reasons for increase-decrease in production-nil production, if any, during the year compared to the previous year.

a) NA

7. Give reasons for increase-decrease in grade wise ex-mine price, if any, during the year compared to

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the previous year.

a) NA

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PART-VI (PRODUCTION, DESPATCHES AND STOCKS) (MANGANESE ORE)

(To be submitted separately for each mineral)

(Unit of Quantity in Tonnes)

1. Type of ore produced:

(Applicable for Iron ore only; tick mark whichever is applicable)

2. Production and Stocks of ROM ore at Mine-head

Category	Opening stock	Production	Closing stock
(a) Open Cast workings	1231.800	553.900	1785.700
(b) Underground Workings	0.000	0.000	0.000
(c) Dump workings	0.000	0.000	0.000

3(i) Grade-wise ROM ore despatches from mine head ($):

Grade of ROM	Despatches from mine-head	Ex-mine Price (₹)

($): Applicable for iron ore and chromite only. For other minerals data of dispatches to be reported in 3(ii)

3(ii) Grade-wise Production, Dispatches, Stocks and Ex-mine prices:

Grades**	Opening stock at mine-head	Production	Despatches from mine-head	Closing stock at mine-head	Ex-mine price (₹-Tonne)
(i) Ore					
(a) Below 25% Mn	153.886	0.000	0.000	153.886	0.00
(b) 25% to below 35% Mn	366.705	1516.573	1743.970	139.308	8984.91
(c) 35% to below 46% Mn	999.455	0.000	0.000	999.455	0.00
(d) 46% and above Mn	0.000	0.000	0.000	0.000	0.00
(e) Dioxide ore	0.000	0.000	0.000	0.000	0.00
(a) CONCENTRATES	0.000	0.000	0.000	0.000	0.00

3(iii) In case the mineral is being pulverized in own factory, please give the following particulars (*):

Grade**	Total quantity of mineral Pulverized (in tonnes)	Total quantity of pulverized mineral produced (for each mesh size)		Total Quantity of pulverized mineral sold during the month		
		Mesh size	Quantity (tonne)	Mesh size	Quantity (tonne)	Ex-factory Sale value (₹)

3(iv) Average cost of pulverization (*) : ₹ per tonne

(*): Not applicable for Iron ore, Manganese ore, Bauxite and Chromite

4. Details of deductions made from sale value for computation of Ex-mine price (₹- Tonne)

Final Submitted

Deduction claimed #	Amount (in ₹- Tonne)	Remarks
(a) Cost of transportation (indicate loading station and distance from mine in remarks)	0.00	NA
(b) Loading and unloading charges	0.00	NA
(c) Railway freight, if applicable (indicate destination and distance)	0.00	NA
(d) Port Handling charges- export duty (indicate name of port)	0.00	NA
(e) Charges for sampling and analysis	0.00	NA
(f) Rent for the plot at Stocking yard	0.00	NA
(g) Other charges (specify clearly)	0.00	NA
Total (a) to (g)	0.00	

 # Not applicable for captive dispatches and ex-mine sales

5. Sales- Despatches effected for Domestic Purposes and for Exports:

Grade	Nature of Despatch *(indicate whether Domestic Sale or Domestic Transfer or Captive consumption or Export)*	For Domestic Purposes				For export		
		Registration number as allotted by the Indian Bureau of Mines to the buyer ##	Consignee name ##	Quantity	Sale value (₹)	Country	Quantity	F.O.B Value (₹)
NIL	NIL	0	NIL	0.000	0.00		0.000	0.00

To indicate separately if more than one buyer.

NOTE:- Mine owners are required to substantiate domestic sale value- FOB value for each grade of ore quoted above with copy of invoices (not to be submitted with the return; to be produced whenever required)

6. Give reasons for increase-decrease in production-nil production, if any, during the year compared to the previous year.

a) NA

7. Give reasons for increase-decrease in grade wise ex-mine price, if any, during the year compared to the previous year.

a) NA

Final Submitted

PART-VII: COST OF PRODUCTION

Cost of production per tonne of ore-mineral produced

Sl. No.	Item	Cost per tonne (₹)
(i)	Direct Cost	147.48
	(a) Exploration	6.85
	(b) Mining	140.63
	(c) Beneficiation(Mechanical Only)	0.00
(ii)	Over-head cost	92.19
(iii)	Depreciation	53.23
(iv)	Interest	20.42
(v)	Royalty	682.23
(vi)	Payments made to DMF	67.08
(vii)	Payments made to NMET	13.64
(viii)	Taxes	14.14
(ix)	Dead Rent	0.00
(x)	Others (specify) Bid Premium	4862.98
	Total	5953.39

Note: Information given under Part VII will be kept confidential. The Government, however, will be free to utilize the information for general studies without revealing the identity of the firm.

Mineral Name	Production proposal for financial year 2023 - 2024	Production reported during the financial year 2023 - 2024	Difference
IRON ORE - HEMATITE	10000000	5627775	4372225
MANGANESE ORE	36000	553.9	35446

Final Submitted

I Certify that the information furnished above is correct and complete in all respects.

Place:
Dist: SUNDARGARH, ODISHA
Pin: 770048
Date:

Signature

Name in full:
Designation:
Owner-Agent-Mining Engineer-Manager

From: 14.143.191.114 at 2024-06-29 16:15:16

Esigned by: Guest
Date: 29/06/2024 04:15:18 PM

ANNEXURE XXVIII

JSW

JSW ted

Regd Office:JSW Centre,
Bandra Kurla Complex,
Bandra (E), Mumbai- 400051
CIN: L27102MH1994PLC152925
Phone: +91 22 4286 1000
Fax: +91 22 4286 3000
Website: www.jsw.in

No.JSW/S/CO/2023/357

Date: 03/08/2023

OFFICE OF THE
DIVISIONAL FOREST OFFICER
BONAI DIVISION
Receipt No. 7010
Dt. 03.08.23

To,
TheDivisionalForest Officer,
Bonai Division, Dept. of Forest &
Environment.At. /P.O.Bonai,
Dist.Sundargarh.Odisha.

Sub:-Requestforfinancial details of compensatory afforestation &progress so far in respect of Narayanposhiiron& Manganese OreMines ofM/s.JSW SteelLimited(erstwhile lesseeM/s. AMTCPvt. Ltd.),At Narayanposhi,Koira, Dist.Sundargarh.

Ref: - Approved Environment Clearance vide letter no J-11015/288/2008-IA.II(M) by MoEF&CC (GoI), dated 18th June 2019 to M/S AMTC Pvt Ltd.

DearSir,

With reference to aforesaid subject, it is to request for obtaining all financial expenditure details with respect to compensatory afforestation &progress till time for**Narayanposhi Iron & ManganeseOre Mines of M/s. JSW Steel Limited** (erstwhile lessee M/s. AMTC(P) Ltd.), At Narayanposhi,VillageKasira,Koira, Dist. Sundargarh. Odisha.

Financial outlay for activities in project area given Rs.27,43,000 for Compensatory afforestation (Rs. 20,84,000 through DDNo 095664 Dtd 14.06.2006 &Rs. 6,59,000 DDNo239093 Dtd 13.06.2007and Rs.16,82,000 as Penal Compensatory afforestation (Rs. 15,84,000 DD No 004561 Dtd 31.03.2001 &Rs. 98,000 DDNo 121818 Dtd 16.06.2001.

Expenditure detail and implementation certificate is requested to fulfill the compliance of given specific condition number 22 of Environmental clearance as referred, for which wechallremaingrateful toyou.

Yourssincerely,

For**JSWSteelLimited**

MrutyunjayaMahapatro
(AuthorizedSignatory)

ANNEXURE XXIX

JSW Steel Limited

Regd. Office: JSW Centre,
Bandra Kurla Complex,
Mumbai (Govt), Maharashtra – 400 051
CIN L27102MH1994PLC076536
Phone +91 22 4286 1000
Fax +91 22 4286 3000
Website www.jsw.in

No. JSW/SSWCP/2023/333 Date: 14/06/2023

To,
The Divisional Forest Officer,
Bonai Division, Dept. of Forest & Environment
At/P.O. Bonai, Dist. Sundargarh, Odisha.

Sub: - Request for the issuance of implementation certificate of approved Site-specific wildlife conservation plan (SSWCP) for Narayanposhi Iron & Manganese Ore Mines of M/s. JSW Steel Limited (erstwhile lessee M/s. AMTC Pvt. Ltd.), At.Narayanposhi, Koira, Dist. Sundargarh.

Ref: - Approval of Site-Specific Wildlife Conservation Plan vide letter no. 1WL-C-SSP-250/2010 Memo no 6157, dated 04.09.2019 by PCCF(Wildlife) and Chief Wild Life Warden, Odisha.

Dear Sir,

With reference to aforesaid subject, it is to request for the issuance of implementation certificate of approved Site-specific wildlife conservation plan (SSWCP) for **Narayanposhi Iron & Manganese Ore Mines of M/s. JSW Steel Limited** (erstwhile lessee M/s. AMTC(P) Ltd.), At.Narayanposhi, Village Karira, Koira, Dist. Sundargarh.

Financial outlay for activities in project area given Rs. 92.0 lakhs and for activities in project impact area given Rs. 196.0 lakh; in total it was laid for Rs. 288.0 lakhs were submitted. The amount was deposited vide DD No. 045122 (by HDFC BANK), dated 10th Sept 2019 at office of DFO, Bonai through MS-CAMPA account to undertake activities both inside the project area & project impact area.

Implementation certificate is requested to fulfill the compliance of given EC condition, for which we shall remain grateful to you.

Thanking you
Yours sincerely,

For **JSW Steel Limited**

Mrutyunjaya Mahapatro

(Authorized Signatory)

Annexure: XII-A

ANNEXURE XXX

VETIVER GRASS PLANTATION





ANNEXURE XXXI

Seeking information regarding implementation status of approved SSWLCP for Narayanposhi Iron & Manganese Mines

1 message

Rajgopal Patra <rajgopal.patra@jsw.in> Thu, 29 Feb, 2024 at 10:21 am
To: dfo.bonai@odisha.gov.in
Bcc: Suresh Mohapatra <suresh.mohapatra@jsw.in>

Dear Sir,

In continuation to our earlier mail dated 15th June 2023, with our letter no JSW/SSWLCP/2023/333 which is enclosed here with , we would like to bring to your kind attention that it is required to submit the Implementation Status of SSWLCP as approved vide letter no 1WL-C-SSP-260/2010/ Memo no 6257 dated 04/09/2010 by PCCF (Wildlife) and Chief Wildlife warden , Orissa for Narayanposhi Iron & Manganese Mine against which an amount of Rs 288 Lakh was remitted to CAMPA against the demand raised by your good office.

In this regard once again we seek information
regarding status of SSWLCP for onward submission to MoEF & CC as part of compliance of Environment clearance condition.

Your early reply will be highly appreciated

Regards.
RG Patra

On Thu, 15 Jun, 2023, 3:13 pm Rajgopal Patra, <rajgopal.patra@jsw in> wrote:

> Sir,
> Please find attachettached request for issuance of implementation certificate of approved Site-specific wildlife conservation plan (SSWCP) for Gonua Iron & Manganese Ore Mines & Narayanposhi Mines
>
> Regards
> Raj Gopal Patra

ANNEXURE XXXII

6F

SITE SPECIFIC CONSERVATION PLAN FOR NARAYANPOSI IRON & MANGANESE ORE MINES OF SUNDARGARH DISTRICT OF ORISSA

OF

M/s. ARYAN MINING AND TRADING CORPORATION (P) LIMITED

By

Sri S.K. Mishra, IFS (Retd.)

&

Sri S.K. Mohanty, OFS (Retd.)

App. copy

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EXECUTIVE SUMMARY

0.1.1. Narayanposi Manganese and Iron Ore Mines held by M/s. AMTC (Pvt.) Limited since 1945 is located in Koira and Kasira villages in Sundargarh district and lies 2 km NW of Koira.

0.1.2. The lease area of 349.263 Ha includes forest area of 259.191 Ha with Kathmala R.F. over 92.113 Ha, Kathmala PRF over 96.977 Ha and Khesra forests of 70.101 Ha.

0.1.3. Final forest diversion over 244.327 Ha (including virgin forest land over 184.591 Ha) has been approved by MoEF under Sec.2 of F.C. Act, 1980 vide their F.No. 884/2000-FC (Vol.I) dt.15.11.2007.

0.1.4. The mine is in 3rd renewal stage from 03.02.2005 to 02.02.2025.

0.1.5. Mining plan for 7 years (2003-04 to 2009-10) has been approved by IBM vide their No. BBS/SG/Fe & Mn/MP-193 dt.20.05.2004 and progressive mine closure plan approved on 26.05.2005.

0.1.6. Environmental Clearance has been issued vide MoEF No. J-11015/388/2005-IA.II(M) dt.28.03.2007 for production of iron ore & manganese ore upto 0.6 mtpa and 0.0078 mtpa respectively.

0.1.7. A modified mining plan has been prepared from 2008-09 to 2009-10 for enhanced production of iron and manganese ore from 0.6 to 3 mtpa and 0.0078 to 0.36 mtpa respectively.

0.1.8. As per the revised plan as on 29.04.2010, mineable reserve of iron & Manganese ore are 67,776,800t and 254,592t respectively. The corresponding mine life is 23 and 8 years respectively.

0.1.9. Environmental Clearance for the enhanced production has been applied for.

0.2.1 The terrain is undulating from 545-640m from MSL. Two small dry nalas originate from the area.

0.2.2 The entire mining operation is open cast, semi mechanized with wet crushers at site.

0.2.3 There are 16 small iron ore quarries and 11 small trial pits for Mn Ore. Active quarries are Q1 (top), Q3, 3A, Q6, 6A, 6B, 6C for iron ore and Q5 (Mn Ore). The latter is under temporary suspension. All

pits will merge with each other as the mining proceeds. There are 11 dumps but only 1 active now.

0.2.4 Iron & Mn Ore raised from the mine is supplied to various iron & steel plants, sponge iron units and also exported.

0.3.1 The mine area does not form a part of any P.A. or any declared conservation unit nor there any such unit within the BZ. There is no recognized elephant corridor between viable populations within the BZ.

0.3.2 The vegetation of core zone is scattered trees and patchy forests of sapling/pole crop of dry peninsular sal. Fauna is represented by squirrel, rat, mongoose and crow.

0.3.3 The vegetation of BZ is mostly moist peninsular high level sal with Shorea-Xylia-Terminalia-Schleichera association. Bambusa bambos is found in valley bottoms & nala banks. Faunal components include langur, macaque, spotted deer, barking deer, hyena, jackal and Schedule-I fauna like Elephant, Sloth bear, Python and Pea fowl. The status of Schedule I fauna is not known precisely.

0.4.1 The perceived impacts of mining are habitat loss, dust pollution, noise, light & water pollution, soil erosion, accidental fall of animals, dearth of water, ground fire, garbage generation in core area.

0.4.2 The perceived impacts in buffer zone are loss of habitat quality, fragmentation, loss of biodiversity, depredation of wild animals, forest fire, disturbance and accidents due to road traffic, poaching, unauthorized mining, conflict over forest resources etc.

0.5.1 In order to minimize the impacts stated above, plantation of species qualifying elephant habitat on O.B. dumps, reclaimed area, protection of plantations by engaging Van Sahayaks, fixing coir geo textile, grass seeding, pollution control measures, HDPE tanks (2) for small animals & birds, solar powered fencing, fire prevention incentive, garbage disposal and promotion of awareness among mine workers & transporters have been suggested for M.L. area.

0.5.2 For the BZ, assisted natural regeneration, game tanks, check dams of random rubble on upper catchments of nalas for soil and

moisture conservation, salt licks, baseline studies and monitoring of biodiversity, engagement of trackers to collect data on elephant movement and as part of anti-depredation squad, equipments, corpus fund, fire line maintenance, fire prevention incentive to VSS, check gates and remuneration to watchers, provision of alternative livelihood to 200 beneficiaries after due training, awareness promotion amongst school students & villagers and digited maps and cover assessment of buffer zone has been provided for.

0.5.3 The plan is for 10 years from 2010-11 to 2019-20. The implementation will be planned and monitored by a committee under the chairmanship of DFO Bonai Division with representative of mine owner, 2 VSS Presidents, a NGO, R.O. Koira, a mine worker as members.

0.6.1 The cost of the plan is Rs.302.00 lakhs; Rs.188.00 lakhs for the M.L. area and Rs.144.00 lakhs for the buffer zone. In addition, the lease will provide a vehicle, wages of a driver and 100 litres HSD per month, which comes to Rs.20.00 lakhs.

CHAPTER-I
INTRODUCTION

1.0.1 **Lease Grant Order:** The lease for Narayanposi Manganese ore mines in Village Koira & Kairs of Bonai tahasil in Sundergarh District was originally granted by the Ex-State Rulers of Bonai in favour of M/s. AMTC (P) Limited for a period of 20 years with effect from 03.02.1945 to 02.02.1965for 839.24 acres or 349.263 Ha. The first renewal was granted by the Govt. of Orissa, Mining & Geology Dept. for a period of 20 years from 03.02.1965 to 02.02.1985. However, Govt. in Mining & Geology Department vide their letter No.III(B)-MG_AA/77-4824 Dt.19.05.1978 conveyed their approval to the inclusion of Iron ore in the renewal of Mining lease for Manganese ore over 349.263 Ha. In villages Koira and Kasira in Bonai Tahasil to be co-terminus with the existing lease for Manganese ore already held by the lessee. The 2nd RML of this lease was granted for another 20 years w.e.f. 03.02.1985 to 02.02.2005 vide Mining & Geology Dept. letter No. 12413/III(B)MG/12/85/MG dt.16.11.1985 and the lease deed was executed on 15.01.1986. So, this lease has been granted over 349.263 ha of area out of which 259.191 ha is forest land.

1.0.2 **Lease area:** The total lease area is 349.263 ha which includes 259.191 ha of forest area and 90.072 ha of non-forest land.

1.0.3 **Details of forest land:** The forest land of 259.191 ha comprises of 92.113 ha of Kathmal R.F., 96.977 ha in Kathmal P.R.F. and 70.101 ha of Khasra Forest.

1.0.4 **Diversion of forest land:** Out of the total lease area, the lessee vide his application Dt.09.091997 had applied for diversion of 244.327 ha (59.736 ha of broken forest land and 184.591 ha of virgin forest land) leaving aside 14.864 ha as Safety Zone. The Govt. of India, MoEF in their letter No.8-34/2000-FC-12324(F) Dt.29.06.2001 approved for diversion of 59.736 ha broken forest land only leaving 1.604 ha of Safety Zone and 0.416 ha for

public purpose. The MoEF in their above approval order stipulated that, the User Agency will get the virgin forest land of 184.591 ha fenced and protected at the Project Cost under the supervision of the Forest Dept. and this area will not be leased out to any one else for mining till expiry of this lease. The User Agency has already applied for 3rd RML of this mining lease for 20 years w.e.f. 03.02.2005 to 02.02.2025 to the State Govt. of Orissa, Steel & Mines Dept. MoEF considering the proposal during 3rd RML has granted diversion of 244.327 ha vide their letter No.8-34/2000-FC (Vol.1) Dt.15.11.2007.

1.0.5 **Area allowed for mining:** MoEF vide their letter No. 8-34/2000-FC (Vol.1) Dt.15.11.2007 has granted diversion of 244.327 Ha of forest land for mining and allied purposes.

1.0.6 **Mining Plan:** The current Mining Plan duly approved by IBM is valid upto 2009-10.

1.0.7 According to the approved Mining Plan the potential mineable reserve of 26.28 million ton of Iron Ore and 0.17 million ton off Manganese ore. The annual rate of production is projected as 06.00 million ton of Iron Ore and 7,800 M.T. of Manganese ore. The life of the mine has been estimated to be 48 years for Iron ore and 22 years for Manganese ore years. Further exploration of the area by the lessee up to mineralized depth may further increase the life of the mine.

Divisional Forest Officer
& Wildlife Warden
BONAI DIVISION

24.05.2010
Conservator of Forests,
Rourkela Circle

For Aryan Mining & Trading Corporation (P) Ltd.
Dy. Manager,(Survey)
For A.M.T.C (P) Ltd.

CHAPTER – II
ESSENCE OF THE LEASE AREA

2.0.0 **Location of the mine:** The mine is located in villages Koira, Kasira and in Kathmal R.F. as well as in Kathmal P.R.F. of Bonai Tahasil of Sundergarh Dist. of Orissa, forming a part of the Survey of India Topo Sheet No.73 G/1 and G/5. The lease area is bounded by latitude 21° 54' 00" to 22° 57' 00" north and longitude of 85° 13' 00" to 85° 16' 00" east.

2.1.0 **Communication:** This area is located at a distance of 05 Kms from koira town in Bonai Tahasil. The nearest railhead is Barsuan on South Eastern Railway which is located at a distance of 33 Kms. Other nearest railheads at Barbil and Badjamda.

2.2.0 **Topography:** The landscape of the area along with the ZOI (10 K.Ms.) are undulating hills with altitudes varying from 545 mtr to 640 mtrs above MSL. General slope of the area is towards north. The three peak points are at 640 mtr, 620 mtr and 595 mtr within the lease area.

2.3.0 **Drainage:** Drainage in this area is dendritic type. The peak-points mentioned in the foregoing para 2.2.0 are connected with each other in different trends with intervening valley from where seasonal nallas have emerged. The prominent ones are flowing due north which divide the M.L. area into three parts. River Karo flowing due north close to the western boundary outside the lease area, constitutes the principal drainage system and collects surface run-off water through the seasonal nallis.

2.4.0 **Climate:** The area experiences tropical climate. The highest temperature is 45° in the valley zone during May/June and lowest 6.3° in January. The average annual rainfall is 2146.4 mm. About 75% of annual rain is distributed between June to September, being the period when south west monsoon is

active. Relative humidity is 87.3% in September and 37% in March.

2.5.0 **Geology:** The rocks in the lease area are shale and phyllites and laterites of various compositions. A vast reserve of iron ore occurs along the hill top and ridges.

2.1.1 **Forest and Forest type:** Sundergarh District has a forest cover of 4,047 Sq.Km. out of which moderately dense forest constitute 2,787 Sq.Km. (Canopy density 0.40 and above) and open forest cover of 1,260 Sq.Km. (Canopy density 0.10 to 0.40). This is as per information in State of India's Forest Report, 2005 prepared by Forest Survey of India, Dehradun. Bonai Forest Division is in Sundergarh District. The total forest land of Bonai Forest Division is 1493.93 Sq.Km. This figure is as per Working Plan of Bonai Division which is valid from 1997-98 to 2016-17. Champian & Seth has classified the forests of this Division in the eastern part of the division into two types and sub-types.

1. Sub-group 3C-Northern Indian Tropical Moist Deciduous Forests.
2. Sub group 5B- Northern Tropical Dry Deciduous Forests
3. Sub group 2B-Northern Tropical semi evergreen Forests & *Terminalia tomentosa* Forests 3/1 E.

