

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT & ENVIRONMENTAL MANAGEMENT PLAN

FOR

Block - XII Codli Mineral Block Auctioned Block Area: 377.0881 ha

With Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA

(Total Excavation: 11.71 Million TPA)

along with Installation 04 Crusher

(3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH)

and 600 TPH Dry Processing/Screening Plant &

2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA

At

Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Study Period : Summer Season (March to May, 2025)

PROJECT PROPONENT



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Undertaking

I, Ambarish Volvoikar Authorized Signatory of JSW Steel Limited give this undertaking to the effect for Draft EIA/EMP Report has been prepared as per the Terms of Reference (ToR) issued by MoEF&CC, New Delhi Vide File No. J-11015/49/2025-IA.II(NCM) dated 18.05.2026 for carrying out the Environmental Impact Assessment (EIA) study for "Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)" have been compiled with and the data submitted are factually correct.

Date: 20.08.2026

Place: Goa

For JSW Steel Limited



Ambarish Volvoikar
(Authorized Signatory)

ABBREVIATIONS

µg/m ³	:	Micro gram per meter cube
µm	:	Micro Meter
AAQ	:	Ambient Air Quality
AAQM	:	Ambient Air Quality Monitoring
AAQS	:	Ambient Air Quality Standards
AERMOD	:	American Meteorological Society/Environmental Protection Agency Regulatory Model
AMSL	:	Above Mean Sea Level
Approx.	:	Approximately
BDL	:	Below Detection Limit
BGL	:	Below Ground Level
BIS	:	Bureau of Indian Standards
CA	:	Compensatory Afforestation
CEP	:	Corporate Environment Policy
CHC's	:	Community Health Center
CPCB	:	Central Pollution Control Board
CRZ	:	Coastal Regulation Zone
CSR	:	Corporate Social Responsibility
CT	:	Concentrate Thickeners
CTE	:	Consent to Establish
CTO	:	Consent to Operate
CuM	:	Cubic meter
CWW	:	Chief Wildlife Warden
dB	:	Decibel
DDVS	:	Double Deck Vibrating Screen
Dec.	:	December
Dept.	:	Department
DFO	:	District Forest Officer
DGMS	:	Directorate General of Mines & Safety
DGPS	:	Differential Global Positioning System
dia.	:	Diameter
DIP	:	Digital Image Processing
DL	:	Detection Limit
DMF	:	District Mineral Fund
DMG	:	Department Of Mines and Geology
DTH	:	Down The Hole
E	:	East
EAC	:	Expert Appraisal Committee
EC	:	Environmental Clearance
ECO	:	Emergency Coordinating Officer

EIA	:	Environmental Impact Assessment
EMC	:	Environment Management Cell
EMP	:	Environmental Management Plan
EMS	:	Environment Management System
ENE	:	East of North East
EPA	:	Environmental Protection Act
EPO	:	Emergency planning officer
ERDAS	:	Earth Resources Data Analysis System
ESE	:	East of South East
FAE	:	Functional Area Expert
FCC	:	False Colour Composite
FPS	:	Fine Particulate Sampler
Ft.	:	Feet
G	:	Ground Levels
GDP	:	Gross Domestic Product
GIS	:	Geographical Information System
GLC	:	Ground Level Concentration
gm/sec	:	Gram per second
Gm/sec/m	:	Gram per second per meter
Gm/sec/m ²	:	Gram per second per meter square
GOI	:	Government of India
Govt.	:	Government
GPS	:	Global Positioning System
GSI	:	Geological Survey of India
GSPCB	:	Goa State Pollution Control Board
ha	:	Hectare
HEMM	:	Heavy Earth Moving Machinery
HFL	:	Highest Flood Level
HIRA	:	Hazard Identification and Risk Analysis
HOD	:	Head Of Department
HR Deptt.	:	Human Recourses Department
hr/day	:	Hour per day
Hrs.	:	Hours
HSD	:	High Speed Diesel
HTL	:	High Tide Line
Hz	:	Hertz
IB	:	Inter Burden
IBM	:	Indian Bureau of Mines
ILO	:	International Labour Organization
IMD	:	India Meteorological Department

IS	:	Indian Standards
ISO	:	International Organization of Standardization
IUCN	:	International Union for Conservation of Nature
IWPA	:	Indian Wildlife Protection Act
JSWSL	:	JSW Steel Limited
kg	:	Kilogram
Kg/ha	:	Kilogram per hectare
Kg/hr	:	Kilogram per hour
KL	:	KiloLitre
KLD	:	Kilo Litre Per Day
km	:	Kilometer
Km/hrs.	:	Kilometers per hours
KW	:	Kilo Watt
LARR	:	Land Acquisition, Rehabilitation and Resettlement Act
LOI	:	Letter Of Intent
Ltd.	:	Limited
LTL	:	Low Tide Line
Ltr/Ton	:	Litre per tonnes
LULC	:	Land Use Land Cover
m	:	Meter
m/sec.	:	Meter per second
MCR	:	Mineral Concession Rule
mg/l	:	Milligram per Liter
ML	:	Mining lease
mm	:	Millimeter
mm/sec	:	Milli meters per second
MMR	:	Mines & Mineral (Development & Regulation) Act
MoEF&CC	:	Ministry Of Environment, Forest and Climate Change
MoH	:	Ministry of Health
mRL	:	Meter Reduced Level
MT	:	Million Tonne
MTPA	:	Million Tonnes per Annum
Mts.	:	Meters
MW	:	Mega Watt
N	:	North
NAAQS	:	National Ambient Air Quality Standards
NABET	:	National Accreditation Board for Education & Training
NABL	:	National Accreditation Board for Testing and Calibration Laboratories
NBWL	:	National Board of Wildlife
NE	:	North East

Ng/m ³	:	Nanogram per meter cube
NGO	:	Non-Governmental Organization
NH	:	National Highway
NMET	:	National Mineral Exploration Trust
NNE	:	North Of North East
NNW	:	North North West
NOC	:	No Objection Certificate
NONEL	:	Non-Electric
Nos.	:	Numbers
NPV	:	Net Present Value
NRSA	:	National Remote Sensing Agency
NRSC	:	National Remote Sensing Centre
NW	:	North West
OB	:	Over Burden
Oct.	:	October
OHS	:	Occupational Health and Safety
OM	:	Office Memorandum
OSHA	:	Occupational Safety and Health Administration
PAF	:	Project Affected Families
PAP	:	Project Affected People
Para.	:	Paragraph
PCCF	:	Principal Chief Conservator of Forest
PESO	:	Petroleum and Explosives Safety Organization
PF	:	Protected Forest
PFR	:	Pre-Feasibility Report
Pg no.	:	Page Number
pH	:	Potential of Hydrogen
PH	:	Public Hearing
PHCs	:	Primary Health Centers
PM	:	Particulate Matter
PMKKKY	:	Pradhan Mantri Khanij Kshetra Kalyan Yojana
PP	:	Project Proponent
PPE	:	Personal Protective Equipment
PPV	:	Peak Particle Velocity
PUC	:	Pollution under control
Pvt.	:	Private
QCI	:	Quality Council of India
R&R	:	Rehabilitation and Resettlement
RDS	:	Respirable Dust Sampler
Ref.	:	Reference

Reg.	:	Regarding
RET	:	Rare Endangered Threatened
RF	:	Reserve Forest
ROM	:	Run Of Mine
RPM	:	Revolution per minute
Rs.	:	Rupees
RSPM	:	Respirable Suspended Particulate Matter
S. No.	:	Serial Number
SC	:	Scheduled Caste
SE	:	South East
SG	:	Sub Grade
SHCs	:	Secondary Health Centers
SHE	:	Safety, Health & Environment
SOI	:	Survey of India
SOPs	:	Standard Operating Protocols
SPCB	:	State Pollution Control Board
SPM	:	Suspended Particulate Matter
Sq.km	:	Square Kilometer
Sq. m	:	Square meter
SSE	:	South Of South East
ST	:	Scheduled Tribe
SW	:	South West
T	:	Tonnes
T/Kg	:	Tonnes per Kilogram
TDS	:	Total Dissolved Solids
ToR	:	Terms of Reference
TPA	:	Tones Per Annum
TPD	:	Tones Per Day
TPH	:	Tones Per Hour
Trees/ ha	:	Trees per hectare
TS	:	Top Soil
UNFC	:	United Nations Framework Classification
UPL	:	Ultimate Pit Limit
US-EPA	:	United State Environmental Protection Act
WRD	:	Water Resource Department, Goa
w.r.t.	:	With respect to
WNW	:	West North West
WSW	:	West-South West

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File No: J-11015/49/2025-IA.II(NCM)
Government of India
Ministry of Environment, Forest and Climate Change
IA Division



Dated: 18/05/2026



To,

Mr. BASWARAJ MAHADEVPPA DALGADE
M/s. JSW STEEL LTD
JSW CENTRE, BANDRA KURLA COMPLEX, BANDRE (EAST) , Mumbai, MAHARASHTRA,
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Subject: Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited located at Village Codli, Taluka Dharbandora, District South Goa, Goa – Prescribing of Terms of Reference - reg.

Sir/Madam,

This is in reference to your application for Grant of Terms of Reference under the provision of the EIA Notification 2006-regarding in respect of project Block-XII Codli Mineral Block submitted to Ministry vide proposal number IA/GA/MIN/571910/2026 dated 14/04/2026.

2. The particulars of the proposal are as below:

(i) TOR Identification No.	TO26A0000GA5346025N
(ii) File No.	J-11015/49/2025-IA.II(NCM)
(iii) Clearance Type	TOR
(iv) Category	A
(v) Project/Activity Included Schedule No.	1(a) Mining of minerals,2(b) Mineral beneficiation
(vi) Sector	Non-Coal Mining
(vii) Name of Project	Block-XII Codli Mineral Block
(viii) Name of Company/Organization	JSW STEEL LTD
(ix) Location of Project (District, State)	SOUTH GOA, GOA
(x) Issuing Authority	MoEF&CC
(xi) Applicability of General Conditions	yes
(xii) Applicability of Specific Conditions	no

3. In view of the particulars given in Para 1 above, the project proposal, including Form-1 (Part A and B), was submitted to the Ministry for appraisal by the Expert Appraisal Committee (EAC) under the provisions of the EIA Notification, 2006, and its subsequent amendments.

4. The above-mentioned proposal has been considered by Expert Appraisal Committee of 5th EAC in the meeting held on 23rd – 24th April, 2026. The minutes of the meeting and all the Application and documents submitted [(viz. Form-1 Part A, Part B) are available on PARIVESH portal which can be accessed by scanning the QR Code above.

5. Based on aforesaid discussions and presentation made by the Project Proponent and the Consultant, the Expert Appraisal Committee (EAC) in 5th EAC meeting held on 23rd - 24th April, 2026, under the provisions of the EIA Notification, 2006 and its subsequent amendments, **recommended** the proposal for Terms of Reference (ToR) of Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited, located at Village Codli, Taluka Dharbandora, District South Goa (Goa) subject to certain specific conditions in addition to the standard ToR conditions applicable to Non-Coal mining projects and mineral beneficiation projects (Annexure III).

6. The details of the project as per the information submitted by the Project Proponent are enclosed as Annexure (II)

7. The Ministry of Environment, Forests & Climate Change (MoEF&CC) has reviewed the proposal in accordance with the Environment Impact Assessment (EIA) Notification, 2006, and its subsequent amendments. Following the acceptance of recommendations made by the Expert Appraisal Committee (EAC), the Ministry has decided to grant the Terms of Reference (ToR) for **Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited located at Village Codli, Taluka Dharbandora, District South Goa, Goa**, under the provisions of the EIA Notification, 2006, and its amendments, subject to certain specific conditions in addition to the standard ToR conditions applicable to Non-Coal mining projects and mineral beneficiation projects.

8. The Ministry reserves the right to stipulate additional conditions, if found necessary.

9. The Terms of Reference (ToR) granted to the aforementioned project are under the provisions of the EIA Notification, 2006. This does not tantamount to approvals, consents, or permissions that are required to be obtained under any other Act, Rule, or Regulation. The Project Proponent is obligated to obtain approvals and clearances under any other applicable Acts, Regulations, or Statutes for the project.

10. You are requested to kindly submit the final EIA/EMP, prepared as per the Terms of Reference (ToRs), to the Ministry for consideration of the proposal for environmental clearance within 4 years, as per the extant rules of the Ministry notified from time to time.

11. The consultants involved in the preparation of the EIA/EMP report, after accreditation with the Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET), are required to include a certificate in this regard in the EIA/EMP reports. This certificate should also cover the data provided by other organizations/laboratories, including their status of approvals and other relevant information.

12. This issues with the approval of the Competent Authority.

Copy to:

- i. **The Secretary**, Ministry of Mines, Government of India, Shastri Bhawan, New Delhi.
- ii. **The Secretary**, Department of Mines and Geology, Ground Floor of Institute Menezes Braganza, Government of Goa.
- iii. **The Director**, Department of Environment and Climate Change (DoE and CC), Government of Goa.
- iv. **The Secretary**, Department of Forests, Government of Goa, Goa Van Bhavan, Goa.
- v. **Director General**, Directorate General of Mines Safety, Hiraapur, Dhanbad, Jharkhand, 826001
- vi. **The Chief Wildlife Warden**, Goa Van Bhavan, Forest Department, Altinho, Panaji Goa. 403001.
- vii. **The Deputy Director General of Forests (C)**, Ministry of Environment Forest and Climate Change, Integrated Regional Office, Kendriya Sadan, 4thFloor, E&F Wings, 17th Main Road, Koramangala II Block, Bangalore - 560034.
- viii. **The Member Secretary**, Central Pollution Control Board, Parivesh Bhawan, CBD-Cum-Office Complex, East Arjun Nagar, New Delhi-110 032.
- ix. **The Member Secretary**, Central Ground Water Authority, 18/11, Jam Nagar House, Man Singh Road, New Delhi-110011.
- x. **The Member Secretary**, Goa State Pollution Control Board, Nr. Pilerne Industrial Estate, Opp. Saligao Seminary, Saligao, Goa 403511.
- xi. **The Controller General**, Indian Bureau of Mines, Indira Bhawan, Civil Lines, Nagpur- 440 001.
- xii. **The District Collector**, South Goa District, Government of Goa.
- xiii. **Guard File.**
- xiv. **PARIVESH Portal.**

Copy To

1. The Member Secretary, CGWA, 18/11 Jamnagar House Man Singh Road, Central, Delhi, cgwa@nic.in
2. The Member Secretary, CPCB, Parivesh Bhawan Cbd-Cum-Office Complex East Arjun Nagar, East, Delhi, mscb.cpcb@nic.in
3. The District Collector, DC Office, Collectorate Of South Goa District Mathany Saldanha Administrative Complex Near Ktc Bus Stand Margao South Goa District Goa, South Goa, Goa, cols.goa@nic.in
4. The Deputy Director General, Regional Office, Deputy Director General Of Forests (C) Ministry Of Environment Forest And Climate Change Integrated Regional Office Ground Floor East Wing New Secretariat Building Civil Lines Nagpur-440001., N/A, N/A, apccfcentral-ngp-mef@gov.in
5. The Member Secretary, SPCB/PCC, Nr. Pilerne Industrial Estate Opp. Saligao Seminary Saligao-Bardez, North Goa, Goa, ms-gspcb.gov@nic.in

Annexure 1

Specific Terms of Reference s for (Mining Of Minerals)

1. Specific Conditions

S. No	Terms of Reference
1.1	Project proponent shall comply with the directions of the Hon'ble High Court of Bombay at Goa (Order dated 29.06.2024 in WP (PIL) No. 06/2024) and prepare a transportation plan in line with DMG and GSPCB recommendations.
1.2	Project proponent shall submit the status of Stage – I forest clearance for 65.9686 ha forestland involved in the project as per MoEF&CC OM dated 09/09/2011 and its amendment.
1.3	Certificate from concerned District Magistrate/Executive Engineer from the State Water Resources department (or) any officer authorized by the State Government in this regard shall be submitted stating that mining activity is not located within flood plain of Dudhsagar/ Kandevar River corresponding to one in 25 years of flood as per Ministry's O.M. dated 14/02/2022.
1.4	Project proponent shall prepare an integrated water shed management plan through reputed institute for protection and conservation of water bodies within the mine lease area and its study area Besides, PP needs to consult State Water Resource Department for protection of water bodies and follow their recommendations. The study report along with the action plan for implementing the recommendations of the report shall be submitted along with the EIA/EMP report. The study shall inter-alia include the following: - Catchment Area Treatment (CAT) Plan to ensure protection and ecological integrity of the river. - Impact of mining activities on the Dudhsagar/ Kandevar River and nearby nala(s), including assessment of aquatic ecology, hydrological changes, risks of disturbance, and formulation of appropriate safeguard measures in consultation with the State Water Resources Department. - River ingress study to assess the likelihood of water inflow into the mine pit and to design suitable preventive and mitigation measures. - Provision of embankment with stone pitching on both sides (towards and outwards of the river) shall be developed with a height of 3 m above the HFL of Dudhsagar/ Kandevar River.
1.5	PP shall submit a comprehensive transportation and material handling plan, including route map, traffic assessment, habitation impact (100 m on both sides), number of trips, vehicle capacity, road dimensions, traffic load, carrying capacity, and SOP for transportation from mine to destination.
1.6	PP shall undertake a detailed mine safety and design study (including bench geometry, slope stability, blasting, and operational safety) in consultation with DGMS and incorporate recommendations in the EIA/EMP.
1.7	PP shall explore the feasibility of a solar-powered jetty for mineral transportation.
1.8	PP shall undertake prior consultation with the Central Ground Water Authority (CGWA) and/or the State Ground Water Board (SGWB) regarding groundwater abstraction, management, and associated hydrogeological aspects of the project. The recommendations, conditions, and observations provided by the concerned authority shall be duly incorporated in the EIA-EMP report, along with a clear commitment and mechanism for their implementation and compliance.
1.9	PP needs to obtain the HFL data of the Nala and Dudhsagar/ Kandevar River from Irrigation Department. No mining shall be proposed within the HFL of Dudhsagar/ Kandevar River.
1.10	The Project Proponent (PP) shall incorporate the action plan with respect to following

S. No	Terms of Reference
	recommendations, made by the Goa State Pollution Control Board (GSPCB), as detailed below: a. A Comprehensive plan must be prepared by the Project Proponent (PP) to address the potential overflow of water from the open mining pit during heavy rainfall or other likelihood eventualities. b. Flow of groundwater also needs to be furnished. Consultations in this regard should be carried out by the PP with the Central Ground Water Authority (CGWA)/SGWB. c. Sufficient number of Garland drains, settling ponds, and silt traps will be constructed and maintained to prevent runoff, silt, and sediment from entering the river. d. Mine pit water will be analysed as per GSR 422(E) Schedule-VI of Environmental Protection Act 1986 prior to discharge; further discharge into the river shall be undertaken only after ensuring compliance with prescribed standards and as per the recommendations/permission of the State Water Resources Department (WRD). e. Regular river water quality monitoring will be carried out at upstream and downstream locations, and monitoring records shall be submitted to GSPCB & WRD every month. f. A green belt will be developed along the lease boundary facing the river, using native species, to act as a protective barrier and to safeguard the river ecosystem. g. The Project Proponent shall prepare a detailed plan, including a mandatory buffer zone or no-activity zone of suitable width, to safeguard the Khandepar River, which flows just 0.01 km from the eastern boundary of the mining lease area. GSPCB and Goa Water Resources Department (WRD) shall be consulted in this regard. h. The Project Proponent shall consult the Goa Water Resources Department or an institute of national repute to obtain the High Flood Level (HFL) data for the Khandepar River and the seasonal nallah flowing within the mining lease area. i. The primary concern to be addressed on priority is that pollutants/silt shall not directly enter the Khandepar River, and mining shall not be conducted close to the river. A buffer zone of at least 50 m shall be maintained from the lease boundary along its south-eastern end. j. Mining operations may be optimized by utilizing dewatering water for recharging the riverine system downstream and for consumptive uses, with proper coordination with the Goa WRD and adoption of suitable management practices.
1.11	PP shall implement integrated surface water, drainage, and runoff management measures including garland drains, settling ponds, silt traps, diversion of runoff to pits, and prevention of contaminated discharge into natural drains.
1.12	PP shall ensure zero discharge outside ML area by preparing a plant-specific water balance plan integrating mine water and beneficiation water demand with maximum reuse.
1.13	PP shall design and install appropriate wastewater treatment systems including ETP with oil & grease traps and ensure compliance with prescribed discharge standards.
1.14	PP shall prepare a geo-referenced (KML) layout of the beneficiation plant showing all components including crushers, screening units, tailing areas, drainage, pits, and environmental sensitivities.
1.15	PP shall justify siting of crushers and screening units considering wind direction, forest areas, and nearby habitations.
1.16	PP shall prepare a site-specific tailings/slimes management plan including in-pit disposal, embankment stability, and prevention of overflow.
1.17	PP shall prepare detailed design of slurry handling, containment systems, and emergency control

S. No	Terms of Reference
	measures.
1.18	PP shall submit a synchronized mine–beneficiation plan aligned with production capacity to avoid excess stockpiling.
1.19	PP shall explore renewable energy use and submit a detailed plan for increased adoption. PP needs to clarify through the scientific studies whether there is any chance of water ingress in the mine from Northern side (i.e. river side) of the ML area.
1.20	PP shall consult the Directorate General of Mines Safety (DGMS) on safety aspects related to potential water ingress from the river flowing along the northern side, after sharing the hydrological study with DGMS.
1.21	PP should explore the extraction of Iron Ore from BHQ through latest available technologies. Appropriate R& D should be conducted /done in this regard. Consultation with Indian Bureau of Mines should also be done in this regard along with other institutes of national repute.
1.22	PP needs to submit a detailed transportation and material handling plan as part of the EIA/EMP, covering transportation from Mine to Capxem Jetty and Proposed Railway Sidings Via SH-7 & other connecting road. The plan shall clearly indicate the mode-wise breakup of material transport (conveyor/rail/road), measures for dust suppression and pollution control, traffic management, and mitigation of impacts on nearby habitation.
1.23	Project proponent needs to submit the detailed scientific plan for constructing the retaining wall/other structures so that there is no flow of dump/ore silt outside the lease area.
1.24	The Project proponent needs to submit a detailed plan showing more use of renewable energy in the project.
1.25	Project Proponent shall submit the drone video & photographs of the ML area and transportation route proposed for this project with special focus on the sensitive receptors in the ML area and in the transportation route.
1.26	Site Specific Wildlife Conservation Plan shall be prepared and approved by the DFO/ PCCF Wildlife for the Schedule – I species present within the ML area.
1.27	Biodiversity analysis of the core zone and buffer zone of the ML area shall be done through any reputed institutions having NABET accreditation. The study report shall inter-alia include impact of mining on flora and fauna and action plan for complying with the mitigation measures shall be submitted.
1.28	The Project Proponent needs to monitor the ambient air quality and noise level at the mine lease boundary, nearest village, proposed crusher & beneficiation plant, predominant downwind direction and at other sensitive receptors. Accordingly, Project Proponent shall propose to install Continuous Ambient Air Quality Monitoring Stations within certain timeline.
1.29	The Project Proponent should prepare the EMP considering the scenario of pollution to be generated for normative and peak total excavation for assessing air pollution, noise level and ground vibration.

S. No	Terms of Reference
1.30	The Project Proponent needs to carry out the Public Hearing as per provisions of EIA Notification, 2006. PP should also submit the time bound action plan on concerns of the public through a separate budget with capital expenditure with a timeline of 3 years. The Project proponent shall ensure that the activities proposed under the public hearing shall be different from the CSR activities. PP needs to submit a tangible and monitorable action plan for meeting the public hearing commitments.
1.31	The Project Proponent needs to undertake the enumeration of the species within the mine lease area before cutting. The Project Proponent also needs to submit the compensatory afforestation plan for the number of trees to be cut in the mine lease area and also to explore the possibility of tree transplantation.
1.32	The Project Proponent needs to submit the action plan for undertaking the plantation along the 7.5m barrier, safety zone of tar road/cart tracks, electric line etc., PP should also submit the details of numbers of saplings to be planted (2500/ha), type of saplings proposed and the area to be covered under greenbelt/plantation along with the timeline and budget. The greenbelt/plantation plan shall be prepared in such a way that the ecology of the area shall be restored. Miyawaki plantation technique in atleast 20 % of the overall plantation. PP also needs to submit an action plan for development of greenbelt around crusher and beneficiation plant.
1.33	The Project Proponent shall carry out the assessment of impact due to the proposed project as per the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP.
1.34	The project proponent shall conduct hydrological study for projects involving intersection of ground water table as per the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP.
1.35	The Project Proponent shall explore the possibility of reduction of specific water requirement by optimization / technology up gradation, etc. The efforts shall be delineated in the EIA/EMP.
1.36	The Project Proponent shall prepare the scheme for mandatory recycle/re-use of water as specified by the Central Ground Water Authority for different category areas.
1.37	The Project Proponent needs to submit the plan for Socio economic development of the neighborhood's habitats based on the need-based survey along with the time bound action plan in consultation with the local people. Inclusive development with initiatives focused on employment generation, educational support, healthcare facilities for the local communities be planned.
1.38	The Project Proponent shall provide the details of Special Pollution Control/ Abatement devices that have been installed/ proposed to be installed within the ML area and how does the technology compare with the best available technology in the field.
1.39	PP should ensure that all the documents including the approved Mining plan and EIA /EMP should be in consonance with each other.
1.40	The Project Proponent needs to prepare the installation plan for permanent fixed water sprinkling system along the Haul roads. Installation of fog canons at necessary locations in the project should also be planned.

S. No	Terms of Reference
1.41	The Project Proponent needs to prepare plan to develop the treatment facility for wastewater within the ML area.
1.42	The Project Proponent needs to submit employment-based skill development plan for the local people, and thrust should be to provide employment to local people after imparting training.
1.43	PP needs to project & submit yearwise back filling plan.
1.44	The Project Proponent (PP) shall conduct a pit slope stability study through a reputed institute, covering all safety aspects, including the height and angle of slopes of OB dumps, and incorporate the findings along with a compliance commitment in the EIA/EMP report.
1.45	PP need to assess impact on nearby villages, traffic, and state highway due to mining operations including blasting and transportation. Necessary consultation/ permissions from DGMS may be taken in this regard. PP needs to take mitigation measures including dust suppression, traffic management, noise reduction, and health safeguards based on public hearing/ stakeholder consultations.
1.46	PP is required to conduct a cumulative impact assessment including the adjacent mines. This assessment should encompass key factors, including water requirements, air, water, noise pollution levels, power consumption, transportation logistics, waste management practices, and the combined emissions load from projects effects on flora & fauna, etc. EMP should be prepared accordingly.
1.47	Since the volume of OB dumps is increasing manifold, catchment area treatment plan can be prepared in consultation with reputed institute. Planning should be such that there are no chances of silt flow outside the ML area. Catch drains, Siltation ponds, retaining walls, gabions structures, check dams, etc. shall be planned accordingly and submitted with locations, drawing/ layouts.
1.48	PP should plan and submit pollution control measures at Railway Sidings as per CPCB guidelines including permanent water sprinkling system, greenbelt development, metal windcreens, etc.
1.49	Project Proponent should clearly bring out that what is the specific diesel consumption ~ (Liters/Tonne of total material handled) and steps to be taken for reduction of the same. The year-wise target for reduction in the specific diesel consumption needs to be submitted. PP shall also explore the possibility of using e-vehicles/LPG/CNG-based machinery and HEMM trucks for the operation and transportation of limestone.
1.50	Project proponent is advised to implement the 'Ek Ped Maa Ke Naam' Campaign which was launched on 5th June 2024 on the occasion of the World Environment Day to increase the forest cover across the Country. This plantation drive is other than Green belt development.
1.51	Necessary coordination shall be made with concerned SPCB (who is responsible for

S. No	Terms of Reference
	Compliance of OM dated 14.01.2025 & 08.10.2025) regarding streamlining the implementation of GSR 702 and GSR 703 dated 12.11.2024 through which projects requiring prior EC were exempted from requirement of CTE.

Standard Terms of Reference for (Mining of minerals)

1.

S. No	Terms of Reference
1.1	Year-wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification 1994 came into force, w.r.t. the highest production achieved prior to 1994
1.2	A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given
1.3	All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee
1.4	All corner coordinates of the mine lease area, superimposed on a High Resolution Imagery/toposheet, topographic sheet, geomorphology and geology of the areashould be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone)
1.5	Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics
1.6	Details about the land proposed for mining activities should be givenwith information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority
1.7	It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large,may also be detailed in the EIA Report
1.8	Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided

S. No	Terms of Reference
1.9	The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period
1.10	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given
1.11	Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given
1.12	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees
1.13	Status of forestry clearance for the broken up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished
1.14	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated
1.15	The vegetation in the RF / PF areas in the study area, with necessary details, should be given
1.16	A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted
1.17	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/ Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished
1.18	A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan alongwith budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost

S. No	Terms of Reference
1.19	Proximity to Areas declared as Critically Polluted or the Project areas likely to come under the Aravali Range, (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered
1.20	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority)
1.21	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report
1.22	One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season) ; December-February (winter season)]primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given
1.23	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map
1.24	The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated
1.25	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided
1.26	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided
1.27	Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided
1.28	Based on actual monitored data, it may clearly be shown whether working will intersect

S. No	Terms of Reference
	groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished
1.29	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out
1.30	Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same
1.31	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution
1.32	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines
1.33	Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report
1.34	Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report
1.35	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed
1.36	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations
1.37	Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation
1.38	Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if

S. No	Terms of Reference
	any, occupational health impacts besides other impacts specific to the proposed Project
1.39	Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project
1.40	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given
1.41	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out
1.42	A Disaster management Plan shall be prepared and included in the EIA/EMP Report
1.43	Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc
1.44	Besides the above, the below mentioned general points are also to be followed:- a) All documents to be properly referenced with index and continuous page numbering. b) Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated. c) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project. d) Where the documents provided are in a language other than English, an English translation should be provided. e) The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted. f) While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed. g) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation. h) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable. i) The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area

Standard Terms of Reference for (Mineral beneficiation)

1.

S. No	Terms of Reference
1.1	The alternate sites considered, the relative merits and demerits and the reasons for selecting the proposed site for the Beneficiation Plant should be indicated.

S. No	Terms of Reference
1.2	Details of the technology and process involved for beneficiation should be given. .
1.3	Location of the proposed Plant w.r.t. the source of raw material and mode of transportations of the ore from mines to the beneficiation plant should be justified.
1.4	Treatment of run of mine (ROM) and or of the fines/waste dump should be spelt out.
1.5	Estimation of the fines going into the washings should be made and its management described.
1.6	Details of the equipment, settling pond etc. should be furnished.
1.7	Detailed material balance should be provided.
1.8	Sources of raw material and its transportation should be indicated. Steps proposed to be taken to protect the ore from getting air borne should be brought out.
1.9	Management and disposal of tailings and closure plan of the tailing pond, if any after the project is over, should be detailed in a quantified manner.
1.10	The water requirement for the project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the project should also be indicated.
1.11	A copy of the document in support of the fact that the Proponent is the rightful lessee of the unit should be given.
1.12	All documents including EIA and public hearing should be compatible with one another in terms of the production levels, waste generation and its management and technology and should be in the name of the lessee.
1.13	All corner coordinates of the Unit, superimposed on a High Resolution Imagery/Toposheet should be provided. Such an Imagery of the proposed Unit should clearly show the land use and other ecological features of the study area (core and buffer zone).
1.14	It should be clearly indicated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the EIA Report.
1.15	Issues relating to Safety should be detailed. The proposed safeguard measures in each case should also be provided. Disaster management plan shall be prepared and included in the EIA/EMP Report.
1.16	The study area will comprise of 10 km zone around the Plant.
1.17	Cumulative impact study of both Beneficiation Plant with suggested mitigation measures as per the

S. No	Terms of Reference
	study should be described.
1.18	Location of Railway siding with its handling capacity and safety measures should be indicated.
1.19	Option to provide only silo for storage of minerals instead of open stacking to avoid fugitive dust should be explored and arrangements finalized justified.
1.20	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.
1.21	Details of the land for any Over Burden Dumps outside the lease, such as extent of land area, distance from lease, its land use, R&R issues, if any, should be given.
1.22	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the Project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.
1.23	Status of forestry clearance for the broken up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.
1.24	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.
1.25	The vegetation in the RF / PF areas in the study area, with necessary details, should be given.
1.26	A study shall be got done to ascertain the impact of the Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly detailed mitigative measures required, should be worked out with cost implications and submitted.
1.27	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Tiger/Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.
1.28	A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan alongwith budgetary provisions for

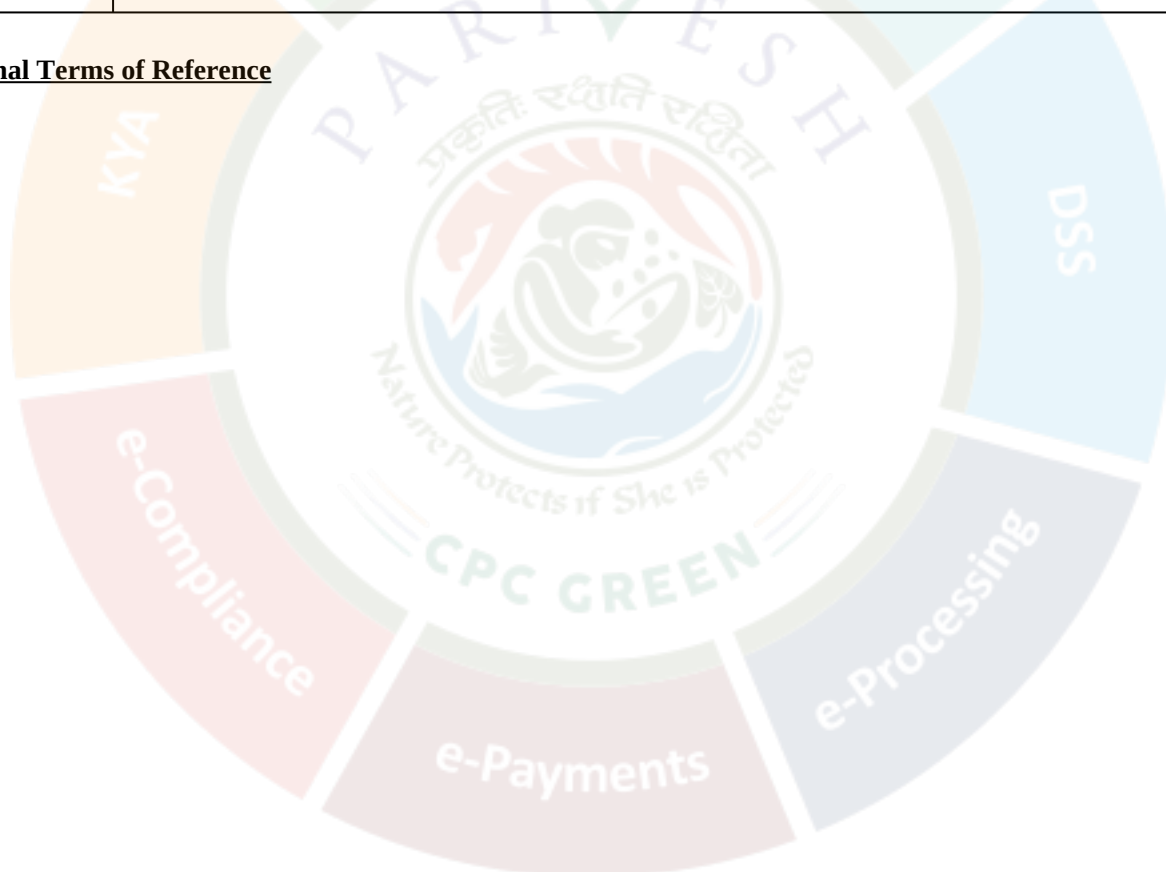
S. No	Terms of Reference
	their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.
1.29	Proximity to Areas declared as 'Critically Polluted' shall also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB/CPCB shall be secured and furnished to the effect that the proposed activities could be considered.
1.30	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the unit w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).
1.31	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects, should be discussed in the report.
1.32	One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season) ; December-February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the unit in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.
1.33	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.
1.34	The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.
1.35	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be secured and copy furnished. .
1.36	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.
1.37	Impact of the project on the water quality, both surface and groundwater should be assessed and necessary safeguard measures, if any required, should be provided.

S. No	Terms of Reference
1.38	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out.
1.39	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the project. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to the pollution.
1.40	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered.
1.41	Details of the onsite shelter and facilities to be provided to the workers should be included in the EIA report.
1.42	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area should be detailed.
1.43	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.
1.44	Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.
1.45	Public hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.
1.46	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the project should be given.
1.47	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.
1.48	A brief background of the Project, its financial position, Group Companies and legal issues etc should be provided with past and current important litigations if any.
1.49	Benefits of the Project, if the project is implemented should be outlined. The benefits of the projects shall clearly indicate environmental, social, economic, employment potential, etc.
1.50	Besides the above, the below mentioned general points are also to be followed:- a) All documents to be properly referenced with index and continuous page numbering. b) Where data are presented in

S. No	Terms of Reference
	the report especially in Tables, the period in which the data were collected and the sources should be indicated. c) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the project. d) Where the documents provided are in a language other than English, an English translation should be provided. e) The Questionnaire for environmental appraisal of project as devised earlier by the Ministry shall also be filled and submitted. f) While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should also be followed. g) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation. h) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified Report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project by the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.

Additional Terms of Reference

N/A



Annexure-II

Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited located at Village Codli, Taluka Dharbandora, District South Goa, Goa.

The details of the project: -

The details of the project as ascertained from the document submitted by the Project Proponent are given as under:

i. Project details:

Name of the Proposal	Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited, located at Village Codli, Taluka Dharbandora, District South Goa (Goa).	
Location	Village	Codli
	Taluka	Dharbandora
	District	South Goa
	State	Goa
	Latitudes	15 ⁰ 21'15.638" N to 15 ⁰ 19'42.607" N
	Longitudes	74 ⁰ 7'10.922" E to 74 ⁰ 8'39.034" E
	SoI Topo sheet No.	Core Zone: D43C3_48I/3 Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
Company's Name	JSW Steel Limited	
Accredited Consultant and certificate no.	J.M. EnviroNet Pvt. Ltd. Accredited EIA Consultant by NABET (QCI) Certificate No. NABET/EIA/23-26/SA 0250, dated 25.07.2025 which is valid up to 07.08.2026.	
KML file	KML has been uploaded in Form 1 & same is enclosed.	
Seismic zone	Zone-III as per IS:1893 (Part-I): 2002 & 2025	

ii. Category details:

Category of the project	Category “A” (>250 ha)
Schedule No	Project or Activity 1 (a) for Mining of Minerals and 2 (b) for Mineral Beneficiation. - Iron Ore production capacity of 3.50 Million Tonnes Per Annum (MTPA) of iron ore and 8.21 Million TPA of Overburden (OB)/waste, involving a total excavation of 11.71 Million TPA. - The project includes installation of Mineral Handling and Processing Facilities comprising 04 Crushers, i.e., 03 Primary Crushers (1 × 250 TPH and 2 × 90 TPH) and 01 Secondary Crusher (150 TPH). - In addition, a 600 TPH Dry Processing/ Screening Plant and 2 × 300 TPH Wet Beneficiation Plants are proposed to achieve a total throughput capacity of 3.50 Million TPA
Mining lease Area (MLA) (in ha.)	377.0881 ha
General Conditions (if any)	None

iii. Details of Mine Lease in Chronological Manner:

S. No.	Prospecting License/ Letter of Intent (LoI)/ Grant of Mine lease and Lr No	Date of the Grant	Name of the Mineral & (Major/ Minor)	Period of Grant	Granted by	Mine Lease Area in Ha
1.	Letter of Intent (LoI) was issued through e-auction process conducted by the Govt. of Goa.	10.12.2024	Iron Ore (Major Mineral)	3 years (up to 09.12.2027)	Govt. of Goa	377.0881 ha

iv. Land Use/Land Cover of the Mine Lease Area:

Type of Land	As per RoR	As per DGPS
Private land	74.7713 ha	--
Government land	236.3482 ha	--
Forest Land	65.9686 ha	--

Type of Land	As per RoR	As per DGPS
Total Mining lease area (MLA), Ha	377.0881 ha	--
Private land for crusher, workshop & other infrastructure outside the MLA	No infrastructure is proposed outside the ML area.	
Additional information (if any)	Out of total 377.0881 ha land; 65.9686 ha is Forest Land, 236.3482 ha is Government land, 58.9087 ha is Private land and 15.8626 ha is Alvara land.	

Land use pattern						
Pre Mining	Parameter			Area in ha		
	Forest land			65.9686		
	Government Non-Forest			311.1195 (Govt. and Pvt. Land)		
	Water bodies			-		
	Tenancy Land including agricultural, settlement etc			-		
	Total Area			377.0881		
During Mining and post mining	S.N.	Description	Post Mining Land Use (In Ha)			
			Plantation/ Re-grassing	Water Body	Civil Use	Total
	1.	Excavation (Voids) Water Reservoir	-	249.2021	-	249.2021
		Reclamation (Backfilled)	51.9500	-	-	51.9500
	2.	Area under Dump (Rehabilitated)	6.8700	-	-	6.8700
	3.	Area comes under utility services	-	-	14.5597	14.5597
	4.	Mineral Separation Plant	-	-	10.8981	10.8981
	5.	Greenbelt	17.4500	-	-	17.4500
	6.	Tailing Dam	26.1582	-	-	26.1582
	Total		102.4283	249.2021	25.4578	377.0881

v. Mining plan details:

Mining Plan including Progressive Mine Closure Plan (approved by Indian Bureau of Mines/DMG)	Letter No.	MCDR-MPC0FE/6/2025-GOA-IBM_RO_GOA
	Date	06.08.2025
	Mineral & (Major/Minor)	Iron Ore (Major Mineral)
	Mine Lease Area, Ha	377.0881 ha
	Validity	5 years from the date of Mining Lease Registration
Additional information (if any)	Mining Plan along with Progressive Mine Closure Plan has been approved by IBM, Goa Vide their letter No. MCDR-MPC0FE/6/2025-GOA-IBM_RO_GOA dated 06.08.2025.	
Mining Parameters	Quantitative Description	
Method of Mining	Fully Mechanized Opencast Mining Method.	
Drilling/Blasting	No Drilling and Blasting will be carried out.	
Geological Reserves	48.50 Million Tonnes	
Mineable Reserves	27.32 Million Tonnes	
Breakup of Total Excavation (Topsoil/OB/SB/IB/Mineral Rejects/ Waste, MTPA)	Iron Ore: 3.50 Million TPA OB/Waste: 8.21 Million TPA Total Excavation: 11.71 Million TPA	
Life of mine	8 years as per Mineable Reserves 14 years as per Reserves and Resources	
Mine Bench Height & Bench Width	Bench height: 7 m Bench Width: 9 m	
No. of Mine Benches	15 Benches at Conceptual Stage	
Existing Depth, m bgl	It is a proposed mining project. Hence, not applicable.	
Ultimate Depth of Mining, m bgl	At Conceptual Stage: 164.48 m	
Ground Water Table, m bgl	19 m bgl	
Details of ground water intersection	The water table in the core zone is 19 m bgl. During Plan period, the working depth will be 112 m and ultimate working depth will be 164.48 m. Hence, the ground water will be intersected. Prior permission will be taken from competent authority before such intersection.	
Individual bench slope	80°	
Overall pit slope	<38°	

Details of existing/ proposed Crusher	Primary Crusher: 1 x 250 TPH & 2 x 90 TPH Secondary Crusher: 150 TPH
Mineral Beneficiation	Dry Processing/Screening Plant: 600 TPH Wet Beneficiation Plant: 2 x 300 TPH
RoM output size	-500 mm
Transportation details including capacity of dumper/tipper, mode of transport and distance	The Iron Ore will be transported from Mine to Capxem Jetty and Proposed Railway Sidings Via SH-7 & other connecting road with capacity of truck is 10.5 tons.
Generation of Topsoil/OB & its Management during plan period & conceptual period.	- There are no top soil present in the ML area. - At present, there are six dumps within the mine, out of which four are active waste dumps containing ~ 8.96 Million tonnes of waste spread over an area of 32.23 hectares. The remaining two are stabilized dumps, which together hold about 2.976 Million tonnes of waste across an area of 22.55 hectares at the mine site. - During the plan period, ~23.43 million tonnes of overburden (OB) and waste will be generated. This material will be disposed of in the existing waste dump (D4) as well as in two proposed new dumps, namely D4A and D7, covering a total dump area of 46.84 hectares. - At conceptual period, ~68.0 Million Tonnes of waste will be generated which will be used in backfilling in the mined-out area.
Generation of Mineral Rejects/ Waste & its Management during plan period & conceptual period	-

vi. Water requirement

Total water requirement	Total Water Requirement is 1716 KLD	Fresh Water	1716 KLD
		Treated water	-
Source	The total water requirement for the project is 1716 KLD, primarily met from pit water, i.e., rainwater harvested within the mine. The water will be utilized for the beneficiation plant, domestic use, water sprinkling on roads, firefighting, greenbelt/plantation, and dust suppression.		
Permission for withdrawal/ intersection along with details of grant and its validity	This proposal is for ToR. Details will be incorporated in EIA/EMP Report.		

vii. Nearest village/ town/ highway/ interstate boundary/ railway station/ water bodies/ monument/forest

Particulars	Particular's Name	Distance & Directions
Village	Codli	(Adjacent in North)
Town	Sanvordem	~7.5 km in SSW
Highway	SH-7	Adjacent in WNW
Interstate Boundary	Goa-Karnataka State Boundary	~14.20 Km in SW Direction
Railway Station/Railway line	Sanvordem Chuch Railway Station	~7.8 km in SSW
Water Bodies	Kandepar River, Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Sanguem or Zuvari River, Jamboli Nala, Paroda River	Adjacent to ~9.0 Km in the study Area
Forest	Unclassified Forest and Reserve Forest	Core zone, ~0.5 Km in ENE, ~1.0 Km in West ~2.5 Km in West, ~4.0 Km in South, ~6.5 Km in WSW, ~7.0 Km in NNE, ~8.0 Km in WSW, ~8.5 Km in NW, ~9.0 Km in West.

viii. Presence of Environmentally Sensitive areas in the study area

Forest Land / Protected Area / Environmental Sensitivity Zone	Yes/No	Details of Certificate/ letter issued by the concerned Department mentioning the Lr no, date of grant and remarks
Forest Land within the mine lease area and (if yes) status of Forest Clearance	Yes	Block - XII Codli Mineral Block comprises of 65.9686 ha Forest Land. Online Application for obtaining the Forest Clearance has been submitted on Parivesh 2.0 Web Portal on 23.02.2026.
National Park	No	There are No National Park within 10 Km Study Area
Wildlife Sanctuary	Yes	- Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE) - Bondla Wildlife Sanctuary (~5.5 Km in NNW)
Elephant/Tiger Reserve	No	
Eco-Sensitive Zone (ESZ) /Eco-Sensitive Area (ESA)	Yes	ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE)

		ESZ Bondla Wildlife Sanctuary (~6.5 Km in NNW) Map Authenticated from DCF, Goa Indicating shortest Distance Between ESZ & WLS From ML Boundary on 10.10.2025.
Coastal Regulation Zone (CRZ)	No	-
Schedule-I species (No.s and name of schedule-I species with authenticated letter)	-	Details regarding Schedule-I species will be provided in the EIA/EMP report.
Wildlife Conservation Plan	-	

ix. Green belt/plantation details:

Proposed area for green belt/plantation and no. of saplings proposed	102.43 ha & 256075 saplings
Budget for green plant & plantation till the end of life of mine.	5.12 Crores
Budget for nursery	10 Lakhs
Details of existing plantation and its survival rate	It's a greenfield project.
No. of tree cuts in the mine lease area and compensatory afforestation	Approx. 4000, Tree enumeration is under process. Details will be incorporated in EIA after finalization of Tree enumeration.
Particulars for Green belt/plantation	Area covered (in Ha)
7.5 m barrier & non-mineralized zone	17.4500
500 m safety zones of nearest habitation villages	-
50 m safety zone of nallah, roads, electric lines	-

x. Baseline detail

Baseline Data (Air / Water / Noise / Soil / Hydro geological study/ Traffic Study/ others)	
Period of baseline data collection	March to May, 2025
Season (Summer/Pre-monsoon/Post-monsoon/Winter)	Summer Season
Predominant Wind direction (From)	North-West

Ambient Air Quality (no. of locations) and results	11
Noise level (no. of locations) and results	11
Water Quality (no. of locations) and results	Ground water – 10 Surface water – 8
Soil Quality (no. of locations) and results	10

xi. Rehabilitation & Resettlement (R&R):

R & R details	PP reported that the total mining lease area is 377.0881 ha (Govt. revenue land – 236.3482 ha, Private land – 58.9087 ha, Alvara land – 15.8626, Forest land – 65.9686 ha). No habitation present within the Mineral Block. Hence, no displacement of human settlement is proposed.
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xii. Court case details:

Court Case, No and its present status	No Court Case or Litigation is pending
Undertaking by Project Proponent w.r.t court case	The Project Proponent has submitted the undertaking dated 18.09.2025 stating that there is no litigation pending against the project and/or any direction/ order passed by any court of law against the project and that for any such litigation whatsoever, the sole responsibilities will be borne by the company.

xiii. Affidavit/Undertaking details:

Affidavit as per Ministry's OM dated 30.05.2018	Project Proponent has submitted the Affidavit in a non-judicial stamp paper of Rs. 100 bearing no: C 223133 dated 13.03.2026 stating that the company undertakes to comply all the statutory requirement & judgment of Hon'ble Supreme Court order dated 2nd August 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of common cause versus Union of India & Ors before grant of ToR/EC.
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xiv. EDS Raised by MoEF&CC on 17.03.2026. Reply submitted by PP on 14.04.2026.

S. No.	EDS Point	Reply by Project Proponent
1.	PP needs to submit a certificate from State DMG stating that no mining activity has been undertaken by PP at the lease boundary /safety zone (7.5m) and within mine lease area.	A Certificate has been obtained from State DMG Govt. of Goa vide letter No. 03/20/2025/Major/Mines/ 3940 dated 31.03.2026 stating that no mining activity has been undertaken by JSW Steel Limited within the Lease

S. No.	EDS Point	Reply by Project Proponent
		boundary/safety zone (7.5m) in the mine lease area. Copy of the Certificate is uploaded with EDS Reply.
2.	Since the mine site is located at 0.01 Km from Dudhsagar River, PP may consult State Water Resource Department and State Pollution Control Board and obtain their recommendations for safeguarding the Dudhsagar River.	Consultation has been carried out with the Goa State Pollution Control Board. A letter was also submitted to the Chief Engineer, Water Resources Department, Goa, on 18.03.2026, seeking their recommendation for safeguarding the river. The recommendation of the Goa State Pollution Control Board, along with a copy of the letter submitted to the Water Resources Department, are uploaded with EDS Reply.

xv. Details of project cost and employment:

Particulars	(Rs. in Crores)
Project Cost	500 Crores
Employment	154 Persons

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).
ToR Compliance

ToR Compliance

Point wise compliance of ToR Points issued by MoEF&CC, New Delhi vide File No. J-11015/49/2025-IA.II(NCM) dated 18.05.2026, Proposal No. IA/GA/MIN/571910/2026, for proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) by JSW Steel Limited.

S.N.	ToR Point	Compliance	Reference in EIA/EMP Report
A.	Specific Terms of Reference for (Mining of Minerals)		
1.1	Project proponent shall comply with the directions of the Hon'ble High Court of Bombay at Goa (Order dated 29.06.2024 in WP (PIL) No. 06/2024) and prepare a transportation plan in line with DMG and GSPCB recommendations.	JSWSL will comply with the directions of the Hon'ble High Court of Bombay at Goa (Order dated 29.06.2024 in WP (PIL) No. 06/2024). The recommendations of GSPCB and DMG will be followed. Transportation activities will be carried out strictly as per the DMG Standard Operating Procedure (SOP) for mineral transportation. The Transportation Route Action Plan is enclosed with this Draft EIA/EMP Report.	Chapter 4 Para 4.5.8 Pg No. 232-240 Annexure XX
1.2	Project proponent shall submit the status of Stage – I forest clearance for 65.9686 ha forestland involved in the project as per MoEF&CC OM dated 09/09/2011 and its amendment.	Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I. Copy of the Application submitted for Forest Clearance is enclosed with this EIA/EMP report.	Annexure III
1.3	Certificate from concerned District Magistrate/Executive Engineer from the State Water Resources department (or) any officer authorized by the State Government in this regard shall be submitted stating that mining	A letter has been submitted to the Water Resources Department (WRD) seeking High Flood Level (HFL) data of the Khandepar River. The mining lease area is located outside the flood plain of the Khandepar River. The	Annexure XVIII

	activity is not located within flood plain of Dudhsagar/ Kandevar River corresponding to one in 25 years of flood as per Ministry's O.M. dated 14/02/2022.	certificate/confirmation from the concerned authority will be submitted upon receipt.	
1.4	Project proponent shall prepare an integrated water shed management plan through reputed institute for protection and conservation of water bodies within the mine lease area and its study area Besides, PP needs to consult State Water Resource Department for protection of water bodies and follow their recommendations. The study reports along with the action plan for implementing the recommendations of the report shall be submitted along with the EIA/EMP report. The study shall inter-alia include the following: A. Catchment Area Treatment (CAT) Plan to ensure protection and ecological integrity of the river. B. Impact of mining activities on the Dudhsagar/ Kandevar River and nearby nala(s), including assessment of aquatic ecology, hydrological changes, risks of disturbance, and formulation of appropriate safeguard measures in consultation with the State Water Resources Department. C. River ingress study to assess the likelihood of water inflow into the mine pit and to design suitable preventive and mitigation measures. D. Provision of embankment with stone pitching on both sides (towards and outwards of the river) shall be developed with a height of 3 m above the HFL of Dudhsagar/ Kandevar River.	The integrated watershed management study, including the Catchment Area Treatment (CAT) Plan, impact assessment of Dudhsagar/Khandepar River and nearby nala(s) and river ingress study, has been prepared by Dr. K G Guptha, Retd. Prof. & Head, Goa Engineering College (Principal Consultant). The study findings, WRD recommendations and the corresponding action plan and mitigation measures have been included in the same Report. Letter is submitted on dated 28.05.2026 to WRD regarding High Flood Level (HFL) data and mining activity is not located within flood plain of Dudhsagar/ Khandepar River corresponding to one in 25 years of flood as per Ministry's O.M. dated 14/02/2022.	Annexure XXI, XXII, XXIII Annexure XVIII
1.5	PP shall submit a comprehensive transportation and material handling plan, including route map, traffic assessment, habitation impact (100 m on both sides),	The Iron Ore will be transported from the ML Area to Capxem Jetty, TPL, Fomento Jetty, Andre Minescape & Bandekar Jetty and also transport to the proposed Kalay Railway	Chapter 4 Para 4.5.8 Pg No. 232-240

	number of trips, vehicle capacity, road dimensions, traffic load, carrying capacity, and SOP for transportation from mine to destination.	Siding in Costi & in Pauskar yard Via Road through Trucks of 11.5 Tonnes capacity from where the mineral will be further supplied to JSW Steel Plants and other end users. The transportation will be carried out via three routes viz. Codli to Capxem Route, Codli to Costi Route and Puskar Yasrd Road Route. The details of no. of trips/day to and fro, capacity of the dumper/tipper to be deployed and the dimensions of the road, mitigation measures during transportation, etc. are given in this EIA/EMP report. Mineral transportation will be carried out in strict compliance with the Standard Operating Procedure (SOP) prescribed by DMG and GSPCB after consultation. A detailed Traffic Study has been carried out for the proposed mining project and the same is enclosed with this EIA/EMP Report.	Annexure XX
1.6	PP shall undertake a detailed mine safety and design study (including bench geometry, slope stability, blasting, and operational safety) in consultation with DGMS and incorporate recommendations in the EIA/EMP.	The detailed mine safety and design study, including bench geometry, slope stability and operational safety aspects, is under preparation. No drilling and blasting activities are proposed in the mine. Upon finalization of the study, the report will be submitted to DGMS and the recommendations received, if any, will be incorporated in the Final EIA/EMP Report.	-
1.7	PP shall explore the feasibility of a solar-powered jetty for mineral transportation.	JSW Steel Limited has also proposed a provision for production of Solar energy to the tune of 100 KW which will be installed within first 3-4 years and the solar power will be used in providing the sufficient power for street lights, office etc. in the mine lease area. JSW also proposed to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption.	Chapter 2 Para 2.7.2 Pg. No. 105-106

1.8	PP shall undertake prior consultation with the Central Ground Water Authority (CGWA) and/or the State Ground Water Board (SGWB) regarding groundwater abstraction, management, and associated hydrogeological aspects of the project. The recommendations, conditions, and observations provided by the concerned authority shall be duly incorporated in the EIA-EMP report, along with a clear commitment and mechanism for their implementation and compliance.	An application has been submitted to the Water Resources Department (WRD) for dewatering permission on dated 14.08.2026. Approximately 80% of the water accumulated in the mine pit comprises harvested rainwater. The detailed hydrogeological study report has been given in the Draft EIA/EMP Report. The recommendations, conditions and observations received from the concerned authority will be incorporated in the Final EIA/EMP Report, along with the proposed compliance and implementation mechanism.	Annexure VII Annexure XIX
1.9	PP needs to obtain the HFL data of the Nala and Dudhsagar/ Kandevar River from Irrigation Department. No mining shall be proposed within the HFL of Dudhsagar/ Kandevar River.	A letter has been submitted to the Water Resources Department (WRD) seeking High Flood Level (HFL) data of the Khandepar River on dated 28.05.2026. The mining lease area is located outside the flood plain of the Khandepar River. The certificate/confirmation from the concerned authority will be submitted upon receipt.	Chapter 2 Table 2.3 Pg. No. 101 Annexure XVIII
1.10	The Project Proponent (PP) shall incorporate the action plan with respect to following recommendations, made by the Goa State Pollution Control Board (GSPCB), as detailed below: a. A Comprehensive plan must be prepared by the Project Proponent (PP) to address the potential overflow of water from the open mining pit during heavy rainfall or other likelihood eventualities.	Based on the mine pit dimensions, available storage capacity and analysis of historical rainfall data of the project area, it has been assessed that the mine pit possesses adequate water holding capacity to accommodate the anticipated runoff generated during peak rainfall events. Accordingly, no overflow of water from the open mining pit is envisaged under normal monsoon conditions. Nevertheless, the JSWSL will maintain appropriate precautionary measures, including regular monitoring of pit water levels, maintenance of garland drains and settling ponds and provision of standby pumping arrangements to address any unforeseen or extreme rainfall events.	Chapter 4 Para 4.5.3.3 Pg. No. 212-214 Annexure XVII

b. Flow of groundwater also needs to be furnished. Consultations in this regard should be carried out by the PP with the Central Ground Water Authority (CGWA)/SGWB.	The groundwater flow regime and associated hydrogeological characteristics of the project area have been assessed and are presented in the Hydrogeology Report. JSWSL has submitted an application to the concerned Water Resources Department (WRD) for obtaining the necessary approvals and recommendations pertaining to groundwater abstraction and management. Upon receipt of the recommendations and approval from the concerned authority, the same will be duly incorporated into the Final EIA/EMP Report, along with a commitment for their implementation and compliance.	Annexure XIX
c. Sufficient number of Garland drains, settling ponds, and silt traps will be constructed and maintained to prevent runoff, silt, and sediment from entering the river.	Sufficient number of garland drains, settling ponds and silt traps will be constructed and maintained to prevent runoff, silt and sediment from entering nearby water bodies, including the river. At present, there are 02 settling pond present within the mine premises covering 2.0395 ha. JSWSL will operate and maintain these structures in accordance with the approved Mining Plan and implement any additional measures, if required, to ensure effective sediment control and compliance with statutory requirements throughout the life of the mine.	Chapter 4 Para 4.5.3.3 Pg. No. 212-214 Annexure XVII
d. Mine pit water will be analyzed as per GSR 422(E) Schedule-VI of Environmental Protection Act 1986 prior to discharge; further discharge into the river shall be undertaken only after ensuring compliance with prescribed standards and as per the recommendations/permission of the State Water Resources Department (WRD).	The mine pit water has accumulated over the last eight years, during which no mining activity was carried out and no hazardous chemicals were used in the mine. The pit water has been analyzed by a MoEF&CC-accredited laboratory and all parameters were found to be within the prescribed limits. An application/letter has been submitted to the Water Resources Department (WRD) and the recommendations received from the concerned authority will be incorporated in the Final EIA/EMP Report. Analysis report is attached with the Draft EIA/EMP Report.	Chapter 4 Table 4.17 Pg. No. 214 Annexure XIX

e. Regular River water quality monitoring will be carried out at upstream and downstream locations, and monitoring records shall be submitted to GSPCB & WRD every month.	Once mining operations commence, regular river water quality monitoring will be carried out at upstream and downstream locations. The monitoring records and analytical results will be submitted to the Goa State Pollution Control Board (GSPCB) and the Water Resources Department (WRD) on a monthly basis.	-
f. A Greenbelt will be developed along the lease boundary facing the river, using native species, to act as a protective barrier and to safeguard the river ecosystem.	There is total 17.45 ha area will be covered under greenbelt development at 7.5 m mine lease boundary. This will also include the greenbelt which will be developed along the lease boundary facing the river. Indigenous & fruit bearing species will be planted by JSW in consultation with local forest department will be such as Terminalia tomentosa, Terminalia bellerica, Bauhinia species, Teak, Cassia fistula, Arjun, Assan, Lagerstromia species, Shiwan, Ficus species, Pongamiapinnata, Reetha, Rain tree, Pangara, Peltoforum, Palas, Saton, Mahagony, bamboo species etc.	Chapter 4 Para 4.5.9.6 & 4.5.9.7 Table 4.32 Pg No. 243- 244
g. The Project Proponent shall prepare a detailed plan, including a mandatory buffer zone or no activity zone of suitable width, to safeguard the Khandepar River, which flows just 0.01 km from the eastern boundary of the mining lease area. GSPCB and Goa Water Resources Department (WRD) shall be consulted in this regard.	A 50 m buffer zone will be maintained along the SE boundary of the mining lease to ensure the safety and protection of the Khandepar River. Appropriate mitigation measures will be implemented throughout the mining operations to safeguard the river from any adverse environmental impacts.	Chapter 4 Para 4.5.3.1 Pg. No. 209- 211 Annexure XVIII
h. The Project Proponent shall consult the Goa Water Resources Department or an institute of national repute to obtain the High Flood Level (HFL) data for the Khandepar River and the seasonal nallah flowing within the mining lease area.	Letter is submitted on dated 28.05.2026 to WRD regarding High Flood Level (HFL) data and mining activity is not located within flood plain of Dudhsagar/ Khandepar River corresponding to one in 25 years of flood as per Ministry's O.M. dated 14/02/2022.	Annexure XVIII
i. The primary concern to be addressed on priority is that pollutants/silt shall not directly enter the Khandepar River, and mining shall not be conducted close to the river. A buffer zone of at least 50 m shall be maintained from the lease boundary along	There is no mining activity proposed within the safety buffer zone adjoining the river and a minimum buffer distance, as stipulated in the approved mining plan and statutory clearances, will be maintained. JSWSL will undertake all necessary precautionary	Chapter 4 Para 4.5.3.1 Pg. No. 209- 211 Annexure XVIII

	its south-eastern end.	measures to ensure that no pollutants or silt enter the Khandepar River prior to and during mining operations.	
	j. Mining operations may be optimized by utilizing dewatering water for recharging the riverine system downstream and for consumptive uses, with proper coordination with the Goa WRD and adoption of suitable management practices.	JSWSL will optimize the utilization of dewatering water for beneficial uses, including downstream river recharge and other consumptive purposes, wherever feasible. Such utilization will be undertaken in coordination with the Goa Water Resources Department (WRD) and in accordance with the recommendations and suitable water management practices prescribed by the concerned authorities.	Chapter 4 Para 4.5.3.1 Pg. No. 209-211 Annexure XVIII
1.11	PP shall implement integrated surface water, drainage and runoff management measures including garland drains, settling ponds, silt traps, diversion of runoff to pits, and prevention of contaminated discharge into natural drains.	No waste water/untreated water will be discharged in any natural water bodies located near the block area. During Plan Period 1682 m length retaining wall and 1682 m length garland drain will be constructed around the working mine pits, waste dump to channelize rain water flowing into working mine pit and if required then 02 nos. of settling ponds with 100000 Cum capacity will be constructed within block to check flow of surface runoff as well as to prevent siltation of natural courses.	Chapter 4 Para 4.5.3.3 Pg. No. 212-214 Annexure XVII
1.12	PP shall ensure zero discharge outside ML area by preparing a plant-specific water balance plan integrating mine water and beneficiation water demand with maximum reuse.	There is no discharge of water during wet beneficiation process. The total water will recirculate in process and make water is required 1716 KLD which will be fulfilled from Mine Sump water. Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled. Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank.	Chapter 4 Para 4.5.3.2 & 4.5.3.3 Pg. No. 212-214
1.13	PP shall design and install appropriate wastewater treatment systems including ETP with oil & grease traps and ensure compliance with prescribed discharge standards.	An Effluent Treatment Plant with oil & grease trap will be constructed near Workshop. These facilities will be developed before the commencement of mining operations. No	Chapter 2 Para 2.7.1 Pg No. 103-105

		wastewater will be generated from the mining activities. Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled. Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank.	
1.14	PP shall prepare a geo-referenced (KML) layout of the beneficiation plant showing all components including crushers, screening units, tailing areas, drainage, pits, and environmental sensitivities.	A geo-referenced (KML) layout of the beneficiation plant showing all components including crushers, screening units, tailing areas, drainage, pits, and environmental sensitivities is given in this EIA/EMP Report.	Chapter 2 Para 2.3.3 Figure No. 2.4 Pg No. 97-98
1.15	PP shall justify siting of crushers and screening units considering wind direction, forest areas, and nearby habitations.	The proposed crusher and screening units are planned within the existing infrastructure area established by the erstwhile lessee; accordingly, no additional land disturbance is envisaged. The selected location has been retained after considering the prevailing wind direction, nearby forest areas and surrounding habitations. The forest area at the proposed site was already disturbed by the erstwhile lessee. Further, there are no habitations within a 1.0 km radius of the proposed crusher and screening units. The predominant wind direction in the project area is from North-West (NW) to South-East (SE). A few habitations are located within a 2.0 Km radius in the downwind directions i.e., the North East (for the South West wind) and South East (for the North West wind), from the mining lease boundary. Appropriate environmental mitigation measures, including dust suppression and regular environmental monitoring, shall be implemented during operations.	Chapter 4 Para 4.5.6.4.1 Pg. No. 228-230
1.16	PP shall prepare a site-specific tailings/ slimes management plan including in-pit disposal, embankment stability, and prevention of overflow.	About 0.628 Million TPA of tailings will be generated in the form of filter press cake with a moisture content of approximately 10–12% and an Fe content of 27.83%. The generated	Chapter 2 Para 2.7.7.5 Pg No. 123

		tailings shall be temporarily stacked in the designated area and subsequently transported for disposal at waste dump in accordance with the approved Mining Plan.	
1.17	PP shall prepare detailed design of slurry handling, containment systems, and emergency control measures.	No slurry handling is proposed within the lease area. The tailings generated from the beneficiation process will be dewatered using a filter press system to produce filter press cake with a moisture content of approximately 10–12%. Accordingly, no slurry containment systems are required, and the filter press cake shall be managed and disposed of in the designated waste dump area as per the approved Mining Plan.	Chapter 2 Para 2.7.7.5 Pg No. 123
1.18	PP shall submit a synchronized mine - beneficiation plan aligned with production capacity to avoid excess stockpiling.	JSW Steel Limited is proposed One 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA will be installed within the ML area.	Chapter 1 Para 1.3.1 Table 1.2 Pg. No. 88
1.19	PP shall explore renewable energy use and submit a detailed plan for increased adoption. PP needs to clarify through the scientific studies whether there is any chance of water ingress in the mine from Northern side (i.e. river side) of the ML area.	JSWSL proposes to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption. The detailed renewable energy adoption plan shall be included in the Final EIA/EMP Report. The hydrogeological investigations indicate the presence of a phyllitic clay layer within the mine area, which acts as an impervious barrier and restricts the movement of groundwater. Further, JSWSL will maintain a 50 m safety buffer along the nalla in accordance with the approved Mining Plan and statutory requirements. Accordingly, the possibility of water ingress from the northern side (river side) into the Mining Lease area is considered minimal. The River Ingress Study has been prepared and its findings are given in River Ingress Study which is enclosed with this Draft EIA/EMP Report.	Chapter 2 Para 2.7.2 Pg. No. 105-106 Annexure XXIII

1.20	PP shall consult the Directorate General of Mines Safety (DGMS) on safety aspects related to potential water ingress from the river flowing along the northern side, after sharing the hydrological study with DGMS.	The River Water Ingress Study is currently under preparation. Upon finalization of the study, the report will be submitted to the Directorate General of Mines Safety (DGMS) for review and recommendations pertaining to mine safety aspects related to potential water ingress. The recommendations received from DGMS will be duly incorporated in the Final EIA/EMP Report and implemented during mining operations.	-
1.21	PP should explore the extraction of Iron Ore from BHQ through latest available technologies. Appropriate R& D should be conducted /done in this regard. Consultation with Indian Bureau of Mines should also be done in this regard along with other institutes of national repute.	During the present plan period, no Banded Hematite Quartzite (BHQ) is envisaged to be encountered within the proposed mining area. However, if BHQ is encountered during subsequent plan periods, JSWSL will undertake appropriate studies to explore the feasibility of Iron Ore extraction using the latest available technologies. Necessary consultations with the Indian Bureau of Mines (IBM) and other institutes of national repute will also be undertaken, as applicable.	-
1.22	PP needs to submit a detailed transportation and material handling plan as part of the EIA/EMP, covering transportation from Mine to Capxem Jetty and Proposed Railway Sidings Via SH-7 & other connecting road. The plan shall clearly indicate the mode-wise breakup of material transport (conveyor/rail/road), measures for dust suppression and pollution control, traffic management, and mitigation of impacts on nearby habitation.	Two scenarios have been considered for the transportation of Iron Ore, i.e., transportation through jetties and railway sidings. In the initial scenario, a total quantity of 3.5 Million TPA of Iron Ore will be transported through jetties until the railway siding becomes operational. Subsequently, upon commissioning of the Railway Siding, 1.5 Million TPA of Iron Ore will be transported through the railway mode. Accordingly, the quantity of Iron Ore transported by jetties will be reduced, which will consequently result in a reduction in emissions associated with road transportation. A proper mitigation measures for transport of mineral via road through sea and rail route will be maintained. A detailed Traffic Study have been carried out and same is enclosed with this Draft EIA/EMP Report.	Chapter 4 Para 4.5.8 Pg No. 232-240 Annexure XX

1.23	Project proponent needs to submit the detailed scientific plan for constructing the retaining wall/other structures so that there is no flow of dump/ore silt outside the lease area.	No waste water/untreated water will be discharged in any natural water bodies located near the block area. During Plan Period 1682 m length retaining wall and 1682 m length garland drain will be constructed around the working mine pits, waste dump to channelize rain water flowing into working mine pit and 02 nos. of settling ponds with 100000 Cum capacity will be constructed within block to check flow of surface runoff as well as to prevent siltation of natural courses.	Chapter 4 Para 4.5.3.3 Pg. No. 212-214 Annexure XVII
1.24	The Project proponent needs to submit a detailed plan showing more use of renewable energy in the project.	JSW Steel Limited has also proposed a provision for production of Solar energy to the tune of 100 KW which will be installed within first 3-4 years and the solar power will be used in providing the sufficient power for street lights, office etc. in the mine lease area. JSW also proposed to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption.	Chapter 2 Para 2.7.2 Pg. No. 105-106
1.25	Project Proponent shall submit the drone video & photographs of the ML area and transportation route proposed for this project with special focus on the sensitive receptors in the ML area and in the transportation route.	Real time aerial footage and video of the mine lease area and buffer area through Drone Survey will be presented during the appraisal of EAC.	-
1.26	Site Specific Wildlife Conservation Plan shall be prepared and approved by the DFO/ PCCF Wildlife for the Schedule – I species present within the ML area.	As per the provisions of the Wild Life (Protection) Amendment Act, 2022, a total of 19 Schedule-I species has been identified within the study area, comprising 10 mammal species, 4 reptile species, and 5 avifaunal species. A Site-Specific Wildlife Conservation Plan has been prepared in accordance with the guidelines issued by the Forest Department, Government of Goa, covering appropriate conservation and protection measures for the identified Schedule I species. The Wildlife Conservation Plan has been	Chapter 3 Para 3.17.3 Page No. 173 Annexure XIV & XV

		submitted to the Deputy Conservator of Forests (DCF), Goa, for approval on dated 10.08.2026. A budget provision of ₹50.90 Lakhs has been earmarked towards the implementation of conservation measures for Schedule-I species in connection with the proposed Iron Ore Mine. The approved conservation measures will be implemented in consultation with and as per the directions of the competent Forest/Wildlife authorities.	
1.27	Biodiversity analysis of the core zone and buffer zone of the ML area shall be done through any reputed institutions having NABET accreditation. The study report shall inter-alia include impact of mining on flora and fauna and action plan for complying with the mitigation measures shall be submitted.	Biodiversity analysis of the core zone and buffer zone of the ML area has been done through J.M. EnviroNet Pvt. Ltd. which is accredited with ISO-9001: 2015 for EIA Division. EIA Division is also approved by National Accreditation Board for Education & Training (NABET) formerly NRBPT (Quality Council of India), Certificate no. NABET/EIA/26-29/RA 0504, dated 06.08.2026 which is valid up to 07.08.2029. The biodiversity study has assessed the existing flora and fauna of the core and buffer zones and evaluated the potential impacts of the proposed mining activities on biodiversity. Based on the findings, appropriate mitigation measures and an action plan have been incorporated into the Environment Management Plan (EMP).	Chapter 3 Para 3.17.3 Page No. 173 Annexure XXV Annexure XV
1.28	The Project Proponent needs to monitor the ambient air quality and noise level at the mine lease boundary, nearest village, proposed crusher & beneficiation plant, predominant downwind direction and at other sensitive receptors. Accordingly, Project Proponent shall propose to install Continuous Ambient Air Quality Monitoring Stations within certain timeline.	Annual as well as seasonal micro-meteorological data was collected from the nearest IMD station i.e. Mormugao, to access the annual wind pattern of this area. As per the data, pre-dominant wind direction throughout the year was observed from SW and Seasonal was observed from NW, according to which, the site selection for assessing the ambient air quality within the 10 km from the mine site is done in the upwind and downwind of dominant wind direction. Meteorological station was also set-up at site	Chapter 3 Para 3.12 Pg No. 148 Chapter 3

		to record surface meteorological parameters during Summer Season (March to May, 2025). The Ambient Air Quality and Noise Level monitoring has been carried out at the mine lease boundary, nearest village, crusher, predominant downwind direction and at other sensitive receptors. Same are given in this EIA/EMP Report. Considering the climatological data about wind direction (predominant wind directions) and surroundings, 01 nos. of CAAQMS will be installed within the mine. The details of Action plan for installation of CAAQMS along with timeline is given in this EIA/EMP Report.	Para 3.12.1 Pg No. 150 Chapter 4 Para 4.5.1.2.12 Table No. 4.13 Page No. 203-205
1.29	The Project Proponent should prepare the EMP considering the scenario of pollution to be generated for normative and peak total excavation for assessing air pollution, noise level and ground vibration.	EMP has been prepared considering the scenario of pollution to be generated for normative (Overall production 39034 TPD) and peak (Overall production 46841 TPD) considering rain and exigency production for assessing air & noise pollution and ground vibration due to HEMM. In EMP, budget proposed for monitoring and sampling is Rs. 544.02 Lakhs as Capital Cost and Rs. 117.0 Lakhs/Annum as Recurring Cost.	Chapter 10 Para 10.4 Table 10.2 Pg No. 299
1.30	The Project Proponent needs to carry out the Public Hearing as per provisions of EIA Notification, 2006. PP should also submit the time bound action plan on concerns of the public through a separate budget with capital expenditure with a timeline of 3 years. The Project proponent shall ensure that the activities proposed under the public hearing shall be different from the CSR activities. PP needs to submit a tangible and monitorable action plan for meeting the public hearing commitments.	Public hearing is yet to be conducted and same will be carried out as per provisions of EIA Notification, 2006. The company will propose a detailed time bound action plan along with budgetary allocation after conduction of Public Hearing considering issues raised during public hearing on the basis of MoEF&CC, OM dated 30.09.2020 & 20.10.2020 and will be submitted with the Final EIA/EMP Report.	-
1.31	The Project Proponent needs to undertake the enumeration of the species within the mine lease area before cutting. The Project Proponent also needs to submit the	Tree enumeration has been carried out in the forest land within the Mining Lease area, wherein approximately 4,007 trees were identified. Out of these, 4,004 trees are	Chapter 4 Para 4.5.9.2 Page No. 241

	compensatory afforestation plan for the number of trees to be cut in the mine lease area and also to explore the possibility of tree transplantation.	Acacia species and the remaining 3 trees are Cashew species. JSWSL will undertake final tree enumeration prior to commencement of tree cutting. The compensatory afforestation plan for the trees proposed to be felled will be prepared and implemented as per the directions and conditions of the concerned Forest Department, Goa. The feasibility of tree transplantation will also be explored for suitable trees, wherever technically feasible.	
1.32	The Project Proponent needs to submit the action plan for undertaking the plantation along the 7.5m barrier, safety zone of tar road/cart tracks, electric line etc., PP should also submit the details of numbers of saplings to be planted (2500/ha), type of saplings proposed and the area to be covered under greenbelt/plantation along with the timeline and budget. The greenbelt/plantation plan shall be prepared in such a way that the ecology of the area shall be restored. Miyawaki plantation technique in atleast 20 % of the overall plantation. PP also needs to submit an action plan for development of greenbelt around crusher and beneficiation plant.	According to Greenbelt/ Plantation development plan, Greenbelt along 7.5m lease periphery will be started in between 1st to 5th year of mine operation (area covered: 1.5 ha) and will be complete at Conceptual stage covering a total area of 17.45 ha. 51.95 ha area will be backfilled and subsequently rehabilitated through plantation & regrassing, 6.87 ha on dump plantation and 26.1582 ha area under tailing dam rehabilitated by plantation. Thus, total area to be covered under the greenbelt/plantation will be 102.4282 ha. Out of which 20% is 20.49 ha which 10.24 ha will be developed on the backfilled area and remaining 10.25 ha will be developed on tailing dam area using the Miyawaki plantation technique at an estimated development cost of Rs. 40 lakhs Capital Cost and Rs. 4.0 Lakhs/annum as Recurring Cost. Remaining (102.4282 – 20.49 = 81.9382 ha) will be developed as 2500/ha saplings. Thus, total nos. of saplings are 204846 @2500/ha. Budget allocated for greenbelt/plantation till the end of life of mine is Rs. 145.02 Lakh including Miyawaki Plantation. The budget includes the cost of Saplings, Watering facilities, Labour Charge, Organic manure, Bio-fertilizers, Maintenance, fencing etc., which may vary in due course of time.	Chapter 4 Para 4.5.9.7 Pg No. 243-245

		Suitable local, native and fruit-bearing species shall be planted in consultation with the Forest Department and as per applicable CPCB guidelines. Plantation shall be carried out at approximately 2,500 saplings/ha, with a minimum 80% survival rate. JSWSL will undertake phase -wise plantation around the Crusher and Beneficiation Plant. High-canopy and suitable native tree species will be planted to develop a greenbelt and help control dust, noise, and other environmental impacts.	
1.33	The Project Proponent shall carry out the assessment of impact due to the proposed project as per the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP.	A Hydrogeological Report, including Groundwater Impact Assessment and Groundwater Modelling, has been prepared by M/s J.M. EnviroNet Pvt. Ltd., accredited by NABET for the relevant scope. Groundwater modelling has been carried out to assess the potential impact of the proposed project on groundwater resources as per the SOP issued by the Central Ground Water Authority (CGWA). The Hydrogeological Report has been submitted to the Water Resources Department (WRD), Government of Goa. The details of the groundwater assessment and modelling are provided in the Hydrogeological Report enclosed with the EIA/EMP Report.	Chapter 4 Para 4.5.3.2 & 4.5.3.3 Pg. No. 212-215 Annexure XIX
1.34	The project proponent shall conduct hydrological study for projects involving intersection of ground water table as per the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP.	A Hydrogeological Report, including Groundwater Impact Assessment and Groundwater Modelling, has been prepared by M/s J.M. EnviroNet Pvt. Ltd., accredited by NABET for the relevant scope. Working depth during the plan period will be 112 m bgl and at conceptual stage, ultimate working depth will be 164.48 m bgl. According to ground water level monitoring, it is found that the depth of water level in core zone during pre-monsoon is around 16.0 m bgl and during post-monsoon season it rises slightly to 15.0 m bgl. Hence, the groundwater will be	Chapter 4 Para 4.5.3.2 Page no. 212 Annexure XIX

		intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026.	Annexure VII
1.35	The Project Proponent shall explore the possibility of reduction of specific water requirement by optimization / technology up gradation, etc. The efforts shall be delineated in the EIA/EMP.	The total water requirement for the proposed mining project is estimated at 1,716 KLD, which will be met mainly from mine sump water and well water for drinking purposes. Water conservation and recycling measures have been proposed to reduce the specific water requirement. 92.1% of the water used in the beneficiation plant will be recycled through concentrate thickeners, tailings thickener, and pressure filters for recovery and reuse of process water. Wastewater from the workshop will be treated through an oil and grease separator and reused for dust suppression. Water from the wheel wash system will also be recycled and reused. Domestic wastewater from the mine office, toilets, and canteen will be treated through a septic tank and soak pit.	Chapter-2 Para 2.7.1 Page no. 103 Chapter 2 Para 2.7.4.1 Page No. 108-109
1.36	The Project Proponent shall prepare the scheme for mandatory recycle/re-use of water as specified by the Central Ground Water Authority for different category areas.	The total water requirement for the proposed mining project is estimated at 1,716 KLD, which will be met mainly from mine sump water and well water for drinking purposes. As per the Central Ground Water Authority (CGWA) guidelines, the project area falls under the Safe Category in South Goa District. JSWSL has proposed mandatory recycling and reuse of water to conserve water resources. Approximately 92.1% of the water used in the beneficiation plant will be recycled and reused through concentrate thickeners, tailings thickener, and pressure filters. The detailed water balance and water recycling/reuse scheme are provided in the EIA/EMP Report.	Chapter-2 Para 2.7.1 Page no. 103 Chapter 2 Para 2.7.4.1 Page No. 108-109 Figure 2.6, 2.7 Pg. No. 104, 105

1.37	The Project Proponent needs to submit the plan for Socio economic development of the neighbourhood's habitats based on the need-based survey along with the time bound action plan in consultation with the local people. Inclusive development with initiatives focused on employment generation, educational support, healthcare facilities for the local communities be planned.	The total mining lease area is 377.0881 ha (Govt. revenue land – 236.3482 ha, Private land – 58.9087 ha, Alvara land – 15.8626, Forest land – 65.9686 ha). There is no any habitation present within the Mineral Block. Hence, no displacement of human settlement is proposed. JSW Steel Limited shall adopt the surface rights procedure for use of land required for the proposed mining project and there is no proposal of land acquisition. The mining lease area comprises private and government land. Surface rights over the land required for mining operations shall be acquired through mutual agreement and payment of compensation, in accordance with the provisions of the Goa Daman & Diu Land Revenue Code, 1968 and the MMDR Act, 1957, prior to commencement of mining operations.	Chapter 7 Para 7.3 Pg No. 264
1.38	The Project Proponent shall provide the details of Special Pollution Control/ Abatement devices that have been installed/ proposed to be installed within the ML area and how does the technology compare with the best available technology in the field.	Permanent water sprinklers will be installed along main haul roads. Bag filter will be provided with crusher. Mist fog system (Atomized water sprinkler) will be installed near the unloading points of the mineral. Modern fuel-efficient machinery will be deployed. Mechanized road sweeping machine will be used for cleaning the public road. Wheel wash arrangement will be provided during the exit of trucks from the mine. 01 nos. of Continuous Online Ambient Air Monitoring stations will be installed and regular ambient air quality monitoring will be carried out.	Chapter 4 Para 4.5.1.2.12 Page No. 203-205
1.39	PP should ensure that all the documents including the approved Mining plan and EIA /EMP should be in consonance with each other.	All documents including Approved Mining Plan and EIA/EMP are consonance with one another and all documents are in the name of JSW Steel Ltd.	-
1.40	The Project Proponent needs to prepare the installation plan for permanent fixed water sprinkling system along the Haul roads.	Permanent fixed water sprinklers will be installed along the Haul Roads. The installation plan for the permanent fixed	Chapter 4 Para 4.5.1.2.12 Pg No. 205

	Installation of fog canons at necessary locations in the project should also be planned.	water sprinkling system and fog canons have been incorporated the EIA/EMP Report.	
1.41	The Project Proponent needs to prepare plan to develop the treatment facility for wastewater within the ML area.	An Effluent Treatment Plant with oil & grease trap will be constructed near Workshop. These facilities will be developed before the commencement of mining operations. No wastewater will be generated from the mining activities. Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled. Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank.	Chapter 2 Para 2.7.1 Pg No. 103-105
1.42	The Project Proponent needs to submit employment-based skill development plan for the local people, and thrust should be to provide employment to local people after imparting training.	The skill development training programs are designed on the basis of identification of local needs based on their qualification, eligibility and requirement in the project and nearby industries. The budget proposed for skill development program is Rs. 790 Lakhs.	Chapter 8 Para 8.2.2.1 Table 8.1 Pg No. 283-284
1.43	PP needs to project & submit year wise back filling plan.	The erstwhile lessee has already backfilled an area of 51.95 ha within the lease area. During the First Block Period, no backfilling is proposed in the mine. From the 6th year onwards, progressive backfilling of the mined-out areas will be undertaken as per the mine development sequence. The proposed backfilling area from the 6 th to 14 th year is 141.48 ha, with a total backfilling quantity of approximately 45.588 million tonnes. The backfilled areas will be properly graded and stabilized, with adequate drainage arrangements and subsequent plantation/reclamation measures to ensure safe and sustainable restoration of the mined-out areas.	Chapter 2 Para 2.7.7.5.3 Table 2.34 & 2.35 Pg. No. 125

		S.N.	Year	Total Quantity (Tonnes)	Area (In ha)	
		1	6 th year	4.41	8.56	
		2	7 th year	4.36	15.28	
		3	8 th year	4.59	25.86	
		4	9 th year	4.25	31.85	
		5	10 th year	4.42	37.82	
		6	11 th year	5.79	2.48	
		7	12 th year	6.09	4.86	
		8	13 th year	6.00	6.54	
		9	14 th year	5.68	8.23	
		Total		45.59	-	
1.44	The Project Proponent (PP) shall conduct a pit slope stability study through a reputed institute, covering all safety aspects, including the height and angle of slopes of OB dumps, and incorporate the findings along with a compliance commitment in the EIA/EMP report.	The Pit Slope Stability Study, covering all relevant safety aspects including the height and angle of slopes of the mine pits and OB dumps, is currently under preparation by NITK Surathkal, a reputed national-level institute. The study report is awaited. Upon receipt, the findings and recommendations of the study will be duly incorporated in the Final EIA/EMP Report, along with a commitment for implementation of the recommended safety measures.				-
1.45	PP need to assess impact on nearby villages, traffic, and state highway due to mining operations including blasting and transportation. Necessary consultation/permissions from DGMS may be taken in this regard. PP needs to take mitigation measures including dust suppression, traffic management, noise reduction, and health safeguards based on public hearing/stakeholder consultations.	Traffic impact assessment has been carried out considering the existing and proposed traffic volume. Adequate mitigation measures, including regular water sprinkling on haul roads, covering of mineral carrying trucks, maintenance of internal rads, speed control, designated transportation routes, installation of traffic signages and periodic vehicle maintenance have been proposed to minimize dust, noise and traffic congestion. No blasting operations will be carried out. Public hearing issues related and stakeholder concerns related to transportation, dust, noise and safety have been addressed through the Environment Management Plan. Detailed Traffic impact assessment study is enclosed with this EIA/EMP Report.				Chapter 4 Para 4.5.8 Pg No. 232-240 Annexure XX

1.46	PP is required to conduct a cumulative impact assessment including the adjacent mines. This assessment should encompass key factors, including water requirements, air, water, noise pollution levels, power consumption, transportation logistics, waste management practices, and the combined emissions load from projects effects on flora & fauna, etc. EMP should be prepared accordingly.	The impact assessment for the proposed Iron Ore mining project has been done and the mitigation measures have been incorporated in this EIA/EMP Report.	Chapter 4 Para 4.5 Pg No. 196 Annexure XXIV
1.47	Since the volume of OB dumps is increasing manifold, catchment area treatment plan can be prepared in consultation with reputed institute. Planning should be such that there are no chances of silt flow outside the ML area. Catch drains, Siltation ponds, retaining walls, gabions structures, check dams, etc. shall be planned accordingly and submitted with locations, drawing/ layouts.	The integrated watershed management study, including the Catchment Area Treatment (CAT) Plan, impact assessment of Dudhsagar/Khandepar River and nearby nala(s) and river ingress study, has been prepared by Dr. K G Guptha, Retd. Prof. & Head, Goa Engineering College (Principal Consultant). The study findings, WRD recommendations and the corresponding action plan and mitigation measures have been included in the same Report and enclosed with this EIA/EMP Report.	Annexure XXI, XXII, XXIII
1.48	PP should plan and submit pollution control measures at Railway Sidings as per CPCB guidelines including permanent water sprinkling system, greenbelt development, metal windscreens, etc.	Regular water sprinkling on mine haul roads during transportation and at transfer points. Use of mechanized road sweeping machine for cleaning public road & railway sidings. Installation of metal windscreens at Railway Sidings. JSW will develop an additional greenbelt/plantation near the proposed Kalay Railway Siding at Costi & Pauskar yard in accordance with the CPCB guidelines. A total of 2500 saplings will be planted over an area of 1.0 ha. Proper protective and safety measures will be implemented along the railway route in accordance with the guidelines and safety requirements prescribed by the Ministry of Railways.	Chapter 4 Para 4.5.8.1 Pg No. 237 Annexure XX

1.49	Project Proponent should clearly bring out that what is the specific diesel consumption ~ (Liters/Tonne of total material handled) and steps to be taken for reduction of the same. The year-wise target for reduction in the specific diesel consumption needs to be submitted. PP shall also explore the possibility of using e-vehicles/LPG/CNG-based machinery and HEMM trucks for the operation and transportation of limestone.	The company will adopt specific measures for reduction of diesel consumption and will also explore the provision of use of e-vehicles/LPG/CNG-based machinery and HEMM trucks within the ML area in order to reduce dependency upon diesel. Detailed for steps to be taken for reduction of diesel consumption are given in this EIA/EMP Report.	Chapter 2 Para 2.7.2 Pg. No. 105-106
1.50	Project proponent is advised to implement the 'Ek Ped Maa Ke Naam' Campaign which was launched on 5th June 2024 on the occasion of the World Environment Day to increase the forest cover across the Country. This plantation drive is other than Greenbelt development.	The total area covered under Greenbelt and plantation will be 102.4282 ha. JSW will develop an additional greenbelt/plantation near the proposed Kalay Railway Sidings at Costi & Pauskar yard in accordance with the CPCB guidelines. A total of 2500 saplings will be planted over an area of 1.0 ha. A budget of Rs. 2.50 Lakhs (Capital cost) has been earmarked for this activity. The plantation will be undertaken under the 'Ek Ped Maa Ke Naam' campaign which was launched on 05.06.2024 on the occasion of World Environment Day to enhance the country's forest cover.	Chapter 4 Para 4.5.9.7 Pg No. 243-245
1.51	Necessary coordination shall be made with concerned SPCB (who is responsible for Compliance of OM dated 14.01.2025 & 08.10.2025) regarding streamlining the implementation of GSR 702 and GSR 703 dated 12.11.2024 through which projects requiring prior EC were exempted from requirement of CTE.	Noted and will be complied with.	-
B.	Standard Terms of Reference for (Mining of minerals)		
1.1	Year-wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification 1994 came into force, w.r.t. the highest production achieved prior to 1994.	This is a proposed Iron Ore mining project therefore; past production details are not applicable. Mine will be operated after obtaining all the statutory clearances from the competent authority.	--

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

ToR Compliance

1.2	A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given.	JSW Steel Limited has been successfully declared as the “Preferred Bidder” through e-auction conducted by Govt. of Goa, for the Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) through e-auction conducted by Government of Goa. The Letter of Intent (LoI) was issued in favour of JSW Steel Limited vide letter no. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024 by Directorate of Mines & Geology, Govt. of Goa. Copy of Letter of Intent is enclosed with this EIA/EMP Report.	Chapter 1 Para 1.2.1 C Pg No. 86 Annexure I																			
1.3	All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.	All documents including Approved Mining Plan and EIA are compatible with one another in terms of mine area, production levels, waste generation & its management and mining technology etc. and all documents are in the name of JSW Steel Ltd.	-																			
	<table><tr><th>S.N.</th><th>Particular</th><th>Description</th><th>Ref. Approved Mining Plan</th><th>Ref. in EIA/EMP Report</th></tr><tr><td>1.</td><td>Mine Lease Area</td><td>377.0881 ha</td><td>Chapter 1, Pg No. 3</td><td>Chapter 1 Para 1.1 Pg No. 85</td></tr><tr><td>2.</td><td>Production Capacity</td><td>➤ Iron Ore Production: 3.50 Million TPA ➤ OB/Waste: 8.21 Million TPA Total Excavation: 11.71 Million TPA 03 Primary Crushers: 1 x 250 TPH & 2 x 90 TPH 01 Secondary Crusher: 150 TPH Dry Processing/Screening Plant: 600 TPH Wet Beneficiation Plant with throughput capacity 3.50 Million TPA: 2 x 300 TPH</td><td>Page no. 102 4A.3.2</td><td>Chapter 1 Table 1.2 Pg No. 88</td></tr><tr><td>3.</td><td>Mining Technology</td><td>Fully Mechanized Opencast Mining</td><td>Chapter 2, Para 2A.2.4.5 Pg No. 54</td><td>Chapter 1 Table 1.2 Pg No. 88</td></tr></table>	S.N.	Particular	Description	Ref. Approved Mining Plan	Ref. in EIA/EMP Report	1.	Mine Lease Area	377.0881 ha	Chapter 1, Pg No. 3	Chapter 1 Para 1.1 Pg No. 85	2.	Production Capacity	➤ Iron Ore Production: 3.50 Million TPA ➤ OB/Waste: 8.21 Million TPA Total Excavation: 11.71 Million TPA 03 Primary Crushers: 1 x 250 TPH & 2 x 90 TPH 01 Secondary Crusher: 150 TPH Dry Processing/Screening Plant: 600 TPH Wet Beneficiation Plant with throughput capacity 3.50 Million TPA: 2 x 300 TPH	Page no. 102 4A.3.2	Chapter 1 Table 1.2 Pg No. 88	3.	Mining Technology	Fully Mechanized Opencast Mining	Chapter 2, Para 2A.2.4.5 Pg No. 54	Chapter 1 Table 1.2 Pg No. 88	
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	4.	Waste Generation & its Management	Top Soil: There is no Top Soil present in the ML Area. Waste: Presently, there is total 6 waste dump out of which 4 dumps have 8.96 Million Tonnes waste present in 32.23 ha at the mine site. In the mine site, 2 waste dumps are also present which are stabilized by plantation. During Plan Period, approx. 23.43 Million Tonnes of Waste will be generated which will be dumped in existing waste dump D4 and in 2 new dumps over an area of 46.84 ha at their designated place. At Conceptual Stage, 68.0 Million Tonnes of waste will be generated which will be used in backfilling in the mined-out area. Tailing Disposal Plan: About 0.628 Million TPA of tailings will be generated in the form of filter press cake with a moisture content of approximately 10–12% and an Fe content of 27.83%. The generated tailings will be temporarily stacked in the designated area and subsequently transported for disposal at waste dump in accordance with the approved Mining Plan.	-	Chapter 2 Para 2.7.7.5 Pg No. 123
1.4	All corner coordinates of the mine lease area, superimposed on a High-Resolution Imagery/ toposheet, topographic sheet, geomorphology and geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).		Geology of the Area: Goa is dominantly covered by the rocks belonging to Archaean Dharwar Super Group referred in Goa as Goa group and the Codli Mineral block comprises rocks belonging to Bicholim Group of rocks Formation of Dharwar Supergroup. The iron ore deposits are found in small mounds of hillocks in a generally low undulating landmass and are locally known as Codli-Daucona hillock. Map showing area with geographical extents, geomorphology and geology of the area, superimposed on Toposheet are incorporated in this Final EIA/EMP Report. Land use/Land cover and Ecological Features: The map clearly depicts the land use/land cover and other ecological features of the		Chapter 2 Para 2.7.5 Pg No. 109 Chapter 2 Para 2.3.1 Figure 2.2 & 2.3 Pg No. 95-96 Chapter 3 Figure 3.1 Page No. 131 Figure 3.5 & 3.6

		study area, covering both the core and buffer zones. The relevant maps are provided in the EIA/EMP Report.	Pg No. 140, 142
1.5	Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.	Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, important water bodies, streams, river and soil characteristics. Map showing Geomorphology of land form of the area, existing minerals and mining history of the area, same details given in this EIA/EMP Report. Nallah/Stream: A water body Khandepar river is present at Adjacent in North direction. Other than this, Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Sanguem or Zuvari River, Jamboli Nala and Paroda River are also present in within the 10 Km radius of study area.	Chapter 2 Figure 2.2 & 2.3 Pg No. 95, 96 Chapter 3 Table 3.1 Page No. 129 Figure 3.1 Page No. 131
1.6	Details about the land proposed for mining activities should be given with information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.	The Letter of Intent (LoI) was issued in favour of JSW Steel Limited vide letter no. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024 by Directorate of Mines & Geology, Govt. of Goa. Copy of Letter of Intent is enclosed with this EIA/EMP Report. The area of proposed mine is 377.0881 ha which spreads in only 1 revenue Village namely Codli. Out of the total mining lease area, 236.3482 ha is Govt. land, 58.9087 ha is Private Land, 15.8626 ha is Alvares land & 65.9686 ha is Forest Land. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I.	Chapter 1 Para 1.2.1 C Pg No. 86 Annexure I Chapter 2 Para 2.3.2 Pg no. 97 Annexure III