However, Kathmal R.F. has been included in Forest type – 3c/C2e (i) Moist Peninsular High Level Sal and 3C/C2 (ii) Dry Peninsular Sal forests. This sub-type is confined to the upper slopes, ridges and flat tops of the forest blocks like Kathmal, Khajurdihi, Mandhamaruni, Sarkunda, Toada and Rakshi R.Fs. Here quality II Sal finds its occurrence in the valleys and low lying areas having deep loamy soil while hill slopes are mostly covered with Q.III. In these areas, the patches of mixed forests with predominance of Anogesissus latifolia are also found within the Sal belts. Regeneration of Sal is fairly well but there is risk of annual repeated fire. The area is however free from frost. The common associates of Sal available in the top canopy are

Terminalia alata (Asan), Anogeissus latifolia (Dhaura), Syzygium cuminii (Jamun), Lagerstroemia parviflora (Paluli), Pterocarpus marsupium (Bija). The middle storey contains Careya arborea (Kumbhi), Bauhinia purpurea (Kanchan), Bridelia retusa (Kasi), Ougeinia oogeinensis (Bandhan) and Wedlandia excreta. Helectoris Isora Modaphal) and Indigofera pulchela are commonly found as undergrowth. The common species of climbers available are Bauhinia vahlii (Siali) and Smylax macrophylla (Muturi). Themida and Imperata are the common grasses. Bamboo species like Dendrocalamus strictus (Salia) does not occur in this sub-type.

The total area of Khandadhar R.F. is 927.56 ha and has been allotted to Protection Working Circle whereas the total area of Khandadhar P.R.F. is 1570.375 ha and allotted to Rehabilitation Working Circle.

2.1.1 **Working Plan prescription**

Kathmal R.F. has been included in Selection Working Circle in the current Working Plan. Mostly Sal Conversion and Coppice system which had been adopted in the last plan and prior to that could not achieve the set target. On account of these reasons and as per the prescribed guidelines, forest areas worked under these systems have been incorporated in this working circle so as to improve the crop status by taking suitable silvicultural operation as narrated below:-

a. To improve the density and composition of forest crop and to encourage the natural regeneration and establishment of principal species by taking suitable silvicultural operation with due emphasis on soil and water conservation. To restock to artificial regeneration wherever necessary.

b. inconsistence with primary objective, removal of mature and siviculturally available trees before they become un-sound on sustained yield basis.

Removal of un-sound and defective trees under improvement felling so as to improve and increase the stocking of principal species

2.1.3 **Flora and Fauna**

The common species noticed in the lease area and in the impact area of 10 Kms is furnished below. This is as per field observation and as per list authenticated by D.F.O., Bonai Division **(Annexure-VI).**

Core Zone

Local Name	Botanical Name	Family
TREES		
Asan	*Terminalia alata*	Combretaceae
Bahada	*Terminalia belerica*	Combretaceae
Char	*Buchnania lanzan*	Anacardiaceae
Dhaura	*Anogeissus latifolia*	Combretaceae
Harida	*Terminalia belerica*	Combretaceae
Kusum	*Schleichera oleosa*	Sapindaceae
Kurum	*Adina cordifolica*	Rubiaceae
Mahul	*Madhuca indica*	Sapotaceae
GRASSES		
Phulabandhuni	*Thysanolaena maxima*	Gramineae
SHRUBS / HERBS		
Basanga	*Adhetoda vasica*	Acanthaceae
Dhatki	*Woodfordia fruticosa*	Lythraceae
Kurei	*Holarrhena antidysenterica*	Apcynaceae
CLIMBERS		
Atundi	*Combretum decandrum*	Combretaceae
Mututri	*Smylax macrophylla*	Liliaceae
Siali	*Bauhinia vali*	Papilonaceae
Satabari	*Asparagus racemosus*	Liliaceae

2.1.4 **Fauna**

The lease area and its Zone of Influence do not form part of any National park, Wildlife Sanctuary, Biosphere Reserve, Tiger Reserve, Elephant Reserve or Ramsar site. The wild animals occurring in the lease area and its surrounding (buffer) are listed below:

Local Name	English Name	Zoological Name	Schedule
MAMMALS			
Squirrel	Indian Palm Squirrel	*Funambulus pennanti*	II
Cat	Jungle Cat	*Felis chaus*	II
Musa	Rat	*Rattus rattus*	V
Thekua	Rabbit	*Lepus nigricolis*	IV
BIRDS			
Baya	Weaver bird	*Ploceus phillipinus*	IV
Koili	Cuckoo	*Eudynamis Scolopaceus*	IV
Kau	Crow	*Corvus splendens*	V
Suga	Parrot	*Psittacula krameri*	IV
Para	Pigeon	*Columba livia*	IV
Ghar Chatia	Sparrow	*Passer domesticus*	IV
REPTILES			
Dhamana	Rat snake	*Ptyas mucosus*	II
Godhi	Yellow monitor	*Varanus monitor*	II
Naga	Cobra	*Naja naja naja*	II
Chiti	Krait	*Bungarus caeruleus*	II
Cahndan Boda	Russell's viper	*Vipera ruseelli*	II

Flora of Buffer Zone

Local Name	Botanical Name	Family
TREES		
Bel	*Aegle marmelos*	Rutaceae
Bahada	*Terminalia belerica*	Combretaceae
Bana Bhalia	*Semicarpus anacardium*	Anacardiaceae
Dhaura	*Anogeissus latifolia*	Combretaceae
Dimiri	*Ficus glomerata*	Moraceae
Haldu	*Adina cordifolia*	Rubaceae
Harida	*Terminalia chebula*	Combretaceae
Jamun	*Syzygium cuminii*	Myrtaceae
Jack fruit	*Artocarpus heterophyllus*	Moraceae
Kendu	*Diospyrus melanoxylon*	Ebenaceae
Kusum	*Schleichera oleosa*	Sapindaceae
Kasi	Bridelia retusa	Euphorbiaceae
Tamarind	*Tamarindus indicus*	Ceasalpiniaceae
GRASSES		
Khara grass	*Imperata cylindrical*	Gramineae
Phulabandhuni	*Thysanolaena maxima*	Gramineae
SHRUBS / HERBS		
Anantamula	*Hemidesmus indicus*	Asclepidaceae
Arakha	*Calotropis gigantia*	Asclepidaceae

Local Name	Botanical Name	Family
Basanga	*Adhatoda vasica*	Acanthaceae
Dhatki	*Woodfordia fruticosa*	Lythraceae
Kurei	*Holarrhena antidysenterica*	Apocynaceae
CLIMBERS		
Atundi	*Combretum decandrum*	Combretaceae
Baldanka	*Mucuna monosperma*	Papilionaceae
Bichhuati	*Urtica dioica*	Euphorbiaceae
Mututri	*Smylax macrophylla*	Liliaceae
Siali	*Bauhinia vaili*	Papilonaceae
Satabari	*Asparagus racemosus*	Liliaceae

2.1.5 Fauna of Buffer Zone

Local Name	English Name	Zoological Name	Schedule
MAMMALS			
Bilua	Jackal	*Canis aureus*	II
Harina	Chital	*Axix axis*	III
Kutura	Barking deer	*Muntiacus muntijack*	III
Neula	Mongoose	*Herpestes eduardsii*	II
Cat	Jungle Cat	*Felis chaus*	II
Musa	Rat	*Rattus rattus*	V
Thekua	Rabbit	*Lepus nigricolis*	IV
Hanu	Languor	*Presbytes entellus*	II
Monkey	Rhesus monkey	*Macaca mulatta*	II
BIRDS			
Baya	Weaver bird	*Ploccus phillipinus*	IV
Koili	Cuckoo	*Eudynamis Scolopaceus*	IV
Kau	Crow	*Corvus splendens*	V
Sua	Parrot	*Psittacula krameri*	IV
Para	Pigeon	*Columba livia*	IV
Ghar Chatia	Sparrow	*Passer domesticus*	IV
Bana Kukuda	Red Jungle fowl	*Gallus gallus*	IV
Bhadbhadalia	Blue Jay	*Coracias benghalensis*	IV
REPTILES			
Ajagar	Python	*Python molurus*	I
Naga	Cobra	*Naja naja naja*	II
Chiti	Krait	*Bungarus caeruleus*	I
Chandan Boda	Russells viper	*Vipera ruseelli*	II

Land use pattern of the lease area:

2.1.6 The land use pattern of this lease area as has been furnished in the recent forest diversion proposal is as follows:

Purpose	Forest Land (Ha)
Mining including Mobile Crusher & Screening Plant	136.505
Storing of minerals	9.244
Ore Dressing and Staking	33.239
Dumping of O.B.	41.201
Storing of tools and machineries	Nil
Const. of building, weigh bridge, Magazine etc.	3.861
Construction of roads/ railway siding	2.950
Sub Total	***227.000***
Safety Zone	84.256
Area covered under Afforestation	10.920
Area for public use and Nala	18.156
Grand Total	**340.332**

24.06.2018
Conservator of Forests,
Rourkela Circle

Divisional Forest Officer
& Wildlife Warden
BONAI DIVISION

For Aryan Mining & Trading Corporation (P) Ltd.
Dy. Manager, (Survey)
For A.M.T.C (P) Ltd.

CHAPTER – III
PROCESS OF MINING

3.0.0 **Salient features of Mining:** This is an opencast semi-mechanized mechanized mine. Sizing of iron ore will be done by crushing. Natural fines will be screened for separating large size boulders. This mine is being worked on single shift basis.

3.1.0 **Size of benches:** Average height of benches is 5.0 m and 10.0 m wide for safe working. The individual benches will be kept nearly vertical (70^0 to 80^0) and overall slope angle of quarry will be kept at less than 27^0. Mining will progress laterally as well as depth wise.

3.2.0 **Development of quarries:** Manganese ore is proposed to be mined out by the formation of 3m high and 5m wide benches. Overall pit slope angle will be maintained at less than 31^0 with the horizontal.

3.3.0 **Surface and rain water management:** All preventive measures would be adopted for prevention and regulation of wash offs from the excavated area during rains. Retaining walls and garland drains around the ultimate pit limits of all working quarries and ore stacks shall be built in a phased manner and a series of check dams as well as settling tanks would be provided at the end of each garland drain so as to allow the clean water to escape out of the lease area. This will also help in recharging the ground water.

3.4.0 **Extent of mechanization:** Presently the following machinery for construction, leveling, compaction, drilling, blasting, loading and transporting operations is deployed in this mine.

Sl. No.	Equipments	Total
01	Excavator	2
02	Pay loader	2
03	Wagon/DTH Drill	3
04	Water Tanker Sprinkler	2
05	Jeep	3
06	Tipper 10t	16
07	Dozer	1
18	Crushing Unit	2
19	Explosive Van	-
10	Jack Hammer	5
11	Screening Unit	1
12	Mobile wet plant	-
13	Truck mounted Compressor	1
14	Tractor mounted Compressor	1
15	Ambulance	1

3.5.0 **Blasting:** Drilling wagon is done with Jack hammer drill of 32 mm dia, 1.0 m deep holes, single row with 0.75 x 0.75 m spacing and burden in Manganese mines. However, DTH drill of 100 mm dia, burden and spacing of 1.20 m and 1.50 m will be adopted in proposed drilling in Iron ore mining.

3.6.0 The blasting is carried out by using ANFO explosive in the proposed blasting; ANFO will be used as primer in proportion of 70:30 to 60:40. Safety fuse in conjunction with ordinary non-electric detonator and detonating fuse combination will be used for ignition. Hole depth in case of Jack Hammer & DTH drill will be 1.60 m and 5.50 m respectively. Powder factor will be 7t/Kg and 8t/Kg respectively.

3.7.0 **Employment:** Employment potentially of this mine per day is about 400 laborers.

3.8.0 **Use of mineral:** The Iron and Manganese ore raised from the mine is sized and supplied to various Steel Plants, Sponge Iron Plants and Silico & Ferro Manganese Plants. The manganese ore fines generated during the sizing process are also being

exported to various countries like China. Since there is a good market for the Manganese ore fines at present, the sub-grade ore, if any, is blended and utilized along with the Iron ore fines.

3.9.0 **Mineral beneficiation:** A screening & crushing unit of 650 tonnes per hour capacity consisting of screening, gyratory crusher with associated belts and screens is proposed to be established. However, the Manganese ore will be stored manually.

CHAPTER – IV

PERCEIVED IMPACT ON WILDLIFE AND ITS HABITAT

4.0.0 The lease area of Narayanposi iron and manganese ore mines covers an area of 349.263 Ha including forest area of 259.191 Ha. Of this, Kathmala R.F. area covers 92.113 Ha, proposed extension of R.F. 96.977 Ha and P.F. area 70.101 Ha.

4.0.1 This is old manganese mine worked since 1945, from which; State government approved raising of iron ore as well since 1978. The third renewal of lease has been applied for from 03.02.2005 to 02.0 2.2025 and based on this, Stage II forest diversion has been allowed for 244.327 Ha during 2007.

4.0.2 The terrain is undulating from 545m to 640m from MSL. Two small nalas originate from the area, which drain to Karo nala flowing on the western edge of the M.L. area. The buffer zone is divisible to 3 catchments, the Central Karo nala and the eastern Tehrai nala flowing to north and the western Samij nala flowing to south. The buffer zone is hilly with highest peak, Mayurnacha pahar to north. Generally western side is higher than eastern.

4.0.3 The forest growth of M.L. area is patchy in distribution and mostly of rooted waste of Sal, Sal pole crop and plantation of Acacia auriculaeformis. There are few scattered middle aged trees of Sal. Secondary growth confirms to Dry peninsular Sal [(3C/C2(ii)] with Sal – Anogeissus – Terminalia – Pterocarpus association.

4.0.4 The buffer zone has 8 R.F's, viz. Karo, Uliburu, Siddh amath, Mendhamaruni, Kathmala, Khajuridihi, Sarkanda and Toda R.F's, which with patches of Khesra forests account for 65.91% of landuse. This includes open forests which is less than 1%. Agriculture accounts for 2.22% and mining 1.33%, while waste land is 30.39%. There are 48 mines in buffer zone.

4.0.5 Forests of BZ confirm to moist peninsular high level Sal (3C/C2e) with Shorea-Xylia-Terminalia-Schleichera association. Throny bamboos

(Bambusa bambos) are found in valley bottoms, nala banks and northern slopes.

4.0.6 The fauna of core zone is represented by striped squirrel rats, crow indicative of extremely poor vegetation. The buffer zone has stripped squirrels, giant squirrels, langur, spotted deer, barking deer, hyena, jackal and the like. Schedule I fauna is represented by sloth bear, migratory elephant, rock python and pea fowl.

4.0.7 Earlier, there were 16 small quarries for iron ore and 11 small ones for Mn Ore, which have merged to 12 only. Of these, currently active quarries are Q1 top, Q3 & 3A, Q6, 6A, 6B and 6C. Manganese quarry Q4, 5 have been temporarily suspended. Similarly, there is only one active dump 'A' near quarry 1 top, dump D for Mn quarry waste is suspended, while dumps 'C' & 'D' are proposed in north & west respectively. Of the total forest area, 94.26% has been diverted (244.327 Ha), which includes 184.591 Ha virgin area & 59.736 Ha broken up area as on November 2007.

4.0.8 The mineable reserve of iron ore as on 1.1.2008 was 67,776,800 tons and Mn Ore 254,592 tons. With the increase in raising of iron ore from 0.6 tpa to 3 tpa and Mn Ore from 0.0078 tpa to 0.036 tpa, the mine life has been calculated as 23 and 8 years respectively.

4.0.9 Semi mechanized open cast method will be employed. Machineries include 16 x 10t tippers, 1 dozer, 2 compressors, J.H. drill 5 nos, DTH drill 3 nos, excavators 2 crushing & screening plant-1. In the proposed capacity build up, internal transportation will go up from 90 to 200 trips per day and external transport, will like wise increase from 40 to 160 trips.

4.1.0 **Impact within the mining lease area:** Mining pits, dumping of overburden, stacking of mineral, sub-grade dump, roads, crusher plant, office building, labour shed, garage for machineries, all involve clearance of forest growth. Pits bring about changes in geomorphology of the area as pits advance in all directions with increase in area and depth. About 400 persons will be engaged in the process. Mining will change about 89% of the original land use, except a green belt of 34.902 Ha (11%). The frequency of tipper movement will also

considerably disturb the area. The anticipated adverse impacts are summarized below:

4.1.1 **Habitat loss:** Habitat loss is the outcome of forest destruction or deforestation, which is inevitable in mining activity. This significantly alters or out rightly eliminates conditions needed for plants and animal to survive. The habitat is rendered functionally weak and unviable to support the resident species. This triggers loss of biodiversity and consequently, reduced carrying capacity of the area. The end result is the displacement of fauna. The present scenario is not conducive to medium or large animals except few smaller ones and birds in forest patches.

4.1.2 **Dust pollution:** The mining area is highly dusty due to blasting, loading, unloading, crusher site dust and haulage on earthen roads. Heavy dust deposit was seen on roads, buildings, vehicles, plant foliage and all over. The highest SPM & RPM levels recorded are 187.80 ug/m^3 and 50.31 ug/m^3 respectively. This level of dust is not conducive to plant and animal survival and growth in optimal conditions not withstanding higher permissible limits set under pollution norms.

The adverse effect on plants are:

- Reduced photosynthesis due to reduced light penetration and blockade of stomata openings.
- Reduced seeding affecting natural regeneration.
- Increased incidents of plant pests and diseases; the dust acting as a medium of growth of fungi and inhibiting the growth of predators of insect pests.

The adverse effects on animals are:

- Overly aggressive immune responses caused by inflammation of lungs and distressed breathing.
- Disruption of normal living conditions
- Alteration of normal heart rate
- Larger incidences of disease due to proliferation of bacteria, fungi and virus

4.1.3 **Noise pollution:** Noise produced from blasting, drilling, excavation, loading and unloading, haulage is very irritating and disturbing to all form of life. The effects of noise are 3 types viz. auditory, physiological and behavioural. Auditory effects include hearing impairment and threshold shifting to elicit response from mating or alarm calls. Physiological effects comprise of stress, metabolic changes and hormonal changes resulting in emigration, reproductive failure, failure in lactation and suckling and vulnerability to disease. Behavioural changes include signal marking and avoidance behaviour. Signal marking is inability to respond to call of a predator and its foot steps. Avoidance behaviour is reluctance in mating and running away from noise source.

4.1.4 **Light pollution:** Mine site office and surrounding area, particularly, gates, mineral stacks, haul roads and crusher plant is electrified. All wild animals have an active and passive phase based on natural light intensity. Some animals are diurnal, while others are nocturnal. Artificial light disturbs this conditioning of behaviour with natural light. Other effect is disorientation and zig-zag movements.

4.1.5 **Soil erosion:** Loss of ground cover, geo-morphological changes, bringing bottom soil to top result in loss of top soil. Soil disturbance, compaction by plying of tippers result in soil erosion. Soil erosion has been noticed in shape of sheet erosion from bald areas, shoe string erosion in overhead dumps & scouring of garland drains. The effects are breakdown of soil structure and aggregates resulting in loss of fertility and making the area refractory from the reforestation point o view. Soil erosion leads to water pollution.

4.1.6 **Water pollution:** The erosion from roads, O.B. dumps, barren slopes, ore stacks carry red silt with iron fines which may contaminate the stream down below affecting use of polluted water by wild animals. A hectare – metre of sediment may be produced annually for every 30-40 Ha of disturbed land. The aquatic environment may be degraded affecting turtles, snakes, fish, frogs and crabs directly and water birds indirectly. Run off water is somewhat toxic to animals due to high

concentration of iron. Turbidity affects growth of underwater plants affecting spawning of fish etc.

4.1.7 **Absence of water:** Nalas being seasonal, there is dearth of water in M.L. area, when it is required most. Moreover, mining has obliterated many depressions, which used to carry surface flow. Consequently, the habitat is not suitable for residence of any wild animal on a permanent basis.

4.1.8 **Accidental fall of animals:** There are 12 pits in the M.L. area varying from 5m to 40m deep, which may go upto 70-80 metres. Such deep pits are dangerous for wild animals and accidental fall may result in death or grievous injury. For reasons of safety, mining pits need to be barricaded and converted to smooth slopes.

4.1.9 **Ground fire:** Fire is the greatest scourge in the establishment of plantations, continuance of growth and establishment of regeneration. Fire is currently scarce due to lack of leaf litter as the over wood is patchy and discontinuous. But, keeping in view, the plantations to be established, fire protection awareness needs to be instilled in the work force.

4.1.10 **Garbage:** With 400± people working in the area garbage is likely to be generated in the area in shape of waste paper, polythene, tetra packs, cans, glass bottles, left over food. Garbage offends all and is an eye sore. Left over food and kitchen scraps may attract crows, kites, jackals, pie dogs and even hyena. Special care will be taken for safe disposal of all garbage.

4.2.0 **Impact on wildlife in the surrounding buffer zone:** There are 48 mines in the buffer zone. Mining activity disturbs tranquility and serene environs of a forest. The synergic effect of all mines on the quality of the habitat of BZ is significant enough to cause displacement of species to comparatively undisturbed habitats. As all mines are largely over forest areas, there is honey combing of otherwise contiguous forests' resulting in a fragmented landscape of forest, mine, waste land and cultivation. Adverse impacts on wildlife in BZ is enumerated below:

4.2.1 **Loss of habitat quality:** The impact on habitat is both direct and indirect. Direct impact involves proliferation of plant species of edge

habitats at the expense of those of interior habitats. Indirect effect may be due to pollution load as a results which, regeneration & growth of food plants may be slower or altogether absent.

Noise factor and illumination of otherwise natural areas may limit habitat utilization even though food and water resources may be well distributed. Unexpected fluctuation in lights due to passing of trucks is quite disturbing and lower habitat quality indirectly. The above are short term effects, which may end once mining is closed. But long term effects are change in plant composition and structure and change in animal species due to disturbance related emigration. Loss of habitat quality results in lower fecundity, miscarriage or unsuccessful rearing of young to juvenile stage.

Large mammals and other animals displaced from their home ranges may be forced to use adjacent remote areas of buffer. This could potentially lead to overcrowding of individuals in smaller undisturbed areas. In turn, the remaining better habitats may be overstocked leading to degradation of vegetation. Consequently, carrying capacity of the habitat is lowered giving rise to inter & intra-specific competition. This ultimately results in greater losses in animal numbers than originally displaced animals from M.L. area through higher vulnerability to diseases and shortage of resources for survival.

4.2.2 **Fragmentation of forest habitat:** Before the mining was initiated in the area, Siddhamath R.F. (Keonjhar Division) in NE was almost contiguous to Toda R.F. and Karo R.F. in west and Sarkanda & Khajuridihi R.F's in south through Mendhamaruni R.F., Kathmala R.F. and numerous other Khesra forests. The mining activities have not only lowered the habitat quality but have fragmented once contiguous patch of forests. Habitat fragmentation includes 6 discrete phenomena, viz.

i) Reduction in total area of the habitat
ii) Increase in the quantum of interior habitats
iii) Decrease in the amount of interior habitats
iv) Isolation of habitat fragments
v) Breaking up of one patch to several smaller habitat patches
vi) Decrease in average size of each patch

Habitat fragments are rarely representative samples of the initial landscape. Small fragments support small populations of plants and animals. Distance between the fragments, if higher than cruising radius of the species, prevents the scope of movement. This has conservation implications as lack of viability in smaller habitat fragments make the species of animals threatened or endangered. Fragmentation of habitats has put a great stress on movement of elephants in particular. The species is exploring new habitats where habitat is more or less contiguous. Secondly, the movement of family groups is now restricted.

4.2.3 **Loss of biodiversity:** Apart from habitat impairment and deforestation, growing concern in mining belt is loss of biodiversity in species, eroding genetic variability within species, diversity in community structure and ecosystems. Rates of species loss are feared to proceed must faster than scientific assessment of different species not identified as yet. Lower plants and insects fall in this category. As compared to developmental stages of vegetation, mature forest has higher biomass supported/unit of energy flow, food chains are complex and web like, higher species diversity, well organized vertical and horizontal stratification, high niche specialization (many smaller micro habitats and food chains). The ecosystem is more stable to external perturbations, nutrient conservation is good and internal symbiosis is well developed. Diversity loss is due to direct drivers such as change in land cover, fragmentation, invasion of alien species, over drawl of biomass, pollution, habitat loss. Indirect drivers comprise of population build up, use of machineries, creating roads and other artifacts within a habitat. Biodiversity and ecosystems are resilient to certain extent meaning, they spring back to original form once the causal drivers are suspended. However, once, the threshold is crossed, biodiversity is irreversibly lost and so are the ecosystem functions. Indicator species, e.g. frogs have an acute sensibility to environmental harm and serve useful role in indicating the early warning signals through their death and decline in number as well as variety. Hence, biodiversity needs constant monitoring.

4.2.4 **Depredation of wild animals:** Movement of animals, particularly, elephants in a fragmented landscape brings them close to habitation. Elephants come in conflict with people during crop season and cause loss of crop, stored grains, damage houses and worse trample upon or toss over human beings to death. Country liquor, rice brew, stored Mahua flowers, semi ripe or ripe mangoes, jack fruit and banana grown in villages are great attractants. Occasionally, sloth bear comes out of forest limits in search of Mahua flowers, Kendu, Jhadi Barkoli fruits and termite mounds. Accidental encounter with sloth bear leaves a man either dead or severely mauled to lead a disabled life. Depredation needs to be controlled to save precious human life, save the errant animal and allow it a free passage to forest.

The erstwhile elephant migratory route from Saranda R.F. (Jharkhand) via Rakshi, Toda and Sarkunda R.F's of Barsuan Range appear to be deflected west wards to Sundargarh Division. Elephants rarely visit Toda R.F. but visit Koira, Mendhamaruni, Khajuripada and Sarkunda R.F's from Keonjhar Division in east. However, there is no elephant corridor within buffer zone used by viable populations.

Agression in elephants is a survival strategy to secure food and to supplement their nutritional requirement from cultivated areas. From the point of view of elephants, paddy crop is a palatable grass d espite economic bankruptcy to the farmer due to repeated assault on his crop. The degree of aggression by individual elephants is conditioned partly by genetic trait and partly by frustrating experience in the past. Hence, depredating animals, particularly aggressive ones need careful management.

4.2.5 **Forest fire:**

4.2.6 **Disturbance & Road Accidents:** Keonjhar-Rourkela NH-215 via Barbil-Koira-Tensa passes 150m to the north-eastern side of the M.L. area but Koira-Kalta-Lahunipada link road pass right through the M.L. area. These roads are in bad shape and repair is in progress. Besides, there are several truck tracks connecting each mine to the main road. Transport of ore to railway sidings at Barbil, Rakshi, Barsuan or to Paradip Port takes place on these roads. There is continuous

movement of thousands of mineral laden trucks on these roads leading to dust, noise and hubl pollution. At times, there is road jam which is definitely extremely unpleasant situation to all including wild animals. The latter are denied passage from one side of the forests to the other forcing them to remain confined on one side, which triggers stress related random movements. There are a few cases of accidents due to speeding trucks

4.2.7 **Poaching:** Although this is not very acute, but occasional poaching takes place for bush meat. Cases of snaring wild pigs, trapping of jungle fowl and hare have surfaced. As high stakes are involved in killing pythons for skins, elephants for tusks and bear for alleged medicinal value of its bile and trapping of young of pea fowl, deer etc and outsiders entering the area may allure the local people to indulge in such activities, constant vigil need to be exercised. Poaching may accelerate wiping out of the species from the area, which has very low density of animals.

4.2.8 **Unauthorized mining:** With the increase in the price of iron ore, unauthorized mining has become a cottage industry with the people, particularly, in situations, where ore is available on the surface. Some unscrupulous traders and transporters are luring the villagers in this activity and even giving monetary help for surface stripping of ore. Now, local educated youth are in this illegal trade and they have organized the villagers for such work. They arrange transporters and dispatch the raised ore, which has a ready market and distribute the sale proceeds amongst the labourers. Such unauthorized mines, few inches deep, look like huge borrow pits, which are seen scattered in forest areas, hardly 200-300 metres of the road. Surface mining and extraction paths leads to loss of forest cover, honey combs the forest, are focal points of accidental conflagration and brings down the habitat utilization. This needs to be checked with an iron hand.

4.2.9 **Conflict over forest resources:** Mining involves destruction / depletion of forest resources and loss of biodiversity over which people rely as watersheds of drinking water, reservoir of non-timber forest produce, fishing or hunting grounds, religious sites, grazing lands,

wood lots and as foster mother of agriculture. If these forest dependent people are not involved in reforestation and decision making process in any developmental activity involving change in land use, a conflict will ensue, which will not be congenial for conservation in general and wildlife conservation in particular. As such, people not involved in mining must have alternative options of livelihood in the interest of conservation.

CHAPTER – V

HABIT AND HABITAT REQUIREMENTS OF SCHEDULE I FAUNA FOUND IN THE BUFFER ZONE OF 10 KM

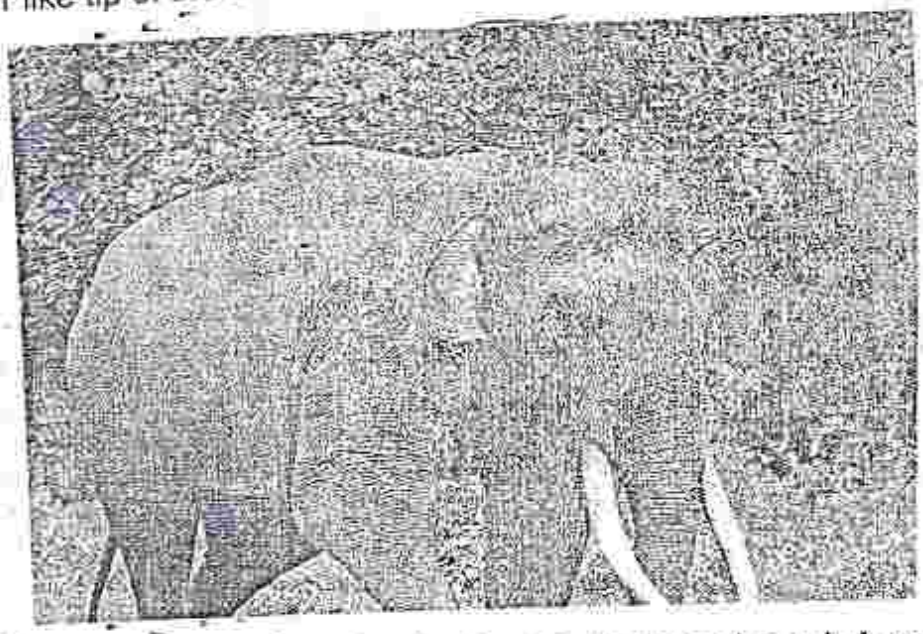
5.0 Elephant, probably python and sloth bear are the only three species of wild animals which are part of Schedule-I of the Wildlife (Protection) Act, 1972 found along the buffer zone of the mine and its neighboring area. Their habits and habitat preferences are given in the following paragraphs.

5.1 **Indian Elephant:** (*Elephas maximus indicus*)

5.1.1 **Habit:** Elephants are social animals and may form herds of 20-30 individuals led by the oldest female. Herds usually break into stable family groups of 4-7 animals for foraging and may rejoin. The large matriarchal groups' movement is coordinated by the older female for optimal sites of food and water. The different groups maintain long distance contact through sub sonic vocalizations. Males usually remain away from herds at a distance but join in when a female comes to oestrous. Generally, one dominant and super virile male mates with females in oestrous (polygamy). Old males, past prime reproductive life usually lead solitary life and so are sub-adult males. Sometimes, 2-4 sub-adult males form their own groups. During mating, it is common to see the dominant male escorting the oestrous female away from the family group. Elephant is intolerant of hot summer and retreats into a shady spot during noon. In the past, when forest ranges were continuous, elephants used to migrate seasonally in search of better pastures alternating with forests. Human activities like cultivation, highways, townships, railways, dams, industries and mines have now fragmented their habitat and made seasonal migrations virtually impossible. Individual temperaments vary from gentle natured to ill tempered, believed to be due to imprint of normal living or harassed living during juvenile period. An elephant may run at 45 km / hour for short distances for two or three minutes. Elephants live for 70 years. The oestrous cycle of the cow is about 22 days, out of which she is receptive for copulation on the first day only. There is no seasonality in copulation. The gestation period is 18-22 months and period of suckling of about an year and half though 6 months onwards soft grass diet is initiated. In good quality habitats, the inter birth interval may be 3-4 years while in poor ones; it may be prolonged to five. Mothers continue to bestow

maternal care to their offspring for several years after weaning. The senses of touch and hearing are acute but their eye sight is poor.

Only males have prominent tusks and cows, one or two rudimentary tusks known as tushes, which is hardly visible to outside. Elephants have a genetic aberration single tusked, right or left, usually known as Ganesh. Tusk less males are known as Makhna. An elephant develops 6 molars in each jaw, on either side during its life time. But at any one time, there is one exposed molar and one partly exposed molar on either side of each jaw. The first molar is shed at 2, the second at 6, the third at 9, the fourth between 20-25 years, the fifth at 60 and the sixth lasts for rest of the life. The nature of elephant dentition suggests that it is primarily meant to masticate rough siliceous grass. The trunk of the elephant is an organ of versatile utility, which is used in eating, drinking, smelling, and breathing, touching, vocalizing, washing, dusting and fighting. The sensitive finger like tip of the trunk is used in manipulation of objects.



5.1.2 **Habitat:** Elephants are animals of grass lands and scrub forests who have secondarily switched over to forests once grass lands were mostly brought under cultivation. The mosaic of grass, scrub forests, open forests and dense forests suits them well. Elephants are constantly on the move and may cover 10-15 km during a single night. Annual home ranges for bulls may vary from 200-1000 sq.km. where as, that of family group may be 50-300 sq.km. depending on the quality of the habitat. Elephants consume a variety of diet, bark, roots, leaves, stems and twigs, bamboos, vines, shrubs belonging to 100 plus species. An average day's intake for adults is 150 kg of vegetation (20-25% body weight). An equal quantity is damaged and

left half eaten, when the animal moves on. The efficiency of digestion is poor with only 44% with the symbiotic bacteria in the stomach. Elephant may drink 100-140 liters of water at least once in a day. They make small water pools in dry nala beds by digging sand by their front feet. Elephants enjoy cultivated foods such as ripe paddy, banana, mango, jack fruit, sugar cane. They take to crop depredation, where cultivation is interspersed with forest landscape or where the habitat is too degraded to meet their foraging needs or where the continuity of the habitat is broken with settlements, industries, mines or other similar developments, or where the habitat is linear, i.e. boundary of habitat/area ratio is near to 1. In areas, where this ratio is less than 0.5, crop raiding is generally less or occasional. They are fond of salt for which purpose, they gather at salt licks. They are also fond of mud wallowing and body rubbing. Elephants are in endangered category for tusk poaching and habitat loss and fragmentation.

5.2 Sloth bear (*Melursus ursinus*):

5.2.1 **Habitat:** Sloth bears have long snout and their lips are detached from the gum. Mobile and protrusible, lips are well adapted to the forceful intake and expulsion of air. Bears have a large protrusible tongue. The claws are longer in the fore feet than the hind and are good digging implements. The bear's palate is deeply concave. The gap between the teeth permits the passage of air as middle pair of incisors in the upper jaw is absent. The animal produces enough suction force to suck out termites from mounds.

Sloth bears are mainly nocturnal. Their sense of smell is well developed but their sight and hearing usually poor. They run away with human smell. But during accidental confrontation they defend and can cause nasty injuries by its claws and teeth. Not much is known about social life of bears. Sightings indicate that they are either solitary, in pairs with opposite sex or mother with cubs. Sloth bears are usually restrictive in their movement during the rains as insect food is plentiful. Mating occurs mostly in June and 1-2 cubs, sometimes 3 are born 6-7 months later. Most cubs are dropped between December-January. Birth and rearing takes place in a cave or climber thickets. Cubs are blind for about 3 weeks. The cubs leave the den when about 2 months

old and trail the mother. Males do not participate in parental care. Sloth bear leaves up to 40 years.

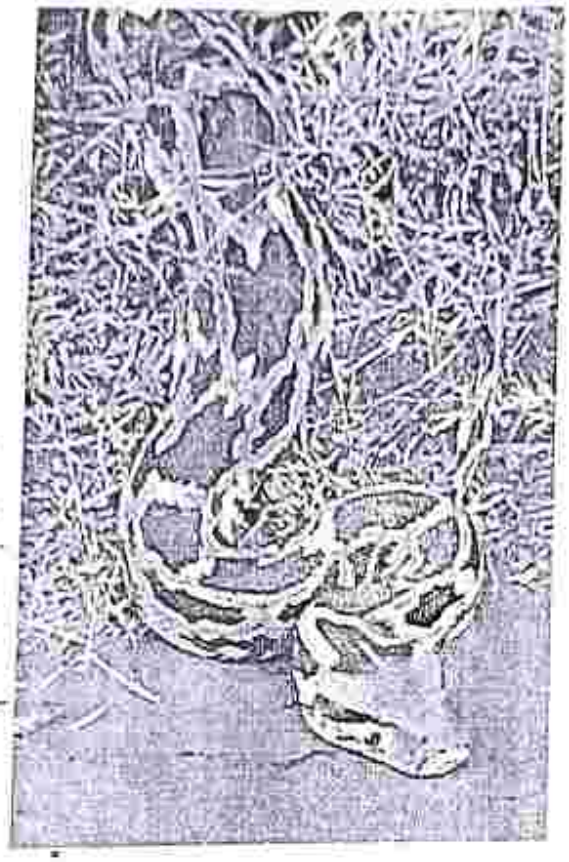


5.2.2 Habitat: Bears frequent drier and secondary forests but also found in dense forests. Rocky outcrops and grass lands are also preferred. The dentition indicates that bears are more herbivores and there is a departure from carnivory. In fact, they are omnivorous. Their diet includes largely insects and grubs which can be dug out from the ground or from the underneath of bark of standing trees or fallen logs. They eat termite and bee nests by suction and creating a vacuum in the nest by keeping snout close to the mound. Leaves, root, honey flowers (Mahua, Semul) and fruits (Ber, Tendu, Jamun, Baheda, Amla etc.) in season. Bears sometimes raid sugarcane and maize crop. Several human casualties or grievous injury occur due to bear attack. Bears disperse forest seeds from the fruit they eat and keep a control over termite population. In quest of food, bears may travel several km. Bears are endangered for their gall bladder and bile to which medicinal properties are attributed.

5.3 Indian Rock Python (*Python molurus molurus*):

5.3.1 Habit: This is a non venomous snake and can grow up to 4m and weigh 45 kg. The colour is dark brown and yellowish white in a blotched pattern. They are very good swimmers and take to water when disturbed but on land, they hiss and remain motionless. The

species in oviparous and lay up to 100 eggs in a clutch protected and incubated by the female. Being exothermic, python basks in open but can also raise body temperature by muscular contractions.



5.3.2 Habitat: Python occurs in wide range of habitats viz. rocky foot hills, grass lands, marshes, swamps, wood lands, open jungle. At times, they take refuge in mammal burrows, hollow trees etc. It has also been reported close to habitation and crop fields. The snake feeds on mammals, birds and reptiles but prefers the first. Chital deer, fawns, hares, mouse deers, jungle fowl are natural food. It can swallow prey bigger than its size as the jaw bones are not hinged. The prey is constricted to death by muscular movement and swallows head first. Once held in jaw, prey can not escape because of inward bent teeth.

Pythons are held endangered according to law. Many specimens are killed due to ignorance or out of fear when they enter habitation and capture goats or poultry. Specimens are also silently poached for their ornamental skin.

CHAPTER – VI
WILDLIFE MANAGEMENT PLAN

6.0.1 Narayanposi is one of 48 mines in Kolra belt. East of this mine, forests are discontinuous but to west, north & south, forests are more or less in a dense continuum. There is no scope of large or even medium sized animals in M.L. zone. Therefore, the management of core zone will focus on reclamation and reforestation of the mined pits at the earliest possible and maintenance of safety zone and green belt as a habitat for smaller animals like hare, mongoose, civets, squirrels and bird life accustomed to human presence with option of colonization and transit of large animals after mining comes to an end. The management of buffer zone shall target maintenance of optimal forest habitat and its linkage to west and south for large animals like deer, sambar, sloth bear and elephants while fostering natural biodiversity through four pronged strategy. These are one beefing up protection mechanism, two, redressal of genuine livelihood needs of forest dependent people, three, management of man-elephant conflicting interaction and four, building up of alternate biomass resources in the village limits.

6.0.2 Conservation is a state of harmony between man and land (forest included) and all that is above and beneath this. The civil society has a dilemma: Whether mining as an enterprise, is really concerned about conservation imperatives of natural resources on which we are all dependent? Are we leaving scars all over the landscape and making the earth poorer in biodiversity? This scar, known as ecological foot print (EF) is a measure of consumption or 'load' imposed on the natural environment by man's consumptive use in a region. The EF also represents the biologically productive capacity of the land necessary to sustain current levels of resource consumption. It is now generally believed that mining activities exceed the EF, that is earth's capacity of near future with the present rate of use and hence, resources need to be perused more vigorously with the active support of the user agency through a well spelt out plan.

6.0.3 **Objectives of management:** Before planned actions are implemented, it is necessary to set objectives of management and these are:

i) To reduce severity of impact on the forest & wildlife by adoption of attenuation measures in mining process including reforestation in mined out areas.

ii) Systematically Improve and maintain optimum habitat conditions for all wildlife in general and Schedule-I fauna in particular in buffer zone surrounding mines.

iii) Involve and energies village level institutions like VSS, EDC, SHGs etc in particular and people in general in conservation management.

iv) Management of animal depredations to elicit people's support for conservation.

v) Enlisting people's support and participation by providing alternate livelihood support to maximize above objectives.

6.0.4 **Conservation plan for M.L. area:**

6.1.1 **Reforestation:** An area of 40 Ha will be available for plantation over mine benches in reclaimed area of pits and O.B. dumps during the plan period, i.e. an average of 8 Ha per year. Plantation will be taken up from 2011 planting season and hence, preparatory activities will be taken up from 2010-11, which will comprise of site preparation, digging of pits, enriching the pits with farm yard manure and establishment of nursery. Nursery raised seedlings 6 months to one and half year old will be planted in 45 cm cube pits previously dug, withered and enriched with valley soil/FYM mixture. A plant population of 1600 will be aimed at. During planting, 30 gm of NPK, 20 gm of 'Ralli meal' and 10 gm of Neem Shield will be added to each pit. Soil working and weedings will be done as per requirement but not less than thrice in first year, twice in second year & once in third year. Clod breaking and pruning etc may be done in fourth & fifth year. Watering will be done as per necessity. Plantation will be tended for minimum of 5 years. Since safety zone has not come up well and not intelligible on the ground, this will be taken up urgently. Species of plants will be as under:

1) Sissoo (*Dalbergia sissoo*)
2) Ambolata (*Bauhinia racemosa*)
3) Ban Kapasia (*Kydia calycina*)
4) Dhaman (*Grewia tiliacfolia*)
5) Tentra (*Albizzia stipulate*)
6) Pani Kodalo (*Sterculia colorata*)
7) Gohira (*Acacia leucophloea*)
8) Salia Bamboo (*Dendrocalamus strictus*)
9) Chhatian (*Alstonia scholaris*)
10) Jamu (*Syzygium cuminii*)
11) Karanj (*Pongamia pinnata*)
12) Kangda (*Xylia xylocarpa*)
13) Neem (*Azadirachta indica*)
14) Karada (*Cleistanthus collinus*)
15) Kamlagundi (*Mallotus phillipensis*)
16) Fasi (*Anogeissus acuminate*)
17) Java Bara (*Ficus benjamina*)

During 5th year, plantation, when fully established can be seeded with Modaphal (*Helictres isora*) to form an under-storey, which is an excellent food plant for elephants.

6.1.2 **Coil geo-textile:** Dump stabilization will be done over 6 Ha through coir geo-textile, where the slope is pretty high and where afforestation is yet to be taken up. Dumps will be further made safer by making terraces and construction of retaining wall below the toe of the dump.

6.1.3 **Grass seeding:** Dumps and sloping lands bereft of vegetation will be further stabilized by seeding of grass pellets. Pellets of 2 cm dia can be made by mixing powdered clayey loam with FYM in 6:1 ratio, kneaded with water and grass seeds @ 5 kg/hectare and sun dried in March and dibbled in slopes and barren areas well before monsoon to strike roots effectively. This will provide a soil cover and minimize erosion.

6.1.4 **Protection of plantations:** About 22 Ha plantations exist on the safety zone and outer periphery within the plan period, 60 Ha plantations will

be added. Upto 5th year, 2 Van Sahayaks and thereafter, 3 such will be engaged to look after the plantations Rigid protection will ensure colonization of plants by air borne seeds and through bird droppings. Small animals may also return to the safety of plantations when left undisturbed and unmolested.

6.1.5 **Dust control:** Water spraying twice on roads, ore storage yard, sub-grade will reduce fugitive dust. Ore, during transport shall be covered with tarpaulin. In the crushing unit, dust will be substantially reduced by fogging system. Drills will be provided with dust collection bags etc plantations will act as useful dust trap.

6.1.6 **Noise / light pollution control:** Proper maintenance of equipments, subdued blasting, use of delay detonators, avoidance of air blast and blasting in an asynchronus manner between adjacent mines, blasting during lunch-break hours will have least impact on wildlife through noise. Dispersion of light can be minimized by painting upper half of headlights black, allowing light over required area only. Sky glow will be prevented with overhead shade. However, effective safety zone and other green belt will act as an acoustic and light barrier.

6.1.7 **Water pollution control:** This is very important as Karo nala flows on the western edge of the M.L. area. Water will be collected in garland drains all round the area. Garland drains will be 1-5m wide and 1m deep with sloping sides. The side slopes and bottom of the drain will be stone pitched to prevent scouring and bank erosion, water from the drains will be taken to a sedimentation tank at the toe of the dump, where water is allowed to travel in a zig-zag manner, which reduce the velocity and facilitates sedimentation of suspended solids. The clear water will be discharged to the nala. The garland drains will be taken on contour and water will be allowed to drop at masonary tanks, where there is abrupt change in contour. Further, check dams and contour trenches will reduce turbidity by trapping silt.