1.7	It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the EIA Report.	Yes, the company has well laid down Integrated Management System Policy adopted by the Board of Directors of JSW Steel Limited. The hierarchical system or administrative order of the company to deal with the environmental issues has been given in Environmental Policy of the company. Copy of Integrated Management System Policy issued on 01.07.2020 is enclosed with the EIA/EMP Report.	Chapter 10 Para 10.3 Figure 10.1 Pg No. 292-293
1.8	Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.	This is a proposed Iron Ore mining project. Being an opencast mine, occurrence of subsidence is not envisaged. The mining will be carried out by opencast mechanized mining method without Drilling and Blasting. Slope study will be carried out as per the guidelines.	Chapter 4 Para 4.5.2.2 Page No. 207
1.9	The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine/lease period.	The study area comprises of 10 km radius zone around the mining lease periphery. There is no Top Soil present in the ML Area. At Conceptual Stage ~68.0 Million Tonnes of waste will be generated which will be used in backfilling in the mined-out area.	Chapter 2 Para 2.7.7.5 Page No. 123
1.10	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.	Land use/Land cover has been assessed by satellite data. According to the LULC study, Core area mainly comprises of Surface Water Bodies/Mine Sump (137.4421 ha), Forest/Open Jungle (120.2584 ha), Road (101.9594 ha), Mine Area (11.599 ha) and Human Settlement/Mine Infrastructure (5.8292 ha), with 36.45%, 31.89%, 27.04%, 3.07% and 1.55% respectively. The study area mainly comprises of	Chapter 3 Para 3.6.4 & 3.6.5 Table 3.5 & 3.6 Fig No. 3.5 & 3.6 Pg No. 140 - 143

		Forest/Open Jungle (30668.88 ha), Agriculture Land (3564.89 ha), Open Scrub Land/Waste Land (1271.74 ha), Human Settlement/Mine Infrastructure (1243.38 ha), Surface Water Bodies/Mine Sump (1033.77 ha), Mine Area (670.53 ha), Mangrove (657.04 ha), Road (538.94 ha), Vegetation/Plantation (400.77 ha), Industries (87.86 ha) and Railway (26.36 ha) with 76.36%, 8.88%, 3.17%, 3.09%, 2.57%, 1.67%, 1.64%, 1.34%, 0.99%, 0.22%, and 0.07% of area falling under respectively. Stage wise land use plan has been prepared to encompass preoperational, operational and post operational phases and given in the EIA/EMP Report.	Chapter 4 Table 4.19 Pg No. 217
1.11	Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.	As per the approved mining plan, there will be no waste dumping outside the mining lease area and therefore, such issues are not applicable.	-
1.12	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.	As per revenue record, the area of proposed mine is 377.0881 ha which spreads in only 1 revenue Village namely Codli. Out of the total mining lease area, 236.3482 ha is Govt. land, 58.9087 ha is Private Land, 15.8626 ha is Alvara land & 65.9686 ha is Forest Land. Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I.	Chapter 2 Para 2.3.2 Pg No. 97 Annexure III
1.13	Status of forestry clearance for the broken-up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation	Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under	Chapter 2 Para 2.3.2 Pg No. 97

	(CA) should be indicated. A copy of the forestry clearance should also be furnished.	clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I. Copy of the Application submitted for Forest Clearance is enclosed with this EIA/EMP report.	Annexure III
1.14	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.	The ML area is already Broken-up area. Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I.	Chapter 2 Para 2.3.2 Pg No. 97 Annexure III
1.15	The vegetation in the RF / PF areas in the study area, with necessary details, should be given.	The total ML area is 377.0881 ha, out of which 65.9686 ha is Forest Land. Besides this, the forests present within 10 km radius study area are: Unclassified Forest – Core zone Reserve Forest – ~0.5 Km in ENE Direction, ~1.0 Km in West Direction, ~2.5 Km in West Direction, ~4.0 Km in South Direction, ~6.5 Km in WSW Direction, ~7.0 Km in NNE Direction, ~8.0 Km in WSW Direction, ~8.5 Km in NW Direction, ~9.0 Km in West Direction. Details of the same are given in EIA/EMP Report.	Chapter 3 Table 3.1 Page No. 129 Figure: 3.1 Page No. 131
1.16	A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and	A detailed biological study was done to ascertain the impact of mine on wildlife. There are no National Park, Biosphere Reserves, Tiger Reserves & Wildlife Corridors	Chapter 3 Para 3.17 Page No. 172-174

	any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted.	etc. within 10 km radius of the ML area. However, Bhagvan Mahavir Wildlife Sanctuary & ESZ of Bhagvan Mahavir Wildlife Sanctuary and Bondla Wildlife Sanctuary & ESZ of Bondla Wildlife Sanctuary are present within the Buffer zone. Various measures will be undertaken and environment management plan will be implemented to curb pollution of air, noise, water & land environment. Air quality & noise level will be maintained well within the standards prescribed by the MoEF&CC and CPCB. Greenbelt development and plantation will help in creating habitats for local faunal species and to create better environment for various fauna. Activities for creating and developing awareness for nature and wildlife in the nearby villages will also be undertaken. Wildlife Conservation Plan for protection of all 19 schedule - I species has been prepared and submitted to DCF for authentication on dated 10.08.2026.	Annexure XIV
1.17	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/ Elephant Reserves/ (existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.	There are no National Park, Biosphere Reserves, Tiger Reserves & Wildlife Corridors etc. within 10 km radius of the ML area. However, Bhagvan Mahavir Wildlife Sanctuary & ESZ of Bhagvan Mahavir Wildlife Sanctuary and Bondla Wildlife Sanctuary & ESZ of Bondla Wildlife Sanctuary are present within the Buffer zone. Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025. Copy of the same are enclosed with EIA/EMP Report.	Chapter 3 Table 3.1 Pg No.129 Annexure VI
1.18	A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer	A detailed biological study has been carried out as per the latest Wildlife Protection Amendment Act, 2022. There are 19 species listed under Schedule I species as per the Wildlife (Protection) Amendment Act, 2022, found within core and	Chapter 3 Para 3.17.3 Page No. 173

	zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.	buffer zone of the Mine area. Wildlife Conservation Plan for protection of all the schedule - I species has been prepared and submitted to DCF for authentication on dated 10.08.2026. Budget earmarked for the conservation of Schedule - I species considering the proposed Iron Ore Mine is Rs. 50.90 Lakhs.	Annexure XIV & XV
1.19	Proximity to Areas declared as Critically Polluted or the Project areas likely to come under the Aravali Range, (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered.	No Critically Polluted Areas as notified by the Central Pollution Control Board are located within 10 km from the boundary of mining lease. The mine lease area is located in District South Goa of State of Goa which is not falls in the Aravali range.	Chapter 2 Table 2.3 Pg No. 101
1.20	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).	The mine lease area is located in District South Goa of Goa state, which is not covered under coastal zone. Therefore, the project area does not come under the purview of CRZ notification.	-
1.21	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need-based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line	The total ML area is 377.0881 ha (Govt. revenue land – 236.3482 ha, Private land – 58.9087 ha, Alvara land – 15.8626, Forest land – 65.9686 ha). There are no any habitations present within the Mineral Block. Hence, no displacement of human settlement is proposed. JSW Steel Limited will adopt the surface rights procedure for use of land required for the proposed mining project and there is no proposal of land acquisition. The mining lease	Chapter 7 Para 7.3 Pg No. 264

	departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report.	area comprises private and government land. Surface rights over the land required for mining operations shall be acquired through mutual agreement and payment of compensation, in accordance with the provisions of the Goa Daman & Diu Land Revenue Code, 1968 and the MMDR Act, 1957, prior to commencement of mining operations.	
1.22	One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season); December-February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM ₁₀ , particularly for free silica, should be given	One season primary baseline data for ambient air quality, (as per CPCB quality Notification, 2009), water quality, noise level, soil and flora & fauna has been collected during the summer season (March to May, 2025). Details regarding the same have been incorporated in this Final EIA/EMP Report. Photographs of baseline monitoring locations for Air Quality & Noise Level and sampling locations of Ground Water, Surface Water & Soil has been taken and same is enclosed with this EIA/EMP Report. Detailed AAQM data of sampling locations are enclosed with this EIA/EMP Report. Site-specific meteorological data has been recorded. The dominant wind direction is from North West direction. Location of the monitoring stations were selected keeping in view the pre-dominant downwind direction and location of the sensitive receptors and also that they represent whole of the study area. One location has been selected in downwind direction within 500 m from the lease boundary. Mineralogical composition of PM₁₀ is given & enclosed with this EIA/EMP Report.	Chapter 3 Para 3.13 to 3.16 Pg No. 152-171 Annexure XI Annexure X Annexure XIII
1.23	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for	Air quality modelling has been carried out by AERMOD view 10.2.1 - Model based on steady state Gaussian Plume Dispersion was used for the prediction of incremental value due to proposed mine. Impact of movement of vehicles for transportation of mineral has	Chapter 4 Para 4.5.1.2 Pg No. 199

	modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.	been considered. Impact prediction has been carried out for total excavation of 11.71 Million TPA. At Normative Stage, total Iron Ore handling will be 11667 TPD whereas at peak stage it will be 14001 TPD considering exigencies and rainy season. The Iron ore mined out from this mine will be supplied to JSW Steel Plant and or sold in open market like Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant. Isopleths showing incremental concentration of PM from area source and clearly indicating the air quality contours on a location map indicating the location of the site, location of sensitive receptors and wind roses showing pre-dominant wind direction have been prepared. Detail of same along with details of the model used and input parameters used for modelling is incorporated with this EIA/EMP Report.	Annexure XVI
1.24	The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.	Total water requirement for the proposed mining project will be 1716 KLD which will be fulfilled from Mine Sump water and well water for drinking purpose. Rainwater harvesting techniques will be implemented for conservation of water. At the end of 5th year of mining operations, around 7122 KLD of water will be accumulated in the pit which will be utilized to meet the water requirement. In the beneficiation plant, 92.1% is recycled. The process flow includes concentrate thickeners (70 TPH capacity), tailings thickener (120 TPH capacity), Tailing Thickener and 2 pressure filters to recover water from both product and tailings streams. Details regarding the same and detailed water balance is given in this EIA/EMP Report. Ground water table will be intersected during	Chapter-2 Para 2.7.1 Page no. 103 Chapter 4 Para 4.5.3.3 Table 4.17 Pg No. 214 Chapter 2 Para 2.7.4.1 Page No. 108 Annexure VII

		mining operation. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. A detailed Hydrogeological study has been conducted and same is enclosed with this EIA/EMP Report.	Annexure VII Annexure XIX
1.25	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.	Total water requirement for the proposed mining project will be 1716 KLD which will be fulfilled from Mine Sump water and well water for drinking purpose. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026.	Chapter 2 Para 2.7.1 Page no. 103 Table 2.3 Pg No. 101 Annexure VII
1.26	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.	Water conservation measures will be adopted. Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled. Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank. Rainwater harvesting techniques will be implemented for conservation of water. At conceptual stage, 249.2021 ha area will be converted into water reservoir which will serve as a source of water. A detailed Hydrogeology study with modelling has been conducted and same is enclosed with this EIA/EMP Report.	Chapter 4 Para 4.5.3.2 Page no. 212 Annexure XIX
1.27	Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided.	No water body is present within the lease area. However, a water body Khandepar river is present at Adjacent in North direction. Other than this, Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Sanguem or Zuvari River, Jamboli Nala and Paroda River are also present in within the 10 Km radius of study area. In the Beneficiation Plant, the process water	Chapter 4 Para 4.5.3 Pg No. 209-215

		will be recycled back to the plant. Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled. Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank. Necessary safeguard measures such as construction of Garland drain having siltation pits, catch drains, retaining wall will be adopted to control the surface runoff. At conceptual stage, 249.2021 ha area will be converted into water reservoir which will serve as recharge pit. Ground Water and Surface Water quality monitoring will be carried out.									
1.28	Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished.	<table><tr><td>Elevation Range</td><td>-76 m AMSL to 109 m AMSL</td></tr><tr><td>Ground Water Table</td><td>Pre-monsoon: 16.0 m bgl Post-monsoon: 15.0 m bgl</td></tr><tr><td>Ultimate Working Depth</td><td>164.48 m bgl</td></tr></table>	Elevation Range	-76 m AMSL to 109 m AMSL	Ground Water Table	Pre-monsoon: 16.0 m bgl Post-monsoon: 15.0 m bgl	Ultimate Working Depth	164.48 m bgl	<table><tr><td>Groundwater will be intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. Detailed Hydro-geological study with modelling has been carried out and same is enclosed with this EIA/EMP Report.</td></tr></table>	Groundwater will be intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. Detailed Hydro-geological study with modelling has been carried out and same is enclosed with this EIA/EMP Report.	Chapter 4 Para 4.5.3.2 Page no. 212 Annexure VII Annexure XIX
Elevation Range	-76 m AMSL to 109 m AMSL										
Ground Water Table	Pre-monsoon: 16.0 m bgl Post-monsoon: 15.0 m bgl										
Ultimate Working Depth	164.48 m bgl										
Groundwater will be intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. Detailed Hydro-geological study with modelling has been carried out and same is enclosed with this EIA/EMP Report.											
1.29	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out.	No water bodies i.e. nalla, river or streams are present within the lease area. The nearest water body is Khandepar River which is present at adjacent tin North Direction. A proper mitigation measures is proposed for the safety of the river. Necessary safeguard measures such as construction of Garland drain having siltation pits, catch drains, retaining wall will be adopted to control the surface runoff.		Chapter 4 Para 4.5.3 Pg No. 209-215							

		A Catchment Area Treatment (CAT) Plan has been prepared to ensure the protection and ecological integrity of the river. Besides this, a proper safeguard measures have been adopted in consultation with the State Water Resources Department. Copy of the same are enclosed with the EIA/EMP Report.	
1.30	Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same.	Elevation Range	-76 m AMSL to 109 m AMSL
		Ground Water Table	Pre-monsoon: 16.0 m bgl Post-monsoon: 15.0 m bgl
		Ultimate Working Depth	164.48 m bgl
		Groundwater will be intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026.	
			Chapter 4 Para 4.5.3.2 Page no. 212 Annexure XIX Annexure VII
1.31	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution.	According to Greenbelt/ Plantation development plan, Greenbelt along 7.5m lease periphery will be started in between 1st to 5th year of mine operation (area covered: 1.5 ha) and will be complete at Conceptual stage covering a total area of 17.45 ha. 51.95 ha area will be backfilled and subsequently rehabilitated through plantation & regrassing, 6.87 ha on dump plantation and 26.1582 ha area under tailing dam rehabilitated by plantation. Thus, total area to be covered under the greenbelt/plantation will be 102.4282 ha. Out of which 20% is 20.49 ha which 10.24 ha will be developed on the backfilled area and remaining 10.25 ha will be developed on tailing dam area using the Miyawaki plantation technique at an estimated development cost of Rs. 40 lakhs Capital Cost and Rs. 4.0 Lakhs/annum as Recurring Cost. Remaining (102.4282 – 20.49 = 81.9382 ha) will	
			Chapter 4 Para 4.5.9.7 Pg No. 243-245

		be developed as 2500/ha saplings. Thus, total nos. of saplings are 204846 @2500/ha. Budget allocated for greenbelt/plantation till the end of life of mine is Rs. 145.02 Lakh including Miyawaki Plantation. The budget includes the cost of Saplings, Watering facilities, Labour Charge, Organic manure, Bio-fertilizers, Maintenance, fencing etc., which may vary in due course of time. Local & fruit bearing species will be planted after consultation with local forest officer and as per CPCB guidelines will be planted by JSW Steel Ltd. and survival rate of 80% will be maintained.	
1.32	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines.	The Iron Ore will be transported from the ML Area to Capxem Jetty, TPL, Fomento Jetty, Andre Minescape & Bandekar Jetty and also transport to the proposed Kalay Railway Siding in Costi & in Pauskar yard Via Road through Trucks of 11.5 Tonnes capacity. Proper measures will be taken for the transportation of mineral in order to arrest fugitive emissions. The transportation of Iron Ore will be done via Road (SH-7 & Village Road). Detailed traffic study has been conducted and the same is incorporated in this EIA/EMP Report.	Chapter 4 Para 4.5.8 Pg No. 232-240 Annexure XX
1.33	Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.	The proposed mine will have all the necessary infrastructure such as Mine office, workshop building, Crushers, diesel storage facility, rest shelters, canteen, DG set building for backup, roads, etc. within the ML Area.	Chapter 2 Para 2.4.1 Pg No. 100
1.34	Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report.	At conceptual stage, out of the total mine lease area, total mined out area will be 301.1521 ha, out of which 51.95 ha will be backfilled and 249.2021 ha will be covered under water reservoir, 14.5597 ha area will be under utility services, 10.8981 ha area will be under Mineral Separation Plant, 6.87 ha under dump rehabilitated by plantation, 17.45 ha under greenbelt and 26.1582 ha will be	Chapter 2 Para 2.7.7.6 Pg No. 126

		covered under plantation. Out of the 51.95 ha of backfilled area, 20.49 ha will be developed under the Miyawaki Plantation technique. At Conceptual Stage, total Greenbelt/Plantation will be carried out on 102.4282 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled including Miyawaki Plantation, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation). Conceptual Plan is enclosed with this EIA/EMP Report.	Annexure IVB
1.35	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.	Occupational health impacts have been identified; Preventive health measures will be taken, and are incorporated in this EIA/EMP Report. In accordance with the guideline of DGMS Pre-placement medical examination and periodical medical examinations will be done and records will be maintained in Form O under Mines Rule 1955 and schedule of health examination of workers will be followed. Proper health records will be maintained.	Chapter 4 Para 4.5.10 Pg No. 246
1.36	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.	Public health implications of the project and related activities for the population in the impact zone have been evaluated and common prevailing diseases in the area were identified. Anticipated impacts have been assessed and corresponding mitigative measures have been suggested and detailed in the EIA/EMP report. Mining will be carried out as per the provisions outlined in mining plan approved by IBM as well as by abiding to the guidelines of DGMS. An implementation of recommended Environmental Management Plan/mitigation measures during the operation of the mine shall control the impacts significantly and will be confined within the mine boundary. Various measures such as Water spray on haulage roads, use of Mist fog canons, Bag filter at crusher will be	Chapter 4 Para 4.5.7 Page No. 230 Chapter 4 Pg No. 196 Annexure XVI

		adopted to control pollution. Regular Ambient air quality monitoring, noise level monitoring & water quality analysis will be carried out. Greenbelt of 7.5 m width will be developed along the lease periphery. Efforts will be made to improve the hygiene, sanitation, education and infrastructure of the nearby villagers. First aid centre will be established in the mine block and medical camps will be organized regularly in surrounding area.	
1.37	Measures of socio-economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.	The proposed project will result in growth of the surrounding areas by increased direct and indirect employment opportunities in the region including ancillary development and supporting infrastructure. Beside this, Royalty, DMF & NMET etc. will be additional benefits & will be utilized by local administration for the development of socioeconomic infrastructure and well-being of the local population. The mine shall be contributing around Rs. 275.68 Crores every year to the State and Central Govt. exchequer by way of mining revenue (Royalty, DMF, NMET etc) after the mine will be operated at peak capacity.	Chapter 8 Para 8.2.3.1 Pg No. 284-285
1.38	Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.	The area of proposed mine is 377.0881 ha which spreads in only 1 revenue Village namely Codli. Out of the total mining lease area, 236.3482 ha is Govt. land, 58.9087 ha is Private Land, 15.8626 ha is Alvara land & 65.9686 ha is Forest Land. Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on	Chapter 2 Para 2.3.2 Pg No. 97 Annexure III

		PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I. Proper mitigative measures will be taken for protection of Forest Land and agricultural land and details of the same have been incorporated in this EIA/EMP Report. Detailed Environmental Management Plan to mitigate the environmental impacts specific to the proposed project along with occupational health impacts due to the proposed project and its management plan is incorporated in this EIA/EMP Report.	Chapter 4 Para 4.5.5.1 A & D Pg No.219-223
1.39	Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.	Public hearing is yet to be conducted and same will be carried out as per provisions of EIA Notification, 2006. The company will propose a detailed time bound action plan along with budgetary allocation after conduction of Public Hearing considering issues raised during public hearing on the basis of MoEF&CC, OM dated 30.09.2020 & 20.10.2020 and will be submitted with the Final EIA/EMP Report.	--
1.40	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.	There is no litigation pending against the project in any court. Undertaking regarding the same is enclosed with this draft EIA/EMP report.	Annexure XXVII
1.41	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	➤ Capital Cost of the Project: Rs. 500.0 Crores ➤ Capital cost for EMP is Rs. 544.02 Lakhs ➤ Recurring cost for the EMP is Rs. 117.0 Lakh/annum. ➤ Budget for Wildlife Conservation Plan is Rs. 50.90 Lakhs.	Chapter 10 Para 10.4 Table 10.2 Pg No. 299
1.42	A Disaster management Plan shall be prepared and included in the EIA/EMP Report.	Disaster Management and Risk Assessment Plan has been prepared and incorporated in this EIA/EMP report.	Chapter 7 Para 7.4 Pg No. 265 - 280
1.43	Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc.	The benefits of the Project clearly indicating environmental, social, economic, employment potential, etc. are incorporated in this EIA/EMP Report.	Chapter 8 Para 8.2.3 Pg No. 284- 288

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

ToR Compliance

1.44	Besides the above, the below mentioned general points are also to be followed: -		
a.	All documents to be properly referenced with index and continuous page numbering.	Complied with EIA/EMP Report.	--
b.	Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.	Complied with EIA/EMP Report.	--
c.	Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.	Analysis results of water, air, soil, noise etc. for the project have been endorsed from JM EnviroLab MoEF&CC/NABL accredited laboratory and same has been incorporated in this EIA/EMP Report. Original analysis/testing report is enclosed with this Final EIA/EMP Report.	Chapter 3 Para 3.13 to 3.16, Pg no. 152-171 Annexure XII
d.	Where the documents provided are in a language other than English, an English translation should be provided.	Complied with EIA/EMP Report.	--
e.	The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.	Questionnaire for environmental appraisal of mining projects will be enclosed with the Final EIA/EMP report.	-
f.	While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed.	Instructions issued by MoEF&CC vide O.M. No. J11013/41/2006-IA.II (I) dated 4 th August, 2009, have been followed.	--
g.	Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.	Noted and complied with EIA/EMP Report.	--
h.	As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in	Not applicable as this is a proposed Iron Ore mining project.	--

	the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.		
i.	The EIA report should also include: (i) Surface plan of the area indicating contours of main topographic features, drainage and mining area. (ii) Geological maps and sections and Sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.	Surface plan, Geological plan and sections of the mine area are enclosed with this EIA/EMP Report.	--
C	Standard Terms of Reference for (Mineral beneficiation)		
1.1	The alternate sites considered, the relative merits and demerits and the reasons for selecting the proposed site for the Beneficiation Plant should be indicated.	In the proposed Iron Ore mining project; mineral beneficiation will be carried out by installation of Dry Processing/Screening Plant beneficiation of relatively high-grade ore and Wet Beneficiation Plant within the ML area with a throughput capacity of 3.5 Million TPA, for beneficiation of low grade ore & Siliceous ore. Hence, no alternative site is proposed for the beneficiation plant.	Chapter 5 Para 5.3 Pg No. 254
1.2	Details of the technology and process involved for beneficiation should be given.	The Beneficiation Plant will enhance the quality of the ore since the Fe content of Iron Ore varies from 40-55% Fe. It has been proposed to beneficiate the low-grade and Siliceous Iron Ore to produce iron ore concentrates for the production of Iron in steel industries. The alumina and silica content in the ore is around 20-30% and LOI is about 6-10%. To achieve this, JSW Steel Limited is decided to have three numbers processing plants within the lease boundary i.e., 01 dry crushing & classification plant of 600 TPH and 02 number of wet beneficiation plants of 300 TPH each to take care the varied grade ore production and processing. The wet beneficiation plant consists of four divisions namely, Dry Crushing Circuit, Wet	Chapter 2 Para 2.7.2.2 & 2.7.2.3 Pg No. 115 - 121

		Classification Circuit, Magnetic Separators Circuit & Dewatering Circuit. The dry processing plant of consists basically crushing and screening plants to cater below 500 mm ROM feed with 54% Fe. Detailed process of Mineral Beneficiation is incorporated in this EIA/EMP Report.	
1.3	Location of the proposed Plant w.r.t. the source of raw material and mode of transportations of the ore from mines to the beneficiation plant should be justified.	The proposed beneficiation plant is located within the mine lease area, in close proximity to the source of raw material. Therefore, the ore generated from the mine will be transported directly to the beneficiation plant through an internal haul road/conveyor system, as applicable. This arrangement minimizes the transportation distance, fuel consumption, vehicular emissions and associated environmental impacts. Hence, the proposed location of the beneficiation plant within the ML area is technically and environmentally justified.	Chapter 2 Para 2.7.7.1 Pg No. 113-115
1.4	Treatment of run of mine (ROM) and or of the fines/waste dump should be spelt out.	The Run-of-Mine (ROM) ore will be processed in the proposed beneficiation plant through appropriate crushing, screening and wet beneficiation processes to recover Iron Ore of the desired quality. The generated fines and suitable material from waste dumps, wherever feasible, will also be processed through appropriate beneficiation techniques for recovery of Iron values. The beneficiation process will include suitable separation and concentration methods, followed by dewatering and handling of the beneficiated product and tailings. Detailed process flow and material balance are provided in the EIA/EMP Report.	Chapter 2 Para 2.7.2.2 & 2.7.2.3 Pg No. 115 – 121 Annexure IX
1.5	Estimation of the fines going into the washings should be made and its management described.	The entire Run-of-Mine (ROM) ore generated from the mining operation will be subjected to wet washing/beneficiation. Therefore, no separate estimation of fines going into washing is required, as the complete ROM ore will be processed through the washing circuit.	Chapter 2 Para 2.7.7.2.1 Pg No. 116

		The generated fines/slimes will be separated during the washing process and managed through the designated thickener/tailings management system. Recovered water will be recycled back into the beneficiation plant to minimize fresh water consumption.	
1.6	Details of the equipment, settling pond etc. should be furnished.	The erstwhile lessee has provided 02 settling pond covering 2.0395 ha area within the mine lease. However, under the proposed beneficiation process, the latest technology and process design do not require additional settling ponds. 02 settling ponds are proposed for future requirements, if any. The process water will be effectively managed through the proposed water recovery and recycling system.	Chapter 2 Para 2.3.3 Pg. No. 98
1.7	Detailed material balance should be provided.	The material balance is given in the EIA/EMP Report.	Annexure IX
1.8	Sources of raw material and its transportation should be indicated. Steps proposed to be taken to protect the ore from getting air borne should be brought out.	Iron Ore is the raw material for beneficiation which will be sourced from the proposed Block - XII Codli Mineral Block. It involves the transportation of Iron Ore to the JSW Steel Plant for manufacturing steel and /or for sale to the end users, for its use in Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant. Export facility is also envisaged. Proper measures will be taken for the transportation of mineral in order to arrest fugitive emissions such as regular water sprinkling on mine haul roads during transportation and at transfer points, overloading and Over-speeding will be avoided, haul roads within mines will be maintained properly by using motor grader & soil compactor in order to minimize the impact of mineral transportation, etc. Details of the mitigation measures to be adopted during transportation are given in the EIA/EMP Report.	Chapter 4 Para 4.5.8 Pg No. 232 Chapter 4 Para 4.5.8.1 Pg No. 237 Annexure XIX

1.9	Management and disposal of tailings and closure plan of the tailing pond, if any after the project is over, should be detailed in a quantified manner.	About 0.628 Million TPA of tailings will be generated in the form of filter press cake with a moisture content of approximately 10–12% and an Fe content of 27.83%. The generated tailings shall be temporarily stacked in the designated area and subsequently transported for disposal at waste dump in accordance with the approved Mining Plan.	Chapter 2 Para 2.7.7.5 Page No. 123
1.10	The water requirement for the project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the project should also be indicated.	Total water requirement for the proposed mining project will be 1716 KLD which will be fulfilled from Mine Sump water and well water for drinking purpose. Rain water harvesting techniques will be implemented for conservation of water. At the end of 5th year of mining operations, around 6118 KLD of water will be accumulated in the pit which will be utilized to meet the water requirement. Details regarding the same and detailed water balance is given in this EIA/EMP Report. Ground water table will be intersected during mining operation. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. A detailed Hydrogeology study with modelling have been conducted and same is enclosed with this EIA/EMP Report.	Chapter-2 Para 2.7.1 Page no. 103 Chapter 4 Table 4.17 Pg No. 214 Chapter-2 Para 2.7.1 Page no. 103 Annexure VII Annexure XIX
1.11	A copy of the document in support of the fact that the Proponent is the rightful lessee of the unit should be given.	JSW Steel Limited has been successfully declared as the “Preferred Bidder” through e-auction conducted by Govt. of Goa, for the Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) through e-auction conducted by Government of Goa. The Letter of Intent (LoI) was issued in favour of JSW Steel Limited vide letter no. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024 by Directorate of Mines & Geology, Govt. of Goa. Copy of Letter of Intent is enclosed with this EIA/EMP Report.	Chapter 1 Para 1.2.1 C Pg No. 86 Annexure I

1.12	All documents including EIA and public hearing should be compatible with one another in terms of the production levels, waste generation and its management and technology and should be in the name of the lessee.	All documents including EIA are compatible with one another in terms of mine area, production levels, waste generation & its management and mining technology etc. and all documents are in the name of JSW Cement Limited.	--
1.13	All corner coordinates of the Unit, superimposed on a High-Resolution Imagery/Toposheet should be provided. Such an Imagery of the proposed Unit should clearly show the land use and other ecological features of the study area (core and buffer zone).	Geology of the Area: Goa is dominantly covered by the rocks belonging to Archaean Dharwar Super Group referred in Goa as Goa group and the Codli Mineral block comprises rocks belonging to Bicholim Group of rocks Formation of Dharwar Supergroup. The iron ore deposits are found in small mounds of hillocks in a generally low undulating landmass and are locally known as Codli-Daucona hillock. Map showing area with geographical extents, geomorphology and geology of the area, superimposed on Toposheet are incorporated in this Final EIA/EMP Report. Land use/Land cover and Ecological Features: The map clearly depicts the land use/land cover and other ecological features of the study area, covering both the core and buffer zones. The relevant maps are provided in the EIA/EMP Report.	Chapter 2 Para 2.7.5 Pg No. 109 Chapter 2 Para 2.3.1 Figure 2.2 & 2.3 Pg No. 95-96 Chapter 3 Figure 3.1 Page No. 131 Figure 3.5 & 3.6 Pg No. 140, 142
1.14	It should be clearly indicated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the	Yes, the company has well laid down Integrated Management System Policy adopted by the Board of Directors of JSW Steel Limited. The hierarchical system or administrative order of the company to deal with the environmental issues has been given in Environmental Policy of the company. Copy of Integrated Management System Policy issued on 01.07.2020 is enclosed with the EIA/EMP Report.	Chapter 10 Para 10.3 Figure 10.1 Pg No. 292-293

	Company and/or shareholders or stakeholders at large, may also be detailed in the EIA Report.		
1.15	Issues relating to Safety should be detailed. The proposed safeguard measures in each case should also be provided. Disaster management plan shall be prepared and included in the EIA/EMP Report.	Details regarding issues related to safety i.e. identification of hazards and preventive measures are given in this EIA/EMP report. A Disaster Management and Risk Assessment Plan has also been prepared and the same is incorporated in this EIA/EMP report.	Chapter 7 Para 7.4 Pg No. 265 - 280
1.16	The study area will comprise of 10 km zone around the Plant.	The study area comprises of 10 km radius zone around the mining lease periphery. According to the Land Use/Land Cover study, the total study area is 40164.16 ha.	Chapter 3 Fig. 3.6 Pg No. 142
1.17	Cumulative impact study of both Beneficiation Plant with suggested mitigation measures as per the study should be described.	The impact assessment for the proposed Iron Ore mining project has been done and the mitigation measures have been incorporated in this EIA/EMP Report.	Chapter 4 Para 4.5 Pg No. 196 Annexure XXIV
1.18	Location of Railway siding with its handling capacity and safety measures should be indicated.	The Iron Ore will be transported from the ML Area to Capxem Jetty, TPL, Fomento Jetty, Andre Minescape & Bandekar Jetty and also transport to the proposed Kalay Railway Siding in Costi & in Pauskar yard Via Road through Trucks of 11.5 Tonnes capacity. Two scenarios have been considered for the transportation of Iron Ore, i.e., transportation through jetties and railway sidings. In the initial scenario, a total quantity of 3.5 Million TPA of Iron Ore will be transported through jetties until the railway siding becomes operational. Subsequently, upon commissioning of the Railway Siding, 1.5 Million TPA of Iron Ore will be transported through the railway mode. Accordingly, the quantity of Iron Ore transported by jetties will be reduced, which will consequently result in a reduction in emissions associated with road transportation. A proper mitigation measures for transport of mineral via road through sea and rail route will be maintained. A detailed Traffic Study have been carried out and same is enclosed with this Draft EIA/EMP Report.	Chapter 4 Para 4.5.8 Pg No. 232-240 Annexure XX

1.19	Option to provide only silo for storage of minerals instead of open stacking to avoid fugitive dust should be explored and arrangements finalized justified.	This is a proposed Iron Ore Mining project. The ore will be transported to Capxem Jetty, TPL, Fomento Jetty, Andre Minescape & Bandekar Jetty and also transport to the proposed Kalay Railway Siding in Costi & in Pauskar yard Via Road. The crushed Iron Ore will be supplied to JSW Steel Plant and the low-grade Iron Ore and Siliceous Ore; post-beneficiation will be supplied to JSW Steel Plant and/or sold in the open market. Therefore, only temporary stacking of the mineral is proposed; before transportation of Iron Ore.	Chapter 4 Para 4.5.8 Pg No. 232-240 Annexure XX
1.20	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.	Land use/Land cover has been assessed by satellite data. According to the LULC study, Core area mainly comprises of Surface Water Bodies/Mine Sump (137.4421 ha), Forest/Open Jungle (120.2584 ha), Road (101.9594 ha), Mine Area (11.599 ha) and Human Settlement/Mine Infrastructure (5.8292 ha), with 36.45%, 31.89%, 27.04%, 3.07% and 1.55% respectively. The study area mainly comprises of Forest/Open Jungle (30668.88 ha), Agriculture Land (3564.89 ha), Open Scrub Land/Waste Land (1271.74 ha), Human Settlement/Mine Infrastructure (1243.38 ha), Surface Water Bodies/Mine Sump (1033.77 ha), Mine Area (670.53 ha), Mangrove (657.04 ha), Road (538.94 ha), Vegetation/Plantation (400.77 ha), Industries (87.86 ha) and Railway (26.36 ha) with 76.36%, 8.88%, 3.17%, 3.09%, 2.57%, 1.67%, 1.64%, 1.34%, 0.99%, 0.22%, and 0.07% of area falling under respectively. Stage wise land use plan has been prepared to encompass preoperational, operational and post operational phases and given in the EIA/EMP Report.	Chapter 3 Para 3.6.4 & 3.6.5 Table 3.5 & 3.6 Fig No. 3.5 & 3.6 Pg No. 140 - 143 Chapter 4 Table 4.19 Pg No. 217
1.21	Details of the land for any Over Burden Dumps outside the lease, such as extent of land area, distance from lease, its land use, R&R issues, if any, should be given.	As per the approved mining plan, there will be no waste dumping outside the mining lease area and therefore, such issues are not applicable.	-

1.22	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the Project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.	As per revenue record, the area of proposed mine is 377.0881 ha which spreads in only 1 revenue Village namely Codli. Out of the total mining lease area, 236.3482 ha is Govt. land, 58.9087 ha is Private Land, 15.8626 ha is Alvara land & 65.9686 ha is Forest Land. Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I.	Chapter 2 Para 2.3.2 Pg No. 97 Annexure III
1.23	Status of forestry clearance for the broken-up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.	Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I. Copy of the Application submitted for Forest Clearance is enclosed with this EIA/EMP report.	Chapter 2 Para 2.3.2 Pg No. 97 Annexure III
1.24	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.	The ML area is already Broken-up area. Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli	Chapter 2 Para 2.3.2 Pg No. 97 Annexure III

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		various fauna. Activities for creating and developing awareness for nature and wildlife in the nearby villages will also be undertaken. Wildlife Conservation Plan for 19 Schedule I species has been prepared and submitted to Deputy Conservator of Forests, Goa along with the list of flora & fauna and enclosed with this EIA/EMP Report.	
1.27	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Tiger/Elephant Reserves/ (existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.	There are no National Park, Biosphere Reserves, Tiger Reserves & Wildlife Corridors etc. within 10 km radius of the ML area. However, Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE Direction) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction) and Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction) are present within the Buffer zone. Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025. Copy of the same are enclosed with EIA/EMP Report.	Chapter 3 Table 3.1 Pg No.129 Annexure VI
1.28	A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.	Detailed biological study has been carried out as per the latest Wildlife Protection Amendment Act, 2022. There are 19 species listed under Schedule I species as per the Wildlife (Protection) Amendment Act, 2022, found within core and buffer zone of the Mine area. Wildlife Conservation Plan for protection of all the 19 Schedule - I species has been prepared and submitted to DCF for authentication on dated 10.08.2026. Budget earmarked for the conservation of Schedule - I species considering the proposed Iron Ore Mine is Rs. 50.90 Lakhs.	Chapter 3 Para 3.17.3 Page No. 173 Annexure XIV & XV

1.29	Proximity to Areas declared as 'Critically Polluted' shall also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB/CPCB shall be secured and furnished to the effect that the proposed activities could be considered.	No Critically Polluted Areas as notified by the Central Pollution Control Board are located within 10 km from the boundary of mining lease. The mine lease area is located in District South Goa of State Goa which is not falls in the Aravali range.	Chapter 2 Table 2.3 Pg No. 101
1.30	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the unit w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).	The ML area located in District South Goa (Goa) which is not covered under coastal zone. Therefore, the project area does not come under the purview of CRZ notification.	-
1.31	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need-based sample survey, family-wise, should be undertaken to assess their requirements and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects, should be discussed in the report.	The total ML area is 377.0881 ha (Govt. revenue land – 236.3482 ha, Private land – 58.9087 ha, Alvara land – 15.8626, Forest land – 65.9686 ha). There are no any habitations present within the Mineral Block. Hence, no displacement of human settlement is proposed. JSW Steel Limited will adopt the surface rights procedure for use of land required for the proposed mining project and there is no proposal of land acquisition. The mining lease area comprises private and government land. Surface rights over the land required for mining operations shall be acquired through mutual agreement and payment of compensation, in accordance with the provisions of the Goa Daman & Diu Land Revenue Code, 1968 and the MMDR Act, 1957, prior to commencement of mining operations.	Chapter 7 Para 7.3 Pg No. 264
1.32	One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season); December-February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data	One season primary baseline data for ambient air quality, (as per CPCB quality Notification, 2009), water quality, noise level, soil and flora & fauna has been collected during the summer season (March to May, 2025). Details regarding the same have been incorporated in this Final EIA/EMP Report.	Chapter 3 Para 3.13 to 3.16 Pg No. 152-171

	so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the unit in the pre-dominant downwind direction. The mineralogical composition of PM₁₀, particularly for free silica, should be given.	Photographs of baseline monitoring locations for Air Quality & Noise Level and sampling locations of Ground Water, Surface Water & Soil has been taken and same is enclosed with this EIA/EMP Report. Detailed AAQM data of sampling locations are enclosed with this EIA/EMP Report. Site-specific meteorological data has been recorded. The dominant wind direction is from North West direction. Location of the monitoring stations were selected keeping in view the pre-dominant downwind direction and location of the sensitive receptors and also that they represent whole of the study area. One location has been selected in downwind direction within 500 m from the lease boundary. Mineralogical composition of PM₁₀ is given & enclosed with this EIA/EMP Report.	Annexure XI Annexure X Annexure XIII
1.33	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.	Air quality modelling has been carried out by AERMOD view 10.2.1 - Model based on steady state Gaussian Plume Dispersion was used for the prediction of incremental value due to proposed mine. Impact of movement of vehicles for transportation of mineral has been considered. Impact prediction has been carried out for total excavation of 11.71 Million TPA. At Normative Stage, total Iron Ore handling will be 11667 TPD whereas at peak stage it will be 14001 TPD considering exigencies and rainy season. The Iron ore mined out from this mine will be supplied to JSW Steel Plant and or sold in open market like Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant. Isopleths showing incremental concentration of PM from area source and clearly indicating the air quality contours on a location map indicating the location of the site, location of	Chapter 4 Para 4.5.1.2 Pg No. 199 Annexure XVI

		sensitive receptors and wind roses showing pre-dominant wind direction have been prepared. Detail of same along with details of the model used and input parameters used for modelling is incorporated with this EIA/EMP Report.	
1.34	The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.	Total water requirement for the proposed mining project will be 1716 KLD which will be fulfilled from Mine Sump water and well water for drinking purpose. Rainwater harvesting techniques will be implemented for conservation of water. At the end of 5th year of mining operations, around 6118 KLD of water will be accumulated in the pit which will be utilized to meet the water requirement. In the beneficiation plant, 92.1% is recycled. The process flow includes concentrate thickeners (70 TPH capacity), tailings thickener (120 TPH capacity), Tailing Thickener and 2 pressure filters to recover water from both product and tailings streams. Details regarding the same and detailed water balance is given in this EIA/EMP Report. Ground water table will be intersected during mining operation. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. A detailed Hydrogeological study has been conducted and same is enclosed with this EIA/EMP Report.	Chapter-2 Para 2.7.1 Page no. 103 Chapter 4 Para 4.5.3.3 Table 4.17 Pg No. 214 Chapter 2 Para 2.7.4.1 Page No. 108 Annexure VII Annexure XIX
1.35	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be secured and copy furnished.	Total water requirement for the proposed mining project will be 1716 KLD which will be fulfilled from Mine Sump water and well water for drinking purpose.	Chapter 2 Para 2.7.1 Page no. 103
1.36	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.	Water conservation measures will be adopted. Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash	Chapter 4 Para 4.5.3.2 Page no. 212

		system will also be recycled. Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank. Rainwater harvesting techniques will be implemented for conservation of water. At conceptual stage, 249.2021 ha area will be converted into water reservoir which will serve as a source of water. A detailed Hydrogeology study with modelling has been conducted and same is enclosed with this EIA/EMP Report.	Annexure XIX
1.37	Impact of the project on the water quality, both surface and groundwater should be assessed and necessary safeguard measures, if any required, should be provided.	A water body Khandepar river is present at Adjacent in North direction. Other than this, Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Sanguem or Zuvari River, Jamboli Nala & Paroda River are also present in within the 10 Km radius of study area. In the Beneficiation Plant, the process water will be recycled back to the plant. Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled. Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank. Necessary safeguard measures such as construction of Garland drain having siltation pits, catch drains, retaining wall will be adopted to control the surface runoff. At conceptual stage, 249.2021 ha area will be converted into water reservoir which will serve as recharge pit. Ground Water and Surface Water quality monitoring will be carried out.	Chapter 4 Para 4.5.3 Pg No. 209-215
1.38	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out.	No water bodies i.e. nalla, river or streams are present within the lease area. The nearest water body is Khandepar River which is present at adjacent tin North Direction. A proper mitigation measures is proposed for the safety of the river.	Chapter 4 Para 4.5.3 Pg No. 209

		Necessary safeguard measures such as construction of Garland drain having siltation pits, catch drains, retaining wall will be adopted to control the surface runoff. A Catchment Area Treatment (CAT) Plan has been prepared to ensure the protection and ecological integrity of the river. Besides this, a proper safeguard measures have been adopted in consultation with the State Water Resources Department. Copy of the same are enclosed with the EIA/EMP Report.	Annexure XXII
1.39	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the project. The plant species selected for greenbelt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to the pollution.	Reply of the same is given in Standard ToR Point No. 1.31 for “Mining of minerals” in this Draft EIA/EMP Report.	Chapter 4 Para 4.5.9.7 Pg No. 243-245
1.40	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered.	The Iron Ore will be transported from the ML Area to Capxem Jetty, TPL, Fomento Jetty, Andre Minescape & Bandekar Jetty and also transport to the proposed Kalay Railway Siding in Costi & in Pauskar yard Via Road through Trucks of 11.5 Tonnes capacity. Proper measures will be taken for the transportation of mineral in order to arrest fugitive emissions. The transportation of Iron Ore will be done via Road (SH-7 & Village Road). Detailed traffic study has been conducted and the same is incorporated in this EIA/EMP Report.	Chapter 4 Para 4.5.8 Pg No. 232-240 Annexure XX
1.41	Details of the onsite shelter and facilities to be provided to the workers should be included in the EIA report.	The proposed mine will have all the necessary infrastructure such as Mine office, workshop building, Crushers, diesel storage facility, rest shelters, canteen, DG set building for backup, roads, etc. within the ML Area.	Chapter 2 Para 2.4.1 Pg No. 100

1.42	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area should be detailed.	Occupational health impacts have been identified; Preventive health measures will be taken, and are incorporated in this EIA/EMP Report. In accordance with the guideline of DGMS Pre-placement medical examination and periodical medical examinations will be done and records will be maintained in Form O under Mines Rule 1955 and schedule of health examination of workers will be followed. Proper health records will be maintained.	Chapter 4 Para 4.5.10 Pg No. 246
1.43	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.	Public health implications of the project and related activities for the population in the impact zone have been evaluated and common prevailing diseases in the area were identified. Anticipated impacts have been assessed and corresponding mitigative measures have been suggested and detailed in the EIA/EMP report. Mining will be carried out as per the provisions outlined in mining plan approved by IBM as well as by abiding to the guidelines of DGMS. An implementation of recommended Environmental Management Plan/mitigation measures during the operation of the mine shall control the impacts significantly and will be confined within the mine boundary. Various measures such as Water spray on haulage roads, use of Mist fog canons, Bag filter at crusher will be adopted to control pollution. Regular Ambient air quality monitoring, noise level monitoring & water quality analysis will be carried out. Greenbelt of 7.5 m width will be developed along the lease periphery. Efforts will be made to improve the hygiene, sanitation, education and infrastructure of the nearby Villagers. First aid centre will be established in the mine block and medical camps will be organized regularly in surrounding area.	Chapter 4 Para 4.5.7 Page No. 230 Chapter 4 Pg No. 196 Annexure XVI

1.44	Measures of socio-economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.	The proposed project will result in growth of the surrounding areas by increased direct and indirect employment opportunities in the region including ancillary development and supporting infrastructure. Beside this, Royalty, DMF & NMET etc. will be additional benefits & will be utilized by local administration for the development of socioeconomic infrastructure and well-being of the local population. The mine will be contributing around Rs. 275.68 Crores every year to the State and Central Govt. exchequer by way of mining revenue (Royalty, DMF, NMET etc) after the mine will be operated at peak capacity.	Chapter 8 Para 8.2.3.1 Pg No. 284-285
1.45	Public hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.	Public hearing is yet to be conducted and same will be carried out as per provisions of EIA Notification, 2006. The company will propose a detailed time bound action plan along with budgetary allocation after conduction of Public Hearing considering issues raised during public hearing on the basis of MoEF&CC, OM dated 30.09.2020 & 20.10.2020 and will be submitted with the Final EIA/EMP Report.	-
1.46	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the project should be given.	There is no litigation pending against the project in any court. Undertaking regarding the same is enclosed with this EIA/EMP report.	Annexure XXVII
1.47	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	➤ Capital Cost of the Project: Rs. 500.0 Crores ➤ Capital cost for EMP is Rs. 544.02 Lakh ➤ Recurring cost for the EMP is Rs. 117.0 Lakh/annum. ➤ Budget for Wildlife Conservation Plan is Rs. 50.90 Lakhs.	Chapter 10 Para 10.4 Table 10.2 Pg No. 299
1.48	A brief background of the Project, its financial position, Group Companies and legal issues etc. should be provided with past and current important litigations if any.	JSW Steel Limited has proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with	Chapter 1 Para 1.1 Pg No. 85

		Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa). The total cost of the project is Rs. 500.0 Crores. A brief introduction about JSW Steel Limited, group companies, etc. are given in this EIA/EMP report.	Chapter 1 Para 1.2.2 Pg No. 87
1.49	Benefits of the Project, if the project is implemented should be outlined. The benefits of the projects shall clearly indicate environmental, social, economic, employment potential, etc.	The benefits of the Project clearly indicating environmental, social, economic, employment potential, etc. are incorporated in this EIA/EMP Report.	Chapter 8 Para 8.2.3 Pg No. 284-288
1.50	Besides the above, the below mentioned general points are also to be followed: -		
a.	All documents to be properly referenced with index and continuous page numbering.	Complied with EIA/EMP Report.	-
b.	Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.	Complied with EIA/EMP Report.	-
c.	Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.	Analysis results of water, air, soil, noise etc. for the project have been endorsed from JM EnviroLab MoEF&CC/NABL accredited laboratory and same has been incorporated in this EIA/EMP Report. Original analysis/testing report has been enclosed with Final EIA/EMP Report.	Chapter 3 Para 3.13 to 3.16, Pg no. 152-171 Annexure XII
d.	Where the documents provided are in a language other than English, an English translation should be provided.	Complied with EIA/EMP Report.	-
e.	The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.	Questionnaire for environmental appraisal of mining projects will be enclosed with the Final EIA/EMP report.	-
f.	While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I)	Instructions issued by MoEF&CC vide O.M. No. J11013/41/2006-IA.II (I) dated 4 th August, 2009, have been followed.	-

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

ToR Compliance

	dated 4th August, 2009, which are available on the website of this Ministry, should be followed.		
g.	Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.	Noted and complied with EIA/EMP Report.	--
h.	As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.	Not applicable as this is proposed Iron Ore mining project.	-



CHAPTER - 1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

JSW Steel Limited has proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Under the provision of EIA Notification, 2006 and its subsequent amendments, the application for the grant of Terms of Reference (ToR) was submitted on Parivesh 2.0 web portal of MoEF&CC on 13.03.2026 and the project was considered in 5th meeting of the Expert Appraisal Committee EAC (Non-coal Mining) and Technical Presentation was held on 23.04.2026 (Agenda Item No. 4). The ToR was issued vide file no. J-11015/49/2025-IA.II(NCM), dated 18.05.2026.

This report has been prepared as per Terms of Reference (ToR), issued by Ministry of Environment, Forest and Climate Change (MoEF&CC) Govt. of India, New Delhi for carrying out the Environmental Impact Assessment study.

The baseline data for the Environmental Impact Assessment studies was collected during the Summer Season (March to May, 2025).

The main purpose of the EIA report is to provide a coherent statement after analyzing all significant impacts of the proposed mining project and measures that should be taken to mitigate them. It contains essential information for:

- The proponent to implement the proposal in an environmentally and socially responsible way;
- The project proponent to understand the mitigation measures suggested and earmark proper resources & budget for the impacts envisaged;
- The responsible authority to make an informed decision on the proposal, including the terms and conditions that must be attached to an approval or authorization; and
- The public to understand the proposal and its likely impacts on people and the environment.

1.2 IDENTIFICATION OF PROJECT & PROJECT PROPONENT

1.2.1 IDENTIFICATION OF THE PROJECT

A. PROPOSED PROJECT

JSW Steel Limited has submitted an application to MoEF&CC, New Delhi for obtaining Environment Clearance for the Proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary

Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Normal-grade iron ore will be subjected only to dry screening before dispatch from the mine. Low-grade iron ore and siliceous ore will be processed through the wet beneficiation plant to produce a concentrate with an iron (Fe) content of more than 54%. The beneficiated product will then be supplied to the JSW Steel Plant or sold in the open market to blast furnace industries, sponge iron industries, and other industries equipped with sinter plants.

B. SCREENING CATEGORY

As per EIA Notification dated 14th September, 2006 as amended from time to time, the project falls under Category “A” (>250 ha), Project or Activity 1 (a) for Mining of minerals and 2 (b) for Mineral Beneficiation.

C. MINING LEASE STATUS

- The present E-auction Block i.e., Codli Mineral Block (Block-XII) (Amalgamated Mineral block of 3 Nos. of lease areas of erstwhile lessee – M. L. No. 03/AMLG(ML-3)/VL/17 (T. C. No. 69/195,170/1952, 126/1953), T. C. No. 14/1958 and part of T. C. No. 61/1953 (i.e., mainly southern pit) comprises of an area previously operated by M/s. Vedanta Limited and M/s. Sociedade Timblo Irmaos Ltd, Represented by M/s. Panduronga Timblo Industrias, Margao, Goa. The Codli Mineral Block forms the part of Dharbandora Taluka, South Goa District of State of Goa and falls in SOI Toposheet number 481/3. The earlier mining lease was terminated (quashed) by Supreme Court dated 07/02/2018 in Special Leave to Appeal (Civil) No. 32138 of 2015 with SLP (C) Nos. 32699-32727 of 2015, Writ Petition (C) No. 711 of 2015 and Writ Petition (C) No. 720 of 2015. The total area of the Codli Mineral block is 377.0881 Ha. Mining operations have been stopped in the Mine/Lease Area w.e.f. 16-3-2018 as per the order of Honourable Supreme Court.
- JSW Steel Limited has been successfully declared as the “Preferred Bidder” under Rule 9(9)(iii) of the Mineral (Auction) Amendment Rules 2015 for the grant of Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) through e-auction conducted by Government of Goa. The Block was won at Final Price Offer of 92.60%.
- Letter of Intent (LoI) was issued vide letter no. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024 for grant of Block-XII Codli Mineral Block over an extent of 377.0881 ha area for a period of 50 Years. Copy of the same is enclosed as **Annexure I**.

D. STATUS OF APPROVAL OF MINING PLAN

Mining Plan along with Progressive Mine Closure Plan for Proposed Block-XII Codli Iron Ore mine over an area of 377.0881 ha has been approved by Indian Bureau of Mines (IBM), Goa vide letter no. MCDR-MPCoFE/6/2025-GOA-IBM_RO_GOA dated 06.08.2025. Copy of the Mining Plan approval letter is enclosed as **Annexure II**.

E. STATUS OF PROPOSED PROJECT FOR ENVIRONMENTAL CLEARANCE

The chronology of the project activities undertaken so far with respect to the process of obtaining Environmental Clearance is given in the table below:

Table 1.1
Status of Proposal for Environmental Clearance

S.N.	Project Activity	Date/Duration
1.	Baseline Monitoring & Data Collection	Summer Season (March to May, 2025)
2.	ToR Application submitted on Parivesh 2.0 Web Portal vide Proposal no. IA/GA/MIN/571910/2026	13.03.2026
3.	Technical Presentation (Consideration for ToR) held before 5 th EAC (Non-Coal Mining) Meeting	23.04.2026
4.	ToR Letter issued by MoEF&CC, New Delhi vide File no. J-11015/49/2025-IA.II(NCM)	18.05.2026

1.2.2 INTRODUCTION OF PROJECT PROPONENT

- JSW Steel Limited is the flagship company of the US\$24 Billion JSW Group and one of India's leading integrated steel manufacturers. The Company has a consolidated crude steel production capacity of 35.7 million tonnes per annum (MTPA), including 1.5 MTPA in the United States. With ongoing expansion projects, the Company's total steelmaking capacity is expected to increase to 43.5 MTPA over the next few years.
- JSW Steel's Vijayanagar Works in Karnataka is India's largest single-location integrated steel manufacturing facility, with an installed crude steel production capacity of 17.5 MTPA. An additional 5 MTPA capacity is currently under commissioning at the Vijayanagar plant, which will further strengthen the Company's production capabilities.
- The Company has consistently demonstrated leadership in research, innovation, and technological excellence through its long-standing strategic collaboration with JFE Steel Corporation, Japan. This partnership enables JSW Steel to adopt advanced steelmaking technologies and manufacture high-value-added and specialized steel products that meet international quality standards.
- JSW Steel is globally recognized for its commitment to sustainable steel production and has been honoured multiple times as a Steel Sustainability Champion by the World Steel Association. The Company is also included in leading global sustainability indices and has committed to achieving net-zero carbon emissions by 2050 while targeting 100% renewable electricity sourcing by 2030.
- The Company has received several prestigious national and international awards for excellence in quality, operational performance, innovation, and sustainability. These recognitions reflect JSW Steel's continuous commitment to responsible manufacturing practices, environmental stewardship, and business excellence.

1.3 BRIEF DESCRIPTION OF NATURE, SIZE, LOCATION OF THE PROJECT & ITS IMPORTANCE TO THE COUNTRY & REGION

1.3.1 BRIEF DESCRIPTION OF NATURE, SIZE & LOCATION OF PROJECT

The brief description of the nature, size and location of the project has been given in table below:

Table 1.2
Brief description of the project

S.N.	Particular	Details	
A.	Nature of Project	Fully Mechanized Opencast Iron Ore Mining and Dry/Wet Beneficiation Plant	
B.	Size of the Project		
1.	Mining Area	377.0881 ha (Govt. Land: 236.3482 ha, Private Land: 58.9087 ha, Alvara Land: 15.8626, Forest Land: 65.9686 ha)	
2.	Proposal	➤ Iron Ore: 3.50 Million TPA ➤ OB/Waste: 8.21 Million TPA Total Production: 11.71 Million TPA 03 Primary Crushers: 1 x 250 TPH & 2 x 90 TPH 01 Secondary Crusher: 150 TPH Dry Processing/Screening Plant: 600 TPH Wet Beneficiation Plant with throughput capacity 3.50 Million TPA: 2 x 300 TPH	
C.	Location Details	Village	Codli
		Taluka	Dharbandora
		District	South Goa
		State	Goa
D.	Location Coordinates	Latitude	15°21'15.638" N to 15°19'42.607" N
		Longitude	74°7'10.922" E to 74°8'39.034" E
E.	SOI Open Series/Toposheet no.	Core Zone: D43C3/ 48I/3 Buffer Zone: D43C3, D43B15, D43C4/ 48I/3, 48E/15, 48I/4	
F.	Seismic Zone	Zone – III as per IS: 1893 (Part-I): 2016	

1.3.2 PROJECT IMPORTANCE TO THE COUNTRY & REGION

National Importance

- There is a significant scope for new mining capacities in iron ore and considerable opportunities for future discoveries of sub-surface deposits. Infrastructure projects continue to provide lucrative business opportunities for steel, zinc, and aluminium producers. Iron and steel make up a core component for the real estate sector. Demand for these metals is set to continue given strong growth expectations for the residential and commercial building industry.

- India is the fourth-largest producer of Iron Ore in the world. India holds a fair advantage in cost of production and conversion costs in steel and alumina. India's iron ore production stood at 310.0 MT in FY26, an increase of 7.0% compared with 289.4 MT in FY25.
- Rise in infrastructure development and automotive production are driving growth. Demand for iron and steel is set to continue given the strong growth expectations for the residential and commercial building industry.
- Iron ore remains the most crucial driving force for the steel industry in India and the industry's growth so far can largely be attributed to the domestic availability of low cost and high-quality Iron ore.
- Steel production and consumption are frequently seen as measures of a country's economic development because it is both a raw material and an intermediary product. India is the world's second-largest producer of crude steel.
- In FY26 (April-February), crude steel production in India stood at 153.6 MT, while finished steel production reached 146.8 MT. India is expected to surpass its steel production capacity target of 300 MT by 2030, reaching an estimated 330 MT.

(Source: <https://www.ibef.org/industry/metals-and-mining>)

Regional Importance

- The mine will contribute to the State & Central Govt. exchequers by way of mining revenue.
- The project will bring about gains in gross domestic product which will add to the gains in the GDP.
- Around 154 persons will be employed directly in the Mining Project. Although direct employment opportunities are limited but mining activities also result in generation of numerous indirect employment avenues/opportunities for the local people.
- Since Iron ore is the main raw material for steel production, the demand is always there with that of steel.
- Major part Iron Ore produced from this mine will be supplied to JSW Steel Plant whereas low grade iron ore and siliceous ore will be fed to Wet Beneficiation Plant to attain a product of +54% Fe and then supplied to JSW Steel Plant and / or sold in open market for its use in to Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant.
- Maximum part of the produced material will be supplied to JSW Steel Plant. To some extent ore will also be sold in domestic market to Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant.
- Apart from the mining activities, plantation will also be carried out in the area which will improve the local environment to a certain extent.
- The project will help in the overall growth of the region.

1.4 SCOPE OF THE STUDY

Scope of this study covers all the points given in the Terms of Reference (ToR) issued by the MoEF&CC, New Delhi vide File no. J-11015/49/2025-IA.II(NCM) dated 18.05.2026. The regulatory scoping of the project has been mentioned in “Point wise compliance of ToR” on Page no. 28 to 74 of this EIA/EMP Report. The data generated from various studies for the EIA/EMP are presented and discussed in following chapters of this report prepared as per Appendix - III of the EIA Notification, 2006.

Chapters	Description
Chapter-1	Introduction
Chapter-2	Project Description
Chapter-3	Description of the Environment
Chapter-4	Anticipated Environmental Impacts and Mitigation Measures
Chapter-5	Analysis of Alternatives (Technology & Site)
Chapter-6	Environmental Monitoring Programme
Chapter-7	Additional Studies
Chapter-8	Project Benefits
Chapter-9	Environment Cost Benefit Analysis
Chapter-10	Environmental Management Plan
Chapter-11	Summary & Conclusion
Chapter-12	Disclosure of Consultants Engaged

1.5 STATUTORY PROVISIONS APPLICABLE TO THIS MINING PROJECT

Company will adhere to the statutory provisions related to environment, safety and pollution control, as applicable, for the following:

1. Mines and Minerals (Development and Regulation) Act, 1957, as amended thereof.
2. Guidelines and circulars for statutory requirements of Directorate General of Mines Safety, Ministry of Labour and Employment, Government of India.
3. The Air (Prevention and Control of Pollution) Act, 1981, as amended thereof.
4. The Water (Prevention and Control of Pollution) Act, 1974, as amended thereof.
5. Environment (Protection) Act, 1986, as amended thereof and Rules thereunder.
6. Environmental (Protection) Rules, 1986, as amended thereof.
7. Environment Impact Assessment Notification 2006, as amended thereof.
8. Manufacture, Storage and Import of Hazardous Chemical Rules 1989 amended in 1994 and 2000.
9. Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and amendments 2016, 2017, 2018, as amended thereof.
10. Solid Waste Management Rules, 2016, as amended thereof.
11. Construction and Demolition Waste Management Rules 2016, as amended thereof.

12. Plastic Waste Management Rules 2016, as amended thereof.
13. Batteries Management Rules, 2022, as amended thereof.
14. E-Waste Management Rules, 2022, as amended thereof.
15. GSR 94(E): Mandatory Implementation of Dust Mitigation Measures for all Construction and Demolition Activities.
16. Noise Pollution (Regulation and Control) Rules 2000 and amendment 2000, 2002, 2017, as amended thereof.
17. Wildlife Protection Act, 1972, as amended thereof.
18. Wetland Rules, 2017, as amended thereof.
19. Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 and Van (Sanrakshan Evam Samvardhan) Rules, 2023
20. The Petroleum Act, 1934, as amended thereof.
21. Green Credit Rules, 2023
22. Environment Audit Rule, 2025
23. Motor Vehicles Act, 1988, as amended thereof.
24. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996, as amended thereof.
25. The Factories Act, 1948, as amended thereof.
26. Public Liability Insurance Act, 1991, as amended thereof.
27. Occupational Safety, Health and Working Conditions Code (OSHWC) Code 2020 and OSHWC Rules, 2026.



CHAPTER - 2 PROJECT DESCRIPTION

2.1 TYPE OF THE PROJECT

As mentioned in the previous chapter, the Proposed Block - XII Codli Mineral Block, over mining lease area of 377.0881 ha falls under Category 'A' as per the Schedule of EIA Notification, 2006 & its subsequent amendments thereof; Project or Activity 1 (a)(3) for Mining of minerals and 2 (b) (3) for Mineral Beneficiation.

The Iron Ore production capacity will be 3.50 Million TPA, OB/Waste: 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crushers (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Mining will be carried out by opencast mechanized method by deployment of Heavy Earth Moving Machinery without drilling and blasting. The transportation of excavated Iron Ore will be transported from mine face to the crushers proposed to be installed within the ML area.

The crushed ore will be supplied to JSW Steel Plant or sold in open market. Normal Iron ore will be only subjected to dry screening and dispatch from mine whereas low grade iron ore and siliceous ore will be fed to Wet Beneficiation Plant to attain a product of +54% Fe and then supplied to JSW Steel Plant and / or sold in open market (for its use in Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant or exported).

2.2 NEED FOR THE PROJECT

- Steel production is the primary driver of iron ore demand. India's growing steel sector relies heavily on iron ore as its main raw material.
- Iron ore production in India is essential to support domestic steel manufacturing, infrastructure development, and economic growth, while also serving export markets.
- Demand for iron and steel is set to continue given the strong growth expectations for the residential and commercial building industry.
- In the financial year 2025-26, India's Iron Ore production was 310.0 MT with an increase of 7.0% compared with 289.4 MT in financial year 2024-25.

(Source: <https://www.ibef.org/industry/metals-and-mining>)

- Goa is primarily known for its significant iron ore availability, which has been the backbone of its mining industry and economy. The state has a moderate variety of other minerals, including bauxite, manganese ore, and various minor construction minerals like laterite and river sand.
- Mining in Goa today is synonymous with iron ore mining. The Goa iron ore is exported to China, Japan, Taiwan, South Korea and Eastern European Countries.
- Iron ore mining in Goa is completely in the private sector. The Iron ore deposits are distributed

over the Northern, Southern and Central Blocks of Goa. The Northern Block deposits are richer both in terms of quality and quantity of the ore, as compared to the Southern and Central Blocks.

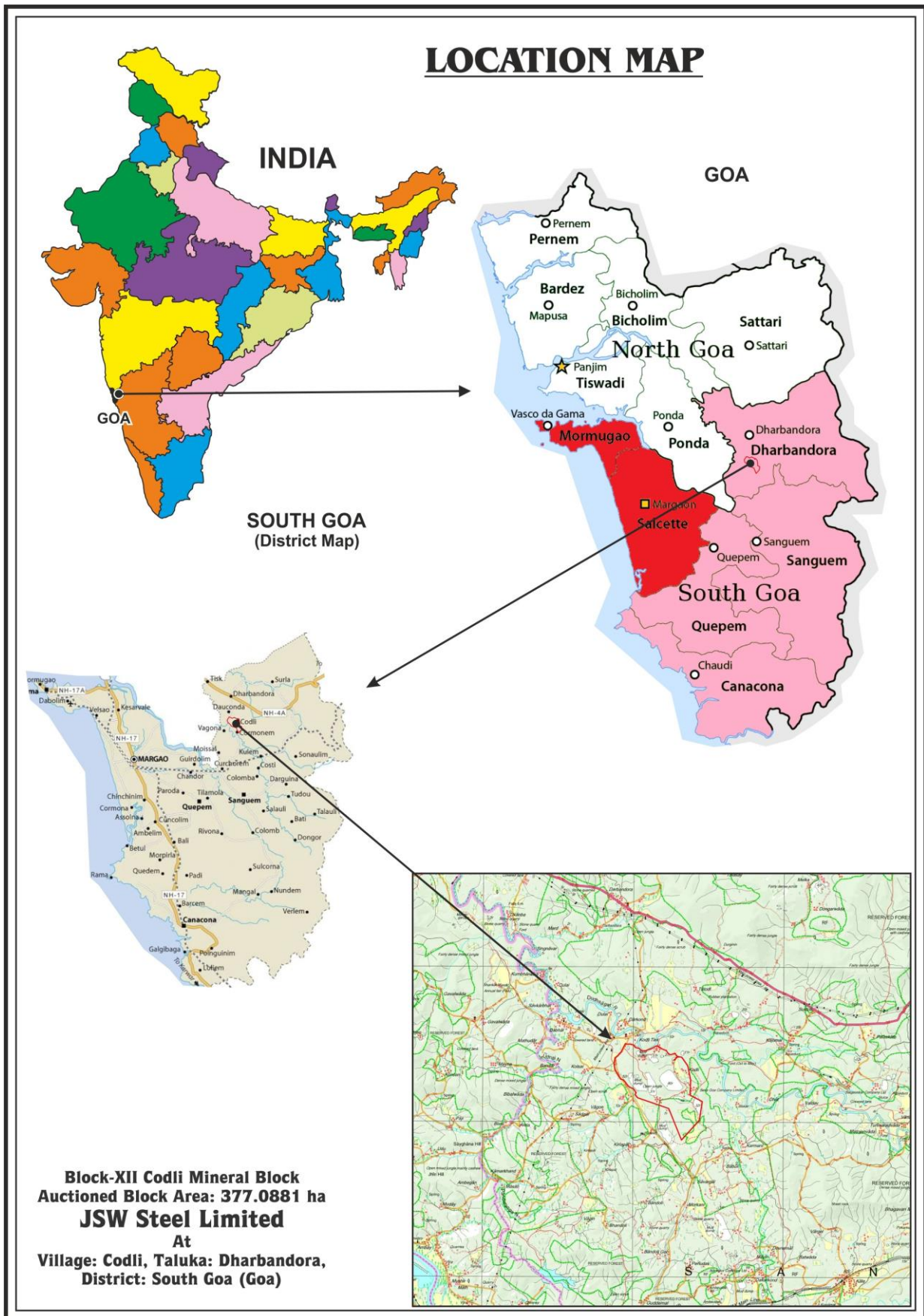
(Source: <https://dmg.goa.gov.in/#>)

- The Iron ore produced from Codli Mineral Block - XII Iron Ore Mine will be supplied to JSW Steel Plant or sold in open market. Normal Iron ore will be only subjected to dry screening and dispatch from mine whereas low grade iron ore and siliceous ore will be fed to wet beneficiation plant to attain a product of +54% Fe and then supplied to JSW Steel Plant or sold in open market.
- Maximum part of the produced material will be supplied to JSW Steel Plant. To some extent ore will also be sold in domestic market to Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant or exported.
- Total 154 persons will be directly employed in this mine. Preference will be given to the locals as per their eligibility, qualification & experience. Various indirect employment opportunities are also envisaged for local people from this proposed mining project.
- With the proposed project, there will be additional development in and around the area, increase in supporting facilities/ infrastructure eventually leading to further development of the area. It will also bridge the gap between demand and supply of iron ore to the consumers. The project will boost the overall growth of the region and in the State; the local economy will flourish due to increased income expenditure in the local market. Therefore, project is having great importance to the state and national economy.

2.3 LOCATION OF THE PROJECT

The mine site is located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

- Map showing India & District South Goa (Goa) along with general as well as specific location of the project site is given in Figure 2.1.
- Map showing Geology & Geomorphology along with geographical extent of mine site marked on SOI Toposheet is given in Figure 2.2.



Source: SOI Toposheet & <https://www.mapsofindia.com/>

Figure 2.1: Location Map (Showing General as well as Specific Location of the Proposed Mine)

2.3.1 MAP SHOWING GEOLOGY & GEOMORPHOLOGY OF THE MINE SITE WITH CORNER COORDINATES

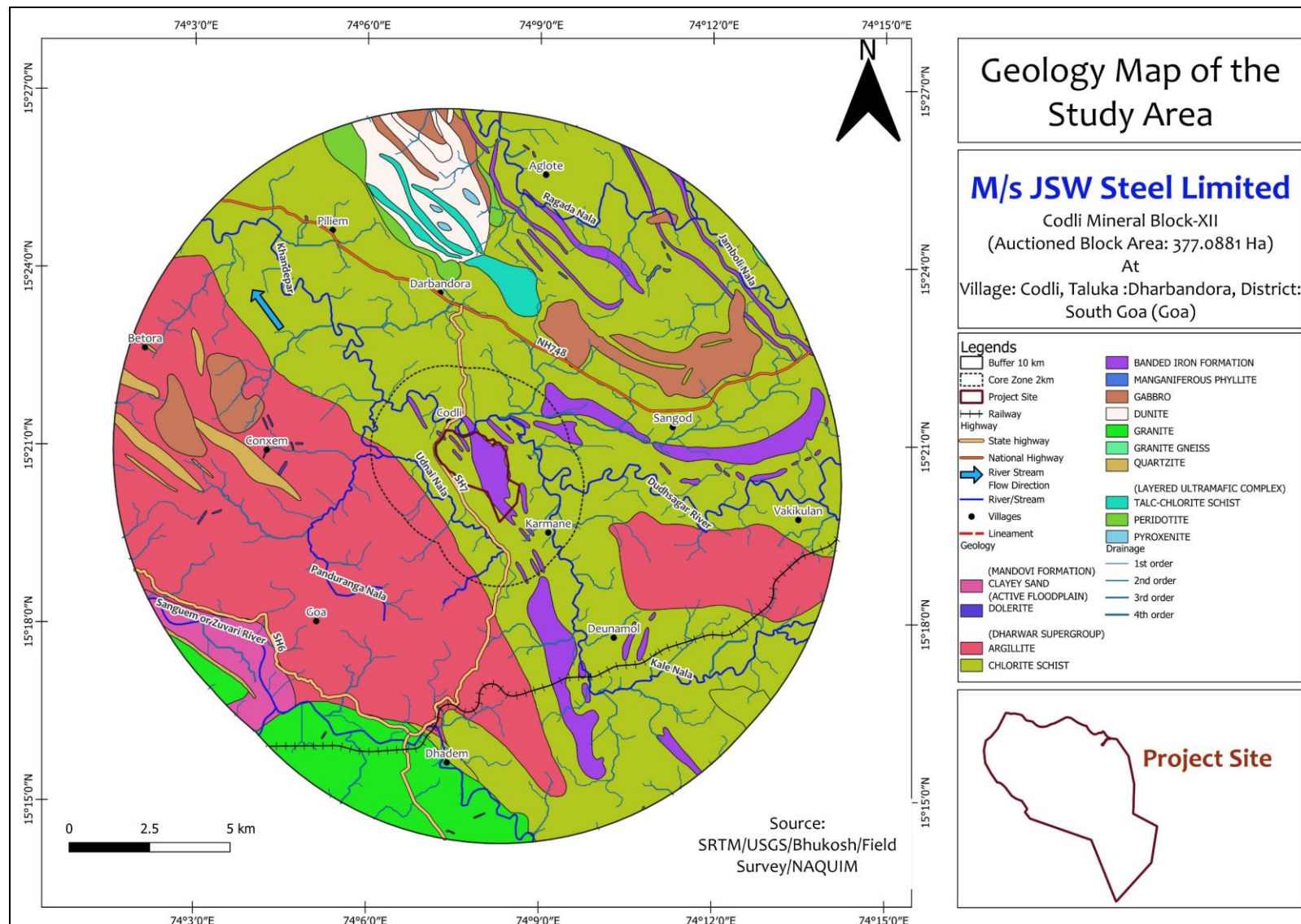


Figure 2.2: Map showing Geology and Geomorphology of the Mine Site with Geographical Extents

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Chapter 2 of Draft EIA/EMP Report

Corner/Pillar Co-ordinates given in Surface Plan & same is enclosed as **Annexure IV A**.

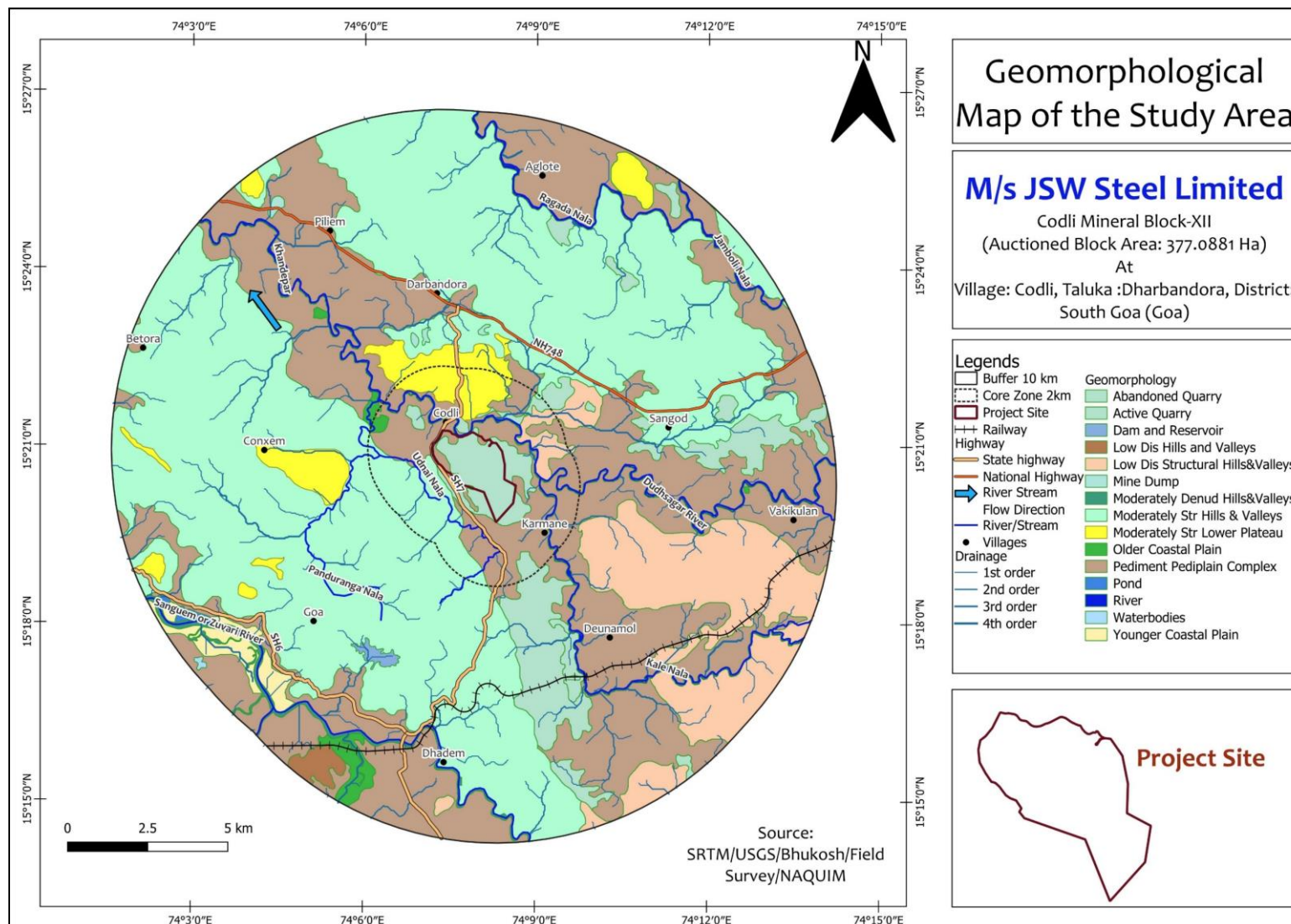


Figure 2.3: Map showing Geomorphology of the Mine Site with Geographical Extents

2.3.2 PROJECT SITE LAYOUT

Land Details

The area of proposed mine is 377.0881 ha which spreads in only 1 revenue Village namely Codli. Out of the total mining lease area, 236.3482 ha is Govt. land, 58.9087 ha is Private Land, 15.8626 ha is Alvara land & 65.9686 ha is Forest Land.

Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I. Break-up of Village wise land details is given below:

Table - 2.1
Breakup of Land area

Type of Land	Nature of Land	Area (ha)
Non-Forest Land	Govt. Land	236.3482
	Private Land	58.9087
	Alvara Land	15.8626
Forest Land	Forest land	65.9686
Total		377.0881

Source: Approved Mining Plan along with Progressive Mine Closure Plan

2.3.3 SALIENT FEATURES OF THE LEASE AREA

A. Mine Pits

The mineral block comprises a total of 07 pits, out of which 03 are mined-out pits and remaining 04 are active mining pits. The total area under the mined-out pits is 51.9542 ha, while the active mining pit area is 157.7670 ha. The mined-out pits developed during the erstwhile lease period are presently being utilized as tailing ponds for the safe storage and management of mine tailings. This utilization optimizes the use of existing excavated voids, minimizes the requirement for additional land and supports environmentally sustainable mine waste management practices.

B. Dumps

At present, there are total 06 waste dumps present within the mine area. Out of which, 04 are active waste dumps and 02 are stabilized waste dumps, contains 2.976 Million tonnes of OB/waste and occupying an area of total 22.55 ha within the mine site.

The active waste dump currently contains approximately 8.96 Million tonnes of waste and occupies an area of about 32.23 ha within the mine site.

During the plan period, approximately 23.43 Million tonnes of OB/Waste will be generated. This material will be disposed of in the proposed 02 new waste dumps (D4A and D7) covering an area of 46.84 ha and by extending the existing D4 waste dump.

At the conceptual stage, approximately 68.0 Million tonnes of OB/Waste will be generated. The waste will be stored in surface dumps and subsequently utilized for backfilling of mined-out areas

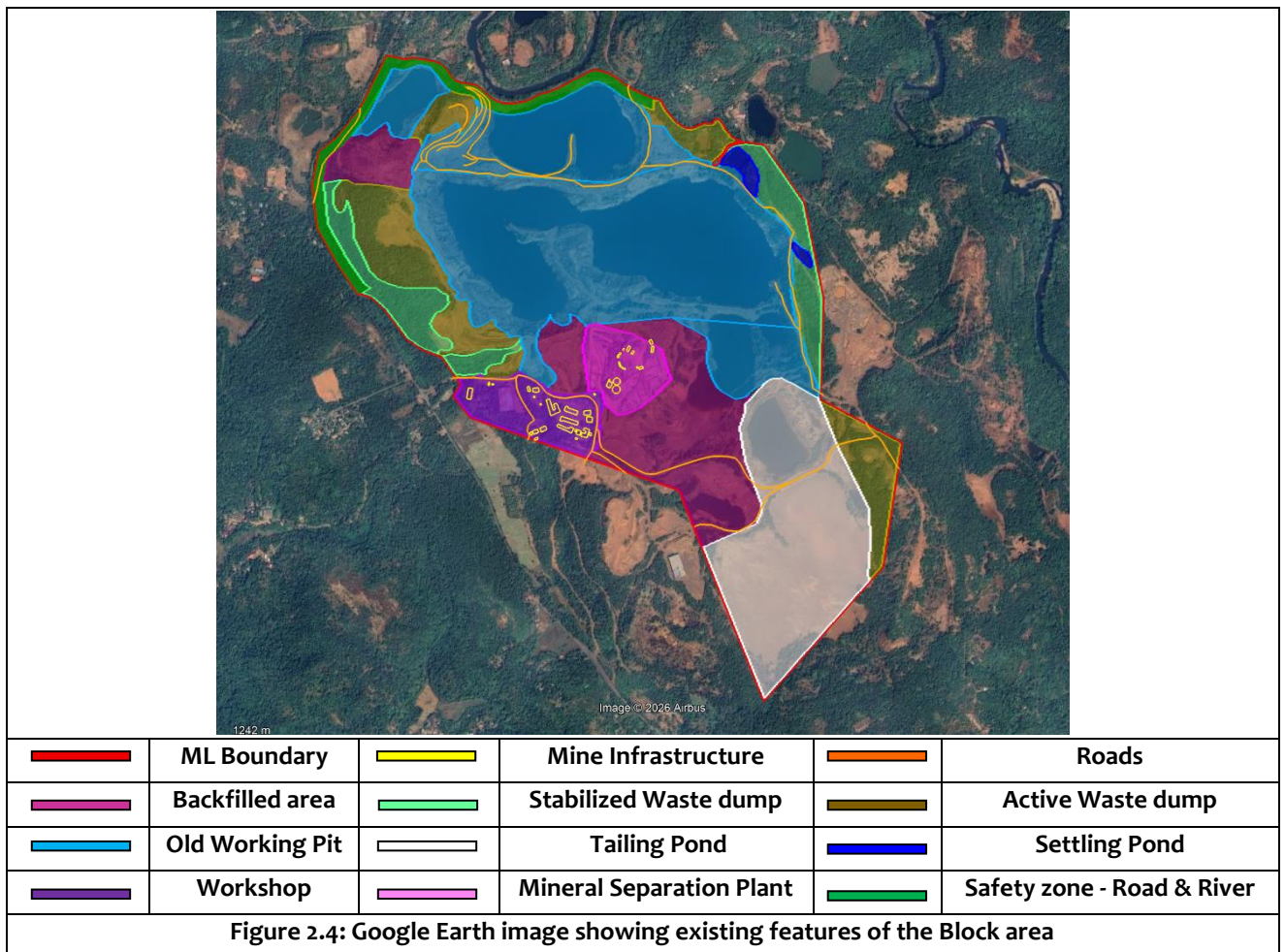
C. Mine Infrastructure and Mineral Separation Plant

D. Tailing Pond

E. Settling Pond

F. Backfilled area

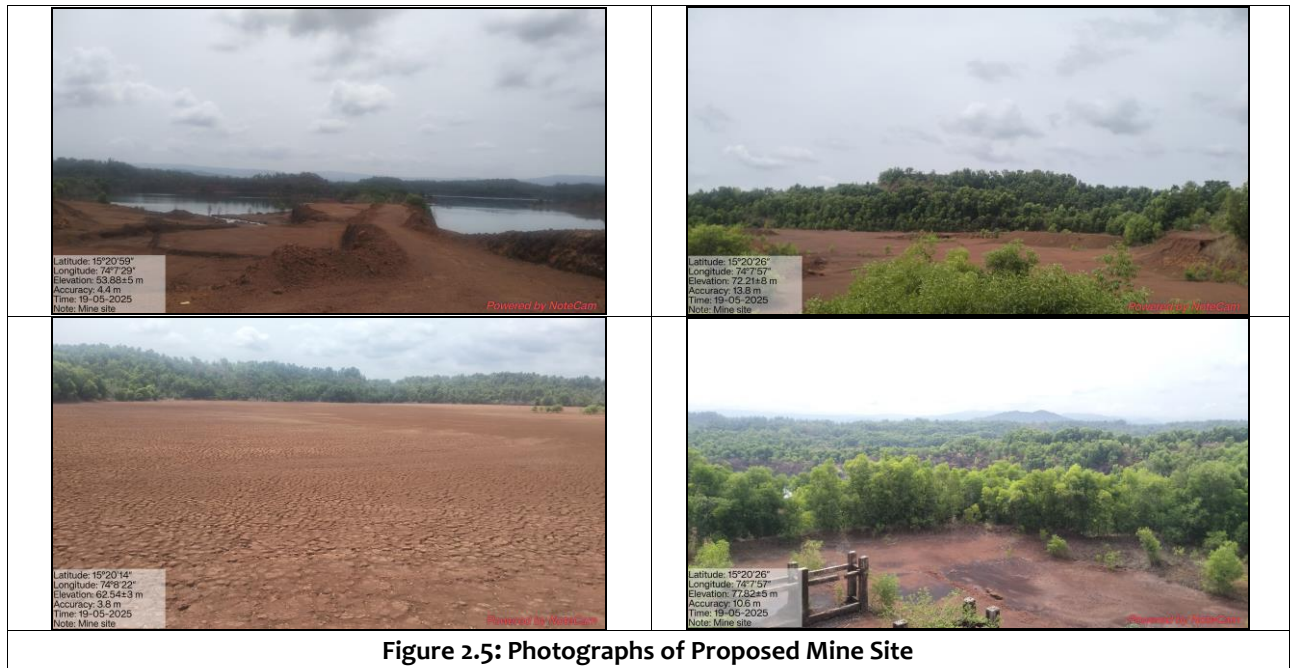
All above said mine site features of core zone marked on Google Image is given below and also shown in Surface Plan. Copy of the same is enclosed as **Annexure IVA**. Impacts and mitigation measures of the above are mentioned in the Chapter 4 of this EIA/EMP Report.



Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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2.3.4 PROJECT SITE PHOTOGRAPHS



2.4 SIZE OR MAGNITUDE OF OPERATION

JSW Steel Limited has proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Table - 2.2
Size and magnitude of operation

S.N.	Particulars	Details
1.	Area (In ha.)	377.0881 ha
2.	Type of Mine	Opencast Mine
3.	Method of Mining	Fully Mechanized Opencast mining (No drilling and Blasting)
4.	Total Geological Resources	48.50 Million Tonnes
5.	Total Mineable Reserves	27.32 Million Tonnes
6.	Production Capacity	Iron Ore: 3.5 Million TPA Wet Beneficiation Plant 3.5 Million TPA
7.	Total Excavation	11.71 Million TPA (Iron Ore: 3.5 Million TPA and OB/Waste: 8.21 Million TPA)
8.	Life of Mine	~ 8 Years (including the Plan period) (~ 14 Years based on the Reserves and Resources)
9.	Man Power (Nos.)	154 Persons
10.	Estimated Cost of the Project	Rs. 500.0 Crores
11.	Cost for Environment Management Plan	Capital cost of EMP: Rs. 543.9 Lakhs Recurring Cost of EMP: Rs. 117.0 Lakhs/annum

Source: JSW Steel Ltd. and Approved Mining Plan along with Progressive Mine Closure Plan

2.4.1 ASSOCIATED ACTIVITIES/FACILITIES PROVIDED

The proposed mine will have all the necessary infrastructure such as Mine office, workshop building, Crushers, diesel storage facility, rest shelters, canteen, DG set building for backup, roads, etc. within the ML Area.

- i. **Office Facilities:** A full-fledged office with all facilities will be established within the mine.
- ii. **Crushers:** It is proposed to install 4 Crushers (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) within the ML Area for crushing of the excavated Iron Ore.
- iii. **Workshop:** A well-equipped workshop is already established within the mine which will cater to the maintenance requirements for the HEMM. A fully equipped mobile Service Van; equipped with Compressor, Oils, Water, greasing arrangement, etc. will be also be provided at the proposed mine for field maintenance facilities.
- iv. **Store:** A store to cater the needs of mining equipment and allied mining activities will be established within the proposed mine.
- v. **Oil Room:** A well-maintained room is proposed to be established for the storage of various types of oils and lubricants.
- vi. **Fuel Storage:** There is no proposal of fuel storage within the mine lease area. However, to cater the need of fuel for HEMM, Diesel will be procured from the nearest petrol pump located at a distance of approx. 3.0 Km from the proposed mine site.

2.5 STATUS OF STATUTORY CLEARANCES, PERMISSIONS, NO OBJECTION CERTIFICATES, CONSENTS

The mining project will be implemented after getting all the Statutory Clearances, Permissions, No Objection Certificates and consents etc. which are required/necessary for this project under various Acts, Rules and Regulations is as given in table below:

Table - 2.3

Status of Statutory Clearances, Permissions, NOC, Consents

S.N.	Particular	Status
A. Statutory Clearances		
Mining Lease Status		
1.	LOI was issued by Directorate of Mines & Geology. Govt. of Goa, over 377.0881 ha area.	Vide letter no. DGM/28/Auction Cell/3 rd NIT/2023/2703 dated 10.12.2024. Copy of same is enclosed as Annexure I.
Mining Plan Approval Status		
2.	Mining Plan along with Progressive Mine Closure Plan over an area of 377.0881 ha approved from IBM, Goa	Vide letter no. MCDR-MPCoFE/6/2025-GOA-IBM_RO_GOA dated 06.08.2025. Copy of same is enclosed as Annexure II.
Environmental Clearance Status		
3.	Environment Clearance from MoEF&CC, New Delhi	➤ ToR Application was submitted on Parivesh 2.0 Web Portal vide Proposal no. IA/GA/MIN/571910/2026, dated 13.03.2026. ➤ ToR granted vide MoEF&CC File No. File no. J-

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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		11015/49/2025-IA.II(NCM), dated 18.05.2026. Remaining procedure to get the EC is under progress.
Forest Clearance Status		
1.	Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa.	Application was submitted on Parivesh 2.0 Web Portal vide Proposal no. FP/GA/MIN/QRY/569926/2026 dated 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I. Copy of the same is enclosed as Annexure III .
B. Permissions		
1.	Certificate from Goa State Pollution Control Board which states that proposed ML Area does not fall under Aravali Range.	Not Applicable as the proposed Mine Site is located at South Goa (Goa).
2.	Certificate from Goa State Pollution Control Board which states that no Critically Polluted area falls within the study area.	As the proposed Mine Site is located at South Goa (Goa). There is No Critically Polluted Area present.
3.	Permission for deployment of HEMM to be taken	Permission will be obtained before commencement of mining operations.
C. No Objection Certificates		
1.	Authenticated list of flora & fauna and location map	List of flora and fauna along with location map has been submitted to DCF, South Goa, Margao - Goa for authentication on dated 03.08.2026. Copy of the same is enclosed as Annexure V .
2.	Authenticated Location Map showing Distance between National Park/Wildlife sanctuaries and its ESZ from ML Boundary by Deputy Conservator of Forests, Govt. of Goa.	Vide Letter No. DCF(WP)/Tech/Digi/Vol-I/75/2025-26/751 dated 10.10.2025. Copy enclosed as Annexure VI .
3.	NOC from CGWA for ground water intersection	Application for obtaining NoC for ground water intersection will be submitted to CGWA. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. Copy of the same is enclosed as Annexure VII .
4.	Certificate from concerned District Magistrate/Executive Engineer from the State Water Resources department or any officer authorized by the State Government in this regard shall be submitted stating that mining activity is not located within flood plain of Dudhsagar/ Khandepar River corresponding to one in 25 years of flood as per Ministry's O.M. dated 14/02/2022.	Letter is submitted on dated 28.05.2026 to WRD regarding mining activity is not located within flood plain of Dudhsagar/ Khandepar River corresponding to one in 25 years of flood as per Ministry's O.M. dated 14/02/2022. Copy enclosed as Annexure VIII .

2.6 PROPOSED SCHEDULE FOR APPROVAL & IMPLEMENTATION

Proposed schedule for approval of the proposed mining project is given as under:

2.6.1 SCHEDULE FOR APPROVAL

Table - 2.4
Proposed Schedule for Approval

S.N.	Activity Description	Cumulative Duration (Months)
1.	Mining plan preparation & Approval by IBM	Completed
2.	Environment Clearance from MoEF&CC, New Delhi	
	Application submission to MOEF&CC, New Delhi	Completed
	Grant of ToR	Completed
	Baseline Study & Data Collection Summer Season (March to May, 2025)	Completed
	Submission of PH documents to SPCB	August 2026
	Conduction of Public hearing	45 days from date of receipt of the request letter
	Appraisal from MoEF&CC, New Delhi	60 days from the submission of Final EIA/EMP Report
	Grant of EC by MoEF&CC, New Delhi	60 days after recommendation of EAC
3.	Grant of Consent of Consent to Operate (CTO)	60 days from the grant of EC

Proposed schedule has been prepared as per EIA Notification, 2006; as amended thereof.

Note: ToR Application was submitted to MoEF&CC on 13.03.2026 and the ToR was granted by MoEF&CC on 18.05.2026. Baseline data was collected during Summer Season (March to May, 2025). The documents will be submitted to SPCB for conduction of Public Hearing. After conduction of Public Hearing the Final EIA/EMP report will be submitted to MoEF&CC. Further, after obtaining EC from MoEF&CC, consent under section 21 of the Air (Prevention and Control of Pollution) Act, 1981 and section 25/26 Water (Prevention and Control of Pollution) Act, 1974 will be obtained from Goa State Pollution Control Board (GSPCB).

2.6.2 IMPLEMENTATION

Implementation of the proposed mining project will be done in accordance with the existing Acts and Rules applicable on mining operations as well as in accordance with any Act/Rule/Guidelines issued by Central or State Government from time to time. Implementation of the proposed mining project will be done as per Mining Plan and Progressive Mine Closure Plan approved by Indian Bureau of Mines, Goa.

2.7 BASIC REQUIREMENTS FOR THE PROJECT

The project requirements such as water, power, man-power, fuel, machinery with source of supply is described in the sections below.

2.7.1 WATER REQUIREMENT

Total water requirement for the proposed mining project will be 1716 KLD which will be fulfilled from Mine Sump water and well water for drinking purpose. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026. The break-up of water for Mining and Beneficiation Plant is given below:

Table - 2.5
Water Requirement

Activity	Water Requirement (KLD)	Source
Beneficiation Plant	1416	Mine Sump Water and Well water for Domestic Purpose
Mining and Allied Activities	300	
Total	1716	

Source: JSW Steel Ltd.

Table - 2.6
Water Availability for mining

S.N.	Activity	Water Requirement (KLD)	Source
1	Domestic Use	20	Mine Sump Water and Well water for Domestic Purpose
2	Greenbelt	50	
3	Dust Suppression	130	
4	Vehicle Washing	50	
5	Workshop	50	
	Total	300	

Source: JSW Steel Limited

Table - 2.7
Water Availability and Requirement

Activity	Water Requirement (KLD)
Moisture in Feed	492
Beneficiation Process	8424
Total	8916

Table - 2.8
Initial water requirement

S.N.	Details	Water Requirement (KLD)
1	Moisture in the Feed	492
2	Drum Scrubber	3,108
3	Double Deck Vibrating Screen	1,200
4	Hydro Cyclone 1	480
5	Pump Box 2	996
6	MIMS	1,800
7	HGMS	840
	Total	8,916

Table - 2.9
Recovery of water from different unit operations

S.N.	Details	Amount of water (KLD)
1	Dewatering Screen-1	60
2	Dewatering Screen-2	228
3	Intermediate thickener	960
4	Concentrate Thickener	636
5	Concentrate Filter Press	372
6	Tailings thickener	4800
7	Tailings filter press	1320
Total		8376

Table - 2.10
Water Loss

S.N.	Sources	Amount of water (KLD)
1	Product 1 (-30+10 mm)	60
2	Product 2 (-10 mm)	108
3	Concentrate Filter Cake	108
4	Tailings Filter Cake	264
5	Evaporation Loss @2 %	168
Total Loss		708

Note: Each unit consume 708 m³/day

Table - 2.11
Make up Water Requirement

Description	Amount of water (KLD)
Water Availability in Process	8916
Water recovery & recycle to plant	8376
Water loss in tailing, production and evaporation losses	708
Make-up water to Plant	708

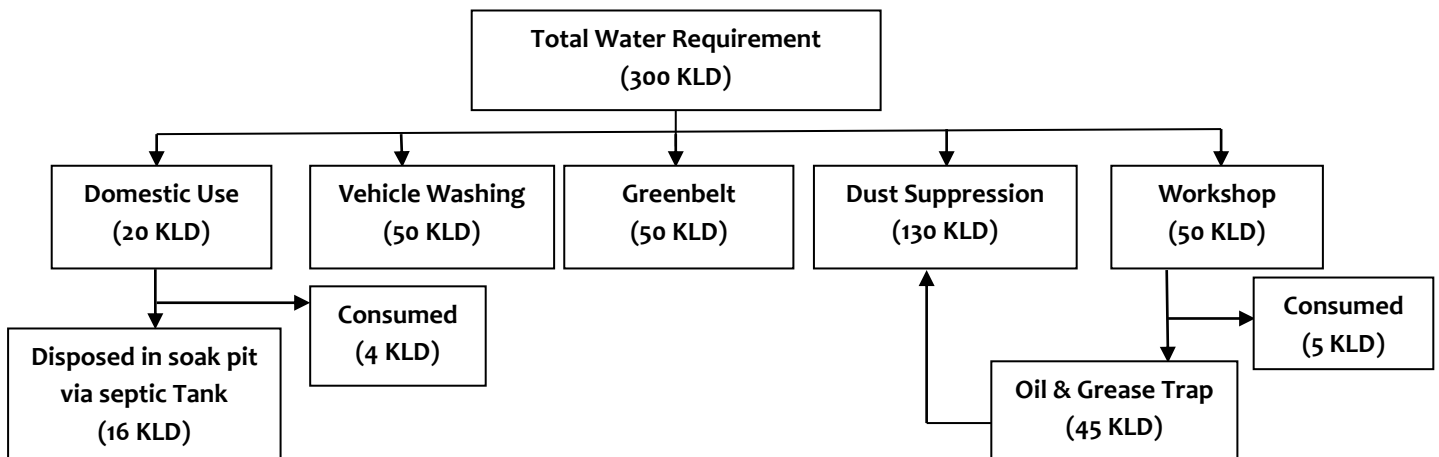


Figure 2.6: Water Balance Chart for mining operation

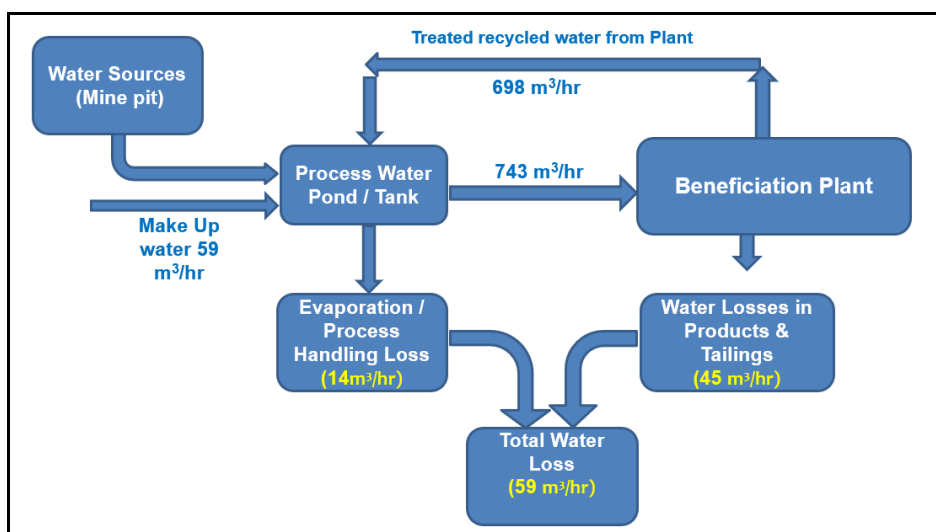


Figure 2.7: Water Balance Chart for Beneficiation Plant

Treatment of waste water through Oil & Grease Trap and ETP

An Effluent Treatment Plant with oil & grease trap will be constructed near Workshop. These facilities will be developed before the commencement of mining operations.

2.7.2 POWER REQUIREMENT

Total power requirement for the proposed mining project will be 3.2 MW. The required power will be met from Goa Electricity Department and power will be supplied for mining operations, mineral beneficiation unit and other functional buildings. For emergency power back-up, 10 D. G. sets of 20Kva each, are proposed to be installed.

JSW Steel Limited has also proposed a provision for production of Solar energy to the tune of 100 KW which will be installed within first 3-4 years and the solar power will be used in providing the sufficient power for street lights, office etc. in the mine lease area.

JSW also proposed to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption.

Fuel Requirement

The details regarding fuel requirement are given below:

Table – 2.12
Details of Fuel Requirement

S.N.	Particular	Detail
1.	Fuel	HSD
2.	Quantity per Annum	21.84
3.	Source	Nearby Pump
4.	Mode of Transport	Road
5.	Distance of Source from Proposed Mine Site	~30 Km
6.	Type of Linkage (Linkage / Fuel Supply Agreement / e-auction / MoU / LOA / Captive / Open market / Others)	Open Market

Source: JSW Steel Ltd.

Steps to be taken for reduction of diesel consumption:

1. Purchase of most fuel-efficient equipment
2. Regular repair and schedule maintenance of equipment
3. Regular Checking and air inflation of tyres of dumpers
4. Reduction in idle running of equipment along with Strict Monitoring & Control on equipment
5. Maintaining optimum lead & lift for transportation to ensure minimum fuel consumption.
6. Regular repair and maintenance of haul roads grading, bench floor, ramps & maintenance for diesel conservation in transportation
7. Installation of Engine auto idling device in all HEMMs so that engine comes down to low RPM when machine remains idle.
8. Educating Excavator and Dumper operators to operate in “Economy Mode” instead of “Power Mode”.
9. Good fragmentation of blasting material which will help in reduction of specific fuel consumption (Litr/T)
10. Optimizing the time spent by vehicles during the following instances:
 - Vehicle Travelling while empty
 - Loading & Unloading
 - Vehicle Stopped while loaded
 - Vehicle Travelling while loaded
 - Vehicle stopped while empty
11. Improving blast fragmentation to reduce stress on excavators and thereby fuel savings.
12. Training to HEMM operators on fuel conservation techniques.

The company will also explore the provision of use of electrically/LPG/CNG based machinery and HEMMs trucks for the operation and transportation of Iron Ore.

In compliance with the Specific ToR condition, JSW Steel Limited shall explore the feasibility of utilizing renewable energy for project-related infrastructure. In this regard, the Company shall consider augmentation of solar power capacity and the feasibility of a solar-powered jetty for mineral transportation, if found technically and economically viable. It is also proposed to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption.

2.7.3 MAN POWER REQUIREMENT

The total Manpower requirement will be 154 persons for mining operation. Skilled, Semi- skilled & Unskilled manpower will be sourced from the outside & local area. Out of total manpower, 19 persons will be there in the Managerial staff, 12 persons will be for Supervisory staff, 99 persons will be skilled workers/operators, 18 persons will be skilled & 24 persons will be semi-skilled or unskilled workers. Beside this, 82 persons will be employed for the Beneficiation Plant activities and 5 persons will be engaged for Environment Management Cell. The mining activity and beneficiation plant will create vast opportunities of employment under various posts to the local people in various activities like afforestation, canteen, transportation, etc. Preference will be given to the locals as per their eligibility.

Table - 2.13
Detailed list of Proposed Manpower

S.N.	Designations	Proposed Manpower
A.	Managerial Staff	
1	1 st Class Manager	1
2	2 nd Class Manager	3
3	Mining Engineer	3
4	Geologist	4
5	Mechanical Engineer	2
6	Electrical Engineer	2
7	Other	4
Sub Total		19
B.	Supervisory Staff	
1	Foreman	6
2	Mine - mate	6
Sub Total		12
C.	Skilled workers/Operators	
1	Operator	39
2	Dumper Operator	45
3	Dozer/Grader operator	6
4	Pump Operator	3
5	Technician	3
6	Other	3
Sub Total		99
C.	Semi-Skilled workers	12
D.	Unskilled Workers	12
Total Employment		154

Source: Approved Mining Plan along with Progressive Mine Closure Plan

Role & responsibilities of persons responsible for implementation of EMP is given in Table 10.1 of Chapter 10.

2.7.4 EXTENT OF MECHANIZATION

The capacity of machinery proposed to be deployed in the ML Area is considering the material proposed to be handled. Same is given in mining plan which is approved by IBM, Goa. Furthermore, all the proposed machinery will be procured and deployed prior to the commencement of mining operations. The machinery & equipment which will be required for mining operation are given below:

Table - 2.14
Proposed Machinery & Equipment required for Mining

S.N.	Equipment (Type)	Equipment (Make)	Capacity (in m ³)	Requirement (Nos.)
Excavator & Loading Equipment				
1	Excavator	Volvo	4.0	5
2	Backhoe	Volvo	2.90	3

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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3	Dumper	Volvo	20.0	17
4	Wheel Loader	Volvo	2.50	3
Transportation & Hauling Equipment				
1	Dumper	Volvo	20	17
2	Tipper	Tata	4.50	25
3	Water Tanker	Tata	10	4
Dozing Equipment Details				
1	Hydraulic (Dozzer)	CAT	200 HP	2

Source: Approved Mining Plan along with Progressive Mine Closure Plan

2.7.4.1 EQUIPMENT USED FOR BENEFICIATION PLANT

Major equipment of the beneficiation plant includes:

Table - 2.15
Proposed Machinery & Equipment required for 2 Wet Beneficiation Plant

S.N.	Equipment	Quantity	Capacity (TPH) / Remarks
1	Hopper	2	360
2	Feeder	2	360
3	Vibrating Grizzly	2	360
4	Jaw Crusher	2	100
5	Drum Scrubber	2	350
6	Double Deck Vibrating Screen	2	415
7	Dewatering Screen-1	2	375
8	Cone Crusher	2	60
9	Dewatering Screen-2	2	100
10	Screw Classifier	2	300
11	Pump Box-1 (for feeding Hydro-cyclone 1)	2	200
12	Hydro cyclone 1	2	200
13	Hydro cyclone 2	2	100
14	Pump Box-2 (for feeding to Hydro-cyclone 2)	2	100
15	Intermediate Thickener	2	140
16	Pump Box-3 (for feeding to MIMS)	2	140
17	MIMS (4000 Gauss)	2	140
18	HGMS (12000 Gauss)	2	120
19	Conc. Thickener	2	70
20	Conditioner cum Pump 1	2	70
21	Filter Press 1	2	70
22	Tailing Thickener	2	120
23	Conditioner cum Pump 2	2	120
24	Pressure Filter-2	2	120

The above-mentioned equipment's are designed to handle a feed of 300 TPH of Low-grade Wet Iron Ore having 12% moisture.

Table - 2.16
Proposed Machinery & Equipment required for 1 Dry Beneficiation Plant

S. No.	Equipment	Quantity	Capacity (TPH) / Remarks
1	Hopper	1	700
2	Feeder	1	700
3	Vibrating Grizzly	1	700
4	Jaw Crusher	1	300
5	Vibrating Screen	1	700
6	Cone Crusher	1	200
7	Double Deck Vibrating Screen	1	500

The above-mentioned equipment's are designed to handle a feed of 600 TPH of Dry Iron Ore having 7% moisture.

2.7.5 GEOLOGY OF THE AREA

2.7.5.1 REGIONAL GEOLOGY

Most part of the Goa is covered by rocks belonging to Archaean Dharwar Super Group referred in Goa as Goa group represented by Barcem Formation, Vageri Formation, Bicholim Formation and Sanvordem Formation which are overlain by a younger rock. The common rock types exposed are Quartz-Sericite Schist, Quartz Chlorite Schist, Phyllite with BIF, Meta-graywacke, Argillite, Limestone, Metarhyolite and Metabasalt. The general strike of the Dharwarian rocks is NW_SE. All these rocks have suffered greenschist facies metamorphism. A small portion of the area in the northern part is covered by Deccan Traps. Most of the Goan iron ore deposits are associated with iron ore formations of Bicholim group of rocks. These iron ore formations are covered by thick laterite capping of 15 to 20 m followed by lumpy ore, powdery iron ore with intercalations of manganiferous and phyllitic clay. Intensely weathered quartzites with manganiferous clay/phyllite form are seen along the foot wall of iron formation rocks.

Table – 2.17
Stratigraphic Succession of the Dharwar Super Group (After GSI)

Era	GROUP	FORMATION	LITHOLOGY
Quaternary	-	-	Beach sands and river alluvium
Pliocene to Pleistocene	-	-	Laterite and aluminous laterite
Late Cretaceous to Paleocene	Deccan Trap	-	Continental flood basalts mainly tholeiitic type with dykes
Palaeo Proterozoic to Meso Proterozoic	Closepet Granite	Chandranath Granite, Dudsagar Granite, Canacona Granite	Alkaline granites mainly also variants from monzo granite to grano diorite
Archaean to Palaeo Proterozoic	Mafic-ultramafic Layered Complex	-	Pridotite-chromite-dunite- abbronorite, pyroxenite
		Vageri	Carbonate-quartz-chlorite Bicholim schist/greywacke
	Goa Group of Dharwar Super Group	Bicholim	Dolomitic limestone
			Quartz-sericite schist
			Banded Iron Formation

			Quartz-chlorite-biotite schist inter-layered with chert, iron and Mn oxides, carbonates, metabasalt and meta-gabbro
			Sanvordem
		Barcem	Quartzite/greywacke with Conglomerate
			Quartz-chlorite schist
Archaeon	Peninsular Gneiss-II	Ankola Gneiss, Anmod Ghat Gneiss	Meta-acid volcanic (meta- rhyodacite), quartz porphyry, tuff
			Meta-basalt, meta-gabbro and meta - anorthositic gabbro, quartzite
			Migmatite and granites (s.1); tonalite
			trondjemite-granodiorite

Source: Approved Mining Plan along with Progressive Mine Closure Plan

2.7.5.2 LOCAL GEOLOGY

The Codli Mineral block comprises rocks belonging to Bicholim Group of rocks Formation of Dharwar Supergroup. This iron ore deposit within the Codli Mineral block is part of South Goa Formation. The iron ore deposits are found in small mounds of hillocks in a generally low undulating landmass and are locally known as Codli-Daucona hillock. Based on the exploration data, the ore body has been systematically delineated both structurally and qualitatively. The deposit occurs as discrete synclinal basins with top lateritic cover often enriched with iron content in isolated pockets. The ore body is intercalated with phyllites, manganiferous clays and limonitic clays. Due to active mining in the area iron ore zones are exposed in the mining pits. Few of the pits which are either exhausted required concentration of ore or reached ultimate pit level are back filled with the tailings which also contain Fe concentration by the erstwhile lessees. Due to igneous activity, a number of weathered and altered intrusive bodies exist mostly in the form of clays along and across the ore body. Altered intrusive of doleritic composition show cross cutting relationship with majority of the litho-units. The total strike length of the ore body in the subjected mineral block area is more than 3000m running NW-SE direction having width more than 300 m.

Table - 2.18
Ore Body Geometry and Grade

S.N.	Name of the Ore Band	General Strike / Trend	Dip of Mineral Body	Average Strike Length (m)	Average Width (m)	Chemical Parameters				
						Average Depth (m)	Name of the Radical	Min Grade (%)	Max Grade (%)	Avg Grade (%)
1	Ore Band	NW-SE	NE	>3000	>300	60	Fe	35.00	67.00	52.00

General Stratigraphic succession of lithology in the area is given below:

Litho Unit	Thickness
Laterite	15.0 m to 20.0 m
Discontinuous Lens of Lumpy Ore	5.0 m to 10.0 m
Manganiferous/ Phyllitic / Limonitic Clay	6.0 m to 10.0 m
Friable / Powdery Ore	30.0 m to 40.0 m
Manganiferous Siliceous Clay / BHQ Forms	Footwall Dyke/Sills Intrusive

Source: Approved Mining Plan along with Progressive Mine Closure Plan

2.7.6 DETAILS OF MINING

2.7.6.1 EXPLORATION CARRIED OUT IN THE AREA

The exploration was carried out by Vedanta Ltd, Panduronga Timblo Industrias, Timblo Pvt Ltd. (Erstwhile Lessees). The exploration was carried out exclusively by core drilling during the period from 01.04.2017 to 31.03.2018 on a scale of 1:2000 covering an area of 377.0881 ha.

Table - 2.19
Exploratory Drilling Carried Out

Exploration Agency	Core holes		Non - Core holes		Grand Total	
	Number of boreholes drilled	Total meters	Number of Boreholes drilled	Total meters	Number of boreholes drilled	Total meters
Vedanta Ltd	1326	84582.37	0	0	1326	84582.37
Timblo Pvt Ltd.	213	10531.50	0	0	213	10531.50
Panduronga Timblo Industrias	111	10241.17	1	74.00	112	10315.17

Source: Approved Mining Plan along with Progressive Mine Closure Plan

Table - 2.20
Exploration Details

Level of Exploration	Forest Area in Ha	Non-Forest Area in Ha	Total Area in Ha
G-1	36.5335	191.9156	228.4491
G-2	0.0000	14.5502	14.5502
G-3	0.0000	11.0104	11.0104
G-4	0.0000	0.0000	0.0000
Area Proved as non-mineralized	29.4351	93.6433	123.0784
Area to be explored	0.0000	0.0000	0.0000
Total	65.9686	311.1195	377.0881

Source: Approved Mining Plan along with Progressive Mine Closure Plan

2.7.6.2 EXPLORATION TO BE CARRIED OUT IN THE AREA

In order to classify the resources in the G1 category, the exploratory drilling is proposed to be carried out in entire lease area during the from second year and third year post mine lease execution in the non-forest area. After the completion of proposed exploration, a complete geological set up of the deposit shall be available with greater confidence for the entire depth. Based on the outcome of the proposed exploration, the life of the mine may change.

Table - 2.21
Exploratory drilling details with core drilling in the non-forest area

Year	No of Borehole	Total Meter	Borehole Type	Grid Interval	Scale
2 nd	21	840.00	Core	50.00	1:2000
3 rd	21	880.00	Core	50.00	1:2000
Total	42	1720.00	-	-	-

2.7.6.3 ESTIMATION OF RESOURCES/RESERVES

The summary of area covered and corresponding resources of Iron Ore estimated in the ML area as per UNFC is given in table below:

Table - 2.22
Mineral Resources & Reserves (Iron Ore) as per UNFC as on 31.03.2018

Classification		UNFC Code	Quantity (Million Tonnes)			Grade	
			Forest	Non-Forest	Total	Forest	Non-Forest
A	Total Mineral Reserves						
1.	Proved Mineral Reserve (A)	111	1.89	23.69	25.58	>54%Fe	35-67% Fe
2.	Probable Mineral Reserve (A)	121	0	0	0	-	-
3.	Probable Mineral Reserve (A)	122	0	1.74	1.74	-	35-67% Fe
B	Total Remaining Resources						
1.	Feasibility Mineral Resource (B)	211	2.88	12.01	14.89	>47%Fe	35-67% Fe
2.	Prefeasibility mineral Resource (B)	221	0	0	0	-	-
3.	Prefeasibility mineral Resource (B)	222	0	3.35	3.35	-	35-67% Fe
4.	Measured Mineral Resource (B)	331	0	2.90	2.90	-	35-67% Fe
5.	Indicated Mineral Resource (B)	332	0	0	0	-	-
6.	Inferred Mineral Resource (B)	333	0	0.04	0.04	-	>54%Fe
7.	Reconnaissance Mineral Resource (B)	334	0	0	0	-	-
Total Mineral Resources (A+B)			4.77	43.73	48.50	-	-

Source: Approved Mining Plan with Progressive Mine Closure Plan

The reserve and resources are estimated by cross sectional method. Cross sections are drawn at 50 m interval and the section areas calculated and multiplied by bulk density. Reserve has been calculated after incorporating data of drilled boreholes. The open pit also geologically mapped and geological structure is interpreted after incorporating the mapped out. The reserves and resources estimated as per the approved mining plan. May be increase based on future exploration results.

Method of Estimation:

- Reserves are estimated by the cross-sectional method. Cross sections are drawn at 50m interval.
- The area of individual litho units in every cross section is calculated separately.
- The volume between the cross section is arrived on the basis of the average cross-sectional area of a particular ore band on successive parallel cross sections i.e. $((S_1 + S_2)/2)$ and the same was multiplied by the sectional interval to arrive at volume in cubic meters of respective type/category of ore.
- Further the tonnage is calculated by multiplying the volume with average bulk density of the respective formation.
- Area of influence of each potential bore hole has been calculated by polygon area method.
- Total Mineral Resources in Block - XII Codli Mineral Block are 48.50 Million Tonnes (Grade- Normal Ore: +54% & Siliceous Ore: +35%). Out of these, 27.32 Million Tonnes are mineable reserves in 4 existing pits present within the ML area.

Pit wise Mineral reserves given in the table below:

Table - 2.23
Mineral available in the Existing Pits

S.N.	Particular	Mineral Available (In Million Tonnes)		
		Reserve	Resources	Total
1.	Pit - 1	8.22	6.29	14.51
2.	Pit - 2	9.46	4.05	13.51
3.	Pit - 3	3.14	8.37	11.51
4.	Pit - 4	6.50	2.47	8.97
Total		27.32	21.18	48.50

2.7.6.4 LIFE OF MINE

With the peak annual Iron Ore production to the tune of 3.5 Million TPA, the life of mine will be ~8 years considering mineable reserves as 27.32 Million Tonnes and life of mine is ~14 Years based on total mineral resources (48.50 Million Tonnes). However, the life of the mine may be extended after further exploration of the lease area.

2.7.6.5 USE OF MINERAL

The excavated Iron Ore (approximately 11,667 TPD) will be transported to the processing plant, located within the Mining Lease (ML) area, by road using 40 Tonnes capacity dumpers. After beneficiation, the processed iron ore will be supplied to the JSW Steel Plant or sold to prospective buyers.

Normal-grade iron ore will be subjected only to dry screening before dispatch from the mine. Low-grade iron ore and siliceous ore will be processed through the wet beneficiation plant to produce a concentrate with an iron (Fe) content of more than 54%. The beneficiated product will then be supplied to the JSW Steel Plant or sold in the open market to blast furnace industries, sponge iron industries, and other industries equipped with sinter plants.

2.7.7 TECHNOLOGY & PROCESS DESCRIPTION

2.7.7.1 PROPOSED METHOD OF MINING

The proposed method of mining will be fully mechanized opencast mining. Mining will be carried out using Ripper-dozer and other heavy earth moving machinery without drilling and blasting. The mining operation will involve excavation, loading, unloading, crushing, hauling, Iron Ore Beneficiation and transportation activities. Height of Benches will be 7.0 m (maximum) and width of Benches will be kept 9.0 m (minimum). The Overall pit slope will be maintained at 45°. Loading operations will be done by Hydraulic Excavators. Dumpers of 40 Tonnes capacity will be used for transportation of mineral from mine face to the proposed Crushers. After crushing, iron will be sent to the Beneficiation Plant. Post beneficiation, the normal ore will be supplied to JSW Steel Plant whereas low grade Iron Ore and Siliceous Ore will be fed to Wet Beneficiation Plant and then supplied to JSW Steel Plant and/or sold in open market (for its use in Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant).

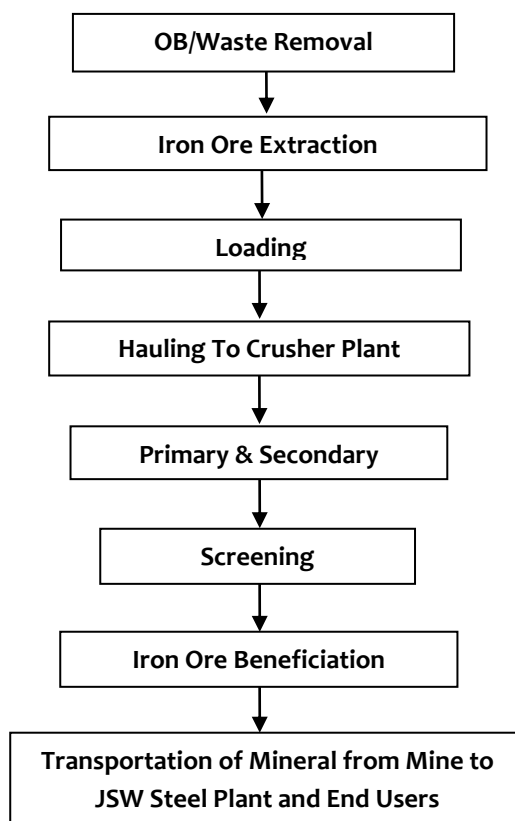


Figure 2.8: Flow Chart for Mining Process

a) OB/Waste Removal

There is no generation of Topsoil as the working is proposed in already broken-up area. The mine working will involve removal of overburden/waste which will be dumped separately and will be simultaneously used in backfilling.

b) Loading & Hauling

Loading is proposed to be with hydraulic excavator having bucket capacity of 4.0 m³ & 2.9 m³ and from mine face to crusher will be transported by dumper of 40 tonnes and wheel loader 2.5 m³ capacity. Waste generated will be transported to waste dumps present in the mine site.

c) Crushing

Crushing of Iron ore will be done in Primary Crusher of 90 TPH & 250 TPH and Secondary Crusher 150 TPH capacity which will be installed within the lease area. Iron Ore will be transported from mine face to crusher by 20 m³ capacity Dumper via haul road. The details of the feed size and output size for the crushers are given below:

Table - 2.24
Crusher Details

S.N.	Type of Crusher	Crusher Capacity	Nos.	Feed Size	Output Size
1.	Primary Crusher (Jaw Crusher)	250 TPH	1	- 500 mm	- 100 mm
2.	Primary Crusher (Jaw Crusher)	90 TPH	2	+75 mm	-75 mm
3.	Secondary Crusher (Cone Crusher)	150 TPH	1	+ 100 mm	- 30 mm

Source: Approved Mining Plan along with Progressive Mine Closure Plan

d) Beneficiation Plant

One 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA will be installed within the ML area.

e) Transportation

All the Fines generated from the crushing will be loaded by loader of 2.5 m³ capacity & transported through dumpers or wheel loaders capacity of 20 m³ or 2.5 m³ and after that transported through tippers of 4.5 m³ via road to railway siding and jetty end users via Rail and Sea.

Table - 2.25
Mining Details

S. No.	Particular	Details
1.	Mining Method	Fully Mechanized Opencast Mining Method
2.	Production Capacity	➤ Iron Ore Production: 3.5 Million TPA ➤ OB/Waste: 8.21 Million TPA Total Excavation: 11.71 Million TPA Along with 04 Crushers {(1 x 250 TPH) & (2 x 90 TPH) - Primary Crusher} and 150 TPH of Secondary Crusher Dry Beneficiation/Screening Plant: 600 TPH Wet Beneficiation Plant: 2 x 300 TPH
3.	Total Mineral Resources	48.50 Million Tonnes
4.	Total Mineable Reserves	27.32 Million Tonnes
5.	Life of Mine	8 Years As per Mineable Reserves 14 Years As per Reserves & Resources
6.	Bench Height	7.0 m
7.	Bench Width	9.0 m
8.	Ultimate Pit Slope	<38°
9.	Elevation Range	-76 m AMSL to 109 m AMSL
10.	Average Ground Level	16.5 m AMSL
11.	Existing depth of the Pit	-76 m AMSL (146 m bgl)
12.	Working Depth in Plan Period	112 m bgl
13.	Ultimate working depth	164.48 m bgl
14.	ROM/Waste Ratio (Tonnes: Tonnes)	1: 2.35
15.	Number of Working days	300 days
16.	Number of Working Shifts	3 Shifts (effective shift time: 7 Hours)

Source: Approved Mining Plan with Progressive Mine Closure Plan

2.7.7.2 MINERAL BENEFICIATION

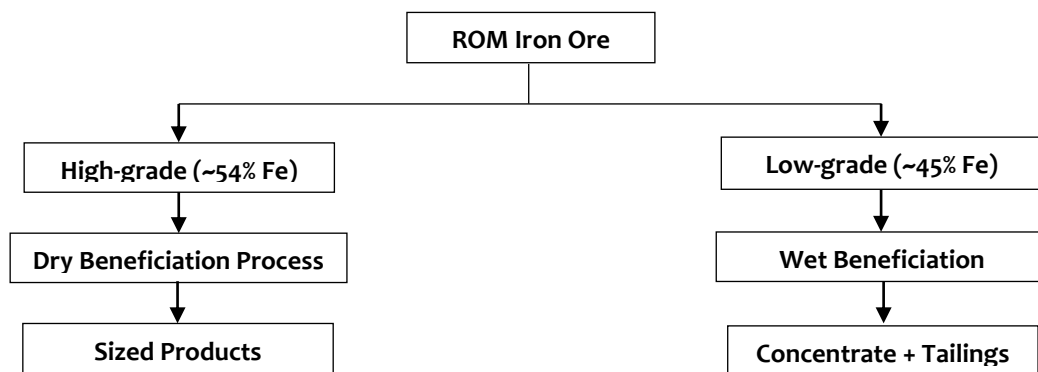
The Iron Ore extracted from the mining operations will be transported to a mineral beneficiation plant located within the mining lease area. This plant will enhance the quality of the ore since the Fe content of iron ore varies from 40-55% Fe. It has been proposed to beneficiate the low-grade and siliceous iron ore to produce iron ore concentrates for the production of iron in steel industries. The alumina and silica content in the ore is around 20-30% and LOI is about 6-10%. The objective of the

beneficiation is to enrich the iron value in both coarser and finer sizes to meet the market demand. To achieve this, JSW Steel Limited is decided to have three numbers processing plants within the lease boundary i.e., one dry crushing & classification plant of 600 TPH and two number of wet beneficiation plants of 300 TPH each to take care the varied grade ore production and processing. Installing the plant on-site reduces transportation costs, minimizes environmental impact and ensures efficient resource utilization and quality control.

2.7.7.2.1 PROCESS

The beneficiation scheme consists of two parallel processing routes depending on ROM ore quality:

1. Dry Crushing & Screening Process – for relatively high-grade ore (~54% Fe)
2. Wet Beneficiation Process – for low-grade and siliceous ore (~45% Fe)



A. WET BENEFICIATION PROCESS

The feed rate of the beneficiation plant will be 300 TPH. The beneficiation plant consists of 4 divisions:

1. Dry crushing and screening circuit
2. Wet classification circuit
3. Magnetic separators circuit
4. Dewatering circuit

The capacity of the plant will be 300 TPH with a working period of 10 hours/day and 320 working days per annum. The overall wet beneficiation plant capacity will be 1.92 Million Tonnes per annum.

i. DRY CRUSHING AND SCREENING CIRCUIT

The size of the ROM sample will be below 500 mm. It is to be crushed to the required size of the beneficiation plant by using primary Jaw Crusher and Screening. The capacity of the feed hopper is 350 tonnes. The material will be fed to the screen through Apron Feeder to the Vibrating Grizzly to classify at 75 mm. The -500+75 mm size fraction is around 90 TPH. It is crushed in the Jaw Crusher. The Jaw Crusher is operating in an open circuit. The Jaw Crusher product and -75 mm size fraction of the Vibrating Grizzly are fed to the Drum Scrubber. The process flow diagram is shown in figure.

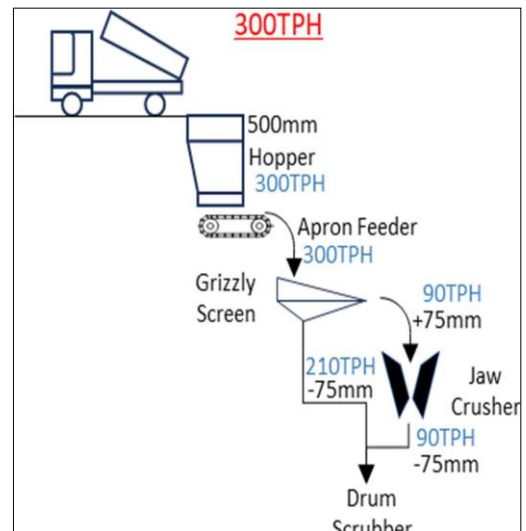


Figure 2.9: Dry Crushing & Screening Circuit

ii. WET CLASSIFICATION CIRCUIT

The scrubbed material is classified in the Double Deck Vibrating Screen. The -75+30 mm size fraction which is around 45 TPH is fed to the Cone Crusher through Dewatering Screen1. The Cone Crusher product is returned to the Double Deck Screen and the -30+10 mm size material which is about around 45 TPH is called as Product 1 of 54% Fe. The underflow -10 mm material which is about 255 TPH (75%) is fed to the Screw Classifier. The underflow material of the Screw Classifier is dewatered in Dewatering Screen2 and it is called as Product 2 which is of 85 TPH with 54% Fe. The overflow of size fraction -0.15 mm from the Screw Classifier of capacity 170 TPH is pumped to Hydrocyclone1 through the Slurry Pump1 for further classification at the cut point of 25 μ m. The overflow material of -25 μ m from the Hydrocyclone1 is fed to the Hydro cyclone 2 for further classification at the cut point of 10 μ m. The overflow of below 10 μ m size material of 29.97% Fe and of capacity 60 TPH fed to the Tailing Thickener. The underflow from the Hydrocyclone1 and the Hydrocyclone2 is fed to the Intermediate thickener. The process flow diagram is shown in figure 2.6 & 2.7.

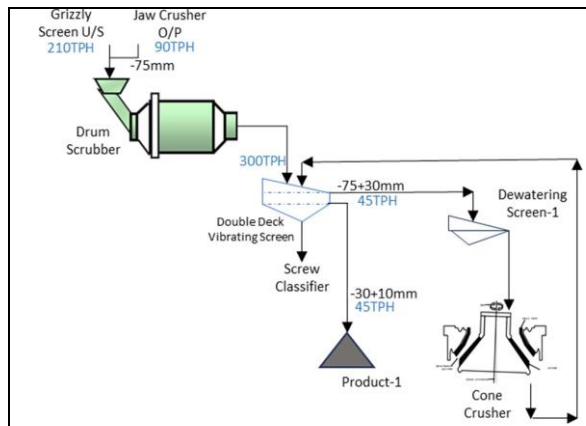


Figure 2.10: Wet Classification Circuit for Product 1

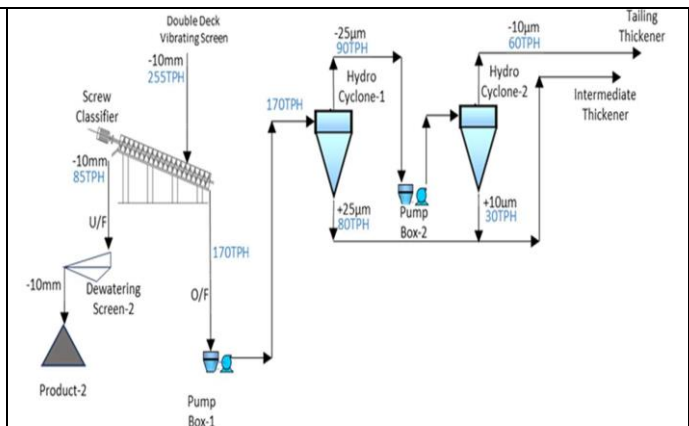


Figure 2.11: Wet Classification Circuit for Product 2

iii. MAGNETIC SEPARATOR CIRCUIT

The underflow of the Intermediate Thickener is fed to the MIMS to recover iron phase minerals which is fed to the Concentrate Thickener. The concentrate fraction contains 54% Fe with 0.67% yield @2 TPH. The non-magnetic fraction which is of 108 TPH and of 43.45% Fe is treated in the High Gradient Magnetic Separator (HGMS). The Fe content of the HGMS magnetic fraction is 54% with an overall yield of 20%. Both the MIMS and the HGMS concentrates are mixed together and sent to the Concentrate Thickener. The underflow of the Concentrate Thickener is dewatered using the Filter Press-1. The filter cake contains 54% Fe with an overall yield of 20.67% @62 TPH is called as the Product 3. The process flow diagram is shown in figure.

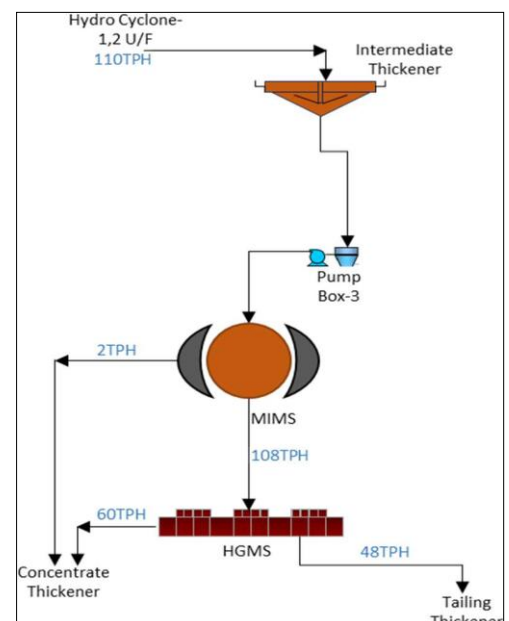


Figure 2.12: Magnetic Separation Circuit

iv. DEWATERING CIRCUIT

The non-magnetic size fractions of the HGMS along with the overflow of the Hydrocyclone2 are fed to the Tailing Thickener and the underflow of the Tailing Thickener is dewatered using the Filter Press-2 to produce cake as tailings. It contains 36% Fe with an overall yield of 29%. This cake is designated as the tailings. The process flow diagram is shown in figure.

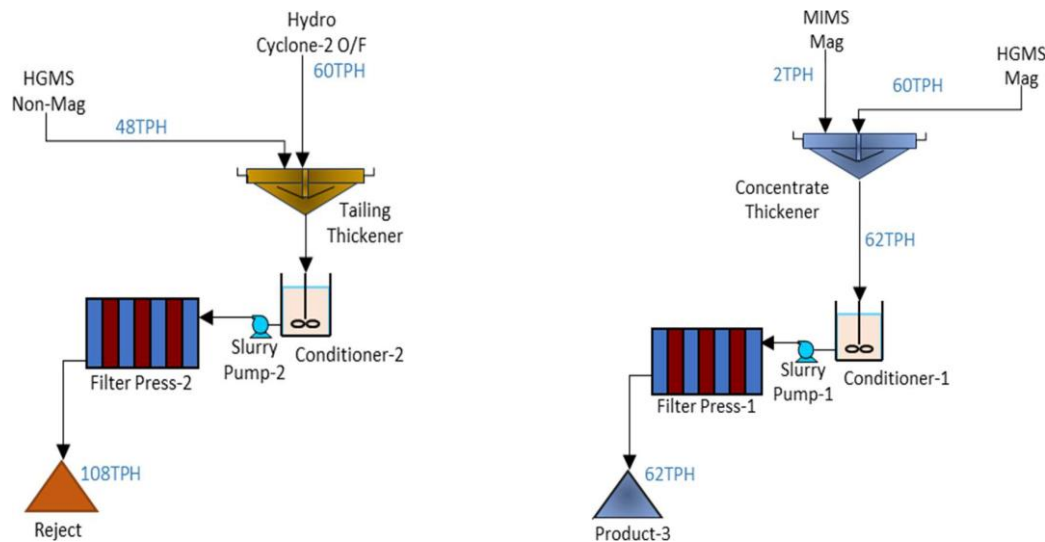


Figure 2.13: Dewatering Circuit

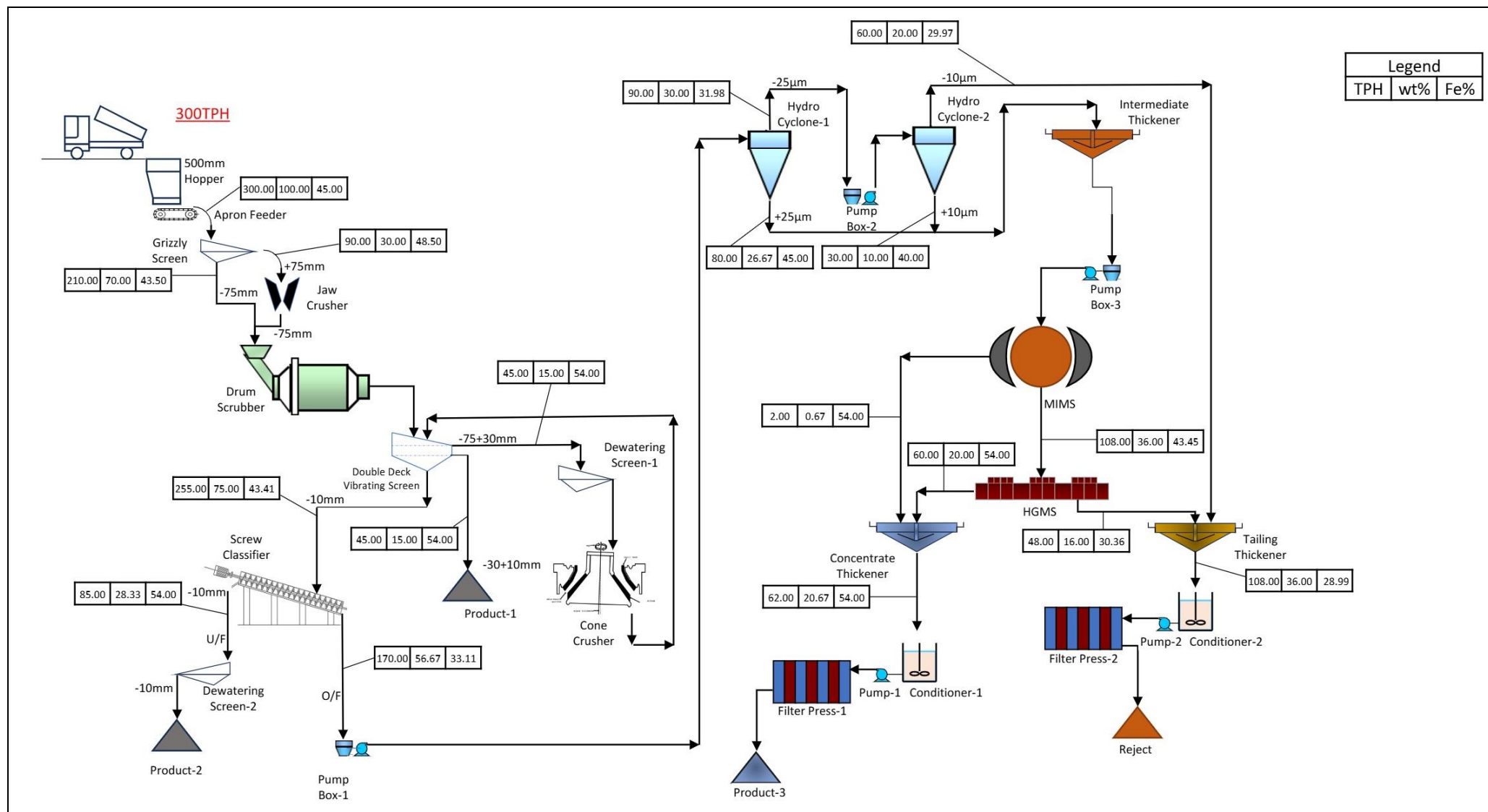


Figure 2.14: Mineral Beneficiation Process flow diagram for Low Grade Iron Ore

2.7.7.3 MATERIAL BALANCE

Table - 2.26

Material Balance for the Iron Ore Beneficiation Plant

Raw Material (Dry Basis)	Quantity (In MTPA) (240-245 Days/Year)	Quantity (In Tonnes/Day) (12 Hrs./Day)	Quantity (In Tonnes/Hr.)
Feed	3.50	14400	1200
Iron Ore Concentrate	2.881	11808	984
Tailings	0.628	2592	216

The overall product contains 54.25% Fe with yield of 64%. The details of products & rejects are given in the table below:

Table - 2.27

Details of Products and Rejects (For Wet Beneficiation Plant)

Details	Weight (%)	Fe (%)	TPH
Product 1 (-30+10 mm)	15	54	45
Product 2 (-10 mm)	28.33	54	85
Product 3 (LIMS & MIMS Concentrates)	20.67	54	62
Total	64	54	192
Tailings	36	28.99	108
Feed	100	45.0	300

The makeup water requirement is 59 m³/hr or 196 litre per Tonnes of feed. All the estimation mentioned above is for only one wet beneficiation Plant. When two beneficiation plants of similar capacity are considered, the make-up water requirement would be 118 m³/hr.

Detailed Material Balance & Water Balance is enclosed as **Annexure IX**.

B. DRY PROCESSING PLANT

The dry processing plant of consists basically crushing and screening plants to cater below 500 mm ROM feed with 54% Fe. The dry processing plant will prepare two products like -30+10 mm size and below 10 mm size. The ROM feed is sent to the Hopper by trucks and then it is sent to the 100 mm Vibrating Grizzly through the Apron Feeder. The +100 mm size fraction is crushed by the Jaw Crusher and then mixed with -100 mm size fraction. The mixed material is fed to the 10 mm Vibrating Screen. The -10 mm size material is separated and +10 mm size is sent to the Double Deck Vibrating Screen. The -100+30 mm, -30+10 mm and -10mm size fractions are generated. The -100+30 mm size fraction is further crushed by the Cone Crusher and the crushed product is fed again to the Double Deck Vibrating Screen. The -30+10 mm size fraction is the Product1 with 54.91% Fe whereas -10 mm is the Product 2B with 53.84% Fe. The Product1 of -30+10 mm size is around 15% of feed or 120 TPH. Similarly, Product 2B of -10 mm size fraction is around 32% of the total feed. In overall -10 mm size fraction as Product 2 is 83% of the feed material with Fe 53.84%.

Dry Crushing and Screening Plant Feed Capacity is to be at 600 TPH, i.e., with an annual feed capacity of 1.764 MTPA with 12 hours and 245 working days for the same.

Table - 2.28

Details of Products and Rejects (For Dry Beneficiation Plant)

Details	Weight (%)	Fe (%)	TPH
Product 1 (-30+10 mm)	15	54.91	90
Product 2 (-10 mm)	85	53.84	510
Total	100	54.00	600
Feed	100	54.00	600

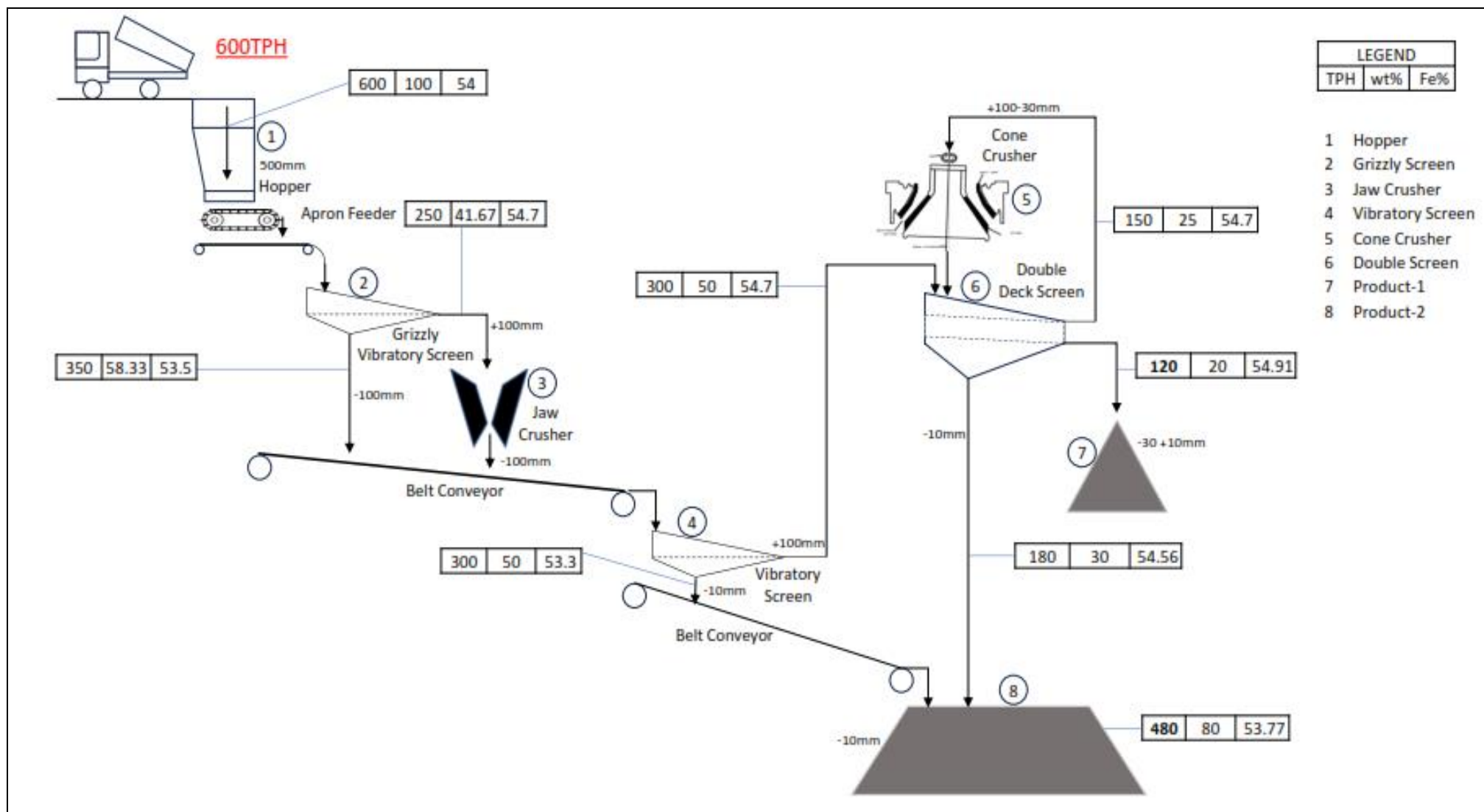


Figure 2.15: Mineral Beneficiation Process flow diagram for High Grade Iron Ore



Figure 2.16: Google Earth Image showing location of Iron Ore Beneficiation Plant within the ML Area

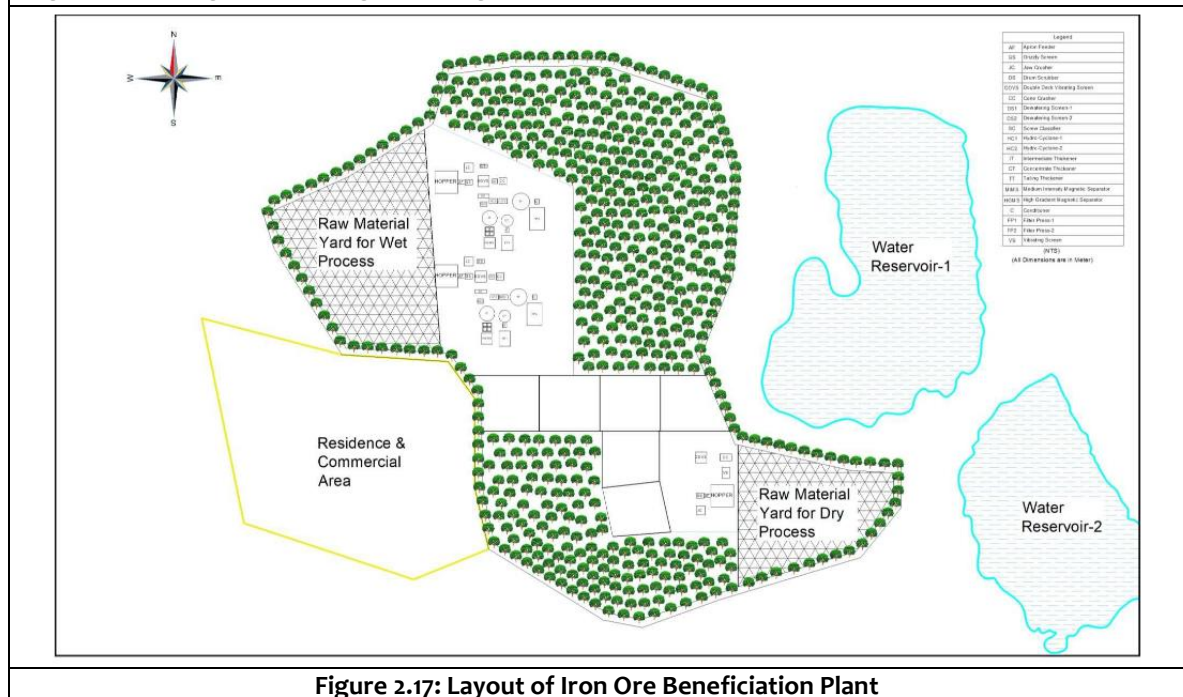


Figure 2.17: Layout of Iron Ore Beneficiation Plant

2.7.7.4 PRODUCTION & EXCAVATION DETAILS

Table - 2.29
Excavation Details

Year	Area (In Hectare)	OB/Waste (In Million Tonnes)	Iron Ore (In Million Tonnes)	Total Handling (In Million Tonnes)
1	209.72	1.85	3.5	5.35
2	205.42	2.79	3.5	6.29
3	205.42	3.41	3.5	6.91
4	205.42	8.21	3.5	11.71
5	205.42	7.17	3.5	10.67
6	212.50	4.98	3.5	8.48
7	215.96	4.98	3.5	8.48
8	222.71	4.98	3.5	8.48
9	230.25	4.98	3.5	8.48
10	245.87	4.98	3.5	8.48
11	268.68	4.98	3.5	8.48
12	279.85	4.98	3.5	8.48
13	285.35	4.98	3.5	8.48
14	298.15	4.80	3.0	7.80
Total	301.15	68.07	48.50	116.57

Source: Approved Mining Plan along with Progressive Mine Closure Plan

2.7.7.5 TOP SOIL & SOLID WASTE GENERATION & ITS MANAGEMENT

1.	Top Soil generation & Management	
	There is no Top Soil present in the ML Area.	
2.	Waste generation & Management	
A.	At Present	There is total 6 waste dump out of which 4 dumps have 8.96 Million Tonnes waste present in 32.23 ha at the mine site. In the mine site, 2 waste dumps are also present in 22.55 ha area which are stabilized by plantation.
B.	During Plan Period	Approx. 23.43 Million Tonnes of Waste will be generated which will be dumped in existing waste dump D4 and in 2 new dumps over an area of 46.84 ha at their designated place.
C.	At Conceptual Stage	68.0 Million Tonnes of waste will be generated which will be used in backfilling in the mined-out area.
3.	Tailings Disposal Plan	
	About 0.628 Million TPA of tailings will be generated in the form of filter press cake with a moisture content of approximately 10–12% and an Fe content of 27.83%. The generated tailings will be temporarily stacked in the designated area and subsequently transported for disposal at waste dump in accordance with the approved Mining Plan.	

Source: Approved Mining Plan with Progressive Mine Closure Plan

2.7.7.5.1 DETAILS OF EXITING DUMPS

At present, there are 4 active waste dumps present within the ML area. Details of existing dumps are given below:

Table - 2.30
Details of Existing Waste Dumps

S.N.	Dump ID	Dump Status	Total Quantity of Waste (MT)	Area covered by dump (Ha)	Height (m)	No. of Terraces	Location
1.	D1	Active	0.90	3.8677	28.0	3	15°21'03.91" E to 15°21'10.48" E 74°07'28.26" N to 74°07'35.51" N
2.	D2	Active	0.95	4.0132	35.0	4	15°21'01.72" E to 15°21'05.51" E 74°07'59.95" N to 74°08'14.18" N
3.	D3	Active	2.52	10.2541	22.0	2	15°19'59.87" E to 15°20'25.84" E 74°08'26.62" N to 74°08'38.75" N
4.	D4	Active	4.59	21.5316	44.0	4	15°20'28.83" E to 15°20'57.42" E 74°07'12.54" N to 74°07'42.68" N
Total			8.96	39.6666	-	-	-

At the mine site, two waste dumps have been stabilized by plantation.

Table - 2.31
Details of Stabilized Waste Dumps

S.N.	Dump ID	Total Dump Quantity (MT)	Total Height (m)	No. of Terraces	Average height of Terraces (m)	Area stabilized (ha)
1.	D5	1.43	60	6	10.00	11.84
2.	D6	1.546	50	5	10.00	10.71
Total		2.976	-	-	-	22.55

2.7.7.5.2 WASTE DUMP DURING PLAN PERIOD

During the plan period, approximately 23.43 Million Tonnes of waste will be generated. Out of this, approx. 13.74 Million Tonnes will be dumped in the existing waste dump (D4), covering a spread area of 14.59 ha. The remaining 9.69 Million Tonnes of waste will be accommodated in the two proposed waste dumps (D4A and D7), covering a combined spread area of 9.78 ha, at their designated locations, as summarized below:

Table - 2.32
Details of Existing Waste Dump D4

S.N.	Year	Dump ID	Total dump quantity (MT)	Proposed Area (Ha)	Height (m)	Dump Location
1.	Year 3	D4	2.53	4.23	10.0	15°20'49.40" E to 15°21'02.82" E 74°07'16.71" N to 74°07'26.41" N
2.	Year 4	D4	6.85	14.59	10.0	15°20'42.38" E to 15°21'01.34" E 74°07'17.29" N to 74°07'29.19" N
3.	Year 5	D4	4.36	9.36	10.0	15°20'50.53" E to 15°21'05.84" E 74°07'13.85" N to 74°07'25.08" N
Total			13.74	-	-	-

New dump:

Table - 2.33
Details of Proposed Waste Dumps

S.N.	Year	Dump ID	Total dump quantity (MT)	Proposed Area (Ha)	Height (m)	Dump Location
1.	Year 1	D4A	1.85	3.48	10.0	15°20'56.56" E to 15°21'04.43" E 74°07'14.53" N to 74°07'25.16" N
2.	Year 2	D4A	2.79	4.31	10.0	15°20'52.85" E to 15°21'03.96" E 74°07'13.93" N to 74°07'26.98" N
3.	Year 3	D7	0.88	1.80	10.0	15°20'20.29" E to 15°20'24.40" E 74°07'56.96" N to 74°08'04.60" N
4.	Year 4	D7	1.35	3.60	10.0	15°20'19.24" E to 15°20'25.82" E 74°07'56.00" N to 74°08'05.96" N
5.	Year 5	D7	2.82	5.47	10.0	15°20'16.78" E to 15°20'27.25" E 74°07'54.73" N to 74°08'07.27" N
Total			9.69	-	-	-

The sections of the waste Dumps are enclosed as **Annexure IV C**.

2.7.7.5.3 YEAR WISE BACKFILLING PLAN FOR MINED OUT PITS

Table – 2.34
Proposed dump details

S.N.	Year	Dump Id	Total Dump Quantity (MT)	Area (ha)	No. of Terrace	Height (m)
1	1 st year	D4A	1.85	3.48	1	10
2	2 nd year	D4A	2.79	4.31	1	10
3	3 rd year	D4 & D7	3.41	6.03	2	10
4	4 th year	D4 & D7	8.20	18.19	2	10
5	5 th year	D4 & D7	7.18	14.83	2	10
Total			23.43	51.95	-	-

Table - 2.35
Proposed Backfilling Plan

S.N.	Year	Backfilling Plan	Total Quantity (In MT)	Area (In ha)
1	6 th year	BF-1 15°20'58.27'' N– 15°21'09.43'' N & 74°07'27.15'' E–74°07'44.73'' E	4.41	8.56
2	7 th year		4.36	15.28
3	8 th year		4.59	25.86
4	9 th year		4.25	31.85
5	10 th year		4.42	37.82
6	11 th year	BF-2 15°20'57.23'' N – 15°21'07.62'' N 74°07'43.38'' E – 74°08'03.97'' E	5.79	2.48
7	12 th year		6.09	4.86
8	13 th year		6.00	6.54
9	14 th year		5.68	8.23
Total			45.59	-

2.7.7.6 CONCEPTUAL PLAN

Total ML area of Proposed Block - XII Codli Mineral Iron Ore Mine is 377.0881 ha. At conceptual stage, out of the total mine lease area, total mined out area will be 301.1521 ha, out of which 51.95 ha will be backfilled and 249.2021 ha will be covered under water reservoir, 14.5597 ha area will be under utility services, 10.8981 ha area will be under Mineral Separation Plant, 6.87 ha under dump rehabilitated by plantation, 17.45 ha under greenbelt and 26.1582 ha under tailing dam rehabilitated by plantation.

At Conceptual Stage, total Greenbelt/Plantation will be carried out on 102.4282 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation).

Out of the total plantation area of 102.4282 ha, 20% (20.49 ha) is proposed to be developed using the Miyawaki plantation technique.

Local & fruit bearing species will be planted after consultation with local forest officer and as per CPCB guidelines are as follows: Neem, Arjuna, Mango, Jamun, Kindal, Kaju etc. will be planted by JSW Steel Ltd. in consultation with the State Forest Department. Conceptual Plan is enclosed with this EIA/EMP Report as **Annexure IVC**.

Post Mining Land Use of the ML area of the proposed mine is given in the table below:

Table - 2.36
Post Mining Land Use of Core Zone (Conceptual Stage)

S.N.	Description	Land Use (In Ha)			
		Plantation/Re-grassing	Water Body	Civil Use	Total
1.	Excavation (Voids) Water Reservoir	-	249.2021	-	249.2021
	Reclamation (Backfilled)	51.9500	-	-	51.9500
	Total Excavation	51.9500	249.2021		301.1521
2.	Area under Dump (Rehabilitated)	6.8700	-	-	6.8700
3.	Area comes under utility services	-	-	14.5597	14.5597
4.	Mineral Separation Plant	-	-	10.8981	10.8981
5.	Greenbelt	17.4500	-	-	17.4500
6.	Tailing Dam	26.1582	-	-	26.1582
Total		102.4282	249.2021	25.4578	377.0881

Source: Approved Mining Plan with Progressive Mine Closure Plan

2.8 DESCRIPTION OF MITIGATION MEASURES

The mitigation measures given in this section are for management of the emissions, effluents and solid waste generation from the plant to meet the environmental standards and environmental operating conditions. Detailed Mitigation measures are also given in Chapter - 4 of this EIA/ EMP Report.

2.8.1 DETAILS OF EMISSIONS FROM THE PLANT AND THEIR MITIGATION

The Iron ore beneficiation Plant is Dry and Wet Beneficiation Plant and it will involve processing of Iron ore under dry and wet conditions. Fugitive emission is anticipated due to loading/unloading of Raw material/ product and movement of trucks/dumpers. Suppression of Fugitive dust pollution will be carried out by means of water spraying by tankers and by covering the carriers of Iron Ore carrying tipper trucks, thereby preventing dust getting air borne.

Emissions	Source	Mitigation Measures
	Plant Unit/Section	
PM	Beneficiation Plant	- Due to Inherent moisture of the feed, dust emission will be minimal; Water spray jet facility will be made to the plant at feed point while feeding of the raw material - As the process is wet beneficiation, particulate matter from the process will not be generated.
	DG sets	Regular maintenance of DG set
SO ₂	DG sets	Regular maintenance of DG set
NO _x	Beneficiation Plant	NO _x not generated from Beneficiation plant
	DG sets	Regular maintenance of DG set
HC	DG sets	Regular maintenance of DG set
Fugitive Emission	Raw Material Handling, Storage & Transportation activity	- Well maintained trucks conforming to the norms laid by the state transport authority and having valid Pollution under Control Certificate (PUC) will be engaged for transporting raw material and product. - Speed limit of the trucks will be maintained. - Regular training will be imparted to truck drivers for safe driving and conduct. - The trucks carrying raw material and finished product will be covered with tarpaulin to prevent dust from getting airborne. - Regular road cleaning through road sweeping machine will be done as per the requirement. - All trucks carrying material will be passed through Wheel wash system before entering on the public road. - The major part of transportation route for finished product is tarred.

2.8.2 STACK EMISSIONS

In case of emergency or power backup company has proposed to install 10 D.G. Sets of 20 KVA each. The DG sets will comply with the applicable CPCB emission and noise standards notified under G.S.R. 281(E), as amended from time to time, and will be regularly maintained to ensure that particulate matter (PM) emissions from the stack remain below 30 mg/Nm³. It is proposed to install 4 Crushers of 1 x 250 TPH, 2 x 90 TPH & 1 x 150 TPH within the ML Area. Regular stack monitoring will be done to keep the emissions within the norms.

2.9 ASSESSMENT OF NEW & TESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE

Assessing new and tested technology for the risk of technological failure is crucial in the context of setting up an Iron Ore beneficiation plant. The beneficiation process incorporates various stages and equipment, ranging from crushing and screening to magnetic separation and thickening. While the

use of established technologies such as wet low intensity magnetic separators (WLIMS) and wet medium intensity magnetic separators (WMIMS) provides a foundation of reliability, integrating newer technologies like high gradient magnetic separators (HGMS) introduces an element of innovation.

Furthermore, considerations such as energy consumption, raw material characteristics and environmental impact are pivotal in evaluating the feasibility and reliability of new technologies. While modernized systems promise higher recovery rates and improved product quality, potential drawbacks such as increased energy requirements or operational complexities must be carefully assessed.

In conclusion, while embracing new technologies can offer opportunities for enhanced efficiency and productivity, a comprehensive risk assessment process is essential to identify and mitigate potential technological failures. By carefully evaluating factors such as compatibility, reliability and environmental impact, stakeholders can make informed decisions to ensure the successful implementation of new and tested technologies in Iron Ore beneficiation processes. The plant will be fully automated using latest state-of-the-art technology.

From the nature and extent of the deposit, the reserves and the quality have been proved with adequate degree of reliability. Considering the type of mineralization, opencast mechanized method is the most feasible method for mining in the proposed mine. It is also a matter of fact that the mining machineries are upgrading with time and therefore, the project proponent would act fast to adopt more advanced equipment and automation for safe and environment friendly mining technology in the years to come. In addition to this, the company will explore the possibility of using Electric vehicles/CNG based vehicles in future.



CHAPTER - 3 DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

The knowledge of present environment of the core and buffer zone of the proposed mining area is important to assess the potential impacts of various project activities on environment. The knowledge of present day environment is also helpful in planning management of environment and planning of mitigation measures. To assess the baseline environmental quality of the area, field assessment has been conducted considering following components of the environment, viz. land, meteorology, air, noise, water, soil, biological and socio-economic.

The relevant information and data (both primary and secondary) were collected in core as well as buffer zone (10 km distance from the Mine Lease boundary) of Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA; during Summer Season (March to May, 2025) in accordance with the guidelines of MoEF&CC for undertaking EIA Studies and for preparation of Final EIA/EMP report.

3.2 STUDY AREA AT A GLANCE

Study Area: The study area is an area of 10 km radius (aerial distance in each direction) from the boundaries of the mining lease, also known as buffer zone. The area of Mine site (within ML boundary) is considered as core zone. Mine site is located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

The area of mining lease is considered as core zone.

❖ **Core Area:** 377.0881 ha (within 10 Km radius)

❖ **Buffer Area:** 39787.0719 ha (within 10 Km radius from the core area)

The major environmental settings of the study area w.r.t. the mining lease are as given in the table below:

Table - 3.1
Environmental Settings of the Area
(with approx. Aerial Distance & Direction from the Mining Lease boundary)

S.N.	Particulars	Details
1.	Nearest State/National Highway	➤ SH-7 (Adjacent in WNW Direction) ➤ NH-748 (~3.0 Km in NNE Direction)
2.	Nearest Railway Station	Sanvardem Chuch Railway Station (~7.8 Km in SSW Direction)
3.	Airport	Dabolim International Airport (~30.0 Km in WNW Direction)
4.	Nearest Town / City	Sanvardem (~7.5 Km in SSW Direction)
5.	Wildlife Sanctuary, National Park,	There are no National Park, Biosphere Reserve or Corridor present

	Biosphere Reserves within 10 km radius study area	within 10 Km of radius study area. 2 Wildlife Sanctuaries are present: ➤ Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE Direction) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction) ➤ Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction) Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025. Copy of the same is enclosed as Annexure VI.																											
6.	Reserve Forests (RF) / Protected Forest (PF) within 10 km radius study area	Unclassified Forest – Core zone Reserve Forest – ~0.5 Km in ENE Direction, ~1.0 Km in West Direction, ~2.5 Km in West Direction, ~4.0 Km in South Direction, ~6.5 Km in WSW Direction, ~7.0 Km in NNE Direction, ~8.0 Km in WSW Direction, ~8.5 Km in NW Direction, ~9.0 Km in West Direction.																											
7.	Water bodies within 10 km radius study area	There is total 8 water bodies present within 10 km of study area: <table border="1"> <thead> <tr> <th>S.N.</th><th>Water Body</th><th>Distance & Direction</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Khandepar River</td><td>Adjacent in North Direction</td></tr> <tr> <td>2.</td><td>Kale Nala</td><td>~ 0.7 Km in ESE Direction</td></tr> <tr> <td>3.</td><td>Udnai Nala</td><td>~ 1.5 Km in West Direction</td></tr> <tr> <td>4.</td><td>Panduranga Nala</td><td>~ 5.0 Km in SW Direction</td></tr> <tr> <td>5.</td><td>Ragada Nala</td><td>~ 7.0 Km in NNE Direction</td></tr> <tr> <td>6.</td><td>Sanguem or Zuvari River</td><td>~ 8.0 Km in South Direction</td></tr> <tr> <td>7.</td><td>Jamboli Nala</td><td>~ 9.0 Km in NE Direction</td></tr> <tr> <td>8.</td><td>Paroda River</td><td>~ 9.0 Km in SSW Direction</td></tr> </tbody> </table>	S.N.	Water Body	Distance & Direction	1.	Khandepar River	Adjacent in North Direction	2.	Kale Nala	~ 0.7 Km in ESE Direction	3.	Udnai Nala	~ 1.5 Km in West Direction	4.	Panduranga Nala	~ 5.0 Km in SW Direction	5.	Ragada Nala	~ 7.0 Km in NNE Direction	6.	Sanguem or Zuvari River	~ 8.0 Km in South Direction	7.	Jamboli Nala	~ 9.0 Km in NE Direction	8.	Paroda River	~ 9.0 Km in SSW Direction
S.N.	Water Body	Distance & Direction																											
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7.	Jamboli Nala	~ 9.0 Km in NE Direction																											
8.	Paroda River	~ 9.0 Km in SSW Direction																											
8.	Critically Polluted Area	No, the Site doesn't fall under the critically polluted area																											
9.	Seismic Zone	Zone – III as per IS: 1893 (Part-I): 2016																											

Source: Site Visit & Pre- Feasibility Report

Table - 3.2

Environmental Sensitive Places within the Study Area

S.N.	Particulars	Details
1.	Temples	➤ Ghadyacho Aajobha Devasthan (Adjacent in ENE Direction) ➤ Shri Somnath Sateri Temple (~0.07 Km in ENE Direction) ➤ Shree Sarvajani Ganeshotsav Mandal Mandal (~0.2 Km in NNW Direction) These temples are the only temples located within the Village Codli. The remaining temples located within the 10 Km radius of the study area do not belong to JSW Steel Limited.
2.	Archaeology	➤ Shigao Historic Caves (~6.0 Km in ESE Direction) ➤ Shri Kamakshi Temple (~9.5 Km in WSW Direction)
3.	Biodiversity Park	➤ Biodiversity Park, Mollem Goa (~6.5 Km in ENE Direction)

Chapter 3 of Draft EIA/EMP Report

Survey of India Toposheet No.
Core Zone- D43C3_48I/3
Buffer Zone- D43C3_48I/3, D43B15_48E/15
D43C4_48I/4

INDEX

Mine Site

Buffer Zone Boundary

Wildlife Sanctuary

Environment Setting Map
Block-XII Codli Mineral Block
Auctioned Block Area: 377.0881 ha
JSW Steel Limited
At
Village: Codli, Taluka: Dharbandora,
District: South Goa (Goa)

Scale: 0 0.5 1 2 3 4 5 km

Grid Coordinates:
 North: 15°20'N, 15°21'N, 15°22'N, 15°22'30'N
 East: 74°10'E, 74°11'E, 74°12'E, 74°12'30'E

Map Features:
 - **Topography:** Contour lines, spot heights, and elevation markers.
 - **Water Bodies:** Rivers (Kandepar, Bondia, Paroda, Panduranga, Sangem), streams, and reservoirs.
 - **Infrastructure:** Roads, railways, and bridges.
 - **Settlements:** Villages and hamlets.
 - **Forest:** Reserved Forest, Sanjivdham Chuch RS, and other forested areas.
 - **Other:** Mines, quarries, and various landmarks.

JSW Steel Limited

3.3 STUDY PERIOD

The relevant information and data (both primary and secondary) were collected in core as well as buffer zone (10 km distance from the mine boundary) during Summer Season (March to May, 2025) in accordance with the guidelines for preparation of EIA studies in order to assess the impact of the mine site within the 10 Km study area on existing physical, biological and social environment.

3.4 ENVIRONMENTAL COMPONENTS

Information on the following components/parameters were collected to understand the existing scenario of the core and buffer area:

- Land Use & Land Cover
- Meteorology
- Air Environment
- Noise Environment
- Water Environment
- Soil Environment
- Biological Environment
- Socio-economic Environment

3.5 BASELINE DATA COLLECTION

Baseline environment data on various components of the environment in the study area was collected during Summer Season (March to May, 2025) to assess the present scenario of the area. Details are given in the table given below:

Sampling, preservation, transportation & storage of samples were carried out by J.M. EnviroLab Pvt. Ltd. under supervision of concerned EC/FAE. J.M. EnviroLab Pvt. Ltd. is NABL accredited (Certificate No. TC-6821, Issued date: 24.05.2025 & valid upto 23.05.2029).

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Chapter 3 of Draft EIA/EMP Report

Table - 3.3
Baseline data collection
During Summer Season (March to May, 2025)

S.N.	Environmental component	Primary data				Secondary data
		Parameters	Frequency	Monitoring locations	Methodology	
1.	Land	Water bodies, rivers, nallah, agriculture land, Forest land, plantation/greenbelt, mine pit, crusher zone, open land, settlement, railway, roads, conveyor belts, industry, etc.	Once for EIA Study	Study area	Primary and secondary data collection using field survey and authenticated credentials Processing using DIP technique and preparation of LULC using ERDAS Imagine 9.2.	Satellite data procurement from NRSC, Hyderabad and Survey of India (Toposheet). Approved Mining Plan with Progressive Mine Closure Plan
2.	Meteorology	Temperature, Relative Humidity, Wind Speed, Wind Direction, rain fall	Hourly (For Study Period)	1 (Mine Site)	Automatic Weather Monitoring Station	IMD book (Climatological normals 1991-2020), Past year Rainfall data for South Goa District
3.	Air	PM ₁₀ , PM _{2.5} , SO ₂ and NO ₂	(24 hourly), twice a week	11	Sampling: CPCB Guidelines/NAAQS/IS 5182 and Instrument Manual Analysis: CPCB Guidelines/IS 5182	--
		CO	8 Hourly			
		O ₃ , Pb, CO, NH ₃ , C ₆ H ₆ , BaP, As, Ni	Once in a season			
4.	Noise	Equivalent noise levels in Leq dB (A)	Once in a season (day & night time)	11	Sampling: IS 9989 Analysis: CPCB Guidelines/IS 9989	--
5.	Surface Water	-	Once in a season	08	-	-
	Ground Water/Drinking water	Parameters as per IS 10500-2012	Once in a season	10	Sampling: CPCB Guideline & APHA 24 th edition 2024 Analysis: IS 10500-2012/IS 3025/APHA 24 th edition 2024	CGWB for ground water level
6.	Soil	Parameters As per IS 2720/USDA	Once in a season	08	Sampling: USDA Analysis: As per IS 2720/USDA	-
7.	Biological Environment	Flora and Fauna	Once in a season	Study area	Quadrat method/random sampling	➤ Forest working plan, Wildlife (Protection) Act, 1972 & its Amendment 2022 and information from locals ➤ EIA Reports of nearby Mines & Industries
8.	Socio - Economic Environment	Socio - Economic Demography	Once in a season	Study area	Random Sampling of the villages, Group Discussions with local villagers, Site visit, Field survey through questionnaire	➤ Demographic Parameter-Census data, 2011 ➤ List of prevailing diseases from Health and medical Centre. ➤ List of Educational facilities ➤ Taluka Map, details on socio - economic developmental activities undertaken

3.5.1 INSTRUMENTS USED FOR ENVIRONMENTAL BASELINE DATA COLLECTION

The following instruments were used at the site for environmental baseline data collection work.

1. Respirable Dust Sampler with attachment for gaseous Pollutants, Envirotech APM 460.
2. Fine Particulate Matter (FPS) Sampler, Envirotech APM 550
3. Sound Level Meter Lutron, Model SL 4033SD
4. Digital D.O. Meter Model - 831 E (CPCB Kit)
5. Weather Monitoring Station Model Enviro WM 271
6. Water Level Indicator and
7. Global Positioning System (GPS)

The samples of air, water, noise and soil as given in above section were collected from the representative sampling points. The primary data covering the details such as type of vegetation/ various agricultural crops, type of habitation, their occupation type, existing infrastructure and communication/ medical facilities were also collected by the site visit team through interaction with a large number of local inhabitants from the study area and also with different government departments for preparation of additional studies such as Land use Land cover study; Biological Environment, Hydrogeological study, Socio-economic study etc. Based on the primary and secondary data obtained from the 10 km radius buffer area and the core area, the Analysis interpretation and conclusion of the baseline conditions within the core zone and buffer zone is given in sections below:

3.6 LAND USE / LAND COVER STUDY

OBJECTIVE

The objectives of the LULC study are as follow:

- To develop the Land use & Land cover map using land coordinates of the ML Area (Core Zone) and 10 km radius from the Mine site (Buffer area).
- To identify and mark the important Land use and Land cover features using the primary and secondary data collected.
- To evaluate the impacts on existing land use/cover features of the buffer area by the Proposed Project activities.
- To identify the mitigative measures for the sustainable use of land and to protect the buffer zone from the adverse impacts.

DATA USED

Current vintage data of Indian Remote Sensing Satellite RESOURCESAT-2A (Sensor-Liss 4) digital FCC (False Color Composite) has been used for preparation of Land use/ Land cover thematic map of study area.

Satellite image has been procured from National Remote Sensing Centre, Hyderabad. Survey of India toposheet as a reference map on 1:50,000 scale has been used for preparation of base layer

data like road, rail network and villages for geo-referencing of satellite image. Technical Description of Satellite image is given in Table No.3.3 Whereas the Satellite Imagery for the Core zone and Buffer zone is shown in Figure 3.2 & 3.3 respectively.

Table - 3.4
Data Used for the Land Use/Land Cover Mapping

S.N.	Particular	Details
1.	Satellite Image	RESOURCESAT-2A (Sensor-Liss 4)
2.	Vintage Date	20.01.2025
3.	Satellite Data Source	NRSC, Hyderabad
4.	SOI Toposheets No	Core Zone: D43C3_48I/3 Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
5.	Software Used	Earth Resources Data Analysis System (ERDAS) Imagine 9.2

Source : Satellite Image from NRSC

3.6.1 SATELLITE IMAGE OF CORE ZONE

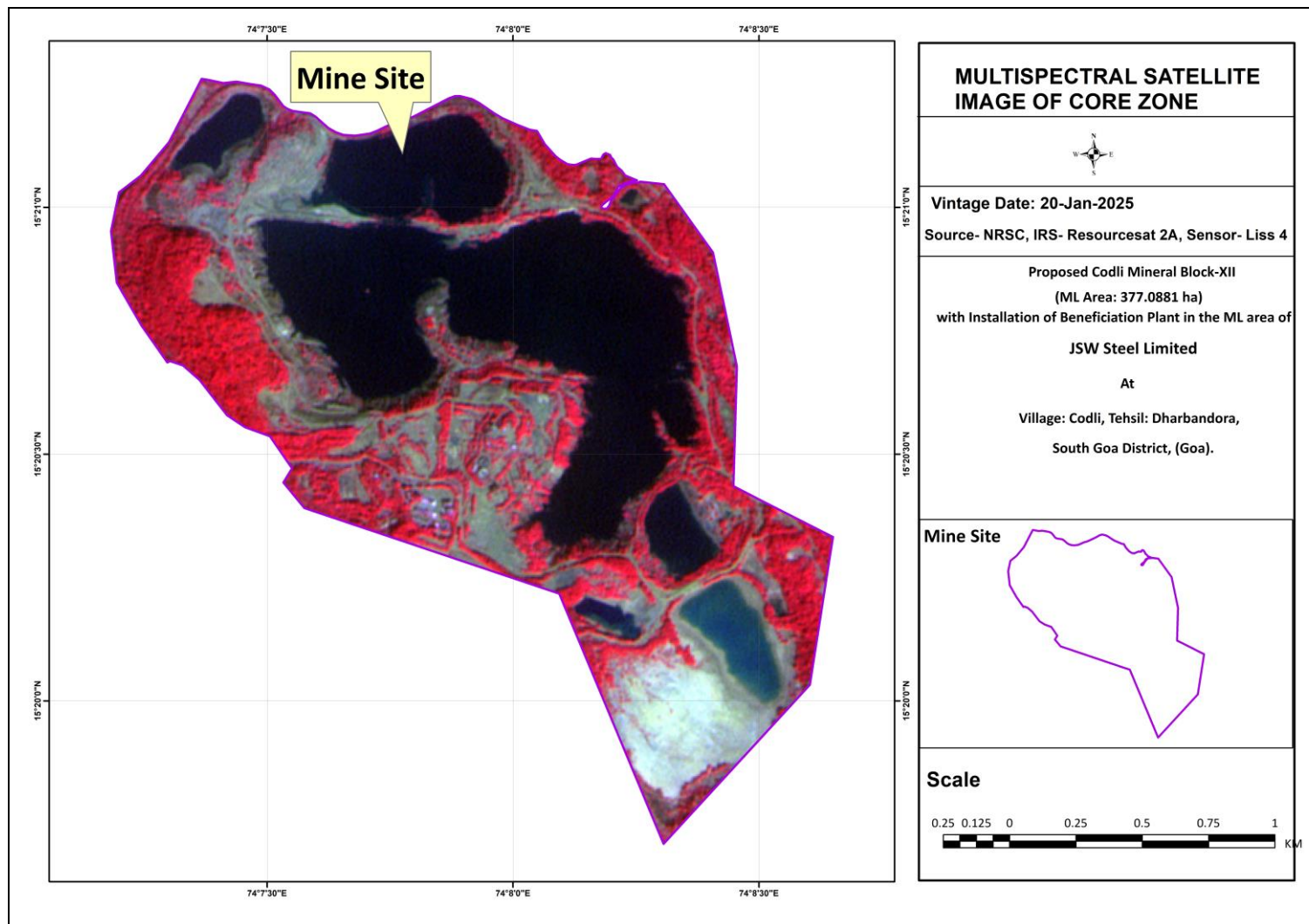


Figure: 3.2 Satellite Image of Core Zone

3.6.2 SATELLITE IMAGE OF STUDY AREA

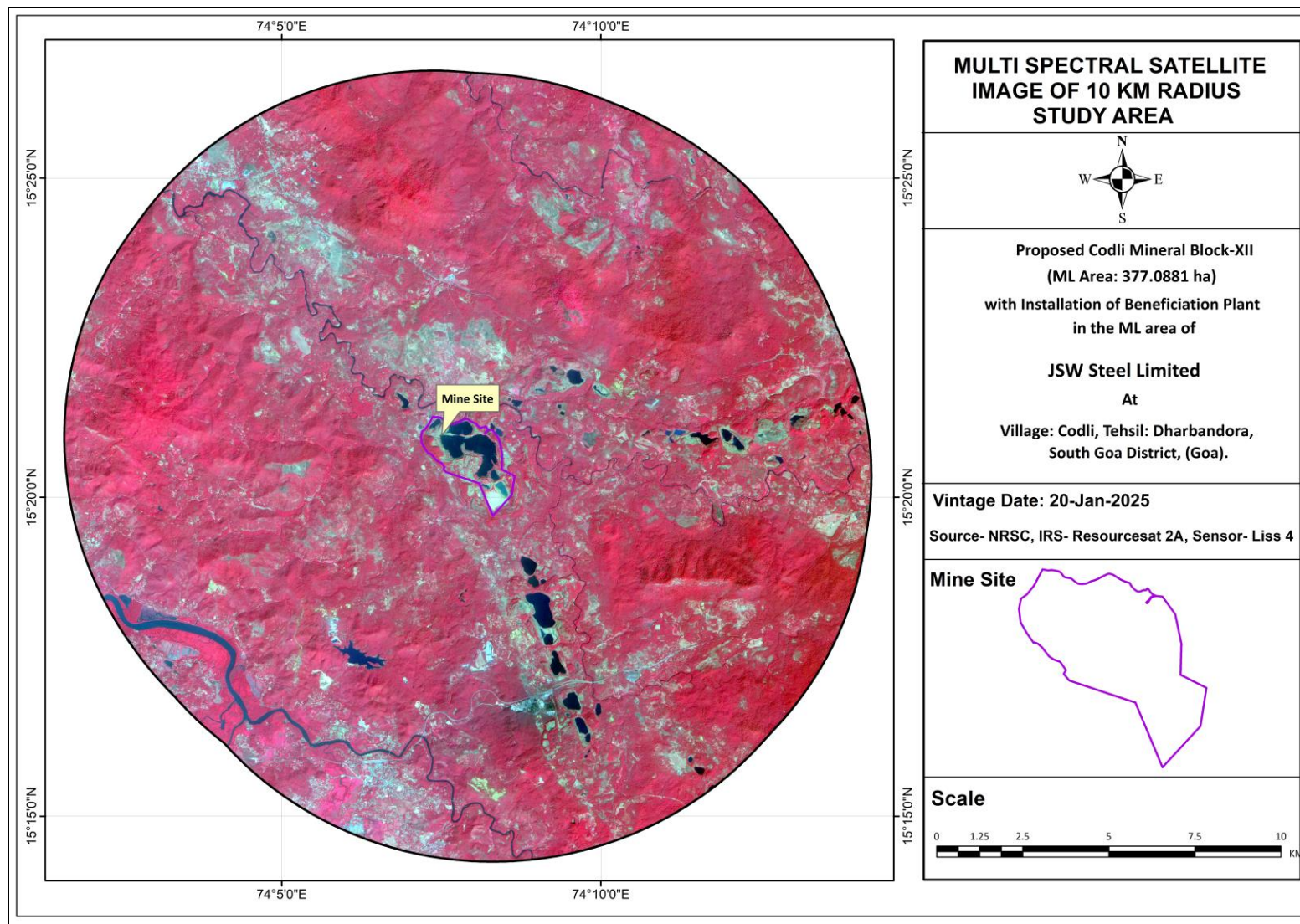


Figure: 3.3 Satellite Image of Buffer Zone

3.6.3 METHODOLOGY

The land use/land cover map is prepared by adopting the interpretation techniques of the Satellite image in combination with collateral data such as Survey of India topographical maps. Image classification is done by using visual interpretation techniques and digital classification using any of the image processing software. The various activities for preparation of LULC include preprocessing, rectification, image enhancements and classifying the satellite data for assessing the change in land use land cover due to proposed developmental activities.

The imagery is interpreted and ground checked for corrections. The final map is prepared after ground thruthing. The different land use/land cover categories in the study area has been carried out based on the NRSC land use / land cover classification system.

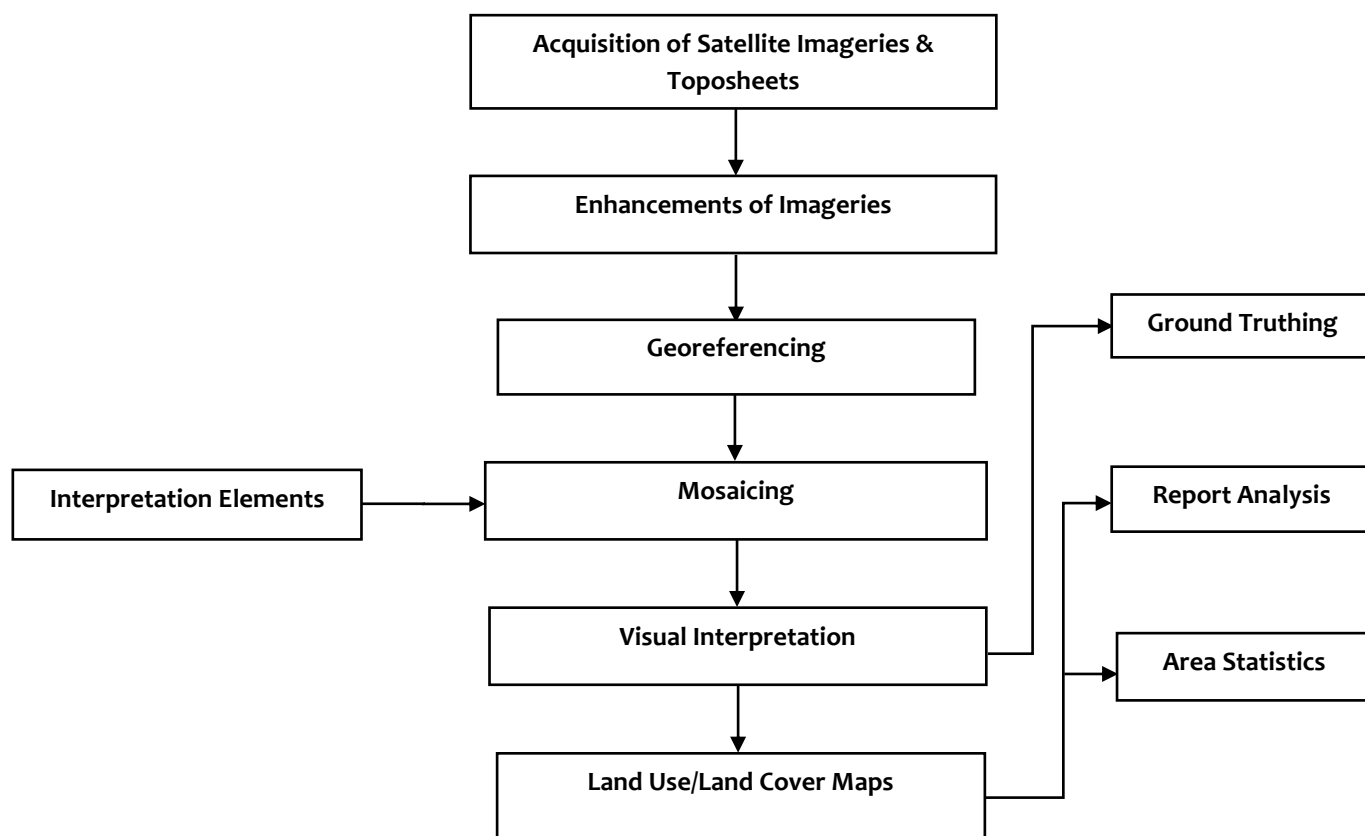


Figure 3.4 Methodology Flowchart for LULC Classification and Mapping

- Preliminary / primary data collection of the study area
 - Satellite data procurement from NRSC Hyderabad
- Secondary data collection from authorized bodies
 - Survey of India Toposheet (SOI)
 - Cadastral / Khasra map
 - GPS Coordinates of Mine Boundary
 - Mining Maps (as a part of Mining Plan) approved by IBM, Goa

- Processing of satellite data using ERDAS Imagine 9.2 and to prepare the Land use and Land cover maps (e.g. Forest, agriculture, settlements, wasteland, water bodies etc.) by digital image processing (DIP) technique.
 - Geo-Referencing of the Survey of India Toposheet
 - Geo-Referencing of satellite Imagery with the help of Geo-Referenced Toposheets
 - Geo-Referenced Khasara Maps
 - Enhancement of the Satellite Imagery
 - Base Map layer creation (Roads, Railway, Village Names and others Secondary data etc.)
 - Data analysis and Classification using Digital interpretation techniques.
 - Ground truth studies or field Verification.
 - Error fixing / Reclassification
 - Final Map Generation

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

3.6.4 LAND USE/LAND COVER DETAILS OF THE CORE ZONE

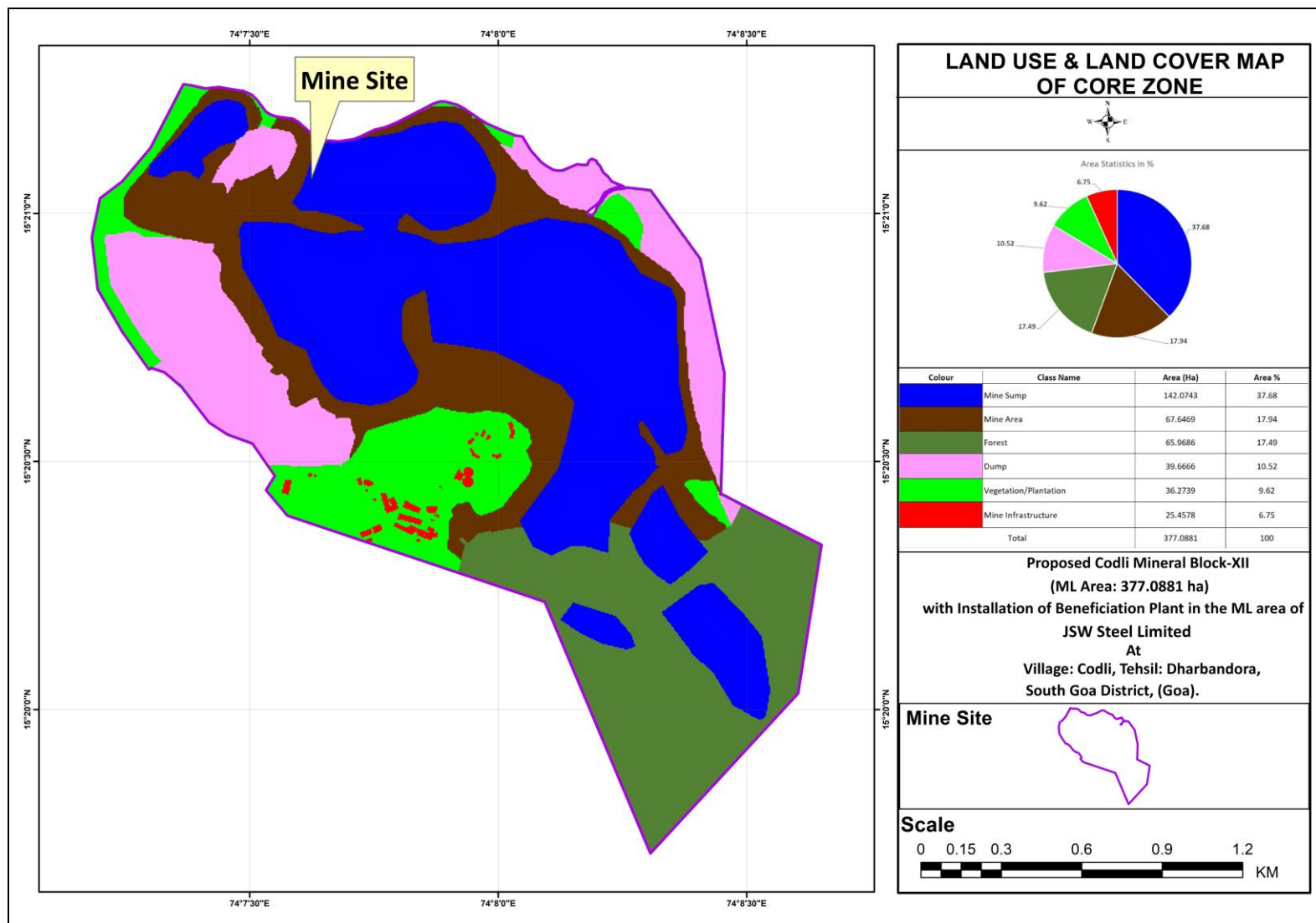


Figure: 3.5 Land Use/Land Cover Map of the Core Zone

The land use and land cover details of the Core Zone are given in Table - 3.5:

Table - 3.5
Land Use / Land Cover Details of Core Zone

S.N.	Legend	Area (In Ha)	Area (In %)
1	Mine Sump	142.0743	37.68
2	Mine Area	67.6469	17.94
3	Forest	65.9686	17.49
4	Dump	39.6666	10.52
5	Vegetation/Plantation	36.2739	9.62
6	Mine Infrastructure	25.4578	6.75
Total		377.0881	100.0

Source: LU/LC Map for Core Zone

3.6.4.1 INTERPRETATION OF THE LAND USE/LAND COVER STUDY

According to Satellite Image of NRSC, dated 20.01.2025, the land use of the core area mainly comprises of Mine Sump (142.0743 ha), Mine area (67.6469 ha), Forest (65.9686 ha), Dump (39.6666 ha), Vegetation/Plantation (36.2739 ha) and Mine Infrastructure (25.4578), with 37.68%, 17.94%, 17.49%, 10.52%, 9.62% and 6.75% respectively falling under above category.