6.1.8 **HDPE tank:** Two HDPE tanks can be made at two different locations within the safety zone to provide water to small mammals and birds. This will be 60 cm deep and slanting on one side to emerge at ground level. The size will be 3x3m whose sides will be covered with HDPE

sheet. The edges of the sheet will be covered with a boulder line and eyes will be firmly anchored with iron spikes. Clear water will be filled in this every alternate day or twice a week and rotting leaves and soil etc removal from inside and disinfected with a mugful of $KMnO_4$ solution. Care will be taken that the tank received good sun light but lateral shade is okay from adjacent trees/shrubs, which may serve useful purpose as cover patch or as perching tree.

6.1.9 **Solar powered fencing:** With a view to prevent accidental fall of animals that may stray into the M.L. area, the pits will be kept fenced with solar powered fencing, particularly in deep sides. About 7 km steep sides need to be barricaded. As the reclamation proceeds and slopes are eased, the fencing can be removed and taken to cover deeper locations.

6.1.10 **Participatory fire control:** In addition to whole time Van Sahayaks, who will be patrolling the area during fire season, villagers of Roladihi, Lengdasahi & Kasira will be associated in fire prevention and fire fighting in case of accidental break up. For this purpose, villagers will be given financial incentive after fire season is over without any or minimal incidents of fire. Fire outbreak is an emergency, during which all workers and villagers will be pressed into service. However, fire lines will be kept cleaned ahead of fire season to prevent any outbreak. A lump sum provision will be made.

6.1.11 **Garbage disposal:** All garbage will be segregated in separately assigned bins for biodegradable and non biodegradable components. Biodegradable garbage will be made to vermin compost and non biodegradable garbage will be disposed for recycling or incinerated.

6.1.12 **Creation of awareness:** Conservation is effective only where all stakeholders understand their duties and responsibilities well. To make the workers and adjoining villagers aware of the issues involved and action plan under implementation, it with will be worthwhile to have meetings & seminars, where all villagers workers will be given opportunity to put forth their view points and suggestions. Suitable rewards may also be given to the best eco-sensitive worker and villager after prior evaluation.

6.2.0. **Conservation plan for the buffer zone:**

6.2.1 **Assisted Natural Regeneration:** Dense Sal scrub lying between Mendhamaruni R.F. & Karo R.F. will be rehabilitated over 50 ha. This will have the advantage in building up additional food and cover resources and also reinforcing the connectivity between two R.F's by nursing up of the coppice growth by regeneration cleaning, singling out shoots and enriching the growth by putting 300 plants/ha of browse value to elephants. For this purpose, at an interval of 10m grid lines will be cleaned and 45 cm cube pits will be excavated every 3m avoiding overhead shade. Nursery raised seedlings will be planted in these pits with basal dose of manure and tended for 5 years. The species and method of planting & post planting care will be the same as given in para 6.1.1. Villagers of Rengalbera will be completely involved in this work.

6.2.2 **Game tanks:** One game tanks will be made of 100x100m size in suitable locations, one each in Karo R.F. and Sarkanda R.F. by diverting small streams. Game tanks will be located in valley bottoms or such level areas, where water will be retained during summer, when it is most needed. Each tank will have an inlet and an outlet channel with well designed flood water escape weir. Each tank will hold 0.6 ha water of minimum 1.5m deep during summer. The sides of game tank will be of proper slope to eliminate chances of drowning due to accidental fall of young ones.

6.2.3 **Check dams:** Rubble check dams on the upper reaches of Karo, Samij and Sarkanda nalas will be constructed to improve percolation and consequently, optimum growth of browse plants and other herbaceous growth. Check dams will also arrest silt and prevent erosion and bring overall improvement in the habitat. One hundred such check dams will be constructed upto – 3m in width and height not exceeding a metre. With a view to channelise water flow, the centre of such dams should have a V-notch, where boulders are not available locally, as in valleys, brush wood check dams can be made. Spikes of easily rooting species e.g. Erythrina, Sissoo, Ficus, Lannea may be treated with Indolyl acetic acid, a rooting hormone and planted. Brush wood can be intertwined

and woven horizontally to the spikes. Spikes can further be reinforced with a layer of boulders downstream as additional support and to act as apron to the falling water. The distance between two check dams will depend on the slope of the nala bed. General principle to be adopted is the bottom of a check dam should be on the same horizontal line as the top of the dam downstream.

6.2.4 **Salt licks:** Artificial salt licks will be made close to game tanks to be excavated and other small water holes, where wild animals' signs are found. Salt licks will be made by mixing 96% common salt, 3% rock salt and 1% mineral mixture (having essential trace elements). Elephants, deer and wild pigs lick salt to meet the mineral requirements and for proper health. The lick should be placed on a higher ground so that it remains free from contaminants like urine and faecal matter.

6.2.5 **Monitoring biodiversity:** Permanent trend transects will be laid out along fertility gradient to represent the local diversity of flora and fauna. Transects will be laid perpendicular to appropriate baseline in Karo-Toda R.F's and Sarkanda-Khajuridihi R.F's. A minimum of 5 transects each 2 km long will be marked in each sector. Thus, a total transect length of 20 km will be marked. Each transect may be laid 500m apart. The starting point GPs reading and bearing of compass will be noted for future reference.

Transect lines can be marked in central red paint band with two white paint bands on either side on breast height of trees. While aligning the transect, care will be taken to avoid least damage to flora. Transects will be taken to avoid least damage to flora. Transects will be selected and laid out on the ground on the basis of stratified random sampling after marking on the map. Following readings will be taken.

a) Recording of herbs and shrubs every 2m on the sides and every 2.02m on the diagonals of a 10x10m plot every 100m on the transect. The central point of transect will be marked with a wooden peg.

b) Recording tree growth in 15 cm girth classes' species wise in 20m strip along the grid. Trees of less than 30 cm girth will not be listed.

c) Any animal sighted in 20m strip will be noted with its direction of movement and flushing distance carefully noted perpendicular from the grid line and also from the grid measured.

d) All elephant dung encountered on the grid and visible from the grid will be noted and its perpendicular distance from the grid measured.

e) Pellet groups of deer encountered and visible in 10x10m plots will be noted.

f) All other animal signs like feeding signs, bedding, faecal matter, rubbing posts, claw marks, ground scrapping, ground nests, pelage, shed antlers will be recorded. Alarm and mating calls will be recorded.

g) Nala beds and game trails will be intensively searched to find foot prints, pug marks and other animal signs including kills by predators.

h) Rare species will be recorded and its location noted through GPs reading.

Following indices of biodiversity will be estimated to know importance of species in community and the diversity of community itself.

a) Species richness index = $d = S-1 / \log N$

Where, S = Number of species in the sample

N = Number of individuals in the sample

b) Shanon Index of general diversity

$H = -\sum (ni / N).\log (ni / N)$

Where, ni = Importance value of a species based on its number/basal area

N = Total of importance values of all species

c) Relative frequency of a species

R = Number of individuals of the species / Total number of species x 100

d) Index of dominance = $C = \sum (ni / N)^2$

Where, ni = Number of individuals in a species

N = Total number of individuals of all species in the sample

e) Animal density in strip count

N/A = C/2L. ∑1/dj

N = Animals sighted from the transect

A = Area of strip covered (based on the average flushing distance)

N/A= Average density of animal surveyed

L = Length of the transect (strip)

dj = Flushing perpendicular distance of an animal from the survey line on either side

f) Elephant dung count:

E = (Y x R) / D

Where, E = Elephant density

Y = Dung density

R = Decay rate

D = Defecation rate = 16 piles per day

To assess the defecation rate, fresh dung piles are monitored every 15 days for over 4 months (8 readings), when more than 50% dung piles are seen totally obliterated. A minimum of 50 dung piles will be monitored.

g) Pellet group count (for deer)

t = 1/a. ∑y

Where, ∑y =.Sum of pellet groups counted over 10x10m plots

a = Area of entire sample (ha) = number of plots x 100 sq.m. / 100x100

t = pellet groups per ha

N/A = t / r x d

Where, N = Number of deer in the habitat

A = Area of the habitat

N/A = Deer density per ha

r = Defecation rate

d = Days over which pellet groups have been deposited (Number of days needed for total obliteration)

The baseline studies will l d out in the first year and diversity and animal numbers monito ly alternate year, i.e. 3rd, 5th, 7th and 9th year. Thus, in all, 5 surveys will be done during the plan period. Rare fauna, flora and indicator species in particular, will be monitored specifically as indicator of pollution levels.

The survey can be done departmentally, particularly tree enumeration, animal strip count, dung density count, pellet count etc in collaboration of scientific institutions. Analysis of data can be outsourced. Survey of amphibians, algae, fungi, lichens, grasses and insects will be outsourced.

6.2.6 **Antidepredation squad:** This will consist of R.O. Koira, Section Forester, 2-3 forest guards and 5 trackers. Trackers will be deployed to move on foot in forest areas as per instruction of the R.O./Forester with a view to collect data on wild animals more specifically of elephants. Each tracker will be provided a haver sack, set of uniforms, whistle, pen knife, measuring tape, a note book, pencil, a set of polythene bags and a bamboo stick. Tracking will be done every morning between 5 AM – 8 AM. Information on number of elephants, location and probable line of movement is shared between villagers and staff members to plan driving in case of need. During evening hours, the squad may patrol the probable area and alert the villagers. This squad will also mount vigilance against poaching and illegal strip mining.

6.2.7 **Equipment for antidepredation work:** Following equipments will be purchased for the squad and for distribution in villages.

i) Rechargeable flash lights (heavy duty) – 30 nos
ii) Battery operated megaphone-cum-siren – 15 nos
iii) Mobile phone – 5 nos
iv) Fire crackers (rocket type) – As per need
v) Solar lights – 25 nos

6.2.8 **Corpus fund:** A lump sum amount will be deposited as corpus fund to be operated by the human deaths and grievous injury cases.

6.2.9 **Fireline:** Karo R.F. will be totally fire protected for which 5 km fireline will be maintained in R.F. boundary skirting villages to check ingress of fire from outside. Adjoining villagers will be involved on this work on payment of wages so that they develop a sense of ownership with the forest. The work may also be entrusted to the VSS if well organized. The line will be in a width of 10m and repeatedly fire traced to keep it clean of any inflammable material.

6.2.10 **Incentive to VSS:** Five villages will be kept incentivised through VSS for successful prevention and fire fighting. They will also assist in elephant watch and sharing information with the antidepredation squad. Incentive will be released after successful fire prevention/fighting and assisting the squad in antidepredation work.

6.2.11 **Check gates:** Two check gates will be fixed on forest roads in Karo and Sarkanda R.F's.to prevent vehicular poaching. The check gate will be kept open during day and kept locked during night. The gate will be operated by a selected local, who will be paid a consolidated wage of Rs.3,000.00 per month. This will prevent poaching and illegal transport of ore after prescribed hours and also illegal mining.

6.2.12 **Eco-development:** To resolve the conflict over shrinking forest resources and changing land use, willing villagers will be selected for skill development training in alternative livelihoods. The selection will be entrusted to the VSS/SHG as is active in the village. After training is imparted, micro credit will be sanctioned and released through the aforesaid bodies for undertaking selected enterprises. Marketing of products can be done by these bodies with active support and facilitation by the Forest Department.

6.2.13 **Control of vehicular traffic:** Tipper movement will be regulated in a manner so as not to pass through forest areas after sunset. At other times, speed will not exceed 25 KmpH. The drivers will be advised to maintain 50m gap between vehicles to reduce dust pollution and to

stick the speed limits set to prevent accidents. Fitness of vehicle need to be periodically checked.

6.2.14 **Awareness promotion:** Apart from VSS, local youth in schools will be sensitized on forest and wildlife conservation and the necessity thereof. Meetings, debates, film shows can be held to impart cutting edge knowledge to students to enthuse them. Van Mahotsav and wildlife week may also be organized for the purpose. Eminent social worker of the area, NGO, local DFO, Collector etc may be invited to address the gathering and distribute prizes to the winners of competitions in debate, essays, paintings etc.

6.2.15 **Digitised maps and forest cover assessment:** Every second year, forest cover assessment will be made in the buffer zone from digitized maps to be procured from NRSA. The assessment can be taken up by ORSAC.

CHAPTER – VII
FINANCIAL FORECAST

7.0.0 The financial requirement of various interventions suggested in the plan is as per the current costs and is given in tables 7.1 and 7.2 for the M.L. area and BZ.

7.0.1. The activities within the M.L. area will be implemented by M/s. AMTC Limited and that within the BZ through the DFO Bonai Division.

7.0.2. The total cost of the plan is Rs.302.00 lakhs; Rs.138.00 lakhs for the M.L. area and Rs.144.00 lakhs for the BZ. In addition, a vehicle cost of driver and 100 litres diesel per month will be given in kind. Running cost of vehicle will be deposited with the DFO every month by cheque. This works out to an additional Rs.20.00 lakhs.

7.0.3. **Monitoring Committee:** There will be a Monitoring Committee to oversee the implementation of the plan for reasons of transparency. The committee will also guide implementation, resolve bottlenecks, select sites, and shall have the power to modify various provisions in the interest of conservation. The committee will be headed by the DFO with mine representative, 2 VSS Presidents, R.O. Koira and a member from local NGO as members.

CHAPTER-VII
FINANCIAL FORECAST

7.0.0 Based on activities suggested in the Chaptor ad financial estimate for activities within the lease hold area and in the adjoining forest etc. areas are as under.

7.1.0 The activities proposed to be taken up inside the lease hold area are to be executed by the DFO, Bonai Forest Division under the guidance of C.F., Rourakela.

7.2.0 The following table indicates the cost estimate for measures to be taken up inside and outside the project area within 10-years. The cost of activities to be taken up in the Project area and in the project impact area (ZoI) i.e. outside leasehold area shall be deposited with the Forest Department to be utilized by the Divisional Forest Officer, Bonai Division for execution of works under the guidance of Conservator of Forests, Rourakela Circle. User agency will deposit Rs.288.00 lakhs with DFO, Bonai Forest Division under CAMPA for implementation of the plan.

7.1.1: Activities within the Project Area. (Rs. In lakhs)

Sl. No.	Item of work	Amount approved by CWLW
1	Plantation of intimate mixture of food and cover species over 40 ha @ Rs.50.00 lakhs per ha.	Dump reclamation & plantations are to be done as per dump reclamation plan for approval by competent authority separately & intimated to us.
2	Coir Geo textile over 6 Ha to stabilize steep dumps	
3	Grass seeding over 30 ha.	
4	Van Sahayaks	
5	Dust control	Pollution Control Board to separately approve such proposals
6	Noize /light pollution control	
7	Garbage disposal	
8	Water pollution control	
9	Creation of water sources in 184 ha. of virgin forest area in the ML area as per GOI stage – 1 & 2 clearance etc.	20.00
10	Solar powered fencing - to be done around mining pits to save straying wild animals and not to obstruct wildlife corridors existing in the mining lease area.	15.00
11	Fire incentive to 3 villages	6.00
12	Habitat improvement in 184 ha. of virgin forest area as per stage-1& 2 clearance of GOI with fruit, fodder and cover species for both avi-fauna and other wildlife in the area.	25.00
13	Soil and moisture conservation measures in the lease hold area to avoid silting up of nalas and to revive two nalas originating from the ML area	6.00
14	Distribution of seedlings under farm forestry to local villagers to augment fruit, fodder and fuel wood sources in the area	6.00
15	Creation of awareness, sinages of wildlife, livelihood activities, supplying of various types kits and livelihood training etc.	10.00
16	Unforeseen expenses	4.00
	Total	92.00

7.1.2: Activities within the Project Impact area (zone of influence).

Sl. No.	Item of work	Amount approved by CWLW
1	Habitat improvement measures with fruit fodder and cover species/ bamboo plantations/ meadow development/ ANR/ staggered trenches in forest areas	30.00
2	Creation of water spurces in forest areas with wallowing grounds on the down side of spill way by creating muddy and slushy area for wild animals to wallow and gambol.	25.00
3	Check dams of random rubble in upper reaches of Karo, Samij and Sarkanda nala And soil and moisture conservation measures in forest areas to avoid chocking of nalas, rivulets and drainage channels	8.00
4	Salt licks = 5 nos.	3.00
5	~~Trackers = 5nos. for anti-depredation squad~~ Anti-depredation/ anti-poaching squad with hired vehicle/ manpower/ equipment/ barracks/ crackers, megaphone, search lights/ flare guns/ tents & camping equipments for 10 years including engagement of elephant trackers	40.00
6	Equipments for 10 years: Flash light - 30 nos. Megaphone = 15 nos. Mobile phone with SIM card = 5nos. Fire crackers Solar light = 25 nos.	12.00
7	Corpus fund to meet ex-gratia payment	10.00
8	Creation of fire lines and maintenance of old fire lines/ fire fighting equipments/ fire fighting squads/ incentive to VSS for prevention of fire as encouragement incentive.	11.00
9	a) Check gates = 2nos. = 1.00 b) Remuneration to VSS members = 2 nos. = 6.00	7.00
10	Livelihood activities promotion, training, supplying of various kits/ machines/ equipments/ self-help groups formation/ micro credit seed money etc.	25.00
11	Awareness promotion, sinages for wildlife etc.	5.00
12	Biodiversity and animal status monitoring & Development of communication network / GIS based maps Satellite maps on GIS domain should be procured every year to know the changing profile of the project area in both dry season and wet season for 10 years preferably using the GIS lab of PCCF(WL), Orissa	15.00
13	Unforeseen & misc.	5.00
	Total	**196.00**
	Grand Total	**288.00**

N.B. All measures for dump reclamation, dust suppression, garbage bins, soil erosion measures should be taken up including retaining walls , plantation etc. as per the reclamation plan etc to be prepared in terms of the approved mining plan and other guidelines. This component is to be dealt separately as per the above guidelines. Hence no financial forecast on this account is indicated in the conservation plan.

Approved by PCCF(WL)& CWLW, Orissa.

Conservator of Forests(WL)

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ANNEXURE-I

F.No.8-34/2000-FC (Vol. I)
Government of India
Ministry of Environment & Forests
(F.C. Division)

Paryavaran Bhawan, C.G.O. Complex,
Lodi Road, New Delhi-110003.
Dated: 11-03-2005

19 MAR 2005

The Principal Secretary (Forests),
Government of Orissa,
Bhubaneswar.

Sir,

Diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) Ltd., in Sundergarh district of Orissa.

I am directed to refer to your letter No. 10F(Cons)-130/2004/18319/F&E dated: 09.2004 on the above mentioned subject seeking prior approval of the Central Govt. under section-2 of Forest (Conservation) Act, 1980, and to say that the proposal has been examined by the Forest Advisory Committee constituted by the Central Government under section 3 of the aforesaid Act.

After careful consideration of the proposal of the State Government, and on the basis of recommendations of the above-mentioned Advisory Committee, the Central Government, hereby, agrees in-principle for diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) Ltd., in Sundergarh district of Orissa, subject to fulfilment of following conditions:

1. User agency shall carry out immediate transfer and mutation of 184.591 ha. of non-forest land in favour of State Forest Department.
2. The User Agency shall deposit the cost of raising and maintaining compensatory afforestation over 184.591 ha. of non-forest land with the State Forest Department.
3. The non-forest land for compensatory afforestation shall be notified by the State Government as RF under section - 4 or PF under section - 29 of the Indian Forest Act, 1927 or the State Forest Act within a period of 6 months and Nodal Officer (Forest Conservation) shall report the compliance.
4. User Agency shall deposit the Net Present Value (NPV) of the diverted forest land of 244.327 ha. with the State Forest Department as per the orders of the Hon'ble Supreme Court dated 30-10-2002 & 1-8-2003 in I.A No.566 in WP (C) No.202/1995 and the guidelines issued by this Ministry vide letter No.5-1/98-FC(Pt-II) dated 18-9-2003 and 22-9-2003 in this regard.
5. The State Government shall deposit all the above-mentioned fund in form of Fixed Deposits in the name of concerned DFO/ Nodal Officer of the State, till such time the CAMPA intimates the Head of Account for deposition of fund.

Demarcation of the area will be done on ground at project cost using four feet high RCC pillars, if not done earlier for entire area. The pillars shall indicate serial numbers, forward and back bearings and distance between adjacent pillars.

The user agency shall prepare a plan for soil conservation measures in project area in consultation with the State Forest Department and will submit it to the Central Government prior to Stage-II clearance.

User agency shall contribute to the State Government for the implementation of Regional Wildlife Management Plan prepared for Bonai and Keonjhar Divisions. The State Government shall submit the progress report of the Wildlife Management Plan.

The user agency shall protect the top soil at the project cost.

Concurrent Reclamation plan shall be executed by the user agency from the very first year, and an annual report shall be sent to the Nodal Officer and the Regional CCF, Bhubaneswar. If it is found from the Annual Report that the annual programme mentioned in Concurrent Reclamation Plan is not being adhered to by the user agency, the mining activities shall remain suspended till such time the annual programme is completed for that year.

The mining lease shall be coterminus with the current lease granted under MMRD Act, 1957.

Other standard conditions as applicable in respect of mining projects, shall apply in the instant case also.

After receipt of compliance report on the fulfilment of the above-mentioned conditions Nos.2,4,5,6,7 and 8 from the State Government, formal approval will be issued in this regard under Section 2 of the Forest (Conservation) Act, 1980. Transfer of forest land to user agency shall not be effected by the State Government till the final orders for diversion of forest land are issued by the Central Government. However, in accordance with para 4.18 of the guidelines issued under Forest (Conservation) Act, 1980, temporary working permission shall be allowed over already broken up area of 59.736 ha. for a period of 6 (six) months to comply with the above conditions.

Yours faithfully,

Sd/-

(ANURAG BAJPAI)
Asstt. Inspector General of Forests

Copy to:

1. The Principal Chief Conservator of Forests, Government of Orissa, Bhubaneswar.
2. The Nodal Officer, Forest Department, Government of Orissa, Bhubaneswar.
3. The Chief Conservator of Forests (Central), Regional Office(EZ), Bhubaneswar.
4. Regional Office (Hqs), New Delhi.
5. User Agency.
6. Monitoring Cell of FC Division.
7. Guard file.

(ANURAG BAJPAI)
Asstt. Inspector General of Forests

OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS, ORISSA, BHUBANESWAR

Memo No. 6455 /9F(MG)-103/04 Dt. 23-3-05

Copy forwarded to the D.F.O., Bonai Division for information and necessary action. He is requested to implement the Govt. order and report compliance to, this office at an early date.

Copy forwarded to the Conservator of Forests, Rourkela Circle for information and necessary action.

Chief Conservator of Forests(Nodal

11. Corporate Office

F. No. 8 – 34/2000-FC (Vol.-I)
Government of India
Ministry of Environment & Forests
(FC Division)

ANNEXURE – II

Paryavaran Bhawan
CGO Complex, Lodhi Road
New Delhi-110 003

Dated 15th November, 2007

To:

The Principal Secretary (Forests),
Government of Orissa,
Bhubaneswar.