There is no National Park, Wildlife Sanctuary, Biosphere Reserve, Protected Forest etc. within the core area. This project will eventually result in increased built-up area in terms of rainwater harvesting structures, office/workplace, haul roads etc.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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3.6.5 LAND USE/LAND COVER DETAILS OF STUDY AREA

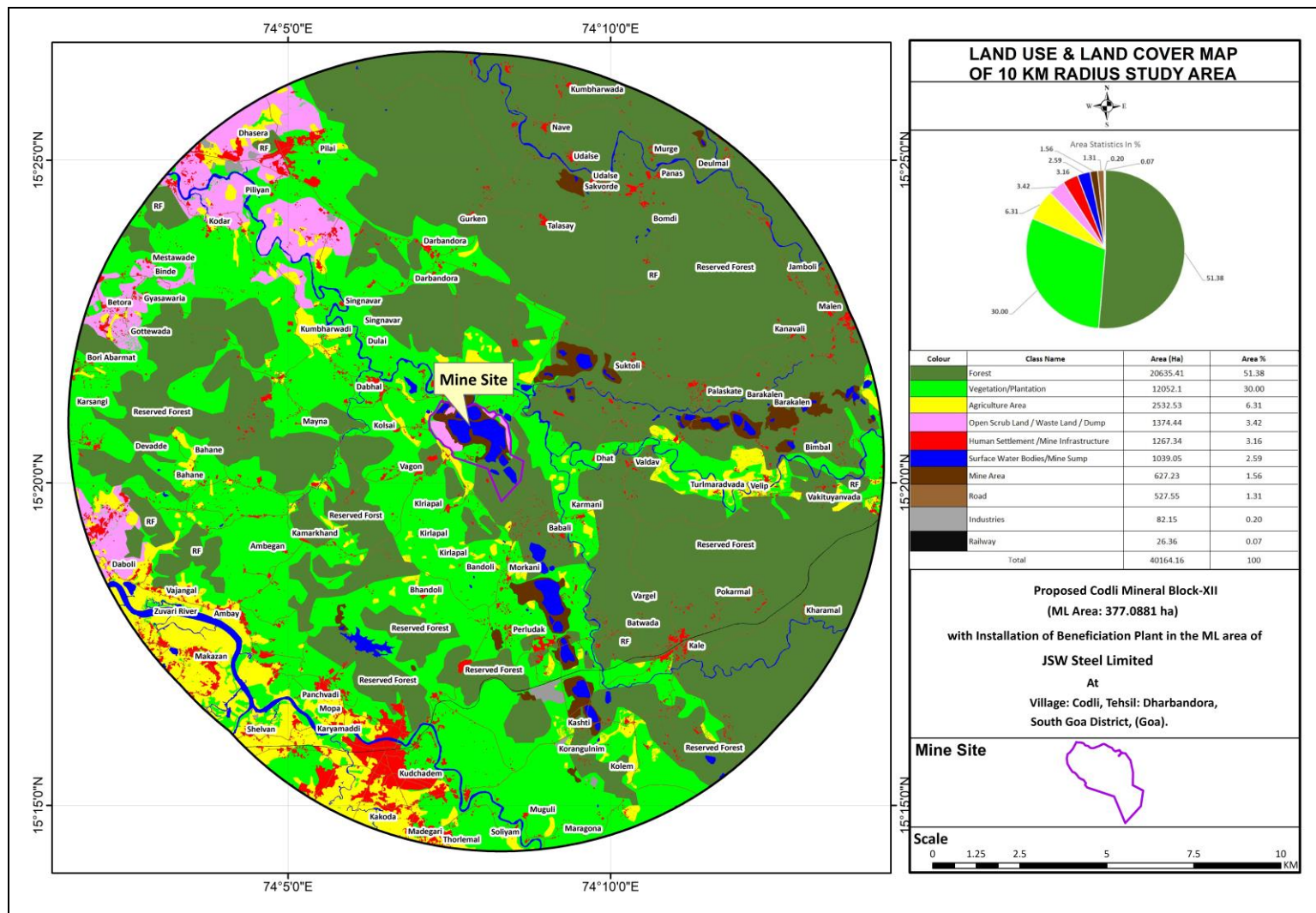


Figure: 3.6 Land Use / Land Cover Map of the Study Area

The land use and land cover details of the Study area are given in Table - 3.6:

Table - 3.6
Land Use/Land Cover Details of Study Area

S.N.	Legend	Area (In Ha)	Area (In %)
1	Forest	20635.41	51.38
2	Vegetation/Plantation	12052.1	30.00
3	Agriculture Land	2532.53	6.31
4	Open Scrub Land/Waste Land/Dump	1374.44	3.42
5	Human Settlement/Mine Infrastructure	1267.34	3.16
6	Surface Water Bodies/Mine Sump	1039.05	2.59
7	Mine Area	627.23	1.56
8	Road	527.55	1.31
9	Industries	82.15	0.20
10	Railway	23.36	0.07
Total		40164.16	100.0

Source: LU/LC Map

3.6.5.1 INTERPRETATION OF THE LAND USE/LAND COVER STUDY

- The study area mainly comprises of Forest (20635.41 ha), Vegetation/Plantation (12052.1 ha), Agriculture Land (2532.53 ha), Open Scrub Land/Waste Land/Dump (1374.44 ha), Human Settlement/Mine Infrastructure (1267.34 ha), Surface Water Bodies/Mine Sump (1039.05 ha), Mine Area (627.23 ha), Road (527.55 ha), Industries (82.15 ha) and Railway (23.36 ha) with 51.38%, 30.00%, 6.31%, 3.42%, 3.16%, 2.59%, 1.56%, 1.31%, 0.20%, and 0.07% of area falling under respectively.
- The Surface Water Bodies/Mine Sump, comprise of 1039.05 ha (2.59%) area of the total buffer area. As per the primary Survey and SOI Toposheet, there are 08 water bodies present within the buffer zone viz. Khandepar River, Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Sanguem or Zuvari River, Jamboli Nala and Paroda River.
- There are no National Park, Biosphere Reserves, Tiger/Elephant Reserves, Wildlife Corridors present within 10 of study area. 2 Wildlife sanctuaries are present that are:
 - Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE Direction) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction)
 - Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction)
 - Forests and Reserve Forests are also present within buffer zone of the mine site.

3.7 SEISMICITY OF THE AREA

Many parts of the Indian subcontinent have historically high seismicity. Seven catastrophic earthquakes of magnitude greater than 8 (Richter scale) have occurred in the western, northern and eastern parts of India and adjacent countries in the past 100 years.

Bureau of Indian Standards [IS - 1893 (Part-1): 2016], has grouped the country into four seismic zones viz. Zone - II, III, IV and V. Out of these, Zone - V is the most seismically active region, while Zone - II is the least. The Modified Mercalli Intensity (MMI) scale, which measures the impact of the earthquakes on the surface of the earth, broadly associated with various zones is as follows:

Table - 3.7
Seismic Zones in India

S.N.	Seismic Zone	Risk	Intensity of Earthquake (on Mercalli Intensity Scale)
1	Zone – V	Very High Risk Zone	IX and above
2	Zone – IV	High Risk Zone	VIII
3	Zone – III	Moderate Risk Zone	VII
4	Zone – II	Low Risk Zone	VI and below

Source: www.ndma.gov.in/images/guidelines/earthquakes.pdf

➤ **January 2004 - Canacona region, South Goa**

A series of minor tremors were felt in towns in Canacona taluka in the district of South Goa in January 2004 beginning 7 January 2004. The exact location of the epicentre of this earthquake is unknown at this point though it does seem to be somewhere in the Canacona region in southern Goa.

➤ **07 January 2004**

The first quake struck on 7 January 2004 at 16:07 IST. It was felt at Amona, Dellem, Kharegal, Poiguinum and Tirwol in Canacona taluka in South Goa. People heard a loud sound and some even said that temporary sheets of their roof-top fell down. The tremor was also felt by residents in the hilly part of the district.

➤ **11 January 2004**

The second tremor struck on 11 January 2004 at 14:20 IST. Felt at Poiguinum and other areas in Canacona taluka in South Goa. Many people ran outdoors in panic. This event was not recorded and it is believed that it might be related to mining in the immediate region.

- According to the “Vulnerability Atlas - 2nd Edition; Peer Group, Ministry of Health (MoH) and UPA; based on digitized data of SOI, GOI; Seismic Zones of India Map, IS 1893 – 2016, BIS, GOI, Seismotectonic Atlas of India and its environs, GIS, GOI” (as shown in Figure-3.3) the project site falls in Seismic zone III i.e. Moderate Damage Risk Zone.

Source: <https://asc-india.org/seismi/seis-go.htm>

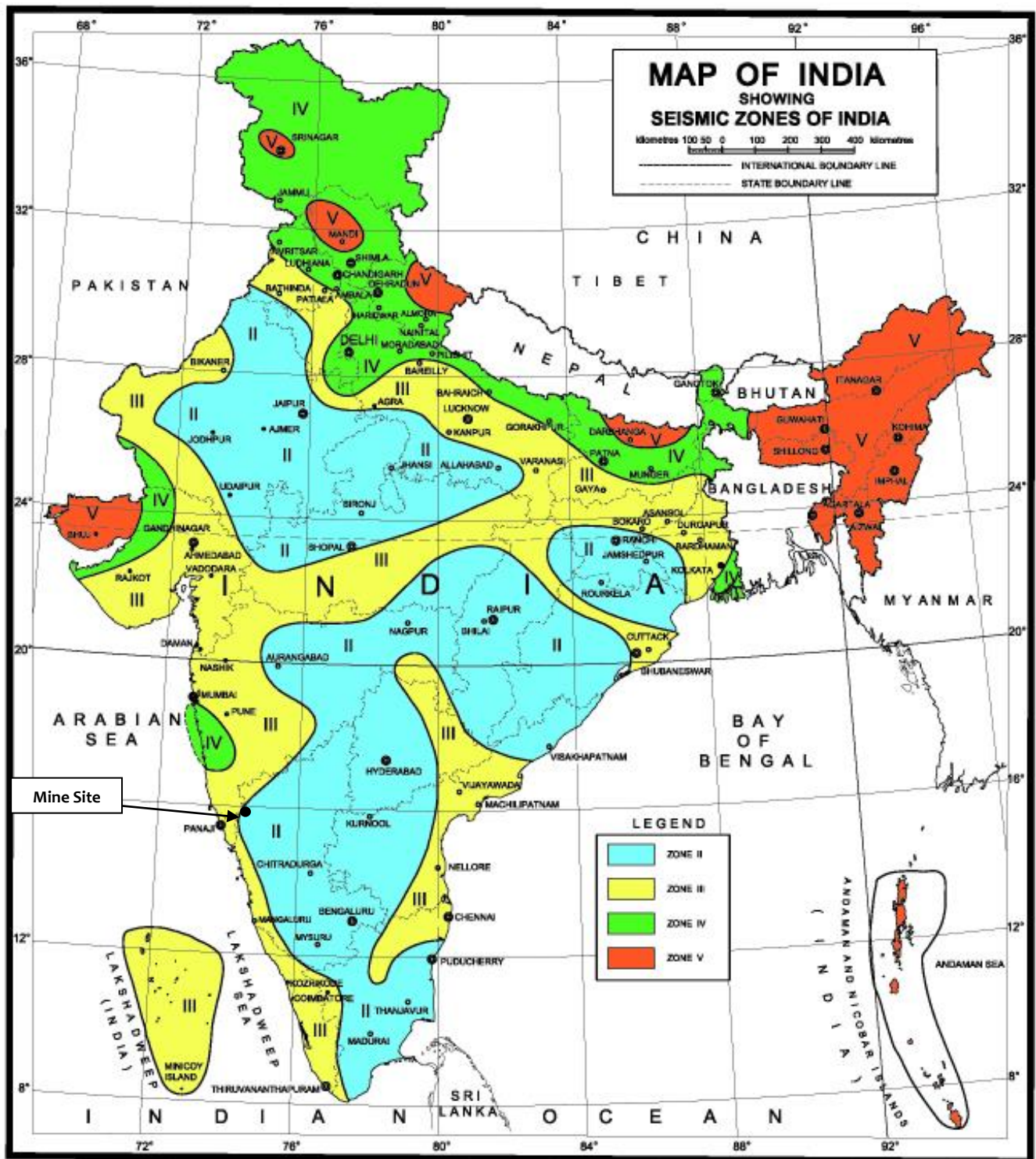


Figure 3.7 Seismic Zone Map Showing Mine Site falls in Zone III

3.8 FLOOD HAZARD ZONATION OF THE AREA

As per the “Vulnerability Atlas-2nd Edition; Peer Group, Ministry of Housing (MoH) and UPA (Urban Poverty Alleviation); based on digitized data of SOI, GOI; Flood Atlas, Task Force Report, C.W.C., GOI” the mine site does not fall under “area liable to flood”. Flood Hazard Zonation Map showing the mine site is given in below Figure.

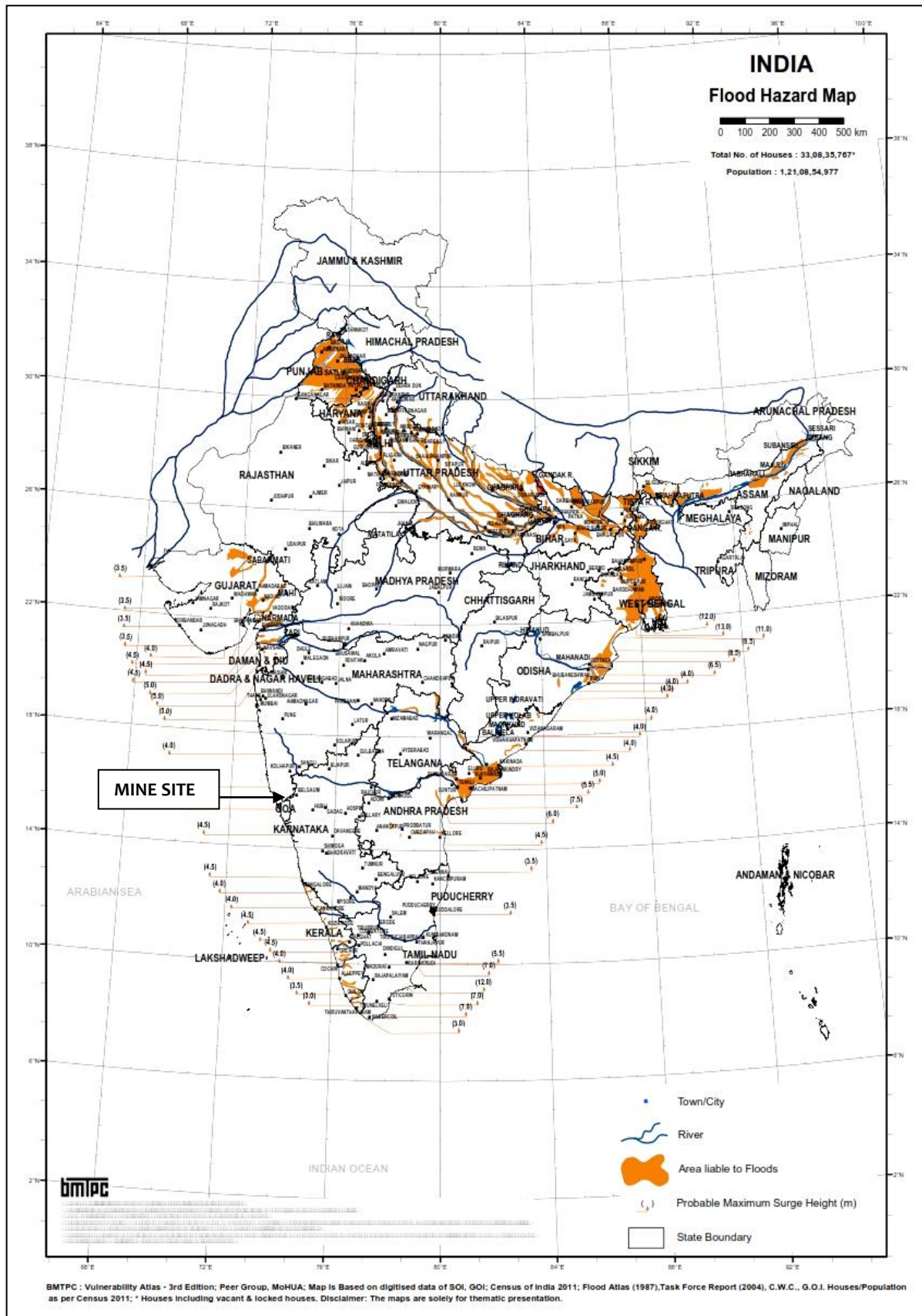


Figure 3.8 Flood Hazard Zonation Map of the Area

3.9 TOPOGRAPHY & DRAINAGE PATTERN

Topography

Codli Mineral block is situated in the central crest portion of Daucona Codli hillock. The area is gently sloping towards NNE & SSW. The mining lease is disposed in a general northwest-southeast direction. Almost entire lease hold area is broken-up and put to use for mining and allied operations. The highest elevation within mining lease is on rehabilitated dump towards the southwest part at 109 m AMSL and the lowest portion at -76 m AMSL towards the northeast part of the lease which was achieved during mining operation in the past and now it is partly filled with silt & water.

Drainage Pattern

The Khandepar River flows towards northern part of the block, flowing from SE to NW. However, the block area is devoid of any perennial surface water body. The area receives approximately about 3500-4000 mm of rainfall every year. Monsoon run-off is channelized and collected into settling ponds / pits through a network of drains.

3.10 CLIMATE & RAINFALL

The area is characterized by extreme climate with very hot (38°C) summer and very cold winter (16°C). It experiences tropical and humid climate which shows three distinct seasons viz. summer, rainy and winter. The summer is hot and humid starting from March and continues till end of May. May is the hottest month of this region. The rainy season lasts from early June to end of September. October and November are the post monsoon months followed by a cold winter which lasts till end of February.

RAINFALL

The annual average rainfall in the region is around 3239.672mm (average of last 25 years rainfall data from 2000-2024) varying from minimum 2367.6 mm in 2001 to maximum 4787.8 mm in 2024.

Table - 3.8
Rainfall data of South Goa District (25 years)

Year	Rainfall (In mm)	Year	Rainfall (In mm)
2000	3145.7	2013	3684.9
2001	2367.6	2014	2913.3
2002	2500.4	2015	2591.7
2003	2817.7	2016	2984.5
2004	2929.9	2017	2593.3
2005	3526.6	2018	2480.6
2006	3484.3	2019	4315.7
2007	3462.3	2020	4262.6
2008	3075.7	2021	3685.1
2009	2772.8	2022	2835.5
2010	3794.7	2023	3590.9
2011	3394.3	2024	4787.8
2012	2993.9	Average	3239.672

Source: WRIS

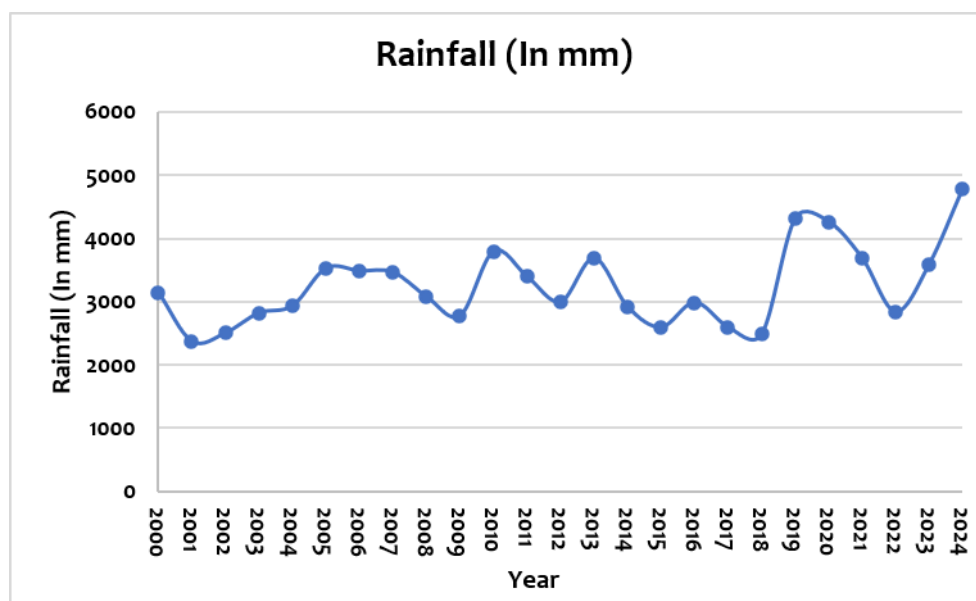


Figure 3.9: Showing Trend of average rainfall from 2000 to 2024 in South Goa

3.11 LIST OF INDUSTRIES/MINES IN STUDY AREA

Table - 3.9
List of Industries/Mines in Study Area

S.N.	Industries/Mines	Type of Industry/Mine	Approx. Distance (Mine Boundary) and direction from (Centre point of the Mine site)	Status Operational/ Non-operational
1.	Kalay Mineral Block IV	Iron Ore Mine	~3.0 Km in the SSE Direction	Operational
2.	Sociedade de fomento Industrial Pvt. Ltd.	Iron Ore Mine	~3.2 Km in SSE Direction	Operational
3.	Shraddha Ispat Private Limited (Sponge Division)	Steel Industry	~5.7 Km in SSE Direction	Operational
4.	Goa Sponge and Power Limited	Steel Industry	~5.7 Km in SSE Direction	Operational
5.	Combat Industries	Manufacturer	~8.5 Km in SSW Direction	Operational
6.	Madras Rubber Factory 620 Plant	Manufacturere	~8.8 Km in NW Direction	Operational
7.	Finolex Cables Limited	Cable Company	~9.4 Km in NW Direction	Operational
8.	Marpol Private Limited	Manufacturer	~9.5 Km in SSW Direction	Operational
9.	Veneshell Industries	Manufacturer	~10.0 Km in SSW Direction	Operational

Source: SOI Toposheet and Field Survey

3.12 METEOROLOGY

Meteorology plays a vital role in determining the transport and diffusion pattern of air pollutants released into atmosphere. The principal variables include horizontal convective transport (average wind speed and direction), vertical convective transport (atmospheric stability) and topography of the area.

Meteorological characteristics of an area are very much important in assessing possible environmental impacts and in preparing environmental management plan.

Meteorological factors are time dependent and changes with respect to time thus meaningful interpretation can be drawn only from long-term reliable data. For collecting the baseline data, understanding of the meteorological conditions at the project site is done through annual records data obtained from Indian Meteorological Department (IMD). The prime importance of understanding the factor wind speed/wind direction from the IMD data was to determine the baseline monitoring sites for air with respect to the direction of the dominant meteorological factor. The nearest IMD stations to the mine site is located at Mormugao. Based on the previous IMD data [Climatological Normals (1991-2020)], the pre-dominant wind direction (seasonal as well as annual) was considered. As per the data, pre-dominant wind direction throughout the year was observed from South West and Seasonal was observed from North West, according to which, the site selection for assessing the ambient air quality within the 10 km from the mine site is done in the upwind and downwind of dominant wind direction. Seasonal as well as annual windrose, prepared based on secondary meteorological data (Figure 3.10) is given as under.

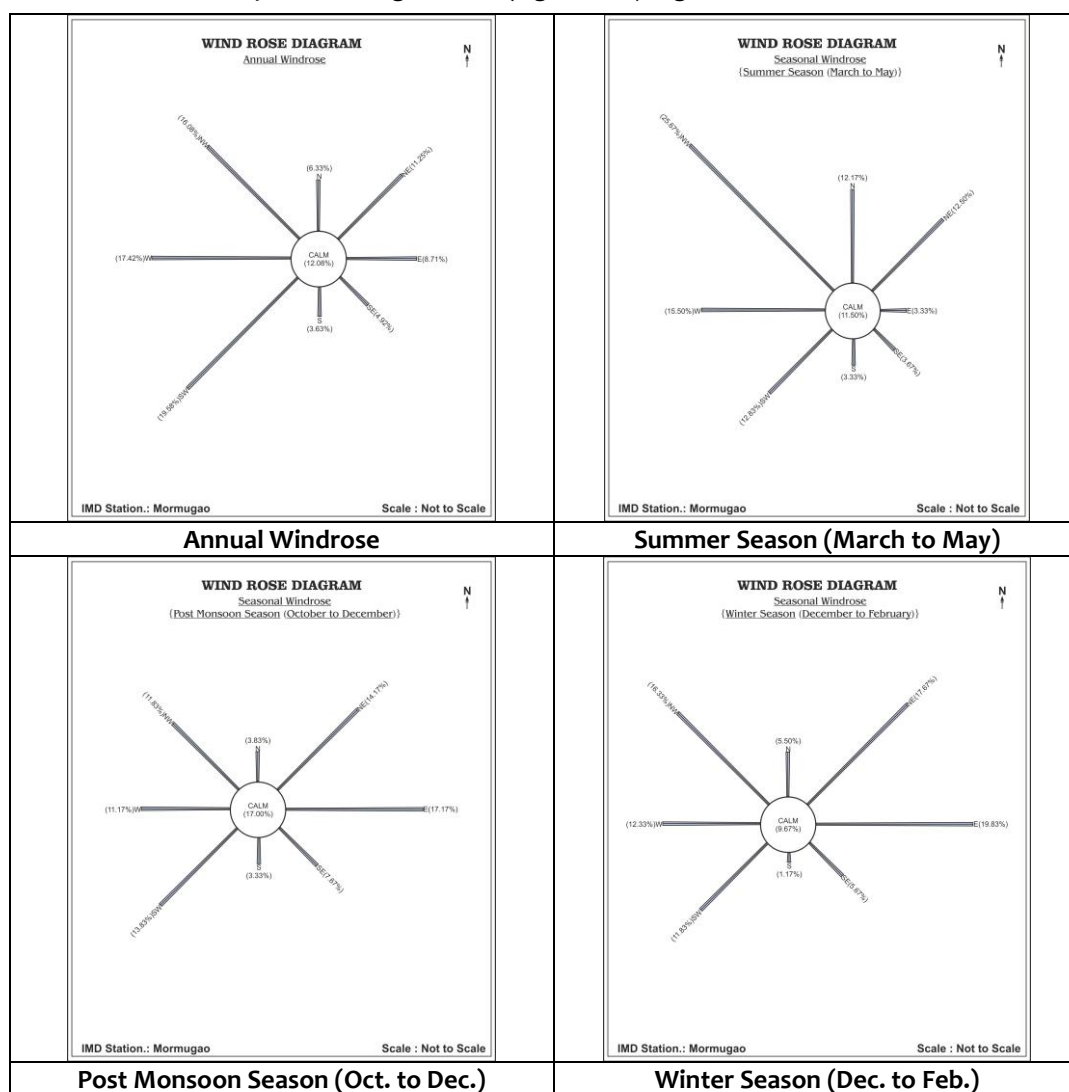


Figure 3.10 Windrose based on secondary Meteorological data of Mormugao
(Seasonal as well as Annual)

Pre dominant Wind direction

Winter Season (December to February): East (E)

Post Monsoon Season (October to December): East (E)

Summer Season (March to May): North West (NW)

Annual: South West (SW)

3.12.1 METEOROLOGY AT SITE

Meteorological station was set-up at site to record meteorological parameters like wind speed, wind direction etc. during Summer Season (March to May, 2025) which has enabled in identifying the influence of meteorology on the air quality of the area. Based on the collected meteorological data, relative percentage frequencies of different wind directions were calculated and plotted as wind rose diagrams. Maximum and minimum temperatures including percentage relative humidity were also recorded simultaneously.

The percentage calculated for all parameters wind speed, wind direction, rainfall, temperature can influence the quality, dispersion and movement of the pollutant thereby helps in the determining the impacts caused by the proposed mine activity.

It was observed that the predominant overall wind patterns for the study period was from North West direction. Summary of the meteorology at site is given in Table - 3.9.

Table - 3.10
Meteorology at Site

Study Period: Summer Season (March to May, 2025)

Month	Temperature (°C)		Relative Humidity (%)		Wind Speed (m/sec.)	
	Min.	Max.	Min.	Max.	Min.	Max.
March, 2025	19.4	35.5	60	73	0.3	9.3
April, 2025	22.7	34.9	68	71	0.3	6.8
May, 2025	22.7	35.3	76	82	0.3	5.9

Source: Meteorological Station at Site

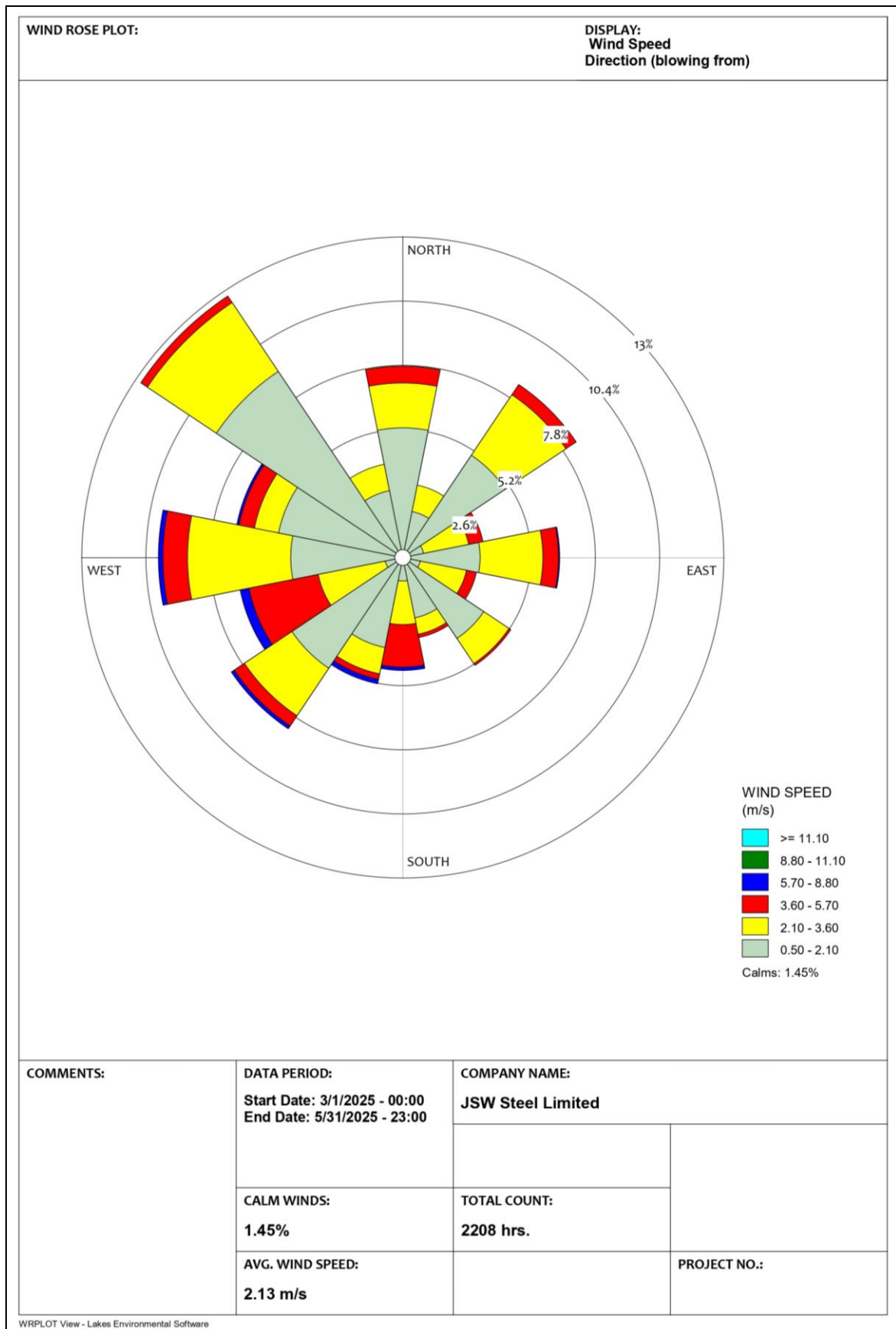


Figure 3.11 Windrose Diagram
Summer Season (March to May, 2025)

Conclusion

It was observed from the above figure that during the study period the dominant wind direction was from NW. The second dominant wind direction was observed to be from West. The average wind speed during Summer Season (March to May, 2025) was calculated to be 2.13 m/s.

3.13 AMBIENT AIR ENVIRONMENT

Ambient air quality monitoring has been carried out within the 10 Km of study area of proposed Block - XII Codli Mineral Block of JSW Steel Ltd. to determine the baseline concentration of various air pollutants in the ambient air. It helps in providing a data base for predicting impact on the surrounding area due to a project activity. It will also be useful in ascertaining the quality of air environment in conformity to standards of the ambient air quality during operation phase of project.

Monitoring schedule

Ambient air quality monitoring has been carried out at 11 locations for 24 hours (twice a week) for three months (26 observations for one location).

Parameters monitored are:

- Particulate Matter (PM₁₀ and PM_{2.5})
- Sulphur Dioxide (SO₂)
- Nitrogen dioxide (NO₂)
- Carbon Monoxide (CO)

Table - 3.11
Details of Test Procedures

S.N.	Parameter	Test Method Specification against which tests are performed	Range of testing	Limit of detection	Equipment used for monitoring	
					Equipment required for Sampling	Equipment required for Analysis
1.	Sulphur Dioxide (SO ₂)	IS: 5182, (P-2), 2001 Reaffirmed 2017	5 µg/m ³ to 1050 µg/m ³	4 µg/m ³	Respirable dust sampler/Low flow Pump	UV spectrophotometer
2.	Nitrogen Dioxide (NO ₂)	IS: 5182, (P-6), 2006 Reaffirmed 2017	5 µg/m ³ to 750 µg/m ³	6 µg/m ³	Respirable dust sampler/Low flow Pump	UV spectrophotometer
3.	Particulate Matter (PM ₁₀)	IS: 5182, (P-23), 2006 Reaffirmed 2017	10 µg/m ³ to 1000 µg/m ³	10 µg/m ³	Respirable dust sampler	Desiccator, high accuracy weighing balance
4.	Particulate Matter (PM _{2.5})	IS: 5182, (P-24), 2019	10 µg/m ³ to 500 µg/m ³	10 µg/m ³	Fine Particulate sampler	Desiccator, high accuracy weighing balance
5.	Carbon Monoxide (CO)	IS: 5182, (P-10), 1999 Reaffirmed 2014	0.5 mg/m ³ to 50 mg/m ³	0.5 mg/m ³	Sampling in Tedlar Bag with low flow pump	Non dispersive Infrared (NDIR) Spectroscopy
6.	Benzene	IS:5182, (P-11):2006 Reaffirmed 2017	1 µg/m ³ to 100 µg/m ³	1 µg/m ³	Sampling in Charcoal tube with low flow pump,	Gas chromatography with detector (FID)

7.	Benzo (a) pyrene (BaP) particulate Phase Only	IS:5182, (P-12):2004 Reaffirmed 2014	0.5 ng/m ³ to 2000 ng/m ³	0.5 ng/m ³	Sampling in Charcoal tube with low flow pump,	Gas chromatography with detector (FID)
8.	Arsenic	IS:5182 (P-22) 2004 Reaffirmed 2014/ CPCB Guidelines	0.5 ng/m ³ to 100 ng/m ³	0.5 ng/m ³	Respirable dust sampler with EPM filter paper	Atomic absorption spectroscopy
9.	Nickel	IS:5182 (P-22) 1979/ 2004 Reaffirmed 2014/ CPCB Guidelines	1 ng/m ³ to 100 ng/m ³	1 ng/m ³	Respirable dust sampler with EPM filter paper	Atomic absorption spectroscopy
10.	Lead	IS:5182 (P-22) 2004 Reaffirmed 2014	0.02 µg/m ³ to 50 µg/m ³	0.02 µg/m ³	Respirable dust sampler with EPM filter paper	Atomic absorption spectroscopy
11.	Ozone	IS:5182 (P-9) 1974 Reaffirmed 2014	1.0 µg/m ³ to 200 µg/m ³	1.0 µg/m ³	Respirable dust sampler/Low flow Pump	UV spectrophotometer
12.	Ammonia	Method of Air Sampling & Analysis (3 rd Edition – 1988)	1 µg/m ³ to 400 µg/m ³	1 µg/m ³	Respirable dust sampler/Low flow Pump	UV spectrophotometer

Note: Protocol Used: CPCB Guidelines/IS-5182

FID: Flame Ionization Detection

RDS: Respirable Dust Sampler

FPS: Fine Particulate Sampler

Source of Air Pollution

The sources of air pollution in the region are dust emission from unpaved roads, domestic fuel burning, vehicular traffic, agricultural activities, industries and mining activities etc.

Monitoring Locations

Monitoring locations were selected for AAQ Monitoring keeping in view the pre-dominant wind direction prevailing in the area based on the previous IMD source.

It can be observed from the wind rose diagram (Figure – 3.11) that the dominant wind direction prevailing in the area during the study period was from North West Direction followed by West.

Villages/locations have been selected in the downwind direction as well as in the upwind direction for AAQ monitoring from the mine site.

Monitoring locations selected for Ambient Air Quality Monitoring during the study period are given in Table - 3.12:

Table - 3.12
Ambient Air Quality Monitoring and Noise Level Monitoring Locations
Study Period: Summer Season (March to May, 2025)

Location Code	Monitoring Locations	Tentative Distance (from mining lease boundary) & direction (from center point)	Selection Criteria
SAN1	Mine Site	-	Core Zone
SAN2	Village Codli	~0.4 Km in SW direction	Near Habitation from ML boundary
SAN3	Within 500 meters	~0.5 Km in SE direction	Within 500 meters
SAN4	Village Dabal	~0.5 Km in NW direction	Upwind direction of pre-dominant Wind
SAN5	Village Sangod	~3.8 Km in NE direction	Near Habitation In the study Area
SAN6	Village Darbandora	~4.0 Km in North direction	Nearby habitation of National Highway-748
SAN7	Village Konsen	~5.4 Km in West direction	Upwind direction of dominant Wind
SAN8	Village Kale	~6.5 Km in SE direction	Downwind direction of pre-dominant wind & Within Bhagvan Mahavir WLS
SAN9	Village Shigao	~6.7 Km in East direction	Nearby ESZ of Bhagwan Mahavir WLS in the study area
SAN10	Village Panchvadi	~7.2 Km in SW direction	Nearby Zuvari River in the study area
SAN11	Village Sanvardem	~7.3 Km in South direction	Densely populated habitation in the study area

Source: SOI Toposheet and Field Survey

AMBIENT AIR QUALITY MONITORING

Table - 3.12 shows the maximum and minimum concentration of the air pollutants monitored at different locations (as mentioned in Table: 3.12) during the study period. All 26 observations of pollutants for each location are detailed in Ambient Air Quality Monitoring Tables enclosed as **Annexure X**. Photographs of Baseline Monitoring & Sampling Locations are enclosed as **Annexure XI**.

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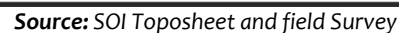


Figure 3.12 Key Plan showing Ambient Air Quality & Noise Level Monitoring Locations

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 3.13
Ambient Air Quality Monitoring Results
Study Period: Summer Season (March to May, 2025)

Location Code	Sampling Locations	Parameters																		
		PM2.5 (µg/m3)		PM10 (µg/m3)		Nitrogen Dioxide (µg/m3)		Sulphur Dioxide (µg/m3)		Carbon Monoxide (mg/m3)		Benzo(a) Pyrene (ng/m3)	Ozone (µg/m³)		Lead (µg/m³)	Ammonia (µg/m³)		Benzene (µg/m³)	Arsenic (ng/m³)	Nickel (ng/m3)
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.		Min.	Max.			
SAN1	Mine Site	21.8	28.5	37.6	50.9	14.4	19.7	6.5	10.2	BDL	BDL	BDL	9.1	19.6	BDL	7.8	14.2	BDL	BDL	BDL
SAN2	Village Codli	20.3	32.2	41.5	55.4	15.3	23.1	5.1	13.4	BDL	BDL	BDL	10.2	20.2	BDL	10.1	19.1	BDL	BDL	BDL
SAN3	Within 500 m	19.0	26.3	34.1	46.2	9.4	16.0	4.2	10.7	BDL	BDL	BDL	7.4	15.0	BDL	10.4	21.0	BDL	BDL	BDL
SAN4	Village Dabal	25.9	36.4	44.5	64.6	13.6	22.2	7.6	13.1	BDL	BDL	BDL	13.7	22.0	BDL	11.5	24.3	BDL	BDL	BDL
SAN5	Village Sangod	17.2	29.8	33.0	45.3	9.0	15.7	4.1	10.1	BDL	BDL	BDL	11.5	18.4	BDL	7.3	18.6	BDL	BDL	BDL
SAN6	Village Darbandora	22.5	33.4	41.3	59.0	11.4	19.5	7.6	12.9	BDL	BDL	BDL	7.0	15.1	BDL	8.5	22.2	BDL	BDL	BDL
SAN7	Village Konsen	15.3	25.6	36.5	51.0	10.2	17.6	4.5	10.2	BDL	BDL	BDL	5.6	11.4	BDL	15.0	24.3	BDL	BDL	BDL
SAN8	Village Kale	27.5	39.8	48.6	65.9	13.3	24.8	8.9	14.0	0.51	0.67	BDL	13.5	25.7	BDL	16.4	29.0	BDL	BDL	BDL
SAN9	Village Shigao	22.1	34.2	38.3	57.4	10.4	17.4	6.0	11.9	BDL	BDL	BDL	10.1	17.2	BDL	10.1	21.2	BDL	BDL	BDL
SAN10	Village Panchvadi	26.6	36.7	44.2	63.0	13.6	20.2	7.2	12.6	BDL	BDL	BDL	8.4	20.0	BDL	13.3	26.7	BDL	BDL	BDL
SAN11	Village Sanvordem	30.8	40.1	51.6	72.9	16.9	26.4	9.3	14.5	0.55	0.72	BDL	15.9	26.0	BDL	7.0	19.0	BDL	BDL	BDL
Detection Limit								4.0		0.5		0.5	1.0		0.02	1.0		0.5	1.0	0.5
NAAQS* (24 Hourly)		60		100		80		80		4**		1***	180**		1	400		5 ***	1 ***	20 ***

Source: Ambient Air Quality Monitoring Results from JM EnviroLab Pvt. Ltd.

***NAAQS** - National Ambient Air Quality Standards; Schedule-VII, [Rule 3 (3B)], [Part-II-sec.-3(i)] 16.11.2009, ** - 1 Hourly & *** - Annually

3.13.1 NATIONAL AMBIENT AIR QUALITY STANDARDS

The National Ambient Air Quality Standards prescribed by CPCB are given below:

Table - 3.14
National Ambient Air Quality Standards

S.N.	Pollutant	Time Weighted Average	Concentration in Ambient Air		Method of Measurement
			Industrial Area, Residential Rural and Other Areas	Ecologically Sensitive Area (Notified by Central Govt.)	
1	Sulphur Dioxide (SO ₂), µg/m ³	Annual Average * 24 hours **	50 80	20 80	1. Improved West and Gaeke Method 2. Ultraviolet fluorescence
2	Oxides of Nitrogen as NO ₂ , µg/m ³	Annual Average * 24 hours **	40 80	30 80	1. Modified Jacob and Hochheiser (Na-Arsenite) Method 2. Chemiluminescence (Gas phase)
3	Particulate Matter (size less than 10 µm) or PM ₁₀ , µg/m ³	Annual Average * 24 Hours **	60 100	60 100	1. Gravimetric 2. TOEM 3. Beta attenuation
4	Particulate Matter (size less than 2.5 µm) or PM _{2.5} , µg/m ³	Annual Average* 24 Hours **	40 60	40 60	1. Gravimetric 2. TOEM 3. Beta attenuation
5	Ozone (O ₃), µg/m ³	8 Hours ** 1 Hours *	100 180	100 180	1. UV Photometric 2. Chemiluminescence 3. Chemical Method
6	Lead (Pb), µg/m ³	Annual Average * 24 Hours **	0.50 1.0	0.50 1.0	1. AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper 2. ED-XRF using Teflon filter
7	Carbon Monoxide (CO), mg/m ³	8 Hours** 1 Hours	02 04	02 04	Non Depressive Infrared (NDIR) Spectroscopy
8	Ammonia (NH ₃), µg/m ³	Annual Average* 24 hours **	100 400	100 400	1. Chemiluminescence (Gas phase) 2. Indophenol blue method
9	Benzene (C ₆ H ₆), µg/m ³	Annual Average*	05	05	1. Gas Chromatography based continuous analyzer, 2. Adsorption and Desorption followed by GC analysis
10	Benzo (α) Pyrene (BaP)- Particulate Phase only, ng/m ³	Annual Average*	01	01	Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m ³	Annual Average*	06	06	AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m ³	Annual Average*	20	20	AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper

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

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it was considered as adequate reason to institute regular or continuous monitoring and investigation.

3.13.2 INTERPRETATION OF AAQM RESULTS

Ambient Air Quality Monitoring results reveals that the concentrations of PM_{2.5} and PM₁₀ for all the 11 AAQM stations were selected between 15.3 to 40.1 µg/m³ and 33.0 to 72.9 µg/m³ respectively.

As far as the gaseous pollutants SO₂ and NO₂ are concerned, the prescribed limit of 80 µg/m³ has never surpassed at any station. The concentrations of SO₂ and NO₂ were found to be in range from 4.1 to 14.5 µg/m³ and 9.0 to 26.4 µg/m³ respectively. CO concentration was found only in Villages Kale and Sanvordem between the range of 0.51 to 0.72 mg/m³ or in remaining Villages it's found below detection limit (0.5 mg/m³). The concentration of Ozone and Ammonia were found to be in range from 5.6 µg/m³ to 26.0 µg/m³ and 7.0 µg/m³ to 29.0 µg/m³.

AAQ parameters in the study area have been found well within prescribed norms; though the values were found more at Village Sanvordem due to the transportation activities, vehicular emissions etc. & minimum results were found at Village Sangod and Konsen as there is no major source of air pollution. The concentrations of AAQ at all monitoring locations were found well within the prescribed standards of NAAQS.

Impact assessment and mitigation measures suggested for the same have been detailed in Chapter 4 of this EIA/EMP Report.

3.13.3 MINERALOGICAL COMPOSITION FOR RSPM

RSPM is “defined as the component of inhaled Respirable dust small enough to reach the pulmonary or alveolar region of the lung”.

Table - 3.15
Classification of RSPM

Classification	Type of particles	Size of the particles
PM ₁₀	Inhalable particles	≤10µm
PM _{2.5}	Fine particles	≤2.5µm

Table - 3.16
Mineralogical Composition of PM₁₀

S.N.	Ions	Units	Concentration
1	Free Silica (SiO ₂)	%	1.7
2	Calcium (Ca)	µg/m ³	1.4
3	Magnesium (Mg)	µg/m ³	BDL (DL 1.0)
4	Iron (Fe)	µg/m ³	4.6
5	Aluminium (Al)	µg/m ³	2.5
6	Sodium (Na)	µg/m ³	BDL (DL 1.0)
7	Potassium (K)	µg/m ³	BDL (DL 1.0)
8	Manganese (Mn)	µg/m ³	1.6
9	Chromium (Cr)	µg/m ³	BDL (DL 1.0)
10	Nickel (Ni)	µg/m ³	BDL (DL 1.0)
11	Zinc (Zn)	µg/m ³	BDL (DL 1.0)
12	Copper (Cu)	µg/m ³	BDL (DL 1.0)

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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13	Cobalt (Co)	µg/m ³	BDL (DL 1.0)
14	Lead (Pb)	µg/m ³	BDL (DL 0.02)
15	Mercury (Hg)	µg/m ³	BDL (DL 1.0)
16	Cadmium (Cd)	µg/m ³	BDL (DL 1.0)

Note: BDL- Below Detectable Limit, DL- Detection Limit

Source: Mineralogical Composition of PM10 analysis Results, JM EnviroLab Pvt. Ltd.

Copy of the analysis results of mineralogical composition of PM10 is enclosed as **Annexure XIII**.

3.14 NOISE ENVIRONMENT

Noise is often defined as unwanted sound, interferes with speech communication, causes annoyance, distracts from work & disturbs sleep; thus, deteriorating quality of human environment.

Source of Noise

There are several sources of noise in the 10 km radius study area, which contributes to the local noise level of the area. Ambient noise sources in the vicinity of the project include the noise from traffic on road and highways, mining activities, human activities in villages and agricultural fields.

Monitoring Schedule

Noise level monitoring was carried out at 11 locations during the day and night time once in the study period. Locations were categorized based on industrial/residential/commercial/activities. Locations selected for noise level monitoring are given in table - 3.11.

Ambient Noise Level Monitoring

Ambient noise levels monitoring results monitored at different locations (as mentioned in Table - 3.12) during the study period are given in table - 3.17.

Table - 3.17
Ambient Noise Level Monitoring Results
Study Period: Summer Season (March to May, 2025)

Location Code	Locations	Category of Area	Noise Levels dB Leq (A)	
			Day Time (06:00 AM to 10:00 PM)	Night Time (10:00 PM to 06:00 AM)
SAN1	Mine Site	I	47.2	38.1
SAN2	Village Codli	R	50.4	39.6
SAN3	Within 500 meters	R	46.2	38.7
SAN4	Village Dabal	R	51.9	40.6
SAN5	Village Sangod	R	48.3	38.8
SAN6	Village Darbandora	R	51.8	40.7
SAN7	Village Konsen	R	49.6	38.1
SAN8	Village Kale	R	53.8	42.9
SAN9	Village Shigao	R	51.0	40.5
SAN10	Village Panchvadi	R	51.6	41.2
SAN11	Village Sanvardem	R	56.8	44.4

Source: Ambient Noise Level Monitoring Results, JM EnviroLab Pvt. Ltd.

CPCB Noise Standards are given in Table - 3.18.

Table - 3.18
CPCB Noise Standards

Area Code	Category of Area	Limits in Leq. dB (A)	
		Day Time (06.00 am–10.00 pm)	Night Time (10.00 pm–6.00 am)
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40
1. Day Time is from 6.00 AM to 10.00 PM. 2. Night Time is reckoned between 10.00 PM to 6.00 AM. 3. Silence Zone is defined as an area up to 100m around premises of Hospitals, Educational Institutions and Courts. Use of vehicle horn, loudspeaker and bursting of crackers is banned in these zones. Note: Mixed categories of areas be declared as one of the four above mentioned categories by the competent Authority and the corresponding standards shall apply.			
Source: Central Pollution Control Board Norms			

3.14.1 INTERPRETATION OF NOISE RESULTS

Ambient noise levels were measured at 11 locations around the project site. Noise levels varied from 46.2 to 56.8 Leq dB (A) during day time and from 38.1 to 44.4 Leq dB(A) during night time.

Maximum noise levels during day time as well as night time were found at Village Sanvardem due to the transportation activities. Whereas, the minimum noise level was found within ~500m of Mine site during day time as well as at mine site and Village Konsen during night time; as there is no major source of noise pollution.

From the above study and discussions, it can be concluded that noise levels in the study area are well within the standards as prescribed by the CPCB. Impact assessment and mitigation measures suggested for the same have been detailed in Chapter 4 of this report.

3.15 WATER ENVIRONMENT

In order to assess the groundwater quality as well as the water quality of the surface waterbodies present within 10 km radius area study area, a reconnaissance survey was carried out. Groundwater sampling locations have been identified/selected considering the aspects like drainage pattern of the area. Surface water sampling was done from the surface water bodies present within 10 Km radius study area.

Scope of Sampling

Sample were collected manually from various type of sampling location with respect to Surface water & Groundwater. The sources of water sampling are as under:

Surface Water: The samples were collected from water bodies (Rivers/Nallahs).

Drinking Water/Ground water: Samples have been collected from Open well and Borewells.

Methodology of Sampling

Grab sampling has been done as single sample collected at a specific spot and at a site over a short period of time in order to assess the properties such as physio-chemical, biological and heavy metals. Grab samples are taken at a single selected location, depth and time.

3.15.1 SURFACE WATER QUALITY

Surface Water Sampling has been carried out below mention 8 sampling Locations.

Table – 3.19
Surface Water Sampling Locations
Study Period: Summer Season (March to May, 2025)

Station Code	Sampling Location	Distance & direction from proposed Mine Site
SW 1	Khandepar River	Adjacent in North direction
SW 2	Kale Nala	0.7 km in ESE direction
SW 3	Udnai Nala	1.5 km in West direction
SW 4	Panduranga Nala	5.0 km in SW direction
SW 5	Ragada Nala	7.0 km in NNE direction
SW 6	Sanguem or Zuari River	8.0 km in South direction
SW 7	Paroda River	9.0 km in SSW direction
SW 8	Jamboli Nala	9.0 km in NE direction

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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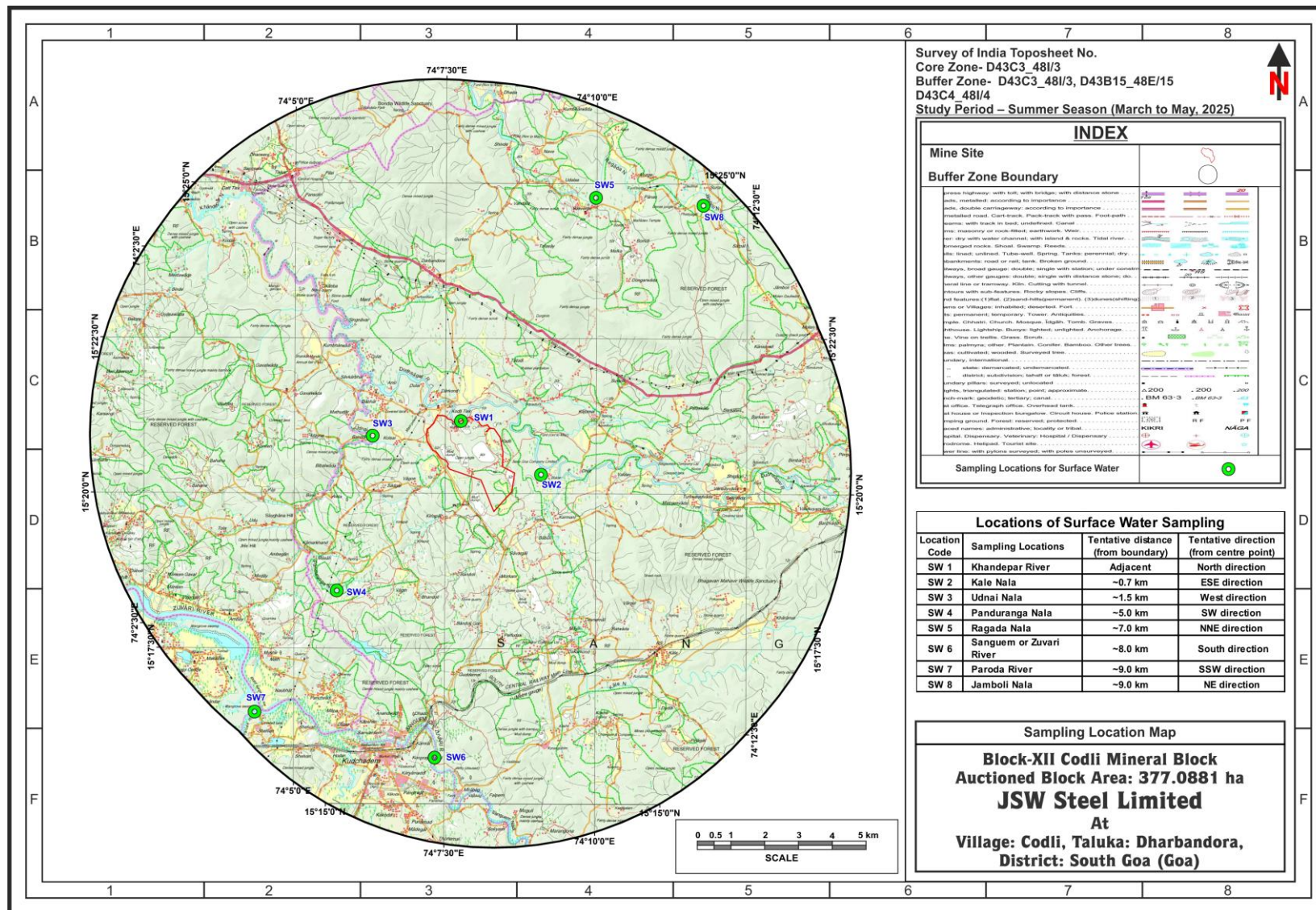


Figure 3.13 Key Plan showing Surface Water Sampling Locations

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 3.20
Surface Water Quality Monitoring Results
Study Period: Summer Season (March to May, 2025)

S.N.	Parameters	Unit	Sample Locations							
			Khandepar River SW1	Kale Nala SW2	Udnai Nala SW3	Panduranga Nala SW4	Ragada Nala SW5	Sanguem or Zuvari River SW6	Paroda River SW7	Jamboli Nala SW8
1.	pH (at 25°C)	--	7.65	6.88	6.88	6.79	6.72	6.72	6.78	6.91
2.	Odour	--	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3.	Total Hardness as CaCO ₃	mg/l	40.0	30.0	25.0	15.0	15.0	64.0	45.0	20.0
4.	Calcium as Ca	mg/l	10.86	7.93	5.95	3.97	3.97	11.9	13.89	5.95
5.	Alkalinity as CaCO ₃	mg/l	42.2	27.6	19.82	15.82	17.1	50.37	31.1	22.37
6.	Chloride as Cl	mg/l	4.89	4.89	6.45	3.26	4.34	20.46	16.12	7.34
7.	Magnesium as Mg	mg/l	3.73	2.48	2.46	1.24	1.24	8.33	2.51	1.25
8.	Total Dissolved Solids	mg/l	71.0	52.0	48.0	24.0	34.0	101.0	74.0	47.0
9.	Sulphate as SO ₄	mg/l	1.3	3.04	3.74	1.3	2.15	7.5	6.09	1.42
10.	Fluoride as F	mg/l	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	0.10
11.	Iron as Fe	mg/l	0.38	0.23	0.73	0.27	0.27	0.50	0.46	0.24
12.	Zinc as Zn	mg/l	0.02	0.04	0.02	0.20	0.05	0.02	0.03	0.02
13.	Total Suspended Solid	mg/l	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	2.0	BDL(DL 1.0)	BDL(DL 1.0)
14.	BOD	mg/l	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	2.8	1.3	BDL(DL 1.0)
15.	COD	mg/l	4.0	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	16.0	10.0	BDL(DL 1.0)
16.	Sodium as Na	mg/l	3.0	3.0	5.0	3.0	4.0	9.0	6.0	5.0
17.	Potassium as K	mg/l	1.0	1.0	1.0	BDL (DL 1.0)	1.0	2.0	1.0	2.0
18.	Conductivity	µs/cm	108.0	78.0	74.0	38.0	53.0	151.0	111.0	72.0
19.	Dissolve Oxygen	mg/l	7.8	7.5	7.6	7.7	7.8	7.5	7.1	7.3
20.	Total Coliform	MPN/100ml	110	90	70	50	80	170	140	70

BDL – Below Detection Limit, DL- Detection Limit

Source: Surface Water Analysis Report

Note: Surface water quality was also analyzed for Colour, Turbidity, Residual free Chlorine, Cyanide, Nitrate, Aluminium, Boron, Phenolic Compounds, Anionic Detergents, Hexa Chromium, Copper, Manganese, Lead, Selenium, Arsenic, Mercury, Phosphate and Nickel were found below detection limit.

3.15.2 INTERPRETATION OF SURFACE WATER QUALITY RESULTS

The above mentioned chemical analysis of surface water samples reveals that there is a variation in a chemical composition of water samples from the nearby water bodies.

- The pH of the water bodies were found from 6.72 to 7.65 indicating neutral to slightly alkaline in nature. The odour was found agreeable. Less turbidity in the above mentioned water body indicates that it is good for the growth of aquatic life.
- Total hardness (15.0 to 64.0 mg/l), Total Dissolved Solids (24.0 to 101.0 mg/l), Alkalinity (15.82 to 50.37 mg/l) and Conductivity (38 to 151 µs/cm) were found to be within standards in water samples.
- The COD (4.0 to 16.0 mg/l) and BOD (1.3 to 2.8 mg/l). The nutrients were also found in less quantity viz. Sulphate (1.3 to 7.5 mg/l), Calcium (3.97 to 13.89 mg/l), Sodium (3.0 to 9.0 mg/l), Potassium (1.0 to 2.0 mg/l), Magnesium (1.24 to 8.33 mg/l), Iron (0.23 to 0.73 mg/l), Zinc (0.02 to 0.2 mg/l), Chloride (3.26 to 20.46 mg/l), indicated clean water bodies.
- Dissolved Oxygen (7.1 to 7.8 mg/l) indicated that the water bodies are safe for aquatic biodiversity. Although, the physico-chemical quality is good and safe for aquatic biodiversity.
- Flouride were found 0.1 mg/l only in Jamboli Nala and in other locations its found Below Detection Limit (DL 0.05 mg/l). Total Suspended Solid were found 2 mg/l only in Sanguem/Zuvari River water.
- Some of the parameters like Colour BDL (DL 1.0 Hazen), Turbidity (DL 1.0 NTU) Residual free Chlorine (DL 0.20 mg/l), Cyanide as CN (DL 0.02 mg/l), Nitrate as NO₃ (DL 0.05 mg/l), Aluminium as Al (DL 0.03 mg/l), Boron (DL 0.20 mg/l), Phenolic Compounds (DL 0.001 mg/l), Anionic Detergents as MBAS (DL 0.02 mg/l), Hexa Chromium as Cr+6 (DL 0.03 mg/l), Zinc as Zn (DL 0.0005 mg/l), Copper as Cu (DL 0.02 mg/l), Manganese as Mn (DL 0.01 mg/l), Lead as Pb (DL 0.008 mg/l), Selenium as Se (DL 0.005 mg/l), Nickel as Ni (DL 0.005 mg/l), Phosphate as PO₄ (DL 0.02 mg/l) Arsenic as As (DL 0.002 mg/l), Mercury as Hg (DL 0.001 mg/l) were also analysed and not detected.

3.15.3 GROUND WATER QUALITY

Ground water as well as potable water samples were collected from the available water resources within core zone and also 10 Km radius study area i.e. from Borewell and open wells. The samples from different sites were collected and tested.

The quality of ground water was studied by collecting 10 water samples. The water samples were collected from Open-wells and Borewells. Details of ground water and soil sampling locations and their distance and directions are given in Table - 3.21 & shown in Figure - 3.14. Ground water analysis results are given in Table - 3.22.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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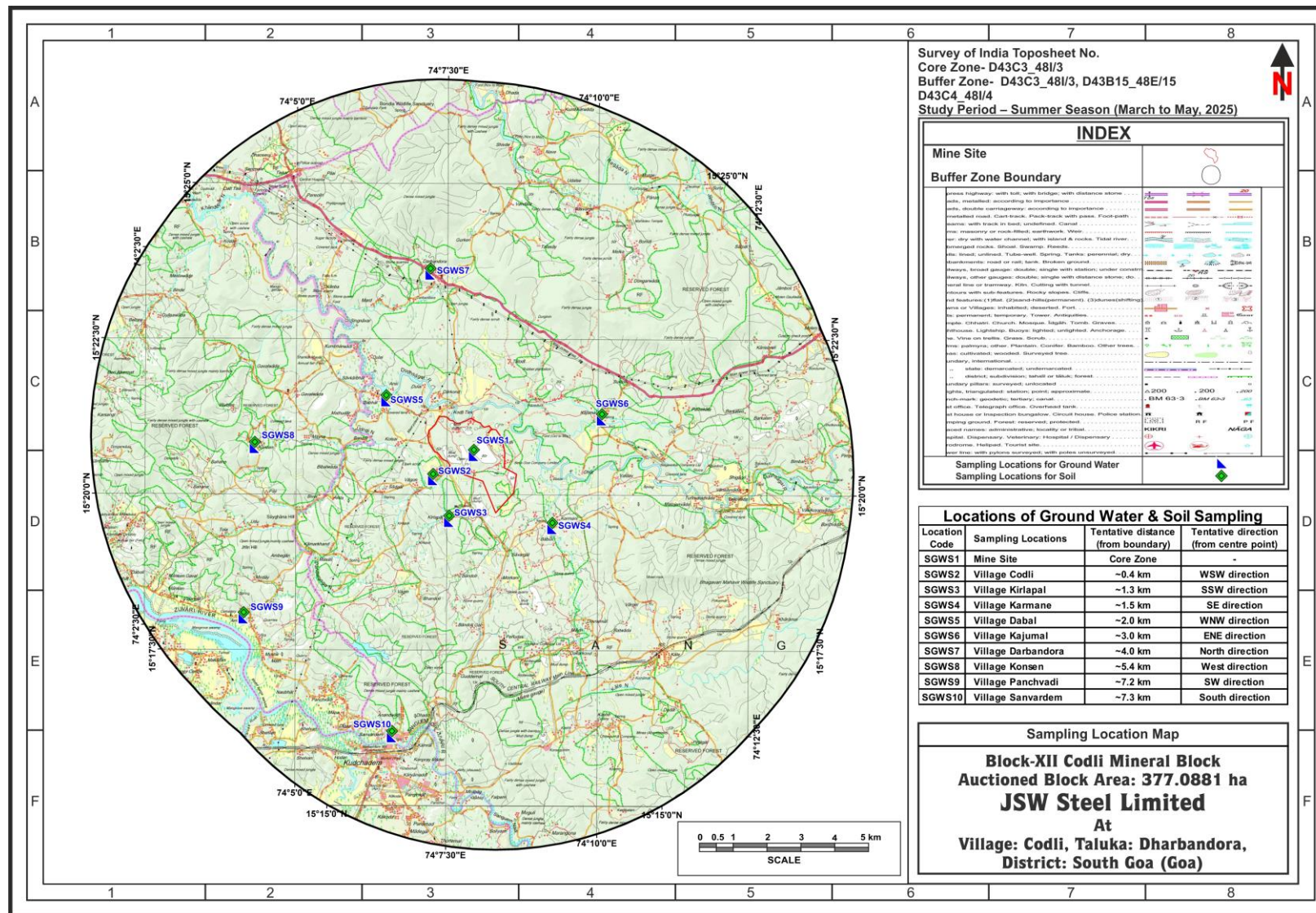
Table - 3.21
Ground Water & Soil Sampling Locations
Study Period: Summer Season (March to May, 2025)

Location Code	Sampling Location	Tentative distance (from mining lease boundary) & direction (from centre point)
SGWS 1	Mine Site	Core area
SGWS 2	Village Codli	0.4 km in WSW direction
SGWS 3	Village Kirlapal	1.3. km in SSW direction
SGWS 4	Village Karmane	1.5 km in SE direction
SGWS 5	Village Dabal	2.0 km in WNW direction
SGWS 6	Village Kajumal	3.0 km in ENE direction
SGWS 7	Village Darbandora	4.0 km in North direction
SGWS 8	Village Konsen	5.4 km in West direction
SGWS 9	Village Panchvadi	7.2 km in SW direction
SGWS 10	Village Sanvardem	7.3 km in South direction

Source: SOI Toposheet & field Survey

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Source: SOI Toposheet and field Survey

Figure 3.14 Key Plan showing Ground Water & Soil Sampling Locations

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 3.22
Ground Water Analysis
Study Period: Summer Season (March to May, 2025)

S.N.	Parameter	Unit	Sampling Location										Specification as per IS 10500- 2012	
			SGWS1	SGWS2	SGWS3	SGWS4	SGWS5	SGWS6	SGWS7	SGWS8	SGWS9	SGWS10	Requirement Acceptable Limit	Permissible Limit in the Absence of Alternate Source
			Mine Site	Village Codli	Village Kirlapal	Village Karmane	Village Darbandora	Village Sanvardem	Village Dabal	Village Kajumal	Village Konsen	Village Panchvadi		
1.	pH (at 25°C)	-	7.26	6.91	6.85	6.80	6.89	6.61	6.60	6.93	7.11	6.41	6.5-8.5	No Relaxation
2.	Odour	-	Agreeable										Agreeable	Agreeable
3.	Taste	-	Agreeable										Agreeable	Agreeable
4.	Total Hardness as CaCO ₃	mg/l	52.0	40.0	58.0	45.0	82.0	70.4	35.0	144.0	218.0	40.0	200	600
5.	Calcium as Ca	mg/l	11.2	8.4	12.6	10.3	16.8	14.9	7.93	39.68	61.50	3.97	75	200
6.	Alkalinity as CaCO ₃	mg/l	45.6	31.65	47.47	31.1	60.2	52.2	31.65	130.4	221.5	36.92	200	600
7.	Chloride as Cl	mg/l	12.23	14.68	12.10	14.2	20.7	24.3	16.57	12.23	12.23	11.68	250	1000
8.	Magnesium as Mg	mg/l	5.8	4.6	6.43	4.7	9.7	8.1	3.69	10.91	15.66	7.03	30	100
9.	Total Dissolved Solids	mg/l	96.00	68.0	102.0	86.0	123.0	134.0	98.0	167.0	255.0	72.0	500	2000
10.	Sulphate as SO ₄	mg/l	5.41	2.82	3.8	1.85	8.65	12.06	5.43	2.93	4.56	8.04	200	400
11.	Fluoride as F	mg/l	0.36	0.07	0.54	0.36	0.23	0.29	0.11	0.16	0.22	0.21	1.0	1.5
12.	Nitrate as NO ₃ -N	mg/l	1.87	0.88	1.35	0.43	0.32	1.34	0.43	0.86	0.92	0.18	45	No Relaxation
13.	Iron as Fe	mg/l	0.26	0.58	0.33	0.19	0.15	0.23	0.33	0.42	0.24	0.14	1.0	No Relaxation
14.	Sodium as Na	mg/l	8.0	6.0	5.0	4.0	7.0	11.0	11.0	3.0	13.0	10.0	--	--
15.	Potassium as K	mg/l	1.0	1.0	1.0	1.0	3.0	6.0	1.0	BDL(DL 1.0)	2.0	2.0	--	--
16.	Conductivity	µS/cm	140.0	102.0	150.0	136.0	202.0	218.0	152.0	237.0	370.0	104.0	--	--

BDL - Below Detectable Limit, DL - Detection Level

Source - Ground Water Analysis Report, JM EnviroLab Pvt. Ltd.

Note: Ground water quality was also analyzed for Colour, Turbidity, Cyanide, Aluminium, Phenolic Compounds, Boron, Anionic Detergents as MBAS, Hexa Chromium, Chromium, Zinc, Copper, Manganese, Cadmium, Lead, Arsenic, Mercury, Phosphate, Nickel and Total Suspended Solid were found below detection limit.

3.15.4 INTERPRETATION OF GROUND WATER QUALITY RESULTS

The physico-chemical quality of groundwater was compared with drinking water standard (IS:10500-2012). The ground water/drinking water samples were collected from 10 locations, the ground water was found potable. All the groundwater samples showed less similar and good quality of water. Ranges observed for some of the ground water quality parameters are given as under:-

- The pH of collected water samples varied from 6.41 to 7.26 indicating slightly acidic to neutral conditions.
- Total hardness varied from 35.0 to 218.0 mg/l indicating that the groundwater varies from soft to moderately hard in nature.
- Total dissolved solids varied from 68.0 to 255.0 mg/l indicating low mineralization and good water quality.
- The concentrations of major ions and other physico-chemical parameters were found within acceptable limits. The water samples contain, Chloride varied from 11.68 to 24.3 mg/l, SO₄ varied from 1.85 to 12.06 mg/l, Ca varied from 3.97 to 61.5 mg/l, Fluoride varied from 0.07 to 0.54 mg/l, Magnesium varied from 3.69 to 15.66 mg/l, Alkalinity varied from 31.1 to 221.5 mg/l, Magnesium varied from 3.69 to 15.66 mg/l, Sulphate varied from 1.85 to 12.06 mg/l, Nitrate varied from 0.18 to 1.87 mg/l, Iron varied from 0.14 to 0.58 mg/l, Sodium varied from 3.0 to 13.0 mg/l, Potassium varied from 1.0 to 6.0 mg/l & Conductivity (102.0 to 370.0 µS/cm).

Thus can be conclude from the baseline sampling results for groundwater that all the samples, were observed to be in the permissible limits & complies to the drinking water standard (IS: 10500-2012).

Some of the parameters like Colour BDL (DL 1.0 Hazen), Turbidity (DL 1.0 NTU), Cyanide as CN (DL 0.02 mg/l), Aluminium as Al (DL 0.03 mg/l), Boron (DL 0.20 mg/l), Phenolic Compounds (DL 0.001 mg/l), Anionic Detergents as MBAS (DL 0.02 mg/l), Hexa Chromium as Cr+6 (DL 0.03 mg/l), Chromium as Cr (DL 0.002 mg/l), Zinc as Zn (DL 0.0005 mg/l), Copper as Cu (DL 0.02 mg/l), Manganese as Mn (DL 0.10 mg/l), Cadmium Cd (DL 0.002 mg/l), Lead as Pb (DL 0.008 mg/l), Arsenic as As (DL 0.002 mg/l), Mercury as Hg (DL 0.001 mg/l), Nickel as Ni (DL 0.005 mg/l), Phosphate (DL 0.02 mg/l) and Total suspended solids (DL 1.0) were also analyzed and not detected.

Overall, the groundwater quality in the study area of South Goa is generally good and suitable for domestic use after conventional treatment and disinfection. Most of the analyzed parameters were found to be within the permissible limits prescribed by Bureau of Indian Standards for drinking water quality.

3.16 SOIL ENVIRONMENT

3.16.1 SOIL QUALITY AND CHARACTERISTICS

The information on soil quality has been gathered by collecting data from various secondary sources and supplemented by collection and analysis of soil samples from representative locations.

In order to assess the baseline characteristics of soil profile of the area representing project and nearby areas, the samples were analyzed for key and chemical parameters.

The sampling locations were finalized with the following considerations:

- To enable information on baseline characteristics.
- To determine the impact of mining activities on soil characteristics.
- To determine the type of plantation.

Sampling Schedule

Representative soil samples were collected from 10 different specified locations within the study area of the proposed mine site. Standard operating procedures were followed for the sampling and analysis of physico-chemical parameters.

Sampling Locations

Details of locations of soil sampling along with the directions are given in Table - 3.21. Soil analysis results are given in Table - 3.23 and Standard Soil Classification is given in Table - 3.24.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 3.23
Soil Quality Analysis Results
Study Period: Summer Season (March to May, 2025)

S.N.	Parameter	Unit	Sampling Location									
			SGWS1	SGWS2	SGWS3	SGWS4	SGWS5	SGWS6	SGWS7	SGWS8	SGWS9	SGWS10
			Mine Site	Village Codli	Village Kirlapal	Village Karmane	Village Kajumal	Village Darbandora	Village Konsen	Village Panchavadi	Village Sanvardem	Village Dabal
1.	pH (at 25°C) (1:2.5 soil water sus.)	-	5.63	5.99	5.52	5.66	6.07	5.54	5.56	7.17	7.21	6.94
2.	Conductivity (1:2 soil water sus)	mS/cm	0.06	0.09	0.05	0.10	0.04	0.08	0.04	0.07	0.09	0.16
3.	Soil Texture	-	Clay	Sandy Loam	Clay	Clay	Sandy Loam	Silt Loam	Silt loam	Clay	Loamy Sand	Clay
a)	Sand	%	15.0	62.0	12.0	14.0	60.0	20.0	21.0	16.0	73.0	13
b)	Silt	%	21.0	32.0	30.0	22.0	33.0	74.0	74.0	18.0	17.0	21
c)	Clay	%	64.0	6.0	58.0	64.0	7.0	6.0	5.0	66.0	10.0	66
4.	Colour	-	Brown	Brown	Brown	Brown	Brown	Reddish Brown	Dull Yelloish Brown	Brown	Reddish Brown	Brown
5.	Bulk Density	gm/cc	1.22	1.57	1.26	1.19	1.57	1.43	1.45	1.18	1.63	1.36
6.	Porosity	%	51.97	37.70	49.60	52.59	37.45	43.25	42.46	52.80	36.33	45.60
7.	Water Holding Capacity	%	49.94	31.56	44.47	51.60	30.49	40.33	37.96	50.22	25.63	40.38
8.	Chloride	mg/kg	513.42	401.72	403.50	325.02	298.01	787.92	563.02	410.21	539.10	623.49
9.	Potassium	kg/hect	132.74	122.09	110.81	188.09	77.73	133.51	114.54	122.44	94.43	357.22
10.	Sodium	mg/kg	49.38	39.64	44.52	54.33	34.70	39.73	34.79	44.72	29.75	54.82
11.	Calcium	mg/kg	370.52	289.14	329.92	288.24	247.97	286.84	365.76	414.25	224.02	1038.65
12.	Magnesium as Mg	mg/kg	199.85	130.25	193.09	164.93	175.23	150.75	175.43	125.68	150.17	226.89
13.	Organic Matter	%	0.69	0.59	1.04	0.99	0.88	1.17	1.23	1.08	0.72	1.21
14.	Organic Carbon	%	0.40	0.34	0.60	0.57	0.51	0.68	0.71	0.63	0.42	0.78
15.	Available Nitrogen as N	kg/hect	231.22	208.57	219.91	246.81	210.55	255.54	261.35	218.91	187.08	316.15
16.	Available Phosphorus	kg/hect	9.03	10.43	14.11	12.97	9.22	17.23	13.04	33.48	14.85	26.80
17.	Zinc as Zn	mg/kg	44.12	34.83	29.03	49.95	43.47	44.77	26.69	58.68	35.33	36.82
18.	Manganese as Mn	mg/kg	1697.68	1151.32	785.10	1364.30	2617.65	1638.41	196.38	1702.74	2486.98	2117.25
19.	Lead as Pb	mg/kg	27.82	11.77	22.77	29.78	38.74	8.57	13.35	16.35	44.63	13.57
20.	Chromium as Cr	mg/kg	13.59	9.04	21.29	24.01	8.51	25.72	8.58	27.52	26.03	8.72
21.	Copper as Cu	mg/kg	39.32	28.06	31.93	35.54	32.13	40.01	40.04	74.07	33.47	15.50

Source: Soil Quality Analysis results from JM EnviroLab Pvt. Ltd.

Note: Soil quality was also analyzed for Cadmium which were found below detection limit (DL 5.0 mg/kg).

Table - 3.24
Standard Soil Classification

S.N.	Parameters	Classification
1.	pH	<4.5 extremely acidic 4.51 – 5.0 very strong acidic 5.01 – 5.5 strongly acidic 5.51 - 6.0 moderately acidic 6.1 – 6.5 slightly acidic 6.51-7.3 Neutral 7.31-7.8 slightly alkaline 7.81-8.5 moderately alkaline 8.51 – 9.0 strongly alkaline >9.0 Very strongly alkaline
2.	Salinity Electrical Conductivity (mho/cm)	Up to 1.0 average 1-2 harmful to germination 2-3 harmful to crops
3.	Nitrogen (kg/ha)	Up to 50 very less 51-100 less 110-150 good 151-300 better >300 sufficient
4.	Phosphorus (kg/ha)	Up to 15 very less 15 – 30 less 31-50 medium 51-65 on average sufficient 66-80 sufficient >80 more than sufficient
5.	Potassium (kg/ha)	0-120 very less 120-180 less 180-240 medium 241-300 average 301-360 better >360 more than sufficient

Source: Indian Agricultural Research Institute Handbook

3.16.2 INTERPRETATION OF SOIL QUALITY RESULTS

The soil samples exhibit brownish, reddish brown or dull yellowish brown which indicates good fertility and presence of organic matter in the soil samples. The organic matter (0.59% to 1.23%) and organic carbon (0.34% to 0.78%) present in the soil observed to be appropriate for the plant growth. The soil texture in the study area was found to be Clay, Sandy Loam, and Silty Loam. All soil samples have moderately acidic to neutral having pH ranging from 5.52 to 7.21 which is an optimal range for most of the plants to thrive and grow.

All the essential macronutrients and secondary nutrients were observed to be present in moderate to adequate amount than the other micro nutrient and macro nutrient such as Nitrogen (187.08 to 316.15 kg/ha), Phosphorous (9.03 to 33.48 kg/ha), Potassium (77.73 to 357.22 kg/ha), Magnesium (125.68 to 226.89 mg/kg), Calcium (224.02 to 1038.65 mg/kg). Less calcium values in the soil sample

is due to the presence of moderately acidic to neutral soil in nature within the area, thus would not affect the plant growth.

Overall, the soil quality within the study area is considered good and capable of supporting healthy vegetation due to the presence of adequate organic matter and essential nutrients. However, phosphorus levels were observed to be low to moderate in certain locations, indicating the need for phosphorus supplementation to enhance agricultural productivity and support effective greenbelt development in the area.

3.17 BIOLOGICAL ENVIRONMENT

3.17.1 SCOPE OF WORK

The scope of work for this study includes identifying ecologically sensitive receptors based on a literature review, conducting field investigations and mitigating them with a conservation action plan. The research was conducted in both the core and buffer zones of the ML Area. The study was conducted systematically and scientifically, utilising primary and secondary data to produce factual information on the ecological conditions of the mine site and 10 Km radius study area.

The study included an assessment of general habitat type, vegetation pattern and the preparation of an inventory of flora and fauna of terrestrial ecosystems within a 10 Km radius of the mine site's boundary. The site was biologically assessed to identify ecologically sensitive areas and whether there are any rare, endangered, endemic or threatened (RET) species of flora and fauna in the core area as well as its buffer zone that could be impacted. The study is also intended to recommend appropriate mitigation measures for the protection of wildlife habitats and the conservation of RET species, if any.

3.17.2 OBJECTIVES OF THE STUDY

The Biological study was undertaken with the following objectives:

- i. To understand the spectrum of domesticated and wild biodiversity of the study area.
- ii. To study the likely impact of the proposed project on the local biodiversity and to suggest mitigation measure, if required, for vulnerable biota.
- iii. To assess the nature and distribution of vegetation (Terrestrial and Aquatic) in and around the proposed project area.
- iv. Detail of flora and fauna, Endemic, Rare, Endangered and Threatened (RET Species) separately for core and buffer area based on such primary field survey and clearly indicating the Schedule of fauna present. In case of any Scheduled- I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished.
- v. To devise management & conservation measures for biodiversity.

There are no National Park, Biosphere Reserves, Tiger/Elephant Reserves, Wildlife Corridors etc. within the core zone. However, Bhagvan Mahavir Wildlife Sanctuary and Bondla Wildlife Sanctuary are present within the 10 Km study area.

S.N.	Name of the Sanctuary	Distance of WLS from Mine Boundary (In Km)	Distance Between ESZ and ML Boundary (In Km)	Direction of WLS from Centre of the Mine Lease
1	Bhagvan Mahavir Wildlife Sanctuary	~1.52	~0.52	SE
2	Bondla Wildlife Sanctuary	~6.5	~5.5	NNW

Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025. Copy of the same is enclosed as **Annexure VI.**

3.17.3 INVENTORY OF FLORA & FAUNA

Detailed biological study has been carried out for the project. Details of flora and fauna is given in Wildlife Conservation Plan.

3.17.3.1 ANALYSIS OF FLORA & FAUNA

A primary field survey was carried out within 10 km radius impact zone in and around the project area to study the floral and faunal diversity of the terrestrial and aquatic environment of the study area.

FLORAL DIVERSITY:

The study area exhibits a rich diversity of flora, including Trees, Shrubs, Herbs, Grasses and Climber. The presence of various tree species from families like Fabaceae, Anacardiaceae, Moraceae, Meliaceae and others contributes to the ecological complexity. Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026, there are 114 floral species were recorded within the 10 km radius study area. These include 75 Tree species, 15 Shrub species, 16 Herb species, 6 Grass species and 2 Climber species.

FAUNAL DIVERSITY:

Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026, these species include 18 of Species Mammals, 60 Species of Birds, 08 Species of Reptiles, 4 Species of Amphibians, 8 Species of Butterflies and 03 Aquatic Species. Also, based on the secondary information including Management Plan of Bhagwan-Mahavir NP & WLS, there are Tiger (*Panthera tigris*), Gaur (*Bos gaurus*) etc. present within the WLS area.

There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur / Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet Macaque), *Melursus*

ursinus (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site.

Wildlife Conservation Plan for protection of all the schedule - I species has been prepared and submitted to DCF for authentication on dated 10.08.2026. Copy of WLCP and Biological Study Report are enclosed as **Annexure XIV** and **Annexure XV**.

3.18 SOCIO-ECONOMIC ENVIRONMENT

3.18.1 INTRODUCTION

An essential part of environmental study is socio-economic environment incorporating various facts related to socio-economic conditions in the area, which deals with the total environment. The Socio-economic study includes:

- Demographic structure of the area,
- Provision of basic amenities viz., housing, education, health and medical services, occupation, water supply, sanitation, communication, transportation, prevailing diseases pattern,
- As well as feature of aesthetic significance such as temples, historical monuments etc. at the baseline level.

This baseline assessment helps in visualizing and predicting the possible impact depending upon the nature and magnitude of the project.

Socio-economic study of an area provides a good opportunity to assess the socio-economic conditions of an area. This study may possibly facilitate a change in living and social standards of the area around the project. It can undoubtedly be said that this mine will provide some direct and indirect employment and facilitate in improving the infrastructural facilities and standards of living of the area.

The fabrics of socio-economic changes are so complicated that this study would seem to be extremely limited, almost superficial and at times subjective in nature.

3.18.2 OBJECTIVES OF THE STUDY

The objectives of this socio-economic report consist of:

- To conduct socio-economic assessment study in mine area.
- To know the current socio-economic situation in the region to cover the sub sectors of education, health, sanitation, and water and food security.
- To recommend practical strategic interventions in the sector.
- To help in providing better living standards.
- To provide employment opportunities.

3.18.3 SCOPE OF WORK

To study the socio-economic environment of the 10 km study area.

- To study the Socio-economic Environment of area from the secondary sources
- Data collection during primary field survey and collate it with the secondary sources
- Identification of possible impacts from the proposed project
- Prediction of probable impact due to proposed project
- Mitigation measures
- Action plan for the implementation of mitigation measures

3.18.4 METHODOLOGY

∞ Collection of Data

Data for this project was collected from primary sources like Field survey, Interviews of locals and secondary sources like Government department, Maps, Literature research etc. during field survey. JMEPL conducted the socio-economic baseline survey using a survey team of Field Assistants and a Supervisor apprising them about the project area and relevant documents.

∞ Sample selection techniques

The Survey was conducted using Simple Random Sampling method with a well-structured questionnaire prepared enabling subjects to reply appropriately. The questionnaires were designed to suit the subjects considering their rural background enabling them to furnish correct information and data to the extent possible. Primary data has been collected at Village level, household level by questionnaires and focused group discussions. The study area for the field survey has been divided into three major segments namely Primary Zone (0 - 3 km), Secondary Zone (3 - 7 km) and Outer Zone (7 - 10 km).

∞ Sample size selection

Sample size refers to a number of factors including the purposed of study

$$n = \frac{n_0 \times N}{n_0 + (N - 1)}$$

Here,

n = Sample size of known population

n₀ = proportion of unknown population

N = Known population size

∞ Presentation of data & analysis

The data collected were presented in a suitable, concise form for further analysis. The collected data were presented in the form of tabular or diagrammatic or graphic form. These tabulated data were interpreted and analyzed with the help of various qualitative techniques and ideographic approaches.

3.18.5 BACKGROUND INFORMATION OF THE AREA

Goa attained statehood on May 30, 1987. Goa was included as twenty-fifth state of India. Goa state has two districts namely North Goa, which is headquartered at Panaji and South Goa, which is headquartered at Margao. South Goa District covers the entire southern part of Goa state. Arabian Sea is to the west of district, North Goa district to the North and Uttar Kannada district of Karnataka in the East and South. South Goa is situated between the latitudinal parallels of 15°29'32" N and 14°53'57"N and longitudinal parallels of 73°46'21" E and 74°20'11"E. From north to south and from east to west the district spans a distance of 86 km and 40 km respectively. The total geographical area of the district is 1966 square km.

Goa has hot climate as it lies within the tropics. There is no much change in climate throughout the year. Daily temperature range is not very high. Goa gets rains in the months June, July, August and September (monsoon season). The rainfall is more in the mountain region than the coastal region. Goa gets heavy rain from South-West monsoon winds. Goa has cool climate during the months October-January. It starts getting warmer from February and it remains till May.

South Goa district includes the following talukas: Sanguem, Dharbandora, Salcete, Quepem, Canacona, and Mormugao.

Goa is connected by rail route through Konkan Railway and Southern Railway from Delhi. Also, it is well connected by air routes from Bombay and Delhi. Goa has an international airport at Dabolim. The distance from Margao to Dabolim airport is 29 kms.

The Codli region in Dharbandora, South Goa, follows a predominantly rain-fed cropping pattern shaped by lateritic soils and monsoon-dependent agriculture. Kharif paddy is the principal crop, cultivated in low-lying fields during June to September. On upland terrain, farmers grow cashew, coconut, arecanut, and increasingly horticultural crops like mango, banana, and jackfruit. Post-harvest, much of the land remains fallow due to limited irrigation and poor water retention. The area reflects a mixed land-use system, combining subsistence farming with plantation-based cash crops, aligned with agro-climatic conditions and local livelihood practices.

Rice is the most important crop in Goa. Due to warm humid climate rice is mainly grown here and it is grown in the coastal region. After rainy season, rice, chilies, onions crops are grown in Goa. Cash crops are also grown in Goa. Mainly plantation of Cashew, Coconut, Mangoes, Areca palm, Kokum and Jack fruit is done in Goa. Details about types of crops and climate is given in below table 3.25: -

Table 3.25
Types of crops and climate

S.N.	Parameters		Description
1.	Climate	Rainfall	In the months of June, July, August, September
2.	Crops	Kharif crop	Rice, ragi (locally called nachani),
		Rabi crops	Rice, horse-gram (kulith), black gram (udid)
		Cash crops	Coconut, cashew-nut, arecanut, mango, jackfruit, banana, pineapple

Source - <https://southgoa.nic.in/about-district/>

<https://www.mapsofindia.com/maps/goa/goaagriculture.htm>

A detailed socio-economic survey was conducted in the study area (buffer zone) within 10 km radius of proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha Villages - Codli, Taluka - Dharbandora, District: South Goa (Goa) in order to identify the impact of the proposed mining project on nature and inhabitant. To get an overview of the villagers and their perspectives about the proposed mine, different demographic parameters and social aspects such as population density, sex ratio, literacy rate, worker ratio etc. has been identified, analyzed, studied together. These impacts may be beneficial or detrimental. If detrimental, anticipated suggestions/measures are advocated in order to have collective development.

3.18.6 DEMOGRAPHIC PROFILE

The proposed project is located in the Taluka - Dharbandhora in the state of Goa. The details about demography of State, District and study area are given as follows:

Table 3.26
Demographic Profile of Goa State, South Goa District & Study Area

S.N.	Particular	India	Goa	South Goa	Study Area
1.	Area (sq. km.)	3,287,263	3,702	1966	401.64
2.	No. Of households	24,94,54,252	341617	151003	23611
3.	Total Population	1,21,05,69,573	1,458,545	640537	101136
4.	Sex Ratio	943	973	986	986
5.	Schedule Caste	201378086	25449	7843	1334
6.	Schedule Tribe	104281034	149275	92669	13858
7.	Literacy Rate (%)	63.06	88.7	87.89	86.23
8.	Male Literacy (%)	69.7	92.65	91.67	91.49
9.	Female Literacy (%)	73.9	84.66	83.47	78.77
10.	Working Population (%)	39.7	39.58	38.97	30.23
11.	Non-working Population (%)	60.2	60.42	61.03	69.77

Source: Census of India, 2011, India - Census of India 2001 - Goa - Series 31 - District Census Handbook, Part XII - A & B - South Goa

3.18.7 BASELINE DATA AND ANALYSIS

The socio-economic study has been conducted on the basis of questionnaires prepared including demographic, educational, medical & health, occupational, agriculture & cropping pattern, basic amenities and religious rituals details. The primary study was conducted within 10 km radius study area from the mine site. The study area was categorized on the basis of the distance of the village from mine site. First zone was identified from 0-3 km radius area, Second zone in 3-7 km; outer zone 7-10 km radius area from the mine site.

Information was collected from Gram Panchayat, Doctors, Aanganwadi karyakarta, school teachers and other recognized persons of the area. To ensure the accuracy of the primary data collected study area, information collected from all villages was cross checked from census 2011 of Goa

(South and North Goa) and information collected from various government departments like health department, agriculture department, IMD etc.

Baseline data are collected and prepared by conducting a survey by Team Members. Villages falling from the Core Zone (mine site) to 3 km, secondary zone of the villages falling 3 to 7 km, and outer zone 7-10 km of buffer zone.

Total 36 Villages and Towns have been included in buffer zone for this project and keeping in view the socio-economic condition of the project area has been analyzed. Secondary data has been used from census and Voluntary organisations.

To understand the socio-demographic profile of the 10 km study area, village wise distribution has been done based on the below given determinants:

1. Number of Household
2. Number and type of Population
3. Sex Ratio
4. Literacy rate
5. Number and type of workers and Non- workers.

3.18.8 DEMOGRAPHIC PROFILE OF THE STUDY AREA

Study area (buffer zone) is the area within 10 km radius of the mine site. It covers 36 Villages. The total population as per census 2011 is (for 10 km radius buffer zone) 101136.

Total 1267 household within the primary zone, 4817 and 17527 within secondary zone and within outer zone were determined respectively. Sex ratio within primary zone was found 949 (females per 1000 males), 986 & 989 were observed within secondary zone and outer zone respectively.

The Village - wise demographic features of the study area as per area classification are given in Table 3.25 below:

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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3.18.9 DEMOGRAPHY OF THE STUDY AREA

Table - 3.27
Demographic Profile of the Study Area

S.No.	Village Name	No of House Holds	Total Population	Total Population male	Total Population female	Sex Ratio	Population SC	Population ST	Total literacy Rate	Male literacy Rate	Female literacy Rate	Total workers	Main workers	Marginal workers	Non-workers
Primary Zone (0-3Km)															
1.	Cormonem	152	645	358	287	802	0	282	75.11	79.00	71.55	238	213	25	407
2.	Bandoli	231	1060	512	548	1070	14	546	85.61	91.51	79.34	453	277	176	607
3.	Codli	884	3801	1955	1846	944	55	628	85.77	89.52	80.97	1533	1191	342	2268
Total		1267	5506	2825	2681	949	69	1456	83.68	89.10	77.95	2224	1681	543	3282
Secondary Zone (3-7 Km)															
4.	Santona	343	1403	739	664	899	5	29	82.19	86.86	76.79	577	491	86	826
5.	Camarconda	173	793	395	398	1008	0	553	80.19	87.36	73.00	309	158	151	484
6.	Moissal	2	8	5	3	600	0	3	100.00	100.00	100.00	4	4	0	4
7.	Antoriem	Un- inhabited													
8.	Darbandora	672	2991	1493	1498	1003	6	1689	83.49	91.10	75.92	1279	977	302	1712
9.	Rumbrem	131	646	300	346	1153	11	7	80.94	86.72	76.00	283	132	151	363
10.	Ponchavadi	931	4295	2140	2155	1007	3	882	86.42	92.14	80.91	1568	1255	313	2727
11.	Piliem	944	4058	2097	1961	935	92	446	83.14	88.72	77.09	1729	1345	384	2329
12.	Calem	574	2683	1316	1367	1039	42	568	84.93	91.64	78.50	911	754	157	1772
13.	Sigao	405	1724	879	845	961	0	192	82.95	89.10	76.56	783	489	294	941
14.	Sangod	236	1083	557	526	944	8	134	84.89	89.39	80.13	418	328	90	665
15.	Nirancal	406	1772	880	892	1014	0	278	83.63	90.39	76.97	640	1132	488	152
Total		4817	21456	10801	10655	986	167	4781	83.96	90.07	77.79	8501	6421	2080	12955
Outer Zone (7-10 Km)															
16.	Comproi	150	620	301	319	1060	0	3	86.40	95.96	77.55	226	203	23	394
17.	Conxem	39	186	94	92	979	0	0	84.57	91.67	76.92	75	55	20	111

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Chapter 3 of Draft EIA/EMP Report

S.No.	Village Name	No of House Holds	Total Population	Total Population male	Total Population female	Sex Ratio	Population SC	Population ST	Total literacy Rate	Male literacy Rate	Female literacy Rate	Total workers	Main workers	Marginal workers	Non-workers
18.	Costi	196	881	503	378	751	0	1	84.19	92.31	73.39	394	364	30	487
19.	Muguli	119	508	225	283	1258	0	334	81.13	91.35	72.73	249	125	124	259
20.	Dudal	97	446	229	217	948	0	155	75.38	83.66	66.84	226	108	118	220
21.	Coranginim	9	32	14	18	1286	0	0	90.00	100.00	81.25	11	8	3	21
22.	Xic-Xelvona	28	125	67	58	866	0	0	93.91	98.36	88.89	46	41	5	79
23.	Xelvona	418	1725	870	855	983	0	0	91.99	96.03	87.93	658	384	274	1067
24.	Odar	143	569	284	285	1004	9	25	90.51	93.87	87.22	207	180	27	362
25.	Molem	383	1715	883	832	942	2	45	81.55	86.82	75.90	681	407	274	1034
26.	Colem	995	4195	2092	2103	1005	86	106	86.03	91.28	80.85	1695	1016	679	2500
27.	Sancordem	273	1233	624	609	976	15	95	86.41	90.77	81.75	514	439	75	719
28.	Macasana	503	1972	880	1092	1241	0	0	90.14	94.26	86.90	487	436	51	1485
29.	Curchorem-Cacora (M CI)	5667	22730	11601	11129	959	338	1362	88.85	92.57	84.97	9133	7645	1488	13597
30.	Sanvordem (CT)	1187	5103	2552	2551	1000	141	48	86.01	90.86	81.18	2143	1872	271	2960
31.	Aglote	247	1109	566	543	959	0	301	84.92	91.86	78.65	812	650	162	960
32.	Siroda	3197	14041	6886	7155	1039	297	2895	87.72	93.58	82.16	5372	4264	1108	8669
33.	Curchirem	435	2043	1033	1010	978	0	0	76.00	83.98	67.96	822	423	399	1221
34.	Codar	3197	14041	6886	7155	1039	82	169	80.48	87.57	73.27	302	226	76	431
35.	Usgao (CT)	2867	12436	6370	6066	952	118	2075	87.13	91.92	82.05	4970	4197	773	7466
36.	Surla	247	1109	566	543	959	10	7	82.76	91.44	73.85	475	634	354	121
Sub-Total		17527	74174	37298	36876	989	745	6164	87.08	92.08	82.03	19851	15313	4538	54323
Total		23611	101136	50924	50212	986	981	12401	86.23	91.49	80.92	30576	23415	7161	70560

Source: Census of India, 2011

3.18.10 SOCIO-ECONOMIC SURVEY PHOTOGRAPHS



Socio-economic survey at Dabal Village



Socio-economic survey at Darbandora Village



Socio-economic survey at Kale Village



Socio-economic survey at Sangod Village



Socio-economic survey at Konsen Village

Photographs of Primary data collection through random sampling in the study area

3.18.11 POPULATION DISTRIBUTION OF THE STUDY AREA

The population as per 2011 Census records is 101136 (for 10 km radius buffer zone). Table – 26 shows demographic profile of study area that total number of households is 23611. Out of which 1267 household are within the primary zone, 4817 and 17527 within secondary zone and outer zone were determined respectively. SC population distribution is 69, 167 and 1098 respectively in primary, secondary and outer zone. ST population distribution is 1456, 4781 and 7621 respectively in primary, secondary and outer zone respectively. Demographic profile of study area is given in the table below:

Table – 3.28
Summary of Demographic Profile of Study Area

Study Area Zone	No. of Villages	No. of households	Total Population	SC Population	ST Population	Total Literate Population	Workers	Non-Worker
Primary Zone (0 - 3 km)	3	1267	5506	69	1456	4122	2224	3282
Secondary Zone (3 - 7 km)	12	4817	21456	167	4781	16064	8501	12955
Outer Zone (7 - 10 km)	21	17527	74174	1098	7621	57942	20365	53809
Total	36	23611	101136	1334	13858	78128	31090	70046

Source: Census of India, 2011

Population Distribution of the surveyed Villages

On the basis of data shows that the total population of 36 villages is and comprises of households. The population distribution varies from place to place. Outer zone consists of highest population with no. of population in which male and female population is 37298 and 36876 respectively. Zone wise demographic profile of the study area is given below in Table -3.29.

Table – 3.29
Zone Wise Demographical Profile of Study Area

Zone	No. of villages	No. of households	Total Population	Total Male Population	Total Female Population
Primary Zone (0 - 3 km)	3	1267	5506	2825	2681
Secondary Zone (3 - 7 km)	12	4817	21456	10801	10655
Outer Zone (7 - 10 km)	21	17527	74174	37298	36876
Total	36	23611	101136	50924	50212

Source: Census of India, 2011

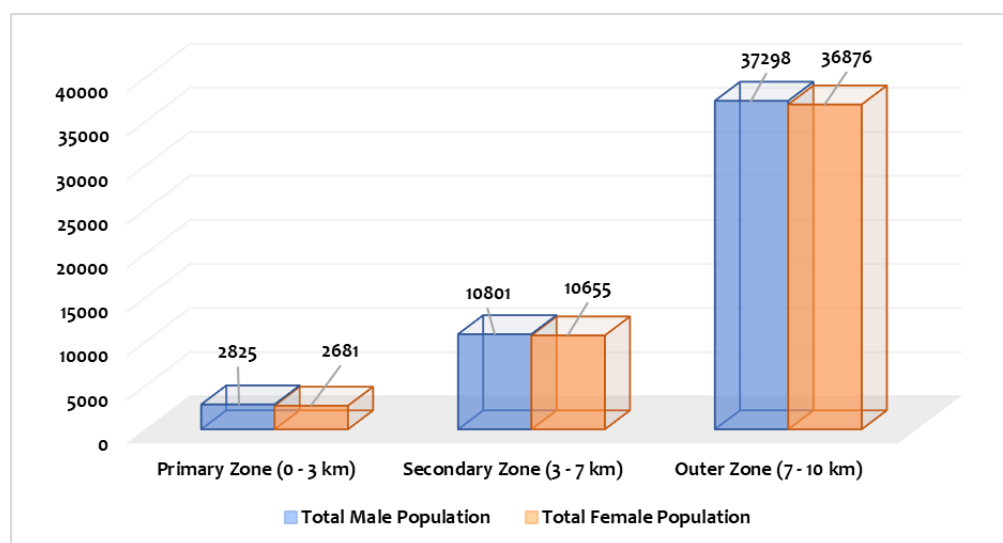


Figure 3.15 Zone-wise Population Distribution of the Study Area

3.18.12 GENDER & SEX RATIO

Gender and sex ratio determine the Human Development Index (HDI) of an area thereby understanding the status of women in that region. Census data suggests that the study area is composed of 50.35 % of male population while 49.65 % of female population. Following table entails information about sex ratio of 36 Villages and one town lying in study area (buffer zone) as primary, secondary and outer zone.

Table – 3.30
Sex Ratio in Study Area

S.N.	Zone	Sex Ratio
1	Primary Zone (0-3 km)	949
2	Secondary zone (3-7 km)	986
3	Outer Zone (7-10 km)	989
Study Area (0-10 km)		986

Source: Census of India, 2011

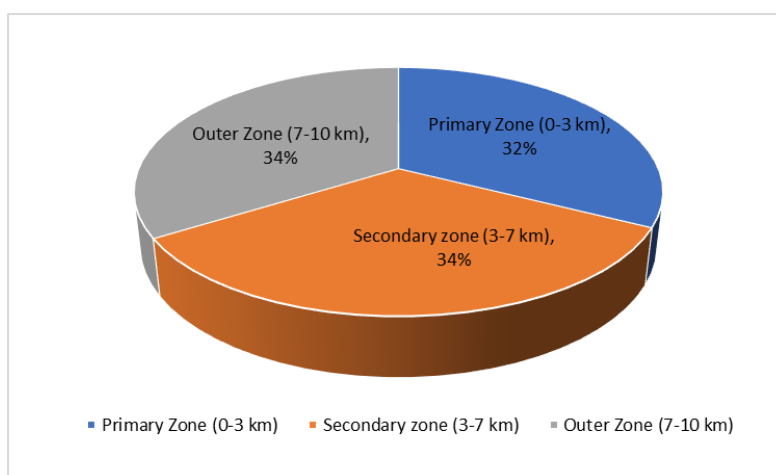


Figure 3.16 Sex ratio in the Study Area

- Table gives brief insight about the sex ratio at different zones in the study area.
- Currently it is 986 females per 1000 male reflecting that due to continuous awareness on considering both genders as equal and boon for family's growth and development, improving basic health infrastructure for women, empowering girl child and realizing the importance of women in society these figures have led to prosperous growth.
- Despite continuing social welfare schemes and awareness programs run by the government, this variation has been referred to restricted sources of earning. Since families in these Villages are mostly involve at working as main workers and men are preferred more over women.

3.18.13 CHILD SEX RATIO

In India, Child sex ratio is defined as number of females born per 1000 males in age group 0 – 6 years in a human population. Field survey suggests that on an average each household has 2 to 3 children of which boys are more than girls, thus showing higher sex ratio in 0-3 km primary zone and in

secondary and outer zone it is found comparatively lesser. Below graph gives a comparative view of child sex ratio (below 6 years) in study area.

Table – 3.31

Child Sex Ratio in the Study Area

S.N.	Zone	Child Sex Ratio
1	Primary Zone (0-3 km)	973
2	Secondary zone (3-7 km)	963
3	Outer Zone (7-10 km)	952
Study Area (0-10 km)		956

Source: Census of India, 2011

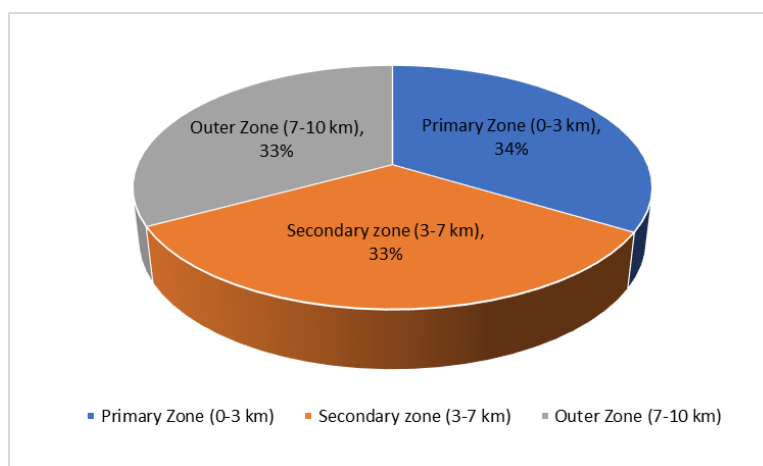


Figure 3.17 Child Sex ratio in the Study Area

3.18.14 VULNERABLE GROUP

While developing an action plan, it is very important to identify the population who fall under the marginalized and vulnerable groups and special attention has to be given on towards these groups while making action plans. Special provisions should be made for them. On the bases of data, it has been observed that the study area comprises total 36 Villages in which total no. of Schedule Caste population is 1334 and total no. of Schedule Tribe population is 13858.

It clearly shows in below table 3.30 that ST population is dominant than SC Population in the study area.

Table 3.32

Population of Vulnerable Groups in the Study Area

Zone	No. of Villages	Total Population	SC Population	ST Population
Primary Zone (0 - 3 km)	3	5506	69	1456
Secondary Zone (3 - 7 km)	12	21456	167	4781
Outer Zone (7 - 10 km)	21	74174	1098	7621
Total	36	101136	1334	13858

Source: Census of India, 2011

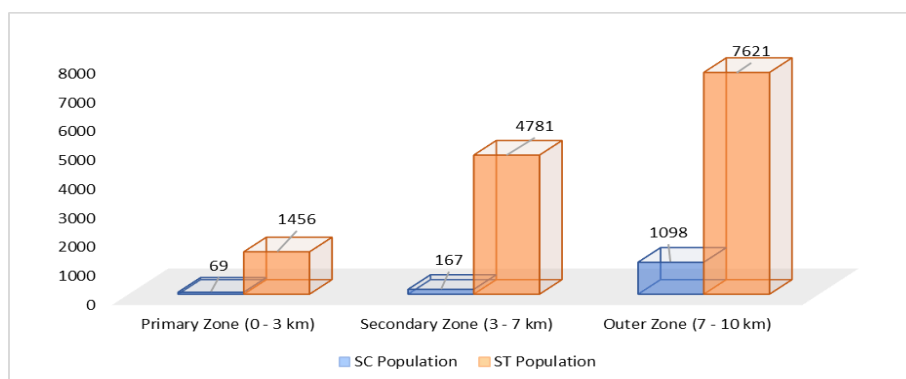


Figure 3.18 SC / ST Population within 10 km Study Area

3.18.15 LITERACY RATE AND OCCUPATION PATTERN OF VILLAGES LITERACY RATE

Literacy Rate is the number of people in a place with the ability to read and write.

The analysis of literacy levels has been done in the study area. As per the 2011 Census of India, the highest male literacy rate, i.e., 92.08 is in the outer zone. Whereas the highest female literacy rate is also in outer zone with a percentage of 79.09.

This indicates that there is a need for sociological development in the region. The distribution of literates and literacy rates in the surveyed villages is given below:

In the present study, the literacy rate is quite moderate in the study area. Male and Female literacy rate of villages are varying from place to place. Although Female literacy rate in the region is coming out low as compared to male.

Table 3.33
Literacy Level of the Study Area

Zone	Male Literacy Rate (%)	Female Literacy Rate (%)	Total Literacy Rate (%)
Primary Zone (0 - 3 km)	89.10	77.95	83.68
Secondary Zone (3 - 7 km)	90.07	77.79	83.96
Outer Zone (7 - 10 km)	92.08	79.09	87.08

Source: Census of India, 2011

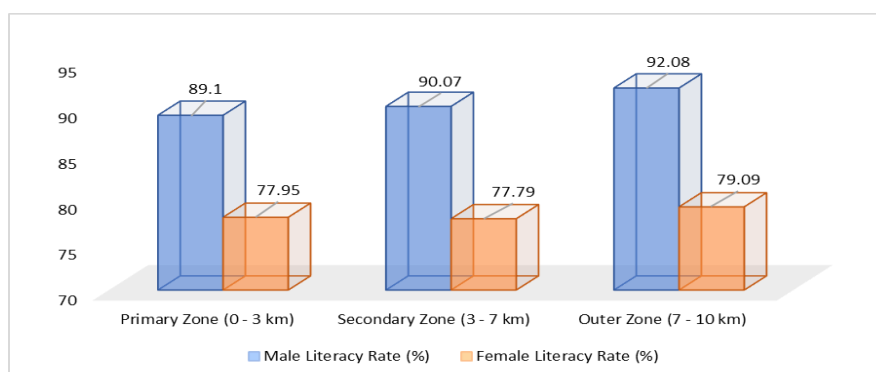


Figure 3.19 Literacy Rate in the Study Area

This above figure 3.19 shows the gap in the literacy rate of male and female. It is very important for development of any society to increase the literacy level among the people as well as wipe out the gap between male and female.

3.18.16 ECONOMIC ACTIVITIES

The economy of an area is defined by the occupational pattern and income level of the people in the area. The occupational structure of residents in the study area is studied with reference to work category. The population has divided occupation wise into three categories, viz., main workers, marginal workers and non-workers. The workers include cultivators, agricultural laborers, those engaged in household industry and other services.

The marginal workers are those workers engaged in some work for a period of less than 180 days during the reference year. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc. besides institutional inmates or all other non-workers who do not fall under the above categories.

In the study area, manufacturing commodities are country liquor, iron ore, sugar, cashew feni, cane furniture, papad, optical frame, mineral water, pickle etc. Agricultural commodities are coconuts, cashew, sugarcane, rice, banana, pineapple, arecanuts etc. and in handicrafts commodities are jute bags, candles, jewellery etc.

Table 3.34
Work Force of the Villages

Zone	Total Population	Main worker	Marginal Worker	Total Worker	Non-Worker
Primary Zone (0 - 3 km)	5506	1681	543	2224	3282
Secondary Zone (3 - 7 km)	21456	6421	2080	8501	12955
Outer Zone (7 - 10 km)	74174	23397	6101	29498	44676
Total	101136	31499	8724	40223	60913

Source: Census of India, 2011

The above Table - 3.32 shows that the total working population which includes (main workers, marginal workers and total workers) and non-working population respectively in the study area.

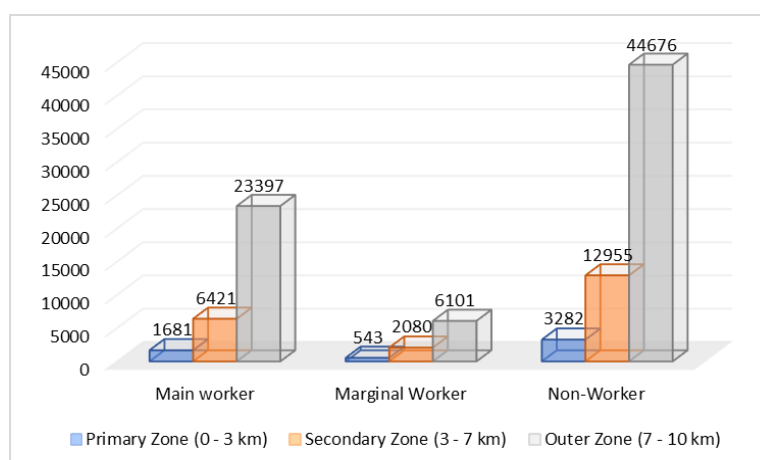


Figure 3.20 Work Force of the Study Area

As per the villages analysis most of them are working population. A major portion of working age people needs to be provided skill-based training so that they can be provided with employment opportunities in the nearby industries.

3.18.17 BASIC AMENITIES

A better network of physical infrastructure facilities (well-built roads, rail links, irrigation, power and telecommunication, information technology, market-network and social infrastructure support, viz. health and education, water and sanitation, veterinary services and co-operatives) is essential for the development of the rural economy.

A review of infrastructure facilities available in the area has been done based on the information from baseline survey of the study area. Infrastructure facilities available in the area have been described in the subsequent sections as below:

✎ Educational Facilities

Education is considered to be one of the most dominant indicators towards the development of a region. According to baseline survey, education facilities are available in the Villages within the study area. Many villages like Codli, Cormonem, Bandoli, Santona, Camarconda, Sangod, Costi, Darbandora, Surla, Ponchavadi, Siroda and Curchorem- Cacora etc. are having Government and private primary school facility.

✎ Health Facilities

Medical facilities are available. In some Village's primary health center and social health centers are available. Maternity and child welfare facilities are available in the 2 Villages. Also, very few Villages are having facilities of dispensary, veterinary and TB health clinic.

✎ Transport and Road Infrastructure Facilities

Villages have fare road connectivity and Private bus operators operate transport service in the Villages. Road condition of the villages is fairly good and the area. As per the survey, in some Villages, there are proper roads with the bus stops available for the people convenience.

✎ Electricity

Villages surveyed in the study area were electrified. Electricity is available for the various domestic, non-domestic, industrial, agricultural and public lighting purposes. But being a rural area, the electric supply is discontinuous.

✎ Sanitation

There are only few public facilities such as common toilets etc. Out of the total 23611 households, most households have proper toilet facility.

✎ Other Infrastructure Facilities

In the study area, other infrastructure facilities mainly for the communication like post offices, Radio stations, telephonic network connections, Television cable connections and other such as motels, Anganwadi Centers are also limited to only few of the Villages.

✎ Inference of the Socio-economic Study

The Socio-Economic study provides a clear picture of demographic as well as economic attributes such as population, average household size, working, non-working population, literacy rate, sex ratio, occupation etc.

As far as the literacy rate is concerned, the study area has an average level as the literacy rate of people is growing.

3.18.18 EDUCATION

- Household survey on prevailing educational conditions in these Villages highlights that study area performs very well, at only Pre- Primary and Primary schools for both genders.
- Provision to free books, uniform and food (mid-day meal) as per Government welfare benefits for students are provided in this primary school however, ratio of teachers to student is not satisfactory.
- Literacy rate of the study area also reveals that male literacy rate is higher than that of female literacy rate. This is due to less availability of schools in the Villages.
- Middle and secondary schools are located mainly in some of villages and towns.
- Facilities provided by Government in kind - such as mid-day meal arrangements are already in practice however still face severe problems of mismanagement and corruption among the organizers.
- These area needs large attention from policy making communities in order to improve prevailing educational facilities and to provide such facilities for young generation living in Villages so that children can get right to education.
- As per census data there are no Government Degree college and other Vocational Institutions in the study area villages.
- This area still has sectors seeking attention from policy making communities in order to improve prevailing issues regarding employment, education, human development, gender equality.

Table - 3.35
Educational Institutes in the Study Area

S.N.	Zone	Primary School	Middle School	Secondary School
1	Primary Zone (0-3 KM)	10	0	0
2	Secondary Zone (3-7 KM)	41	3	3
3	Outer Zone (7-10 KM)	84	2	2
Total		135	5	5

Source: Census of India, 2011

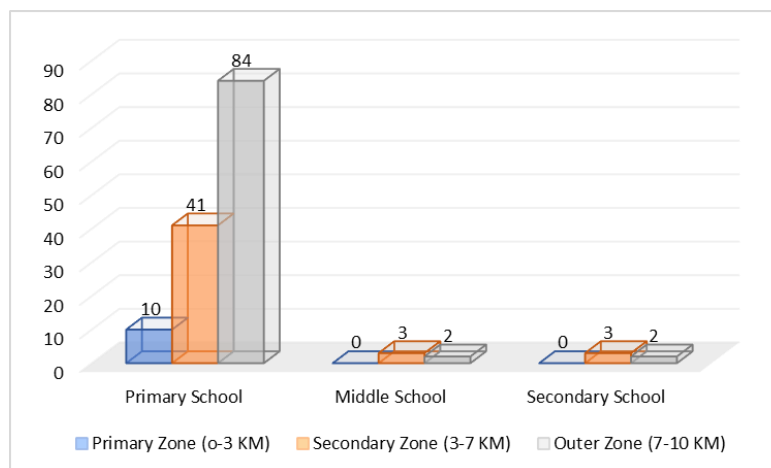


Figure: 3.21 Education facilities in the Study Area

3.18.19 HEALTH FACILITIES

Health is a premier asset of human capital which is an important factor for growth of any economy. It is a source of human welfare. Health and nutrition play a major role for developing a healthy society as it impacts the productivity of a person.

The healthcare facilities in the study area consisted of Primary Health Centre, Primary Health Sub-Centre's; Maternity and Child Welfare Centre; Dispensaries and TB Clinic, Veterinary hospitals, non-government medical facilities Medicine shops, Sub-Centres and Primary Health Centres. As per the data of 10 km radius study area collected from Census India Handbook 2011, medical facilities are needed to be improved by the Government as satisfactory facilities are not available for any medical emergencies. Patients have to move to Cities for any serious illness.

Table - 3.36
Health Facilities in the Study Area

Primary Health Centre	Primary Health Sub Centre	Maternity and Child Welfare Centre	TB Clinic	Dispensaries	Veterinary hospitals	Mobile Health Clinic	Community Health Centre	Family Welfare Centre
2	13	2	2	3	2	0	0	14

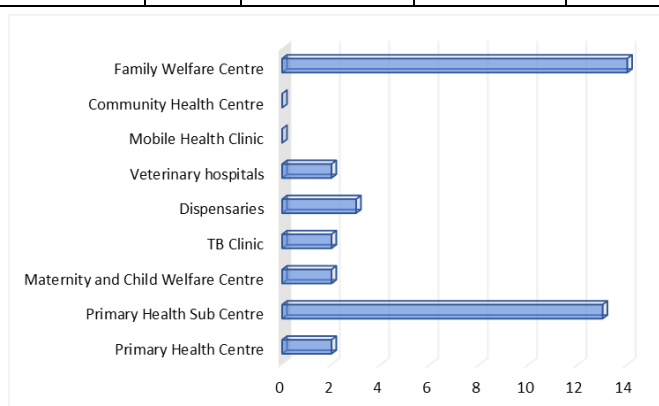


Figure 3.22 Health facilities in the Study Area

3.19 CONCLUSION

The baseline environmental monitoring conducted within the 10 km radius study area establishes a robust foundation for assessing the proposed Codli Mineral Block's potential impacts. The physico-chemical parameters of the ambient air, surface water, groundwater, and soil are predominantly within prescribed national standards, indicating a moderately undisturbed environment. However, the ecological assessment highlights the presence of highly sensitive receptors, notably the Bhagvan Mahavir Wildlife Sanctuary and several Schedule I faunal species, which require stringent, site-specific conservation strategies. Furthermore, the socio-economic baseline reveals a clear need for community development interventions, particularly regarding female literacy and localized employment generation. Ultimately, this comprehensive baseline data will inform the predictive modeling and impact evaluations in Chapter 4, ensuring that the resulting Environmental Management Plan (EMP) is rigorously tailored to safeguard the region's physical, biological and social fabrics. Collection of the primary data is under process, once the primary data collected; details regarding the socio economic will be updated.



CHAPTER - 4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 INTRODUCTION

The analysis of environmental impacts and their mitigation measures helps/results in improving environmental design of the proposal. It also ensures, that the resources are used efficiently and identifying appropriate measures for mitigating the potential impacts of the project.

Excavated Iron Ore will be loaded by hydraulic excavators (capacity: 4.0 m³ & 2.9 m³) into the dumpers for onward dispatch to the Crushers (Primary Crusher: 250 TPH and 90 TPH & Secondary Crusher: 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant proposed to be installed within the lease area. Iron Ore will be transported from mine face to crusher by 20 m³ capacity Dumper via haul road. All the Fines generated from the crushing will be loaded by loader of 2.5 m³ capacity & transported through dumpers or wheel loaders capacity of 20 m³ or 2.5 m³ and after that transported through tippers of 11.5 Tonnes via road to railway sidings and jetties end users via Rail and Sea.

The anticipated environmental impacts of this project would be mainly due to the construction and operational activities. The construction work and operation of beneficiation plant are likely to affect, significantly, the surrounding environment to varying degrees.

The operations may disturb environment of the area in various ways such as removal of mass, change

of landscape, flora and fauna of the area, surface drainage and change in air, water and soil quality & noise level mostly localized to the mine area. While for purpose of development and economic upliftment of people, there is need for establishment of mining industries, because the area is rich in mineral resources, but these should be environment friendly.

Prediction of impacts is the most important component in the Environment Impact Assessment studies. Therefore, it is essential to assess the Impact of mining on different environmental and socioeconomic parameters for all mining operations so that abatement measures could be planned in advance for minimizing the impacts wherever feasible.

The likely impacts on different environmental parameters due to the mine site location, possible accidents, mine design, development, operations & final closure of this mining project are discussed below:

4.2 METHODOLOGY OF IMPACT ASSESSMENT

The impact assessment has been undertaken following a systematic process that identifies, predicts and evaluates the impacts of the project on the physical, biological, social/ socio-economic and cultural environment, and identifies measures that the project will take to avoid, minimize /reduce, mitigate, offset or compensate for the adverse impacts; and to enhance positive impacts where practicable. The stages of the impact assessment process comprise of the following:

- **Impact identification:** To identify the potential impact of the project on the various environmental parameters.
- **Impact prediction:** To determine what could potentially happen to resources/receptors as a consequence of the project and its associated activities.
- **Impact evaluation:** To evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence and the sensitivity, value and/or importance of the affected resources/ receptors.
- **Impact mitigation:** To identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.

4.3 BASIS OF IMPACT ASSESSMENT

The impact of this proposed project would be assessed on the basis of their characteristics i.e., nature, type, extent, duration, intensity & frequency and its significance.

Characteristics of Impacts

The impact is described in terms of its characteristics such as nature, type, etc. Impact characteristics are given in Table - 4.1.

Table - 4.1
Impact Characteristics

Characteristic	Classification	Description
Nature	Positive impact	When impact is considered to represent improvement to baseline or introduce a new positive factor/change.
	Negative impact	When impact is considered to represent adverse change from the baseline or introduce a new undesirable factor/change.
	Neutral	When there is no impact to represent any change from the baseline and not introducing any new factor/change.
Type	Direct impact	Resulting from a direct interaction between a project activity and the receiving environment / receptors.
	Indirect impact	Resulting from other activities that happened as a consequence of the project.
	Cumulative impact	Impacts that act together with other impacts (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as the Project.
Extent	Project Area	When impact due to the project related activities is restricted within the premises of project area i.e. core zone.
	Local	When impact due to the project related activities is restricted within the immediate surroundings i.e. up to 3 km radius.
	Zonal	When impact due to the project related activities is restricted within the study area i.e. up to 10 km radius.
	Regional	When an impact due to the project activity extends within as well as beyond 10 km radius.

Duration	Short - term	When the impact is usually temporary or last for a short time or will have an effect soon rather than in the distant future.
	Long- term	When impact would occur during the development of the project and either takes a long time or lasts a long time or cause a permanent change in the affected receptor/resource.
Intensity	Low	When resulting in slight changes of prevailing baseline conditions and quality of existing physical environment is good. Ecological environment as well as human receptors are not likely to be affected due to the proposed project activity.
	Medium	When resulting in changes of prevailing baseline conditions which are within the benchmark norms and quality of existing physical environment shows some signs of stress. Ecological environment as well as human receptors could be sensitive to change in quality of prevailing baseline condition, but human receptors retain an ability to adapt to change.
	High	When resulting in changes of prevailing baseline conditions which are exceeding the benchmark norms and quality of existing physical environment is already under stress. Ecological environment as well as human receptors would be impacted to the larger extent and the ability of human receptors to adapt to changes would be undermined.
Frequency	Remote (R)	When resulting in remote or one-off chance of an event due to an activity on a receptor/ resource.
	Occasional (O)	When an impact due to an activity is occurring intermittently from time to time on a receptor/resource.
	Periodic (P)	When an impact due to an activity is resulting on periodic basis for a week or a month on a resource/receptor.
	Continuous (C)	When an impact due to an activity is continuously resulting on a resource/receptor.

Significance of Impacts

Impacts are described in terms of 'significance'. Significance is a function of the magnitude & sensitivity / importance of the impact.

Classification of impact significance is given in Table - 4.2.

Table - 4.2
Significance of Impact

Significance	Description
Insignificant	Negligible impact or where a resource or receptor (including people) will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.
Minor	Where an effect will be experienced, but the impact is well within accepted standards/guidelines with or without mitigation.
Moderate	Where an effect will be experienced and the impact is within accepted standards/guidelines

	with mitigation.
Major	Impact where an accepted limit or standard may be exceeded or the impact occurs to the highly valued/sensitive resource/receptors.

Irreversible and Irretrievable commitments of environmental components

Determining the irreversible and irretrievable commitment of the resources is one of the major stages of impact evaluation, which gives an understanding about the potential impacts that are likely to affect future generations of the area and facilitates for adoption of proper mitigation measure regarding the same.

Table - 4.3

Irreversible and Irretrievable commitments of environmental components

Commitment of resources	Description
Irreversible	Irreversible commitment of resources refers to the impact or loss of the resources that cannot be recovered or reversed. Irreversible is a term that describes the loss of future options. It applies primarily to the impacts of use of non-renewable resources or to those factors that are renewable only over long periods of time.
Irretrievable	Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. Irretrievable commitment of resources may be considered as the loss of resources as a result of change (both reversible & irreversible) due to any project activity that cannot be regained or recovered.

4.4 INTERACTION MATRIX

The interaction matrix enables a methodical identification of the potential interactions each project activity may have on the range of resources/receptors within the Area of Influence for the Project.

The interaction matrix for the project activities and likely impacted resources/receptors is presented in Table - 4.4, which covers potential interactions, regardless of probability of occurrence. The matrix consists of a list of resources/ receptors that could be affected against a list of project activities.

Entries in the matrix cells are either left blank or tick marked to indicate whether:

- An interaction is not reasonably expected (blank);
- The interaction is reasonably possible and may lead to potential impact (tick marked).

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 4.4
Interaction Matrix

S.N.	Project Activity Likely Impacted Resources / Receptors	Land Acquisition	Mine development & Process					Reclamation and Greenbelt/plantation			Miscellaneous		
		Acquiring land	Site Clearing within the project area and levelling of site (removal of vegetation, structures etc.)	Mining Operation (excavation with Shovel - Dumper combination)	Loading and unloading of mined out material	Crushing of ROM in the crusher (located within the ML Area)	Transportation of Iron Ore via road to the Jetties and Railway Sidings	Construction of garland drains & retaining walls, check dams, Bunds etc.	Reclamation of mined out pits by backfilling & water reservoir	Greenbelt Development along the 7.5 m mine periphery and plantation on safety zone at conceptual stage and rehabilitated area under	Workshop for HEMM maintenance in mine	Meeting points of workers/ employees i.e. Rest shelter, canteen	Installation of Iron Ore Beneficiation Plant
A.	Physical												
1.	Air		√	√	√	√	√	√	√	√			√
2.	Noise & / Vibration		√		√	√	√				√	√	√
3.	Land Use	√	√	√				√	√	√			
4.	Topography		√	√	√			√	√				
5.	Geology			√				√	√				
6.	Drainage Pattern		√	√				√					
7.	Surface Water							√					
8.	Ground Water			√				√	√				
9.	Soil		√	√	√			√	√	√			√
B.	Biological												
1.	Flora		√	√	√		√	√	√	√			
2.	Fauna		√	√				√	√	√			
3.	NP/WLS/BR/reserves/Forests etc.		√	√	√	√	√	√	√	√			√
C.	Social / Socio-Economic												
1.	Demography	√											
2.	Physical Displacement												
3.	Land Use (w.r.t. Population influx)			√									
4.	Habitation	√											
5.	Economy & Livelihood	√	√	√									

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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S.N.	Project Activity Likely Impacted Resources / Receptors	Land Acquisition	Mine development & Process					Reclamation and Greenbelt/plantation			Miscellaneous		
		Acquiring land	Site Clearing within the project area and levelling of site (removal of vegetation, structures etc.)	Mining Operation (excavation with Shovel - Dumper combination)	Loading and unloading of mined out material	Crushing of ROM in the crusher (located within the ML Area)	Transportation of Iron Ore via road to the Jetties and Railway Sidings	Construction of garland drains & retaining walls, check dams, Bunds etc.	Reclamation of mined out pits by backfilling & water reservoir	Greenbelt Development along the 7.5 m mine periphery and plantation on safety zone at conceptual stage and rehabilitated area under	Workshop for HEMM maintenance in mine	Meeting points of workers/ employees i.e. Rest shelter, canteen	Installation of Iron Ore Beneficiation Plant
6.	Social & Cultural Structure											√	
7.	Infrastructure & Public Services		√										
8.	Public Health			√						√			
9.	Agriculture	√	√	√									
10.	Transport Infrastructure			√			√						
D.	Occupational Health												
1.	Injury		√	√	√								√
2.	Health				√								√
3.	Non - routine risk			√									√
	Legends	Show no interactions is reasonably						√	Show interactions reasonably possible with one of the outcomes may lead to potential impact				

According to the interactions identified between project activities and resource/receptors as described in the above table, it is evident that the following aspects are likely to have impact due to this project (Table: 4.5) and therefore, needs to be considered for Impact Assessment:

Table - 4.5
Likely Impacted Resources / Receptors

S.N.	Likely Impacted Resources / Receptors	
A.	Physical	Air Quality
		Noise Level
		Land Use
		Water environment (Surface & Groundwater)
		Soil Environment
		Topography
		Drainage Pattern
B.	Biological environment	Flora
		Fauna
C.	Socio economic environment	Demography
		Land use (w.r.t. population influx)
		Economy & Livelihood
		Social & Cultural Structure
		Infrastructure & Public Services
		Public Health
		Education
D.	Occupation Health & Safety	Transport Infrastructure
		Injury
		Health
		Non-Routine Risk

Source: Interaction Matrix

The impact of this project related activities on various environmental parameters was assessed and are given below:

4.5 ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

The proposed mining and Beneficiation activities may impact the environment in various ways such as degradation of land, dust generation, deterioration of water and soil quality, affecting the biological and socio-economic environment of the area. The impacts of mining on various environmental parameters were assessed and are given below:

4.5.1 IMPACT ON AIR QUALITY & SAFEGUARD/MITIGATION MEASURES

The proposed project includes various mining operations such as development of benches, excavation, loading, unloading, Crushing of Iron Ore, Beneficiation of ore and transportation of material via Road to nearby jetties and railway sidings for further supply to JSW Steel Plant and /or for sale in the open market, as per the demand. These operations generally result in generation of dust, fumes and thereby pose health hazards. However, adequate control measures will be provided at every stage of operation such as water sprinkling on haul roads, maintaining optimum vehicle speed etc. to reduce fugitive dust emissions.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 4.6
Anticipated Environmental Impacts and Mitigation Measures with EMP

S.N.	Project Activity	Pollutant		Specific impacts with quantification	Mitigation Measure	Budget Provision	Time frame	Responsibility
		Factor	Aspect					
1.	OB/Waste Removal & Iron Ore Excavation	Land, Water and Biodiversity	Land degradation, intersection of the groundwater table and habitat fragmentation	Alteration of natural topography, conversion of private land for mining purposes and potential decrease in groundwater levels due to seepage.	Concurrent backfilling of mined-out areas and deployment of the Miyawaki plantation technique. Regular monitoring of groundwater levels and quality will be strictly enforced.	Budget for Greenbelt/Plantation: Rs. 145.01 Lakhs (Capital) and & 22.0 Lakhs/ Annum (Recurring) for Greenbelt and Plantation including Miyawaki Plantation technique (Included in EMP)	14 years (up to life of mine)	JSWSL
2.	Loading & Haulage to Crusher/Beneficiation Plant	Air, Noise	Generation of Particulate Matter (PM), SO ₂ , NO ₂ and noise emissions from Heavy Earth Moving Machinery (HEMM)	Increase in atmospheric pollution load, respiratory risks for workers and dust deposition on local flora which limits photosynthesis.	Deployment of 04 no. of water tankers for continuous sprinkling on working faces and haul roads. Operators will be provided with air-conditioned closed acoustic cabins and personal protective equipment. Regular maintenance, oiling & greasing of Transportation vehicles.	Budget for 4 Water Tanker: Cost for water tanker is already included in Project Cost. Budget for vehicle maintenance Rs 1.0 lakh (Recurring) (Included in EMP)	14 years (up to life of mine)	JSWSL
3.	Dry & Wet Beneficiation of Low-Grade Ore	Air, Water and waste generation	Process water consumption, dust from crushing/screening and generation of tailings/slimes (0.628 Million TPA)	Potential depletion of fresh water resources, localized dust emissions, and space alteration for tailing stacking	Use of thickeners and filters to recover and recirculate 92.1% of process water ensuring zero wastewater discharge. Installation of Fog canon/mist sprayer at crushers and transfer points.	Budget for EMP: Capital Cost: 544.02 Lakhs Recurring Cost: 117.0 Lakhs/annum	14 years (up to life of mine)	JSWSL

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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S.N.	Project Activity	Pollutant		Specific impacts with quantification	Mitigation Measure	Budget Provision	Time frame	Responsibility
		Factor	Aspect					
4.	Transport of OB Waste to Dumps & Backfilling	Waste generation	Generation of large volumes of solid waste (~68.0 Million Tonnes at conceptual stage) and surface run-off over loose earth.	Erosion of waste dumps, leading to siltation and increased turbidity in nearby water bodies (e.g., Khandepar River) during the monsoon season.	Construction of retaining walls and garland drains at the toe of dumps, channeled into silt settling ponds. Stabilization of dump slopes using biodegradable geotextile mats and systematic plantation.	Budget for construction of Garland Drains, Retaining Walls, Settling Ponds, Check Dam & Check Filter Biodegradable geotextile mats on Dump Slopes and greenbelt/plantation is included in EMP.	14 years (up to life of mine)	JSWSL
5.	Transport of Ore & Concentrate to Jetty/ Railway Siding	Air, Noise	High frequency movement of 11.5 tonnes tippers causing vehicular emissions, noise and road vibrations.	Degradation of Level of Service (LOS) on public and village roads, traffic congestion, and safety risks for nearby habitations.	Mandatory covering of all tippers with tarpaulin and utilization of wheel wash facilities at the mine exit. Deployment of traffic marshals, use of mechanized road sweeping machines, and strengthening of public road infrastructure.	Budget proposed for all the mitigation measures is included in Environment Management Plan.	14 years (up to life of mine)	JSWSL

4.5.1.1 AIR POLLUTION DUE TO IRON ORE MINING PROJECT

Airborne emissions occur during various phases of the mining process but in particular while exploration, development, building and operation. Large volumes of material are mobilized during mining operations and waste stacks containing minute particles may easily get scattered by the wind.

(i) Gaseous Pollution

Gaseous pollutants (SO₂ and NO_x) are anticipated from movement of Machineries like excavators, loaders, dumpers & other vehicles; while generation of pollutants during activities from excavation to crushing is of continuous nature.

(ii) Particulate Matter

The generation of dust is anticipated from various mining activities like excavation, loading, unloading, hauling, crushing and transportation and other related activities.

The ambient air quality monitored Summer Season (March to May 2025) (results discussed in Chapter - 3) shows that the PM concentration in the surrounding villages is within the prescribed limits, which indicates negligible/ no impact on ambient air quality.

4.5.1.2 AMBIENT AIR QUALITY IMPACT PREDICTION MODELING

Impact Prediction is an important part of Environmental Impact Assessment Study. There are various techniques available to predict the impacts. Mathematical Modelling is an established and accepted technique for the same. The ambient air quality impact prediction modelling has been carried out for this Iron ore mining project of JSW Steel Limited.

This report gives the concentration of Particulate Matter up to a distance of 10 km. The concentrations have been predicted in all directions. Spatial distributions of all the pollutants are also presented in the form of Isopleths. The present study has evaluated the impact on surrounding air quality for total excavation of 11.71 Million TPA production capacities as below:

Table - 4.7
Total handling for Impact Assessment

S.N.	Particular	Million TPA	Normative (300 days)		Peak Stage (+20%)	
			TPD	TPH	TPD	TPH
1	Iron Ore	3.5	11667	556	14001	667
2	OB/Waste	8.21	27367	1303	32840	1564
Total Excavation		11.71	39034	1859	46841	2231

Total proposed material handling of 11.71 Million TPA comprises of 3.5 Million TPA Iron Ore, 8.21 Million TPA OB/Waste.

At Peak Stage (+20%)

In case of shut down/breakdown/major maintenance in crusher production of mine may be suspended temporarily and due this short fall may create in Iron ore stock in plant side; therefore, to cover up this short fall, considered 20% maximum production as compared to daily production & meanwhile in that period development work - removal of Waste etc. considered at 20% maximum as

compared to daily capacity. However, the annual production will remain same i.e., Iron ore 3.5 Million TPA, 8.21 Million TPA OB/Waste.

After considering the 20% increase in the Iron Ore production per day will be 14000 tonnes, OB/Waste will be 32840 tonnes; thus, total handling will be 46840 TPD (at Peak Stage). The same has been considered for air quality modelling.

This report gives the cumulative peak incremental concentration of Particulate Matter up to a distance of 10 km, due to the mining & allied activity. The concentrations have been predicted in all directions covering study period. Spatial distributions of all the pollutants are also presented in the form of Isopleths.

4.5.1.2.1 ACTIVITIES INVOLVED IN THE PROJECT

Open cast mining involves excavation, loading/unloading, hauling, crushing, Iron ore beneficiation, transportation via road to jetties or railway sidings, movement of HEMMs etc.

4.5.1.2.2 EMISSION RATE AS PER MATERIAL HANDLED

The emissions in the present case have been computed using empirical factor given in “Indian Mining and Engineering Journal”. The details of emissions computed from mining operations proposed in both the leases are given below:

Table - 4.8
Emission rate as per material handled

S.N.	Activity	Category of Source	Emission Rate		Emission Load	
			Values	Unit	Kg/day	Contribution (%)
1	Iron Ore Loading	Point	0.58401	g/s	44.15	0.33
2	OB/Waste Loading	Point	0.66103	g/s	49.97	0.38
3	Haul Road & transport to Jetty and Railway Sidings	Line	0.023479	g/s/m	5325.04	40.13
4	Iron Ore Unloading	Point	0.904927	g/s	68.41	0.52
5	OB/ Waste Unloading	Point	0.753321	g/s	56.95	0.43
6	Exposed Pit Surface	Area	3.1611E-05	g/s/m ²	7196.91	54.23
7	Exposed Waste Dump	Area	1.01970E-04	g/s/m ²	529.60	3.99
Total SPM Load (kg/day)					13271.04	100%
Uncontrolled (Without EMP)						
SPM Emission (g/s)					175.54	-
PM ₁₀ Emission Rate @50 % of SPM (g/s)					87.77	-
PM _{2.5} Emission Rate @ 40% of PM ₁₀ (g/s)					35.11	-
SO ₂ Emission Rate (g/s)					1.18	-
NO ₂ Emission Rate (g/s)					0.63	-
Controlled (With EMP)						
PM ₁₀ Emission Rate @80 % efficient mitigations measures (g/s)					17.55	-
PM _{2.5} Emission Rate @80 % efficient mitigations measures (g/s)					7.02	-

Source: CMFRI, 1998; Chakraborty et al. 2002

4.5.1.2.3 STACK DETAILS OF PROPOSED CRUSHERS

Table - 4.9
Emission rate as per Material Handled (For crushing activity)

Stack attached to	Stack No.	Height from ground Level (m)	Internal diameter (Top) (m)	Emission Rate of PM (g/sec)	Exit Velocity (m/sec)	Temp (°C)	Volumetric Flow (m³/sec)
Proposed Crusher (Primary) (250 TPH)	1	20	1.0	0.40	10.00	60	20.0
Proposed Crusher (Primary) (2 x 90 TPH)	2	15	0.6	0.25	9.42	52	16.7
Proposed Crusher (Secondary) (150 TPH)	1	15	0.6	0.30	9.50	52	18.0

Source: JSW Steel Limited

4.5.1.2.4 MODELING PROCEDURE

Prediction of incremental ground level concentrations (GLC's) due to the proposed expansion in Codli Mineral Block XII has been made by AERMOD view 10.2.1 - Model. It is US-EPA approved model for prediction of the air quality. For this study, uniform polar receptors have been assumed. Modelling has been done considering area source, line source and point source for mine.

4.5.1.2.5 METEOROLOGICAL DATA/INPUT PARAMETERS FOR AERMOD

a) Meteorological Data

Data recorded at the weather monitoring station on wind speed & direction, relative humidity and temperature at one-hour interval for the monitoring period i.e. Summer Season (March to May, 2025) has been used as meteorological input.

b) Stack Emissions

Stack emission details of Crushers to be installed within the mine.

4.5.1.2.6 AMBIENT AIR QUALITY STANDARDS

Ambient air quality standards promulgated by National Ambient Air Quality Standards for different areas are as follows:

Table - 4.10
Ambient Air Quality Standards

Area	Time Weighted Average	Concentration (µg/m³)			
		PM10	PM2.5	SO2	NO2
Industrial Area, Residential Rural and Other Areas	Annual Average	60	40	50	40
	24 hours	100	60	80	80
Ecologically Sensitive Area (Notified by Central Govt.)	Annual Average	60	40	20	30
	24 hours	100	60	80	80

4.5.1.2.7 AMBIENT AIR QUALITY MODELLING

Air pollution modeling is a numerical tool used to describe the causal relationships between emissions, meteorology, atmospheric concentrations, deposition and other factors. Air pollution measurements give important quantitative information about ambient concentrations and

deposition, but they can only describe air quality at specific locations & time, without giving clear guidance on the identification of the causes of the air quality problem. Air pollution modeling, instead can give a more complete deterministic description of the air quality problem, including an analysis of factors and causes (emission sources, meteorological processes, and physical and chemical changes) and some guidance on the implementation of mitigation measures.

4.5.1.2.8 POLLUTION EMISSION INVENTORY

Development of pollutant emission inventory is essential part of any dispersion modeling and emission rate is one of the important input parameters. It is necessary to understand the source of emission of air pollution from each mining activity.

In Iron Ore mining, most of the major activities contribute to the emission of particulate matter, right from exploration to exploitation including mineral processing. The locations of these activities are Iron Ore/Waste Loading, Haul Road, Iron Ore/Waste Unloading, Crusher, Stock Yard, Exposed Pit Surface etc. Numerous researchers have derived various formulation based on the experimental data and generalized the emission calculation for various opencast mining activities irrespective of type of mining. (CIMFR, 1998; Chakraborty et al. 2002)

4.5.1.2.9 ESTIMATED EMISSION OF PARTICULATE MATTER & FOR GASEOUS EMISSION

The excavated Iron Ore will be transported from mine face to crushers (3 Primary Crusher: 250 TPH & 2 x 90 TPH and Secondary Crusher: 150 TPH, proposed to be installed within the lease area) by 40 Tonnes capacity of dumper via haul road. The crushed Ore will be transport via Road through 11.5 Tonnes capacity of Tippers to the Capxem Jetty, TPL, Fomento Jetty, Andre Minescape & Bandekar Jetty and also transport to the proposed Kalay Railway Siding in Costi & in Pauskar yard from where the Ore will be further dispatched for direct selling and exports to the prospective buyers.

At Normative stage, total trips of 40 Tonnes capacity of dumper required per day for transport of 11667 TPD Iron Ore from mine face to plant will be 292 numbers. The number of trips (to and fro) per hour will be 28 numbers (3 shifts @ 7.0 effective working hours).

At Peak stage, total trips of 40 Tonnes capacity of dumper required for transport of 14000 TPD Iron Ore from mine face to plant will be 350 numbers. The number of trips per hour will be 34 numbers (3 shifts @ 7.0 effective working hours).

4.5.1.2.10 PRESENTATION OF RESULTS

In the present case, model simulations have been carried out for mining project and also cumulative for proposed mine and other existing mine nearby to obtain an optimum description of variations in concentration over the site in 10 km radius covering 16 directions.

The incremental concentrations have been estimated based on mathematical emission data-based modelling. For each time scale i.e., for 24 hrs, the model computes the maximum GLC observed during the period over all the measurement points. In the present case, model simulations have been carried out for proposed mining project and also cumulative for proposed mine and other existing mine nearby to obtain an optimum description of variations in concentration over the site in 10 km radius covering 16 directions. Isopleths are enclosed as **Annexure XVI**.

4.5.1.2.11 IMPACT EVALUATION

Ambient Air Quality monitoring results are given in table 3.12, Chapter 3 of this Draft EIA/EMP report. From this it is evident that AAQ results are well within the prescribed norms. Impact evaluation is given in table below.

Table - 4.12
Impact Evaluations for Ambient Air Quality

Impact Evaluation Element	Change in Air Quality Due to the Proposed Iron Ore Mining Project			
Potential Effect/ Concern	Impact on health of humans and nearby biological/ecological receptors due to line and point sources of air emissions including fugitive dust emissions during Iron Ore mining activities from the proposed Project.			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
			√	
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
		√		
Duration	Short – term		Long- term	
			√	
Intensity	Low		Medium	High
			√	
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
				√
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

4.5.1.2.12 MITIGATION MEASURES

The mining will be carried out by opencast mechanized mining method. The main anticipated air pollutant would be fugitive dust or particulate matter generated by; (i) ore and waste excavation (ii) loading of ore and waste and (iii) transportation of ore & waste. Fugitive dust will be localized and confined to the areas in the vicinity of mining operations and thus, chances of spreading the same in the nearby villages are not anticipated. The emissions of Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x) contributed by diesel operated HEMM and vehicles plying on haul roads will also be marginal.

The following mitigation measures will be adopted to mitigate air pollution generated due to the mining activities:

- Fugitive dust emissions from all sources will be controlled regularly, Water spraying on haul roads, loading, unloading and transfer points will be done.
- Wheel wash arrangement will be provided during the exit of trucks from the mine.
- Permanent water sprinklers will be installed along main haul roads.

- Haul roads will be kept wide to support smooth traffic movement. The roads will be properly maintained by road compactor & motor grader and regular water spraying will be done during work hours to prevent generation of dust from vehicular movement.
- Bag filter will be provided with crusher.
- Mist fog system (Atomized water sprinkler) will be installed near the unloading points of the mineral.
- The raw material conveying systems will be covered and dedusting systems will be provided at transfer points in order to minimize dust generation.
- In the Beneficiation Plant, Ventilation and air-conditioning systems will be provided to ensure suitable working conditions by maintaining an environment that meets human hygiene standards. JSW also provide the controlled conditions required for the proper storage of materials and the efficient operation of plant & equipment.
- Speed limit of vehicular traffic will reduce the airborne fugitive dust.
- Pollution under control (PUC) checking of mining equipment will be done with the help of Govt. approved agencies in every six months for periodical monitoring.
- Vehicular emissions will be kept under norms by regular maintenance of vehicles & machineries.
- Modern fuel-efficient machinery will be deployed.
- Fugitive dust emissions will be monitored quarterly at haul road, loading and unloading points & near transfer points and records will be maintained properly.
- Mechanized road sweeping machine will be used for cleaning the public road.
- Greenbelt & plantation will be developed along the mine boundary, mine office, crusher area, near areas under utility services and on stabilized dumps.
- Overloading of trucks will be avoided and transportation of the ore will be done in trucks covered with tarpaulin.
- Regular water spraying will be done on Crusher hopper to arrest dust from becoming air-borne.
- Personal Protective Equipment including dust masks will be provided to workers & operators working in dusty zones.
- Regular air quality monitoring will be carried out within core and buffer zone (at the ML boundary, near proposed Crusher and beneficiation plant, nearest village from ML area, pre dominant downwind direction and at other sensitive receptors etc.) and the records will be maintained properly.
- 01 nos. of Continuous Online Ambient Air Monitoring stations will be installed at mine site and regular ambient air quality monitoring will be carried out.

Installation plan for permanent fixed water sprinkling system

Wheel washing systems and permanent fixed water sprinklers will be installed at strategic locations within the project area to minimize fugitive dust emissions and ensure effective dust suppression during mining and transportation activities.

Installation of fog canons

To control fugitive dust emissions generated from mining and associated activities, particularly during mineral handling, loading/unloading, crushing/beneficiation, transportation and vehicular movement, a total of 05 dust suppression units comprising 04 fog cannons and 01 mobile mist fog sprayer will be installed within the first year of commencement of mining operations. The fog cannons will be strategically deployed at identified dust-prone locations, including the vicinity of the beneficiation plant, Kopili River, transportation routes, and nearby village habitations located adjacent to the mine lease area. The mobile mist fog sprayer will be utilized at other active mining and material handling locations, as required, to effectively suppress airborne dust and minimize fugitive dust emissions.

The operation of the fog cannons will be integrated with other dust control measures such as regular water sprinkling on haul roads, maintenance of roads, speed control of vehicles, covering of mineral-carrying vehicles with tarpaulin and proper housekeeping. The effectiveness of the fog cannons will be monitored through regular inspection and ambient air quality monitoring.

The fog cannons will be operated judiciously to avoid excessive water consumption and waterlogging. Adequate arrangements will be made for the availability of water and power at the installation locations. The system will be regularly maintained to ensure effective and uninterrupted dust suppression.

Action Plan for Installation of CAAQMS

The CAAQMS will be installed within the ML Area, within first years of commencement of mining operations. The Action Plan for installation of CAAQMS is given below:

Table - 4.13
Action Plan for installation of CAAQMS

S.N.	Activity	Activity Description
1.	Identification of locations for installation of CAAQMS	A Reconnaissance survey will be conducted to ensure easy access to the electrical connectivity, Internet availability & Clear line of sight
2.	Application submission to GSPCB for approval of identified locations	Application to be submitted for finalization of locations in consultation with GSPCB
3.	Site finalization by GSPCB	Locations to be authenticated in consultation with SPCB
4.	Purchase Order Placement	Purchase Order to be issued to the selected Vendor.
5.	Delivery of CAAQMS	CAAQMS will be delivered by the Vendor at the Mine.
6.	Foundation	Based on the dimensions of CAAQMS, foundations will be constructed.
7.	Power supply arrangement	Arrangement of the power supply to be provided from the nearby area.
8.	Installation of CAAQMS	CAAQMS will be installed along with the several analyzers and sensors. Further, integration with the SPCB servers to be done.
9.	Commissioning of CAAQMS	CAAQMS will be commissioned and data will be transmitted to the SPCB servers.

4.5.2 IMPACT OF NOISE / VIBRATIONS AND MITIGATION MEASURES

4.5.2.1 IMPACT OF NOISE ON WORKING ENVIRONMENT

With the mining operations for mine development, excavation, crushing and transportation of Iron Ore, it is imperative that noise levels would increase. However, the expected noise levels are not likely to have any adverse effect from the occupational health point of view.

1. Noise Generated due to mining activity

No drilling operations are proposed in this mine. The noise levels in the working environment will be maintained within the standards prescribed by Central Pollution Control Board. These standards were established with the emphasis on reducing the hearing loss. The permissible limits, as laid down by CPCB, are presented in following table:

Table – 4.14
Permissible Exposure in Case of Continuous Noise (DGMS)

S. No.	Sound Level (dBA)	Continuous Duration (Hours)
1	85	8
2	88	4
3	91	2
4	94	1
5	97	0.5
6	100	0.25

Source: DGMS Standards

2. Noise Impact Analysis on Community

Efforts will be confined to work zone areas only and at present lowest values of noise levels were observed nearby the Proposed Mine site (46.2 dBA in day time). It can be seen that noise levels get diffused rapidly with distance. Noise level in the study area varies from 46.2 to 56.8 Leq dB (A) during day time and from 38.1 to 44.4 Leq dB (A) during night time.

The predicted noise levels indicate that there will be no significant increment to the ambient noise levels and it may not impact the habitations in the Village Codli even though it is in the close vicinity of the proposed Block.

In summary, it can be stated that the impact on the present noise levels due to mining operations will be restricted to the active mine area only and it will attenuate fast at mine boundary in majority of directions.

Recommended Noise Standards

Based on the recent ILO Code of practice the following standards and guidelines are provisionally recommended for attainment, as far as practicable:

- A warning limit value of 85 dB(A) may be set as the level below which very little risk to an unprotected ear, of hearing impairment exists for an eight-hour exposure.

- The danger limit value shall be 90 dB(A), above which the danger of hearing impairment and deafness may result from an unprotected ear: provided that during emergencies, or because of unforeseen technical reasons, a worker may be temporarily authorized to exceed the daily dose, but only if on the next day he recuperates so that the maximum weekly dose does not exceed the value specified above.
- A worker should not be allowed to enter, without appropriate ear protection, in area in which the noise level is 115 dB (A) or more.
- Personal protective equipment (PPEs) shall be worn, if there are single isolated outbursts of noise which can go above 130 dB (A) Impulse or 120 dB (A) 'Fast'.
- No worker shall be allowed to enter an area where the noise level exceeds 140 dB(A).

Source: MMR, 1961 (Cir. Tech. 18/1975)

4.5.2.2 MITIGATION MEASURES TO REDUCE AMBIENT NOISE LEVEL

The following control measures will be adopted to keep the ambient noise levels well below the limits:

- No Drilling and Blasting operations will be carried out, thereby eliminating the risk of high-intensity and impulsive noise generation.
- Proper maintenance, oiling and greasing of machines at regular intervals will be done to reduce generation of noise.
- Preventive maintenance schedules will be implemented to avoid excessive noise due to wear and tear of machinery parts.
- The workers will be provided with personal protective equipment, earmuffs and earplugs as a protective measure from the high noise level generated at the mine site and wherever required.
- Adequate silencers in HEMMs will be provided to reduce generation of noise.
- Vehicle movement within the Beneficiation plant premises will be regulated with speed limits to minimize traffic noise.
- HEMMs equipped with Air-conditioned closed acoustic cabins will be provided for the operators.
- Insulators will be provided in the crusher present in Beneficiation plant to control the noise.
- Enclosures/barriers will be provided around crushers and screening units present in Beneficiation Plant to reduce propagation of noise.
- Earplugs/earmuffs will be provided to mine or plant workers for its utilization in high noise levels immediately near HEMMs whenever required.
- Plantation will be carried out on two sides of the crusher and along the haul roads. Greenbelt of 7.5 m will be developed along the lease periphery.
- Regular monitoring of noise levels will be carried out.

4.5.2.3 IMPACT EVALUATION OF NOISE

Ambient Noise Level monitoring results are given in table 3.15 Chapter 3 of this EIA/EMP report. From this it is evident that results are well within the prescribed norms. Impact evaluation is given in table below.

Table - 4.15
Impact Evaluation for Noise

Impact Evaluation Element	Change of Noise Level due to the Proposed Iron Ore Mining Project and Beneficiation Plant			
Potential Effect/ Concern	Impact on health of humans and biological factors/receptors due to noise generated due to mining activities during day and night time and also on occupational health of the workers exposed to noise.			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
			√	
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
	√			
Duration	Short – term		Long- term	
	√			
Intensity	Low		Medium	High
	√			
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
			√	
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

This is a proposed Iron Ore mining project. The mining will be carried out by opencast mechanized mining method without Drilling and Blasting. The excavation of mineral will be done by deploying Shovel-Dumper combination followed by loading with hydraulic excavators and transportation of the ore from mine face to the crushers through Tippers/dumpers via haul roads, within the ML area.

As no Drilling & Blasting will be done, hence, no effect on noise levels is envisaged.

Furthermore, the effect of vibration due to operation of HEMM will also be marginal and strictly localized within the ML area. Innovative approach will be adopted in machinery designs with inbuilt mechanism to reduce noise emission as well as Corrective & preventive measures will also be undertaken hence, no impact of vibration is envisaged.

4.5.3 IMPACT ON WATER ENVIRONMENT AND MITIGATION MEASURES

4.5.3.1 IMPACT ON SURFACE WATER AND MITIGATION MEASURES

Core Zone: No water bodies i.e. nalla, river or streams are present within the lease area except existing mined pits filled with water.

Buffer Zone: 3 Rivers and 5 Nalas exist within the 10 Km radius of study area viz. Khandepar River (Adjacent in North direction), Kale Nala (~0.7 km in ESE direction), Udnai Nala (~1.5 km in West direction), Panduranga Nala (~5.0 km in SW direction), Ragada Nala (~7.0 km in NNE direction), Sanguem or Zuvari River (~8.0 km in South direction), Jamboli Nala (~9.0 km in NE direction), Paroda River (~9.0 km in SSW direction). These water bodies will not be impacted due to the mining activities.

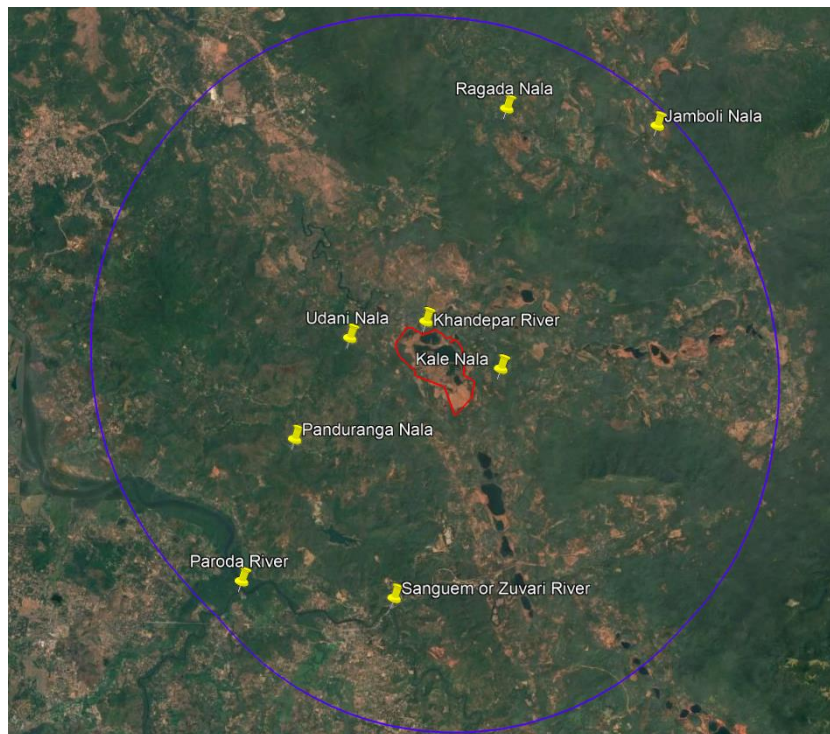


Figure 4.1: Google Earth image Showing Water Bodies in the Buffer Zone (10 Km Radius Study Area)

Possible Impact

- Surface run-off generated from mining activities may disturb the natural drainage pattern of nearby water bodies such as streams, rivers, ponds, etc.
- During monsoon rainwater from the catchment of the mine and internal dumps is diverted into the Mining pit and Settling ponds through trenches and garland drains.
- The run-off may carry suspended solids, causing the water to become turbid and silted.
- Water quality of these bodies may deteriorate, particularly during the rainy season, when the load of suspended solids is higher.
- The nearest water body is Khandepar river (Adjacent in North direction) and Kale Nala (~0.7 km in ESE direction), which may get impacted due to mining operations. Apart from this, the overall adverse impact is expected to be minimal, as the other water bodies are located at a considerable distance from the mining area.
- These impacts can be experienced during rainy season when the suspended solids load is higher.
- Fugitive emissions released during mining activities may degrade the quality of water.

Protection Measures

In order to protect the water bodies of buffer zone, the company will ensure that no waste water will be discharged outside lease area which may contaminate any surface water body. The following mitigation measures will be adopted to control the surface run-off:

- No untreated waste water will be discharged outside Block Area which may contaminate any surface water body.
- Garland drain (Dimensions: L* W*D= 1682 m x 1.0 m x 1.0 m) having a series of siltation pond will be provided at the toe of the dumps, to channelize the runoff water from dumps into the water reservoir (i.e. mined out pits).
- All the garland drains at the toe of the dump are proposed to be connected with a series of settling ponds which will ultimately allow the setting of silt from the water.
- Retaining wall (Dimensions: L* W*D= 1682 m x 1.5 m x 3.0 m) will be constructed around waste dump to control the surface run off.
- Catch drains and siltation ponds will also be constructed within the area to check flow of surface runoff as well as to prevent siltation of natural courses.
- The rainwater falling directly into the mine pits will be stored and used for plantation & dust suppression.
- Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled.
- Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank.
- Vegetative buffer i.e. Greenbelt will be developed around the periphery of the mine which will act as bio filter or sinks for particulate, fugitive and gaseous emissions generated due to mining activities. In addition to this Greenbelt/Plantation will also prevent soil erosion and minimize sediment runoff.
- Periodical monitoring of ground water and surface water quality will be carried out.

Table - 4.16
Details of Proposed Garland Drains, Retaining Wall and Fencing (During Plan Period)

Year	Proposed length (m)	Latitude	Longitude
A. Garland Drain			
Year 2	386	15°20'45.60" N to 15°20'57.36" N	74°07'13.19" E to 74°07'16.61" E
Year 3	386	15°20'37.09" N to 15°20'45.62" N	74°07'13.19" E to 74°07'16.61" E
Year 4	524	15°20'16.85" N to 15°20'24.65" N	74°07'13.19" E to 74°07'16.61" E
Year 5	386	15°20'29.05" N to 15°20'37.12" N	74°07'13.19" E to 74°07'16.61" E
B. Retaining Wall			
Year 2	386	15°20'45.63" N to 15°20'57.34" N	74°07'13.23" E to 74°07'16.67" E
Year 3	386	15°20'37.12" N to 15°20'45.64" N	74°07'16.66" E to 74°07'23.51" E
Year 4	524	15°20'16.85" N to 15°20'24.65" N	74°07'54.23" E to 74°08'07.45" E
Year 5	386	15°20'29.08" N to 15°20'37.15" N	74°07'23.48" E to 74°07'32.76" E

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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C. Fencing

Year 1	1830	15°21'03.25" N to 15°21'13.84" N	74°07'22.95" E to 74°08'13.85" E
Year 2	1830	15°20'22.87" N to 15°21'03.25" N	74°08'13.85" E to 74°08'32.73" E
Year 3	1830	15°19'51.88" N to 15°20'22.87" N	74°08'14.76" E to 74°08'32.73" E
Year 4	1830	15°19'51.88" N to 15°20'27.23" N	74°07'32.66" E to 74°08'14.76" E
Year 5	1830	15°21'03.25" N to 15°21'13.84" N	74°07'22.94" E to 74°07'32.66" E

Source: Approved Mining Plan and Progressive Mine Closure Plan

The proposed retaining wall will be designed from site-specific topographical and geotechnical information and will be integrated with appropriate drainage, toe protection and sediment-control arrangements. The design will demonstrate adequate structural and geotechnical stability and will provide suitable drainage behind the wall to prevent hydrostatic pressure and erosion.

JSW will ensure that the final retaining-wall construction drawings, calculations and specifications are prepared and certified by competent engineering professionals before construction. The structures will be inspected and maintained throughout the mine life, with particular attention before and during the monsoon.

The completed system will be operated so that dump material, ore, waste/overburden and sediment-laden runoff will be contained and managed within the mining lease area and uncontrolled migration outside the lease boundary is prevented.

A detailed Scientific and Engineering Plan for retaining wall design has been prepared and copy of same is enclosed as **Annexure XVII** with this Draft EIA/EMP Report.

Protection Measures for Khandepar River

- During monsoon, mine wash-off from pits will be arrested by series of check dams and silt settling ponds. The check dams & check bunds will be de-silted well before monsoon season every year.
- Retaining wall & garland drains will be constructed around the dump and at strategic points.
- Greenbelt/Plantation will be done along the 7.5 m mine lease boundary facing the river, using native species, to act as a protective barrier and to safeguard the river ecosystem.
- Regular river water quality monitoring will be done at upstream and downstream locations and monitoring records will be submitted to GSPCB & WRD every month.
- The Integrated Watershed Management Study, including the Catchment Area Treatment (CAT) Plan, impact assessment of Dudhsagar/Khandepar River and nearby nala(s) and River Ingress Study, has been prepared by Dr. K G Guptha, Retd. Prof. & Head, Goa Engineering College (Principal Consultant). The study findings, WRD recommendations and the corresponding action plan and mitigation measures have been included in the same Report.

A letter has been submitted to Water Resource department, Goa on dated 18.03.2026 for recommendations for safeguarding the Khandepar River. Copy of the same is enclosed as **Annexure XVIII**.

4.5.3.2 IMPACT ON GROUND WATER AND MITIGATION MEASURES

- a) **Ground water pollution by toxic substances:** Ground water pollution can take place only if the mining rejects contain toxic substances which get leached by the precipitation of water and percolate to the ground water table thus polluting it. The mineral Iron Ore and associated rocks do not contain any toxic substance. Therefore, there is no significant impact of mining activities on quality of any source of water.

Furthermore, hazardous chemicals are not used in the beneficiation process. There is no generation of waste water from the plant process, entire waste water will be used in recirculation process. For these reasons ground water pollution is not anticipated due to beneficiation plant operations.

- b) **Groundwater Withdrawal:** Total water requirement for the proposed project will be 1716 KLD. Out of which 20 KLD water will be used for Domestic Purpose which will be sourced from ground water, subject to obtaining the necessary permission from the competent authority. The remaining water requirement for mining and plant activities will be met from Mine Sump water. Water will also be stored in the water reservoir through harvesting rainwater as well as taking from nearby water resources for yearly consumption taking the permission of competent local authority.
- c) **Ground water intersection due to Mining activity:** Working depth during the plan period will be 112 m bgl and at conceptual stage, ultimate working depth will be 164.48 m bgl. According to ground water level monitoring, it is found that the depth of water level in core zone during pre-monsoon is around 16.0 m bgl and during post-monsoon season it rises slightly to 15.0 m bgl. Hence, the groundwater will be intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026.

No untreated wastewater will be discharged outside the lease boundary. Therefore, no adverse impact on water quality is envisaged due to the proposed expansion of the mining project.

4.5.3.3 WATER CONSERVATION MEASURES

- Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled.
- Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank.
- Mist fog system (Atomized Water Sprinkler) will be installed at crusher hopper.
- Use of wetting agents is recommended to reduce water consumption.

A. Plan for reduction of water requirement

Recovery of Process water in Beneficiation Plant: The proposed Iron Ore Beneficiation Plant will adopt both dry and wet beneficiation processes. The dry beneficiation process is based entirely on physical separation techniques such as crushing, screening, and dry magnetic separation. No

chemical reagents or additives will be used during the beneficiation process. Consequently, no chemical wastewater or hazardous process effluent will be generated.

The proposed wet beneficiation process will involve only physical operations such as crushing, grinding, and size separation, and will not involve the use of any chemical reagents. The tailings slurry generated during the beneficiation process will be directed to thickeners and filters for dewatering and recovery of process water. The recovered water will be recycled back to the beneficiation plant, while the dewatered tailings will be disposed of in the designated abandoned mine pits/dumps. The recirculation of process water will significantly reduce the requirement for fresh water and minimize wastewater discharge.

As per the Water Balance, the total process water circulation in the beneficiation plant is about 743 m³/hr (8,916 m³/day), out of which approximately 698 m³/hr (8,376 m³/day) of process water will be recovered and recirculated back into the beneficiation process. Thus, the overall process water recovery efficiency works out to about 93.95%, while only about 59 m³/hr (708 m³/day) of make-up water will be required to compensate for moisture retained in the products and tailings, as well as evaporation losses.

Accumulation of water in the Mine Pit:

The total water available in the pit has been analytically calculated, in 1st year, Pit-1 will have about 1665 m³/day of water available after evaporation losses. In 2nd year, this increases to 1780 m³/day due to higher rainfall and seepage contribution.

As per analytical calculations, the total rainwater that can be dewatered from the mine pits during the 2nd year of the plan period is estimated to be about 219.5 m³/day, considering an average annual rainfall of 3412.77 mm/year and accounting for 70% losses during handling and wall runoff.

As per the numerical groundwater modelling, after commencement of mining operations, the seepage in 2nd year is estimated to be about 736 m³/day, which is higher than the analytical estimate and therefore has been considered for the application. The rainfall contribution calculated analytically in 2nd year is about 1560 m³/day, and the combined total water availability from seepage and rainfall is approximately 2296 m³/day.

B. Rainwater Harvesting

Rainwater harvesting/Artificial groundwater recharge will be done to minimize the undesirable effect on groundwater status. It is necessary that groundwater resources of an area must be restored by rainwater harvesting so that the existence of mine does not adversely affect the groundwater situation. Besides this, the water accumulated by Rainwater harvesting will be used to meet the water requirement of the proposed Mine and Beneficiation Plant.

- Rainwater harvesting techniques will be implemented for conservation of water. The rainwater falling directly into the mine pits will be stored and used for greenbelt/plantation & dust suppression.
- At conceptual stage, 249.2021 ha area will be converted into water reservoir which will be developed for public/community use.
- Periodical monitoring of ground water quality & water level in core and buffer zone will be carried out.

Existing (Old) Pits

The lease area comprises a total of 07 pits out of that, 04 pits are presently active and proposed for mining operations, while the remaining 03 are mined-out pits that have been backfilled by the erstwhile lessee as part of the mine closure and reclamation activities.

There is total 4 old active pits present covering an area of 157.767 ha within the mine lease. At the conceptual stage, out of total mining lease area i.e. 377.0881 ha, the total excavated area will be 301.1521 ha, out of which 51.95 ha area will be backfilled followed by plantation and remaining 249.2021 ha excavated area will be under voids.

To protect the water reservoir following measures will be adopted:

- Construction of fencing (Length: 9150 m) along the mine lease periphery and bund along the periphery of the reservoir.
- Safety sign boards will be placed on the bunds.
- Retaining wall & Garland drains will be constructed around the working mine pits and dump to channelize rain water flowing into working mine pit.
- Regular monitoring of Ground water level & its quality will be carried out.

Table - 4.17
Summarization of Pit wise Water Accumulation

Year	Pit Id	Total Seepage (m ³ /annum)	Rainfall Accumulation (m ³ /year)	Evaporation Loss (m ³ /year)	Recharge Infiltration (m ³ /year)	Total Water available in pit after Evaporation loss (m ³ /year)	Total Water available in pit after Evaporation loss (m ³ /day)	Total Water available in pit after Evaporation loss (m ³ /day)
Year 1	P-1	71905	790739	194628	60385	607631	1665	1665
Year 2	P-1	80118	840907	206976	64472	649576	1780	1780
Year 3	P-1	81578	1161024	285768	86982	869852	2383	6896
	P-4	153118	2200213	541548	164733	1647049	4512	
Year 4	P-3	12228	188726	46452	14067	140435	385	5503
	P-4	136328	2546609	626808	187806	1868322	5119	
Year 5	P-3	21900	269950	66444	20430	204976	562	6118
	P-4	143080	2771169	682080	203997	2028172	5557	

Source: Comprehensive Hydrogeological Report.

The average rainfall recorded over the past 25 years is 3239.67 mm per annum. For water balance calculations, an annual evaporation loss of 2.1 m has been considered, based on an average pan evaporation of 3.0 m per annum and an assumed pan coefficient of 0.70.

Detailed Hydrogeological Study has been done and copy of same is enclosed as **Annexure XIX** with this Draft EIA/EMP Report.

4.5.3.4 IMPACT EVALUATION

Impact evaluation is given in table below:

Table - 4.18
Impact Evaluation for Water Environment

Impact Evaluation Element	Change in the water environment (quantity as well as quality of Surface and Ground water) due to the proposed Iron Ore mining project.			
Potential Effect/ Concern	Increase in water availability in the area due to development of water storage ponds, water recharge & Rainwater harvesting structures and catch drains in the mine area.			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
	√			
Type	Direct	Indirect	Cumulative	
		√		
Extent	Project Area	Local	Zonal	Regional
	√			
Duration	Short – term		Long- term	
	√			
Intensity	Low		Medium	High
	√			
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
				√
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

Thus, it can be concluded there will not be any adverse impact on the groundwater quality due to mining. The mineral formation does not contain any harmful element, which could percolate into the ground and pollute the groundwater.

4.5.4 IMPACT ON SOIL / LAND USE PATTERN & MITIGATION MEASURES

4.5.4.1 IMPACT ON SOIL ENVIRONMENT & MITIGATION MEASURES

Generation of Top Soil: No Top Soil is present within the ML Area, therefore, no impact on soil is envisaged due to mining operation and Beneficiation plant process.

At conceptual stage, 68.0 Million Tonnes of waste will be generated which will be used in backfilling in the mined-out area.

Disposal of Tailings: Tailings generated from Wet Beneficiation Process will be stacked in a safe & scientific manner. About 0.628 Million TPA of tailings will be generated in the form of filter press cake with a moisture content of approximately 10–12% and an Fe content of 27.83%. The generated tailings will be temporarily stacked in the designated area and subsequently transported for disposal at waste dump in accordance with the approved Mining Plan.

Possible Impacts

Mining process may impact the soil in the following ways:

- Excavation may alter the flow of nitrogen from a stable soil-plant-microbial ecosystem and will cause depletion of soil carbon pool.
- It can cause loss of litter layer which is an integral storage exchange site for nutrients which will cause the infertility of soil.

Protection Measures

- Water sprinkling will be done along the haul roads to control fugitive emission.
- At Conceptual Stage, greenbelt will be developed along 7.5 block periphery covering an area of 17.45 ha, 51.95 ha area will be backfilled and subsequently rehabilitated through plantation & regrassing, 6.87 ha on dump plantation and 26.1582 ha area under tailing dam rehabilitated by plantation.
- Thus, total Greenbelt/Plantation area is 102.4282 ha. 20% of the overall plantation is 20.49 ha from which 10.24 ha will be developed on the backfilled area and remaining 10.25 ha will be developed on tailing dam area using the Miyawaki plantation technique at an estimated development cost of Rs. 40 lakhs Capital Cost and Rs. 4.0 Lakhs/annum as Recurring Cost.
- Remaining (102.4282 – 20.49 = 81.9382 ha) will be developed as 2500/ha saplings. Thus, total nos. of saplings are 2,04,846 @2500/ha.
- The green cover will substantially help to prevent the soil erosion and also help in replenishing the carbon pool, flow of nitrogen and exchange of nutrients etc.
- Fugitive dust due to mining activities will be confined mainly within the lease area and will not impact the soil of buffer zone.
- Water sprinkling will be done along the haul roads to control the fugitive emission.

By adopting efficient dust suppression measures, the contamination of dust with soil will be avoided. Following measures will be taken to reduce the impact of mining on adjacent land with reference to run off, soil erosion and loss of top soil.

Run Off

Waste dump will be provided with proper garland drain & Retaining Wall at dump to prevent wash off from dump entering into surface drainage system.

Soil Erosion

The increased green cover will substantially prevent soil erosion. greenbelt will be developed along 7.5 m block periphery covering an area of 17.45 ha, 51.95 ha area will be backfilled and subsequently rehabilitated through plantation & regrassing, 6.87 ha on dump plantation and 26.1582 ha area under tailing dam rehabilitated by plantation. Plantation will be done @2500 trees/ha with survival rate of 80%.

4.5.4.2 LANDSCAPE AND LAND USE PATTERN

Revenue Record: As per revenue record the total area of the Codli Iron Ore Block-XII is 377.0881 ha which falls in Villages: Codli, Taluka: Dharbandora, South Goa District, (Goa). Out of the total block area; 236.3482 ha is Govt. revenue land, 58.9087 ha is Private Land, 15.8626 ha is Alvara land and 65.9686 ha is Forest land. The details of the land are given in Chapter 2 of this EIA/EMP Report.

Total 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land under clause (ii) of sub section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for Signing of lease Agreement in Respect of "Codli Mineral Block-XII" by M/s JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 12.09.2025 and under process.

There are no Biosphere reserve or corridor present within 10 of study area. 2 Wildlife sanctuaries are present that are:

- Bhagvan Mahavir Wildlife Sanctuary and Mollem National Park (~1.52 Km in SE) & ESZ of Bhagvan Mahavir Wildlife Sanctuary and National Park (~0.52 Km in SE).
- Bondla Wildlife Sanctuary (~6.5 Km in NNW) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW).

Approved Review of Mining Plan: Land use pattern of the lease area, Existing, operational (at the end of 5th year) and post-operational phases is given in table below:

Table - 4.19
Stage wise land use and reclamation area (in ha)

S.N.	Type of Land Use	At Present	At the end of Plan Period	At the end of life of Mine
1	Area Under Mining	209.7212	205.4212	301.1521
A	Excavated area (Backfilled)	51.9542	17.5251	51.95
B	Excavated area (Voids)	157.767	187.8961	249.2021
2	Dump Area	39.6666	39.6666	6.8700
3	Infrastructure	14.5597	14.5597	14.5597
4	Mineral Separation Plant	10.8981	10.8981	10.8981
5	Area Under Tailing	60.2069	64.5069	0
6	Greenbelt (7.5 m Safety Zone)	17.4470	17.4470	17.4500
7	Plantation (Stabilized Waste dump and tailing pond)	22.5491	22.5491	26.1582
8	Settling Ponds	2.0395	2.0395	0
Total		377.0881	377.0881	377.0881

Source: Approved Mining Plan with Progressive Mine Closure Plan

4.5.4.3 RECLAMATION PLAN FOR LAND USE

Reclamation of mine out area is planned in such a way that it could be beneficial to society in future after the closure of mine.

At Present: Out of the total ML area i.e. 377.0881 ha, Land under Mining is 209.7212 ha, out of which 51.9542 ha area is backfilled and remaining 157.767 ha excavated area will be under voids. Area under waste dumps is 39.6666 ha, area under Infrastructure (Workshop, administrative building etc.) is 14.5597 ha, area under Mineral Separation Plant is 10.8981 ha, area under tailing is 60.2069 ha and

area under 7.5 m Greenbelt along the Lease periphery is 17.4470 ha or area under plantation is 22.5491 ha and area under Settling Pond is 2.0395 ha.

Surface Plan of present land use is enclosed as **Annexure IV A**.

At the end of Plan year: Total excavated area will be 205.4212 ha out of which 17.5251 ha area will be backfilled followed by plantation and remaining 187.8961 ha excavated area will be under voids. Area under dump will be 39.6666 ha, area under infrastructure (Workshop, Admin Building etc.) will be 14.5597 ha, area for Mineral Separation Plant will be 10.8981 ha, area under tailing will be 64.5069 ha and area under 7.5 m Greenbelt along the Lease periphery will be 17.4470 ha or area under plantation will be 22.5491 ha and area under Settling Pond will be 2.0395 ha.

At Conceptual Stage: Out of total mining lease area i.e. 377.0881 ha, the total excavated area will be 301.1521 ha, out of which 51.95 ha area will be backfilled followed by plantation and remaining 249.2021 ha excavated area will be under voids. Area under infrastructure (Workshop, Admin. Building, etc.) will be 14.5597 ha, area for Mineral Separation Plant will be 10.8981 ha, area under dump rehabilitated by plantation will be 6.87 ha and area under 7.5 m Greenbelt along the Lease periphery will be 17.45 ha or area under tailing dam rehabilitated by plantation will be 26.1582.

At Conceptual Stage, total Greenbelt/Plantation will be carried out on 102.4282 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled rehabilitated by plantation, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation).

The company will adopt the measures for land reclamation and Ecology restoration in the lease area:

- Concurrent mining and mine reclamation activities will be practiced.
- Use of latest software for mine planning.
- Associating with various Research institutes, Consultants for mine reclamation projects.
- Associating with various technical departments of state govt like Forest, Agriculture, Fisheries, Water Resource etc.
- Regular Biodiversity Assessment and implementing of Biodiversity Management Plan to achieve a No Net Loss w.r.t biodiversity.
- Converting of mining pits into water reservoirs, pond with other ecotourism facilities like water sports, boating, fishing etc.
- Develop Pisciculture in mine pits and also involving the community for cage fishing to make it a commercially viable venture.
- Developing theme-based gardens like medicinal gardens, horticulture gardens, spice gardens.

Converting the mining infrastructure like office buildings, workshops etc. into public utility infrastructure like school, training centre, medical centre etc.

Conceptual Plan showing impact of change in land use is enclosed as **Annexure IVC**. Post-Mining Land Use of Core Zone with Environment Management for the mining area is given in Chapter 2 of this EIA/EMP Report.

4.5.5 IMPACT ON SITE FEATURES DUE TO MINING ACTIVITY & THEIR PROTECTIVE MEASURES

4.5.5.1 IDENTIFICATION OF IMPACTS ON LAND USE PATTERN DUE TO THE MINING ACTIVITY

The total mining lease area of the Codli Iron Ore Block-XII is 377.0881 ha which falls in Villages: Codli, Taluka: Dharbandora, South Goa District, (Goa). Out of the total block area; 236.3482 ha is Govt. revenue land, 58.9087 ha is Private Land, 15.8626 ha is Alvara land and 65.9686 ha is Forest land.

A. IMPACT ON FOREST AREA & ITS PROTECTION MEASURES

Status of Forest Clearance: Total 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land under clause (ii) of sub section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for Signing of lease Agreement in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026 and under process. Most part of the lease area is covered by Trees like *Acacia auriculiformis* (Earleaf acacia), *Artocarpus heterophyllus* (Jackfruit), *Azadirachta indica* (Neem), *Pterocarpus marsupium* (Asan), shrubs like *Calotropis gigantea* (Rui/Aak), *Lantana camara* (Tick berry) and Herbs like *Oscimum sanctum* (Tulasi), Grasses like *Cynodon Dactylon* (Dub) are also frequently found.

As per the Land use and Land Cover study, 20635.41 ha (51.38%) of Forest Land is present in the study area. However, other than Forest Land, major part of the study area comprises of Vegetation/Plantation (30.00%).

Possible Impacts

- The mining activities may have an impact on forest land due to tree cutting, if any.
- Mining activities result in generation of dust which may cause impact the vegetation.
- Land use of the lease area has been altered due to mining activities such as formation of pits, built up areas of office, workshop, crusher, greenbelt, water storage ponds, etc.
- Mining activities may have an impact of the Forest Land, Agriculture Land and Vegetation/Plantation cover falling in the study area due to Fugitive emissions and escaping of mine water from core area.

Protection Measures

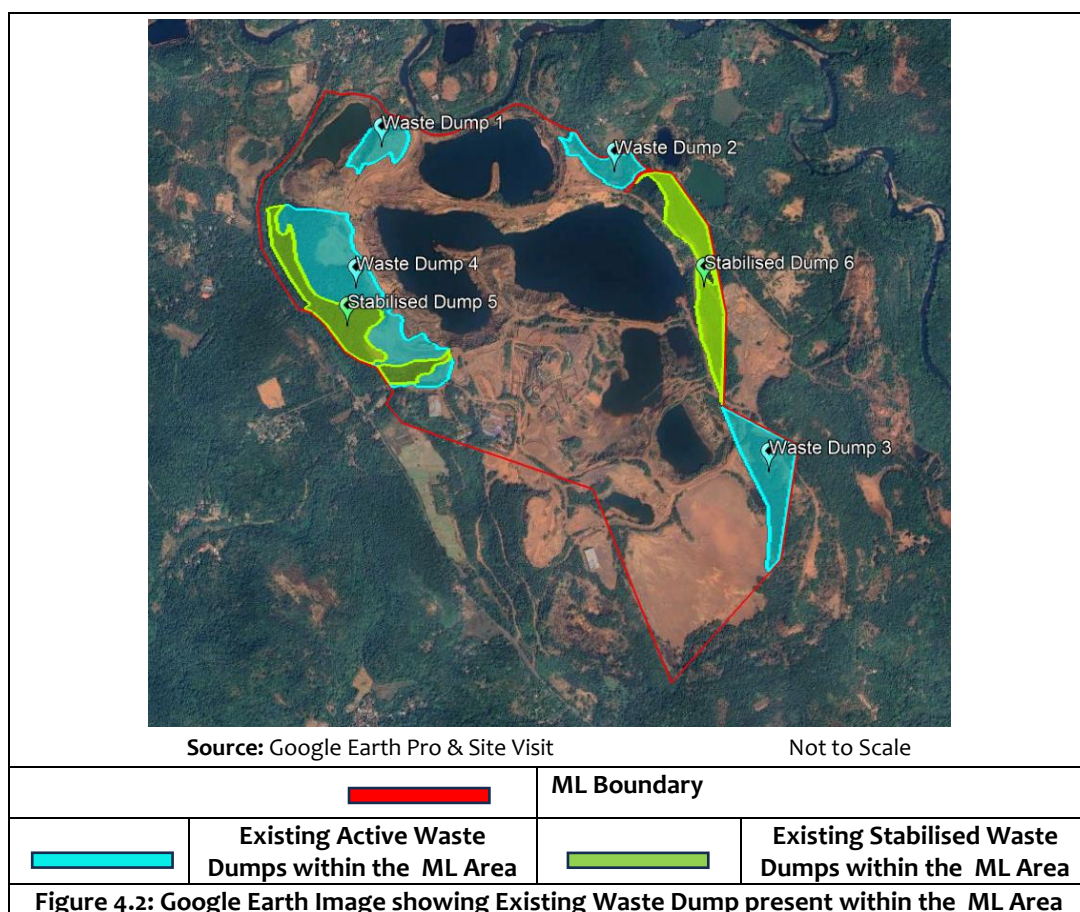
- This is a proposed project; no mining will be done in the Forest Land within first 5 years. Hence, no impact on the forest land due to loss of vegetation is envisaged during the plan period.
- During the planning stage, identification of waste storage area will be done based on slope and run-off characteristics.
- JSW Steel limited will plant trees on the stabilized waste dumps, in Safety zone and other areas within the ML area, in consultation with local Forest development.
- Reclamation and rehabilitation measures will be taken by means of stabilization and rehabilitation of the dumps by plantation, Greenbelt along the lease periphery, etc. At the conceptual stage, the total excavated area will be 301.1521 ha out of which 51.95 ha area will be backfilled followed by plantation and remaining 249.2021 ha excavated area will be under voids.

- The landscape is going to undergo a change due to mining activities. But yet there will be no loss of any RET flora & fauna on account of both vertical and horizontal expansion of mining.
- The reclamation & afforestation will be done in a manner exploring the growth of fruit bearing trees which will attract fauna and thus maintaining the biodiversity of the area.
- Mining activity will be confined to the mineralized zone and proper pollution control measures will be adopted to restrict the pollution load within the active zone in order to prevent any negative impact on nearby areas.

The Wildlife Conservation Plan for Schedule I species has been prepared & approval of the same is under process. Copy of the same is enclosed as **Annexure XIV**.

B. EXISTING DUMPS & ITS PROTECTION MEASURES

At present, there are total 06 waste dumps present within the mine area. Out of which, 04 are active waste dumps and 02 are stabilized waste dumps, contains 2.976 Million tonnes of OB/waste and occupying an area of total 22.55 ha within the mine site. The active waste dump currently contains approximately 8.96 Million tonnes of waste and occupies an area of about 32.23 ha within the mine site. During the plan period, approximately 23.43 Million tonnes of OB/Waste will be generated. This material will be disposed of in the proposed 02 new waste dumps (D4A and D7) covering an area of 46.84 ha and by extending the existing D4 waste dump. At the conceptual stage, approximately 68.0 Million tonnes of OB/Waste will be generated. The waste will be stored in surface dumps and subsequently utilized for backfilling of mined-out areas within the mining lease. The details of the existing waste dumps are given in the Chapter 2 of this EIA/EMP Report.