Sub:- Diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in Villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) Ltd., in Sundargarh district of Orissa.

Sir,

I am directed to refer to your letter No. 10F (Cons) 130/2004/18319/F&E dated 09.12.2004, wherein the above proposal for diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) ltd., in Sundargarh district of Orissa was submitted seeking prior approval of the Central Government in accordance with Section-2 of the Forest (Conservation) Act, 1980.

2. After careful consideration of the proposal of the State Government and on the basis of the recommendations of the Forest Advisory Committee, the Central Government granted in-principle approval to the said proposal under Section-2 of the Forest (Conservation) Act, 1980, on 14.03.2005, subject to the fulfilment of certain stipulated conditions. State Government of Orissa has now submitted a compliance report of the said stipulated conditions vide letter No. 10F (Cons)-6/2007/13514/F&E dated 23.08.2007. After considering the proposal and compliance of the stipulated conditions by the State Government, the Central Government hereby grants **final approval**, under the Forest (Conservation) Act, 1980, for diversion of 244.327 ha. of forest land (including 184.591 ha. of virgin forest land) for 3rd renewal of Narayanposi Iron and Manganese Ore Mines in villages Koira and Kasira of Bonai Forest Division in favour of M/s AMTC (P) ltd., in Sundargarh district of Orissa subject to fulfilment of following conditions :-

1. Legal status of the forest land shall remain unchanged.
2. Compensatory Afforestation shall be raised and maintained over equivalent non-forest land by the User Agency at the Project Cost.
3. The non-forest land identified for raising Compensatory Afforestation shall be transferred and mutated in the name of the State Forest Department and shall be declared as Reserved / Protected Forest under the Indian Forest Act, 1927, or any other relevant Act of the State. Nodal Officer (FC), Government of Orissa shall report compliance within 6 months.
4. The State Government shall charge the Net Present Value of the forest area diverted under this proposal from the User Agency as per the orders of the Hon'ble Supreme Court of India dated 30.10.2002 and 01.08.2003 in IA No. 566 in WP (C) No. 202/1995 and as per the guidelines issued by this Ministry vide letters No. 5-1/1998-FC (Pt. II) dated 18.09.2003, as well as letter No. 5-2/2006-FC dated 03.10.2006 in this regard.
5. The State Government shall deposit NPV and all other funds with the Ad-hoc Body of Compensatory Afforestation Fund Management and Planning Authority (CAMPA) in Account No. CA 1585 of Corporation Bank, Block-11, Ground Floor, CGO Complex, Phase-I, Lodhi Road, New Delhi-110003.
6. Additional amount of NPV of the diverted forest land, if any, becoming due after finalization of the same by the Hon'ble Supreme Court of India on receipt of the report from the Expert [illegible] by the State Government from the User Agency.

7. The User Agency shall provide necessary funds to the State Forest Department to implement the Scheme for Suitable Need Based Soil and Moisture Conservation Measures.
8. The User Agency shall create, fence and maintain a proper safety zone around the mining area. The User Agency shall deposit funds with the Forest Department for the creation, protection and regeneration of the safety zone area, and also shall bear the cost of afforestation over one and a half time of the safety zone area.
9. Concurrent Reclamation Plan shall be carried out by the User Agency as per the approved Reclamation Plan at the Project Cost, and an annual report shall be sent to the Nodal officer and the Regional CCF, Bhubaneswar. If it is found from the Annual report that the annual programme mentioned in the Concurrent Reclamation plan is not being adhered to by the User-Agency, the mining activities shall remain suspended till such time the annual programme is completed for that year.
10. Demarcation of the area shall be done on the ground at the project cost using four feet high RCC pillars with serial numbers, forward and back bearings and distances from pillar to pillar.
11. Tree felling shall be done in a phased manner to coincide with the phasing of area to be put to mining with a view to minimize clear felling. The tree felling will always be carried out under the strict supervision of the State Forest Department.
12. The User Agency shall implement a 'Conservation Plan' in their lease hold area as per the guidelines of the Chief Wildlife Warden, Orissa.
13. The permission granted under the FC Act shall be co-terminus with the mining lease granted under MMDR Act, 1957 or any other relevant Act or for 20 years, whichever is less.
14. No labor camps shall be established on forest land.
15. Sufficient firewood shall be provided by the User Agency to the laborers at the project cost after purchase from the State Forest Department/Forest Development Corporation.
16. The forest land shall not be used for any purpose other than that specified in the proposal.
17. All other standard conditions stipulated for Mining Projects shall be complied with by the User Agency.
18. All other conditions that the CCF, (Central) Regional Office, Bhubaneshwar, may impose from time to time for the protection and improvement of the flora and fauna in the forest area shall also be applicable.

The State Government shall ensure compliance of all the above conditions.

Yours faithfully,

(A.K. Joshi)
Assistant Inspector General of Forests

Copy to:-

1. The Principal Chief Conservator of Forests, Government of Orissa, Bhubaneswar
2. The Nodal Officer, Office of the PCCF, Government of Orissa, Bhubaneswar
3. The Chief Conservator of Forests (Central), Regional Office, Bhubaneswar
4. User Agency
5. Monitoring Cell / FC Div.
6. Guard file.

(A.K. Joshi)
Assistant Inspector General of Forests

ANNEXURE - III

Phone Nos. (0674) 2744430/ 2742463
Fax No. (0674) 2744430
E- mail rcmbbsr@sancharnet.in
rcmbbsr@yahoo.com

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES
OFFICE OF THE REGIONAL CONTROLLER OF MINES

No. BBS/SG/Fe&Mn/MP-193

Mahanadi Complex, 2nd Floor
30E, District Centre
Chandrasekharpur
Bhubaneswar - 751 016
Date: 10.05.2004

To

Shri Rajeswar Thakore
Director-in-Charge
M/s Aryan Mining & Trading Corporation (P) Ltd.
61, Strand Road
Kolkata- 700 006

Sub. Approval of Mining Plan for Narayanposhi Iron & Manganese Mine of M/s A.M.T.C. (P) Ltd. over an area of 349.254.ha. in villages Koira & Kashira in Sundergarh district of Orissa state submitted under Rule 24A of MCR, 1960.

Ref. (1) Your RQP's letter No. Nil dated 07.04.2004.
(2) This office letter of even number dated 19.04.2004.
(3) Your RQP's letter No. Nil dated 14/17.05.2004.

Sir,

In exercise of the power conferred by the clause (b) of sub-section (2) of section 5 of Mines & Minerals (Development & Regulation) Act, 1957, read with Government of India Order No. S.O. 441 (E), dated 28.04.1987, I hereby **APPROVE** the aforesaid Mining Plan. This approval is subject to the following conditions :-

(i) This Mining Plan is approved without prejudice to any other law applicable to the mining area from time to time whether made by the Central Government, State Government or any other authority.

(ii) The Mining Plan is approved without prejudice to any order or direction from any court of competent jurisdiction.

02. It is also clarified that the approval of your aforesaid Mining Plan does not in any way imply the approval of the Government in terms of any other provision of Mines & Minerals (Development & Regulation) Act, 1957, or the rules framed thereunder and any other law.

03. The details of renewal of the lease by the State Government, whenever such an order is passed, may be intimated to the Regional Controller of Mines, Indian Bureau of Mines, Bhubaneswar.

04. Your attention is invited to the Supreme Court interim order in W. P. (C) No. 202, dated 12.12.95 for compliance. The approval of the Mining Plan is, therefore, issued without prejudice to and is subject to the said directions of the Supreme Court as applicable in your case.

contd.....2

05. As per the requirement of Rule 22(5)(va) of Mineral Concession Rules, 1960, a Progressive M... Closure Plan, as defined in clause (oo) of Rule 3 of Mineral Conservation & Development ... 1988, should have been incorporated in the Mining Plan, which has not been done. The Mining Pl... is, therefore approved, subject to the condition that Progressive Mine Closure Plan wh... submitted to this office for approval, within a period of 60 days from the date of issue of ... failing which, this approval shall stand withdrawn.

06. Further, this approval of Mining Plan is subject to the following conditions :

(a) Provisions of the Mines Act, 1952 and Rule & Regulations made thereunder including submissi... of notice of opening, appointment of manager and other statutory officials as required by ... Mines Act, 1952 shall be complied with.

(b) The execution of Mining Plan shall be subjected to vacation of prohibitory orders/ notices, if any.

(c) If anything is found to be concealed as required by the Mines Act in the contents of the Mi... Plan and the proposal for rectification has not been made, the approval shall be deemed to hav... been withdrawn with immediate effect.

Yours faithfully,

Encls: Two copies of approved Mining Plan.

(RANJEET SIN...
Regional Controller of Mine

प्रतिलिपि निम्न को सादर सूचनार्थ अग्रेषित/Copy forwarded for kind information to:

1. श्री एस. सी. नायक, आर. क्यू. पी., एम ए/ 17, जी. जी. पी. कॉलोनी, रसूलगढ़, भुवनेश्वर-751 010. — Shri S C Nayak, RQP, MA/17, GGP Colony, Rasulgarh, Bhubaneshwar-751 010.

2. डायरेक्टर ऑफ माइन्स, डायरेक्टोरेट ऑफ माइन्स, उड़ीसा सरकार, हेड्स ऑफ डिपार्टमेंट बिल्डिंग, न्यू कैपीटल, भुवनेश्वर- 751 001. — Director of Mines, Directorate of Mines, Government of Orissa, Heads of Department Building, New Capital, Bhubaneswar– 751 001.

3. डायरेक्टर ऑफ माइन्स सेफ्टी, डायरेक्टोरेट जनरल ऑफ माइन्स सेफ्टी, चाईबासा क्षेत्र, एट एण्ड पोस्ट चाईबासा, जिला सिंहभूम पश्चिम (झारखण्ड), पिन- 833 201, को अनुमोदित माइनिंग प्लान की एक प्रति के साथ, रजिस्टर्ड पार्सल द्वारा. — Director of Mines Safety, Directorate General of Mines Safety, Chaibasa Region, At & P.O. Chaibasa, Dist. Singhbhum West (Jharkhand), PIN 833 201, along with one copy of approved Mining Plan, by **REGISTERED PARCEL**.

4. खान नियंत्रक (मध्यांचल), भारतीय खान ब्यूरो, नागपुर – 440 001, को अनुमोदित माइनिंग प्लान की एक प्रति के साथ, रजिस्टर्ड पार्सल द्वारा. — Controller of Mines (CZ), Indian Bureau of Mines, Nagpur – 440 001, along with one copy of approved Mining Plan, by **REGISTERED PARCEL**.

5. सम्बंधित माइन फाइल — Concerned mine file.

20/5/2005.

(रणजीत सिंह / RANJEET SINGH)
क्षेत्रीय खान नियंत्रक / Regional Control of Mines

ANNEXURE XXXIII

Government of Odisha
Steel and Mines Department

****

VESTING ORDER

No. 4212 /SM Dated the 30 May 2020
IV(B)SM-21/2020

Whereas a mining lease of the following description, which was held by M/s Aryan Mining & Trading Corporation Pvt. Ltd. (hereinafter referred to as the previous lessee) with validity period upto 31.03.2020 has been auctioned and M/s JSW Steel Ltd., has been declared as the preferred bidder of the said mine.

Description of the Mining Block

- Name of Mineral(s) – Iron & Manganese
- Name of Mining lease - Narayanposhi Iron & Mn Block.
- Address/location of mining lease - Village Koira, Kashira and Kathamala RF under Koira Tahasil of Sundergarh district.
- Area of lease – 347.008 hects (As per DGPS)/ 349.254 hects(As per ROR).

And whereas, a letter of intent bearing no 2288 dated 02.03.2020 has been issued in favour of the preferred bidder for grant of mining lease for the above mentioned mining block;

And whereas, in terms of section 8B(2) of the MMDR Act, 1957 read with rule 9A(4) of the Mineral (Other than Atomic and Hydrocarbon Energy Minerals) Concession Rules, 2016 [herein after called the Rules'2016], the holder of the letter of intent for the said mining block shall be deemed to have acquired all valid rights, approvals, clearances, licenses and the like vested with the previous lessee.

Now therefore, the undersigned being the Nodal Officer for the State of Odisha having been nominated under rule 9A(1) of the Mineral (Other than Atomic and Hydrocarbon Energy Minerals) Concession Rules, 2016 [herein after called the Rules,2016], do hereby, pursuant to the provisions contained in rule 9A(2) of the Rules,2016 order that all the valid rights, approvals, clearances, licenses and the like vested in the previous lessee in respect of the aforementioned mining block are deemed to have vested in favour of the holder of the letter of intent on the same terms and conditions of every rights, approvals, clearances, licenses, and the like which vested with previous lessee.

Without prejudice to the generality of the provisions of section 88(2) of the MMDR Act, 1957, the details of the valid rights, approvals, clearances, licenses, and the like held by the previous lessee and vested in favour of the holder of the Letter of Intent are given in the Annexure-I to this order.

This vesting order is valid for a period of two years from the date of execution of lease deed or till the date of getting fresh approvals, clearances, licenses, permits, and the like, whichever is earlier

(**S. K. Popli**)
Nodal Officer-cum-Special Secretary to Government

Memo No. 4213 / SM Dated: 30 May 2020

Copy to alongwith Annexure-I forwarded to M/s JSW Steel Ltd, JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai- 400051 for information and necessary action. It is requested that one copy each of the documents mentioned in the Annexure-I may be collected from the office of the Director Mines, Odisha, Bhubaneswar during office working hours.

Nodal Officer

Memo No. 4214 /SM Dated: 30 May 2020

Copy to alongwith Annexure-I forwarded to M/s Aryan Mining & Trading Corporation Pvt. Ltd., Aryan House, 8th Floor, P1- Hide Lane, Kolkata- 700073 for information and necessary action.

Nodal Officer

Memo No. 4215 / SM Dated: 30 May 2020

Copy alongwith Annexure-I forwarded to Indian Bureau of Mines, Bhubaneswar/ MoEF & CC, 534, Paryavaran Bhawan, CGO Complex, Lodhi Road, New Delhi 110003/ MoEF & CC (FC Divison), Indira Paryavaran Bhawan, Aliganj, Jorbagh Road, New Delhi 110003/ SPCB, Parivesh Bhawan, A/118, Nilakantha Nagar, Unit-VIII, Bhubaneswar, Odisha, 751012/ Director General of Mines Safety, Chaibasa Regiona, Chaibasa, 833201 /Ministry of Water Resource, River Development and Ganga Rejuvenation, West Block-2, Wing 3, Sector-1, R.K. Puram, New Delhi-110066 for information and necessary action.

Nodal Officer

Memo No. 4216 / SM Date: 30 May 2020

Copy alongwith Annexure-I forwarded to Director of Mines, Odisha, Bhubaneswar for information and necessary action. He is requested to provide one copy each of the documents described in the Annexure-I to the authorized representative of the LoI holder with proper acknowledgement and forward a copy of acknowledgement to the Department for record.

Nodal Officer

Memo No. 4217 / SM Date: 30 May 2020

Copy alongwith Annexure-I forwarded to Collector, Sundergarh/ Deputy Director of Mines, Koira / DFO, Bonai for information and necessary action.

Nodal Officer

Memo No. 4218 / SM Date: 30 May 2020

Copy alongwith Annexure-I forwarded to Forest and Environment Department/ PCCF(Nodal), Bhubaneswar for information and necessary action.

Nodal Officer

ANNEXURE-I

Name of the Block : **Narayanposhi Iron & Manganese ore Block**

LoI Holder : **JSW Steel Ltd.**

Area of the Lease : **349.254 Hects (As per ROR)**

347.008 hects (As per DGPS)

SL No	Nature of approval clearance etc	Issuing officer/authority	Reference No./ Date of Issue
1	Mining Plan	Regional Controller of Mines, Bhubaneswar, Govt. of India	MSM/FM/40/ORI/BHU/2015-16, Dated 02.06.2016
2	EC	MoEF & CC, Govt. of India	J-11015/288/2008-IA.II(M), Dtd 18.06.2019
3	FC	MoEF & CC, Govt. of India,	F. No. 8-34/2000-FC (Vol-I), Dtd. 15.11.2007 over 244.327 hects
4	Consent to Establish	State Pollution Control Board, Odisha	536/IND-II-CTE-6207, Dated 14.01.2019
5	Consent to Operate	State Pollution Control Board, Odisha	6785/IND-I-CON-2258, Dated 08.07.2019
6	Surface Right	District Collector, Sundargarh	Surface Right granted over 324.800 hects
7	Deep Hole Blasting & use of HEMM	Directorate General of Mines Safety, Chaibasa Region, Chaibasa, Govt. of India	[29020/45/2014/RC(SEZ)] No. 2410, Dated 23.12.2015
8	Ground Water Withdrawal	Member Secretary (CGWA), Central Ground Water Authority, Govt. of India	CGWA/NOC/MIN/REN/1/2019/5586 Dtd. 09.10.2019

1. Vesting of clearances/approvals/licences/permissions /rights as above does not have the effect of transfer of ownership of infrastructure established and the ore & minerals raised by the ex-lessee which shall be governed by the provisions of the rules 12(1)(gg) and 12(1)(hh) of the Minerals Concession Rules, 2016. However, on acquisition of such infrastructure from the ex-lessee and submission of evidence thereof, the new lessee may be vested with related clearances/ approvals etc at the relevant time.
2. Vesting of Forest Clearance is subject to payment of NPV as prescribed in letter dtd. 31.03.2020 of Government of India, Ministry of Environment, Forest & Climate Change.

GOVERNMENT OF ODISHA
STEEL AND MINES DEPARTMENT
*****

ORDER

No. 1335 /SM, Dated 15.02.2022
IV(B)SM-21/2020

Whereas, in pursuance to the "invitation of bids for grant of Mining Lease for Iron ore" dated 06.12.2019 issued by the Government and subsequent auction held on dated 01.02.2020, M/s JSW Steel Ltd., the successful bidder has been granted a mining lease for Iron ore in respect of Narayanposhi Iron & Manganese ore block over an area of 347.008ha (as per DGPS) / 349.254ha (as per RoR) in village Koira, Kashira & Kathamala R.F. under tahasil Koira of Sundergarh district for the period of 50(Fifty) years as provided under section 8A, sub-section 2 of the Mines and Minerals Development and Regulation Act, 1957 vide order No.5425/SM dated 26.06.2020.

And whereas, the lease deed has been executed and registered by the lessee.

And whereas, the new lessee was vested with all the valid rights, approvals, clearances, licences and the like vested in the previous lessee for a period of 2 (Two) years vide vesting order No.4212/SM dated 30.05.2020, No.9815/SM dated 13.11.2020 & No.462/SM dated 13.01.2021.

And whereas, in the meantime section 8B of the MMDR Act, and Rule 9A of M.C. Rules, 2016 have been amended w.e.f. 28.03.2021 and 02.11.2021 respectively as noted below.

"8B (1); Notwithstanding anything contained in this Act or any other law for the time being in force, all valid rights approvals, clearances, licenses and the like granted to a lessee in respect of a mine (other than those granted under the provisions of the Atomic Energy Act, 1962 and the rules made thereunder) shall continue to be valid even after expiry or termination of lease and such rights, approvals, clearances, licenses and the like shall be transferred to and vested, subject to the conditions provided under such laws, in the successful bidder of the mining lease selected through auction under this Act."

"Rule 9A(1) in subrule (1), for "in respect of leases expiring under the provisions of sub-sections (5) and (6) of section 8A of the Act, within one week from the date of the notification of the minerals other than Atomic and Hydro Carbons Energy Minerals) Concession (Amendment) Rules, 2020" the words figure and letter, "for the purpose of issuing vesting order for transfer and vesting of all valid rights, approvals, clearances, licences and the like in accordance with sub section (1) of section 8B" shall be substituted,

Rule 9A (5); It shall be lawful for the new lessee to commence and continue mining operation on the land in which mining operations were being carried out by the pervious lessee, after the execution of the lease deed till expiry or termination of mining lease granted."

And whereas, the Director of Mines vide letter No.10120/DM dated 22.12.2021 has proposed to issue the modified vesting and transfer order in respect of Narayanposhi Iron & Manganese mining lease.

Now therefore, in partial modification of the orders as communicated vide vesting orders No.4212/SM dated 30.05.2020, No.9815/SM dated 13.11.2020 & No.462/SM dated 13.01.2021, the undersigned being the Nodal Officer for the State of Odisha having been nominated under rule 9A(1) of the Mineral (Other than Atomic and Hydrocarbon Energy Minerals) Concessions Rules, 2016 (herein after called the Rules 2016), do hereby, pursuant to the provisions contained in rule 9A(2) of the Rules, 2016 issue this order that all the valid rights, approvals, clearances, licences and the like vested in the previous lessee in respect of the aforementioned mining block are now deemed to have been vested and transferred in favour of the holder of the letter of intent on the same terms and conditions of every rights, approvals, clearances, licences and the like which vested with previous lessee till expiry or termination of mining lease granted.

15/2/2022

(Sri Deepak Mohanty)
Nodal Officer & OSD-cum-Special Secretary to Government

Memo No. 1336 **/ SM** **Dated:** 15.02.2022

Copy to forwarded to M/s JSW Steel Ltd, JSW Centre, Bandra Kurla Complex, Bandra (East), Mumbai-400051 for information and necessary action.

15/2/2022

Nodal Officer

Memo No. 1337 **/ SM** **Date:** 15.02.2022.

Copy forwarded to Director of Mines, Odisha, Bhubaneswar for information and necessary action.

15/2/2022

Nodal Officer

Memo No. 1338 **/ SM** **Date:** 15.02.2022

Copy forwarded to Collector, Sundergarh / DFO,Bonai / Deputy Director of Mines, Koira for information and necessary action.

15/2/2022

Nodal Officer

Memo No. 1339 **/ SM** **Date:** 15.02.2022

Copy forwarded to Forest and Environment Department / PCCF(Nodal), Bhubaneswar / Regional Controller of Mines, Indian Bureau of Mines, Bhubaneswar for information and necessary action.

15/2/2022

Nodal Officer

ANNEXURE XXXIV

By Speed Post/ e-mail

GOVERNMENT OF ODISHA

FOREST, ENVIRONMENT & CLIMATE CHANGE DEPARTMENT

*****

No.FE-DIV-FLD-0067-2022- 17050 /FE&CC, Date 22.09.22

10F (Cons) 135/2015

From

Sri Lingaraj Otta,

OSD-cum-Special Secretary to Government

To

The Principal Chief Conservator of Forests & HoFF, Odisha,

Bhubaneswar.

Sub: Transfer of FC approval granted under the Forest (Conservation) Act, 1980 for mining lease from Old Lessee M/s AMTC (P) Ltd. to New Lessee M/s JSW Steel Ltd. as per the provision of the Mines and Minerals (Development and Regulation) Amendment Act, 2021 in respect of Narayanposhi Iron & Manganese Ore Block under Bonai Forest Division, Koira Tahasil, Sundargarh District for diversion of 244.327 ha of forest land-Compliance of Final approval order regarding.