Protection Measures

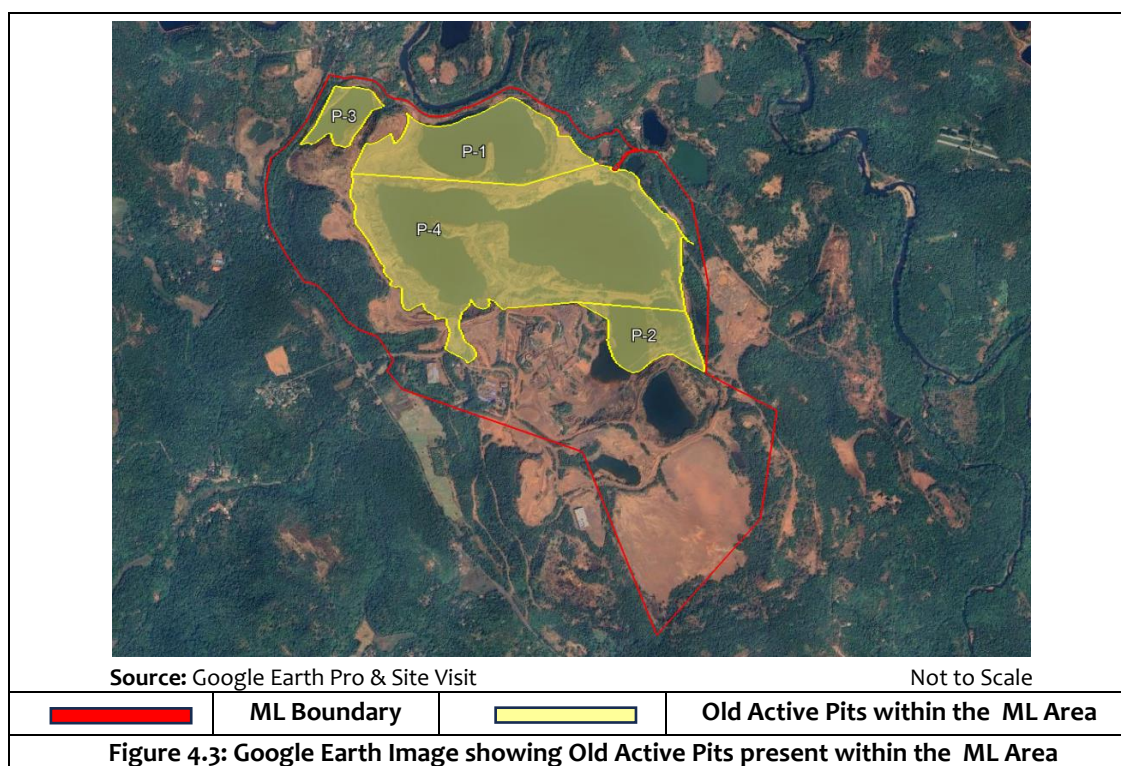
The following mitigative measures will be taken to protect the dumps from washout during rain:

- Garland drain (Dimensions: L* W*D= 1682 m x 1.0 m x 1.0 m) having a series of siltation pond will be provided at the toe of the dumps, to channelize the runoff water from dumps into the water reservoir (i.e. mined out pits).
- All the garland drains at the toe of the dump are proposed to be connected with a series of settling ponds which will ultimately allow the setting of silt from the water.
- Retaining wall (Dimensions: L* W*D= 1682 m x 1.5 m x 3.0 m) will be constructed around waste dump to control the surface run off.
- A stormwater drainage system will be developed and maintained regularly to ensure that water is efficiently channeled away from the dump area.
- Slope stabilization using geo-textiles where required.
- Biodegradable geotextile mats will be deployed on slopes prior to the onset of the monsoon season to mitigate surface erosion and enhance soil moisture retention.
- Regular de-siltation of drains, monitoring of runoff.

The Sections of all the waste dumps are enclosed as **Annexure IV C**.

C. EXISTING PITS

There is total 4 old active pits present covering 157.767 ha area with existing depth 146 m bgl within the mine lease. At the conceptual stage, out of total mining lease area i.e. 377.0881 ha, the total excavated area will be 301.1521 ha, out of which 51.95 ha area will be backfilled followed by plantation and remaining 249.2021 ha excavated area will be under voids.



Some mitigation measures will be adopted for prevention of illegal mining and pilferage of mineral which are as follows:

- Mining will be done as per the proposal in mining plan approved by Indian Bureau of Mines.
- Mining operation will commence only after getting all requisite statutory clearances.
- Mine boundary will be fenced by barbed fence/ earthen berms; wherever required.
- Creating information network with the locals so as to get prompt information about any illegal mining and / or pilferage of mineral etc.
- Educating local habitants through our various CSR initiatives so that they will not indulge in illegal mining.
- Display of caution sign boards at all prominent locations in the mining area. Such display boards will caution about "Dangerous and Prohibited Place" in local language.
- Company will deploy adequate number of Security guards at all the prominent / critical locations to monitor any illegal activity in mining area.
- Frequent and regular patrolling will be conducted by Security Supervisors deployed by the company.
- Stringent action to be taken against transport vehicles caught in the act of theft or pilferage.
- Training of existing security personnel, refresher training and basic training to new recruits in security discipline will be arranged for strengthening the security set up.
- Horizontal movement of executives with aptitude for security work and inducting qualified security personnel at junior, middle and senior levels.
- Entry/exit points will be manned by establishing proper check posts and barrier where all vehicles are physically checked.
- Surprise checks/raids will be conducted by flying squads of security department of company.
- Regular monitoring of land use as per MoEF&CC guidelines.

D. AGRICULTURE LAND & ITS PROTECTIVE MEASURES

- Out of the total mining lease area, 58.9087 ha area is Private Land. The land use of the core area will alter from Forest land and barren land to mining area including pits, waste dumps, crusher, greenbelt, plantation, water reservoir, etc. There is no agricultural land within the lease area.
- Rainwater Harvesting will be practiced in order to facilitate groundwater recharge, utilization of harvested rainwater to meet the water requirement of the proposed mining project and it will also help in increasing the overall agricultural productivity of the area.
- Total area under greenbelt & plantation will be 102.4282 ha which will include Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled rehabilitated by Plantation, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation. This will improve the greenery of the area. Total Greenbelt/Plantation area is 102.4282 ha. 20% of the overall

plantation is 20.49 ha from which 10.24 ha will be developed on the backfilled area and remaining 10.25 ha will be developed on tailing dam area using the Miyawaki plantation technique at an estimated development cost of Rs. 40 lakhs Capital Cost and Rs. 4.0 Lakhs/annum as Recurring Cost.

To reduce the impact on nearby agriculture fields due to mining, following mitigation measures will be taken:

- Mining activity will be confined to the mineralized zone and proper pollution control measures will be adopted to restrict the pollution load within the mine boundary in order to prevent any negative impact on nearby areas.
- Total Greenbelt/Plantation will be carried out on 102.4282 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation) which will act as a bio-filter and will help to control and confine the emission within ML boundary.
- Water Spray arrangement will be provided at crusher hopper and haul roads, loading & unloading areas to control the fugitive emission.
- Bag filter & Mist Fog arrangement will be provided at crusher.
- Garland Drains, check dams, etc. will be constructed to reduce the impact of erosion due to surface off.
- Transportation will be done by via Road in Tarpaulin covered Trucks.
- Ambient Air Quality Monitoring Stations will be installed.
- Training to farmers to grow the Cash crops to enhance agricultural growth. Seed distribution and training on vegetable production.
- Awareness for new methodologies of agricultural practices viz. mixed farming, crop rotation and agricultural cropping pattern suitable for the study area will be carried out to increase the agricultural productivity of the study area.

Adequate measures will be taken to control the pollutants within the mine area. Therefore, no adverse impact is envisaged in the study area.

E. IMPACT ON NEARBY SCHOOL & ITS PROTECTION MEASURES

The nearest School is Immaculate Conception High School (having 451 students & 18 Teachers) which is present at a distance of ~0.2 Km in NW direction from ML Boundary (~0.23 Km from UPL).

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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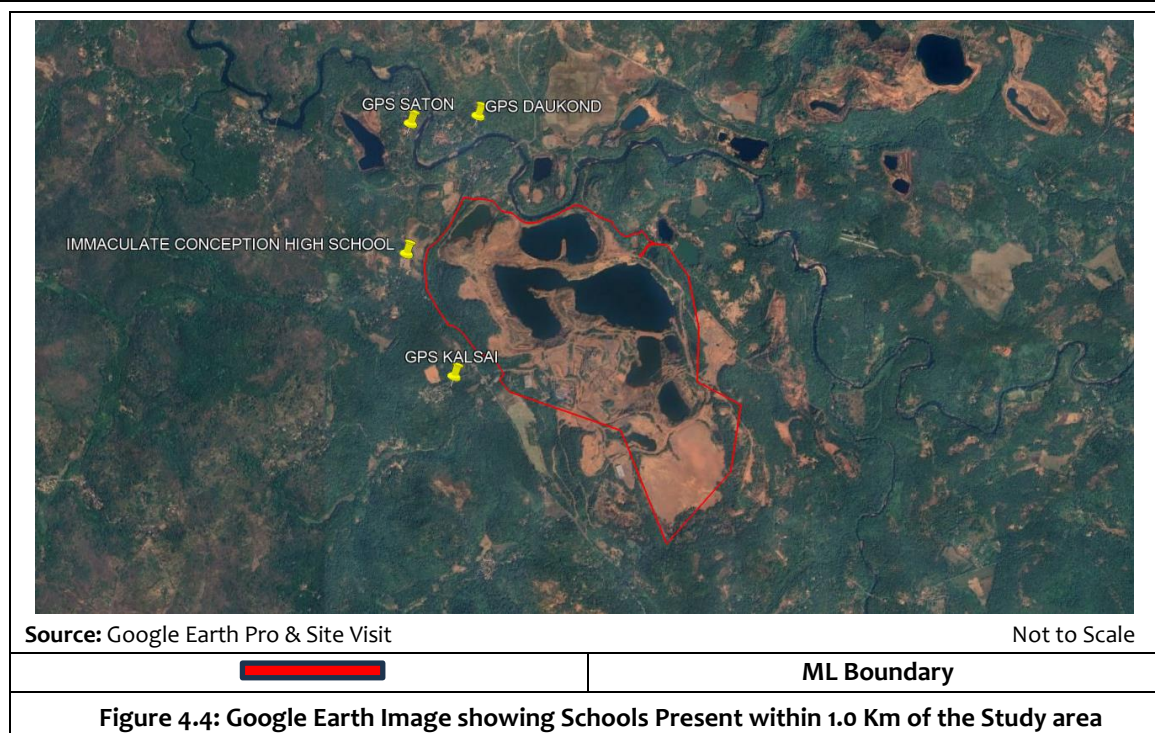


Table – 4.20
Details of School Present within 1.0 Km of the Study area

S.N.	School Name	Location	Distance from ML Boundary	Direction from Centre of ML area	Distance from UPL	Teachers	Students
1.	Immaculate Conception High School	Codli	~0.2 Km	NW	~0.23 Km	18	451
2.	GPR Kalsai	Kolsai	~0.4 Km	West	~0.42 Km	2	4
3.	GPS Daukund	Darkond	~0.6 Km	NNW	~0.65 Km	2	16
4.	GPS Saton	Saton	~0.7 Km	NNW	~0.75 Km	2	6

To reduce the impact of mining activities on schools following protection measures will be adopted:

- No Drilling & Blasting will be carried out. The capping of hard laterite cover and Hematite ore will be removed by deploying Eco-Friendly ripper dozer. The use of ripper dozer will eliminate the conventional drilling and blasting. Hence, no major impact is envisaged on the nearby school due to ground vibration and noise. However, JSW Steel Ltd. will adopt adequate measures to ensure protection of the school.
- Mining will be carried out as per the provisions outlined in mining plan approved by Indian Bureau of Mines (IBM) as well as by abiding to the guidelines of Director General Mines Safety (DGMS) and conditions mentioned in DGMS guidelines will be strictly followed.
- Fixed water sprinklers will be installed along the main haulage road and other roads will be regularly wetted with water tankers fitted with sprinklers. Crusher with G.I. sheet cladding and water sprinkling system at material transfer points will be provided.
- Greenbelt of 7.5 m will be developed along the periphery of ML and other safety zone area covering of 17.45 ha area which will act as bio filter and will avoid the adverse impact of the mining activities.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Chapter 4 of Draft EIA/ EMP Report

- Speed limit of vehicular traffic will be reduced airborne fugitive dust.
- Bag Filter & Mist Fog arrangement will be provided at Crusher to ensure adequate control of air borne dust. Besides this, mist fog canon will also be installed at the school for dust suppression.
- Fugitive dust emissions will be monitored regularly.

4.5.5.2 IMPACT EVALUATION

Impact significance is given in table below:

Table – 4.21
Impact Evaluation to determine the Significance
(Land use – during operation phase)

Impact Evaluation Element	Change in the land use due to mine development & operation			
Potential Effect/ Concern	Change in the land use of core zone due to mining activities i.e. Iron Ore mine development & operation activities.			
Characteristics of Impacts				
Nature	Positive*		Negative	Neutral
	√			
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
		√		
Duration	Short – term		Long- term	
			√	
Intensity	Low		Medium	High
			√	
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
				√
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

*Change in land use due to the mining activity at the conceptual stage will be positive as the land use of the mine area will be converted from agricultural and barren land to water reservoir, plantation area, public use area (at conceptual stage) due to Iron Ore mine development & operation activities.

4.5.6 SOCIO – ECONOMIC ENVIRONMENT

The potential impact on socio-economic environment due to this mining project is given in following heads.

4.5.6.1 POSITIVE IMPACTS

Employment:

Direct and indirect employment opportunities will be generated during mining operation and other allied activities. Employment generated by JSW Steel Limited will provide a safe working

environment for workers. Preference for employment will be given to locals based on need, eligibility and qualification. The total manpower requirement for the project will be 154 persons.

Further, additional employment will be generated through transportation of raw material, development of ancillary industries, local enterprises and in marketing in the form of distributors and retailers. Beside this, there is a huge potential for indirect employment opportunities such as drivers, repair shops etc. which can be availed by local people. Employment benefits are further detailed in Section 8.2.2 of Chapter 8.

Community Skill Development:

The local community will be benefitted from the training programmes that will be instituted by JSW Steel Limited to enable the community labor force to work for their livelihood/Self-growth. This training will improve their skill sets that will not only benefit JSW Steel Limited but also the community at large during and after the project life.

Improved Standard of Living:

Employment opportunities created by the project and skill development activities carried out under CSR, will increase income of local community and therefore improve the overall standard of living in the area. Presently, livelihood depends on agriculture & industry in the nearby area. After the execution of this mine, employment opportunities will be generated which will further help in improving the economic status & living standard of people.

Economic Exposure and Development:

Implementation of the project will make opportunities for sustainable livelihood, better infrastructure facilities and services available to the people. This will expose and introduce the local population to factors of economic development including the banking system, financial services and credit and investment schemes. The exposure will enable community members to invest their income and prevent dependency or living a life with a view of “tomorrow will take care of itself”.

Impact on Civic Amenities:

The impact of the proposed Iron Ore project on the civic amenities will be positive. With improved transportation facilities, educational facilities and other recreational facilities etc. there will be improvement in civic amenities. The communication facilities will also improve in the area.

Population Growth:

Preference will be given to local in employment. Hence, the project does not aim to contribute significantly in the population influx & only marginal population influx is designated for the proposed project.

4.5.6.2 ADVERSE SOCIAL IMPACTS

Health Impacts

The project of this nature triggers negative health impacts through increased dust, population influx which introduces new diseases in the area and put pressure on sanitation facilities. However, JSW Steel Limited will contribute in the development of basic infra-structural and sanitation facilities in

the area under its socio-economic development activities. Therefore, additional adverse health impacts will not be anticipated.

Noise and Vibration

The process of mining will entail excavation (without Drilling & Blasting), loading, crushing and transportation. Hence, impact due to noise and ground vibration caused by drilling & Blasting is not envisaged. Other activities like loading, movement of HEMM, Crushing, etc. will not generate major noise and vibration. The impact of noise and vibration from the epicentre of these activities could have effects on the population living around these areas. Proper mitigation measures will be taken in order to minimize the impacts.

Livelihood Change

Due to the labor intensity of the mining sector, the project will attract the more able-bodied persons i.e. comparatively skilled persons from the community which in turn will lead to low labor availability in other sectors of the economy including agricultural, labor-intensive jobs etc.

Population Growth

This project will not have any substantial impact on the population growth. The proposed Iron Ore mining project will generate employment opportunities for the people of nearby villages and families rendering positive impact on the area on the whole.

However, mitigation measures proposed for the project will prevent any negative impact on health of villagers, population growth and livelihood change.

4.5.6.3 MITIGATION MEASURES

Mitigating Health Impacts

As mentioned above, the predicted incremental GLCs for various air pollutants will be restricted within the mining lease area and the impacts will be negligible on the nearby villages. Nevertheless, awareness programmes on health hazards will be conducted to create awareness amongst the employees as well as the local population. JSW Steel Limited will extend its CSR activities in the area of Health facilities by means of providing primary health services covering nearby villages through health extenders, in conjunction with government and NGOs. It is also planned to focus on infrastructure improvement of the existing PHCs and SHCs of the nearby area. Development of greenbelt/plantation will also act as bio-filters.

Health Care Facilities

Proper health care facilities will be provided to the employees of proposed Iron Ore mining project along with their families. The medical facilities in form of primary medical camps will also be extended to local people in the nearby areas under socio-economic development/CSR activities.

Managing Loss of Livelihood and Income

It is proposed that entire required land within the mine shall not be acquired in one go. Land purchasing shall be done in phases as per the requirement for mining purpose. This is proposed in order to ensure minimal disturbance of the land & associated people. In the proposed mining activities, preference to the suitable land outsees & agricultural labourer would be given for employment opportunities etc., in various sectors based on their capabilities.

The Company will organize vocational training, entrepreneur development programmes for the PAFs including women members and will provide advice for starting suitable small-scale industry. JSW Steel Limited will encourage entrepreneurship amongst PAFs or their qualified family members by awarding services, contracts for activities such as canteens, vehicle hiring, maintenance of gardens, office services and cleanliness, courier services, and material supplies.

To cushion the local population against impacts of mine closure, adequate advance intimation will be given to employees and contractors to allow them to source alternative opportunities. Skill development programmes will also be undertaken by JSW Steel Limited to ensure sustainable livelihood for people of the nearby areas.

4.5.6.4 IMPACT ON HUMAN SETTLEMENT AND RESETTLEMENT & REHABILITATION ACTION PLAN

4.5.6.4.1 IMPACT ON HABITATION & ITS PROTECTION MEASURES

The area of proposed mine 377.0881 ha located at Village - Codli, Taluka: Dharbandora, District: South Goa (Goa). There is not any village habitation present within the lease area. Hence, the mining activities do not involve any displacement of Human Settlement. The nearest habitation outside the lease area is Village Codli which is approximately 0.01 Km from the ML boundary in NNW direction from the Centre of ML Boundary. The mining operations will not disturb/relocate any Village. In view of this, there are no R&R issues. Therefore, no impact on human settlement is envisaged. Nearby villages present within ~1.0 Km of study area are given below:

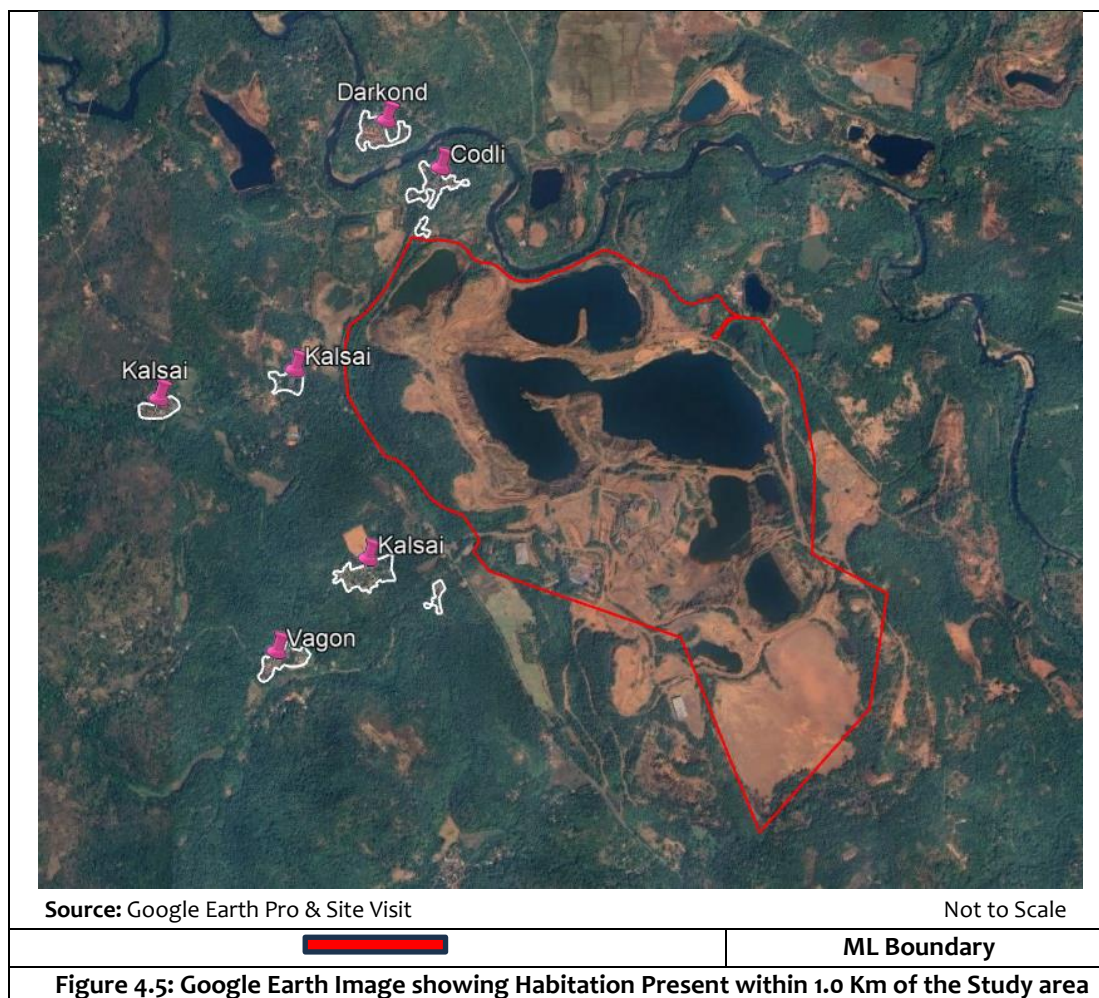


Table – 4.22
Details of Habitation Present within 1.0 Km of the Study area

S.N.	Village Name	Distance from ML Boundary	Direction from Centre point of ML area	Distance from UPL
1.	Codli	~0.01 Km	NNW	~0.06 Km
2.	Kalsai	~0.20 Km	West	~0.25 Km
3.	Darkond	~0.45 Km	NNW	~0.50 Km
4.	Vagon	~0.90 Km	SW	~0.95 Km

Possible Impacts

- The mining activities may have an impact on humans, causing loss of sleep due to noise and light.
- Mining activities result in generation of dust which may cause impact the human health.
- Exposure to dust and other pollutants may lead to various skin-related diseases among the local population.
- Prolonged inhalation of dust generated during mining activities may cause respiratory ailments among nearby residents.

Protection Plan for nearby Habitations

- Mining will be carried out as per the provisions outlined in mining plan approved by Indian Bureau of Mines (IBM) as well as by abiding to the guidelines of Director General Mines Safety (DGMS) and conditions mentioned in DGMS guidelines will be followed strictly.
- As per the micro-meteorological data, the pre-dominant wind direction throughout the year was observed to be from South West direction, while the Seasonal pre-dominant wind direction was observed to be from North West. A few habitations are located within a 2.0 Km radius in the downwind directions i.e., the North East (for the South West wind) and South East (for the North West wind), from the mining lease boundary.
- No drilling and blasting activities are proposed in the project. The nearest educational institution, Immaculate Conception High School, is located approximately 0.2 km towards the north-west of the Mining Lease (ML) boundary. The project will adopt an opencast mechanized mining method and the use of a ripper dozer will eliminate the need for conventional drilling and blasting operations. Therefore, no significant impact on the nearby school is anticipated. Nevertheless, the company will implement all necessary mitigation and safety measures to ensure the continued protection and well-being of the students, staff and surrounding environment.
- Regular ambient air quality monitoring and noise level monitoring will be carried out in Core and buffer zone and sensitive receptors.
- All measures will be adopted to control fugitive dust emission during mining operation and to ensure no impact on nearby habitation.
- Main haulage road and other roads shall be regularly wetted with water tankers fitted with sprinklers. Crusher with G.I. sheet cladding and water sprinkling system at material transfer points will be provided.

- Greenbelt/Plantation will be carried out in area of 102.4282 Ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha backfilled area on rehabilitated by plantation, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation).
- Ambient Air Quality & Noise Levels will be monitored regularly in the nearby villages.
- Best Mining Practices will be adopted for the given mining conditions.
- Adequate number of retaining walls /structures will be constructed. Garland drains and settling ponds will be provided in the mining area to arrest the wash-off with rain water in catchment area.
- The natural water bodies and/or streams which are present in the study area will not be disturbed.
- A provision for regular monitoring of water table in open dug wells located in the nearby villages by establishing Piezometer has been incorporated to ascertain the impact of mining over ground water table and to plan mitigative measures.
- Biological clock of the Villagers will not be disturbed by orienting the flood lights/masks away from the village and keeping the noise levels within the prescribed limits for day and night hours so that it will not affect the health in villages located close to mining operations. Regular health surveillance will be undertaken.
- Main haulage road in the mine will be provided with permanent water sprinklers and other roads will be regularly wetted with water tankers fitted with sprinklers.
- It will be ensured that the productivity of agricultural crops is not affected due to mining operations.
- No road movement will be undertaken in existing village road network without appropriately increasing the carrying capacity of such roads.
- Alteration or re-routing of foot paths, pagadandis, cart roads and village infrastructure /public utilities or roads will be avoided to the extent possible and in case such acquisition is inevitable, alternative arrangements shall be made first and then only the area acquired.
- Socio economic development of the neighbourhood habitats has been planned based on the need-based survey and will be executed as per the recommendation of the plan.

4.5.7 PUBLIC HEALTH IMPLICATION

The most common diseases in the region are viral fever, common cold and cough, stomach disorder etc. which are prevalent amongst the villagers. None of these can be related to the project and allied activities of the project. However, Proper Preventive/control measures will be taken by JSW Steel Ltd. to reduce the impact of mining activities on public health and to improve the public health of the area.

The following are some of the significant points for consideration under public health:

- Mining will be carried out by adopting all adequate protection measures with advanced techniques; like fugitive dust suppression techniques, development of greenbelt/plantation, water sprinkling on haul road etc.

- PPEs will be provided to the workers working in high dust zone and development of greenbelt and plantation will be adopted.
- A full-fledged First Aid Centre will be established to provide medical facilities to the employees/workers.
- Employees when inducted will be medically examined. Further, they will also be medically examined at periodical interval.
- Efforts will be made to improve the hygiene, sanitation, education and infrastructure of the nearby villagers under CSR activities.
- Proper sanitation facilities will be provided to the mine workers organizing camps such as Family planning camp, free medical checkup camp, eye camp, Pulse polio camp etc.
- Organizing vaccination programs such as Hepatitis-B vaccination, Typhoid vaccination, MMR vaccination.
- Construction of toilets in Schools, Public Place etc.
- Regular Ambient air quality monitoring, noise monitoring & water quality analysis will be carried out.

4.5.7.1 IMPACT EVALUATION

Impact significance is given in table below:

Table - 4.23

Impact Evaluation to determine the Significance

Impact Evaluation Element	Impact on socio-economic environment due to the Iron Ore mining project			
Potential Effect/ Concern	Improvement in socio economic conditions of the settlements falling nearby Villages			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
	√			
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
		√		
Duration	Short – term		Long- term	
			√	
Intensity	Low		Medium	High
			√	
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
				√
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

4.5.8 IMPACT ON LOCAL TRANSPORT INFRASTRUCTURE

Movement of dumpers for mineral transport from mine face to crusher may emit gaseous emissions which will be maintained within the mine premises by using efficient control measures. The Iron ore will be transported to crushers (3 Primary Crushers: 1 x 250 TPH & 2 x 90 TPH capacity and 1 Secondary crusher: 150 TPH) with the help of 40 Tonnes capacity dumpers via Haul Road. Total trips of 40 Tonnes capacity of dumpers required for transport of 11667 TPD Iron Ore from mine face to crusher will be 292 numbers (one sided).

The Iron ore mined out from this Mine will be supplied to JSW Steel Plant and or sold in open market like Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant. Transportation of iron ore from mine to end users will be by road via tippers.

The Iron Ore will be transported from Mine to Jetties or Railway Siding via SH-7 and connecting Village Road through tippers of 11.5 Tonnes capacity via road.

Table – 4.24
Details of proposed Transportation Routes

S.N.	Road Name	Transportation Method	Road Length	Avg. Road Width
1.	SH – 7 (Road connecting mine lease to Capxem)	Capxem Jetty, Andre Minescape, Bandekar Jetty, TPL and Fomento	~14.0 Km	8-12 m
2.	Village Road (Connected SH-7 to Costi)	Kalay Siding	~3.5 Km	7 m
3.	Village Road (Connected SH-7 to Pauskar Yard)	Private Siding	~2.6 Km	7 m
4.	Village Road (Connected SH-7 to TPL)	TPL	~0.65 Km	9 m
5.	Village Road (Connected SH-7 to Capxem Jetty)	Capxem Jetty	~0.4 Km	9 m
6.	Village Road (Connected SH-7 to Fomento, Andre Minescape and Bandekar Jetty)	Fomento, Andre Minescape & Bandekar Jetty	~2.0 Km	7 – 9 m

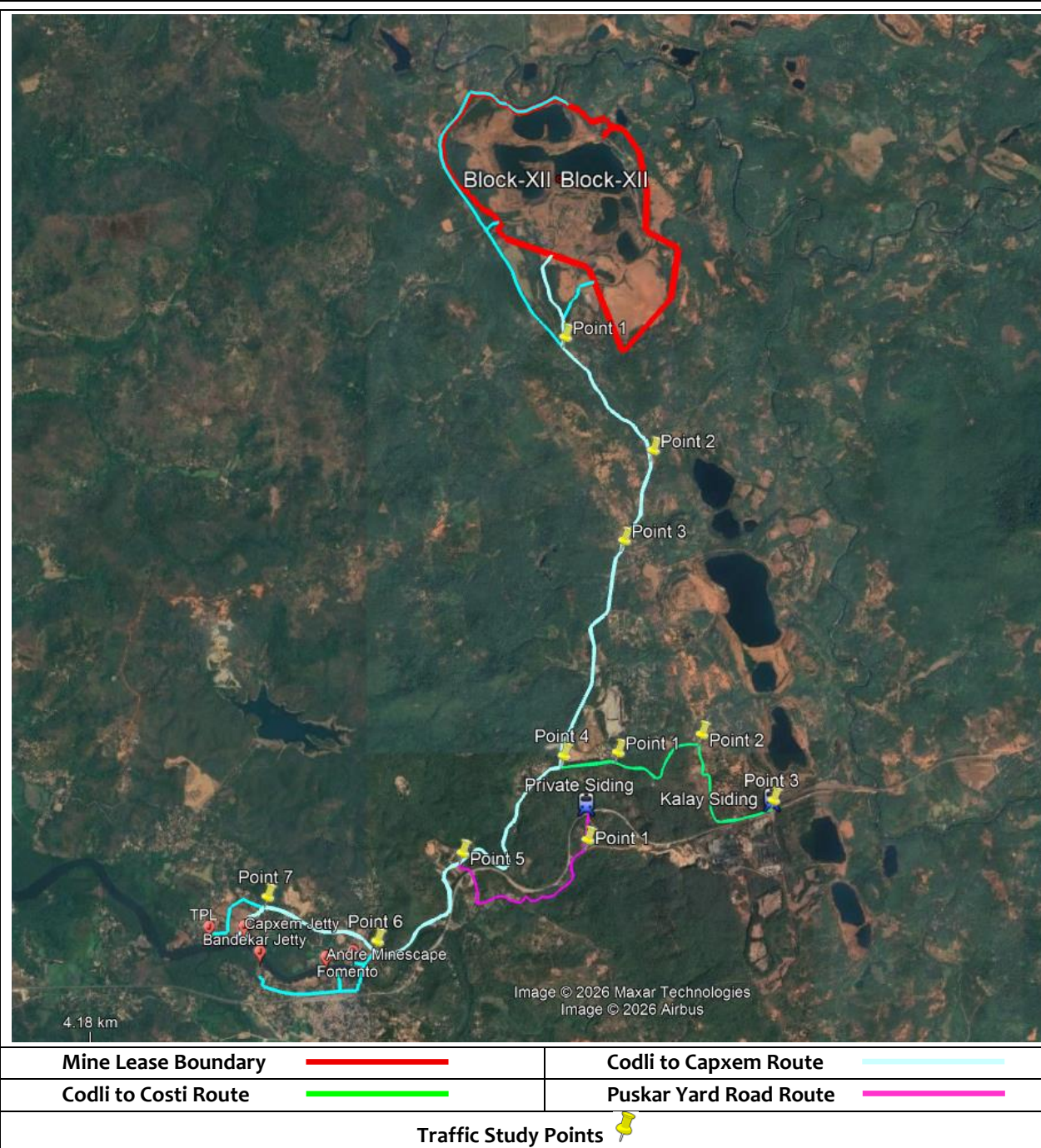


Figure 6: Google Earth Image Showing the Transportation Route & Traffic Survey Points

Existing Traffic Survey:

Traffic survey has been conducted at the 3 connecting road i.e., ~ 14 Km in length with ~8 m to 12 m width of Codli to Capxem Route, ~ 9.8 km in length with 7 m width of Codli to Costi Route and ~ 11.1 km in length with 7 m width of Puskar Yard Road Route at the project site. The traffic survey monitoring was done in the month of May, 2025 to predict the future traffic growth and the load on the road and surroundings due to proposed mining project. The points of study were decided on the basis of transportation route of mineral.

The traffic study was conducted at 11 points along three different routes to assess the impact of the proposed project. Initially, four points on the Codli–Capxem route are common for all three routes.

After Point 4, one route branches toward Costi, referred to as the Codli–Costi route, which is 3.5 km long and includes three traffic study locations. From the same junction of Point 4, the route continues to Point 5, from which the third route known as the Puskar Yard Road route which extends for approximately 2.6 km, with one traffic study location along it.

The existing scenario and LOS (Level of Service) have been calculated for the Traffic survey locations for all routes as per the IRC guidelines and the details are given below:

Table – 4.25
Existing Traffic Scenario & Level of Service

ROAD	Volume (PCU/Day)	C (DSV in PCU/Day)	EXISTING V/C RATIO	LOS
1. Codli to Capxem Route				
Point No. 1	1635.5	15000	0.11	A
Point No. 2	1824	15000	0.12	A
Point No. 3	1602	15000	0.11	A
Point No. 4	1585	15000	0.11	A
Point No. 5	1949	15000	0.13	A
Point No. 6	2144	15000	0.14	A
Point No. 7	2128	15000	0.14	A
2. Codli to Costi Route				
Point No. 1	609	15000	0.04	A
Point No. 2	613	15000	0.04	A
Point No. 3	412	15000	0.03	A
3. Road Pauskar Yard Route				
Point No. 1	1094	15000	0.07	A

*Recommended Service Volume for two lane road and single lane road as per IRC guidelines for capacity of rural roads in plain areas (IRC 064-1990).

Table – 4.26
Capacity as per IRC: 064-1990

V/C	LOS (Level of Service)	Performance
0.0-0.2	A	Excellent
0.2-0.4	B	Very Good
0.4-0.6	C	Good/ Average/Fair
0.6-0.8	D	Poor
0.8-1.0	E	Very Poor
>1.0	F	Highly Unstable (Free Flow = 0)

Additional Traffic due to Proposed Mining Project

Two scenarios have been considered for the transportation of Iron Ore, i.e., transportation through jetties and railway sidings. In the initial scenario, a total quantity of 3.5 Million TPA of Iron Ore will be transported through jetties until the railway siding becomes operational. Subsequently, upon commissioning of the railway siding, 1.5 Million TPA of Iron Ore will be transported through the

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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railway mode. Accordingly, the quantity of Iron Ore transported by jetties will be reduced, which will consequently result in a reduction in emissions associated with road transportation.

In first to fifth year of operation, proposed traffic density has been given below:

Table – 4.27
During Plan period of mine operations (3.5 MTPA) through Road via Jetty

S.N.	Particular	Details at Normative Capacity	Details at Peak Stage @20%
1.	Capacity of mine (TPA)	3500000	3500000
2.	No. of working days	237	237
3.	Capacity of tippers for Transportation of Mineral (Tonnes)	11.5	11.5
4.	Transportation of Mineral (Tonnes per day)	14767.9	17721.5
5.	No. of trips (filled)	1284.17	1541.00
6.	No. of trips/day (to & from)	2568.3	3082.0
7.	Increase in PCU's per hour for roads as per IRC: 064-1990 guidelines	7705.0	9246.0

Table - 28
During Plan period of mine operations (1.5 MTPA) through Road via Railway Sliding

S.N.	Particular	Details at Normative Capacity	Details at Peak Stage @20%
1.	Capacity of mine (TPA)	1500000	1500000
2.	No. of working days	237	237
3.	Capacity of tippers for Transportation of Mineral (Tonnes)	11.5	11.5
4.	Transportation of Mineral (Tonnes per day)	6329.1	7594.9
5.	No. of trips (filled)	550.36	660.43
6.	No. of trips/day (to & from)	1100.7	1320.9
7.	Increase in PCU's per hour for roads as per IRC: 064-1990 guidelines	3302	3963

The modified Traffic scenario and LOS values after expansion for traffic survey locations at all three routes are given below:

Table – 4.29
Modified Traffic Scenario & LOS (At Normative Capacity)

S.N.	Locations	Increased PCUs	V	C	Modified V/C Ratio	LOS
1. Codli to Capxem Route						
1.	Point 1	7705	9341	15000	0.62	D
2.	Point 2	7705	9529	15000	0.64	D
3.	Point 3	7705	9307	15000	0.62	D
4.	Point 4	7705	9290	15000	0.62	D
5.	Point 5	7705	9654	15000	0.64	D
6.	Point 6	7705	9849	15000	0.66	D

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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7.	Point 7	7705	9833	15000	0.66	D
2. Codli to Costi Route						
1.	Point 1	3963	3911	15000	0.26	B
2.	Point 2	3963	3915	15000	0.26	B
3.	Point 3	3963	3714	15000	0.25	B
3. Road Pauskar Yard Route						
1.	Point 1	3963	4396	15000	0.29	B

Table - 30

Modified Traffic Scenario & LOS (At Peak Stage @20%)

S.N.	Locations	Increased PCUs	V	C	Modified V/C Ratio	LOS
1. Codli to Capxem Route						
1.	Point 1	9246	10882	15000	0.73	D
2.	Point 2	9246	11070	15000	0.74	D
3.	Point 3	9246	10848	15000	0.72	D
4.	Point 4	9246	10831	15000	0.72	D
5.	Point 5	9246	11195	15000	0.75	D
6.	Point 6	9246	11390	15000	0.76	D
7.	Point 7	9246	11374	15000	0.76	D
2. Codli to Costi Route						
1.	Point 1	3963	4572	15000	0.30	B
2.	Point 2	3963	4576	15000	0.31	B
3.	Point 3	3963	4375	15000	0.29	B
3. Road Pauskar Yard Route						
1.	Point 1	3963	5056	15000	0.34	B

TRAFFIC PROJECTION DUE TO INCREASED TRAFFIC MOVEMENT

- Due to the proposed project, there will be addition of Heavy and Light motor vehicles in the existing traffic load.
- During the plan period, the production capacity of the mine is 3.5 Million TPA. Mineral transportation is considered through the road network using 11.5-tonne capacity tippers, with provision for transportation through the proposed railway siding. The road-transport calculations in the correction sheet consider 237 working days and a 20% peak-stage increase.
- The LOS value for the traffic survey conducted for Codli to Capxem Route is 'D', Codli to Costi route is 'B' or Codli to Road Pauskar Yard route is 'B'.
- The corrected existing V/C ratios for the seven Codli–Capxem points are 0.109, 0.122, 0.107, 0.106, 0.130, 0.143 and 0.142, all falling in LOS category “A” (Excellent).
- The corrected existing V/C ratios for the three Codli–Costi points are 0.041, 0.041 and 0.027, all falling in LOS category “A” (Excellent).
- The corrected existing V/C ratio for the Road Pauskar Yard point is 0.073, falling in LOS category “A” (Excellent).

The modified Traffic scenarios and LOS values for traffic survey locations have been calculated in order to assess the additional traffic load on transportation route. Based in the modified LOS values for all traffic locations on Codli to Capxem Route, Codli to Costi Route and Road Pauskar Yard route LOS will decrease. Hence, the company will strengthen the road first wherever required, after which transportation will be carried out.

4.5.8.1 MEASURES FOR TRANSPORTATION

The following necessary mitigation measures will be adopted during transportation of Iron Ore:

- Widening and strengthening works will be done public road to increase load-bearing capacity and safety before the beginning of transportation of the mineral and this will be done in consultation with the concerned authorities.
- Plantation will be done along the dedicated transportation route and also at railway sidings.
- Transportation vehicles will be properly maintained to minimize the exhaust emission.
- The company will explore the feasibility of incorporating Electric Vehicles during transportation of mineral which may facilitate in reducing the environmental impacts in line with sustainability targets and regulatory requirements.
- Prior approval for transportation route and Transit permit will be taken from Directorate of Mines & Geology before the commencement of the Transportation activities.
- Wheel-washing facilities will be installed at exit points of mines to avoid transporting mud and dust onto public roads.
- Regular road repairs, pothole fixing and shoulder tar-sealing improve safety for all road users. This will also reduce wear-and-tear from heavy truck loads.
- Regular tests will be carried out to check exhaust emission and PUC certification of transportation vehicles at prescribed interval.
- Transportation trucks will be loaded with prescribed capacity and covered with tarpaulin before leaving mines premises.
- Regular monitoring of the emission levels will be done.
- Clear signages will be installed indicating heavy vehicle movement zones, speed limits and pedestrian crossings.
- Traffic Marshals will be provided for regulating movement of vehicles as well as for safety of persons.
- Training will be given to all drivers about safe and environment friendly driving.
- Regular water sprinkling on mine haul roads during transportation and also at transfer points.
- Used of fixed dust suppression system on haul roads.
- Dedicated manpower will be provided to clean the ore spillage on the public road by manual sweeping and washing.
- Use of mechanized road sweeping machine for cleaning the public road and also at railway sidings.

- Overloading and Over-speeding will be avoided.
- Proper maintenance, oiling and greasing of vehicles will be done.
- All haul roads within mines will be maintained properly by using motor grader & soil compactor in order to minimize the impact of mineral transportation.
- Un-necessary blowing of horn will be avoided.
- Installation of metal windscreens at Railway Sidings.
- Greenbelt and Plantation will be done along ML boundary, waste dumps, tailing dam area, near utility area and railway sidings.
- Proper protective and safety measures will be implemented along the railway route in accordance with the guidelines and safety requirements prescribed by the Ministry of Railways.
- Regular air quality monitoring will be done.

Recommendations & Suggestions:

- In the proposed Block -XII Codli Iron Ore Mine, the transportation of the Iron Ore will be done via SH-7 and connecting Village Road; up to Capxem, TPL, Fomento, Andre Minescape and Bandekar Jetty or by proposed Railway Sidings.
- While the modified Level of Service (LOS) values have been derived by accounting for both normative and peak capacities to anticipate worst-case scenarios, it is advisable that mineral transportation be undertaken at normative capacity. This approach ensures operational efficiency while allowing flexibility to accommodate occasional exigencies.
- Mineral transportation will be carried out in strict compliance with the Standard Operating Procedure (SOP) prescribed by DMG and GSPCB.
- It is advisable to have 1.5 m width of paved shoulders with a provision of 1.0 m earthen Shoulders on the roads to be utilized for transportation of mineral.
- Monitoring stations along the transportation Route will be identified in consultation with Goa State Pollution Control Board.
- Plantation will be done along the roads to minimize the impacts due to generation of dust and noise during transportation.
- Plant species such as *Albizia lebbeck* (Siris, Karo Sirish), *Alstonia scholaris* (Satani) *Azadirachta indica* (Neem), *Artocarpus heterophyllus* (Jackfruit), *Dalbergia sissoo* (Shisham), *Ficus religiosa* (Peepal, Piplo), *Syzygium cumini* (Jamun), *Terminalia tomentosa* (Marat (Matti), *Terminalia arjuna* (Arjun), etc. have been suggested for plantation along the roads. Besides these species, other native and fruit bearing species will also be planted in consultation with horticulture & local Forest Department.

4.5.8.2 IMPACT ON HABITATION LOCATED WITHIN 100 M FROM THE CENTRE OF ROAD ON BOTH SIDES

The habitation located within a distance of 100 m from the centre line on both sides of the road are Village Codli, Village Savargal, Village Morkani, Village Bandoli, Village Santona, Village Rumbrem, Sanvardem that may experience impacts due to increased transportation activities associated with the project. The likely impacts are summarized below:

- **Air Pollution:** Movement of mineral transportation vehicles may generate dust emissions, particularly during dry weather conditions, which can affect the ambient air quality in nearby residential areas.
- **Noise Pollution:** Increased vehicular movement may lead to higher noise levels due to engine operation, honking, loading/unloading activities and road vibrations, causing disturbance to nearby inhabitants.
- **Traffic congestion and safety risks:** Additional transportation vehicles may increase traffic density, leading to congestion, inconvenience to local commuters and potential road safety concerns for pedestrians and residents.
- **Road vibration:** Continuous movement of heavy vehicles may create vibrations, especially on village or narrow roads, which may affect nearby structures over a prolonged period.
- **Impact on human health:** Prolonged exposure to dust and noise may cause discomfort and minor health-related issues to the local population if adequate mitigation measures are not adopted.
- **Impact on daily activities:** Local residents, schools, shops and community facilities situated near the road corridor may face temporary disturbances during transportation hours.

Mitigation measures for the same are given below:

- Transportation will be done under rules and guidelines prescribed by DMG.
- Vehicles will comply with applicable emission norms and possess valid Pollution Under Control (PUC) certificates.
- All mineral-carrying trucks will be covered with tarpaulin to prevent spillage and fugitive dust emissions.
- The transportation road will be maintained in good condition to minimize dust generation and vehicle-induced vibrations.
- Overloading of vehicles will be strictly prohibited to prevent material spillage and road deterioration.
- Wheel washing/cleaning facilities will be provided at the mine exit to prevent mud and dust from being carried onto public roads.
- Unnecessary honking will be prohibited near villages, schools, hospitals and other sensitive receptors. Vehicles will be fitted with properly functioning silencers.
- Adequate warning signboards, speed breakers, reflective road markings, and cautionary signs will be provided at critical locations.
- Drivers will be trained on safe driving practices, adherence to speed limits, and road safety regulations.
- Awareness programs on road safety will be conducted for nearby communities, and coordination will be maintained with local authorities for effective traffic management.
- Regular air quality and noise level monitoring will be done.

A detailed traffic study report has been prepared and copy of the same is enclosed as **Annexure XX**.

4.5.8.3 IMPACT EVALUATION

Table - 4.31
Impact Evaluation for Transportation Infrastructure

Impact Evaluation Element	Change in traffic density due to transportation of mineral to end users via Road to the Jetties and Railway siding.			
Potential Effect/ Concern	Increased load on existing transport infrastructure, Noise and air emissions due to transportation of mineral via Road.			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
			√	
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
			√	
Duration	Short – term		Long- term	
	√			
Intensity	Low		Medium	High
			√	
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
				√
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

4.5.9 IMPACT ON BIOLOGICAL ENVIRONMENT

Habitat loss, degradation and fragmentation are important causes of known species-population extinctions. The main cause of degradation and depletion of forests and wildlife are the human activity (anthropogenic pressure). Population explosion, over exploitation of forest resources, urbanization, unscientific management, encroachment of forest land, illicit felling, lack of regeneration of forests and outdated laws are major factors responsible for the degradation and depletion of forests. Details are given in the follow up points.

4.5.9.1 IMPACT ON FLORA

Core Zone (Block Area): The total mining lease area is 377.0881 ha (Govt. revenue land – 236.3482 ha, Private land – 58.9087 ha, Alvara land – 15.8626, Forest land – 65.9686 ha). Total mine lease area is 377.0881 ha, out of which 65.9686 ha of Forest Land falls within the Mine Lease Area. Application for approval of forest land for non-forest purpose under clause (ii) of sub section (1) under section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 in Respect of "Block-XII Codli Mineral Block" by JSW Steel Ltd. under South Goa District/Division of Goa is submitted on PARIVESH portal on 23.02.2026. At present, application is pending at MS for Acceptance in PSC-I.

There are herbs, shrubs & scattered trees are present within proposed mine. Mining will involve removal of vegetation prior to soil dozing and excavation of mineral. 2000 numbers of trees will be cut during mining in the area. As a part of compensatory plantation program, total 256071 trees will be planted within the mining lease area. Plantation will be developed in the mining lease area as per plantation programme. These activities help to improve the floral cover of the area. The greenbelt and plantation development will eventually attract micro fauna, birds etc. in the area which will also have positive impact.

Buffer Zone (10 km radius Study area): No adverse impact is envisaged on the existing flora in the buffer zone, as there will be no deforestation in the buffer zone by mining operation.

4.5.9.2 IMPACT ON FAUNA

There are no national park, biosphere reserve or corridor present within 10 km radius of the mining lease area. However, 2 Wildlife Sanctuaries and Mollem National Park are present:

- Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE)
- Bondla Wildlife Sanctuary (~6.5 Km in NNW) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW)

Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025. Copy of the same is enclosed as **Annexure VI**.

There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur/Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site.

For the conservation of these species Wildlife Conservation Plan has been prepared. The list of Flora and Fauna has been prepared and submitted to DCF for authentication on dated 03.08.2026. Copy of the same is enclosed as **Annexure V**. Wildlife Conservation Plan for protection of all the schedule - I species has been prepared and submitted to DCF for authentication on dated 10.08.2026. Budget earmarked for the conservation of Schedule- I species considering Block XII Codli Mineral Block is Rs. 50.90 Lakhs. Copy of WLCP is enclosed as **Annexure XIV**.

Only the minimum required trees will be cut. Tree enumeration has been carried out in the forest land within the Mining Lease area, wherein approximately 4,007 trees were identified. Out of these, 4,004 trees are Acacia species and the remaining 3 trees are Cashew species.

The Project Proponent will undertake final tree enumeration prior to commencement of tree cutting. The compensatory afforestation plan for the trees proposed to be felled will be prepared and implemented as per the directions and conditions of the concerned Forest Department, Goa.

The feasibility of tree transplantation will also be explored for suitable trees, wherever technically feasible.

4.5.9.3 MEASURES TO MINIMIZE ANY NEGATIVE IMPACT ON FAUNA

The following measures will be adopted to minimize the impact of mining on faunal environment of the area.

- Wildlife Conservation plan will be implemented for protection of the schedule - I species, as per the Wildlife conservation Plan Rs. 50.90 Lakhs has been earmarked for protection of Schedule-I species in the Study area.
- Measures will be taken and environment management plan will be implemented to control and mitigate the pollution of air, water, land and noise environment.
- At conceptual stage, total Greenbelt and Plantation will be carried out on 102.4282 ha including 20.49 ha area under Miyawaki Plantation techniques.
- Increasing plant diversity, especially with native plants, enhances the potential for attracting greater number of different wildlife species, Habitat components that provide food, cover, water and space are important for self-sustaining ecosystem development.
- Creating and developing awareness for nature and wildlife in the nearby villages.

4.5.9.4 MEASURES FOR IMPROVING BIOLOGICAL ENVIRONMENT & FOREST

Greenbelt development programme has been designed for preventing the soil erosion, improving the greenery and aesthetic beauty of the area. Plantation will be done in consultation of DFO. While selection of species, care will be taken so as the developed greenbelt/plantation will remain useful for habitations. Greenbelt development and plantation is necessary:

- Ground covers reduce runoff velocity and filter out suspended soil particles during storms,
- Shrub and tree roots provide a restraining web that increases soil cohesion and stabilizes soil,
- Provide stabilization to slopes of the waste dumps.
- Landscaping and providing shelter.
- Improvement in aesthetic environment of site.
- Air purification by generation of oxygen.
- Allowing PM to settle on the leaves and to attenuate noise generated by movement of vehicles and other machinery.
- Live plant foliage reduces the impact of rainfall and increases the absorptive capacity of the soil.

4.5.9.5 GENERAL GUIDELINES FOR GREENBELT DEVELOPMENT

- i. Native plant species will be planted in consultation with DFO.
- ii. Trees growing up to 5 m or more in height with large canopy cover & leaf area will be planted around the installation.
- iii. Plantation of trees will be done along in safety barriers inside mine lease.
- iv. Since tree trunks are normally devoid of foliage (up to 3 m), it is appropriate to have shrubbery in form of such trees to give coverage to trunk portion of these trees.
- v. Fast growing trees with thick perennial foliage will be grown, as it takes many years for trees to grow to their full height.

- vi. In order to facilitate the proper growth of vegetation, limited measures involving preparation of seedbed with suitable number of fertilizers and treatment with mulches will be taken. The topsoil will be used for greenbelt development / plantation.

Vegetation covers in and around the mine workings generally helps in:

- Control of dust
- Reducing noise
- Stabilizing erodible slopes to minimize pollution
- Ground water re-charging
- Enhancement of aesthetic value

For re-vegetation, the plants and saplings suitable for the existing soils and site conditions will be considered. It is recommended to plant fast growing local species, which can adapt to the local climate. JSW will raise plantation all along the lease periphery, backfilled area, stabilized Waste Dumps area and tailing dam area etc.

The following characteristics have been taken into consideration while selecting plant species for Greenbelt development and plantation.

- I. Local, indigenous and drought resistant species
- II. Fast growing and tall trees
- III. Perennial and evergreen
- IV. Thick canopy cover
- V. Stratified layers of Plantation to prevent lateral pollution dispersion
- VI. The trees will be selected so as to maintain regional ecological balance and to conform to soil and hydrological conditions.
- VII. Plantation will be done as per CPCB guidelines for greenbelt development and Plantation.

Greenbelt and Plantation will be carried out on 102.4282 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled rehabilitated by Plantation, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation).

4.5.9.6 SPECIES SELECTION FOR PLANTATION/GREENBELT DEVELOPMENT

The plants and saplings suitable for the existing soil and site conditions will be considered. Preference will be given for fast growing local plant species, which can adapt to the local climate. Indigenous & fruit bearing species will be planted by JSW in consultation with local forest department will be such as *Terminalia tomentosa*, *Terminalia bellerica*, *Bauhinia species*, *Teak*, *Cassia fistula*, *Arjun*, *Assan*, *lagerstromia species*, *Shiwan*, *Ficus species*, *Pongamiapinnata*, *Reetha*, *Rain tree*, *Pangara*, *Peltoforum*, *Palas*, *Saton*, *Mahagony*, bamboo species etc. Horticultural species like Mango, Cashew, Ber, Aonla, Jambul, Tamarind, Jackfruit, citrus species, etc will also be grown.

4.5.9.7 GREENBELT DEVELOPMENT PLAN AND BUDGET

The Action Plan for Greenbelt Development on the periphery and Plantation in the Block area. The Action Plan for Greenbelt Development on the periphery and Plantation in the Block area is given as below:

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 4.32
Action Plan for Greenbelt/Plantation Development

S.N.	Year	Greenbelt (7.5 m lease periphery)		Plantation on Waste Dumps		Plantation on Backfilled area		Plantation on tailing dam		Total	
		Area (Ha.)	No. of saplings	Area (Ha.)	No. of saplings	Area (Ha.)	No. of saplings	Area (Ha.)	No. of saplings	Area (Ha.)	No. of saplings
1.	1 st Year	1.5	3750	0.00	0	0.00	0	0.00	0	1.5	3750
2.	2 nd Year	1.5	3750	0.00	0	0.00	0	0.00	0	1.5	3750
3.	3 rd Year	1.5	3750	0.00	0	0.00	0	0.00	0	1.5	3750
4.	4 th Year	1.5	3750	0.00	0	0.00	0	0.00	0	1.5	3750
5.	5 th Year	1.5	3750	0.00	0	0.00	0	0.00	0	1.5	3750
6.	6 th Year	1.12	2800	0.00	0	4.63	11575	0.00	0	5.75	14375
7.	7 th Year	1.12	2800	1.0	2500	4.63	11575	0.00	0	6.75	16875
8.	8 th Year	1.11	2775	1.0	2500	4.63	11575	0.00	0	6.74	16850
9.	9 th Year	1.10	2750	1.0	2500	4.63	11575	0.00	0	6.73	16825
10.	10 th Year	1.10	2750	1.0	2500	4.63	11575	0.00	0	6.73	16825
11.	11 th Year	1.10	2750	1.0	2500	4.64	11600	0.00	0	6.74	16850
12.	12 th Year	1.10	2750	1.0	2500	4.64	11600	0.00	0	6.74	16850
13.	13 th Year	1.10	2750	0.87	2175	4.64	11600	0.00	0	6.61	16525
14.	14 th Year	1.10	2750	0.00	0	4.64	11600	15.9082	39771	21.6482	54121
Total		17.45	43625	6.87	17175	41.71	104275	15.9082	39771	81.9382	204846

Note: Total Greenbelt/Plantation area is 102.4282 ha. 20% of the overall plantation is 20.49 ha from which 10.24 ha will be developed on the backfilled area and remaining 10.25 ha will be developed on tailing dam area using the Miyawaki plantation technique at an estimated development cost of Rs. 40 lakhs Capital Cost and Rs. 4.0 Lakhs/annum as Recurring Cost.

At Conceptual Stage, greenbelt/plantation will be developed along 7.5 block periphery covering an area of 17.45 ha, 51.95 ha area will be backfilled and subsequently rehabilitated through plantation & regrassing, 6.87 ha on dump plantation and 26.1582 ha area under tailing dam rehabilitated by plantation.

Thus, total Greenbelt/Plantation area is 102.4282 ha. 20% of the overall plantation is 20.49 ha from which 10.24 ha will be developed on the backfilled area and remaining 10.25 ha will be developed on tailing dam area using the Miyawaki plantation technique at an estimated development cost of Rs. 40 lakhs Capital Cost and Rs. 4.0 Lakhs/annum as Recurring Cost.

Remaining (102.4282 – 20.49 = 81.9382 ha) will be developed as 2500/ha saplings. Thus, total nos. of saplings are 2,04,846 @2500/ha.

Budget allocated for greenbelt/plantation till the end of life of mine is Rs. 512.115 Lakh and for Miyawaki Plantation is 204.90 Lakh. Thus, total proposed budget is 717.015 Lakh (7.17 Crore). The budget includes the cost of Saplings, Watering facilities, Labour Charge, Organic manure, Bio-fertilizers, Maintenance, fencing etc., which may vary in due course of time.

Other than this plantation, JSW will also undertake phase wise plantation on 33% of the total area 10.8981 ha of the Mineral Separation Plant to minimize fugitive dust emissions, attenuate noise and improve the overall environmental conditions in and around the plant area.

In compliance of Specific ToR Point No. 48, JSW will develop an additional greenbelt/plantation near the proposed Kalay Railway Sidings at Costi & Pauskar yard in accordance with the CPCB guidelines. A total of 2500 saplings will be planted over an area of 1.0 ha. The plantation will be undertaken under the 'Ek Ped Maa Ke Naam' campaign, which was launched on 5th June 2024 on the occasion of World Environment Day to enhance the country's forest cover.

Local & fruit bearing species will be planted after consultation with local forest officer and as per CPCB guidelines as follows: Neem, Arjuna, Mango, Jamun, Kindal, Kaju etc. will be planted by JSW Steel Ltd. and survival rate of 80% will be maintained.

4.5.9.8 IMPACT EVALUATION

Table - 4.33
Impact Evaluation for Biological Resources

Impact Evaluation Element	Change in the biological resources of the area due to mine development & operation and generation of emissions			
Potential Effect/Concern	Loss of habitat, Impact on health of biological receptors due to area and line sources of air emissions including fugitive dust emissions during Iron Ore mine development & operation activities			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
			√	
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
	√			
Duration	Short – term		Long- term	

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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			√
Intensity	Low		Medium
	√		High
Frequency	Remote (R)	Occasional (O)	Periodic (P)
			Continuous (C)
Significance of Impact			
Significance	Insignificant	Minor	Moderate
	√		Major

4.5.10 OCCUPATIONAL HEALTH AND SAFETY

Occupational health and safety (OH&S) are a multidisciplinary field concerned with the safety, health and welfare of people at work. The goal of occupational safety and health programs includes fostering a safe and healthy work environment. OHS may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment.

Occupational Health & Safety is based on the following three aspects:

- Hazard identification
- Risk assessment
- Determination of applicable controls

A Hazard Identification and Risk Assessment (HIRA) is a systematic way to identify and analyze hazards to determine their scope, impact and the vulnerability of the built environment to such hazards and its purpose is to ensure that there is a formal process for hazard identification, risk assessment and control to effectively manage hazards that may occur within the workplaces. Details regarding occupational health hazards as well as mitigation measures have been discussed as under:

4.5.10.1 OCCUPATIONAL HEALTH AND RELATED DISEASE

The following table depicts the potential effects due to Iron Ore mining.

Table - 4.34
Occupational Health and Related Disease

S.N.	EFFECT	SYMPTOMS	FIRST AID MEASURES
1	Eyes	Contact can cause irritation of eyes.	Immediately flushing of eyes with generous amounts of water. Pulling back of eyelid while flushing to ensure that all mineral dust has been washed out. Seeking medical attention promptly if the initial flushing of the eyes does not remove the irritant. No rubbing of eyes.
2	Skin	Contact can cause mild irritation of skin.	Brushing off or removing as much dry mineral as possible. Washing of exposed area with large amounts of water.
3	Ingestion	In large amounts, this material may cause gastrointestinal irritation or Blockage.	No inducing of vomiting. Seeking medical attention immediately. Not taking anything by mouth unless medical personnel instruct to do.
4	Inhalation	It can cause mild irritation of the respiratory system. Long-term exposure may cause permanent damage.	Moving victim to fresh air. Seeking medical attention.

4.5.10.2 IMPLEMENTATION OF OCCUPATIONAL HEALTH AND SAFETY MEASURES

Occupational Health and Safety measures result in improving the conditions under which workers are employed. It improves not only their physical efficiency but also provides protection to their life. JSW will adopt the following safety measures:

- Continuous monitoring for compliance of SOPs.
- Pit Safety Committee will be formed and recommendations given by committee will be implemented.
- Suitable measures for publicity and propaganda for safety and occupational health will be implemented like posters, safety films etc.
- Safety clauses in contract order
- To depute dedicated safety team
- Medical exam for fitness before employment as per standards in Form P-1 of Mines Rules 1955.
- Periodical medical examination as per Mines Rule 1955- will be done every 5 years as per standards laid down in Form P.
- The persons working in dusty environment will be examined every year as per the DGMS circular No. 01 of 21.01.2010.
- Besides that, to avoid any adverse effect on the health of workers due to various pollutants, sufficient measures relating to safety and health will also be practiced.
- Provision of rest shelters for mine workers with amenities like drinking water etc.
- Training of employees for use of safety appliances and first aid in vocational training center.
- Removal of unsafe conditions and prevention of unsafe acts
- Detailed analysis of each and every incident
- Periodic inspection by internal and external safety experts
- Celebrations of various safety events for awareness
- An effective and clearly audible means of giving warning, in case of fire, to every person are provided at the site. A free passage-way giving access to each means of escape in case of fire will be maintained for the use of all workers.
- Regular maintenance and testing of all equipment as per manufacturers' guidelines.
- Close surveillance of the factors in working environment and work practices which may affect environment and worker's health.
- Working of mine will be done as per approved mining plan and environmental plans.
- All safety measures will be taken which includes the use of safety appliances such as:
 - ✓ Suitable Dust Mask for protection from dust
 - ✓ Ear Muffs
 - ✓ Safety Helmets
 - ✓ Reflective jackets
 - ✓ Safety Belts
 - ✓ Leather Hand Gloves
 - ✓ Safety Shoes
 - ✓ Knee guard
 - ✓ Safety Goggles etc.
- Availability of Medical facilities and First Aid Room equipped with first aid boxers.
- Conduction of internal audits and evaluation of legal compliance.

4.5.10.3 PRE-PLACEMENT & PERIODICAL MEDICAL EXAMINATION SCHEDULE

Ideally, the pre-employment medical examination (also referred to as a pre-placement examination) strives to place and maintain employees in an occupational environment adapted to their physiological and psychological capacities. The goal of the pre-employment examination is to determine whether an individual is fit to perform his or her job without risk to himself or others. This is also conceptualized within the practice of occupational medicine - it is assumed that the examiner is required to have detailed knowledge of both working and health conditions.

Parameters to be monitored:

New employees when taken are thoroughly medically examined under initial medical examination and thereafter during continuation of employment; the periodic medical examination will be done suggested by DGMS. The medical examination includes the following parameters -

- Height, weight, body mass index (BMI)
- Cardiovascular examination (heart check, blood pressure, pulse)
- Full musculoskeletal examination including comprehensive range of movement.
- Central nervous system examination.
- Examination for hernia and other abdominal abnormalities
- Urine examination for diabetes or kidney / bladder disorders
- Respiratory examination
- Vision assessment including color blindness
- Medical fitness to work in mines
- Medical examination of drivers
- Drug and alcohol testing
- Spirometry - (Lung Function Test)
- Audiometry (Hearing Test)
- Urine testing
- Vision tests, color vision
- ECG
- CXR (Chest Radiograph)
- Blood glucose
- Strength and mobility screening

Further, Regular Awareness campaign amongst staff/ working about AIDS/ Dengue/Malaria will be done, Ambulance and First Aid facility will be provided.

The medical records of the employees will be maintained. Under initial induction, the workers will be given training related to all safety and health aspects pertaining to their vocation and thereafter, special training courses/ awareness program for Malaria eradication, STDs and health effects on exposure to mineral dust will be organized regularly for employed persons as well as for nearby villagers. Refresher training will also be arranged as per statutes.

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Table - 4.35
Schedule of Occupational Health & Survey

S.N.	Activity relating to Occupational Health Survey as per ILO / DGMS guidelines	Frequency (as applicable)	Implementing Agency
1.	➤ Framing of Mine specific Health & safety Policy as per Mines Act and Rules. ➤ Awareness regarding policy with strict enforcement. ➤ Inclusion of Policy's details in Tender documents ➤ Periodic Review of Policy	Awareness – Once in 3 months Review – Once in a year	Top Management, Mine's Manager and Procurement Cell
2.	➤ Adoption of ILO/ ISO 45001 based Health & Safety management system and proper formulation and implementation of the same in totality. ➤ Allocation of necessary resources for implementation of the control measures identified by the risk assessment process.	Risk assessment – quarterly Review of risks and resource allocation - once in a year	Initial gap analysis and implementation by an external expert agency and subsequent routine system maintenance by In-house team
3.	Necessary training of all employees of Mines shall be organized with the help of experts for optimal adoption of health & safety management system.	Once in a year	External expert agencies and in-house team
4.	Suitable clauses shall be included in tender document stating how the risk arising to men and material from the mining operations to be done by the contractors.	-	Mine's Manager & Procurement Cell
5.	It will be ensured that contractors are familiar with the relevant parts of the statutes, health and safety management system and are provided with such information prior to commencing work.	Regular activity	Mine's Manager & Procurement Cell
6.	All persons deployed in mine must undergo vocational training.	Once in 3 years	Internal/ External faculties
7.	Biometric system of check-in & check-out system of attendance associated with suitable software shall be introduced in the mine for time management.	-	Mine's manager & HR Dept.
8.	The persons working in dusty environment will be examined for Pneumoconiosis/ Silicosis as per the DGMS circular No. 01 of 21.01.2010.	every year	Qualified Medical Officer trained in Occupational Health
9.	Implementation of project specific comprehensive Hearing Conservation Program covering the aspects of monitoring, testing, evaluation and protection of noise.	-	External /Internal medical experts

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10.	Medical Examination of employees/ workmen - All regular employees working in the mine will undergo medical examination as per the recommendation of 10th National conference of safety in mines.		
a)	Pre-employment medical examination with a view to place and maintain employees in an occupational environment adapted to their physiological and psychological capacities so to perform his or her job without risk to himself or others.	Prior to joining	Qualified Medical Officer trained in Occupational Health
b)	Medical examination of employees engaged in driving/ HEMM operation jobs shall be tested for eye refraction test	at least once in a year	
c)	Employees exposed to ionizing radiation shall be tested for blood count.	at least once in a year	
d)	Routine stool test for persons engaged in handling of food and stemming preparation with sputum for AFB (Acid Fast Bacilli)	at least once in a year	
e)	New employees when taken are thoroughly medically examined under initial medical examination and thereafter during continuation of employment. The periodic medical examination will be done as per guidelines of DGMS The medical records of the employees will be maintained. Under initial vocational training, the workers will be given training related to all safety and health aspects pertaining to their vocation.	Periodical Medical examination: ➤ Age of workers < 40 years: After every 5 years ➤ Age of workers > 40 years: Annually	Qualified Medical Officers trained in Occupational Health
11.	Necessary facilities for monitoring the environmental parameters in respect of dust (Particulate Matter) and Gaseous emissions shall be provided at mines and regular monitoring shall be carried out at specified intervals	Twice in a week at 3 locations	Environment Manager / 3rd party approved agencies
12.	Noise mapping of various workplaces in the mine premises based on the various machines being used in concerned mines along with personal noise dosimetry of individual workmen exposed to noise level above 85 dB(A). {Regulation 182 of MMR, 1961 under the Mines Act, 1952.}	Noise dosimetry – once in six months	Through National Institute of Miners' Health (NIMH)
13.	Monitoring and measurement of workplace noise levels	Once in a day	In-house
14.	Vibration studies of various mining machineries before their introduction in	Once in a year	Through National Institute of

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	mining operation as per ISO 2631:1997 (Part 1) Standards. (DGMS circular no. Cir. Tech. 18/1975 Vibration limits 7.1 and 7.2)		Miners' Health (NIMH)
15.	Portability test of drinking water supplied to the mine employees irrespective of its source.	Quarterly as per IS:10500 – 2012	NABL accredited lab
16.	Monitoring and measurement of workplace dust conc. by means of real time dust monitors (Regulation 124 of MMR 1961)	➤ Static monitoring - once in six months (if the conc. exceeds 50% or 75% of the allowable limits, the frequency will be once in 3 months and once in a month respectively) ➤ Measurements shall also be carried on immediately upon the commissioning of any plant, equipment or machinery or upon the introduction or alteration of any new work practice that is likely to bring about any substantial change in the level of airborne respirable dust.	Once in a year by NIMH and routine monitoring by in-house trained person or through 3rd party accredited agency
17.	Operator's Seat in the Vehicle/HEMMs to be ergonomically designed for driver's comfort and ergonomically assessment of all latest machines before their introduction into mining operation as per ISO standards.	Once in a year for existing fleet	Through National Institute of Miners' Health (NIMH)

Frequency of Medical Examination as per Norms

- a. Pre-Placement Medical examination: Prior to joining
- b. Periodical Medical examination:
 - Age of workers < 40 years: After every 5 years
 - Age of workers > 40 years: Annually

4.6 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF ENVIRONMENTAL COMPONENTS

Irreversible commitment of environmental components for the proposed mining project will include Land use, topography, geology, soil, human settlement, agriculture for mine lease area. There will be no irretrievable commitment of environmental components for the said project.

However, it is proposed that out of total mining lease area i.e. 301.1521 ha, out of which 51.95 ha will be backfilled and 249.2021 ha will be covered under water reservoir, 14.5597 ha area will be under utility services, 10.8981 ha area will be under Mineral Separation Plant, 6.87 ha under dump rehabilitated by plantation, 17.45 ha under greenbelt and 26.1582 ha will be covered under tailin pond rehabilitated by plantation. Out of the 102.8292 ha of total greenbelt/plantation area, 20.49 ha (20%) will be developed under the Miyawaki Plantation technique on backfilled area and tailing dam area.

Greenbelt of 7.5 m will be developed along the lease periphery in 17.45 ha i.e. 4.63% area, and 84.9782 ha i.e. 22.54% area will be under Plantation on backfilled, Tailing dam and rehabilitated Waste Dumps.

4.7 CONCLUSION

As discussed above, it is safe to say that the project will not cause any significant impact on the environment of the area, as adequate preventive measures will be adopted to contain various pollutants generated due to the mining project within permissible limits. Backfilling and continuous development of Greenbelt & Plantation in mined out area and around the mining boundary will minimize the environment pollution and improve the aesthetic beauty. The development of water reservoir and afforestation will remain useful for local community. The project will also increase direct and indirect employment opportunities and revenue to the Government. Proposed socio-economic measures will be helpful to improve the quality of life of local residents.



CHAPTER - 5

ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

5.1 GENERAL

Analysis of alternative sites helps in the selection of the best possible site for the project. On the one hand, it helps to estimate the closeness to the existing infrastructure and on the other hand, it also helps to minimize the impact of the project on the environment.

The site for a mining lease is selected on the basis of the occurrence of minerals for suitable end use. A Comparison of alternatives of technology helps to determine the best method of achieving the project objectives with minimum environmental impacts or indicates the most environment-friendly and cost-effective options. Every mine needs to be planned in a way that the mineral is extracted to the maximum extent without causing severe irreversible environmental damage.

5.2 ANALYSIS OF SITE

The Block–XII Codli Mineral Block is a site-specific mineral deposit identified by the Department of Mines & Geology (DMG), Government of Goa, based on the occurrence of Iron Ore (Haematite) and its associated minerals. The mineralized area has been extensively explored by erstwhile lease holders, namely Vedanta Limited, Panduronga Timblo Industrias, and Timblo Private Limited, establishing the presence and continuity of economically viable Iron Ore reserves.

Considering the proven mineral occurrence and the site-specific nature of mining activities, the Directorate of Mines & Geology, Government of Goa, invited bids for the grant of a mining lease through Electronic Auction in accordance with the provisions of the Mines and Minerals (Development and Regulation) Act, 1957, and the Mineral (Auction) Rules, 2015, as amended from time to time. The auction was conducted for the Codli Mineral Block–XII Iron Ore Mine having a total lease area of 377.0881 ha, located at Village Codli, Taluka Dharbandora, District South Goa, Goa.

JSW Steel Limited emerged as the successful bidder and was declared the “Preferred Bidder” for the said mineral block. Since mining activities are inherently site-specific and can only be undertaken where mineral deposits occur, the selection of the project site was based on the established occurrence of Iron Ore within the lease area and the subsequent allocation of the block by the Department of Mines & Geology, Government of Goa through the statutory auction process.

Subsequently, Letter of Intent was issued in favor of JSW Steel Limited vide letter no. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024 by Directorate of Mines and Geology, Govt. of Goa. Hence, no alternative site is considered.

5.3 ANALYSIS OF TECHNOLOGY

METHOD OF MINING

The proposed mining method for extraction of mineral and ROM is Opencast Fully Mechanized (As per IBM approved Mining Plan) with benches of 7 m height and 9 m width for Ore. The Overall pit slope will be maintained at 45°. All operations of mining will be done by deployment of Heavy Earth Moving Machineries without deep hole drilling and blasting. The mining operation will involve

excavation, loading, unloading, crushing, screening, Iron Ore Beneficiation & transportation to ensure maximum mineral conservation and minimum environmental degradation.

Loading & Hauling

Loading is proposed to be with hydraulic excavator having bucket capacity of 4.0 m³ & 2.9 m³ and from mine face to crusher will be transported by dumper of 40 tonnes and wheel loader 2.5 m³ capacity. Waste generated will be transported to waste dumps present in the mine site.

Crushing

Crushing of Iron ore will be done in a Primary Crusher of 90 TPH & 250 TPH and Secondary Crusher of 150 TPH capacity and 600 TPH crushing in the Dry Processing/Screening Plant which will be installed within the lease area. Iron Ore will be transported from mine face to crusher by 20 m³ capacity Dumper via haul road.

Transportation

All the Fines generated from the crushing will be loaded by loader of 2.5 m³ capacity & transported through dumpers or wheel loaders capacity of 20 m³ or 2.5 m³ and after that transported through tippers of 4.5 m³ via road to railway siding and jetty end users via Rail and Sea.

No change is envisaged in the proposed Mining method/technology and mining will be carried out as per IBM approved Mining Plan.

BENEFICIATION PLANT

- One 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA will be installed in 10.9 ha area within the mine lease.
- The overall product contains 54.25% Fe with yield of 64%.
- About 0.628 Million TPA of slimes/tailings will be generated with 27.83% Fe.
- The Iron Ore Beneficiation Plant will produce about 2.881 Million TPA Iron Ore concentrate along with a generation of about 0.628 Million TPA of slimes/tailings with 27.83% Fe.
- Undertake R&D studies to explore the extraction and beneficiation of very low-grade iron ore such as Banded Hematite Quartzite (BHQ) etc.

Merits and demerits of selection of site for beneficiation plant are given below:

Merits:

- Close proximity to the mine, resulting in reduced transportation distance and cost.
- Lower fuel consumption and reduced vehicular emissions.
- Easy integration with existing mine infrastructure.

Demerits:

- Limited availability of suitable land.
- Proximity to active mining operations may lead to dust and noise impacts.

RENEWABLE ENERGY FACILITY

JSW Steel Limited will explore the feasibility of utilizing renewable energy for project-related infrastructure. In this regard, the Company will consider augmentation of solar power capacity and the feasibility of a solar-powered jetty for mineral transportation, if found technically and

economically viable. JSW also proposed to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption.

5.4 CONCLUSION

In case of Mining projects alternate site selection is not necessary as the mining is site specific and the area in which mining will be carried out has been adequately proved for presence of mineral. The deposit is also having good infrastructural facilities for access and development. Mining will be carried out as per Approved Mining Plan along with Progressive Mine Closure Plan by Indian Bureau of Mines (IBM), Goa.

The Iron ore mined out from this mine will be supplied to JSW Steel Plant and or sold in open market like Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant. Transportation of Iron Ore from mine to end users will be by road via tippers to the jetties and railway sidings.



CHAPTER - 6

ENVIRONMENTAL MONITORING PROGRAMME

6.1 INTRODUCTION

Post Project Monitoring is an essential part to check the impact of project related activity. Hence monitoring of various environmental parameters will be carried out on a regular basis to ascertain the following:

- Status of Pollution within the mine site and in its vicinity.
- To generate data for predictive or corrective purpose in respect of pollution.
- To examine the efficiency of pollution control system adopted at the site.
- To assess environmental impacts.

Monitoring will be carried out at the site as per the norms prescribed by CPCB and Indian Standards. Environmental Monitoring Programme will be conducted for various environmental components as per conditions stipulated in Environmental Clearance Letter issued by MoEF&CC & Consent to Operate issued by Goa State Pollution Control Board.

Six monthly compliance reports along with monitoring reports will be submitted on regular basis to all regulatory departments mentioned in granted EC. Quarterly compliance Report for conditions stipulated in Consent to Operate will be submitted to GSPCB on regular basis.

6.2 FORMATION OF ENVIRONMENTAL MANAGEMENT CELL (EMC)

In order to maintain the environmental quality within the standards, regular monitoring of various environmental components is necessary. JSW Steel Limited has a full-fledged Environmental Management Cell (EMC) for environmental monitoring and control. The EMC team will take care of pollution monitoring aspects and implementation of pollution control measures.

A group of qualified and efficient engineers with technicians will be deputed for maintenance, up keeping and monitoring of the pollution control equipment, to keep them in working mode at the best of their efficiencies. The Organizational structure of EMC is given below.

6.2.1 RESPONSIBILITIES OF EMC

The responsibilities of the EMC include the following:

- Environmental monitoring of the core and buffer zone and evaluation of results. Keeping of records to track the surrounding environment quality status.
- Procurement and Commissioning of Pollution Control Monitoring Equipment.
- Specification and regulation of maintenance schedules for Pollution Control Equipment.
- Ensuring that prescribed standards are maintained.
- Development of greenbelt & Plantation.
- Ensuring optimum water usage.
- Implementing the Environmental Management Plan.

- Conducting regular training programs on various environmental requirements especially sustainable development, climate change, environmental monitoring etc. Reporting of compliances and non-compliances (if any) to management and other stakeholders.

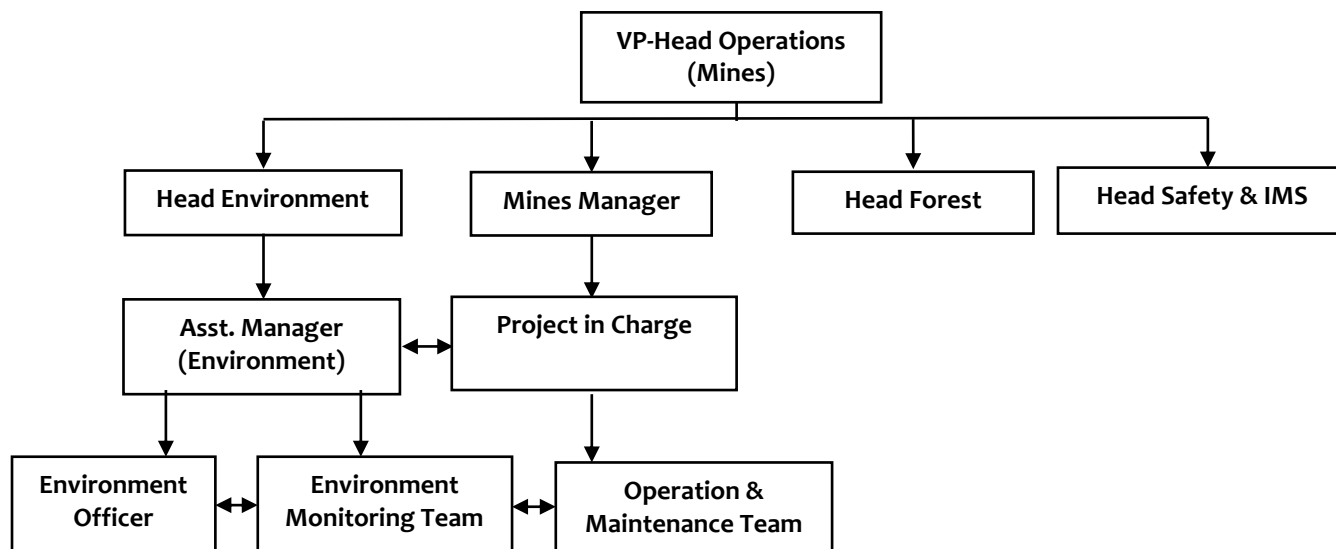


Figure 6.1: Organizational Structure of EMC

6.3 MEASUREMENT METHODOLOGIES

6.3.1 INSTRUMENTS TO BE USED

The following instruments will be used for data collection work in the monitoring schedule:

1. Respirable Dust Sampler (RDS)
2. Fine Particulate Sampler (FPS)
3. Dry and Wet Bulb Thermometer
4. Sound Level Meter
5. Meteorological Station
6. Water Level Indicator/ Piezometer digital water level recorder
7. Global Positioning System (GPS)
8. Stack Monitoring Kit
9. pH meter
10. TDS / Conductivity meter
11. Turbidity Meter

In addition to the above instruments, data on land use, vegetation and agricultural crops to be collected by the field team by meeting with a large number of local inhabitants in the study area and different government departments / agencies.

6.3.2 MONITORING PROGRAMME

The post project Monitoring includes details of any major/ minor impact in the core zone and area within buffer zone for the following parameters: -

- Micro - Meteorological data

- Ambient Air Quality Monitoring
- Fugitive Dust Emission Monitoring
- Noise Level Monitoring
- Stack Monitoring (For stacks attached to Crusher, Plant operation stacks, D. G. sets, etc.)
- Water quality and level monitoring
- Medical Check-up of the employees
- Socio Economic Condition of Villagers

6.3.3 MONITORING SCHEDULE

Details of Environmental Monitoring schedule, which will be undertaken for various environmental components, the location of the AAQM monitoring stations is selected on the basis of prevailing micro - meteorological conditions of the area like; Wind Direction & Wind Speed, Relative Humidity, Temperature. AAQM stations have been selected to assess the ambient air quality of the area. Noise level is also to be measured in core area as well as study area. Water & Soil monitoring locations will be decided on the basis of general slope of the area & drainage pattern. Along with this 1 no. of CAAQMS station will be established and locations will be selected in consultation with MoEF&CC.

Table: 6.1

Post Project Environmental Monitoring Schedule

S.N.	Description	Frequency of Monitoring
1.	Micro-Meteorological Data	Hourly (Online)
2.	Ambient Air Quality Monitoring	Online CAAQMS & Manual as per CPCB Guideline
3.	Ground Water Quality & Level Monitoring	Quarterly
4.	Surface Water Quality Monitoring	Seasonal
5.	Noise Level Monitoring	Quarterly
6.	Soil Quality Monitoring	Once in a year
7.	Crusher Stack Monitoring (Crusher, Plant operation stacks, D. G. Sets)	Monthly
8.	Medical Checkup of employees	Annually to 5 Year ➤ Age of workers <40 years: After every 5 years ➤ Age of workers >40 years: Annually
9.	Digital Mapping/ Drone survey of ML area	Once in 5 years
Source: Standard EC Conditions		

6.3.4 METHODOLOGY ADOPTED

Post project monitoring will be carried out as per conditions stipulated in Environmental Clearance Letter issued by MoEF&CC, New Delhi, Consent issued by GSPCB as well as according to CPCB guidelines. The mine site is considered as core zone and the area lying within 10 km radius from the mine site is considered as the buffer zone where some impacts may be observed on physical and

biological environment. In the Buffer zone slight impact may be observed and that too is occasional.

The following table is showing details of Post Project Monitoring programme:

Table: 6.2
Post Project Monitoring Programme

Attributes	Sampling		Measurement Method	Test Procedure
	Network	Frequency		
A. Micro-Meteorology				
Temperature, Relative Humidity, Wind Speed, Wind Direction, Rainfall	Minimum 1 at project site	Regularly in one season through Weather Monitoring Station	-	-
B. Air Environment				
Pollutants	04 locations in the study area (core zone and buffer zone)	As per Revised National Ambient Air Quality Standards (NAAQS) vide MoEF&CC circular, dated 16.11.2009	Gravimetric method	-
PM ₁₀			Gravimetric method	-
PM _{2.5}			EPA Modified West & Gaeke method	Absorption in Potassium Tetra Chloromercurate followed by Colorimetric estimation using P-Rosaniline hydrochloride and Formaldehyde (IS: 5182 Part - II).
SO ₂			Jacob & Hochheiser modified (NaOH-NaAsO ₂) Method	Absorption in dill NaOH and then estimated colorimetrically with sulphanilamide and N (I-Nephthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (CPCB Method). (IS: 5182 Part – 14: 2000)
NO ₂				
C. Stack Monitoring				
Pollutants	Crusher Stack, Plant operation stacks, D.G. sets	Monthly	Gravimetric method	As per CPCB Guideline and Indian Standard 11255 (1988).
PM				
D. Fugitive Emission				
PM	-	-	Gravimetric method	As per CPCB Guideline and IS: 5182 Part – 14: 2000.
E. Water Environment				
Ground Water: pH, Turbidity, Colour, Odour, Taste, TDS, Total Hardness, Calcium and Magnesium	6-9 locations in the study area	Quarterly	As per IS: 10500 - 2012	Guide manual: Water and Wastewater analysis given by CPCB 2017 Standard methods for

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Attributes	Sampling		Measurement Method	Test Procedure
	Network	Frequency		
hardness, Chloride, Fluoride, Sulphate, Nitrates, Alkalinity, Iron, Copper, Manganese, Mercury, Cadmium, Selenium, Arsenic, Cyanide, Lead, Zinc, Chromium, Aluminium, Boron, Phenolic compounds	(core zone and buffer zone)			examination of water Association and waste water analysis published by American Public Health Association and IS 3025 etc.
Surface Water: PH, BOD, COD, TSS, Faecal coliforms, etc.	3 Locations (Buffer zone)	Once in a month	-	-
F. Noise				
Noise levels at Day & night time and 8-hour Noise Dosimetry	04 locations in the study area (core zone and buffer zone) and Mining machinery which is mentioned in DGMS & Recommended Circulars	Quarterly	As per CPCB norms / As per DGMS circular no. Tech. 18 of 1975 and 5 of 1990	As per CPCB norms and as per DGMS norms
G. Soil				
pH, Bulk Density, Soil texture, Nitrogen, Available Phosphorus, Potassium, Calcium, Magnesium, Sodium, Electrical Conductivity, Organic Matter, Chloride	04 locations in the study area (core zone and buffer zone)	Half Yearly	As per USDA Method	As per USDA Method
H. Medical Checkup of Employee				
Pre-Placement Medical examination & Periodical Medical examination	-	Pre-Placement Medical examination: Prior to joining Periodical Medical examination: Age of workers < 40 years: After every 5 years	-	-

Attributes	Sampling		Measurement Method	Test Procedure
	Network	Frequency		
		Age of workers > 40 years: Annually		
Medical examination for Pneumoconiosis/ Silicosis as per the DGMS circular No. 01 of 21.01.2010.	-	Every year	-	Qualified Medical Officer trained in Occupational Health

Besides above, monitoring of greenbelt/ plantation in terms of percentage of survival of plants and community development programme will be carried out.

6.3.5 LOCATIONS OF MONITORING STATIONS

The location of the AAQ monitoring stations will be selected on the basis of prevailing meteorological conditions of the area like; Wind Direction & Wind Speed, Relative Humidity, Temperature, pressure and rainfall. AAQM stations will be selected to assess the ambient air quality of the area. Noise level monitoring will be carried out within mine boundary & in high noise generating areas of the buffer zone. Water & Soil monitoring will be done on the basis of general slope of the area & drainage pattern. All locations will be finalized in consultation with GSPCB. Locations for the post project Monitoring are as under:

Table - 6.3
Locations of Monitoring Stations

S.N.	Description	Location
1.	Ambient Air Quality	4 locations (Within ML area and in 10 km radius Study Area) and Fugitive dust emission monitoring
2.	Noise Level Monitoring	4 locations in core & buffer zone (Mine Boundary, High noise generating areas within the Mine boundary and nearby village) and Noise Dosimetry monitoring
3.	Water level & Quality Monitoring	Piezometer in mine area and Quality in withdrawal well and up & down streams in mine area and study area.
4.	Soil Quality	4 Locations (core & buffer zone)
5.	Stack Monitoring	Crusher Stack, Plant operation stack, D. G. sets

6.3.6 DATA ANALYSIS

Monitoring data analysis will be done as per CPCB guidelines by laboratory approved under EPA 1986 & will be submitted to concerned authority (specified in Environment Clearance Letter issued by MoEF&CC & Consent issued by GSPCB on regular basis.

6.4 REPORTING SCHEDULE

Environmental Monitoring Program (EMP) will be designed considering conditions stipulated in the Environmental Clearance issued by the MoEF&CC, New Delhi & Consent to Establish and Consent to Operate issued by Goa State Pollution Control Board (GSPCB).

Six monthly compliance reports along with monitoring reports will be submitted on regular Basis to RO, MoEF&CC by 1st of June and 1st of December. Monthly compliance report for conditions

stipulated in CTE/CTO will be submitted to Goa State Pollution Control Board on or before 15th of every month.

Annual compliance report for conditions stipulated in NOC will be submitted to CGWA. Annual Environmental Statement Report will be submitted to concern Regulatory Authorities before 30th September every year.

6.5 CORRECTIVE & PREVENTIVE ACTION PLAN FOR NON-COPLIANCE / NON-CONFORMANCES

The company has a well laid down process for identification & prevention of non- Conformances. In the eventuality of any non-compliance/ non-conformances, it is addressed on priority through mid – course corrective action plan along with appropriate recording & reporting to stake-holders in line with the company policy duly adopted by the board.

The company would detail the process for identification of non-Conformances and address these through mid–course corrective action plan. The measures include:

- To identify non- compliance/ non- conformances.
- To record non- compliance/non-conformances.
- To evaluate the non-compliance/non-conformation, to determine specific corrective and preventive action.
- To identify senior responsible person of EMC to address the non-compliance/non-conformances.
- To review the corrective actions by the senior Management for effective implementation.
- Reporting of any statutory non-compliance if any, to board and other stakeholders at regular interval as per Corporate Environment Policy.

6.6 DETAILED BUDGET

The budget proposed for this proposed Iron Ore mining Project is as follows:

- Capital cost of the project is Rs.: 500 Crores
- Environmental Protection is Rs.: 544.02 Lakhs
- Recurring Cost is Rs.: 117.0 Lakhs/Annum



CHAPTER - 7 ADDITIONAL STUDIES

7.0 INTRODUCTION

As per EIA Notification dated 14th September, 2006, as amended from time to time, Ministry of Environment, Forest & Climate Change (MoEF&CC), New Delhi prescribed Terms of Reference (ToRs) for preparation of the Environmental Impact Assessment (EIA) Report and Environmental Management Plan (EMP) vide File no. J-11015/49/2025-IA.II(NCM) Dated 18.05.2026.

The following Additional Studies were to be carried out in reference to the additional Terms of Reference:

1. Public Consultation
2. Hydro-geological Study & Rainwater Harvesting Plan
3. Resettlement & Rehabilitation
4. Risk Assessment & Disaster Management Plan

7.1 PUBLIC CONSULTATION

Public Hearing is yet to be conducted for Proposed Codli Mineral Block - XII.

7.2 HYDRO-GEOLOGICAL STUDY & RAIN WATER HARVESTING PLAN

SCOPE OF WORK

1. To analyze physiographic conditions of the study area with the help of field observations, GPS readings, Survey of India (SOI) toposheets and Satellite images.
2. To observe hydrogeological conditions and study of aquifer system of the area i.e. in Core and 10 km Buffer Zone.
3. To work out quantitative as well as qualitative variations in groundwater with respect to aerial extent and to find out water balance.
4. To observe surface water features and their impact on groundwater balance.
5. To ascertain the impact of proposed Iron Ore Block on groundwater conditions of the surrounding area.
6. To work out scope of Rainwater harvesting within the proposed Iron Ore Block and design suitable recharge system to the extent possible within the mine area.
7. To suggest ways and means of ground water recharge to negate adverse impact on groundwater regime and their impact on groundwater regime of the area.
8. To improve the understanding of Groundwater Quality, map will be prepared on the basis of chemical analysis and the occurrence of natural and anthropogenic contaminants that affect the potability of groundwater.

METHODOLOGY

Following methodology has been adopted for hydro-geological investigation in the area:

1. Physiographic studies of the proposed Iron Ore Block area and its surroundings with the help of latest Google images, site visit, GPS survey etc. which helps in determining physiographic gradient.
2. Secondary data collection i.e. climate and rainfall, soil and topography, geology, drainage etc. for interpretation.
3. Detailed hydro-geological survey in core and buffer zone including geology, types of aquifers and their hydraulic parameters governing the groundwater regime of the area, depth to water level, groundwater quality, water abstraction structures and their discharge, surface water bodies, drainage pattern, major irrigation sources and their potential etc.
4. Analysis of physical, chemical, and biological characteristics of water to determine its suitability for various uses.
5. Groundwater resources evaluation based on the norms recommended by Groundwater Estimation Committee (GEC), 2015.
6. Analysis of geophysical parameter to determine hydraulic gradient, hydraulic conductivity, transmissivity of the aquifer.
7. Evaluation of present groundwater scenario as well as future course of action for protecting the natural environment.
8. Scope of Rainwater Harvesting from runoff generated in open area of Iron Ore mine depending upon average annual rainfall and its intensity, recharge capacity of the aquifers & the design considerations.

The Working depth during the plan period will be 112 m bgl and at conceptual stage, ultimate working depth will be 164.48 m bgl. According to ground water level monitoring, it is found that the depth of water level in core zone during pre-monsoon is around 16.0 m bgl and during post-monsoon season it rises slightly to 15.0 m bgl. Hence, the groundwater will be intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. A letter has been submitted to WRD for obtaining the required NOC for dewatering of mining pits on dated 14.08.2026.

Detailed Hydro-geological study has been carried for the proposed mining project. Detailed Hydro-geological Report is enclosed as **Annexure XIX** with this Draft EIA/EMP report.

7.3 REHABILITATION & RESETTLEMENT ACTION PLAN

The area of proposed mine is 377.0881 ha which spreads in only 1 revenue Village namely Codli. Out of the total mining lease area, 236.3482 ha is Govt. land, 58.9087 ha is Private Land, 15.8626 ha is Alvara land & 65.9686 ha is Forest Land. There are no habitations present within the mine lease area.

JSW Steel Limited will adopt the surface rights procedure for use of land required for the proposed mining project and there is no proposal of land acquisition. The mining lease area comprises private

and government land. Surface rights over the land required for mining operations shall be acquired through mutual agreement and payment of compensation, in accordance with the provisions of the Goa Daman & Diu Land Revenue Code, 1968 and the MMDR Act, 1957, prior to commencement of mining operations.

The detailed Socio-Economic survey report and need based assessment survey is under process and same will be given in final EIA/EMP Report.

7.4 RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

DEFINITION

A major emergency in a work is one which has the potential to cause serious injury or loss of life. It may cause extensive damage to property and serious disruption both inside and outside the work. It would normally require the assistance of emergency services to handle it effectively.

Emergency may be caused by a number of different factors; it will normally manifest itself in two basic forms viz. fire, explosion or toxic release.

SCOPE

An important element of mitigation is emergency planning i.e. recognizing that accidents are possible, assessing the consequences of such accidents and deciding on the emergency procedures, both on site and off site that would need to be implemented in the event of an emergency. Emergency planning is just one aspect of safety and cannot be considered in isolation.

OBJECTIVE

The objective of onsite disaster management plan for the proposed Iron ore mine is to be in a state of perpetual readiness through training and development to immediately control and arrest any emergency situation so as to avert a full-fledged disaster and the consequence of human and property damage and in the event of a disaster still occurring, to manage the same so that the risk of the damage to life and property is minimized.

JSW Steel Ltd. will make a document elaborating the procedure for Emergency Preparedness & Responses. The overall objectives of the emergency plan are:

- To localize the emergency and eliminate hazards
- To minimize the effect of the accident on people and property.
- Elimination of hazards by local/supervisory personnel and minimizing effects include rendering First aid, evacuation, hospitalization, rehabilitation
- To seek help from outside sources, if required
- To respond immediately and adequately in case of serious accident.
- Notice/information to authorities

High risk accidents are not anticipated in the area because the mining is not hazardous. Mining operations may be carried out by taking all the safety measures, but there is always some element of danger or risk in it. Due to deployment of heavy machineries and large-scale workings, there are a

few chances of un-avoidable accident likely to occur for this, Safety Engineer's regular inspection required will be undertaken. Following risks are anticipated:

- Failure of benches
- Fall of machinery/ person from benches
- Failure of transport machinery
- Heavy rainfall resulting in inundation of mine
- Accidents due to fire

Standard operating procedures shall be made and enforced in case of emergency. To overcome this, provisions reg. 119 of MMR 1961 will be followed:

1. Inundation

- a. For risk of inundation during the heavy rains there will be a chance of flood for few days and due to surface water in the open pit, provisions of M.M.R. 1961 reg. 127 shall apply.
 - b. The working in bench form shall be made on a sloping ground and bottom most bench shall be provided with a sump to collect water which will be directly pumped out to surface.
 - c. A flood warning system will be installed near the office. H.F.L. shall be marked in the area on a pillar. If water level reaches 0.5 m below HFL mark then all men and machinery shall be withdrawn from the pit and work shall be stopped until water recedes to a safe level.
 - d. Immediate safety measures will be taken and also the instruments received from Mines Manager will be implemented.
 - e. In rainy season when there is danger of inrush of water in the pit, mining work shall be carried out on upper-level benches only.
 - f. Entering of unauthorized person will be restricted in the mine area and surroundings, either by deploying an attendant or by the security department, with red flag.
 - g. All the rescue operation shall be carried out under supervision of the Mines Manager and safety Engineer.
 - h. Ambulance and First-aid services shall be kept ready at the site.
 - i. Normal work shall be resumed only after getting permission of the Mines Manager.
2. In case of short circuit of LT line and fire caused due to the mishap, sand bucket and fire extinguishers shall be provided and maintained.
 - (a) For LT line, a safety barrier 0.50 m on either side of electric line shall be left in the lease area.
 - (b) If there is danger of falling of live wire during working, then no machinery shall be allowed to remain or pass through safety barrier.

The salient features are elaborated as below:

- Emergency Response Organization
- Communication System
- Action on the site
- Facilities available at site

- Medical treatment for injured personnel

Elimination requires well planned process/technology and its effective implementation, so that such situation should either not arise or if it comes, a pre-warning is received for timely action in built or by preparedness for zeroing the effects.

Minimizing the effects may include prompt action, rescue, first aid and evacuation, firefighting and also passing on information promptly to people living nearby.

Methodology of Risk Assessment

- Collection of information & identification of hazard
- Classify their severity and probability of occurrence
- Identification of exposed risks
- Assess the risk and risk rating based on

1. Probability

2. Exposure

3. Consequence

- ✓ Prioritization of the risks
- ✓ Implementation of control measures
- ✓ Monitoring risk assessment
- ✓ Evaluation and correction

Risk assessment for the proposed project is mainly based on the environmental impact of various parameters.

i. Land Contamination

The potential for contamination during operation of mine is OB/Waste dumps which is regarded as to contaminate land. However, the waste Dumps will be stabilized. No top soil generation will be there as the working is proposed in already broken-up area.

ii. Aquatic Toxicity

The risk assessment in aquatic toxicity system is based on the total metal concentration in various chemical form or oxidation state. Iron Ore and the associated rocks do not contain appreciable concentration of toxic elements.

iii. Acid Mine Drainage

The mining of Iron Ore does not involve any processing operation by using chemicals. Hence, there is no risk at the ML area site with regard to control of acid mine drainage.

iv. Tailing Dam

About 0.628 Million TPA of tailings will be generated from the Wet Processing Plant in the form of filter press cake with a moisture content of approximately 10–12% and an Fe content of 27.83% which will be stacked in safe & scientific manner in an area of 26.16 ha within the mine lease area and later will be stored in abandoned/exhausted pits or dump areas within the mine lease; hence, no risk is anticipated.

v. Human Health

No tailing Dam will be involved in the project and there will not be any discharge of effluent outside the ML area. No waste water will be generated from mining operations. However, the waste water generated from wheel washing system will be recycled. The effluent generated from the Beneficiation process will be completely recycled within the process. The Tailings generated from the Wet Processing plant will be stacked in a safe and scientific manner in an area of 26.16 Ha within the proposed plant area and then later transferred to the active dumps within the lease. Hence, there will not any discharge of effluent outside the ML area. Factors of risks involved due to human induced activities in connection with mining operations are:

- 1) Removal of OB/waste,
- 2) Excavation of Ore and
- 3) Transportation of Ore.

Other factors may include risk involved due to – Fire, Water Inundation, Electricity and Natural Calamities.

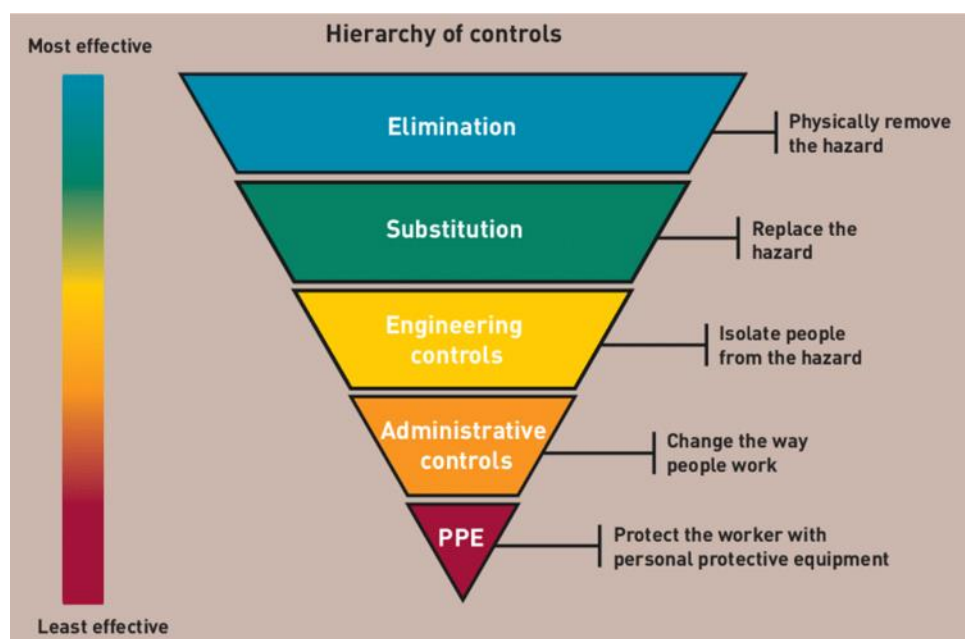


Figure 7.1 Hierarchies Risk Control Measures

7.4.1 IDENTIFICATION OF HAZARDS

Major hazards due to the proposed mining project have been identified & mitigation measures are suggested. Details are given in the table as under:

Table 7.1
Hazard Identification & Mitigation Measures

S. No.	Mining Activity	Occupational Hazard	Potential ill health/ Injury	Preventive Measures	Control Measures
1.	Operation of Excavator in Mines	Noise	NIHL, irritation, headache, stress	-	• Proper maintenance & operation of machine. • Providing ear plug, ear muffs
		Fire in HEMM	Burn injury, fatality	-	• Automatic detection & suppression system • Provision of Fire Extinguisher • Daily checking of electrical system
		Heat	Discomfort, stress	• Proper Ventilation	• Thermal barriers • Provision of cool drinking water • Rest shelters • Showers
		Dust generation	Silicosis, respiratory problems & eye infections	• Operation and Maintenance of Tippers.	• Dust suppression on haul roads through water sprinkling • Providing dust mask
		Cabin Vibrations	Numbness, Raynaud disease	• Standard protocol for evaluation of vibration level in HEMMs	• Ergonomically designed seats and operation and controls • Proper maintenance & operation of machine
		Slipping from stairs	Body injury	-	• Good House Keeping
		Operating system failure	Disabling injury/loss of body parts & fatality	• Training & awareness Programmes	• Regular Maintenance
2.	Transportation with Dumpers	Material spillage	Injury to person	-	• Suitable loading profile ensuring proper condition of dumper
		Collision	Fatality	-	• Follow traffic rules • Competent Driver
		Jerks & Vibration	Numbness, Raynaud disease	• Ergonomically designed Cabin	• Proper cushion of Operator Seat • Mounting of Cabins on Rubber Pads
		Dust generation	Silicosis, respiratory problems & eye infections	• Construction and Maintenance of haul roads	• Spraying of Water on haul roads
		Brake fails	Fatality / injury	-	• Daily checking of brake system • follow maintenance schedule as manufacturer manual

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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S. No.	Mining Activity	Occupational Hazard	Potential ill health/ Injury	Preventive Measures	Control Measures
		Steering fail	Fatality / injury	-	- Daily checking of steering system - Follow maintenance schedule as manufacturer manual
		Bursting of front tyre	Fatality / injury	Use of Good conditions tyres	Daily checking of tyre condition & Pressure.
		Reversing Dumpers	Fatality / injury	-	- Authorized driver - Audio visual alarm - Spotter when reversing - Rear view Camera
3.	Movement and Operation of vehicle other than dumpers	Dust generation	Silicosis, respiratory problems & eye infections	-	- Spraying of Water on haul roads - Provide dust masks
		Brake fails	Fatality	Compliance with operating instructions	- Daily checking of brake system, - Provision of break fail alarm system and alternate break.
		Steering fail	Fatality	Follow maintenance schedule as manufacture manual	Daily checking of steering system
		Collision	Fatality	-	- Follow traffic rules, - Competent Driver - Providing Steel belt
		Bursting of front tyre	Fatality	Use of Good conditions tyres only	Daily checking of tyre condition & Pressure
		Reversing vehicle	Fatality	-	- Audio visual alarm - Authorized driver - Spotter when reversing.
4.	Dozing	Vibration	Numbness, Raynaud disease	-	- Ergonomics cabin and operator seat - Cabins mounted on rubber pads
		Noise	Irritation	-	Providing Ear Plug
		Dust generation	Silicosis, respiratory problems & eye infections	-	- Control of dust at the point of generation - Use of dust Mask
		Slipping & breaking of tools	Injury to person	-	
5.	Diesel storage	Fire	body injury	-	Fire extinguisher
		Leakage of oils	Wastage, skin infection	-	Maintenance & monitoring of machines

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S. No.	Mining Activity	Occupational Hazard	Potential ill health/ Injury	Preventive Measures	Control Measures
6.	Operation & maintenance of DG Set	Noise	NIHL, irritation, loss of appetite, headache	-	• Use of Ear Plugs
		Fire	Burn injury	• Source of fire near diesel generator should be avoided	• Use of Fire Extinguisher
		Electric Shock	Fatality	-	• Use of hand Gloves
		Slipping due to oil slippage	Injury	• Good housekeeping	• Use of Safety Shoes
7.	Unloading of diesel	Falling of drums	Injury	-	• Handling of drum carefully
8.	Air Filling on Tyres, Opening Fitting of tyres	Bursting of Tyres	Injury to eyes	-	• Checking of pressure gauge properly. • Use of safety goggles
		Slipping of tools	Injury to person	-	• Careful usage of tools. • Use of Safety shoes & helmets
9.	Exploration	Smoke	Lung infection	-	• Providing Dust Mask.
		Flying of Drill Chips	Eye injury	-	• Rubber pads at drill machines • Providing Safety goggles
		Bursting of hose	-	-	• Regular pipe checking, • Helmet and shoes.
		Pit failure	Fatal injuries due to burial, Fractures, crush injuries, Head and spinal injuries	• Proper pit slope design as per geotechnical studies • Regular slope stability monitoring • Adequate drainage to prevent water accumulation	• Barricading unstable areas • Emergency response plan • Use of PPE (helmet, safety shoes)
		Dump failure	Fatal injuries due to sliding material, Crush injuries and fractures, Suffocation due to burial, Stress and trauma	• Scientific dump design (benching & slope angle) • Proper compaction of dump material • Avoid overloading and dumping at unsafe heights • Adequate drainage system	• Restricted entry near dump edges • Deployment of dump guards and signage • Continuous inspection of dump stability • Emergency rescue and first-aid facilities

7.4.2 OBJECTIVE OF DISASTER MANAGEMENT PLAN

The disaster management plan is aimed to deal with the situation efficiently to reduce confusion keeping in view of the likely sources of danger in the mine. Objective of the disaster management plan are as follows.

- First aid injury.
- Rescue operation and provision of adequate medical facilities to the injured.
- Safety of the human life in the buffer zone if needed.
- Protecting and minimizing damage to property and the environment.
- Initially restrict and ultimately bring the incident under control.
- Identify any dead.
- Inform to the administration, DGMS and statutory persons as per Rules.

7.4.3 EMERGENCY RESPONSE ORGANIZATION

An emergency organization will be set up which will be led by the First-class Mines Manager. He will organize a team of responsible and statutory personnel under him for controlling the incidence.

(a) Emergency Communication

Whoever notices an accident, disaster or emergency situation etc. would inform immediately to the Mines Manager. When any accident resulting in serious bodily injury to any person or in loss of life occurs in a mine, the Mines Manager shall inspect the site of accident as soon as possible and have an enquiry into the cause of and circumstances attending the accident. The result of such enquiry with plan of the site of the accident showing details shall be recorded in a bound page book kept for the purpose. The Manager shall perform such other duties as prescribed in that behalf under the Mines Act 1952 and MMR, 1961.

(b) Emergency Facilities

Stretchers and general first aid materials for dealing with fire burns etc. will be maintained in the medical center as well as in the emergency control room. A medical practitioner will be appointed for the mine workers. Beside the medical personnel, medical facilities in the area will be created & updated. An ambulance with driver will be ensured and maintained to transport injured or affected persons. At the end of an emergency, the Mines Manager orders an all-clear signal.

(c) Disaster Management

- All safety precautions and provisions of Mines Act 1952, MMR 1961 and Mines Rules 1955 will be strictly followed in all mining operations.
- Avoidance of danger as per Regulation 117 and general precautions and safety as per Regulation 118 and 181 of MMR 1961 will be observed.
- Mining operations will be done under supervision of qualified and statutory personnel as per MMR 1961 and MCDR 2017.

- Mine working will be done as per approved Mining Plan following provisions of MCDR 2017 and Regulation 106, 110, 111 & 115 of MMR 1961.
- General and surface precautions against fire i.e. precautions and provision of firefighting equipment will be taken as per Regulation 119 of MMR 1961.
- Entry of unauthorized persons will be prohibited.
- Provisions of all the safety applications and protective wears such as safety boot, helmets, goggles, hand gloves, ear muffs, etc. as per Regulation 182 will be made available to the employees and regularly checked for their use.
- Cleaning of mine faces will be regularly done.
- Handling of explosive, charging and blasting will be carried out by competent persons only as per MMR.
- Provision of magazine at a safe place with fencing and necessary security arrangement.
- Adequate safety equipment provided at explosive magazine.
- Regular maintenance and testing of all mining equipment as per manufacturer's guidelines.
- Increasing the awareness of safety and disaster through proper training of mining staff.
- The haul roads will be kept sufficiently wide to ensure free and safe movement with proper alignment and gradient.
- Medical appliances/specified First Aid box as per Section 21 of Mines Act 1952 will be maintained in the mine office. The Mine Manager and other qualified persons will render first aid to injure if needed.

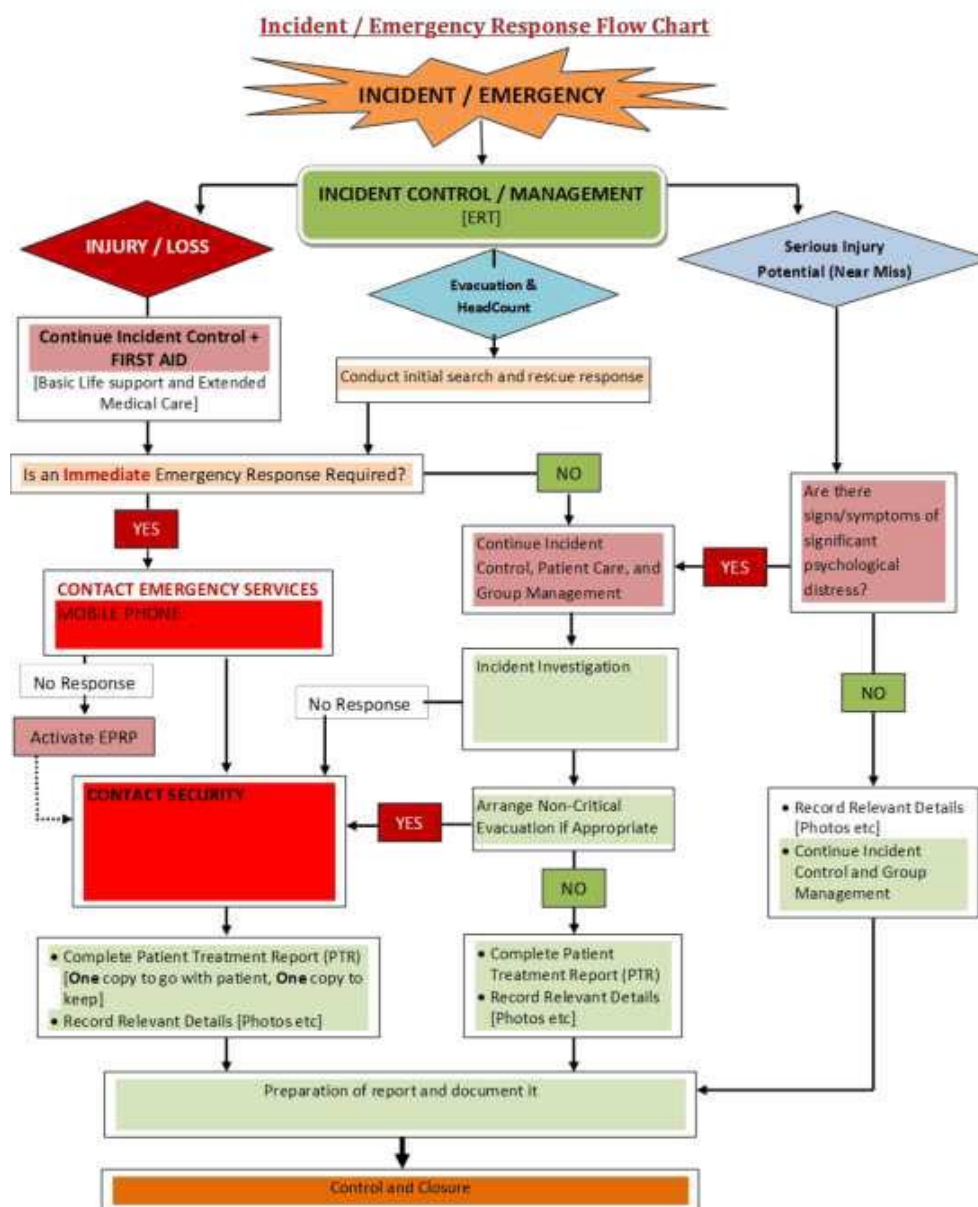


Figure 7.2 Emergency Response Flow Chart

7.4.4 ONSITE EMERGENCIES

The responsible officers for co-ordination in case of emergency will be employed. The following officers will be responsible for co-ordination in case of emergency. They are called as a “Key Personnel”. Their organization positions are indicated as below:

Table - 7.2
Responsibilities of Officers

S. No.	Designation	Responsibility
1.	Mine manager	Site Controller
2.	Shift In-charge/Section in Charge	Accident Controller/ Communication Officer
3.	Employee who gives the first information about the incident/accident	Primary Controller
4.	P & A Department (HOD)	Liaison Officer

Structure of the Disaster Management Plan

1) Out Line of Disaster Management Plan

The purpose of disaster management plan is to restore the normalcy for early resumption of mining operation due to an unexpected, sudden occurrence resulting to an abnormality in the course of mining activity leading to a serious danger to workers or any machinery or the environment.

2) System of Communication

An internal communication system will be provided for the department head and to their line of command with telephone facility. Telephone nos. and addresses of adjoining mines, rescue station, police station, fire service station, local hospital, electricity supply agency and standing consultative committee members are provided.

3) Consultative Committee

A standing consultative committee will be formed under the Mines Manager. The members consist of safety officer / medical officer / Asst. manager/ public relation officer/ Foreman and environmental engineer.

4) Facilities & Accommodation

Accommodation and facilities for medical centre, rescue room and for various working groups will be provided.

5) First Aid & Medical Facilities

The mine management will be having first aid centre for use in emergency situation. All casualties would be registered and will be given first aid. The centre will have facilities for first aid & minor treatment, resuscitation, ambulance and transport. It will have proper telephone/wireless set for quick communication with hospitals where the complicated cases are to be sent.

6) Stores and Equipment

A detailed list of equipment available, its type & capacity and items reserved for emergency will be made available.

7) Transport Services

A well-defined transport control system is provided to deal with the situation.

8) Functions of Public Relations Group

To make a cordial relation with government officials and other social service organization and working groups. To liaise with representatives of the mine to ameliorate the situation of panic, tension, sentiments, grievances and misgivings created by any disaster. To ameliorate the injured, survivors and family members of the affected persons are provided all the material with required arrangements including, moral support and establishing contact with relatives of victims. This will be made immediately.

9) Security

Manning of security posts

10) Catering & Refreshment

Arrangement has been/will be made for the victims, rescue teams and others.

7.4.5 KEY PERSONNEL AND THEIR RESPONSIBILITY

The appointment of all the key personnel i.e., Site Controller, Accident Controller/Communication Officer, Primary Controller and Liaison Officer are taken up and intimated to DGMS and other concerned authorities as per statute. The responsibilities of onsite Disaster Management Plan key personnel are elaborated as follows:

A. Site Controller

The head of the department/ Mine agent shall have on overall responsibility for controlling the incident/ accident and directing the personnel.

- To prepare a full proof plan for control of accident like, landslides, control subsidence, flood and other natural calamities.
- To inform statutory bodies of the State and Central Govt.
- To inform communication officer about the emergency, control centre and assembly point.
- To provide all assistance and call for fire Squad, Security officer and other service required for removing/ control of danger.
- To ensure that all necessary personnel assemble at assembly point.
- Make arrangements for medical treatment to the personnel injured seriously.

B. Accident Controller

- Mock rehearsal of management plan prepared for accident.
- To withdraw men/ machines from the affected area with pointy for safety of personnel, minimize damage to the machines, environment and loss of material.
- To act as an accident controller to all the later arrived.
- To make a report based on the facts and figure and submit to site controller.
- To provide first aid treatment and communicate to the shift in charge.

C. Primary Controller

- To inform the Accident Controller/ shift In-charge from the nearest means of communication about the location and the nature of accident.
- To assist in clearing any obstruction in relief of accident. To carry out all instructions of Accident Controller.
- To provide first aid treatment and communicate with the Shift in charge

7.4.5.1 QUICK EVACUATION, AMELIORATIVE MEASURES FOR EMERGENCY PLAN

A rescue management Team will be formed to deal with the incidence efficiently and quickly and it would be working in close coordination with systematic & structured emergency plan. Display board will be fixed at mine office/pit mouth, showing emergency contact numbers. Rescue Management team will consist various officials of the company at different positions such as Functional Head of

(Mines), Head of Department (Mines), Section Head of (Mines operation), HOD (Safety), HOD (Security), HOD (ER), HOD(Electrical), Chief Medical Officer, Hospital & Fire supervisor etc.

Line of Action: Any person notices incident in ML Area; will immediately take steps to give warning by blowing the siren continuously and will communicate to mine officials. Duties & role of rescue team is defined to tackle the situation in quick & systematic manner, which are as under:

- **Duties of Mine Official:** The Mine officials receiving the warning will forthwith inform to team member and take actions for quick evacuation, ameliorative measures at site. Inform to senior management and statutory bodies.
- **Duties of Head of Department (Safety):** Worked in close coordination with the other team members for defensive, systematic & structured process.
- **Duties of Head of Department (Security):** Responsible to depute the security guard at site, barricaded the area, control to entry of unauthorized person at site/nuisance event etc. and for providing transport vehicle at site.
- **Duties of Head of Department (Employees Relation):** Coordination with local authority for statutory obligation or any assistance will be required by local authorities.
- **Duties of Head of Department (Electrical):** Responsible for cutting off power supply and make lighting arrangement for working in night or any assistance regarding electricity.
- **Duties of Chief Medical Officer (Hospital):** Responsible for making arrangement for medical aid for person.
- **Duties of Fire Supervisor:** On receiving warning, the team will reach the site of fire and depending on its nature, class and extent will take steps to extinguish it and rescue persons if involved in fire.

7.4.5.2 THE CAPABILITY OF LESSEE TO MEET EVENTUALITY

The details of capability of lessee to meet such eventuality are as under:

Communication facility available: Communication facilities like telephone mobile phones, email etc. will be available to communicate with the people at working sites.

Alarm System: For raising alarm, hooters to be located at suitable locations.

Fire Brigade: Well-equipped fire brigade will be provided at site with trained firefighting personnel. Beside this, mining personnel will be trained to tackle emergency situations like immediate evacuation of man and machine, operating fire-fighting equipment, giving first aid etc.

Security: The company has planned to get its security personnel capable of acting in emergency situation.

First Aid Facility: First aid training will be imparted to mining personnel at regular interval. First aid Stations will be established at appropriate locations.

Emergency Control System: In emergency persons to be contacted, location for assembly, telephone numbers for contact, roles and responsibilities of persons etc. will be specified. Emergency telephone numbers will be displayed at the mine site.

7.4.5.3 POST DISASTER ANALYSIS AND EVALUATION

When the emergency is over, the team will carry out a detailed analysis of the cause of accident/occurrence, evaluate the influence of various factors and find out the procedures to minimize them in future. At the same time adequacy of disaster management plan shall also be evaluated and shortcomings shall be rectified to improve the plan.

7.4.6 OFF-SITE EMERGENCY PLANNING

7.4.6.1 INTRODUCTION

The off-site emergency plan is an integral part of any hazard control system. It would be based on those accidents identified by the works management, which could affect people and the environment outside the works. Thus, the off-site plan follows logically from the analysis that took place to provide the basis for the on-site plan and the two plans should, therefore, complement each other. The key feature of a good off-site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan. The roles of the various parties that may be involved in the implementation of an off-site plan are described below. The responsibility for the off-site plan will be likely to rest either with the works management or with the local authority.

Either way, the plan must identify an emergency coordinating officer who would take overall command of the off-site activities. Consideration of evacuation may include the following factors:

- In the case of a major fire but without explosion risk (e.g. an oil storage tank), only houses close to the fire are likely to need evacuation.
- If the fire escalates it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people would be advised to stay indoors and shield themselves from the fire while measures are taken by those outside to douse fire.

7.4.6.2 ASPECTS TO BE INCLUDED IN AN OFF-SITE EMERGENCY PLAN

Some of the aspects to be included in off-site emergency plan are as follows:

a) Organization

Details of command structure, warning systems, implementation procedures, emergency control centers, name and appointments of incident controller, site main controller, their deputies and other key personnel.

b) Communications

Identification of personnel involved, communication center, call signs, network, list of telephone numbers.

c) Special Emergency Equipment

Details of availability and location of heavy lifting gear, bulldozers, specified fire-fighting equipment, fireboats.

d) Voluntary Organizations

Details of organizers, telephone numbers, resources, etc.

e) Meteorological information

Arrangements for obtaining details of weather conditions prevailing at the time and weather forecasts will be made.

f) Humanitarian Arrangements

Transport, evacuation centers, emergency feeding, treatment of injured, first aid, ambulances, temporary mortuaries.

g) Public Information

Arrangements for: -

- (i) Dealing with the media-press office
- (ii) Informing relatives, etc.

h) Assessment

Arrangements for: -

- (i) Collecting information on the causes of the emergency
- (ii) Reviewing the efficiency and effectiveness of all aspects of the emergency plan.

Table - 7.3
Emergency Coordinating Officers

S. No.	Names	Contact No.
1.	Police Control Room, Goa	100/112
2.	Mormagao Police Station	0832-2520740
3.	Fire	101
4.	Ambulance Service	108/102
5.	Child Helpline	1098
6.	Women Helpline	1091

Source: <https://www.goa.gov.in> & <https://citizen.goapolice.gov.in/>

7.4.6.3 ROLES OF MAJOR HAZARD MANAGERMENTS

Where the local authority has the organization to formulate the plan, the role of management in off-site emergency planning will be to establish liaison with those preparing the plans and to provide information appropriate to such plans. This will include a description of possible on-site accidents with potential for off-site harm, together with their consequences and an indication of the relative likelihood of the accidents.

Advice should be provided by works managements to all the outside organizations which may become involved in handling the emergency off-site and which will need previously to have familiarized themselves with some of the technical aspects of the works activities, e.g. emergency services, medical departments, etc.

7.4.7 ROLE OF THE EMERGENCY COORDINATING OFFICER

The various emergency services are coordinated by an Emergency Coordinating Officer (ECO) who is likely to be a senior police officer but, depending on the circumstances, could be a senior fire officer. The ECO is closely connected with the site main controller. Again, depending on local arrangements, for very severe incidents with major or prolonged off-site consequences, the external control may pass to a senior local authority administrator or even an administrator appointed by the Central or State Government.

ROLE OF THE LOCAL AUTHORITY

In some places the duty to prepare the off-site plan lies with the local authorities. They have appointed an emergency planning officer (EPO) to carry out all this duty as part of the EPO's roles in preparing for a whole range of different emergencies within the local authority area. The EPO is need to obtain the information to provide the basis for the plan.

Rehearsals for off-site plans are important for the same reasons as on-site plans and will need to be organized by the EPO.

ROLE OF THE POLICE

The police normally assume the overall control of an emergency, with a senior officer designated as emergency coordinating officer. Formal duties of the police during an emergency include protecting life and property and controlling traffic movements. The functions include controlling bystanders, evacuating the public, identifying the dead and dealing with casualties and informing relatives of dead or injured.

ROLE OF THE FIRE AUTHORITIES

The control of a fire is normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival at the site. The senior fire brigade officer also have a similar responsibility for other events. Fire authorities having major hazard works in their area is familiarize themselves with the location on site of all stores of flammable materials, water and foam supply points and fire-fighting equipment.

ROLE OF THE HEALTH AUTHORITIES

Health authorities, including doctors, surgeons, hospitals, ambulances and so on, have a vital part to play following a major accident and they form an integral part of any emergency plan.

For major fires, injuries are the result of the effects of thermal radiation to a varying degree and the knowledge and experience to handle this in all, but extreme, cases may be generally available in most hospitals.

ROLES OF THE GOVERNMENT SAFETY AUTHORITY

The Inspectors of Director General of Mines Safety may want to satisfy themselves that the organization responsible for including the off-site plan has made adequate arrangements for handling emergencies of all types including major emergencies. In the event of an accident, local

arrangements regarding the role of the factory inspector is applied. In the aftermath, factory inspectors may wish to ensure that the affected areas are rehabilitated safely.

7.4.8 CARE AND MAINTENANCE DURING TEMPORARY DISCONTINUANCE

When the mine will be temporarily discontinued due to any unforeseen circumstances, the following care and maintenance will be carried out.

- Notice of temporary discontinuance of work in mine will be given to the Controller General, Controller of Mines and the Regional Controller of Mines, IBM, DGMS & DMG, State Govt. officials under Rule 24 of MCDR 1988 and Reg. 6 of MMR 1961 respectively.
- All mining machineries will be shifted to a safe place.
- Entrance to the mines or part of the mines to be discontinued will be fenced off as per DGMS Circular and security Guards will be posted for the safety and to restrict any unauthorized entry to the area.
- Competent persons will inspect the area regularly.
- Air, water and other environmental monitoring will be carried out.
- Greenbelt/Plantation is taken care of on a regular basis.
- All rules and regulations will be followed in case of any temporary discontinuance of mine.



CHAPTER - 8 PROJECT BENEFITS

8.1 INTRODUCTION

JSW Steel Limited has proposed Block – XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of 04 Crushers (1 Primary Crusher of 250 TPH and 1 Secondary Crusher of 150 TPH) and Dry & Wet Beneficiation Plant with throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa). The Iron ore mined out from this Mine will be supplied to JSW Steel Plant and or sold in open market like Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant. The proposed mine will help in overall growth of the region.

JSW Steel Limited is committed to strengthening the country's domestic manufacturing capabilities and support Govt. of India initiative “Atmanirbhar Bharat” through this project. The acquired As Iron Ore is the main raw material for steel production; its demand will always be there and the proposed Block – XII Codli Mineral Block of Iron Ore mine will contribute in meeting the demand of Iron Ore with respect to the production of steel and foreseeing the growth potential in Infrastructure sector of the India. To ensure raw material security, cost competitiveness and operational resilience, the company has been steadily expanding its captive iron ore portfolio and investing in beneficiation, infrastructure and technology.

8.2 PROJECT BENEFITS

Project benefits are attributed in various ways as under:

- 1) Improvement in Physical & Social Infrastructure
- 2) Employment Potential: Skilled, Semi-skilled & Un-skilled
- 3) Other Tangible Benefits

JSW Steel Limited has established benchmark with regard to its social responsibility towards the community and has undertaken extensive range of initiatives in the sphere of livelihood, employability, education, health, infrastructure development and Women empowerment etc. The company believes that holistic socioeconomic development of the region is the need of the hour and company's prosperity is linked with that of its neighboring communities.

8.2.1 IMPROVEMENT IN PHYSICAL & SOCIAL INFRASTRUCTURE

The Mining sector is one of the important sectors in India's economy. The Company will contribute to the State and Central Govt. exchequer which will be spent for the betterment of the local community. With the proposed development in and around the area, there will be supporting facilities/ infrastructure eventually leading to development of the area. The Socio-Economic status of the area will improve with the implementation of various development programs under Pradhan Mantri Khanij

Kshetra Kalyan Yojana (PMKKKY) for welfare of the areas and people affected by mining related operations, using the funds generated by District Mineral Foundations (DMFs).

The socio-economic activities will be implemented based on the community priorities. The areas of the development will be identified through socio-economic study and will be considered. The funds allocated will be spent for various socio-economic development activities proposed to be undertaken in the study area with a priority to villages falling in the impact zone, which may be further extended to other villages depending upon the budget and requirement. This approach will strengthen the groups, empower the members and will develop a high sense of ownership.

Time bound action plan on concerns of the public issues along with budgetary allocation as per MoEF&CC, OM dated 30.09.2020 & 20.10.2020 will be prepared & submitted during Final EIA/EMP after conduction of Public Hearing.

8.2.2 EMPLOYMENT POTENTIAL: SKILLED, SEMI-SKILLED & UN-SKILLED

The proposed project will generate various direct & indirect employment opportunities. Total 154 persons will be employed directly in this proposed mine. Managerial, supervisory, Skilled/operators, Semi-skilled/unskilled person will be employed and preference will be given to the local for employment as per their skill, qualification & eligibility and requirement.

Apart from the above, various indirect employment opportunities are envisaged by way of transportation, workshops, plantation & horticulture, petty contractors; shopkeepers, etc. Mining activities also result in numerous indirect employment avenues for the people such as drivers, repair shops, tea-stalls, horticulturist etc.

The Company will organize vocational training, entrepreneur development programmes for the locals including women and will provide advice for starting suitable small-scale industry. JSW Steel Limited will encourage entrepreneurship amongst locals or their qualified family members by awarding services, contracts for activities such as canteens, vehicle hiring, office services and cleanliness and material supply to the villages falling within the mine area and/impact zone of the mine area under CSR plan.

8.2.2.1 EMPLOYMENT BASED SKILL DEVELOPMENT PLAN

The proposed project is expected to generate a range of direct and indirect employment opportunities for local communities. To ensure inclusive and sustainable benefits, JSW Steel Ltd. will implement a structured Skill Development Program aimed at enhancing the employability and entrepreneurial potential of local individuals. The strategy comprises the following key components:

- **Vocational Training for Self-Employment:** The company will offer vocational courses designed to empower individuals with the skills required for self-employment. This includes support for micro-enterprise development and access to market linkages.

- **Needs-Based Training Design:** Skill development programs will be tailored based on a detailed assessment of local demographics, educational qualifications and employment potential within the project and surrounding industries.
- **Trade and Agricultural Skill Enhancement:** Training will be provided in trades such as sewing, tailoring, plumbing, electrical work, and driving. Additionally, farmers will receive guidance on adopting modern irrigation technologies and sustainable agricultural practices aligned with local needs.
- **Youth Empowerment Initiatives:** In addition to trade-specific training, JSW Steel Ltd. will support local youth in pursuing self-employment opportunities in areas such as plumbing, computer operations, and solar street light maintenance, among others.
- **Institutional Partnerships:** The company may collaborate with nearby Industrial Training Institutes (ITIs) and other vocational institutions to deliver certified, high-impact training programs and build a skilled workforce.

Through this integrated approach, the project will not only create employment opportunities within the project and nearby areas within its operational footprint but also foster long-term livelihood resilience, self-employment and entrepreneurship in the surrounding communities through different avenues. The details of activities and Budget earmarked for Skill Development Plan are given below:

Table 8.1
Budget earmarked for Skill Development Plan

S.N.	Particulars	Duration	Target Group	Budget (In Lakhs)
1.	Training for HEMM operations	30–45 days	Local youth	10.0
2.	Plumbing and Fitter	30–45 days	Local youth	5.0
3.	Horticultural & Agricultural and allied activities	30–45 days	Local youth	5.0
4.	Welding & Fabrication	45–60 days	Semi-skilled workers	10.0
5.	Electrician	30 days	ITI/Diploma holders	20.0
6.	Driving Skills Training for LMV/HMV	30 days	Local youth	6.0
7.	Computer & MS Office skill	90 days	Local youth	8.0
8.	Safety & First Aid Training	7–10 days	Local youth	5.0
9.	Housekeeping & Facility Management	15–20 days	Women/SHGs	10.0
Total				79.0

Source: JSW Steel Ltd.

8.2.3 OTHER TANGIBLE BENEFITS

8.2.3.1 ECONOMIC BENEFITS

The Mining sector is one of the important sectors in India's economy. The mine shall be contributing around Rs. 275.68 Crores every year to the State and Central Govt. exchequer by way of mining revenue (Royalty, DMF, NMET etc.) after mine is operated at proposed capacity.

Job opportunities to the local people will improve the earning and spending capacity of the people. The people in area will be able to utilize improved facilities with regard to education, health care, hygiene, recreational opportunities, small business opportunities etc.

With the proposed development in and around the area, there will be supporting facilities/infrastructure eventually leading to the development of the area. The Socio- Economic status of the area will improve with the implementation of various development programs under Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) for welfare of the areas and people affected by mining related operations, using the funds generated by District Mineral Foundations (DMFs).

The mining activity will generate revenue in the form of Royalty and other taxes would be additional benefit, particularly in the form of contribution to the District Mineral Foundation fund (DMF). DMF will be utilized by local administration for the development of socio-economic infrastructure and well-being of the local population.

Table – 8.2

Economic Benefits of the Project

S.N.	Description	Revenue generation/TON (In INR)	Revenue generation/Annum (In Crores)
1.	Royalty (@15% of the Av. Sale Price – Present/Prevailing rate)	107.85	37.75
2.	District Mineral Foundation (@10% of Royalty)	10.78	3.77
3.	National Mineral Exploration Trust (@3% of Royalty)	3.23	1.13
4.	Auction Premium (@92.60% = Rs. 665.79/- per Tonne)	665.79	233.03
Total		787.65	275.68

Revenue generation at peak production @3.5 MTPA (Rs. 275.68/Annum)

The mine will be contributing around Rs. 275.68 Crores every year to the State and Central Govt. exchequer by way of mining revenue after operating at proposed capacity. Increment of revenue to the State & Central exchequer. Besides this, various rural development initiatives for the upliftment of the nearby communities will also be undertaken.

The execution of proposed Iron ore mine, will also boost the economy of the area by creating direct & indirect jobs for locals. There will be a positive cumulative impact of the project on the economy of the area.

8.2.3.2 SOCIAL BENEFITS

The proposed project will help in improving the socio-economic status of the nearby villages by generating direct and indirect employment opportunities in the region including ancillary development and supporting infrastructure. Substantial amount of indirect revenue will be generated by transportation activities along with employment e.g. labour, helper etc.

The population of study area will have positive impact due to adequate inputs proposed by the company besides offering the benefits of revenue to the state exchequer. The CSR Policy and vision of JSW Steel Limited aim at improving the Human Development Index by focusing on Education, Livelihood and Health of the people. The Company has established benchmark with regard to its social responsibility towards the community and has undertaken extensive range of initiatives in the sphere

of livelihood, employability, education, health, local infrastructure development and Women empowerment etc.

JSW Foundation is the social development arm of the US\$ 24 Billion JSW Group. It has a long track record and a rich legacy of empowering rural communities to enrich their lives since the last three decades. JSW Foundation's focus areas are Education; Health and Nutrition; Skill Development; Livelihoods; Water, Environment and Sanitation; Waste Management; Sports Promotion; and Art, Culture and Heritage. Through a strong field presence, it operates across 17 states and 38 districts around JSW's plant & port locations. JSW Foundation also reaches out to communities beyond these locations to contribute towards India's social development in a meaningful way. JSW Foundation's holistic life-cycle based interventions have positively impacted more than 2 million individuals across India.

JSW Skills School, an initiative of JSW Foundation, aims to improve the employability of the youth and women by offering industry-centric courses for vocational skill enhancement. This is achieved through facilitation of infrastructure and development and up-gradation of teaching tools of Governments' Industrial Training Institutes (ITI), across India.

More than 3500 Number of youths trained via JSW Skill Schools and families impacted positively, more than 10,000 Women benefited from tailoring units and more than 10000 rural women are benefitted. Key initiatives of JSW group are as under:

- Six JSW Skill Schools providing short-term and long-term courses
- Partnered with Father Agnel Technical College at Vasind and Nettur Technical Training Foundation, Vijaynagar.
- Member of Institute Development Committee of 21 government-aided it is across India
- Organised self-help groups where rural women are trained in basic financial management to help set up a business
- Partnered with National Skill Development Corporation (NSDC) and got permanent empanelment with Maharashtra State Skill Development Society (MSSDS).

JSW is also working in the field of Infrastructure Development and its projects include, building link roads, bus stands, railway stations, school buildings, student hostels, community centers, water harvesting and storage tanks, toilets etc. through which the company is reaching out to remote areas, helping the people to get access to basic amenities and thereby working towards raising their standard of living.

JSW Steel Limited will contribute for the upliftment of the living standards and development of nearby areas through CSR activities which will be carried out in project vicinity area and nearby villages which will benefit many beneficiaries.

Details of Expenditure proposed to be done by the company in the first five years under CSR activities to be carried out in project vicinity area and nearby villages are given below:

Table - 8.3
Proposed CSR Budget for first Five Years

S. No.	Activity	Budget (Rs. in Lakhs)					
		Year 1	Year 2	Year 3	Year 4	Year 5	Total
1.	Community Development	6.25	6.89	7.5	8.14	8.75	37.53
2.	Health and Nutrition	3.75	4.38	5.00	5.63	6.25	25.01
3.	Water and Sanitation	2.50	3.13	3.75	3.75	5.00	18.13
4.	Education & Sports	6.25	6.25	7.50	7.50	8.75	36.25
5.	Livelihood and Skill Development	5.00	5.00	6.25	6.88	7.50	30.63
6.	Support to social, cultural, recreational activities	6.25	6.25	7.50	7.50	8.75	36.25
Total		30.00	31.90	37.50	39.40	45.00	183.80

Source: JSW Steel Ltd.

8.2.3.3 ENVIRONMENTAL BENEFITS

Proposed project will be beneficial for environment in following ways:

Greenbelt Development/Plantation:

At Conceptual Stage, greenbelt will be developed along 7.5 block periphery covering an area of 17.45 ha, 51.95 ha area will be backfilled and subsequently rehabilitated through plantation & regrassing, 6.87 ha on dump plantation and 26.1582 ha area under tailing dam rehabilitated by plantation.

Thus, total area to be covered under the greenbelt/plantation will be 102.4283 ha. Out of which 20% is 20.49 ha which will be developed on the backfilled area and tailing dam area using the Miyawaki plantation technique.

Remaining (102.4283 – 20.49 = 81.9383 ha) will be developed as 2500/ha saplings. Thus, total nos. of saplings are 2,04,846 @2500/ha and survival rate of more than 90% will be maintained.

Rainwater Harvesting

Out of the total ML area of proposed Block - XII Codli Mineral Block i.e. 377.0881 ha, at conceptual stage, total mined out area will be 301.1521 ha, out of which 249.2021 ha will be covered under water reservoir.

During monsoon, water from the catchment area of the beneficiation plant and the run-off water from mine will be diverted through trenches and drains into settling ponds located within the ML area. These settling ponds will facilitate the settling of suspended particles in the water. Run-off water will be stored in settling pond. The settling ponds will be cleaned before the onset of monsoon. Rainwater harvested and stored in the Mine pit will also facilitate in groundwater recharging. The domestic waste water generated will be disposed in Soak pit via Septic tank and treated water will be used for dust suppression.

Eventually, the aesthetic beauty of the area will be enhanced by massive and planned plantation in and around the mine and township. Hence, conceptual land use will present a better land use of the Area.

Some of the environmental benefits associated with the proposed project are listed below:

S.N.	Benefits	Description
1.	Biodiversity enhancement	Plantation of native species in reclaimed areas create new habitats, promoting local flora and fauna diversity.
2.	Reduced pressure on natural resources	Water harvesting and plantation initiatives reduce reliance on external water resources.
3.	Environmental awareness and community participation	CSR activities and community programs help in raising environmental awareness and involve locals in caring for nature
4.	Resource optimization	Optimum utilization overall resource efficiency

8.3 CONCLUSION

Proposed Project will generate a reasonable amount of direct and indirect employment in nearby region. JSW Steel Limited recognizes CSR activities as their social responsibility. The project activity and the management will aid with the development of public amenities in the region. The mine management will recruit semi-skilled & unskilled eligible workers from the nearby villages depending upon requirement in the mines and the eligibility, qualification and experience of local persons.

The overall development will result in higher standard of living viz. better education, improved health and sanitation facilities, housing and acquisition of consumer durables. Housing, transport, medical, educational and other civic amenities will get improved in the future. This is envisaged as a major positive benefit.



CHAPTER - 9

ENVIRONMENTAL COST BENEFIT ANALYSIS

9.1 ENVIRONMENTAL COST BENEFIT ANALYSIS

As per EIA Notification dated 14th September, 2006, the Chapter on the 'Environmental Cost Benefit Analysis' is applicable only if the same is recommended at the Scoping stage.

As per the ToR points issued by, Ministry of environment, forest and climate change, New Delhi Vide File No. J-11015/49/2025-IA.II(NCM) dated 18.05.2026 in favour of JSW Steel Limited; for the proposed mining project activity, the 'Environmental Cost Benefit Analysis' is not required. But there are 65.9686 ha of Forest Land present within the mine lease area. Therefore, Cost Benefit Analysis (CBA) is carried out to evaluate the economic viability of the proposed project by comparing the environmental costs associated with diversion of forest land against the socio-economic benefits generated by the project. The analysis considers both tangible and intangible environmental losses resulting from forest diversion and compares them with the direct and indirect economic gains arising from mining activities.

For the proposed diversion of 65.9686 ha of forest land under Block-XII Codli Mineral Block, the environmental costs have been estimated considering ecosystem services, habitat fragmentation, compensatory afforestation, and other associated losses. The economic benefits include increased productivity, contribution to the economy, employment generation, and benefits arising from compensatory afforestation.

9.2 ENVIRONMENTAL COST DUE TO FOREST DIVERSION

The environmental cost associated with diversion of forest land has been estimated under different components as summarized below.

Table 9.1
Estimation of cost of Forest diversion

S.N.	Parameters	Amount
1	Ecosystem services losses due to proposed forest diversion	9,47,75,108.56
2	Loss of animal husbandry productivity, including loss of fodder	94,77,510.85
3	Cost of Human resettlement	Nil
4	Loss of public facilities and administrative infrastructure (Roads, Building, Schools, dispensaries, electric lines, railways, etc.) on forest land, which would require forest land if these facilities were diverted due to the project.	Nil
5	Possession value of forest land diverted	2,84,32,532.56
6	Cost of suffering to oustees	Nil
7	Habitat Fragmentation Cost	4,73,87,554.28
8	Compensatory Afforestation & Soil moisture conservation and its maintenance in future at present discounted value	7,91,62,320.00
Total		25,92,35,026.25 (2,592.3502 Lakhs)

9.3 PROJECT BENEFITS

The proposed mining project will generate substantial economic and social benefits at the local, regional and national levels. The major benefits considered in the analysis are given below:

Table 9.2
Estimation guidelines for estimating benefits of Forest diversion in CBA

S.N.	Parameters	Amount (In Lakh)
1	Increase in productively attribute to the specific project.	56,000
2	Benefits to economy due to the specific project	23,581.25
3	No. of population benefited due to specific project	200
4	Economic benefits due to of direct and indirect employment due to the projects	59.30
5	Economic benefits due to Compensatory Afforestation	4,834.19
Total		84,674.74

The analysis indicates that the project contributes significantly to industrial development, employment generation, government revenue, and regional economic growth while implementing environmental safeguards through compensatory afforestation and ecological restoration measures.

9.4 COST-BENEFIT RATIO

Based on the estimated environmental costs and project benefits:

- **Total Environmental Cost:** Rs. 25,92,35,026.25
- **Total Project Benefits:** Rs. 84,674.74 Lakhs

Accordingly, the Loss : Benefit Ratio is: 1 : 32.66

This indicates that every unit of environmental cost incurred due to forest diversion is compensated by approximately 32.66 units of economic and social benefits generated by the project.

9.5 CONCLUSION

The Cost Benefit Analysis demonstrates that the proposed project is economically beneficial while incorporating comprehensive environmental management measures. Although forest diversion results in environmental costs associated with ecosystem services, habitat fragmentation & ecological restoration, these impacts are proposed to be mitigated through compensatory afforestation, soil moisture conservation and implementation of the Environmental Management Plan (EMP).

The projected economic benefits in terms of industrial production, employment generation, contribution to government revenue, regional infrastructure development and socio-economic upliftment substantially outweigh the environmental costs. The calculated **Loss : Benefit Ratio of 1 : 32.66** confirms the overall positive economic viability of the project while emphasizing the importance of implementing all prescribed mitigation measures, compensatory afforestation programmes and long-term environmental monitoring for sustainable mining operations.



CHAPTER - 10

ENVIRONMENTAL MANAGEMENT PLAN

10.1 INTRODUCTION

The environmental management plan (EMP) is required to minimize adverse environmental impacts by implementing suggested mitigation measures with timelines and responsibilities during the project life cycle.

EMP consists of a set of mitigation, management and institutional measures to be taken up during implementation and operation of a project to eliminate adverse environmental impacts or reduce them to an acceptable level. Chapter 4 dealt with environmental impacts of this project and proposed mitigative measures to minimize adverse impacts as well as to improve the existing environment quality. This chapter mainly discusses the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness is monitored after approval of EMP.

It comprises of Corporate Environment Policy (CEP) of company, establishment of an Environment Management Cell (EMC) and developing mechanism of reporting of non-compliances, if any to company board, conduct root cause analysis of non-compliances and propose appropriate mitigation measures to ensure avoidance of adverse Penal action arising out of environment and other statutory regulation.

Good practices of EMP ensured to keep all the environmental parameters of the project w.r.t. Air, Water Quality, Soil, Biological Diversity of the area Socio Economic Improvement, Biological Diversity of the area within statutory limits and sustainable manner.

10.1.1 PURPOSE OF EMP

- To control emission and waste minimization and proper disposal of waste so as to meet statutory requirement.
- To support & implement best technology to achieve environmental standards.
- Judicious use of natural resources and water.
- To ensure good working condition for safety, welfare and good health of the work force.
- Ensure effective operation of all control measures.
- Vigilance towards probable disasters and accidents.
- Monitoring of cumulative and long-term impacts.
- To reduce accident hazards.
- Allocation of funds for environment management supplies.
- To promote greenbelt development & Plantation Programme.

Continuous development and search for innovative technologies for better environment.

10.2 ELEMENTS OF EMP

EMP includes four major elements: -

1. **Planning:** This includes identification of environmental impacts, legal requirement, commitments and policies, setting environmental objectives and environment, health, safety and social compliance requirements;
2. **Implementation:** This comprises of resources available for the project, accountability of employees, contractors and documentation of measures to be taken;
3. **Checking:** Measurement & Evaluation: This includes regular inspection, audits, monitoring corrective actions and record keeping; and
4. **Management Review:** Actions are taken to continually improve the environment, health, safety, and social performance of the organization.

The following Policy & programs have been developed to ensure proper implementation of EMP for the proposed mining project:

- Formulating Corporate Environment Policy (CEP)
- Formation of Environment Management Cell (EMC)
- Greenbelt Development & Plantation Programme
- Occupational Health and Safety
- Budgeting of Environmental Mitigation measures

10.3 CORPORATE ENVIRONMENT POLICY

The importance of environment management has been recognized by JSW Steel Limited and the company has taken necessary steps to identify environmental aspects and to mitigate those aspects which may generate pollution at the sites and also in the peripheral areas. JSW Steel Limited is committed to ensure Clean, Green, Healthy and Sustainable Environment. Few of the features are listed below:

- Compliance with all the applicable environmental laws, regulations and legislations.
- Implementation of Environmental Management System across the organization.
- Efficient use of natural resources, energy, water, plant and equipment.
- Reduction in stack emissions, noise, waste and greenhouse gas emissions.
- Limiting the dependence on coal-based power by increasing share of renewable energy in total power consumption.
- Regularly track the water consumption across operations and reduce stress on water resources through implementation of water saving initiatives as well as water recharge initiatives (such as rainwater harvesting).
- Developing and enhancing green cover and conservation of biodiversity with an aim of achieving Net Positive Impact on biodiversity.

Corporate Environment Policy (CEP) has been formulated adopted by the Board of Directors of JSW Steel Limited. to provide a framework to become an environmentally sustainable company. The hierarchical system or administrative order of the company to deal with the environmental issues and

for ensuring compliance with the EC conditions has been given in the Corporate Environmental Policy of the company.

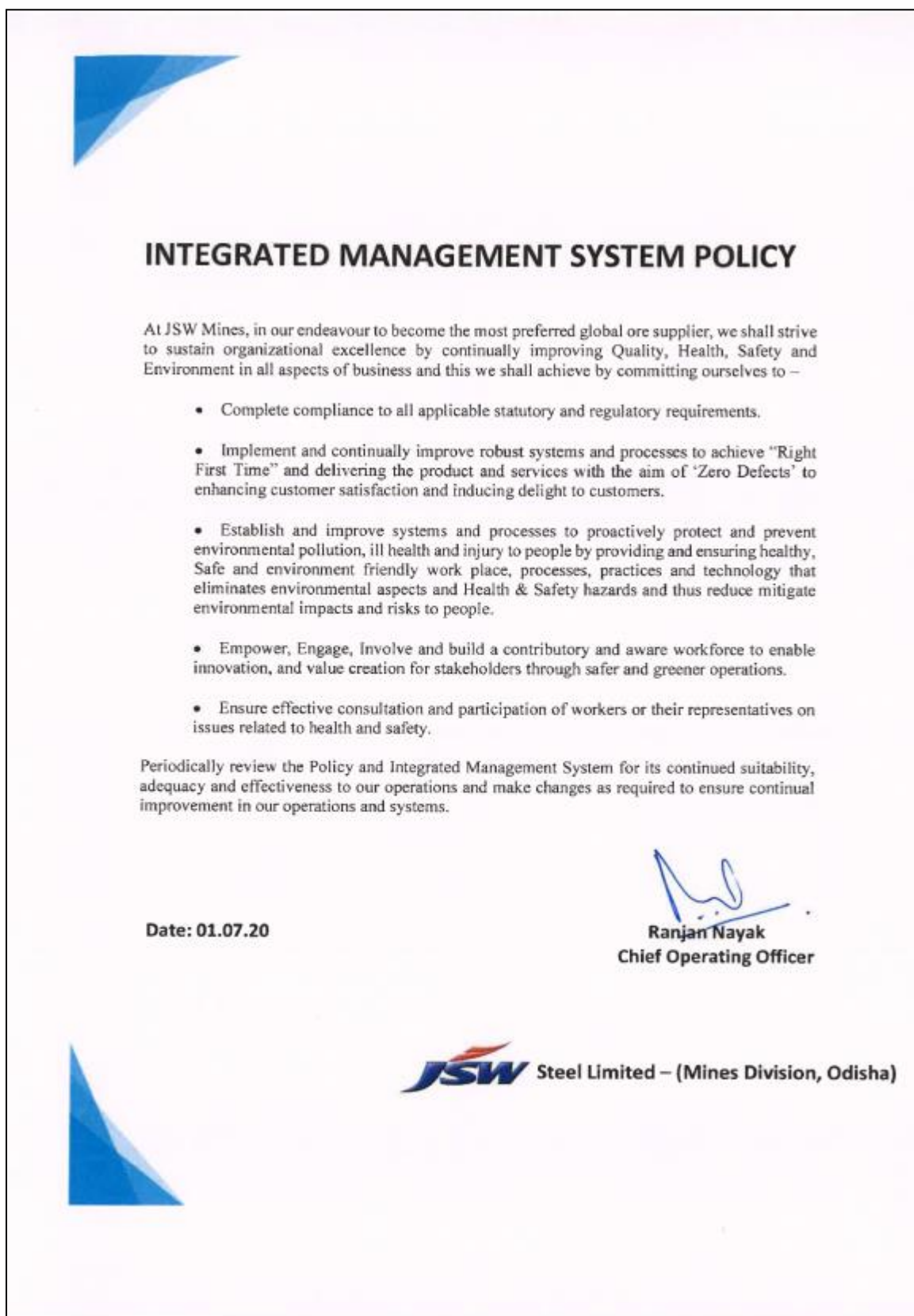


Figure 10.1 Integrated Management System Policy of JSW Steel Limited

10.3.1 FORMATION OF ENVIRONMENTAL MANAGEMENT CELL (EMC)

JSW Steel Limited has implemented Environmental Management System (EMS) at all its locations within the organizational boundaries. Respective unit heads are responsible for implementation of policy at unit level, in consultation with corporate environment team. The head of corporate environment team oversees effectiveness of initiatives implemented across operations. Briefing on environmental matters is communicated to the management and Board of Directors as per requirement. Any non-compliance with reference to implementation of the policy can be reported through grievance mechanism defined in Stakeholder Engagement Policy of JSW Steel Limited.

In order to maintain the environmental quality, regular inspections, audits & monitoring of various environmental components is necessary. The company has a full-fledged Environmental Management Cell (EMC) for environmental monitoring and control. The EMC team will be responsible for pollution monitoring aspects and implementation of control measures as discussed in Chapter 2 & 4 of this Draft EIA/EMP Report.

A group of qualified and efficient engineers with technicians have been deputed for maintenance, up keeping and monitoring the pollution control equipment, to keep them in working mode at the best of their efficiencies. The Organizational structure of EMC is given below:

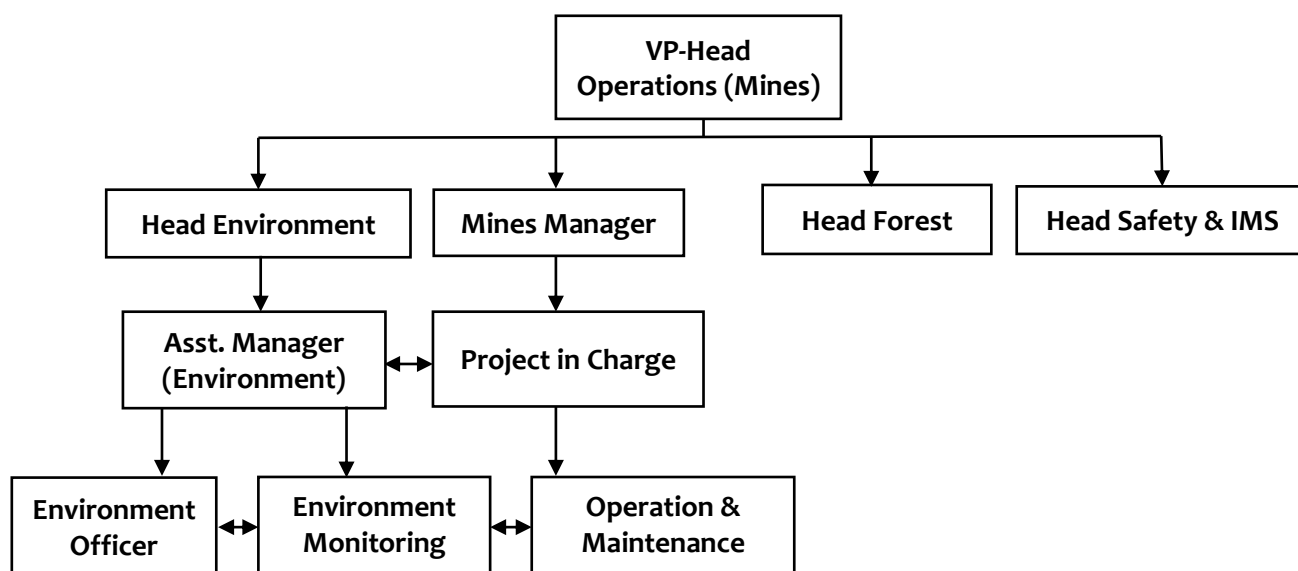


Figure 10.2 Organizational structure of EMC

10.3.2 RESPONSIBILITIES OF EMC

The EMC oversees and implements the various functions to ensure that environmental status of the area remains well within the statutory standard of MOEF&CC and GSPCB. The responsibilities of the EMC include the following:

- Environmental monitoring of the core and buffer zone.
- Environmental monitoring of the core and buffer zone and evaluation of results. Keeping of records to track the surrounding environment quality status.
- Procurement and commissioning of Pollution Control/Monitoring Equipment.

- Specification and regulation of maintenance schedules for pollution control equipment.
- Ensuring that prescribed standards are maintained.
- Ensuring optimum water usage.
- Implementation of the mitigation measures suggested in EIA/EMP Report.
- Ensuring greenbelt development/plantation & its maintenance.
- Compliance with guidelines and statutory requirements.
- Coordination with statutory bodies, functional groups of the unit, Corporate Project/Environment & Engineering department etc.
- Interaction with engineering & operation team for implementation of any modification programmes intended to improve the availability / efficiency of pollution control devices / systems.
- Carry out proactive environmental studies and observe all precautions necessary to avert disasters and emergencies in the mining observations as well as nearby areas.
- Regular environmental review and performance appraisal (Internal) and organizing Environmental Audits by independent agencies/ 3rd party agencies.
- Coordination with the vendors dealing in waste supplies and disposal.
- Ensuring that the waste handling and disposal is carried out as per prescribed conditions.
- Conducting regular training programmes on various environmental requirements especially sustainable development, climate change, environmental monitoring etc.
- Reporting of compliances and non-compliances (if any) to management and other stakeholders.
- Implementation of socio-welfare programmes for economic upliftment.
- Implementation of the Environmental Management Plan and assessment of effectiveness of the same.
- To provide periodic health check-up of workers.

10.4 CORPORATE ENVIRONMENTAL AUDITING

Independent Audit/ evaluation of working of the Policy has been done by the Internal Auditor at least once a year and report the same to the Chief Financial Officer and Managing Director, was designated by the Board of Directors as responsible Director for the preparation and implementation of the Corporate Environmental Policy. It is imperative for the Head of Business /Occupier to ensure avoidance of adverse Penal action arising out of Environment and other statutory regulation. Therefore, third party Corporate Environment Compliance Audit (CECA) has been conducted to assess and quantify the environmental performance/compliance of the project with following scope:

- To check any major or minor non-compliances/non-conformities occurring in respect of the statutory clearances.

- To check with the compliance status of the conditions stipulated in the Environmental Clearance letter/Consent to Operate/other statutory permissions.
- Evaluation of performance of OH&S Policy Implementation.
- Verify selected parameters and methods for internal the company's policies and established environmental performance levels.
- Conduct root cause analysis of non-compliances/deviation and propose appropriate mitigation measures prioritizing the findings as high, medium or low based on potential risk to the organization.

10.5 PERSONS RESPONSIBLE FOR IMPLEMENTATION OF EMP

Manpower Required to execute the Project is given in Chapter 2 of this Draft EIA/EMP Report. Details of persons responsible for implementation of EMP along with their role/responsibilities are given in table below:

Table – 10.1
Role & Responsibilities of Manpower to be deployed

S. No.	Designation	Role/Responsibilities
1.	Mines Manager	➤ Responsible for discharging duties as Mines Manager as per Mines Act 1952, MMR 1961, Mines Rules 1955, MCDR 2017 and various circulars issued by regulatory authorities from time to time. ➤ Create awareness on potential environmental aspects & occupational hazards & risk. ➤ Ensure judicious use of all natural resources including energy, minerals, water etc. ➤ Ensure environment friendly operations with a view to keep the emissions/effluents within the prescribed norms. ➤ To Identify and comply with the applicable Statutory & Regulatory requirements. ➤ To identify, control and reduce the EHS hazards and risks. ➤ Training Need Assessment of Employees for effective implementation of the EMP. ➤ Incident controller in case of any emergency. ➤ To plan for new equipment, minor modification etc. for betterment of plant (i.e. Quality improvement, reduction of environmental impact & OHS Risk etc.) in consultation with Operations Head. ➤ To ensure effective & continuous operation of pollution control & Safety equipment. ➤ Responsible to ensure quality of stacker feed iron ore as per process requirement. ➤ Overall environmental performance of the Mines. ➤ Liaison with statutory / regulatory bodies.

		➤ Regular communication with PAF/ nearby community and establish a feedback system in coordination with Environment Manager. ➤ To ensure effective implementation & adherence to QEHS Criterion at their sub-contracted activities. ➤ Ensure the EMP is implemented and is effective. Assist the Environment Manager with regulatory authorities and/or community consultation (i.e. complaints).
2.	Environment Manager	➤ Establish, implement and maintain the EMP as stipulated. ➤ Ensure that all the applicable environmental parameters are regularly monitored and measured as per defined interval and reports submitted to the concerned regulatory authorities. ➤ Ensure that the environmental objectives and targets are established and achieved. ➤ Review and evaluate EMP to ensure that the same is consistent with EMP formulated by JSW Steel Limited. ➤ Liaise with regulators and other agencies as required in unison with the Mines Manager for effective implementation of the EMP. ➤ Regular communication with PAF/ nearby community and establish a feedback system in coordination with Mines Manager. ➤ Implement appropriate management programs to achieve the management objectives and goals. ➤ Assist operational staff with respect to clarifying or improving existing practices / procedures or adding more stringent requirements / controls). ➤ Ensure that any change in any of the activities/ equipment/ processes are duly evaluated in order to ensure no increase in or introduction of new environmental risks or impacts. ➤ Undertake HSE Manager role in case of an emergency with a potential to degrade environment and/or human health and safety. ➤ Ensure that the requirements of the EMP and related management programs have been addressed in all contractor environmental management documentation. ➤ Undertake regular audits (appoint an appropriately qualified external auditor) for evaluating the environmental performance of the mine.
3.	Environmental Officer	➤ Undertake routine environment monitoring as per schedule. ➤ Daily inspection of the premises, preparing inspection reports. ➤ Checking of emission/ noise levels of mining equipment. ➤ Ensure that regular water sprinkling is done on the haul roads and around waste dumps for effective control of fugitive emissions. ➤ Supervising the overall progress of environmental management programs put in place and ensuring they adhere to all applicable regulations.

		➤ Prepare and submit regular reports to concerned authorities. ➤ Assist horticulturist in developing greenbelt in mining premises in line with stipulated guidelines. ➤ Assist mining engineers in implementing best waste management practices. ➤ Coordinate with mining and other concerned engineers for effective implementation of the EMP.
4.	Horticulturist	➤ Planning for plantation and greenbelt development in mining area ➤ Take assistance from local forest department regarding selection of species for plantation ➤ Ensure regular watering of saplings is done as per schedule ➤ Ensure optimum survival of saplings ➤ Development of lawns and gardens around office and other areas ➤ Ensure regular maintenance of saplings planted in mining area
5.	Civil Engineer	➤ Construction and maintenance of storm water drains, catch drains, siltation ponds etc. ➤ Construction and maintenance of rainwater harvesting structures within and outside mining area. ➤ Provide adequate fencing to safeguard saplings from stray animals. ➤ Regular maintenance of the STP for effective disposal of domestic waste.
6.	Mechanical Maintenance Engineer	➤ Daily inspection of mining machineries. ➤ Regular maintenance of equipment as per OEM recommendations. ➤ Keeping maintenance logs. ➤ Regular monitoring of fuel consumption of vehicles and coordination with suppliers/ OEM if the fuel consumption exceeds the committed values. ➤ Ensure that the mining machineries conform to the applicable environmental norms. ➤ Ensure that the emission/noise levels from the mining machinery do not exceed the permissible levels.
7.	E&I Engineer	➤ Ensure electrical supply in mining area for operation of monitoring and measuring instruments. ➤ Troubleshooting, maintenance and periodic calibration of environmental monitoring equipment. ➤ Maintain appropriate inventory of spares.
8.	Asst. Mines Manager	➤ Carrying out responsibilities as specified in the Mines Act, Regulations and Rules. ➤ Assisting Manager Mines in running the mine and in the absence of Mines Manager, Assistant Manager shall have the same responsibility, discharge the same duties and be subject to the same liabilities as the manager, but not so as to exempt the manager their form.

		➤ Ensuring that all work is carried out in accordance with the provision of the Act and regulations, rules, bye laws made under. ➤ Implementing the Short term / Long term mine planning of Mines. ➤ Preparing & Submitting data required for budget proposal. ➤ Identifying the legal requirements and ensure compliance in respect of all tasks & operations. ➤ Forwarding necessary returns to statutory bodies in time. ➤ Obtaining all necessary statutory permissions. ➤ Ensuring renewal of necessary licenses and permits. ➤ Planning and coordination for Environment and Safety protection measures. ➤ Qualitative and Quantitative Iron Ore feeding to plant. ➤ Ensuring implementation of SOPs, emergency preparedness & emergency response. ➤ Checking all reports, registers and other records; countersign the same with date.
9.	Manager (P&A and CSR)	➤ Liaise with PAFs & nearby communities. ➤ Liaise with Distt. Admin, Forest, Irrigation and other dept. ➤ Recruitment of competent manpower for env. Management. ➤ Implementation of R&R and CSR plan in consultation with Environment manager/ Mines manager.
10.	Workmen/ Helpers for housekeeping and Environment Monitoring	➤ Carrying out general housekeeping of the area. ➤ Regular disposal of office and other municipal waste. ➤ Regular sweeping of roads where water sprinkling is not done. ➤ Assist environment engineer in carrying monitoring equipment at site.

10.6 DETAILED BUDGET FOR EMP

Total cost of the project is Rs. 500 Crores. Capital cost for Environment Protection measures is Rs. 544.02 Lakhs and recurring cost for the EMP is Rs. 117.0 Lakhs/Annum is also envisaged for implementation of the proposed project.

The budget proposed for implementation of the pollution control & impact mitigation measures as suggested for this Iron Ore Mining Project is given as under:

Table – 10.2
EMP Cost Breakup (Rs. In Lakh)

S.N.	Activities	Capital Cost	Recurring Cost
A. Mitigative Measures			
1	Permanent water sprinkling arrangements for Haulage Road (Length 1.0 Km)	30.0	3.0
2	Permanent water sprinkling arrangement for Railway Siding (Length 2.0 Km)	60.0	6.0

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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3	Installation of Fog canon/mist sprayer (No. 5)	35.0	2.0
4	Water tanker for water sprinkling in other roads and mining areas/activities (Capacity 10 KL, No. 4)	-	10.0
5	Installation of Wheel Washing System for Trucks (No. 2)	50.0	5.0
6	Construction of Garland Drains (Dimensions: L*W*D= 1682 m x 1.0 m x 1.0 m)	7.0	1.0
7	Retaining Walls (Dimensions: L* W*D= 1682 m x 1.0 m x 1.0 m) /Bunds	15.0	1.50
8	Settling Ponds (2 nos. & 100000 Cum capacity)	10.0	10.0
9	Construction of 2 nos. of Check Dam & Check Filter	5.0	5.0
10	Installation of Oil Grease Separation System	5.0	1.0
11	Installation of Biodegradable geotextile mats on Dump Slopes	20.0	4.0
12	Fencing along the 7.5 m safety zone (9.15 Km boundary) during Plan Period	50.0	2.0
13	Installation of metal windscreens at Railway Sidings	50.0	5.0
14	Development of embankment with stone pitching on both sides (towards and outwards the Khandepar river) with a height of 3 m above the HFL (Length of 500 m)	5.0	0.5
Sub Total		342.0	56.0
B.	Greenbelt Development/Plantation (Total area = 102.4283 ha)		
1.	Greenbelt along 7.5m block periphery covering 17.45 ha area with 43625 nos. of saplings @ 2500/ha within initial 5 years	21.81	5.0
2.	Plantation on backfilled area covering 41.71 ha with 103650 nos. of saplings @ 2500/ha	52.14	5.0
3.	Plantation on dump area covering 6.87 ha with 17175 nos. of saplings @ 2500/ha	8.59	2.0
4.	Plantation on tailing dam area covering 15.9082 ha with 65396 nos. of saplings @ 2500/ha	19.98	5.0
5.	Miyawaki Plantation at least 20 % of the overall plantation i.e. 20.49 ha	40.00	4.0
6.	Greenbelt/Plantation at Railway Sidings (Area: 1.0 ha and Saplings 2500)	2.50	1.0
Sub Total		145.02	22.0
C. Monitoring			
1	Continuous Ambient Air Quality Monitoring Stations (CAAQMS) at Mine Site (No. 1)	50.0	5.0
2	Four Ambient Air Quality Monitoring Station at nearby area at Villages and at transportation route	-	10.0
3	Fugitive dust emission monitoring (05 locations)	-	2.0
4	Ground water quality and Level Monitoring (10 Locations)	-	3.0
5	Surface water quality Monitoring (5 Locations)	-	3.0
6	Soil quality Sampling (5 Locations)	-	0.3
7	Work Place Noise Level Monitoring and Ambient Noise Monitoring (Quarterly) (6 Locations)	-	2.0
8	Personal dust sampling Free Silica (12 Samples, 6 monthly)	-	1.2

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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9	Regular maintenance, oiling & greasing of Transportation vehicles	1.0	0.5
10	Providing Ear Plugs/Muffs to workers working in high noise level areas & PPEs	1.0	0.5
Sub Total		52.0	27.5
D. Miscellaneous			
1	Occupational Health Check-up of the Employees	-	5.0
2	Digital Mapping of the lease area once in Five years	-	2.5
3	Installation of Piezometers in & around ML area	5.0	1.0
4	Third Party Annual Audit for Compliance of EC Conditions	-	3.0
Sub Total		5.0	11.5
Total (A+B+C+D)		544.02	117.0
E.	Estimated Budget Proposed for Wildlife Conservation Plan	50.90	10.0



CHAPTER - 11 SUMMARY & CONCLUSION

11.1 INTRODUCTION

JSW Steel Limited has proposed Codli Mineral Block - XII, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa). As per EIA Notification dated 14th September, 2006 and subsequent amendments vide S.O. 1886(E) dated 20th April 2022, the proposed project falls under Category A (>250 ha) Project or Activity 1(a) "Mining of Mineral" and 2 (b) for Mineral Beneficiation.

11.2 NEED FOR THE PROJECT

- To cater the Iron Ore requirement for the JSW Steel Plant, the Company has proposed this Block - XII Codli Mineral Block with Iron Ore Production: 3.50 Million TPA.
- It will also bridge the gap between demand and supply of Iron Ore to the consumers. The project will help in the overall growth of the region.
- Total 154 persons will be employed directly in this mine. Various indirect employment opportunities are also envisaged. With the proposed development in and around the area, there will be supporting facilities/infrastructure eventually leading to the development of the area. The project will help in the overall growth of the region.
- The Iron Ore produced from the mine will primarily cater to the iron ore requirement of the JSW Steel Plant. Any quantity available after meeting the plant's requirement may be disposed of/sold in the open market, subject to applicable statutory provisions and permissions.

11.3 MINING LEASE STATUS

- JSW Steel Limited has been successfully declared as the "Preferred Bidder" for the grant of Proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) through e-auction conducted by Government of Goa.
- Lol Vide Letter No. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024 for grant of mining lease over 377.0881 ha area for 3 years. Copy of same is enclosed as **Annexure I**.

11.4 STATUS OF APPROVAL OF MINING PLAN

Mining Plan along with Progressive Mine Closure Plan for Proposed Block - XII Codli Mineral Block over an area of 377.0881 ha has been approved by Indian Bureau of Mines (IBM), Goa vide letter No. MCDR-MPCoFE/6/2025-GOA-IBM_RO_GOA dated 06.08.2025. Copy of the mining plan approval letter is enclosed as **Annexure II**.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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11.5 PROJECT DETAILS

Table - 11.1
Project Details

S.N.	Particulars	Details
A.	Nature of project	Opencast Fully Mechanized Iron Ore Mine
B.	Size of project	
1.	Area	377.0881 ha (Govt. Land: 236.3482 ha, Private Land: 58.9087 ha, Alvara Land: 15.8626, Forest Land: 65.9686 ha)
2.	Project Proposal	Iron Ore: 3.50 Million TPA OB/Waste: 8.21 Million TPA Total Production: 11.71 Million TPA Crusher: 1 x 250 TPH & 2 x 90 TPH - Primary Crusher & 150 TPH of Secondary Crusher Dry Beneficiation/Screening Plant: 600 TPH Wet Beneficiation Plant: 2 x 300 TPH
C	Project Location	
1.	Villages	Codli
2.	Tehsil	Dharbandora
3.	District	South Goa
4.	State	Goa
5.	Latitude & Longitude	Latitude: 15°21'15.638" N to 15°19'42.607" N Longitude: 74°7'10.922" E to 74°8'39.034" E
6.	SOI Toposheet No.	Core Zone: D43C3_48I/3 Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
D	Environmental Settings	
1.	Nearest Village	Codli (Adjacent in North Direction)
2.	Nearest Town / City	Sanvadem (~7.5 Km in SSW Direction)
3.	Nearest State/National Highway	➤ SH-7 (Adjacent in WNW Direction) ➤ NH-748 (~3.0 Km in NNE Direction)
4.	Nearest Railway Station	Sanvadem Chuch Railway Station (~7.8 Km in SSW Direction)
5.	Nearest Airport	Dabolim International Airport (~30.0 Km in WNW Direction)
6.	National Park, Wildlife Sanctuaries, Biosphere Reserves, Wildlife corridors, Tiger/Elephant Reserves etc. within 10 Km radius study area	There are no National Park, Biosphere reserve or corridor present within 10 Km radius of study area. 2 Wildlife sanctuaries are present that are: ➤ Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE Direction) ➤ Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction)
7.	Eco-Sensitive Zoness	➤ ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction) ➤ ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction)

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Chapter 11 of Draft EIA/ EMP Report

S.N.	Particulars	Details																											
8.	Reserve/Protected Forest within 10 Km radius study area	Unclassified Forest – Core zone Reserve Forest – ~0.5 Km in ENE Direction, ~1.0 Km in West Direction, ~2.5 Km in West Direction, ~4.0 Km in South Direction, ~6.5 Km in WSW Direction, ~7.0 Km in NNE Direction, ~8.0 Km in WSW Direction, ~8.5 Km in NW Direction, ~9.0 Km in West Direction.																											
9.	Water bodies within 10 Km radius study area	There is total 8 water bodies present within 10 km of study area: <table border="1"> <thead> <tr> <th>S.N.</th><th>Water Body</th><th>Distance & Direction</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Khandepar River</td><td>Adjacent in North Direction</td></tr> <tr> <td>2.</td><td>Kale Nala</td><td>~0.7 Km in ESE Direction</td></tr> <tr> <td>3.</td><td>Udnai Nala</td><td>~1.5 Km in West Direction</td></tr> <tr> <td>4.</td><td>Panduranga Nala</td><td>~5.0 Km in SW Direction</td></tr> <tr> <td>5.</td><td>Ragada Nala</td><td>~7.0 Km in NNE Direction</td></tr> <tr> <td>6.</td><td>Sanguem or Zuvari River</td><td>~8.0 Km in South Direction</td></tr> <tr> <td>7.</td><td>Jamboli Nala</td><td>~9.0 Km in NE Direction</td></tr> <tr> <td>8.</td><td>Paroda River</td><td>~9.0 Km in SSW Direction</td></tr> </tbody> </table>	S.N.	Water Body	Distance & Direction	1.	Khandepar River	Adjacent in North Direction	2.	Kale Nala	~0.7 Km in ESE Direction	3.	Udnai Nala	~1.5 Km in West Direction	4.	Panduranga Nala	~5.0 Km in SW Direction	5.	Ragada Nala	~7.0 Km in NNE Direction	6.	Sanguem or Zuvari River	~8.0 Km in South Direction	7.	Jamboli Nala	~9.0 Km in NE Direction	8.	Paroda River	~9.0 Km in SSW Direction
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8.	Paroda River	~9.0 Km in SSW Direction																											
10.	Critically Polluted Area	No, the Site doesn't fall under the critically polluted area.																											
11.	Seismic Zone	Zone – III As Per IS: 1893 (Part-I): 2016																											
E	Total Water requirement	1716 KLD (Mine Sump Water and Ground Water)																											
F	Cost Details																												
1.	Total Project Cost	Rs. 500 Crores																											
2.	EMP Cost	Capital Cost: Rs. 544.02 Lakhs Recurring Cost: Rs. 117.0 Lakhs/Annum																											

Source: Site Visit & Pre- Feasibility Report

11.6 MINING DETAILS

Table - 11.2
Mining Details

S.N.	Particulars	Details
1.	Method of mining	Fully Mechanized Opencast Mining
2.	Total Geological Resources	48.50 Million Tonnes
3.	Mineable Reserves	27.32 Million Tonnes
4.	Life of Mine	8 Years As per Mineable Reserves 14 Years As per Reserves & Resources
5.	Bench Height	7 m
6.	Bench width	9 m
7.	Ultimate Pit Slope	<38°
8.	Elevation Range	-76 m AMSL to 109 m AMSL
9.	Average Ground Level	16.5 m AMSL
10.	Existing depth of the Pit	-76 m AMSL (146 m bgl)

S.N.	Particulars	Details
11.	Working Depth during Plan Period	112 m bgl
12.	Ultimate Working Depth	164.48 m bgl
13.	Number of Working Days	300
14.	Number of shifts per day	3

Source: Approved Mining Plan with Progressive Mine Closure Plan

11.7 DESCRIPTION OF THE ENVIRONMENT

Baseline data for the environmental studies has been collected during Summer Season (March to May, 2025) to carry out the Environment Impact Assessment study for the proposed Project.

Ambient Air Quality: Ambient Air Quality Monitoring results reveals that the concentrations of PM_{2.5} and PM₁₀ for all the 11 AAQM Locations were selected between 15.3 to 40.1 µg/m³ and 33.0 to 72.9 µg/m³ respectively.

As far as the gaseous pollutants SO₂ and NO₂ are concerned, the prescribed limit of 80 µg/m³ has never surpassed at any station. The concentrations of SO₂ and NO₂ were found to be in range from 4.1 to 14.5 µg/m³ and 9.0 to 26.4 µg/m³ respectively. CO concentration was found only in Villages Kalay and Sanvordem between the range of 0.51 to 0.72 mg/m³ or in remaining villages it's found below detection limit (0.5 mg/m³). The concentration of Ozone and Ammonia were found to be in range from 5.6 µg/m³ to 26.0 µg/m³ and 7 µg/m³ to 29.0 µg/m³. The concentrations of AAQ parameters at all monitoring locations are found well within the prescribed limits of NAAQS.

Ambient Noise Levels: Ambient noise levels were measured at 11 locations around the project site. Noise levels varied from 46.2 to 56.8 Leq dB (A) during day time and from 38.1 to 44.4 Leq dB(A) during night time.

The maximum noise levels during day time as well as night time were found at Village Sanvordem as this place is densely populated as compared to other locations, therefore, there may be increased human activities and more vehicular movement along with other commercial activities. Whereas, the minimum noise level was found within ~500m of Mine site during day time as well as during night time; as there is no major source of noise pollution. From the above study and discussions, it can be concluded that noise levels in the study area are well within the standards as prescribed by the CPCB. Impact assessment and mitigation measures suggested for the same have been detailed in Chapter 4 of this report.

Surface Water Quality: The Surface water analysis sampling locations shows that pH of the water bodies was found 6.72 to 7.65, Total hardness (15.0 to 64.0 mg/l), Total Dissolved Solids (24.0 to 101.0 mg/l), (Alkalinity (15.82 to 50.37 mg/l) and Conductivity (38 to 151 µs/cm) were found to be within standards in water samples. The COD (4.0 to 16.0 mg/l) and BOD (1.3 to 2.8 mg/l). The nutrients were also found in less quantity viz. Sulphate (1.3 to 7.5 mg/l), Calcium (3.97 to 13.89 mg/l), Sodium (3.0 to 9.0 mg/l), Potassium (1.0 to 2.0 mg/l), Magnesium (1.24 to 8.33 mg/l), Iron (0.23 to 0.73 mg/l), Zinc (0.02 to 0.2 mg/l), Chloride (3.26 to 20.46 mg/l), indicated clean water bodies. Dissolved Oxygen (7.1 to 7.8 mg/l) indicated that the water bodies are safe for aquatic biodiversity. Although, the physico-chemical quality is good and safe for aquatic biodiversity.

Fluoride was found 0.1 mg/l only in Jamboli Nala and in other locations it's found Below Detection Limit (BDL 0.05 mg/l). Total Suspended Solid were found 2 mg/l only in Sanguem/Zuvari River water.

Ground Water Quality: The Ground water analysis for all the 10 sampling locations shows that pH varies from 6.41 to 7.26, Total hardness varied from 35.0 to 218.0 mg/l, Total dissolved solids varied from 68.0 to 255.0 mg/l, Chloride varied from 11.68 to 24.3 mg/l, SO₄ varied from 1.85 to 12.06 mg/l, Ca varied from 3.97 to 61.5 mg/l, Fluoride varied from 0.07 to 0.54 mg/l, Magnesium varied from 3.69 to 15.66 mg/l, Alkalinity varied from 31.1 to 221.5 mg/l, Magnesium varied from 3.69 to 15.66 mg/l, Sulphate varied from 1.85 to 12.06 mg/l, Nitrate varied from 0.18 to 1.87 mg/l, Iron varied from 0.14 to 0.58 mg/l, Sodium varied from 3.0 to 13.0 mg/l, Potassium varied from 1.0 to 6.0 mg/l & Conductivity (102.0 to 370.0 µS/cm Thus can be conclude from the baseline sampling results for groundwater that all the samples, were observed to be in the permissible limits and complies to the drinking water standard (IS: 10500-2012).

Soil Quality: The soil samples exhibit brownish, reddish brown or dull yellowish brown which indicates good fertility and presence of organic matter in the soil samples. The organic matter (0.59% to 1.23%) and organic carbon (0.34% to 0.78%) present in the soil observed to be appropriate for the plant growth. The texture of the soil samples were Clay, Sandy Loam and Silty Loam. All soil samples have moderately acidic to neutral having pH ranging from 5.52 to 7.21 which is an optimal range for most the plant to thrive and grow. All the essential nutrients were observed to be present in medium to average amount than the other micro nutrient and macro nutrient such as Nitrogen (187.08 to 316.15 kg/ha), Phosphorous (9.03 to 33.48 kg/ha), Potassium (77.73 to 357.22 kg/ha), Magnesium (125.68 to 226.89 mg/kg), Calcium (224.02 to 1038.65 mg/kg). Less calcium values in the soil sample are due to the presence of moderately acidic to neutral soil in nature within the area, thus would not affect the plant growth. These results indicate that the soil quality within the study area is of a good quality and contains sufficient macronutrients which is vital for healthy plant life. These results show that there is a need to replenish phosphorus to improve the productivity of the agricultural land in the study area and should be taken care in green belt development.

11.8 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

➤ AMBIENT AIR ENVIRONMENT

Impact:

The key air emissions from the mining activities (Loading, Excavation, Hauling and Transportation) are Particulate Matter. No Drilling & Blasting will be carried out. Gaseous emissions generated from HEMM & transportation of vehicles. The key emissions due to crushing in the mine are Particulate Matter.

Mitigation Measures:

Proper mitigation measures will be taken like Water spraying on haul roads, loading, unloading and transfer points, Wheel wash arrangement during the exit of trucks, Ventilation and air-conditioning systems at Beneficiation plant, etc. and development of greenbelt/plantation area

to control the fugitive emission. Better maintenance of equipment also helps to reduce such emissions. At crushing site, measures such as use of Bag filters, Mist Fog canons regular water spraying on Crusher hopper to arrest dust from becoming air-borne and flexible curtains will be installed/adopted at crusher unloading area to avoid fugitive emission. Development of green belt at ML periphery and plantation all around in the vicinity of the crusher to trap fugitive dust will be carried out. Atomized water sprinkler will be installed at crusher hopper.

➤ **WATER ENVIRONMENT**

Surface Water

No water bodies i.e. nalla, river or streams are present within the lease area. Besides this, 3 Rivers and 5 Nalas exist within the 10 Km radius of study area viz. Khandepar River, Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Sanguem or Zuvari River, Jamboli Nala, Paroda River. These water bodies will not be impacted due to the mining activities.

- The Khandepar is present adjacent to the mine lease area which will not be disturbed during mining. A proper mitigation measures has been adopted for protection of the river.
- Garland drain having siltation pond will be provided at the toe of the dumps, to channelize the runoff water from dumps into the water reservoir (i.e. mined out pits). All the garland drains at the toe of the dump are proposed to be connected with a series of settling tanks which will ultimately allow the setting of silt from the water.
- Retaining wall will be constructed around waste dump to control the surface run off.
- Catch drains and siltation ponds will also be constructed within the area to check flow of surface runoff as well as to prevent siltation of natural courses.
- The rainwater falling directly into the mine pits will be stored and used for plantation & dust suppression.
- Waste water generated from mine workshop (after treatment in oil-grease separator) will be reused for dust suppression. Waste water generated from wheel wash system will also be recycled.
- Domestic waste water generated from mine office, toilets & canteen will be treated in ETP and treated waste water will be used for dust suppression.
- There will be no discharge of wastewater outside the lease area. Therefore, no significant impact of proposed mining on surface water.
- Regular monitoring of surface water quality will be carried out.

Ground Water

Working depth during the plan period will be 112 m bgl and at conceptual stage, ultimate working depth will be 164.48 m bgl. According to groundwater level monitoring, depth of water level in core zone during pre-monsoon is around 16.0 m bgl and during post-monsoon season it rises slightly to 15.0 m bgl. Hence, the groundwater will be intersected during the mining operation. Prior permission will be obtained from Water Resource Department, Goa (WRD) prior to ground water intersection. The mineral Iron Ore and associated rocks that do not contain any toxic

substances so there will not be any adverse impact on ground water quality. Regular monitoring of ground water level & its quality will be carried out.

➤ **NOISE & VIBRATION**

Major noise generating sources of the mining activity are excavation, crushing and HEMM deployed for loading & transportation of Iron Ore. No Drilling and Blasting operations will be carried out, thereby eliminating the risk of high-intensity and impulsive noise generation. Proper maintenance, oiling and greasing of machines at regular intervals will be done to reduce generation of noise PPEs like earplugs/earmuffs will be provided to mine workers. HEMMs equipped with acoustic cabins will be provided for the operators. Proper maintenance, oiling and greasing of HEMMs will be done.

Crushing process will generate noise. Proper mitigation measures i.e. Insulators & sheet cladding will be provided in the crusher to control the noise pollution. Development of greenbelt along ML boundary and plantation in the vicinity of the crusher and at other locations within the ML area will help in reducing the noise levels.

➤ **LAND ENVIRONMENT**

Impact:

The total mining lease area of the Block - XII Codli Iron Ore Block is 377.0881 ha, out of which 236.3482 ha is Govt. land, 58.9087 ha is Private land, 15.8626 ha is Alvara land and 65.9686 ha is Forest land. The land use of the mine area will be altered due to mining operations including pits, OB/Waste dumps, greenbelt/plantation, reservoir etc. but will not have any significant effect on the surface features of the surrounding areas.

Mitigation Measures:

The total mining lease area is 377.0881 ha which spreads over the parts of Village: Codli, Taluka: Dharbandora, District: South Goa of Goa. Total ML area of Proposed Block - XII Codli Mineral Iron Ore Mine is 377.0881 ha. At conceptual stage, out of the total mine lease area, total mined out area will be 301.1521 ha, out of which 51.95 ha will be backfilled and 249.2021 ha will be covered under water reservoir, 14.5597 ha area will be under utility services, 10.8981 ha area will be under Mineral Separation Plant, 6.87 ha under dump rehabilitated by plantation, 17.45 ha under greenbelt and 26.1582 ha will be covered under plantation.

At Conceptual Stage, total greenbelt/plantation will be developed along 7.5 block periphery covering an area of 17.45 ha, 51.95 ha area will be backfilled and subsequently rehabilitated through plantation & regrassing, 6.87 ha on dump plantation and 26.1582 ha area under tailing dam rehabilitated by plantation. Thus, total Greenbelt/Plantation area is 102.4282 ha. 20% of the overall plantation is 20.49 ha from which 10.24 ha will be developed on the backfilled area and remaining 10.25 ha will be developed on tailing dam area using the Miyawaki plantation technique. Local & fruit bearing species will be planted after consultation with local forest officer and as per CPCB guidelines are as follows: Neem, Arjuna, Mango, Jamun, Kindal, Kaju etc. will be planted by JSW Steel Ltd. in consultation with the State Forest Department.

➤ TOP SOIL & SOLID WASTE GENERATION AND MANAGEMENT

Top Soil: There are no top soil present in the ML area.

Waste generation & Management: At present; there are total 6 waste dumps present at the mine site, out of which 4 dumps have 8.96 Million Tonnes waste present in 32.23 ha and 2 waste dumps which are stabilized by plantation. During plan period; approx. 23.43 Million Tonnes of Waste will be generated which will be dumped in existing waste dump D4 and in 2 new dumps over an area of 46.84 ha at their designated place. And during conceptual stage; 68.0 Million Tonnes of waste will be generated which will be used in backfilling in the mined-out area.

Tailing Disposal Plan: About 0.628 Million TPA of tailings will be generated from the Wet Processing Plant in the form of filter press cake with a moisture content of approximately 10–12% and an Fe content of 27.83% which will be stacked in safe & scientific manner in an area of 26.16 ha within the mine lease area and later will be stored in abandoned/exhausted pits or dump areas within the mine lease.

11.9 ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)

The proposed mine site is selected on the basis of occurrence of mineral for suitable end use. The project or activity is site specific. Hence, no alternative site has been considered.

Company will explore the feasibility to use of alternative energy sources, such as hydrogen and electric vehicles (EVs) and solar operated vehicles, after checking the availability/presence of such vehicles in market in consultation with the vendors to reduce the pollution load.

11.10 POST PROJECT ENVIRONMENTAL MONITORING PROGRAMME

Table – 11.3
Post Project Environmental Monitoring Programme

S.N.	Description	Frequency of Monitoring
1.	Micro-Meteorological Data	Hourly (Online)
2.	Ambient Air Quality Monitoring	Online CAAQMS & Manual as per CPCB Guideline
3.	Ground Water Quality & Level Monitoring	Quarterly
4.	Surface Water Quality Monitoring	Seasonal
5.	Noise Level Monitoring	Quarterly
6.	Soil Quality Monitoring	Once in a year
7.	Crusher Stack Monitoring (Crusher, Plant operation stacks, D. G. Sets)	Monthly
8.	Medical Checkup of employees	Annually to 5 Year ➤ Age of workers <40 years: After every 5 years ➤ Age of workers >40 years: Annually
9.	Digital Mapping of the ML Area	Once in 5 years

11.11 ADDITIONAL STUDIES

Additional Studies i.e., Hydro-Geological Study with Ground water Modelling Report, Risk Assessment & Disaster Management Plan, Biological Study & Wildlife Conservation Plan, Land use/Land Cover maps by Satellite Imagery, Traffic Study and Cumulative Impact Assessment Study are covered with this Draft EIA/ EMP Report as per the Terms of Reference granted by MoEF&CC, New Delhi.