Sir,

I am directed to invite a reference to your letter No.14351/9F(MG)-29/2022 dtd.21.07.2022, seeking transfer of FC approval granted under the Forest (Conservation) Act, 1980 for mining lease from Old Lessee M/s AMTC (P) Ltd. to New Lessee M/s JSW Steel Ltd. as per the provision of the Mines and Minerals (Development and Regulation) Amendment Act, 2021 in respect of Narayanposhi Iron & Manganese Ore Block under Bonai Forest Division, Koira Tahasil, Sundargarh District for diversion of 244.327 ha of forest land and with reference to letter File No.FC-11/112/2020-FC (Pt) dtd.07.07.2021 of Govt. of India, MoEF&CC, FC Division, New Delhi.

After careful consideration of the proposal of PCCF & HoFF, Odisha and in pursuance of the guidelines issued by Govt. of India, MoEF&CC vide File No. FC-11/112/2020-FC (Pt) Dated 7th July, 2021, the transfer of approval granted by Govt. of India, Ministry of Environment & Forests under Section-2 of the Forest (Conservation) Act, 1980 vide Letter F.No.8-34/2000-FC (Vol-I) dtd.15.11.2007 with additional condition imposed by Govt. of India, MoEF, Eastern Regional Office in their letter No.8(21)3/2000-

FCE dtd.12.12.2007 from the erstwhile User Agency M/s AMTC (P) Ltd. to the new lessee M/s JSW Steel Ltd. is hereby accorded by the State Govt. for non-forestry use of 184.59 ha (out of 238.201 ha eligible diverted forest land as per the land scheduled of new Mining Lease) of forest land for mining in Narayanposhi Iron and Manganese Block under Bonai Forest Division, Koira Tahasil, Dist-Sundargarh, Odisha subject to fulfilment of the following conditions.

i. DGPS Survey and demarcation of 184.591 ha part diverted forest area shall be done by the User Agency and the same may be ensured by DFO, Bonai Forest Division in the field before handing over the said area.
ii. The DFO, Bonai Forest Division shall upload the KML files of the area under diversion and the non-forest land for Compensatory Afforestation in the E-Green Watch portal of FSI before handing over forest land to the new lessee.
iii. Old lessee has deposited the NPV over 259.191 ha forest area (as per old mining lease) which includes the NPV of diverted forest area of 244.327 ha. The amount deposited by the new lessee @ Rs.7.50 Lakh per ha is the lumpsum amount realized by State Government on issue of LoI (for the total forest area within the mining lease), which may be adjusted towards balance CA and any compensatory levies payable in future.
iv. The new lessee shall furnish an undertaking to pay the additional NPV, if so determined, as per the decision of the Hon'ble Supreme Court of India.
v. The new lessee shall also comply the non-complied conditions and if any pointed out by the Govt. of India, MoEF&CC, IRO, Bhubaneswar, after conducting the inspection of the area for the appraisal of compliance of approval granted under Forest (Conservation) Act, 1980.
vi. The new lessee, after ceasing mining operation shall undertake re-grassing the mining area and any other areas which may have been disturbed due to their mining activities and restore the land to a condition which is fit for growth of fodder, flora, fauna etc.
vii. Forest Clearance of balance 53.61 ha (238.201 ha – 184.591 ha) diverted forest land will be transferred to the new lessee after providing non-forest CA land and acceptance of CA land by DFO, Bonai Forest Division as per the extant procedure for acceptance of CA land.
viii. The new lessee has to submit the fresh diversion proposal for obtaining approval under Section 2 (ii) of FC Act, 1980 for the balance forest area of 19.25 ha (257.451 ha – 238.201 ha).
ix. Execution of project activities by the new lessee will be subject to availability of all other statutory clearances required under relevant Acts/ Rules for this mining project and compliance of Court's order, if any.

Yours faithfully,

dt 22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17051 /FE&CC, Date 22.09.22

Copy forwarded to the Assistant Inspector General of Forests (FC), Government of India, Ministry of Environment, Forests & Climate Change (F.C. Division), Indira Paryavaran Bhawan, Alinganj, Jor Bagh Road, New Delhi-110003 for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17052 /FE&CC, Date 22.09.22

Copy forwarded to the Deputy Director General of Forests (Central), Govt. of India, MoEF&CC, IRO, A/3, Chandrasekharpur, Bhubaneswar for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17053 /FE&CC, Date 22.09.22

Copy forwarded to the Principal Chief Conservator of Forests (Wildlife) & Chief Wildlife Warden, Odisha/ Chief Conservator of Forests (FD&NO), FC Act, O/o PCCF & HoFF, Odisha for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17054 /FE&CC, Date 22.09.22

Copy forwarded to the Regional Chief Conservator of Forests, Rourkela Circle/ Divisional Forest Officer, Bonai Forest Division for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17055 /FE&CC, Date 22.09.22

Copy forwarded to Steel & Mines Department/ R&DM Department/ Director Environment-cum-Special Secretary to Government, FE&CC Department/ Director of Mines, Odisha/ Member Secretary, SPCB, Odisha/ Collector, Sundargarh for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

Memo No. 17056 /FE&CC, Date 22.09.22

Copy forwarded to the Authorized Signatory, M/s JSW Steel Ltd, Plot No.3, Forest Park, Sishu Bhawan Square, Bhubaneswar-751009 for information and necessary action.

22/9/2022

OSD-cum-Special Secretary to Government

ANNEXURE XXXV

JSW ited

Regd. Office: JSW Centre
BandraKurla Complex,
Bandra (East), Mumbai - 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

Ref. No.- JSW/NP/PAO/1968/23-24

Date: 02-08-2023

To
The Gram Panchayat,
Koira, Sundargarh
Odisha-770048

Sub: - **Submission of Environment Clearance in respect of Narayanposhi Iron and Manganese Mines of M/s JSW Steel Limited.**

Ref. – Environment Clearance Letter No-J-11015/288/2008-IA. II (M), Daled-18/06/2019 issued by MOEF & CC, GOI.

Dear Sir,

We are submitting herewith the **Environment Clearance** in respect of Narayanposhi Iron and Manganese Mines of JSW Steel Limited for your kind perusal.

Kindly Acknowledge the receive.

Thanking you

Yours faithfully,

Mines Manager
Narayanposhi Iron and Manganese Mines
JSW Steel Ltd.

Mines Manager
For JSW Steel Ltd.
Narayan Poshi Iron & Mn. Mines

Received
05/08/2023
SARPANCH
KOIRA G.P.

Scanned with OKEN Scanner

ANNEXURE XXXVI

PARIVESH

(Pro-Active and Responsive Facilitation by Interactive, and Virtuous Environment Single-Window Hub)

Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

File No. : werw

EC Identification No. EC21A001OR114614

Proposal No. IA/OR/MIN/8345/2008

Date:11/12/2021

ACKNOWLEDGEMENT

This is to acknowledge that JSW STEEL LIMITED has been registered in the PARIVESH Portal in respect of transfer of EC vested with previous lessee under the provisions of S.O 2817 (E) dated 13th July , 2021.

Therefore, the prior Environmental Clearance vested with the previous lessee Aryan Mining & Trading Corporation Pvt Ltd. shall be deemed to have been transferred during its validity period in terms of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) as amended by the Mines and Minerals (Development and Regulation) Amendment Act, 2021 (16 of 2021) to the successful bidder of the mining leases (JSW STEEL LIMITED), from the date of commencement of new lease for the remaining validity period (Up to 17/06/2049), subject to comply with all the terms and conditions of the Environmental Clearance granted to previous lessee including non-compliance of EC conditions by the previous lessee, if any,

However, if on verification the Ministry or IRO or SPCB or UTPCC, holds that the information submitted found to be false or misleading at any stage, the transfer of EC shall stand revoked.

Remarks by Member Secretary :- werwef

Report URL is Enclosed below :

http://environmentclearance.nic.in/user/MineLease_FormReport.aspx?pid=155788&status=1

Date: 11/12/2021

(e-signed)
Pankaj Verma
Member Secretary
IA - (Non-Coal Mining sector)

Signature Not Verified
Digitally signed by Pankaj Verma
Director
Date: 12/11/2021 2:14:16 PM

ANNEXURE XXXVII

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

O/C

No. JSW/S/O/2021/94 Date: 08/04/2021

To,
The Member Secretary
State Pollution Control Board, Odisha,
Paribesh Bhawan, A/118, Nilakantha Nagar, Unit-8,
BHUBANESWAR- 751012

Sub: - Request to provide updated or create new CAAQMS Credentials details in the OSPCB, Portal for compliance of CTO Special Condition S. No. 19 & 33 dated 31.03.2021 for **Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd.**

Ref: - Consent Order No 2944 vide letter no 5453/IND-I-CON-2258 dated 31.03.2021.

Dear Sir,

With reference to aforesaid subject, we would like to submit that we have installed Three Continuous Ambient Air Quality Monitoring Stations (CAAQMS) and Digital Display Board in consultation with Regional Officer, Rourkela in Narayanposhi Iron & Manganese Ore Mine of M/s JSW Steel Ltd for compliance of CTO Special Condition S. No. 19 & 33. The Locations of the installed CAAQMS and digital display board are as below-

CAAQMS 1. Narayanposi_Mines_Office_AAQMS_01
CAAQMS 2. Narayanposhi_Gate_no_1_AAQMS_02
CAAQMS 3. Narayanposi_Gate_No._2 (New_BabaMath)_AAQMS_03
Digital Display Board- Near Gate No. 6 area

The above three CAAQMS are equipped with data transfer facility to SPCB and we have authorized Phoenix Robotix Pvt. Ltd. (Datoms) for transmitting data to OSPCB and already completed the necessary setup for data transfer from all 3 locations to OSPCB Server. However, the credentials available are in the name of erstwhile lessee i.e. Aryan Mining & Trading Company Ltd.

In view of the above, we humbly request you to **please provide the updated or create new credentials details (like site ID, station name, AES Encryption key, site private key, site public key, server public key etc) of Narayanposhi Iron & Manganese Ore Mine in the name of M/s JSW Steel Ltd** for all three CAAQMS in OSPCB portal for compliance of CTO Special Condition S. No. 19.

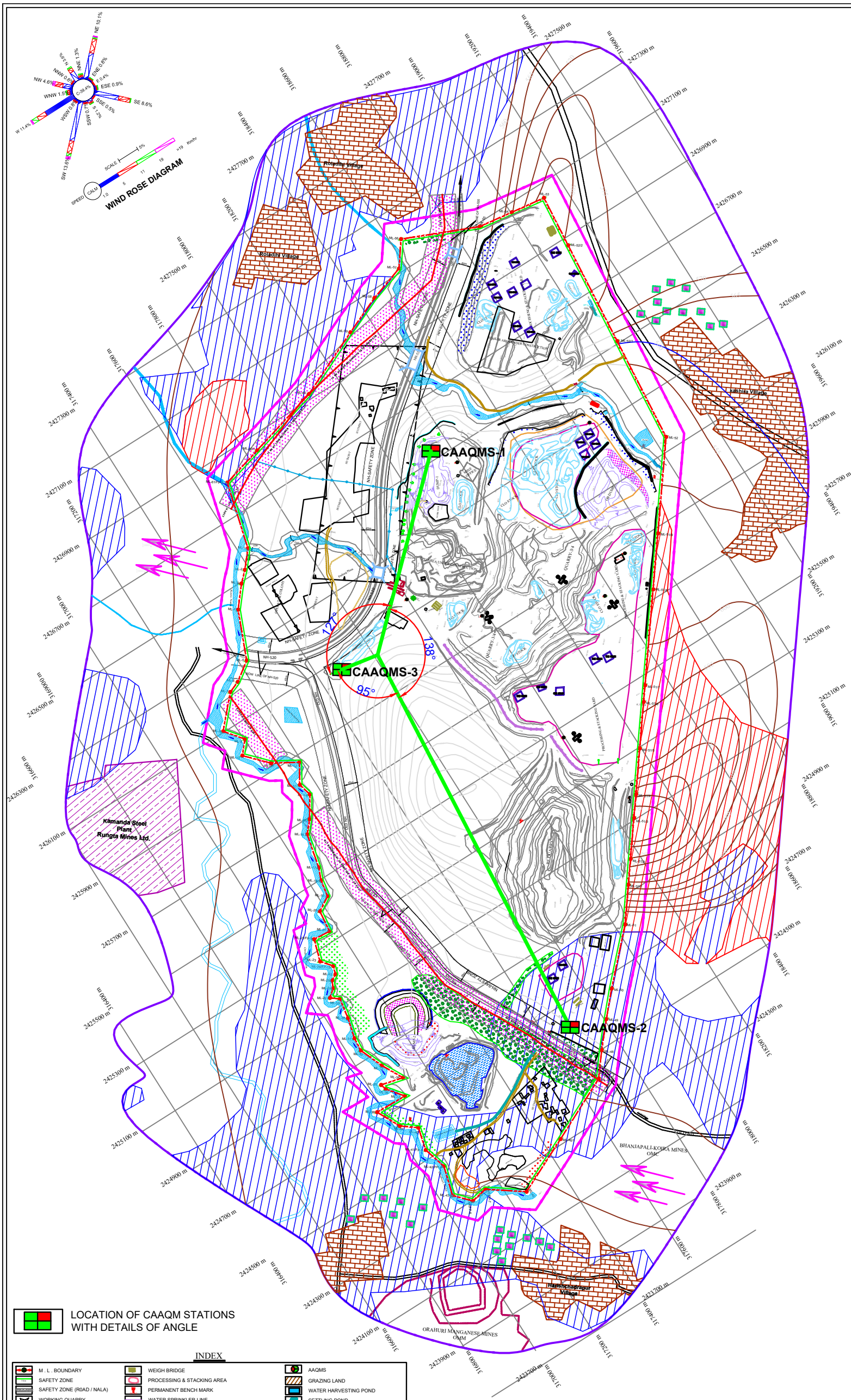
Seeking your co-operation as always.

Thanking you,
Yours Faithfully
For JSW Steel Ltd

Baswaraj M Dalgade
(Authorized Signatory)
Encl: As above

Copy to- The Regional Officer, Regional Office, Rourkela, Office of the State Pollution Control Board, Rourkela Town Engineering Office Premises, Sector – 5, Rourkela – 769 002, Odisha

ANNEXURE XXXVIII



NARAYANPOSHI IRON & MANGANESE MINES

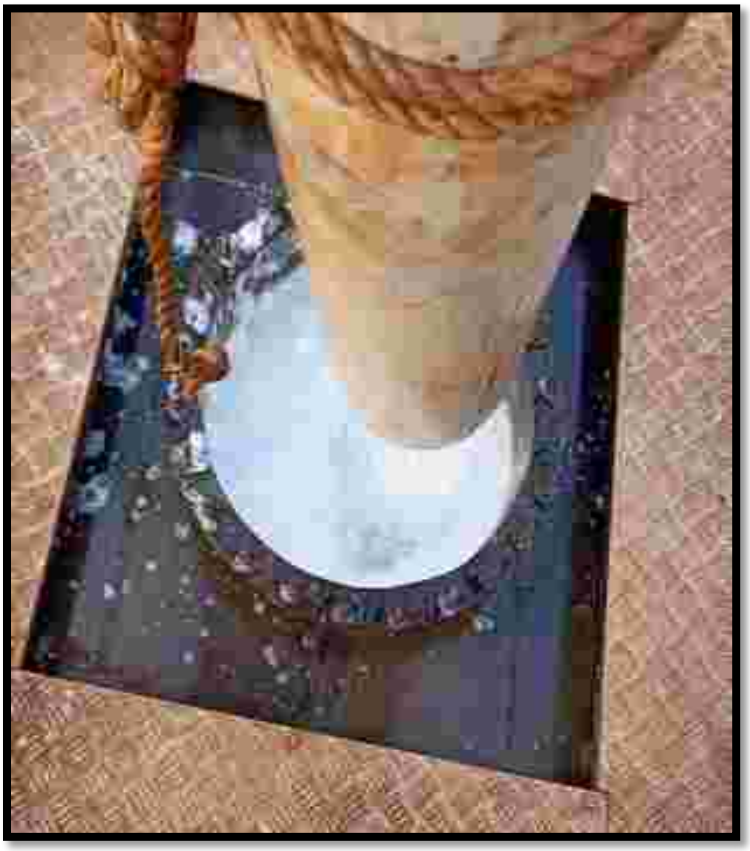
ENVIRONMENT PLAN

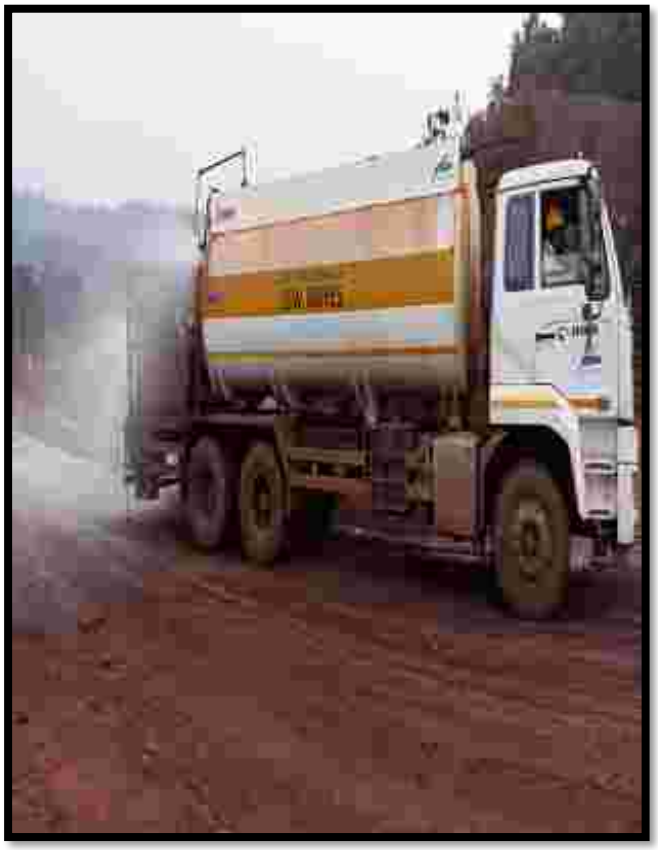
LEASE AREA - 347.008 Ha.	LESSEE: JSW STEEL LTD
VILLAGES - KOIRA & KASHIRA	Certified that the plan is up-date & correct to the best of my knowledge which is based on the true copy of original surface plan.
TEHSIL - KOIRA	
DISTRICT - SUNDARGARH	
STATE - ODISHA	
DATE OF SURVEY - 01/12/2023	
SCALE = 5000 : 1	SURVEYOR MINES MANAGER

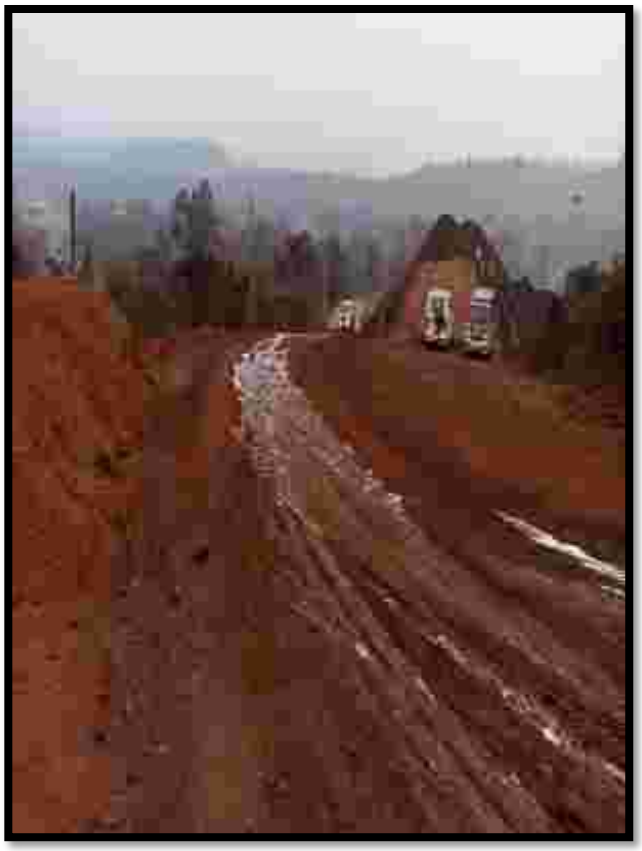
ANNEXURE XXXIX

ANNEXURE IV

DUST SUPPRESSION USING CHEMICAL SURFACTANTS







ANNEXURE XL

JSW STEEL LIMITED

NAME OF THE MINE: **NARAYANPOSHI IRON ORE MINE**

MONTH: **AUGUST 2024**

DESCRIPTION OF WORK: **MINES RUN OFF**

ECOMEN MINING PVT. LTD.
LUCKNOW

Ecomen Mining Pvt. Ltd.
MoEF & CC Approved, NABET & NABL Accredited Consultancy Organization
CIN : 07421989PTC016O / GST : 21AAACE6076H1ZW
PLOT NO. 868, UNIT NO. 1 MOUZA, BANEIKALA BASTI, BANEIKALA, JODA, BANEIKALA, BLOCK CHAKKA, KENDUJHAR, ODISHA KEONJHAR-758038
+91 080 29533368
info@ecomen.in
www.ecomen.in

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Manganese Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/W/0007/0497/08/2024**
		Issue Date of Test Report	**09.09.2024**
Type of Sample	Water		
Sample Registration No.	007	**Name of Location**	Mine Runoff Water Haulage Road
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Lab Team
Date of Sample Collection	09.08.2024	**Time of Sample Collection**	-
Date of Sample Received	15.08.2024	**Time of Sample Received**	10:30 AM
Start Date of Analysis	16.08.2024	**End Date of Analysis**	30.08.2024
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-78% RH	**Sample ID Code**	ECO/LAB/0497/08/2024

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as IS-2296(C)
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	20.0	5-100	300
2.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	6.92	2.0 -12	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	42.22	5 - 5000	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	264.0	5 - 5000	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	APHA, 23rd Ed. : 2017, 5210 A+B	14.0	1 -1000	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 23rd Ed. 2017, 5220 A+C	122.0	1-1000	-
7.	Oil & Grease as O&G	mg/l	APHA, 23rd Ed. 2017, 5520 A+D	6.11	5-600	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 23rd Ed. : 2017, 4500 A+C	4.62	1 -15	4
9.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	20.0	5-1000	600
10.	Sulfate as SO4	mg/l	APHA, 23rd Ed. 2017, 4500-SO42- E	26.0	1.0 -250	400
11.	Nitrate Nitrogen as NO3	mg/l	APHA, 23rd Ed. 2017, 4500-NO3- B	7.20	5.0 - 100	50
12.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.30	0.05-10	1.5
13.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	2.34	0.02-50	50.0
14.	Arsenic as As	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-2	0.2
15.	Hexavalent Chromium as Cr+6	mg/l	APHA, 23rd Ed. : 2017,3111 A+B	BDL	0.05-20	0.05
16.	Copper as Cu	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.05-5	1.5
17.	Zinc as Zn	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	0.11	0.02-50	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 23rd Ed. : 2017, 5530 A+C	BDL	0.05 - 10	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	1.0
20.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.05
21.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 ,CN A+D	BDL	0.005-5	0.05
22.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.1
23.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.01

Statement of Conformity: The above tested parameters confirm as per **INDIAN STANDARDS as IS-2296(C)** limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By
Technical Manager

Authorized By
Quality Manager

Ecomen Mining Pvt. Ltd.
MoEF & CC Approved, NABET & NABL Accredited Consultancy Organization
CIN : 07421989PTC016O / GST : 21AAACE6076H1ZW
PLOT NO. 868, UNIT NO. 1 MOUZA,BANEIKALA BASTI, BANEIKALA, JODA,BANEIKALA, BLOCK CHAKKA,KENDUJHAR, ODISHA KEONJHAR-758038
+91 080 29533368
info@ecomen.in
www.ecomen.in

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Manganese Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/W/0007/0498/08/2024**
		Issue Date of Test Report	**09.09.2022**
Type of Sample	Water		
Sample Registration No.	007	**Name of Location**	Mine Runoff Workshop
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Lab Team
Date of Sample Collection	09.08.2024	**Time of Sample Collection**	-
Date of Sample Received	15.08.2024	**Time of Sample Received**	10:30 AM
Start Date of Analysis	16.08.2024	**End Date of Analysis**	30.08.2024
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-78% RH	**Sample ID Code**	ECO/LAB/0498/08/2024

S. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as IS-2296(C)
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	20.0	5-100	300
2.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	7.0	2.0 -12	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	32.0	5 - 5000	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	260.0	5 - 5000	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	APHA, 23rd Ed. : 2017, 5210 A+B	20.0	1 -1000	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 23rd Ed. 2017, 5220 A+C	132.0	1-1000	-
7.	Oil & Grease as O&G	mg/l	APHA, 23rd Ed. 2017, 5520 A+D	6.56	5-600	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 23rd Ed. : 2017, 4500 A+C	5.2	1 -15	4
9.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	18.0	5-1000	600
10.	Sulfate as SO4	mg/l	APHA, 23rd Ed. 2017, 4500-SO42- E	28.0	1.0 -250	400
11.	Nitrate Nitrogen as NO3	mg/l	APHA, 23rd Ed. 2017, 4500-NO3- B	7.12	5.0 - 100	50
12.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.16	0.05-10	1.5
13.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	1.26	0.02-50	50.0
14.	Arsenic as As	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-2	0.2
15.	Hexavalent Chromium as Cr+6	mg/l	APHA, 23rd Ed. : 2017,3111 A+B	BDL	0.05-20	0.05
16.	Copper as Cu	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.05-5	1.5
17.	Zinc as Zn	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.02-50	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 23rd Ed. : 2017, 5530 A+C	BDL	0.05 - 10	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	1.0
20.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.05
21.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 ,CN A+D	BDL	0.005-5	0.05
22.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.1
23.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.01

Statement of Conformity: The above tested parameters confirm as per **INDIAN STANDARDS as IS-2296(C)** limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By
Technical Manager

Authorized By
Quality Manager

Ecomen Mining Pvt. Ltd.
MoEF & CC Approved, NABET & NABL Accredited Consultancy Organization
CIN : 07421989PTC016O / GST : 21AAACE6076H1ZW
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+91 080 29533368
info@ecomen.in
www.ecomen.in

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Manganese Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/W/0007/0499/08/2024**
		Issue Date of Test Report	**09.09.2024**
Type of Sample	Water		
Sample Registration No.	007	**Name of Location**	Mine Runoff Water Mines Office
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Lab Team
Date of Sample Collection	09.08.2024	**Time of Sample Collection**	-
Date of Sample Received	15.08.2024	**Time of Sample Received**	10:30 AM
Start Date of Analysis	16.08.2024	**End Date of Analysis**	30.08.2024
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-78% RH	**Sample ID Code**	ECO/LAB/0499/08/2024

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as IS-2296(C)
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	15.0	5-100	300
2.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	7.28	2.0 -12	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	62.0	5 - 5000	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	323.0	5 - 5000	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	APHA, 23rd Ed. : 2017, 5210 A+B	14.0	1 -1000	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 23rd Ed. 2017, 5220 A+C	143.0	1-1000	-
7.	Oil & Grease as O&G	mg/l	APHA, 23rd Ed. 2017, 5520 A+D	5.6	5-600	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 23rd Ed. : 2017, 4500 A+C	5.0	1 -15	4
9.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	20.2	5-1000	600
10.	Sulfate as SO4	mg/l	APHA, 23rd Ed. 2017, 4500-SO42- E	24.8	1.0 -250	400
11.	Nitrate Nitrogen as NO3	mg/l	APHA, 23rd Ed. 2017, 4500-NO3- B	6.2	5.0 - 100	50
12.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.24	0.05-10	1.5
13.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	0.48	0.02-50	50.0
14.	Arsenic as As	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-2	0.2
15.	Hexavalent Chromium as Cr+6	mg/l	APHA, 23rd Ed. : 2017,3111 A+B	BDL	0.05-20	0.05
16.	Copper as Cu	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.05-5	1.5
17.	Zinc as Zn	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	0.12	0.02-50	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 23rd Ed. : 2017, 5530 A+C	BDL	0.05 - 10	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	1.0
20.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.05
21.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 ,CN A+D	BDL	0.005-5	0.05
22.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.1
23.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.01

Statement of Conformity: The above tested parameters confirm as per **INDIAN STANDARDS as IS-2296(C)** limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By
Technical Manager

Authorized By
Quality Manager

Ecomen Mining Pvt. Ltd.
MoEF & CC Approved, NABET & NABL Accredited Consultancy Organization
CIN : 07421989PTC016O / GST : 21AAACE6076H1ZW
PLOT NO. 868, UNIT NO. 1 MOUZA,BANEIKALA BASTI, BANEIKALA, JODA,BANEIKALA, BLOCK CHAKKA,KENDUJHAR, ODISHA KEONJHAR-758038
+91 080 29533368
info@ecomen.in
www.ecomen.in

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron Manganese Ore Mines of M/s JSW Steel Ltd.**	**Test Report No.**	**ECOLAB/W/0007/0500/08/2024**
		Issue Date of Test Report	**09.09.2024**
Type of Sample	Water		
Sample Registration No.	007	**Name of Location**	Mine Runoff Water Loading Point
Sampling Method	As per Reference Method	**Sample Collected By**	Ecomen Lab Team
Date of Sample Collection	09.08.2024	**Time of Sample Collection**	-
Date of Sample Received	15.08.2024	**Time of Sample Received**	10:30 AM
Start Date of Analysis	16.08.2024	**End Date of Analysis**	30.08.2024
Laboratory Environmental Condition	Temperature: 25 ± 5 °C	**Sample Quantity**	As per Requirement
	Humidity: 30-78% RH	**Sample ID Code**	ECO/LAB/0500/08/2024

Sl. No.	TESTS	Unit	PROTOCOL	RESULT	Detection Range	INDIAN STANDARDS as IS-2296(C)
1.	Colour	Hazen	APHA, 23rd Ed. 2017, 2120 B	15.0	5-100	300
2.	pH	-	APHA, 23rd Ed. 2017, 4500H+ A+B	7.06	2.0 -12	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 23rd Ed. 2017, 2540-C	34.0	5 - 5000	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 23rd Ed. 2017, 2540-C	324.0	5 - 5000	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	APHA, 23rd Ed. : 2017, 5210 A+B	16.0	1 -1000	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 23rd Ed. 2017, 5220 A+C	106.0	1-1000	-
7.	Oil & Grease as O&G	mg/l	APHA, 23rd Ed. 2017, 5520 A+D	BDL	5-600	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 23rd Ed. : 2017, 4500 A+C	5.4	1 -15	4
9.	Chloride as Cl	mg/l	APHA, 23rd Ed. 2017, 4500 Cl A+B	28.4	5-1000	600
10.	Sulfate as SO4	mg/l	APHA, 23rd Ed. 2017, 4500-SO42- E	32.0	1.0 -250	400
11.	Nitrate Nitrogen as NO3	mg/l	APHA, 23rd Ed. 2017, 4500-NO3- B	7.98	5.0 - 100	50
12.	Fluorides as F	mg/l	APHA, 23rd Ed. 2017, 4500-C	0.18	0.05-10	1.5
13.	Iron as Fe	mg/l	APHA, 23rd Ed. 2017, 3500 Fe B	1.67	0.02-50	50.0
14.	Arsenic as As	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-2	0.2
15.	Hexavalent Chromium as Cr+6	mg/l	APHA, 23rd Ed. : 2017,3111 A+B	BDL	0.05-20	0.05
16.	Copper as Cu	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.05-5	1.5
17.	Zinc as Zn	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	0.10	0.02-50	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 23rd Ed. : 2017, 5530 A+C	BDL	0.05 - 10	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 23rd Ed. 2017, 5540 A+C	BDL	0.01-5	1.0
20.	Selenium as Se	mg/l	APHA, 23rd Ed. : 2017, 3500 Se A+C	BDL	0.02-10	0.05
21.	Cyanide as CN	mg/l	APHA,23rd Ed.2017, 4500 ,CN A+D	BDL	0.005-5	0.05
22.	Lead as Pb	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.01-1	0.1
23.	Cadmium as Cd	mg/l	APHA, 23rd Ed. : 2017, 3111 A+B	BDL	0.002-2	0.01

Statement of Conformity: The above tested parameters confirm as per **INDIAN STANDARDS as IS-2296(C)** limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit

Verified By
Technical Manager

Authorized By
Quality Manager

JSW STEEL LIMITED

NAME OF THE MINE: **NARAYANPOSHI IRON ORE MINE**

MONTH: **SEPTEMBER 2024**

DESCRIPTION OF WORK: **MINES RUN OFF**

ECOMEN MINING PVT. LTD.
LUCKNOW

ecoMen

ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746262
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI

TC-12731

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron & Manganese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400000439F**
		Test Report No.	**ECO/LAB/SW/0092/0439/09/2024**
		Issue Date of Test Report	**08.10.2024**
Type of Sample	Surface Water		
Sample Registration No.	0092	**Name of Location**	Mine Runoff Crusher Area
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	16.09.2024	**Time of Sample Collection**	-
Date of Sample Received	16.09.2024	**Time of Sample Received**	05:30 PM
Start Date of Analysis	16.09.2024	**End Date of Analysis**	08.10.2024
Laboratory Environmental Condition	Temperature: 27 ± 2 °C	**Sample Quantity**	As Per Requirement
	Humidity: 53 %	**Sample ID Code**	ECO/LAB/0439/09/2024

S. No.	TESTS	Unit	PROTOCOL	DETECTION RANGE	RESULT	INDIAN STANDARDS as IS-2296 (C)
1.	Colour	Hazen	APHA, 24rd Ed.2017,2120 B	5 -100	30.0	300
2.	pH	-	APHA, 24rd Ed.2017,4500H+A+B	2 - 12	7.34	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 24rd Ed.2017,2540D	5-5000	45.0	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 24rd Ed.2017,2540-C	5 - 5000	303.0	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	IS-3025 Part-44,1993	1 -1000	2.8	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 24rd Ed.2017, 5220 A+C	1-1000	12	-
7.	Oil & Grease as O&G	mg/l	APHA, 24rd Ed.2017,5520 A+D	5-600	BDL	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 24rd Ed.2017,4500 A+C	1 -15	5.1	4
9.	Chloride as Cl	mg/l	APHA, 24rd Ed.2017,4500 Cl A+B	5 - 1000	28.0	600
10.	Sulphate as SO_4	mg/l	APHA, 24rd Ed.2017,4500-SO42- E	1 - 250	25.5	400
11.	Nitrate Nitrogen as NO_3	mg/l	APHA, 24rd Ed.2017,4500-NO3 2- E	5 - 100	12.5	50
12.	Fluoride as F	mg/l	APHA, 24rd Ed.2017, 4500-C	0.05 -10	0.45	1.5
13.	Iron as Fe	mg/l	APHA, 24rd Ed.2017, 3500 Fe B	0.02-50	0.20	50.0
14.	Arsenic as As	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-2	BDL	0.2
15.	Hexavalent Chromium as Cr^{+6}	mg/l	APHA,24th Ed. : 2023, 3111 A+B	0.05-20	BDL	0.05
16.	Copper as Cu	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.05-5	BDL	1.5
17.	Zinc as Zn	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.02-50	0.10	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 24rd Ed.2017,5530 A+C	0.05 - 10	BDL	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 24rd Ed.2017,5540 A+C	0.01-5	BDL	1.0
20.	Lead as Pb	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-1	BDL	0.1
21.	Cadmium as Cd	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.002-2	BDL	0.01
22.	Total coliform	MPN /100 ml	APHA, 24rd Ed.2017,9221 A+B	1.8	190.0	5000

Statement of Conformity: The above tested parameters confirm as per IS-2296 Class-C limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746262
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1989PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12731

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron & Manganese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400000440F**
		Test Report No.	**ECO/LAB/SW/0092/0440/09/2024**
		Issue Date of Test Report	**08.10.2024**
Type of Sample	Surface Water		
Sample Registration No.	0092	**Name of Location**	Mine Runoff Haulage Road
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	16.09.2024	**Time of Sample Collection**	-
Date of Sample Received	16.09.2024	**Time of Sample Received**	05:30 PM
Start Date of Analysis	16.09.2024	**End Date of Analysis**	08.10.2024
Laboratory Environmental Condition	Temperature: 27 ± 2 °C	**Sample Quantity**	As Per Requirement
	Humidity: 53 %	**Sample ID Code**	ECO/LAB/0440/09/2024

S. No.	TESTS	Unit	PROTOCOL	DETECTION RANGE	RESULT	INDIAN STANDARDS as IS-2296 (C)
1.	Colour	Hazen	APHA, 24rd Ed.2017,2120 B	5 -100	25.0	300
2.	pH	-	APHA, 24rd Ed.2017,4500H+A+B	2 - 12	7.68	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 24rd Ed.2017,2540D	5-5000	31.0	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 24rd Ed.2017,2540-C	5 - 5000	289.0	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	IS-3025 Part-44,1993	1 -1000	3.0	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 24rd Ed.2017, 5220 A+C	1-1000	16	-
7.	Oil & Grease as O&G	mg/l	APHA, 24rd Ed.2017,5520 A+D	5-600	BDL	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 24rd Ed.2017,4500 A+C	1 -15	5.8	4
9.	Chloride as Cl	mg/l	APHA, 24rd Ed.2017,4500 Cl A+B	5 - 1000	18.0	600
10.	Sulphate as SO_4	mg/l	APHA, 24rd Ed.2017,4500-SO42- E	1 - 250	12.5	400
11.	Nitrate Nitrogen as NO_3	mg/l	APHA, 24rd Ed.2017,4500-NO3 2- E	5 - 100	8.50	50
12.	Fluoride as F	mg/l	APHA, 24rd Ed.2017, 4500-C	0.05 -10	0.39	1.5
13.	Iron as Fe	mg/l	APHA, 24rd Ed.2017, 3500 Fe B	0.02-50	0.21	50.0
14.	Arsenic as As	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-2	BDL	0.2
15.	Hexavalent Chromium as Cr^{+6}	mg/l	APHA,24th Ed. : 2023, 3111 A+B	0.05-20	BDL	0.05
16.	Copper as Cu	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.05-5	BDL	1.5
17.	Zinc as Zn	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.02-50	0.10	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 24rd Ed.2017,5530 A+C	0.05 - 10	BDL	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 24rd Ed.2017,5540 A+C	0.01-5	BDL	1.0
20.	Lead as Pb	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-1	BDL	0.1
21.	Cadmium as Cd	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.002-2	BDL	0.01
22.	Total coliform	MPN /100 ml	APHA, 24rd Ed.2017,9221 A+B	1.8	110.0	5000

Statement of Conformity: The above tested parameters confirm as per IS-2296 Class-C limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
Phone No. : 0522 - 4079201/2746262
E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1988PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12731

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron & Manganese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400000441F**
		Test Report No.	**ECO/LAB/SW/0092/0441/09/2024**
		Issue Date of Test Report	**08.10.2024**
Type of Sample	Surface Water		
Sample Registration No.	0092	**Name of Location**	Mine Runoff screen plant area
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	16.09.2024	**Time of Sample Collection**	-
Date of Sample Received	16.09.2024	**Time of Sample Received**	05:30 PM
Start Date of Analysis	16.09.2024	**End Date of Analysis**	08.10.2024
Laboratory Environmental Condition	Temperature: 27 ± 2 °C	**Sample Quantity**	As Per Requirement
	Humidity: 53 %	**Sample ID Code**	ECO/LAB/0441/09/2024

S. No.	TESTS	Unit	PROTOCOL	DETECTION RANGE	RESULT	INDIAN STANDARDS as IS-2296 (C)
1.	Colour	Hazen	APHA, 24rd Ed.2017,2120 B	5 -100	15.0	300
2.	pH	-	APHA, 24rd Ed.2017,4500H+A+B	2 - 12	7.39	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 24rd Ed.2017,2540D	5-5000	21.0	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 24rd Ed.2017,2540-C	5 - 5000	244.0	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	IS-3025 Part-44,1993	1 -1000	2.6	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 24rd Ed.2017, 5220 A+C	1-1000	12	-
7.	Oil & Grease as O&G	mg/l	APHA, 24rd Ed.2017,5520 A+D	5-600	BDL	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 24rd Ed.2017,4500 A+C	1 -15	5.9	4
9.	Chloride as Cl	mg/l	APHA, 24rd Ed.2017,4500 Cl A+B	5 - 1000	28.0	600
10.	Sulphate as SO_4	mg/l	APHA, 24rd Ed.2017,4500-SO42- E	1 - 250	22.5	400
11.	Nitrate Nitrogen as NO_3	mg/l	APHA, 24rd Ed.2017,4500-NO3 2- E	5 - 100	7.5	50
12.	Fluoride as F	mg/l	APHA, 24rd Ed.2017, 4500-C	0.05 -10	0.42	1.5
13.	Iron as Fe	mg/l	APHA, 24rd Ed.2017, 3500 Fe B	0.02-50	0.21	50.0
14.	Arsenic as As	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-2	BDL	0.2
15.	Hexavalent Chromium as Cr^{+6}	mg/l	APHA,24th Ed. : 2023, 3111 A+B	0.05-20	BDL	0.05
16.	Copper as Cu	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.05-5	BDL	1.5
17.	Zinc as Zn	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.02-50	0.09	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 24rd Ed.2017,5530 A+C	0.05 - 10	BDL	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 24rd Ed.2017,5540 A+C	0.01-5	BDL	1.0
20.	Lead as Pb	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-1	BDL	0.1
21.	Cadmium as Cd	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.002-2	BDL	0.01
22.	Total coliform	MPN /100 ml	APHA, 24rd Ed.2017,9221 A+B	1.8	170.0	5000

Statement of Conformity: The above tested parameters confirm as per IS-2296 Class-C limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

Verified By
Technical Manager

Authorized By
Quality Manager

ECOMEN MINING PVT. LTD
(Formerly known as Ecomen Laboratories Pvt. Ltd.)
Second Floor Hall, House No. B-1/8, Sector-H, Aliganj, Lucknow - 226 024
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E-mail: contactus@ecomen.in, Website: www.ecomen.in, CIN - U74210UP1988PTC010601, GSTIN : 09AAACE6076H1ZI
TC-12731

TEST REPORT

FORMAT NO. ECO/QS/FORMAT/07

NAME & ADDRESS OF CUSTOMER:	**Narayanposhi Iron & Manganese Ore Mines M/s JSW Steel Ltd.**	**ULR No.**	**TC127512400000442F**
		Test Report No.	**ECO/LAB/SW/0092/0442/09/2024**
		Issue Date of Test Report	**08.10.2024**
Type of Sample	Surface Water		
Sample Registration No.	0092	**Name of Location**	Mine Runoff View Point Area Road
Sampling Method	APHA	**Sample Collected By**	EMPL Representative
Date of Sample Collection	16.09.2024	**Time of Sample Collection**	-
Date of Sample Received	16.09.2024	**Time of Sample Received**	05:30 PM
Start Date of Analysis	16.09.2024	**End Date of Analysis**	08.10.2024
Laboratory Environmental Condition	Temperature: 27 ± 2 °C	**Sample Quantity**	As Per Requirement
	Humidity: 53 %	**Sample ID Code**	ECO/LAB/0442/09/2024

S. No.	TESTS	Unit	PROTOCOL	DETECTION RANGE	RESULT	INDIAN STANDARDS as IS-2296 (C)
1.	Colour	Hazen	APHA, 24rd Ed.2017,2120 B	5 -100	20	300
2.	pH	-	APHA, 24rd Ed.2017,4500H+A+B	2 - 12	7.52	6.5-8.5
3.	Total Suspended Solids as TSS	mg/l	APHA, 24rd Ed.2017,2540D	5-5000	34.0	-
4.	Total Dissolved Solids as TDS	mg/l	APHA, 24rd Ed.2017,2540-C	5 - 5000	254.0	1500
5.	Biochemical Oxygen Demand as BOD	mg/l	IS-3025 Part-44,1993	1 -1000	2.8	3.0
6.	Chemical Oxygen Demand as COD	mg/l	APHA, 24rd Ed.2017, 5220 A+C	1-1000	13	-
7.	Oil & Grease as O&G	mg/l	APHA, 24rd Ed.2017,5520 A+D	5-600	BDL	0.1
8.	Dissolved Oxygen as DO	mg/l	APHA, 24rd Ed.2017,4500 A+C	1 -15	5.5	4
9.	Chloride as Cl	mg/l	APHA, 24rd Ed.2017,4500 Cl A+B	5 - 1000	24.0	600
10.	Sulphate as SO_4	mg/l	APHA, 24rd Ed.2017,4500-SO42- E	1 - 250	20.5	400
11.	Nitrate Nitrogen as NO_3	mg/l	APHA, 24rd Ed.2017,4500-NO3 2- E	5 - 100	7.5	50
12.	Fluoride as F	mg/l	APHA, 24rd Ed.2017, 4500-C	0.05 -10	0.32	1.5
13.	Iron as Fe	mg/l	APHA, 24rd Ed.2017, 3500 Fe B	0.02-50	0.21	50.0
14.	Arsenic as As	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-2	BDL	0.2
15.	Hexavalent Chromium as Cr^{+6}	mg/l	APHA,24th Ed. : 2023, 3111 A+B	0.05-20	BDL	0.05
16.	Copper as Cu	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.05-5	BDL	1.5
17.	Zinc as Zn	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.02-50	0.11	15
18.	Phenolic Compound as C_6H_5OH	mg/l	APHA, 24rd Ed.2017,5530 A+C	0.05 - 10	BDL	0.005
19.	Anionic Detergent as MBAS	mg/l	APHA, 24rd Ed.2017,5540 A+C	0.01-5	BDL	1.0
20.	Lead as Pb	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.01-1	BDL	0.1
21.	Cadmium as Cd	mg/l	APHA, 24rd Ed.2017, 3111 A+B	0.002-2	BDL	0.01
22.	Total coliform	MPN /100 ml	APHA, 24rd Ed.2017,9221 A+B	1.8	92.0	5000

Statement of Conformity: The above tested parameters confirm as per IS-2296 Class-C limits for above tested parameters and the results are related to the sample tested.

Note: - BDL- Below Detection Limit.

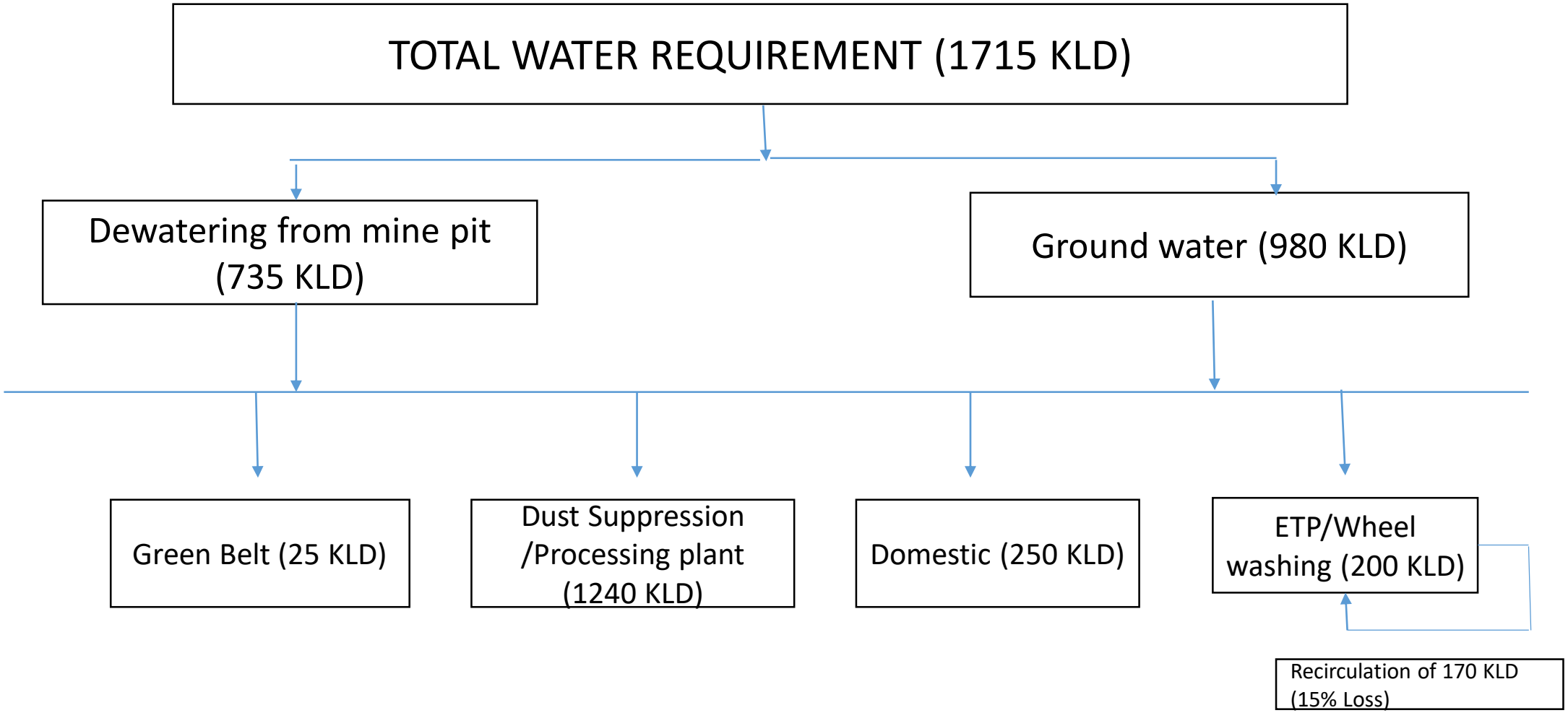
Verified By
Technical Manager

Authorized By
Quality Manager

ANNEXURE XLI

WATER BALANCE DIAGRAM

NARAYANPOSHI IRON & Mn ORE MINES



ANNEXURE XLII

ANNEXURE XV

PLANTATION OF TREES

(i) DUMP PLANTATION













(ii) PLANTATION NEAR NH



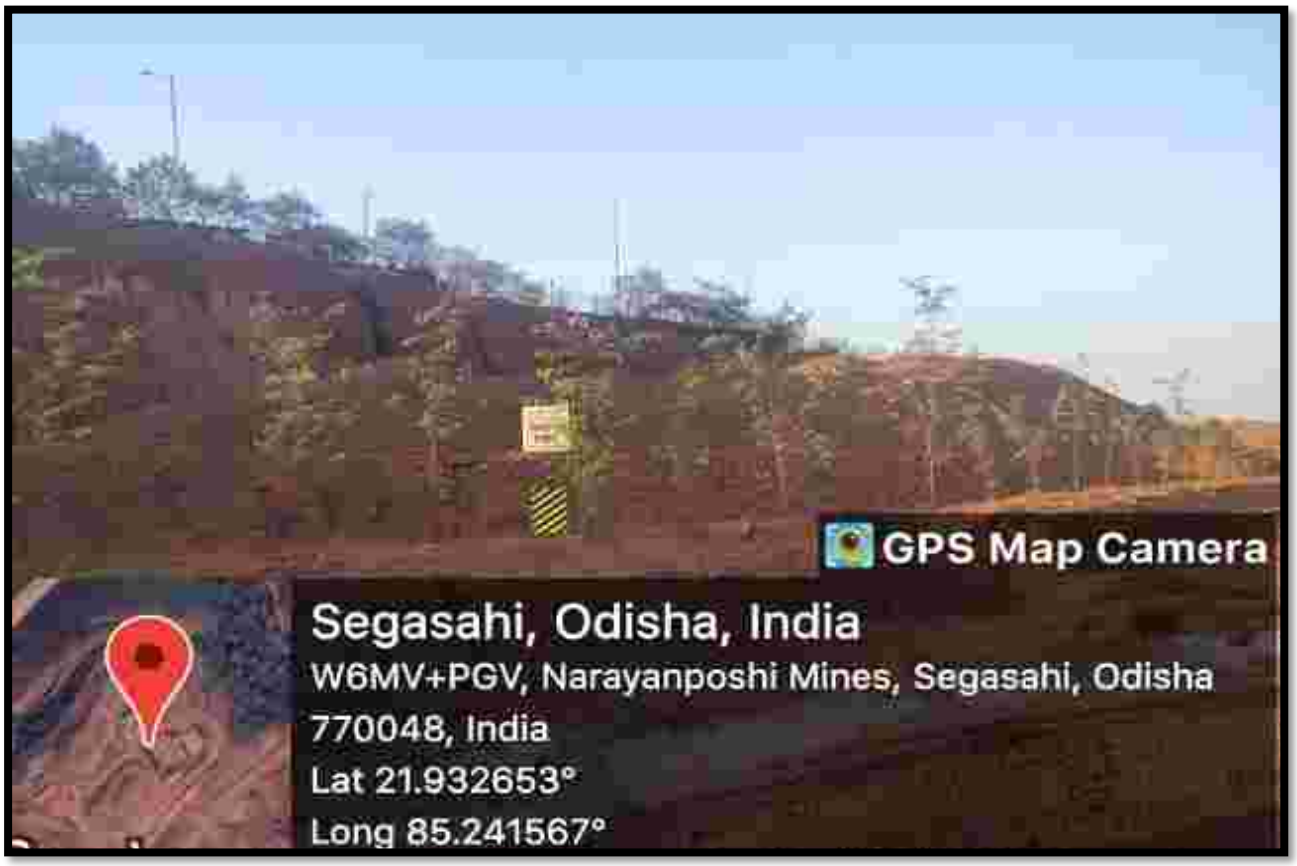






(iii) **PLANTATION OVER THE BERMS**





(iv) **SAFETY ZONE PLANTATION**













ANNEXURE XLIII

OFFICE OF THE PRINCIPAL CCF (WILDLIFE) & CHIEF WILDLIFE WARDEN,ORISSA5TH FLOOR B D A APARTMENT PRAKRUTI BHAWAN NILAKANTHA NAGAR, BHUBANESWAR- 751012

Memo No. 6257 Dt 04.9.2010
1WL-C-SSP- 260/2010

The Chief Conservator of Forests (Nodal),
O/o the Principal CCF, Orissa, Bhubaneswar

Sub: Approval of Site Specific Wildlife Conservation Plan for Iron & Manganese Ore mining in village Koira & Kasira(Narayanposi mines) of Bonai Forest Division in Sundargarh district.

Sir,

I am directed to inform you that the Site Specific Wildlife Conservation Plan for Iron & Manganese Ore mining in village Koira & Kasira (Narayanposi mines) of Bonai Forest Division in Sundargarh district has been approved by PCCF(WL) & Chief Wildlife Warden, Orissa with financial forecast of Rs.288.00 lakhs for the following activities.

1.	For activities in project area	Rs.92.00 lakhs.
2.	For activities in project impact area.	Rs.196.00 lakhs.
	Total	**Rs. 288.00 lakhs**

User Agency will deposit entire amount of Rs.288.00 lakhs with DFO, Bonai Division under CAMPA account for activities to be taken up by the DFO as all the activities both inside the project area and in project impact area are very technical in nature involving habitat management for wildlife. The activities to be executed by DFO, Bonai Division under the guidance of CF, Rourakela.

Conservator of Forests (WL)

Memo No. 6258 dt. 04.9.2010
Copy forwarded to the DFO, Bonai Division for information & necessary action with reference to Memo No. 2870 dt. 26.6.10 of CF., Rourakela Circle.

Conservator of Forests (WL)

Memo No. 6259 Dt. 04.9.2010
Copy forwarded to CF, Rourkela Circle for information & necessary action with reference to his office Memo No. 2868 dt.26.6.10.

Conservator of Forests (WL)

Memo No. 6260 dt. 04.9.2010
Copy forwarded to the Project Proponent for information & necessary action with reference to their letter No.25/PCCF(WL)/10-11 dt. 28.6.10.

Conservator of Forests (WL)

SITE SPECIFIC WILD LIFE CONSERVATION PLAN OF NARAYANPOSHI MINES

The SSWLCP for Narayanposhi Iron & Manganese mine in village Koira and Kasira has been approved by PCCF (WL) with financial forecast of 288 Lakh for following activities

1. For activities in project area : 92 lakh
2. For activities in Project impact area : 196 lakh

Further the total amount was deposited by AMTC in CAMPA account for activities inside the project area & project impact area for activities to be taken up by DFO, Bonai division as the nature of activities are very technical in nature involving habitat management for wildlife.

As per the approved SSWLCP the following activities are to be taken up within the project area

Sl No	**Item of work**	**Amount approved by CWLW (in Lakhs)**
1	Plantation of intimate mixture of food and cover species over 40 ha @ 50 lakh per ha	Dump reclamation and plantation are to be done as per dump reclamation plan for approval by competent authority separately & intimated to us
2	Coir Geo textile over 6 Ha to stabilise steep dumps	
3	Grass seeding over 30 ha	
4	Van Sahayaks	
5	Dust control	Pollution control board to separately approve such proposals
6	Noise/ light pollution control	
7	Garbage disposal	
8	Water pollution control	
9	Creation of water sources in 184 ha of virgin forest area in the ML area as per GoI stage 1& 2 clearance etc	20.00
10	Solar powered fencing – to be done around mining pits to save straying wild animals and not to obstruct wild corridors existing in the mining lease area	15.00
11	Fire incentive to 3 villagers	6.00
12	Habitat improvement in 184 ha. Of virgin forest area as per stage 1 & 2 clearance of GoI with fruit, fodder and cover species for both avi-fauna and other wildlife in the area	25.00
13	Soil and moisture conservation measures in lease hold area to avoid silting of nalas and to revive two nalas originating from the ML area	6.00
14	Distribution of seedling under firm forestry to local villagers to augment fruit, fodder and fuel wood source in the area	6.00
15	Creation of awareness, signages of wildlife, livelihood activities, supplying of various types kits and livelihood training etc.	10.00
16	Unforeseen expenses	4.00
	Total	92.00

As per the approved WLCP the following activities are to be taken up within the project impact area (zone of influence)

Sl No	Item of work	Amount approved by CWLW
1	Habitat improvement measures with fruit fodder and cover species/ bamboo plantation/ meadow development/ ANR/ staggered trenches in forest areas	30.00
2	Creation of water sources in forest areas with wallowing grounds on the down side of spill way by creating muddy and slushy area for wild animals to wallow and gambol	25.00
3	Check dams for random rubble in upper reaches of karo, samij and sarkanda nala and soil and moisture conservation measures in forest areas to avoid chocking of nalas, rivulets and drainage channels	8.00
4	Salt licks = 5 nos	3.00
5	Anti-depredation / anti-poaching squad with hires vehicle/ manpower/ equipment/ barracks/ crackers, megaphone, search lights/ flare guns/ tents and camping equipments for 10 years including engagement of elephant trackers	40.00
6	Equipment for 10 years Flash lights 30 nos Megaphone 15 nos Mobile phone with sim card 5 nos Fire crackers Solar light 25 nos	12.00
7	Corpus fund to meet ex-gratia payment	10.00
8	Creation of fire lines and maintenance of old fire lines/ firefighting equipment/ firefighting squads/ incentive to VSS for prevention of fire as encouragement incentives	11.00
9	a) Check gates = 2 nos = 1.00 b) Remuneration to VSS members = 2 nos = 6.00	7.00
10	Livelihood activities promotion, training, supplying of various kits/ machines/ equipments/ self help groups formation/ micro credit seed money etc.	25.00
11	Awareness promotion, signages for wildlife etc	5.00
12	Biodiversity and animal status monitoring & development of communication network/ GIS based maps satellite maps of GIS domain should be procured every year to know the changing profile of the project area in both dry season and wet season for 10 years preferably using the GIS lab of PCCF(WL), Orissa	15.00
13	Unforeseen and Miscellaneous.	5.00
	Total	196.00
	Grand total	288.00

ANNEXURE XLIV

Occupational Health Centre

JSW, JAJANG
BARBIL, KEONJHAR
REG NO- KEO/00036/2022

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

NARAYANPOSHI IRON AND MANGANESE ORE MINES

Medical Examination

1. After medical examination, it has been found that none of the employee has developed any Persistent Back Pain, Neck Pain, and the movement of their Hip, Knee and other joints have also been found to be normal
2. None of them have found to suffer loss of any body part.
3. It has also been found that no person working within mine lease was suffering from hearing loss.

Dr. Arabinda Satpathy
MBBS, DPHA, DIH, DMCH
Retd, CMO-MCL, Burla
Sambalpur
Regd. No- 12005/BCMR/75

ANNEXURE XLV

JSW Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

NARAYANPOSHI IRON & MANGANESE ORE MINES

SL No.	Commitment Done by AMTC (ex-lessee) during PH	Budget allocated by AMTC	Expenditure by JSW Steel Ltd as on date
1.	Financial provision of Rs. 344.00 lakhs is made for various environmental control measures proposed in this report under capital cost	344 Lakhs	
	a) Air pollution control measures		25 Lakhs
	b) Water pollution control measures		73 Lakhs
	c) Dump management		46 Lakhs
2.	Parking Plaza	15 Lakhs	15 Lakhs
3.	constructing additional 6 new Deep bore Wells	22.5 Lakhs	35 Lakhs
4.	Community Sanitary Toilets and Individual Toilets.	6.5 Lakhs	Proposed in this FY
5.	Education facilities	41 Lakhs	35 Lakhs
6.	School Bus	20 Lakhs	20 Lakhs
7.	Sewing machine and training	18 Lakhs	Proposed in this FY
8.	SHG	18 Lakhs	30 Lakhs
9.	Solar Street Lights	30 Lakhs	15 Lakhs
10.	Upgradation of existing dispensary	47.5 Lakhs	40 Lakhs
11.	Health Clinic Van	20 Lakhs	20 Lakhs

ANNEXURE XLVI

Narayanposhi Environmental Protection Measures Expenditure (head wise breakup)incurred from April 2024 to March 2025

Expenditure Incurred on Environmental Protection Measures for the Financial Year 2024-25		
Sl No	Expenditure head -Particulars	Cost incurred in INR
		Narayanposhi
1	Construction of Retaining walls	540000
2	Construction of Garland drains, desiltation of settling ponds	272160
3	Geotextile works for dump stabilization	795000
5	Greenbelt development- Pit digging, plantation and maintenance	2040920
6	Operation of Road sweeping machines	2040000
7	Operation of fixed sprinklers	50000
8	Operation of mobile sprinklers	11521418
9	Use of chemical dust suppresants in sprinkling	472000
10	Online air quality monitoring	493065.36
11	Environment monitoring through NABL Accredited third party	1069111
12	Installation of Sewage treatment Plant	1975000
13	Study conducted on hydrogeology from CGWA Accredited Agency	410000
14	Nursery Development	-
15	Landscape development	606000
16	Environmental Awareness Programmes	400000
17	Flowmeter calibration and stamping	105000
18	Drip irrigation for plantation	45600
Total		22835274.36

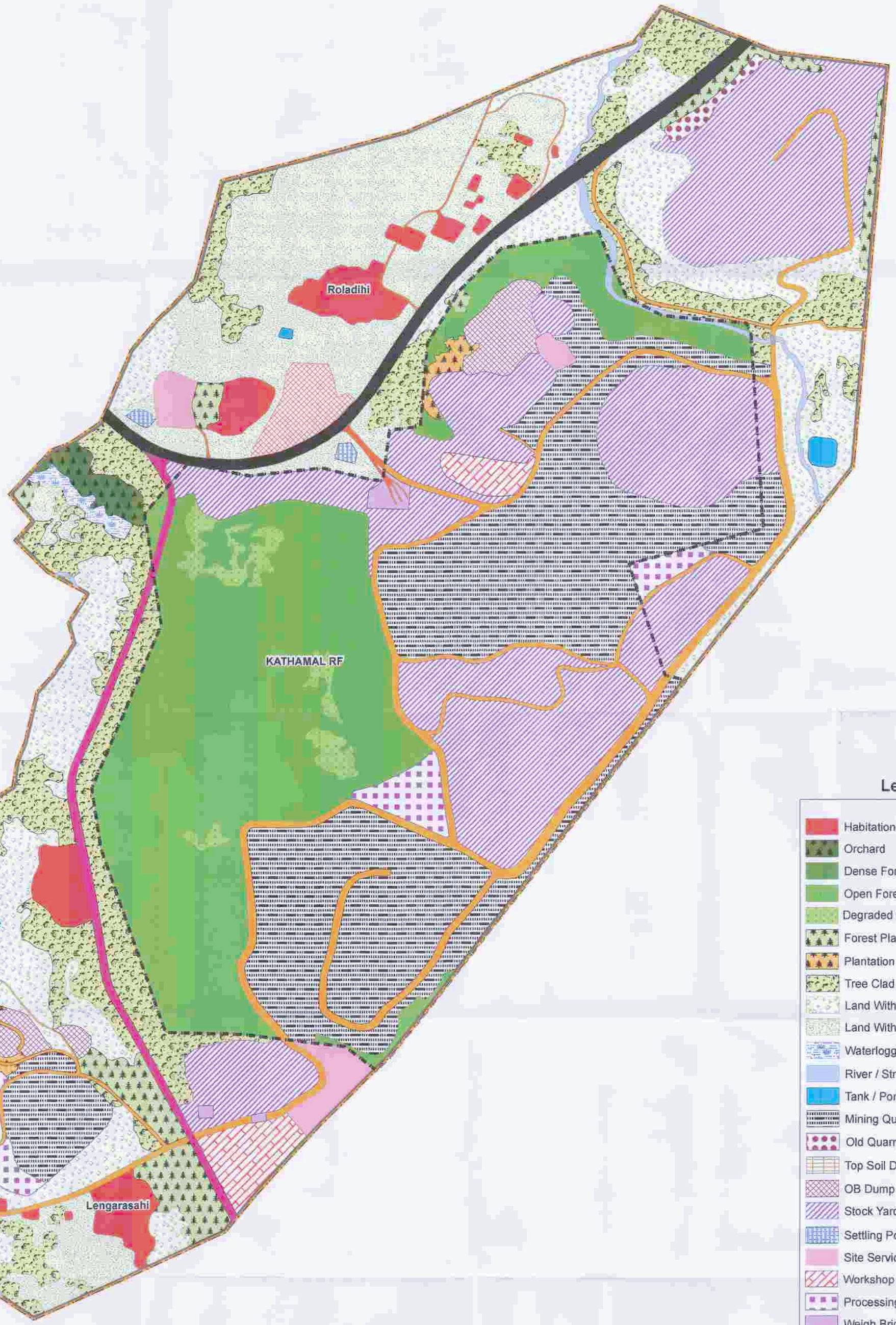
ANNEXURE XLVII

LANDUSE / LANDCOVER MAP OF NARAYANPOSI IRON & MN ORE MINE IN SUNDERGARH DISTRICT OF M/S JSW STEEL LTD.

N
W E
S

0 0.25 0.5 1 Kilometers

SCALE - 1:5,000



Legend

- Habitation
- Orchard
- Dense Forest
- Open Forest
- Degraded Forest
- Forest Plantation
- Plantation Over Dump
- Tree Clad Area
- Land With Scrub
- Land Without Scrub
- Waterlogging / Marshy / Swampy
- River / Stream
- Tank / Pond
- Mining Quarry
- Old Quarry
- Top Soil Dump
- OB Dump
- Stock Yard / Ore Stack
- Settling Pond
- Site Services
- Workshop
- Processing Yard
- Weigh Bridge
- Magazine
- National Highway
- State Highway
- Haul Road
- Other Road
- Bridge / Culvert
- Parking Plaza
- Safety Zone
- Forest Boundary
- Mining Lease Boundary

ORISSA SPACE APPLICATIONS CENTRE * BHUBANESWAR *
Map No. 2602/1
Date 09-12-2021
Auth. Signatory

SOURCE : -

Drone Image Supplied By M/s JSW Steel Ltd.
Month - August , Year - 2021

ANNEXURE XLVIII

Steel Limited

Regd. Office: JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai – 400 051
CIN : L27102MH1994PLC152925
Phone : +91 22 4286 1000
Fax : +91 22 4286 3000
Website : www.jsw.in

OFFICE ORDER

NARAYANPOSHI IRON AND MANGANESE ORE MINES
Environment Management Cell

Environment management cell (EMC) working for the management of Environmental monitoring of the mines and to act upon mitigation measures on the impacts of the production of mine with its surrounding environment so that pollution load, water and air quality can be maintained. Key functioning of EMC would be for compliance monitoring and to adhere with Environmental aspects and issues of the project during operation phase. EMC created with an objective of organizational framework for operating Environment Management System (EMS) and other functions of responsibilities for environmental betterment; and formulating Environmental Action Plans (EAPs) which specify mitigation, periodic and annual monitoring activities during project implementation and operation phase of mining.

The potential activities structured for the control mechanism by EMC, such activities are: Air pollution due to the emission of particulate matter, Gaseous pollutants and fugitive emissions; Noise pollution due to various noise generating equipment and mining activities; Wastewater generation from domestic activities; and Solid waste disposal. In order to minimize these impacts and to ensure that the environment in and around the project site as well as the neighboring population is well protected; an effective environment management plan to be developed and maintained by Environment management cell.

Organogram