11.11.1 HYDRO-GEOLOGICAL STUDY

Total water requirement for the proposed mining project will be 1716 KLD which will be fulfilled from Mine Sump water and well water for drinking purpose.

No waste water will be discharged outside lease boundary. Therefore, no adverse impact on water quality is envisaged due to the proposed mining project.

Working depth during the plan period will be 112 m bgl and at conceptual stage, ultimate working depth will be 164.48 m bgl. According to ground water level monitoring, it is found that the depth of water level in core zone during pre-monsoon is around 16.0 m bgl and during post-monsoon season it rises slightly to 15.0 m bgl. Hence, the groundwater will be intersected during the mining operation.

The groundwater modelling results indicate that the Radius of Influence (ROI) of the Codli Mineral Block remains confined within the mine lease boundary. Beyond the lease area, the groundwater levels show negligible variation from the initial groundwater head, indicating that the proposed mining activities are unlikely to cause any significant drawdown outside the mine lease area.

The Project Proponent (PP) has already submitted an application for obtaining the required NOC from WRD on 14.08.2026.

11.11.2 BIOLOGICAL ENVIRONMENT

Flora Diversity: Dominant species of trees and shrubs that was prevailing in the core and buffer area are *Acacia auriculiformis* (Earleaf acacia), *Cocos Sp.* (Coconut), *Anacardium occidentale* (Kaju) shrubs like *Calotropis gigantea* (Aak), *Ziziphus mauritiana* (Indian jujube) and Herbs like *Oscimum sanctum* (Tulasi), *Cynodon dactylon* (Dub) etc.

There are no National Park, Biosphere Reserves, Tiger/Elephant Reserves, Wildlife Corridors present within 10 of study area. 2 Wildlife sanctuaries are present that are:

- Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE Direction) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction)
- Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction)
- Forests and Reserve Forests are also present within buffer zone of the mine site.

Fauna Diversity: There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur / Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet

Macaque), *Melursus ursinus* (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site. For the conservation of Schedule I species, Wildlife Conservation Plan has been prepared and submitted to DCF, South Goa, Goa on dated 10.10.2026. Budget earmarked for the conservation of Schedule- I species is Rs. 50.90 Lakhs.

Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025.

11.11.3 REHABILITATION AND RESETTLEMENT

The total mining lease area is 377.0881 ha (Govt. Revenue Land – 236.3482 ha, Private Land – 58.9087 ha, Alvara Land – 15.8626, Forest Land – 65.9686 ha). There is no habitation present within the Mineral Block. Hence, no displacement of human settlement is proposed.

JSW Steel Limited will obtain the required surface rights for the land proposed to be utilized for mining and associated activities through mutual agreement and payment of applicable compensation, as per the prevailing statutory provisions, including the Goa, Daman and Diu Land Revenue Code, 1968 and the MMDR Act, 1957, as applicable. There is no proposal for land acquisition for the project.

Since there are no habitations, households, or affected families within the mining lease area and no displacement or resettlement is envisaged, no Rehabilitation and Resettlement (R&R) Plan is applicable or proposed for the project.

11.11.4 RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

A Hazard Identification and Risk analysis is a systematic way to identify and analyze hazards to determine their scope, impact and the vulnerability of the built environment to such hazards and its purpose is to ensure that there is a formal process for hazard identification, risk assessment and control to effectively manage hazards that may occur within the workplaces. Excessive dust, noise and vibration are the chief health hazards for the miners besides physical hazards.

The objective of disaster management plan for the Iron Ore Mine is to be in a state of perpetual readiness through training and development to immediately control and arrest any emergency situation so as to avert a full-fledged disaster and the consequence of human and property damage and in the event of a disaster still occurring, to manage the same so that the risk of the damage to life and property is minimized.

11.12 PROJECT BENEFITS

Employment: The total manpower requirement 154 person. Preference will be given to the locals as per their eligibility. Beside this, the mining activity will also create lot of indirect employment opportunities to the local people in various activities like afforestation, canteen, transportation,

workshops and other petty shops etc. Further, there would be a lot of indirect employment opportunities arising due to this Iron Ore project.

Social Benefits: The mining activity will generate revenue in the form of contribution of additional revenue to state exchequer as notified by Indian Bureau of Mines time to time, beside this, Royalty and other taxes would be additional benefit, particularly in the form of contribution to the District Mineral Foundation (DMF). DMF will be utilized by local administration for the development of socio-economic infrastructure and wellbeing of the local population. The various activities proposed through CSR and Enterprise Social Commitment would help in upgradation of basic infrastructure, amenities.

Economic Benefits: The proposed project will contribute additional revenue to the State and Central Govt. in the form of Royalty, cess and other taxes etc. It is estimated that the project will generate revenue of 275.68 Crores/Annum with the production of 3.50 Million TPA Iron Ore.

11.13 ENVIRONMENT MANAGEMENT PLAN

JSW Steel Ltd. will have a full-fledged Environmental Management Cell (EMC) for environmental monitoring and control. A group of qualified and efficient engineers with technicians will be available for maintenance, up keeping and monitoring of mining machinery & equipment, to keep them in working mode at the best of their efficiencies. The EMC shall oversee and implement the various functions with mining team to ensure that environmental status of the area remains will within the statutory standard of MoEF&CC and SPCB. Total Cost of the project is Rs. 500.0 Crores. Capital cost for EMP is Rs. 544.02 Lakhs and recurring cost for the EMP is Rs. 117.0 Lakhs/Annum. The study area as a whole possesses average of infrastructural facilities however more attention and care will be taken so that the needs and demand of the population of the influence area should be met and can get more exposure to modern facilities of education and development to a bright future.

11.14 POST MINING LAND USE DETAILS

Total ML area of Block - XII Codli Mineral Iron Ore Mine is 377.0881 ha. At conceptual stage, out of the total Mine Lease Area, total mined out area will be 301.1521 ha, out of which 51.95 ha will be backfilled and 249.2021 ha will be covered under water reservoir, 14.5597 ha area will be under utility services, 10.8981 ha area will be under Mineral Separation Plant, 6.87 ha under dump rehabilitated by plantation, 17.45 ha under greenbelt and 26.1582 ha will be covered under plantation. Out of the plantation, 20.49 ha will be developed under the Miyawaki Plantation technique.

At Conceptual Stage, total Greenbelt/Plantation will be carried out on 102.4283 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area under backfilled rehabilitated by plantation, 6.87 ha on Dump Plantation and 26.1582 ha area under Tailing dam rehabilitated by plantation).

11.15 CONCLUSION

This EIA/ EMP study was conducted as per the approved ToR issued by MoEF&CC. Baseline data of land, air, water, noise, biological and socio-economic environment was duly assessed by conducting field investigation as well as by having an access to the available secondary

information. The impacts were identified & evaluated and EMP is suggested to mitigate the environmental concerns arising from the proposed project.

The project will prove beneficial to the local people as direct and indirect employment opportunity will be generated. There will be increase in revenue generation to the government by way of government taxes etc. Further improvement in infrastructure will take place like education, roads, availability of drinking water, medical facilities in adjacent Villages. There will be increase in earnings of local villagers, as they will get employment in the Iron Ore Mine, which ultimately will result in better standard of living of the Villagers.

There will be no significant pollution of air, water, soil and noise. Regular monitoring of all the components of environment will be done and mitigation measures will be adopted. Increased social welfare measures taken by the Company will bring overall development in the near-by Villages.



CHAPTER - 12

DISCLOSURE OF CONSULTANTS ENGAGED

12.1 DISCLOSURE OF CONSULTANTS ENGAGED

This EIA/EMP Report has been prepared by J.M. EnviroNet Pvt. Ltd. (JMEPL). JMEPL is one of the Company of JM Group, established in the year 1993. 'JM' in the name of the Company is derived from the name of 'Lord Shiva' - the Temple of 'Jharkhand Mahadev' (JM). The Temple is located at Queens Road, Vaishali Nagar, Jaipur.

The Registered office of JMEPL is at Jaipur Centre, 403, 4th Floor, B2 Bye Pass, Tonk Road, Jaipur, 302018 (Rajasthan). Its Delhi-NCR Corporate office is at EMMAR Digital Greens, Tower – B, Unit No. 1517, Golf Course Ext. Road, Sector – 61, Gurugram (Haryana) – 122011.

J.M. EnviroNet Pvt. Ltd. is accredited with ISO-9001: 2015 for EIA Division. EIA Division is also approved by National Accreditation Board for Education & Training (NABET) formerly NRBPT (Quality Council of India), Certificate No. NABET/EIA/26-29/RA 0504, dated 06th August, 2026 which is valid up to 07.08.2029.

J.M. EnviroNet Pvt. Ltd. is listed at serial no. "142" of the List of Accredited EIA Consultant Organization displayed on MoEF&CC website (eia.nabet.qci.org.in/Accredited_EIA_Consultant.aspx), updated on 18.08.2026.

JMEPL is offering Environmental Consultancy Services in various sectors viz Industrial Projects /Chemical Industries/Cement Plants/Thermal Power Plants/Mining Projects/Coal Washery Projects/Real Estate Projects/Distilleries/Steel Plants/Mineral Beneficiation plants etc.

In the Mining sector, JMEPL have covered mines of minerals viz. Limestone, Bauxite, Chromite, Coal, Zinc Ore, Copper ore, Gypsum, Soapstone, Iron & Manganese ore, Clay, Silica Sand, Marble, Khanda, Gitti, boulders, Feldspar, Quartz, lignite, magnesite and minor mineral etc.

JMEPL has a highly qualified team of Functional Area Experts (FAE). As Faculty Heads of the EIA Division, company has Retd. General Managers of the Reputed Cement Companies, Ex-Head EIA Division of big Business Group, STP & ETP Designing Experts, Retd. Mining & Geology Experts with vast experience in their respective fields.

JM Group's business is spread over 22 States viz. Andhra Pradesh, Kerala, Gujarat, Maharashtra, Orissa, Tamil Nadu, Goa, Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi, Rajasthan, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Assam, West Bengal, Karnataka, Jharkhand, Bihar & Uttarakhand.

The JM Group has its own Environmental Laboratory i.e., JM Envirolab Pvt. Ltd. Gurugram (Haryana) approved under EPA (Environment Protection Act) by the Ministry of Environment & Forests, Govt. of India, New Delhi and by the National Accreditation Board for Testing and Calibration Laboratories, Govt. of India (NABL accredited Laboratory: - TC-6821).

Besides this, MoEF&CC and NABL approved Environmental Laboratory of JM Group is also providing Analytical Laboratory Services of various elements and environmental parameters.

Annual monitoring as per MoEF&CC / CPCB / SPCB guidelines, Risk Assessment and Disaster Management Plan, consultancy for Rain Water Harvesting Plan, detailed Hydro-geological Study, preparation of Environmental Statement Reports (Environmental Clearance Compliance Conditions) and Statutory Mining Plan etc. are amongst the various other consultancy services offered by the Company.

The Integrated Watershed Management Study, including the Catchment Area Treatment (CAT) Plan, River Ingress Study has been prepared by Dr. K G Gupta, Retd. Prof. & Head, Goa Engineering College (Principal Consultant).



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Government of Goa
Directorate of Mines Geology
Institute Menezes Braganza, Panaji-Goa
Website: www.dmg.goa.gov.in e-mail: auction-dmg@goa.gov.in

No.DMG/28/Auction Cell/3rd NIT/2023/2703

Date: 10/12/2024

Letter of Intent for Block XII- Codli Mineral Block

To,
JSW STEEL LIMITED
JSW Centre Bandra Kurla Complex,
Bandra East,
Mumbai, Maharashtra, 400051

Sub: Letter of intent with reference to e-auction dated November 12, 2024 for grant of a mining lease for Codli Mineral Block-XII for Iron Ore mineral in Codli village, Dharbandora Taluka, South Goa District on – 377.0881 Hectare Area of Survey No. as Codli Survey No.- 15, 21, 22, 23, 24, 25, 26, 27, 29, 30, 35, 36, 46, 47, 48, 49, 50, 51, 54, 96, 97 & Road

1. Background:

1.1 Government of Goa, pursuant to the Mines and Minerals (Development and Regulation) Act, 1957 (the “Act”) and the Mineral (Auction) Rules, 2015 as amended from time to time (the “Auction Rules”), issued the notice inviting tender dated August 13, 2024 to commence the auction process for grant of mining lease for Codli Mineral Block-XII located in South Goa. The e-auction process was conducted in accordance with the tender document for the said mineral block and **JSW STEEL LIMITED** was declared as the ‘Preferred Bidder’ under Rule 9(9)(iii) of Auction Rules, having quoted a Final Price Offer 92.60% (Ninety Two Point Six Zero Per Cent).



1.2 As required under Rule 10(1) of the Auction Rules and the tender document for the said mineral block, **JSW STEEL LIMITED** has made payment of the first instalment, being 20% (twenty per cent) of the upfront payment of Rs. 16,44,89,242 (Rupees Sixteen Crore Forty Four Lakh Eighty Nine Thousand Two Hundred Forty Two) through e-Challan (e-Challan No.202400870971) dated December 04, 2024, which was received at Goa.

2. Grant of Letter of Intent

2.1. Accordingly, pursuant to Rule 10(2) of the Auction Rules and the terms of the Tender Document, the Government of Goa is issuing this letter of intent for grant of Mining Lease for **Codli Mineral Block-XII** for Iron Ore mineral in Codli village, Dharbandora Taluka, South Goa District on – 377.0881 Hectare Area of Codli Survey No.- 15, 21, 22, 23, 24, 25, 26, 27, 29, 30, 35, 36, 46, 47, 48, 49, 50, 51, 54, 96, 97 & Road to **JSW STEEL LIMITED** for a period of 50 (fifty) years.

3. Conditions

3.1. This letter of intent and the subsequent grant of aforementioned mining lease shall be subject to the provisions of the Act and the Rules made thereunder, as amended from time to time, and the **JSW STEEL LIMITED** shall be designated as the 'Successful Bidder' and subsequently granted the mining lease only upon satisfactory completion of all the requirements under the Acts and Rules made thereunder.

The State Government may impose such other conditions in the Mine Development and Production Agreement (MDPA) and/or Mining Lease as may be considered by the State Government to



be in the interest of mineral development and in public interest.

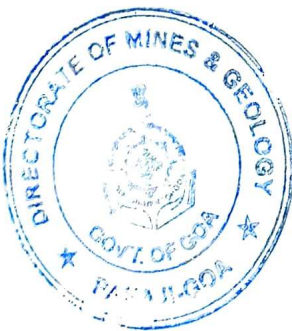
JSW STEEL LIMITED shall be bound by (i) the enactment, bringing into effect, adoption, promulgation, amendment, modification or repeal of any Applicable Laws (including the Act and Rules) occurring at any time, including prior to or after the Bid Due Date; (ii) any amendments made by the State Government to this effect in the Tender Document, the letter of intent, the MDPA and/or the mining lease deed at any time, including prior to or after the Bid Due Date.

- 3.2. For reference, the requirements under the Auction Rules for designation of **JSW STEEL LIMITED** as the “successful bidder” and subsequent grant of the mining lease are reiterated below. It is clarified that the requirements mentioned below are only for reference and in the event of any change in the Act or the Rules made thereunder, the requirements under the modified Act or the Rules made thereunder, as the case may be, shall be applicable.

(a) Designation as the “Successful Bidder”:

JSW STEEL LIMITED shall be considered to be the “Successful Bidder” upon:

- (i) continuing to be in compliance with all the terms and conditions of eligibility;
- (ii) payment of the second instalment being 20% (twenty per cent) of the upfront payment;
- (iii) furnishing an irrevocable and unconditional performance security to the State Government from an Acceptable Bank and payable at Goa, pursuant to the Auction Rules;



(iv) satisfying the conditions specified in clause (b) of sub-section (2) of Section 5 of the Act with respect to a mining plan;

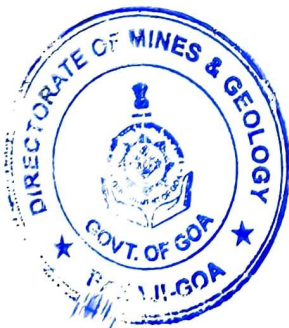
(b) Signing of the Mine Development and Production Agreement

JSW STEEL LIMITED shall sign the Mine Development and Production Agreement with the Government of Goa upon obtaining all consents, approvals, permits, no-objections and the like as may be required under applicable laws for commencement of mining operations.

(c) Grant of Mining Lease

Subsequent to signing of the Mine Development and Production Agreement, **JSW STEEL LIMITED** shall make payment of the third instalment being 60% (sixty per cent) of the upfront payment and thereafter the Government of Goa shall grant the aforementioned mining lease.

- 3.3. (i) The Successful Bidder shall have no rights (including, but not limited to, rights of disposal, sale, exploitation, and/ or appropriation in any manner whatsoever) with respect to any ore that has already been extracted and is present on the surface of the Mineral Block; (ii) The Successful Bidder shall stack, store, secure and/ or otherwise deal with the ore in such manner as may be instructed by the State Government from time to time; (iii) The State Government shall have the sole right, but not the obligation, to appropriate and dispose of (whether by way of sale, auction or such other means as the State Government may, in its sole discretion, determine) all or any part of the ore; and (iv) In the event that the Successful



Bidder reasonably requires to shift, relocate and/ or take any action (within the lease area) with respect to such ore in order to undertake mining operations, it shall make an application to the State Government seeking prior approval of the State Government in this regard. Such approval shall not be unreasonably withheld, and a decision thereon shall be communicated by the State Government within 15 (fifteen) days of the receipt of the application for approval, failing which such approval shall be deemed to have been granted. The liability of such shifting/ relocation/ action shall be borne solely by the Successful Bidder.

4. Validity

4.1. This Letter of Intent shall be valid only if **JSW STEEL LIMITED** ensures that the Bid Security is valid until the Performance Security is furnished to the Government of Goa failing which this letter of intent shall become invalid from the date of expiry of the Bid Security.

4.2. This letter of intent is valid for a period of 3 (three) years from the date of its issuance, within which time all the above conditions must be fulfilled and the Mining Lease deed must be executed between the **JSW STEEL LIMITED** and the Government of Goa. In case there is a delay in execution of Mining Lease Deed due to reasons beyond the control of the Preferred Bidder, then it may submit an application to Government of Goa, requesting for further extension.

4.3. If the Government of Goa is satisfied that there is a delay in execution of Mining Lease Deed due to reasons beyond the control of the Preferred Bidder and a longer period is required to enable the Preferred Bidder to satisfy all or any of the above



conditions, it may extend the validity of this letter of intent for such period or periods as the Government of Goa may specify. Provided that: (a) this letter of intent shall be extended for a maximum period of 2 (two) years; and (b) the total period for which this letter of intent would remain valid must not exceed 5 (five) years from the date of issuance.

4.4. The holder of the Letter of Intent shall comply with the terms and conditions of this Letter of Intent, including executing the Mining Lease within the period referred to in Sub-rule 6 of Rule 10 of the Auction Rules, failing which:

- a) this Letter of Intent shall be revoked; and
- b) the Bid Security or the Performance Security, as the case may be, and any instalment of Upfront Payment paid, shall be forfeited and appropriated in full by the State Government.

Kindly return the duplicate copy of this letter of intent duly signed by authorized signatory in token of having accepted the above terms and conditions. The accepted copy of Letter of Intent along with Board resolution should be submitted latest by December 31, 2024.

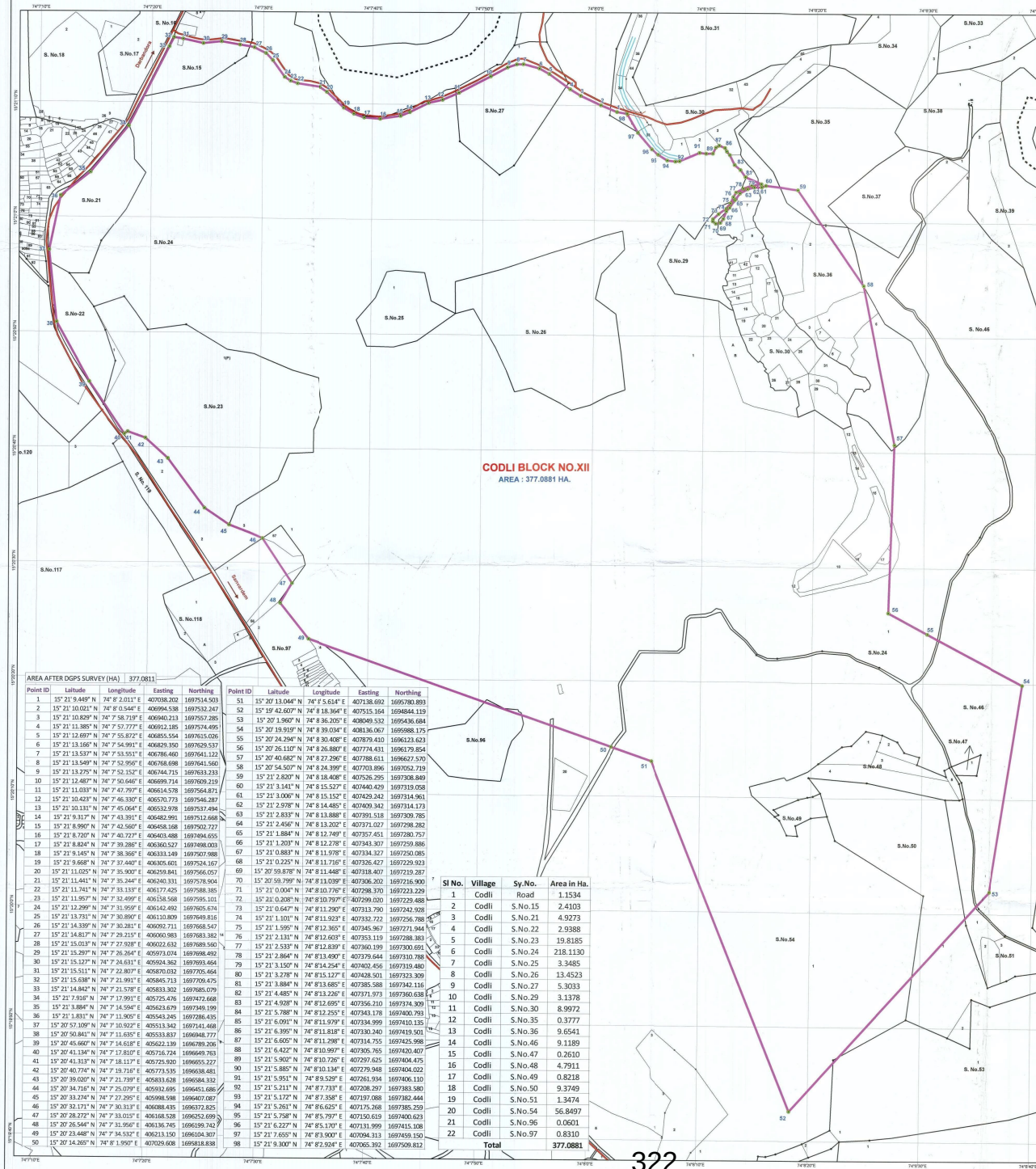


(Narayan M. Gad)

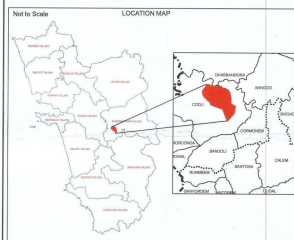
Director



GEO REFERENCED VECTORISE CADASTRAL MAP OF CODLI BLOCK NO.XII OVER AN AREA OF 377.0881 HA. SITUATED IN CODLI VILLAGE OF DHARBANDORA TALUKA OF SOUTH GOA DISTRICT OF STATE OF GOA. GRANTED TO M/S. JSW STEEL LIMITED.



- Legend**
- DGPS POINT OF LEASE BOUNDARY
 - ▭ LEASE BOUNDARY AS PER DGPS SURVEY
 - ~ Nala
 - Road
 - SURVEY NO BOUNDARY
 - SUB-DIVISION OF THE SURVEY NO
 - TALUKABOUNDARY
 - VILLAGE BOUNDARY



AREA AFTER DGPS SURVEY (HA) 377.0881

Point ID	Latitude	Longitude	Easting	Northing	Point ID	Latitude	Longitude	Easting	Northing
1	15° 21' 9.449" N	74° 8' 2.011" E	407038.202	1697514.503	51	15° 20' 13.044" N	74° 5' 5.614" E	407138.692	1695780.893
2	15° 21' 10.021" N	74° 8' 5.544" E	406984.508	1697532.247	52	15° 19' 42.607" N	74° 8' 18.364" E	407515.164	1694844.119
3	15° 21' 10.829" N	74° 7' 58.719" E	406940.213	1697557.286	53	15° 20' 1.967" N	74° 5' 36.202" E	406948.533	1695436.684
4	15° 21' 11.385" N	74° 7' 57.777" E	406912.185	1697574.495	54	15° 20' 18.915" N	74° 8' 39.034" E	408136.067	1695988.175
5	15° 21' 12.697" N	74° 7' 55.872" E	406855.554	1697615.026	55	15° 20' 24.294" N	74° 8' 30.408" E	407870.410	1696123.623
6	15° 21' 13.886" N	74° 7' 54.981" E	406809.300	1697629.537	56	15° 20' 26.110" N	74° 8' 26.880" E	407774.431	1696179.854
7	15° 21' 13.537" N	74° 7' 53.551" E	406786.460	1697641.121	57	15° 20' 40.687" N	74° 8' 27.296" E	407861.611	1696217.530
8	15° 21' 13.549" N	74° 7' 52.959" E	406768.698	1697641.540	58	15° 20' 54.507" N	74° 8' 24.399" E	407038.692	1697052.719
9	15° 21' 13.279" N	74° 7' 52.152" E	406744.713	1697633.231	59	15° 21' 2.807" N	74° 8' 18.408" E	407265.295	1697308.849
10	15° 21' 12.487" N	74° 7' 50.640" E	406691.714	1697609.219	60	15° 21' 3.147" N	74° 8' 15.527" E	407440.420	1697315.058
11	15° 21' 11.033" N	74° 7' 47.797" E	406614.578	1697564.871	61	15° 21' 1.000" N	74° 8' 15.152" E	407429.242	1697314.961
12	15° 21' 10.037" N	74° 7' 46.107" E	406570.773	1697544.287	62	15° 21' 2.978" N	74° 8' 14.485" E	407402.342	1697314.173
13	15° 21' 10.131" N	74° 7' 45.047" E	406531.839	1697517.484	63	15° 21' 2.833" N	74° 8' 13.888" E	407391.518	1697309.785
14	15° 21' 9.317" N	74° 7' 43.391" E	406482.991	1697512.668	64	15° 21' 2.456" N	74° 8' 13.302" E	407371.027	1697298.282
15	15° 21' 8.997" N	74° 7' 42.540" E	406458.188	1697502.727	65	15° 21' 1.884" N	74° 8' 13.749" E	407357.451	1697280.757
16	15° 21' 8.797" N	74° 7' 40.727" E	406431.488	1697484.655	66	15° 21' 1.203" N	74° 8' 12.278" E	407343.307	1697259.886
17	15° 21' 8.824" N	74° 7' 39.287" E	406406.527	1697488.003	67	15° 21' 0.883" N	74° 8' 11.978" E	407334.327	1697250.085
18	15° 21' 9.145" N	74° 7' 38.369" E	406333.148	1697507.988	68	15° 21' 0.225" N	74° 8' 11.715" E	407326.427	1697239.923
19	15° 21' 9.697" N	74° 7' 37.440" E	406265.601	1697514.507	69	15° 20' 59.878" N	74° 8' 11.448" E	407318.407	1697210.287
20	15° 21' 11.025" N	74° 7' 35.900" E	406259.841	1697565.057	70	15° 20' 59.799" N	74° 8' 11.039" E	407306.202	1697216.900
21	15° 21' 11.441" N	74° 7' 35.244" E	406240.331	1697578.904	71	15° 21' 0.044" N	74° 8' 10.716" E	407298.370	1697223.229
22	15° 21' 11.741" N	74° 7' 33.133" E	406177.425	1697588.385	72	15° 21' 0.205" N	74° 8' 10.579" E	407299.020	1697223.489
23	15° 21' 11.957" N	74° 7' 31.499" E	406154.568	1697605.101	73	15° 21' 0.647" N	74° 8' 11.290" E	407313.790	1697242.928
24	15° 21' 12.299" N	74° 7' 31.959" E	406142.482	1697605.674	74	15° 21' 1.101" N	74° 8' 11.923" E	407322.722	1697258.788
25	15° 21' 13.751" N	74° 7' 30.890" E	406110.880	1697649.816	75	15° 21' 1.595" N	74° 8' 12.363" E	407345.967	1697271.944
26	15° 21' 14.307" N	74° 7' 30.261" E	406070.711	1697668.547	76	15° 21' 2.131" N	74° 8' 12.618" E	407381.119	1697286.389
27	15° 21' 14.817" N	74° 7' 29.215" E	406030.983	1697681.382	77	15° 21' 2.533" N	74° 8' 12.839" E	407400.199	1697300.691
28	15° 21' 15.013" N	74° 7' 27.928" E	406022.632	1697688.560	78	15° 21' 2.864" N	74° 8' 13.401" E	407379.644	1697310.788
29	15° 21' 15.297" N	74° 7' 26.284" E	405971.074	1697698.492	79	15° 21' 3.150" N	74° 8' 13.957" E	407360.456	1697319.480
30	15° 21' 15.127" N	74° 7' 24.611" E	405944.862	1697691.464	80	15° 21' 3.278" N	74° 8' 15.127" E	407428.501	1697323.400
31	15° 21' 15.511" N	74° 7' 22.807" E	405870.032	1697705.464	81	15° 21' 3.884" N	74° 8' 15.685" E	407385.588	1697342.116
32	15° 21' 15.538" N	74° 7' 21.991" E	405845.713	1697709.475	82	15° 21' 4.485" N	74° 8' 13.226" E	407371.973	1697360.638
33	15° 21' 14.840" N	74° 7' 21.197" E	405813.302	1697684.079	83	15° 21' 4.938" N	74° 8' 12.685" E	407364.210	1697343.309
34	15° 21' 13.918" N	74° 7' 19.991" E	405745.476	1697472.668	84	15° 21' 5.788" N	74° 8' 12.255" E	407343.176	1697420.793
35	15° 21' 13.884" N	74° 7' 14.594" E	405621.679	1697349.199	85	15° 21' 6.091" N	74° 8' 11.979" E	407334.999	1697410.135
36	15° 21' 13.813" N	74° 7' 11.997" E	405543.295	1697264.435	86	15° 21' 6.399" N	74° 8' 11.818" E	407320.240	1697419.501
37	15° 20' 57.109" N	74° 7' 11.635" E	405533.837	1696948.777	87	15° 21' 6.602" N	74° 8' 11.286" E	407314.755	1697423.986
38	15° 20' 50.843" N	74° 7' 11.635" E	405533.837	1696948.777	88	15° 21' 6.422" N	74° 8' 10.987" E	407305.765	1697420.407
39	15° 20' 45.667" N	74° 7' 11.635" E	405522.139	1696789.206	89	15° 21' 5.902" N	74° 8' 10.726" E	407297.625	1697404.475
40	15° 20' 41.138" N	74° 7' 11.635" E	405512.724	1696664.763	90	15° 21' 5.885" N	74° 8' 10.134" E	407279.948	1697404.022
41	15° 20' 41.313" N	74° 7' 18.117" E	405525.920	1696655.227	91	15° 21' 5.911" N	74° 8' 9.509" E	407261.934	1697405.110
42	15° 20' 40.774" N	74° 7' 19.716" E	405573.535	1696638.481	92	15° 21' 5.211" N	74° 8' 7.733" E	407208.297	1697383.580
43	15° 20' 36.027" N	74° 7' 21.297" E	405613.628	1696648.333	93	15° 21' 5.127" N	74° 8' 7.338" E	407197.088	1697382.444
44	15° 20' 34.716" N	74° 7' 25.079" E	405593.695	1696516.681	94	15° 21' 5.261" N	74° 8' 6.625" E	407179.268	1697378.259
45	15° 20' 33.274" N	74° 7' 27.297" E	405598.588	1696407.087	95	15° 21' 5.798" N	74° 8' 5.797" E	407150.639	1697400.621
46	15° 20' 27.171" N	74° 7' 30.313" E	405608.429	1696371.825	96	15° 21' 6.227" N	74° 8' 5.137" E	407131.999	1697415.108
47	15° 20' 28.272" N	74° 7' 33.013" E	405618.528	1696253.699	97	15° 21' 7.655" N	74° 8' 3.900" E	407094.913	1697439.150
48	15° 20' 26.544" N	74° 7' 31.966" E	405616.745	1696199.742	98	15° 21' 9.300" N	74° 8' 2.930" E	407065.302	1697409.812
49	15° 20' 23.449" N	74° 7' 34.532" E	405613.150	1696104.307					
50	15° 20' 24.200" N	74° 7' 31.957" E	405620.608	169618.838					

Sl No.	Village	Sy.No.	Area in Ha.
1	Codli	Road	1.1534
2	Codli	S.No.15	2.4103
3	Codli	S.No.21	4.9273
4	Codli	S.No.22	2.9388
5	Codli	S.No.23	19.8155
6	Codli	S.No.24	218.1130
7	Codli	S.No.25	3.3485
8	Codli	S.No.26	13.4523
9	Codli	S.No.27	5.3033
10	Codli	S.No.29	3.1378
11	Codli	S.No.30	8.9972
12	Codli	S.No.35	0.3777
13	Codli	S.No.36	9.6541
14	Codli	S.No.46	9.1189
15	Codli	S.No.47	0.2610
16	Codli	S.No.48	4.7911
17	Codli	S.No.49	0.8218
18	Codli	S.No.50	9.3749
19	Codli	S.No.51	1.3474
20	Codli	S.No.54	56.8497
21	Codli	S.No.96	0.0601
22	Codli	S.No.97	0.8310
Total			377.0881

DATUM : WGS 84 **PROJECTION : UTM Zone 43N**

Prepared by: **PGSI REMOTE SENSING INSTRUMENTS LLP** (PVT) LTD., INDUSTRIAL ESTATE, HEMATALLY, VILLAGE, GOA-401001

Engineered by: **Directorate of Mines and Geology** (Govt of Goa, PANAJI)

Vide order no: D/1931/10-mine/203 dated 06/06/2013

CERTIFICATE

This is to certify that the Codli Mining Lease Boundary Pillars have been Surveyed by using DGPS (Differential Global Positioning System). The Survey was conducted earlier and this plan is as per requirement of BM Circular No. 2/2010 dated 06/04/2010.

Surveying Officer: **Dr. J. V. Hegde** (Chief Executive Officer)

Director of Mines and Geology: **Dr. J. V. Hegde** (Chief Executive Officer)

Checked by: **Dr. J. V. Hegde**

Surveying Officer: **Dr. J. V. Hegde**

Annexure - II - Mining Plan Approval Letter

By e-mail

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES
OFFICE OF THE REGIONAL CONTROLLER OF MINES, GOA**

No. MCDR-MPC0FE/6/2025-GOA-IBM_RO_GOA

Dt : 06/08/2025

Shri/M/s. JSW STEEL LIMITED ,
JSW CENTRE BANDRA KURLA COMPLEX BANDRA (EAST)

Sub Approval of Mining Plan in respect of your “Block XII Codli Mineral Block” over an area of 377.0881 Ha. situated in Village- Codli,
: Taluka- Dharbandora, District-South Goa of Goa State submitted under Rule 16(1) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016.

Ref.: (i) Online submission/receipt of draft Mining Plan in respect of your aforesaid Block in the MPAS portal on 13.06.2025.

(ii) This office scrutiny comments on the examination of the draft Mining Plan in respect of your aforesaid Block sent through the MPAS Portal dated. 04/07/2025 and 03/08/2025.

(iii) Online submission/receipt of the corrected Mining Plan in respect of your aforesaid Block in the MPAS portal dated. 18.07.2025 and 04.08.2025 w.r.t. respective scrutiny.

Sir,

In exercise of the powers conferred by clause (b) of sub-section (2) of section 5 of the Mines & Minerals (Development & Regulation) Act, 1957, read with Government of India Order No. S.O. 1857(E) dated 18.05.2016; and in exercise of the powers conferred under sub-rule (3) of Rule 16 of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016, I hereby **approve** the Mining Plan with Progressive Mine Closure Plan in respect of your- “Block XII Codli Mineral Block” over an area of 377.0881 Ha. situated in Village- Codli, Taluka- Dharbandora, District-South Goa, of Goa State, submitted under Rule 16(1) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules 2016. This approval is subject to the following conditions: -

1. That the Mining Plan is approved without prejudice to any other Law applicable to the mine area from time to time, whether made by the Central Government, State Government or any other authority and without prejudice to any order or direction from any court of competent jurisdiction.
2. The proposals shown on the plates and/or given in the document are based on the auctioned Mineral Block/lease map/sketch submitted by the applicant/lessee and are applicable from the date of approval.
3. It is clarified that the approval of aforesaid Mining Plan does not in any way imply the approval of the Government in terms of any other provisions of Mines & Minerals (Development & Regulation) Act, 1957 or the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016 and any other laws including Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986 or the rules made there under, Mines Act, 1952 and Rules and Regulations made thereunder.
4. Indian Bureau of Mines has not undertaken verification of the auctioned Mineral Block / Mining Lease Boundary on the ground and does not undertake any responsibility regarding the correctness of the boundaries of the Mineral Block/leasehold shown on the ground with reference to the lease map & other plans furnished by the applicant.
5. At any stage, if it is observed that the information furnished, or data incorporated in the document, is incorrect or misrepresents facts, the approval of the document shall be revoked with immediate effect.
6. If the approval conflicts with any other law or court order/direction under any statute, it shall be revoked immediately.
7. Terms and conditions of the Mine Development and Production Agreement (MDPA), whenever signed with the State Govt., shall be complied with. The preferred bidder shall submit a copy of the Mine Development & Production Agreement & Mining Lease deed executed with the State Govt. to this office within 15 days of their execution, along with a copy of the Performance Security furnished.
8. The preferred bidder has to comply with the terms & conditions laid down in the LOI issued by the State Govt. If any comments are received from the State Govt., then the necessary action as per the comments shall be taken immediately.
9. It shall be mandatory for the project proponent, abstracting groundwater, to obtain a No Objection Certificate from the Central Groundwater Authority or the Goa State Groundwater Authority.
10. The preferred bidder of the auctioned block shall complete detailed exploration (G1 level exploration) over the potential mineralized area in accordance with Rule 12(4) of MCDR Amendment Rules 2021 (notified dated 03.11.2021) and prepare a detailed feasibility study report conforming to Part IV and V of the Mineral (Evidence of Mineral Contents) Rules, 2015 over the entire area, within five years from the date of commencement of such mining lease.

11. Lessee or preferred bidder, as the case may be, shall handle the dumps in future, if applicable, as per the provisions of “Policy for regulating Iron Ore dump handling in the State of Goa” published on 13.09.2023 by the State Government of Goa.
12. Before the commencement of mining operation in the leasehold area, the lessee or preferred bidder, as the case may be, shall construct and upkeep all Boundary Pillars as per the lease sketch duly authenticated by the State Govt. at his own cost following the provisions of rule 12(1)(v) of the Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016.
13. The lessee or preferred bidder, as the case may be, is required to reassess the entire geological reserve and remaining resources of the leasehold area based on available exploration data and consideration of revised Ultimate Pit Limit (UPL). A modified mining Plan document in this regard shall be submitted after the execution of the Mining Lease.

Yours faithfully,

(Dr. Naresh Kumar Kataria)

Regional Controller of Mines

Indian Bureau of Mines, Goa

Copy forwarded for kind information to: -

- The Controller of Mines (SZ), Indian Bureau of Mines, Bangalore.
- The Director, Directorate of Mines & Geology, Government of Goa, Institute of Menezes Braganza Building, Panaji – Goa, 403001.
- The Director, Directorate of Mines Safety, Goa Region, Agali, Fatorda – Goa, 403602.
- Shri Sripad Pujar & Shri. BVR Achar- QP, Ground Floor, Kaushika, Annapurna, Badavane, Hosapete-583201, Karnataka.

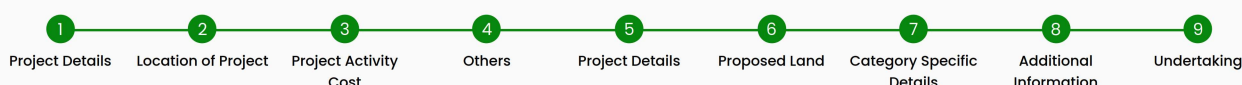
--SD--

(Dr. Naresh Kumar Kataria)

Regional Controller of Mines

Indian Bureau of Mines, Goa

Project Name:	Application for approval of forest land under clause (iii) of sub section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for Signing of lease Agreement in Respect of "Codli Mineral Block-XII" by M/s JSW Steel Ltd. under South Goa District/Division of Goa.	Single Window Number:	SW/259766/2025
		Proposal Number:	FP/GA/MIND/551274/2025
State:	GOA	Current Status:	Pending at PP due to EDS by Nodal Officer
Submission Date:	20/11/2025	Area (in ha):	65.9686

[View Agenda](#)[View MoM](#)**PARIVESH**Ministry of Environment, Forest and Climate Change
Government of India**Form-D (Part-I): Signing of Lease (section 2(iii)) on Forest Land**[Back](#)**Common Application Form****Project Details****1. Details of Project**

1.1. Name of the Project	Application for approval of forest land under clause (iii) of sub section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for Signing of lease Agreement in Respect of "Codli Mineral Block-XII" by M/s JSW Steel Ltd. under South Goa District/Division of Goa.
1.2. Project Proposal For	New
1.3. Project ID (Single Window Number)	SW/259766/2025
1.4. Description of Project	Application for approval of forest land over 65.9686 ha under clause (iii) of sub section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for Signing of lease Agreement in Respect of "Codli Mineral Block-XII" by M/s JSW Steel Ltd. under South Goa District/Division of Goa.

2. Details of the Company/Organization/User Agency making application

2.1. Legal Status of the Company/Organization/User Agency	Company
2.2 Name of the Company/ Organization/User agency	JSW STEEL LTD

Registered address

2.3. Address	JSW CENTRE, BANDRA KURLA COMPLEX, BANDRE (EAST)
2.4. State	MAHARASHTRA
2.5. District	MUMBAI
2.6. Pin Code	400051
2.7. Landmarks	BKC GROUND
2.8. E-mail address	baswaraj.dalgade@jsw.in
2.9. Mobile number	xxxxxx8352

3. Details of the person making application

3.1. Name	BASWARAJ MAHADEVPPA DALGADE
3.2. Designation	AGM-ROJECTS
Correspondence address	
3.3. Address	JSW Steel Ltd, 507, 5th Floor, Gera Imperium II, Patto, Panaji, Goa -403001.
3.4. Village /Town / City	Patto Panaji
3.5. State	GOA
3.6. District	NORTH GOA
3.7. Pin Code	403001
3.8. E-mail address	ambarish.volvoikar@jsw.in
3.9. Landline Number	2596117
3.10. Mobile number	xxxxxx8352

Project Location

4. Location of the Project or Activity

4.1. Upload KML	mlforestnonforest@codli.kml Preview
4.2. Whether the project/activity falling in the state/UT sharing international borders	NO

5. Shape of the Project	Non - Linear
-------------------------	--------------

Location Details

Toposheet No	State/UT	District	Sub District	Village	Plot/Survey/Khasra No.
D43C3	GOA	South Goa	Dharbandora	KODLI	45, 54 21, 22 etc

Remarks
N/A

6. Land Requirement (in Ha) of the project or activity

6.1. Nature of Land involved I	
6.2. Non-Forest Land [A]	311.1195
6.3. Forest Land [B]	65.9686
6.4. Total Land [A+B]	377.0881

Project Activity Cost

7. Project/Activity Cost

7.1. Total Cost of the Project at current price level	50000
7.2. Amount in words	326fty Thousand Lakh(s) Only

8. Employment likely to be generated

8.1. During construction phase

Permanent employment

8.1.1. No. of permanent employment (No.s) [A]	31
8.1.2. Period of employment (No. of days) [B]	300
8.1.3. No. of man-days $[X]=[A]*[B]$	9300

Temporary employment

8.1.4. Temporary / Contractual employment (No. of Man days) [Y]	100
8.1.5. Total $[X] + [Y]$	9400

8.2. During operational phase

Permanent employment

8.2.1. No. of permanent employment (No.s) [A]	31
8.2.2. Period of employment (No. of days) [B]	300
8.2.3. No. of man-days $[X]=[A]*[B]$	9300

Temporary employment

8.2.4. Temporary / Contractual employment (No. of Man days) [Y]	250
8.2.5. Total $[X] + [Y]$	9550

Others

9. Whether Rehabilitation and Resettlement (R&R) involved?	NO
10. Whether project area involves shifting of watercourse/road/rail/Transmission line/water pipeline, etc. required?	NO
11. Whether any alternative site(s) examined or part thereof for the non-site-specific component?	Not applicable as the project or activity is site specific
12. Whether there is any Government Order or Policy/ Court order relevant or restricting to the site?	NO
13. Whether there is any litigation pending against the project and/or land in which the project is proposed to be set up?	NO
14. Whether the proposal involves violation of Act/Rule/Regulation/Notification of Central/State Government?	NO

8. Employment likely to be generated

8.1. During construction phase

Permanent employment

8.1.1. No. of permanent employment (No.s) [A]	31
8.1.2. Period of employment (No. of days) [B]	300
8.1.3. No. of man-days $[X]=[A]*[B]$	9300

Temporary employment

8.1.4. Temporary / Contractual employment (No. of Man days) [Y]	100
8.1.5. Total $[X] + [Y]$	9400

8.2. During operational phase

Permanent employment

8.2.1. No. of permanent employment (No.s) [A]	31
8.2.2. Period of employment (No. of days) [B]	300
8.2.3. No. of man-days $[X]=[A]*[B]$	9300

Temporary employment

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8.2.5. Total $[X] + [Y]$	9550

Others

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10. Whether project area involves shifting of watercourse/road/rail/Transmission line/water pipeline, etc. required?	NO
11. Whether any alternative site(s) examined or part thereof for the non-site-specific component?	Not applicable as the project or activity is site specific
12. Whether there is any Government Order or Policy/ Court order relevant or restricting to the site?	NO
13. Whether there is any litigation pending against the project and/or land in which the project is proposed to be set up?	NO
14. Whether the proposal involves violation of Act/Rule/Regulation/Notification of Central/State Government?	NO

8. Employment likely to be generated

8.1. During construction phase

Permanent employment

8.1.1. No. of permanent employment (No.s) [A]	31
8.1.2. Period of employment (No. of days) [B]	300
8.1.3. No. of man-days $[X]=[A]*[B]$	9300

Temporary employment

8.1.4. Temporary / Contractual employment (No. of Man days) [Y]	100
8.1.5. Total $[X] + [Y]$	9400

8.2. During operational phase

Permanent employment

8.2.1. No. of permanent employment (No.s) [A]	31
8.2.2. Period of employment (No. of days) [B]	300
8.2.3. No. of man-days $[X]=[A]*[B]$	9300

Temporary employment

8.2.4. Temporary / Contractual employment (No. of Man days) [Y]	250
8.2.5. Total $[X] + [Y]$	9550

Others

9. Whether Rehabilitation and Resettlement (R&R) involved?	NO
10. Whether project area involves shifting of watercourse/road/rail/Transmission line/water pipeline, etc. required?	NO
11. Whether any alternative site(s) examined or part thereof for the non-site-specific component?	Not applicable as the project or activity is site specific
12. Whether there is any Government Order or Policy/ Court order relevant or restricting to the site?	NO
13. Whether there is any litigation pending against the project and/or land in which the project is proposed to be set up?	NO
14. Whether the proposal involves violation of Act/Rule/Regulation/Notification of Central/State Government?	NO

8. Employment likely to be generated

8.1. During construction phase

Permanent employment

8.1.1. No. of permanent employment (No.s) [A]	31
8.1.2. Period of employment (No. of days) [B]	300
8.1.3. No. of man-days $[X]=[A]*[B]$	9300

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Others

9. Whether Rehabilitation and Resettlement (R&R) involved?	NO
10. Whether project area involves shifting of watercourse/road/rail/Transmission line/water pipeline, etc. required?	NO
11. Whether any alternative site(s) examined or part thereof for the non-site-specific component?	Not applicable as the project or activity is site specific
12. Whether there is any Government Order or Policy/ Court order relevant or restricting to the site?	NO
13. Whether there is any litigation pending against the project and/or land in which the project is proposed to be set up?	NO
14. Whether the proposal involves violation of Act/Rule/Regulation/Notification of Central/State Government?	NO

Form-D (Part-I): Signing of Lease (section 2(iii)) on Forest Land

1. Project Details

1.1. State	GOA
1.2. Category of the project	Mining
1.2.1. Project Sub-Category	Non-Coal
1.3. Justification of Proposal	This is a Mining project which is site specific and cannot be worked unless diversion is affected where minerals (Iron Ore) exist. The justification in locating the project in forest area is i. Deposits area nature oriented and site specific. ii. The Block XII Codli Mineral Block, Forest overlies continuous deposit of Iron Ore to open cast method only. iii. It would severely affect the mining process of excavation unless these patches of forest plots are excavated as opencast mine in continuity. iv. Non-existence of any eco sensitive zone. v. Proposed area is not cover under declared wildlife sanctuary. vi. No displacement of Habitation.

Proposed Land

2. Details of Forestland proposed to be diverted (Village / Division / District Wise Breakup)

2.1. Total area of forestland proposed for assignment of lease (ha.)	65.9686
--	---------

Legal Status of the Forest land

Area (ha)	Legal Status of Forest Land
65.9686	Unclassed Forests
2.2. Total Area (ha)	65.9686
2.3. Total period for which the forestland is proposed to be leased (No. of years)	50

3. Details of forestland proposed for lease

Division	South Division
No. of Patches	2
KML	136114515_FC_FORM_D_KML_1757593282505_mlforestnonforest@codli.kml Preview

Location Details

Toposheet No.	District	Village	Range	Forest land proposed for leased (ha.)	Non Forest Land (ha.)
D43C3	South Goa	KODLI	Curdi	65.9686	311.1195

Patch Details

Patch/ Segment ID	Forest Area (ha)	Non-Forest Area (ha)	Remarks if any
2	56.8497	155.6664	
1	9.1189	155.4531	

Remarks Details

Forest and Non Forest

Total Patch-wise Forest Land in the division (ha)

3.1. Total Forest Land Area (ha)	65.9686
3.2. Total Non Forest Land Area (ha)	311.1195

Total KML-wise Forest Land in the division (ha.)

3.3. Total Forest Land Area (ha)	65.9686
3.4. Total Non Forest Land Area (ha)	311.1195
3.5. Total Area (ha)	377.0881

3.1. Scanned copy of the map of the forest land proposed to be diverted prepared by using DGPS or Total Station (pdf only)	dgps_codli@forest.pdf Preview
3.2. Copy of map of the outer boundary of mining lease area (pdf only)	dgpsscan-codli_compressed.pdf Preview

4. Distance from the boundary of nearest Protected area/ Eco-sensitive zone(km)	2
5. Letter of Intent	letter of intent codli.pdf Preview

Category Specific Details

7. Details of Mining plan	
7.1. Whether Mining plan is approved?	Yes
7.1.1. Nature of Mining	Opencast
7.1.2. Date of approval of Mining plan	06/08/2025
7.1.3. Enter approval authority	Regional Controller on Mine, Indian Bureau, Goa
7.1.4. Life of Mine (Years)	14
7.1.5. Copy of approved mining plan	approvedmp-codli-1-155.pdf Preview

8. Additional Information

S. No.	Document Name	Remark	Document
1	EDS Reply	EDS Reply	eds reply.pdf Preview
2	Notes of environment management practices	Notes of environment management practices	annexure-27.pdf Preview
3	Undertaking for significance of forest land	Undertaking for significance of forest land from wildlife conservation point of view from concerned authority	annexure-26.pdf Preview
4	Profile of Lessee	Profile of Lessee	annexure-25.pdf Preview
5	Details of year wise plantation in safety zone	Details of year wise plantation in safety zone	annexure-24.pdf Preview
6	DGPS Map of Safety zone forest land	DGPS Map of Safety zone forest land	annexure-23.pdf Preview
7	Certificate regarding payment of additional NPV	Certificate regarding payment of additional NPV	annexure-22.pdf Preview
8	Geo referenced Map	Geo referenced Map	annexure-21.pdf Preview
9	Key Plan	Key Plan	annexure-20.pdf Preview
10	Toposheet Map	Toposheet Map	annexure-19.pdf Preview
11	Contour Plan	Contour Plan	annexure-18.pdf Preview
12	Certificate regarding minimum use of forest land	Certificate regarding minimum use of forest land	annexure-17.pdf Preview
13	Copy of Form-XIV of the forest area	Copy of Form-XIV of the forest area	annexure-16.pdf Preview
14	Copy of Form-I of the forest area	Copy of Form-I of the forest area	annexure-15.pdf Preview
15	Certificate for not affected Historical Monuments	Certificate for not affected Historical Monuments	annexure-14.pdf Preview
16	Cost Benefit Analysis	Cost Benefit Analysis	annexure-13.pdf Preview
17	Statement showing forest area	Statement showing forest area	annexure-12.pdf Preview
18	Brief project Report	Brief project Report	annexure-11.pdf Preview
19	Statement showing non forest land	Statement showing non forest land	annexure-10.pdf Preview
20	Undertaking for payment of NPV	Undertaking for payment of NPV	annexure-9.pdf Preview
21	Undertaking for payment of CA	Undertaking for payment of CA	annexure-8.pdf Preview

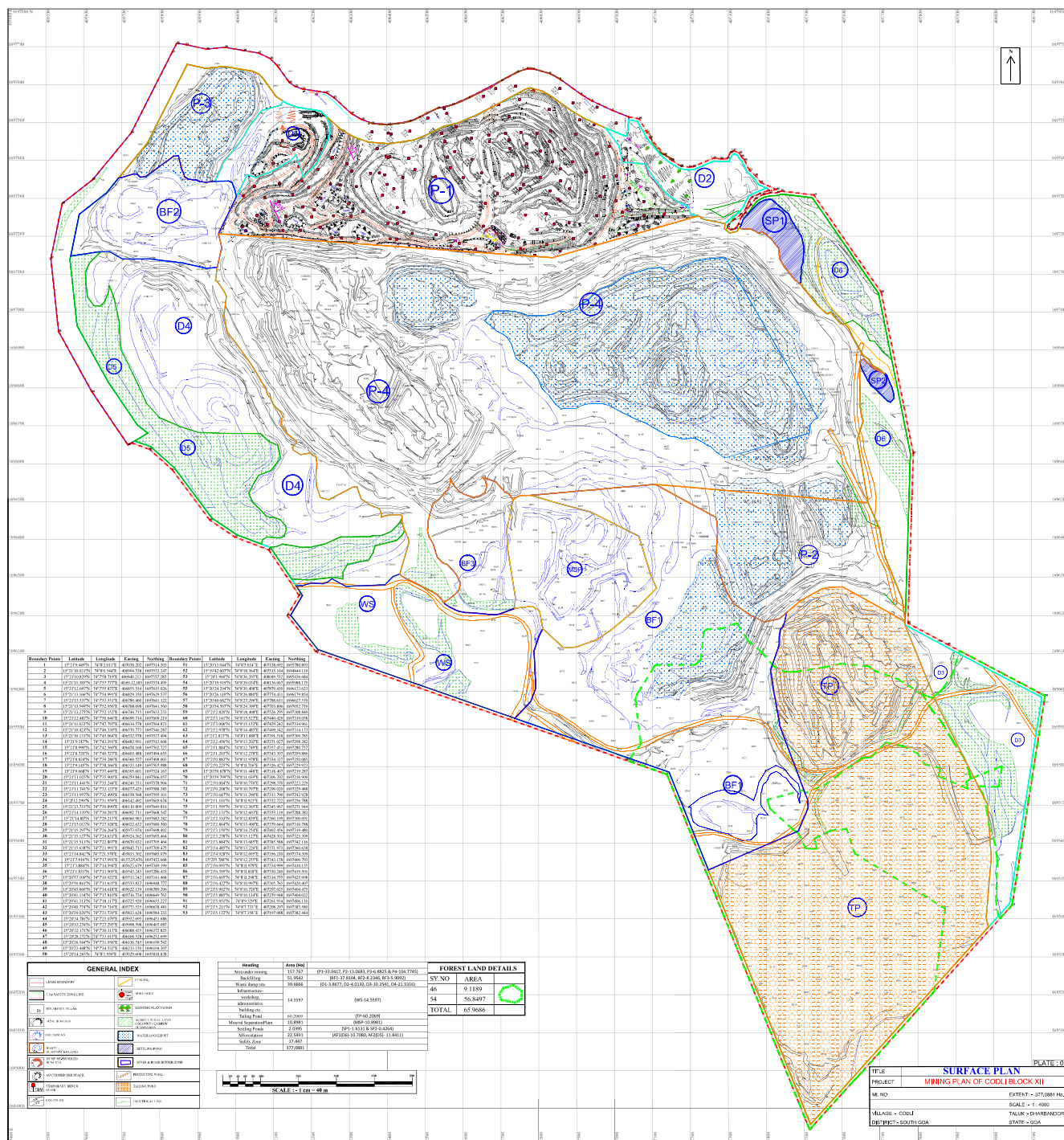
22	Working progression delineated in Map	Working progression delineated in Map	annexure-7.pdf Preview
23	KML file of working areas in progression	KML file of working areas in progression	annexure-6.kml Preview
24	Mitigation Plan	Mitigation Plan for mitigative measures	annexure-5.pdf Preview
25	Details Progressive Mine Closure Plan	Details Progressive Mine Closure Plan	annexure-4.pdf Preview
26	Undertaking to obtain the lease details from DMG	Undertaking to obtain the lease details from DMG	annexure-3.pdf Preview
27	Justification of not leaving the forest area	Justification of not leaving the forest area	annexure-2.pdf Preview
28	Undertaking to obtain NOC from private Owner	Undertaking to obtain NOC from private Owner	annexure-1.pdf Preview
29	DGPS map of Forest land	DGPS map of Forest land	dgps_codli@forest.pdf Preview
30	DGPS map of of lease area	DGPS map of of lease area	dgps_codli.pdf Preview
31	Letter of Authorization of the Company	Letter of Authorization of the Company	authorization.pdf Preview
32	Memorandum of Article of Asociation of the Company	Memorandum of Article of Association of the Company	article of association.pdf Preview
33	Declaration of preferred Bidder	Declaration of preferred Bidder	17685_notice_for_declaration_of_preferred_bidders_in_phase_iii_auction_nit_dated_13th_august_2024.pdf Preview
34	Letter of Intent	Letter of Intent	letter of intent codli.pdf Preview

9. Undertaking

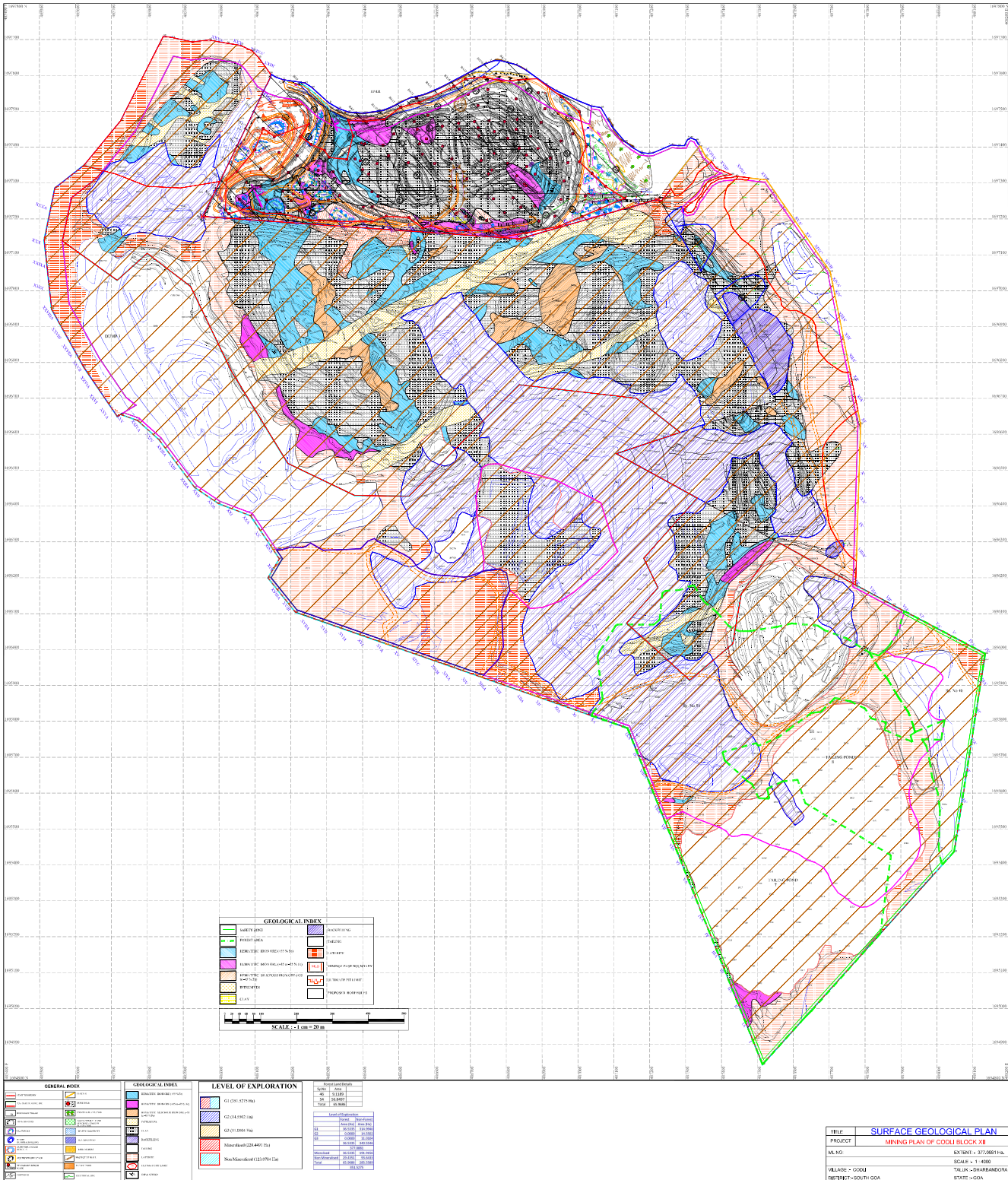
☒ I hereby give undertaking that the data and information given in the application and enclosures are true to be best of my knowledge and belief and I am aware that if any part of the data and information is found to be false or misleading at any stage, the project will be rejected and clearance given if any to the project will be revoked at our risk and cost. In addition to the above, I hearby give undertaking that no activity/construction/expansion has been taken up

9.1. Name	BASWARAJ MAHADEVPPA DALGADE
9.2. Designation	AGM-ROJECTS
9.3. Company	JSW STEEL LTD
9.4. Address	JSW Steel Ltd, 507, 5th Floor, Gera Imperium II, Patto, Panaji, Goa -403001.

Annexure - IVA - Surface Plan

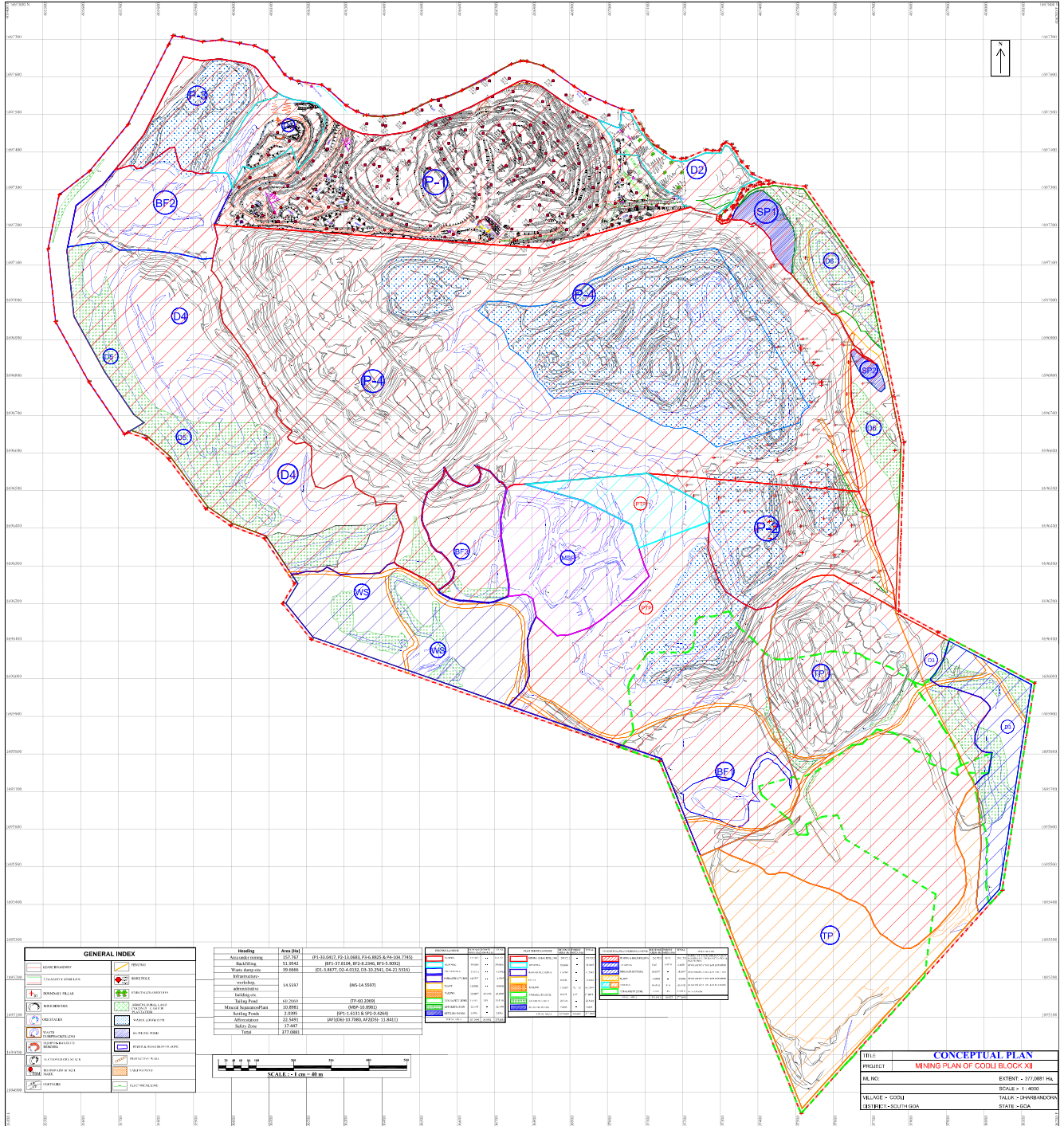


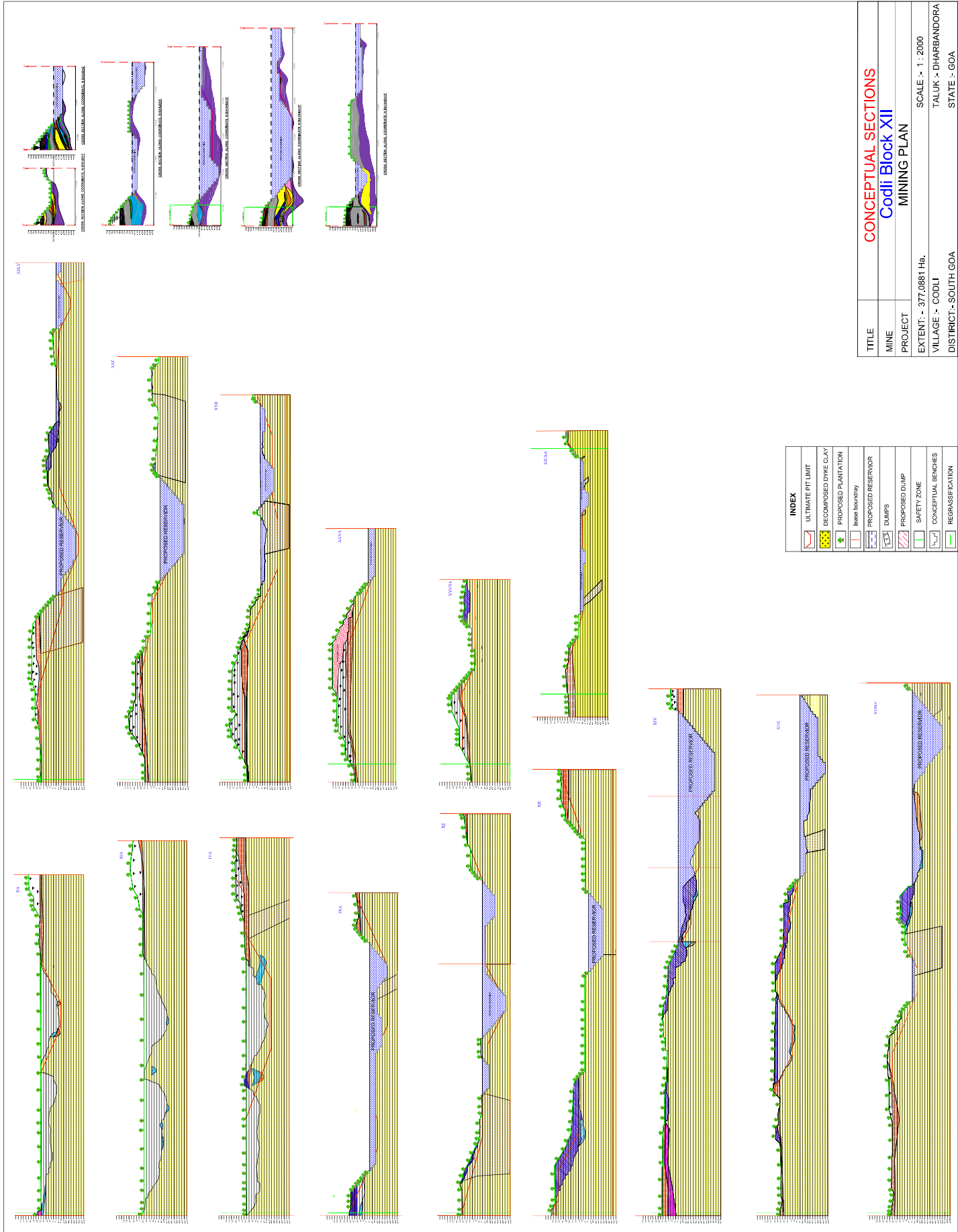
Annexure - IVB - Geological Plan and Sections





Annexure - IVC - Conceptual Plan and Sections







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

To,
The Deputy Conservator of Forests
South Division,
Margao (Goa) – 403601.

Date: 03/08/2026

Subject: Updated list of Flora and Fauna

Reference: No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995

Sir

With reference to the above, we have updated the list of flora and fauna as suggested by you.

Kindly consider the revised list and accord your approval for the same.

Thank you for your kind consideration.

Yours faithfully,

For JSW Steel Limited

Ambarish Volvoikar

Authorized Signatory

CC: PCCF and Chief Wildlife Warden, Van Bhawan, Altinho, Panaji, Goa-403001

Encl.:

Annexure I: Revised List of Flora & Fauna.



Part of O. P. Jindal Group

Dispatch Clerk 03/08/2026
Office of the Dy. Conservator of Forests
South Goa Division
Margao - Goa

Page 1 of 1

TABLE NO. -1
INVENTORY OF FLORAL DIVERSITY IN THE CORE & BUFFER ZONE OF PROJECT SITE
BASED ON ACTUAL SIGHTING, INPUTS FROM LOCALS

S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
Trees						
1	<i>Areca catechu</i>	Betel Nut	Arecaceae	-	+	LC
2	<i>Acacia catechu</i>	khair	Fabaceae	-	+	LC
3	<i>Acacia auriculiformis</i>	Earleaf acacia	Fabaceae	+	+	LC
4	<i>Aegle marmelos</i>	Bel	Rutaceae	-	+	NT
5	<i>Albizia odoratissima</i>	Kaloshiras	Fabaceae	+	+	LC
6	<i>Alstonia scholaris</i>	Satvan/Satan tree	Apocynaceae	+	+	LC
7	<i>Adina cordifolia</i>	Hedu	Rubiaceae	-	+	LC
8	<i>Anacardium occidentale</i>	Kaju	Anacardiaceae	+	+	LC
9	<i>Annona reticulata</i>	Custard Apple	Annonaceae	-	+	LC
10	<i>Artocarpus heterophyllus</i>	Jakfruit	Moraceae	+	+	NE
11	<i>Azadirachta indica</i>	Neem	Meliaceae	+	+	LC
12	<i>Bauhinia racemosa</i>	Apto	Fabaceae	+	+	LC
13	<i>Bombax ceiba</i>	Savar	Malvaceae	-	+	LC
14	<i>Bridelia retusa</i>	Khatem Asan	Phyllanthaceae	+	+	LC
15	<i>Buchanania lanzan</i>	Chara	Anacardiaceae	-	+	LC
16	<i>Butea monosperma</i>	Palash	Fabaceae	-	+	LC
17	<i>Callicarpa tomentosa</i>	Phalyo	Lamiaceae	-	+	LC
18	<i>Calophyllum inophyllum</i>	Undi	Calophyllaceae	-	+	LC
19	<i>Carallia brachiata</i>	Panshi, Makad bhiran	Rhizophoraceae	-	+	LC
20	<i>Careya arborea</i>	Kumbyo	Lecythidaceae	+	+	LC
21	<i>Caryota urens</i>	Birlo mad	Arecaceae	-	+	LC
22	<i>Cassia fistula</i>	Bayo, Amaltas	Fabaceae	-	+	LC
23	<i>Ceiba pentandra</i>	Savar	Malvaceae	+	+	LC
24	<i>Cinnamomum zeylanicum</i>	Tikhi	Lauraceae	+	+	EN
25	<i>Cocos Sp.</i>	Coconut	Arecaceae	+	+	NE
26	<i>Corypha umbraculifera</i>	Karetel	Arecaceae	-	+	DD
27	<i>Dalbergia latifolia</i>	Sisham	Fabaceae	-	+	VU
28	<i>Dalbergia paniculata</i>	Kuri	Fabaceae	-	+	NE
29	<i>Delonix regia</i>	Gulmohar	Fabaceae	+	+	LC
30	<i>Derris scandens</i>	Kanranj	Fabaceae	+	+	LC
31	<i>Dillenia pentagyna</i>	Karmal	Dilleniaceae	-	+	NE
32	<i>Diospyros montana</i>	Goiunda, Govimelu	Ebenaceae	-	+	NE
33	<i>Ficus bengalensis</i>	Vad	Moraceae	-	+	NE
34	<i>Ficus glomerata</i>	Rumad	Moraceae	-	+	LC
35	<i>Ficus Hispida</i>	Kalaumbar	Moraceae	-	+	LC
36	<i>Ficus religiosa</i>	Pipal	Moraceae	+	+	LC
37	<i>Flacourtia jangomas</i>	Jangli Jagam	Salicaceae	-	+	NE
38	<i>Flacourtia montana</i>	Chafra	Salicaceae	-	+	NT
39	<i>Garcinia gummigutta</i>	Dhar ambo	Clusiaceae	-	+	LC
40	<i>Garcinia indica</i>	Bhiran	Clusiaceae	-	+	VU
41	<i>Gmelina arborea</i>	Shivan	Lamiaceae	-	+	LC
42	<i>Grewia tiliifolia</i>	Dhaman	Malvaceae	+	+	LC



S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
43	<i>Helicteres isora</i>	Kivan	Malvaceae	-	+	LC
44	<i>Holarrhena antidysenterica</i>	Kudo	Apocynaceae	+	+	LC
45	<i>Holoptelea integrifolia</i>	Vamolo	Ulmaceae	-	+	LC
46	<i>Lagerstroemia lanceolata</i>	Nano	Lythraceae	+	+	LC
47	<i>Lagerstroemia parviflora</i>	Taman	Lythraceae	-	+	LC
48	<i>Lannea coromandelica</i>	Moi	Anacardiaceae	-	+	LC
49	<i>Mallotus philippensis</i>	Bems, Sendri	Euphorbiaceae	-	+	LC
50	<i>Mangifera indica</i>	Aam	Anacardiaceae	+	+	DD
51	<i>Manilkara hexandra</i>	Kirni	Sapotaceae	-	+	LC
52	<i>Melia azedarach</i>	Firnage nimb	Meliaceae	-	+	LC
53	<i>Mitragyna parvifolia</i>	Kalamb	Rubiaceae	-	+	LC
54	<i>Myristica fragrans</i>	Jayphal	Myristicaceae	-	+	DD
55	<i>Myristica malabarica</i>	Kayphal	Myristicaceae	-	+	VU
56	<i>Pterocarpus marsupium</i>	Asan	Fabaceae	+	+	NT
57	<i>Saraca indica</i>	Ashoka	Fabaceae	+	+	LC
58	<i>Schleichera oleosa</i>	Kasamb	Sapindaceae	-	+	LC
59	<i>Semecarpus anacardium</i>	Biboi	Anacardiaceae	-	+	LC
60	<i>Spondias mangifera</i>	Ambado	Anacardiaceae	-	+	LC
61	<i>Sterculia guttata</i>	Kulinder	Malvaceae	-	+	LC
62	<i>Sterculia urens</i>	Dhavoruk, Pandruk	Malvaceae	-	+	LC
63	<i>Sterculia villosa</i>	Aployo suplo	Malvaceae	-	+	LC
64	<i>Syzygium caryophyllatum</i>	Bhedas	Myrtaceae	-	+	VU
65	<i>Syzygium cumini</i>	Jamun	Myrtaceae	+	+	LC
66	<i>Tamarindus indica</i>	Chinch, Imli	Fabaceae	-	+	LC
67	<i>Tectona grandis</i>	Saylo, Teak	Lamiaceae	-	+	EN
68	<i>Terminalia arjuna</i>	Arjun	Combretaceae	+	+	LC
69	<i>Terminalia bellirica</i>	Goting	Combretaceae	+	+	LC
70	<i>Terminalia paniculata</i>	Kindal	Combretaceae	-	+	LC
71	<i>Terminalia chebula</i>	Hirda	Combretaceae	-	+	LC
72	<i>Terminalia tomentosa</i> (<i>crenulata</i>)	Marat (Matti)	Combretaceae	-	+	NE
73	<i>Vitex altissima</i>	Bavalgi	Lamiaceae	-	+	LC
74	<i>Xylia xylocarpa</i>	Zambo	Fabaceae	+	+	LC
75	<i>Zanthoxylum rhetsa</i>	Tirphal	Rutaceae	-	+	LC
Shrubs						
1	<i>Adhatoda vasica</i>	Aduso	Acanthaceae	-	+	NE
2	<i>Annona muricata</i>	Soursop	Annonaceae	-	+	LC
3	<i>Calotropis gigantea</i>	Rui/ Aak	Asclepiadaceae	+	+	NE
4	<i>Carissa carandas</i>	Karvanda, Kanda	Apocynaceae	-	+	DD
5	<i>Cassia tora</i>	Taykhilo	Fabaceae	+	+	NE
6	<i>Clerodendrum indicum</i>	Bharmgi	Verbenaceae	-	+	LC
7	<i>Hemidesmus indicus</i>	Dudhshiri	Apocynaceae	-	+	NE
8	<i>Ixora brachiata</i>	Gurani tree	Rubiaceae	+	+	LC
9	<i>Lobelia nicotianaefolia</i>	Baknal	Campanulaceae	-	+	NE
10	<i>Lantana camara</i>	Tick berry	Verbenaceae	+	+	NE
11	<i>Microcos paniculata</i>	Asale, Chivara	Malvaceae	-	+	LC

S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
12	<i>Moullava spicata</i>	Wagati, Vakeri	Fabaceae	-	+	NE
13	<i>Pothos scandens</i>	Bemdarli	Araceae	-	+	NE
14	<i>Vitex negundo</i>	Nimgud	Lamiaceae	-	+	LC
15	<i>Ziziphus mauritiana</i>	Indian jujube	Rhamnaceae	+	+	LC
Herbs						
1	<i>Achyranthes aspera</i>	Aghado	Amaranthaceae	-	+	NE
2	<i>Asparagus racemosus</i>	Shatavari	Liliaceae	-	+	NE
3	<i>Alternanthera sessilis</i>	Kanchari	Amaranthaceae	-	+	LC
4	<i>Ananas comosus</i>	Pineapple	Bromeliaceae	-	+	NE
5	<i>Boerhavia diffusa</i>	Punarnava	Nyctaginaceae	-	+	NE
6	<i>Canscora diffusa</i>	Bhui neem	Gentianaceae	-	+	NE
7	<i>Centella asiatica</i>	Gundhurichi bhaji	Apiaceae	-	+	LC
8	<i>Eclipta alba</i>	Mako	Asteraceae	-	+	LC
9	<i>Mentha arvensis</i>	Ortelamv	Lamiaceae	-	+	LC
10	<i>Ocimum omericanum</i>	Ramtulas	Lamiaceae	-	+	NE
11	<i>Ocimum sanctum</i>	Tulas	Lamiaceae	+	+	NE
12	<i>Leucas aspera</i>	Tumbo	Lamiaceae	-	+	NE
13	<i>Rauvolfia serpentina</i>	Atki	Apocynaceae	-	+	LC
14	<i>Smilax zeylanica</i>	Ghot vel or Kaval kamti	Smilacaceae	-	+	NE
15	<i>Sphagneticola trilobata</i>	Wedelia	Asteraceae	+	+	NE
16	<i>Sida cordifolia</i>	Indian country mallow	Malvaceae	+	+	NE
Grasses						
1	<i>Bambusa arundinacea</i>	Velu/bambo	Poaceae	-	+	NE
2	<i>Themeda cymbaria</i>	Karad	Poaceae	+	+	NE
3	<i>Themeda triandra</i>	Karad	Poaceae	-	+	NE
4	<i>Cynodon dactylon</i>	Haryali, Dub	Poaceae	-	+	NE
5	<i>Dendrocalamus strictus</i>	Velu/bambo	Poaceae	+	+	NE
6	<i>Saccharum officinarum</i>	Sugarcane	Poaceae	-	+	NE
Climbers						
1	<i>Piper nigrum</i>	Black pepper	Piperaceae	-	+	NE
2	<i>Epipremnum aureum</i>	Money plant	Araceae	-	+	NE

TABLE NO. -2
INVENTORY OF FAUNAL DIVERSITY IN THE CORE & BUFFER ZONE OF PROJECT SITE
 BASED ON ACTUAL SIGHTING, INPUTS FROM LOCALS

S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
MAMMALS							
1	<i>Axis axis</i>	Spotted Deer	Cervidae	+	+	II	LC
2	<i>Funambulus palmarum</i>	Indian palm squirrel	Sciuridae	-	+	IV	LC
3	<i>Lepus nigricollis</i>	Black-naped Hare	Leporidae	+	+	II	LC
4	<i>Pteropus giganteus</i>	Indian Flying fox	Pteropodidae	-	+	II	LC



S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
5	<i>Rattus rattus</i>	Common House Rat	Muridae	+	+	IV	LC
6	<i>Suncus murinus</i>	Grey Musk Shrew	Tupaiidae	+	+	-	LC
7	<i>Sus scrofa</i>	Indian Wild Boar	Suidae	-	+	II	LC
8	<i>Tatera indica</i>	Indian Gerbil	Muridae	-	+	-	LC
REPTILES							
1	<i>Bungarus caeruleus</i>	Indian Krait	Elapidae	-	+	II	LC
2	<i>Calotes versicolor</i>	Indian Garden Lizard	Agamidae	-	+	IV	LC
3	<i>Hemidactylus brooki</i>	Brooki's Gecko	Gekkonidae	-	+	IV	LC
4	<i>Hemidactylus frenatus</i>	Common House Gecko	Gekkonidae	+	+	IV	LC
AMPHIBIANS							
1	<i>Duttaphrynus melanostictus</i>	Indian toad	Bufonidae	+	+	IV	LC
2	<i>Euphlyctis cyanophlyctis</i>	Indian skipper frog	Dicroglossidae	-	+	IV	LC
3	<i>Hoplobatrachus tigerinus</i>	Indian bull frog	Dicroglossidae	+	+	II	LC
4	<i>Sphaerotheca breviceps</i>	Indian burrowing frog	Dicroglossidae	-	+	IV	LC
AVI FAUNA							
1	<i>Athene brama</i>	Spotted owl	Strigidae	-	+	II	LC
2	<i>Acridotheres fuscus</i>	Jungle Myna	Sturnidae	+	+	II	LC
3	<i>Acridotheres tristis</i>	Common Myna	Sturnidae	+	+	II	LC
4	<i>Aegithina tiphia</i>	Common Iora	Aegithinidae	+	+	II	LC
5	<i>Alcedo atthis</i>	Common Kingfisher	Alcedinidae	-	+	II	LC
6	<i>Apus affinis</i>	House Swift	Apodidae	-	+	II	LC
7	<i>Ardeola grayii</i>	Indian Pond Heron	Ardeidae	+	+	II	LC
8	<i>Bubulcus ibis</i>	Cattle Egret	Ardeidae	+	+	II	LC
9	<i>Ceryle rudis</i>	Pied Kingfisher	Alcedinidae	+	+	II	LC
10	<i>Charadrius dubius</i>	Little Ringed Plover	Charadriidae	+	+	II	LC
11	<i>Cinnyris asiaticus</i>	Purple Sun Bird	Nectariniidae	+	+	II	LC
12	<i>Clamator jacobinus</i>	Pied Cuckoo	Cuculidae	-	+	II	LC
13	<i>Columba livia</i>	Blue Rock Pigeon	Columbidae	+	+	-	LC
14	<i>Copsychus fulicata</i>	Indian Robin	Muscicapidae	-	+	II	LC
15	<i>Copsychus saularis</i>	Oriental Magpie Robin	Muscicapidae	+	+	II	LC
16	<i>Corvus macrorhynchos</i>	Large-billed Crow	Corvidae	+	+	II	LC
17	<i>Corvus splendens</i>	House Crow	Corvidae	+	+	-	LC



S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
18	<i>Cyornis tickelliae</i>	Tickell's Blue Flycatcher	Muscicapidae	-	+	II	LC
19	<i>Dendrocitta vagabunda</i>	Rufous Treepie	Corvidae	+	+	II	LC
20	<i>Dicrurus caerulescens</i>	White Bellied Drongo	Dicruridae	-	+	II	LC
21	<i>Dicrurus macrocercus</i>	Black Drongo	Dicruridae	+	+	II	LC
22	<i>Dicrurus paradiseus</i>	Greater Racket-tailed Drongo	Dicruridae	-	+	II	LC
23	<i>Dinopium benghalense</i>	Black-rumped Flameback	Picidae	-	+	II	LC
24	<i>Elanus caeruleus</i>	Black winged kite	Elanidae	-	+	II	LC
25	<i>Fulica atra</i>	Eurasian Coot	Rallidae	-	+	II	LC
26	<i>Gallinula chloropus</i>	Common moorhen	Rallidae	+	+	II	LC
27	<i>Galloperdix spadicea</i>	Red Spurfowl	Phasianidae	-	+	II	LC
28	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	Alcedinidae	+	+	II	LC
29	<i>Hirundo smithii</i>	Wire Tailed Swallow	Hirundinidae	-	+	II	LC
30	<i>Leptocoma minima</i>	Crimson backed Sunbird	Nectariniidae	-	+	II	LC
31	<i>Lonchura punctulata</i>	Scaly-breasted munia	Estrildidae	-	+	II	LC
32	<i>Megalaima haemacephala</i>	Coppersmith Barbet	Megalaimidae	-	+	II	LC
33	<i>Merops orientalis</i>	Green Bee-eater	Meropidae	+	+	II	LC
34	<i>Milvus migrans</i>	Black Kite	Accipitridae	-	+	II	LC
35	<i>Oriolus kundoo</i>	Golden oriole	Oriolidae	-	+	II	LC
36	<i>Oriolus xanthornus</i>	Black Headed Oriole	Oriolidae	-	+	II	LC
37	<i>Orthotomus sutorius</i>	common tailorbird	Cisticolidae	-	+	II	LC
38	<i>Passer domesticus</i>	House Sparrow	Passeridae	+	+	II	LC
39	<i>Perdica asiatica</i>	Jungle bush quail	Phasianidae	-	+	II	LC
40	<i>Pericrocotus flammeus</i>	Scarlet Minivet	Campephagidae	-	+	II	LC
41	<i>Pitta brachyura</i>	Indian Pitta	Pittidae	-	+	II	LC
42	<i>Ploceus philippinus</i>	Baya Weaver	Ploceidae	-	+	II	LC
43	<i>Prinia inornata</i>	Plain Prinia	Cisticolidae	-	+	II	LC
44	<i>Prinia socialis</i>	Ashy prinia	Cisticolidae	+	+	II	LC
45	<i>Psittacula cyanocephala</i>	Plum-headed parakeet	Psittacidae	-	+	II	LC
46	<i>Psittacula krameri</i>	Rose Ringed Parakeet	Psittacidae	+	+	II	LC



S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
47	<i>Pycnonotus cafer</i>	Red Vented Bulbul	Pycnonotidae	+	+	II	LC
48	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	Pycnonotidae	+	+	II	LC
49	<i>Saxicola caprata</i>	Pied Bushchat	Muscicapidae	-	+	II	LC
50	<i>Streptopelia chinensis</i>	Spotted Dove	Columbidae	+	+	II	LC
51	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	Threskiomithidae	-	+	II	LC
52	<i>Tringa hypoleucos</i>	Common Sandpiper	Scolopacidae	-	+	II	LC
53	<i>Upupa epops</i>	Hoopoe	Upupidae	+	+	II	LC
54	<i>Vanellus indicus</i>	Red-wattled Lapwing	Charadriidae	+	+	II	LC
55	<i>Vanellus malabaricus</i>	Yellow Wattled Lapwing	Charadriidae	+	+	II	LC
AQUATIC SPECIES							
1	<i>Aplocheilus lineatus</i>	Striped panchax	Aplocheilidae	-	+	-	LC
2	<i>Puntius filamentosus</i>	Black spot barb	Cyprinidae	-	+	-	LC
3	<i>Rasbora labiosa</i>	Slender rasbora	Danionidae	-	+	-	LC
BUTTERFLY							
1	<i>Appias lycida</i>	Chocolate albatross	Pierinae	-	+	II	NE
2	<i>Ariadne merione</i>	Common castor	Nymphalinae	-	+	II	NE
3	<i>Euploea core</i>	Common Indian Crow	Nymphalidae	+	+	II	LC
4	<i>Eurema hecabe</i>	Common grass Yellow	Pieridae	+	+	II	LC
5	<i>Hypolimnas misippus</i>	Danaid Eggfly	Nymphalidae	+	+	II	LC
6	<i>Idea malabarica</i>	Malabar Tree Nymph	Nymphalidae	-	+	II	LC
7	<i>Papilio demoleus</i>	Lime butterfly	Papilionidae	+	+	II	NE
8	<i>Troides minos</i>	Southern birdwing	Papilionidae	+	+	II	LC

TABLE NO. -3
INVENTORY OF SCHEDULE-I SPECIES IN THE CORE & BUFFER ZONE OF PROJECT SITE
 BASED ON ACTUAL SIGHTING, INPUTS FROM LOCALS

S.N.	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
MAMMALS							
1	<i>Bos gaurus</i>	Gaur / Indian Bison	Bovidae	-	+	I	VU
2	<i>Canis aureus</i>	Golden Jackel	Canidae	+	+	I	LC
3	<i>Cuon alpinus</i>	Wild dog (Dhole)	Canidae	-	+	I	EN
4	<i>Hystrix indica</i>	Indian Crested Porcupine	Hystriidae	-	+	I	
5	<i>Macaca radiata</i>	Bonnet Macaque	Cercopithecidae	-	+	I	



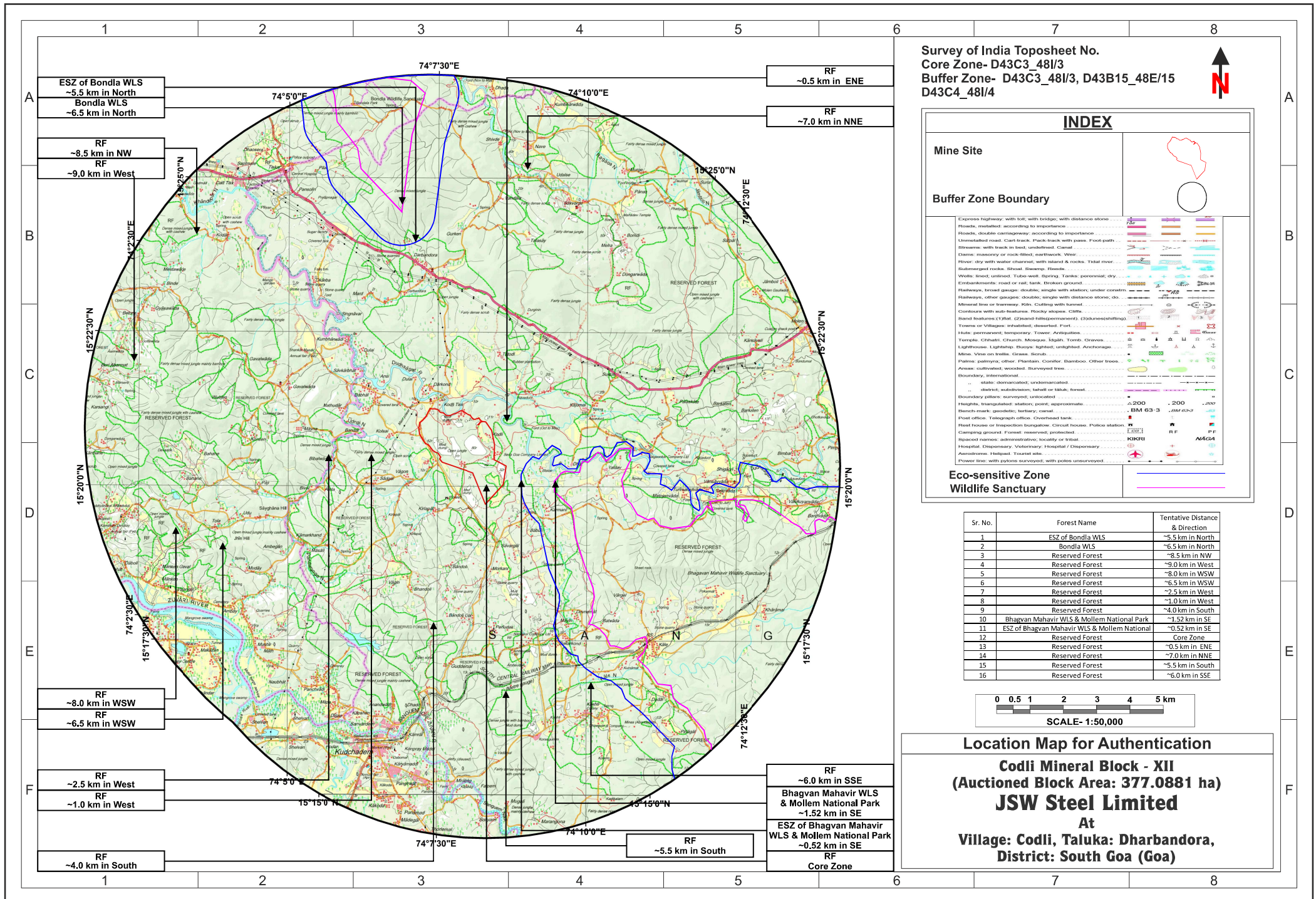
S.N.	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
6	<i>Melursus ursinus</i>	Sloth bear	Ursidae	-	+	I	VU
7	<i>Moschiola indica</i>	Mouse deer	Tragulidae	-	+	I	LC
8	<i>Panthera pardus</i>	Leopard	Felidae	+	+	I	VU
9	<i>Ratufa indica</i>	Malabar giant squirrel	Sciuridae	-	+	I	LC
10	<i>Urva edwardsii</i>	Grey Mongoose	Herpestidae	+	+	I	LC
REPTILES							
1	<i>Crocodylus palustris</i>	Marsh crocodiles	Crocodylidae	-	+	I	VU
2	<i>Naja naja</i>	Indian Cobra	Elapidae	-	+	I	LC
3	<i>Ptyas mucosa</i>	Rat Snake	Colubridae	-	+	I	LC
4	<i>Varanus bengalensis</i>	Monitor Lizard	Varanidae	-	+	I	NT
AVI FAUNA							
1	<i>Accipiter badius</i>	Shikra	Accipitridae	+	+	I	LC
2	<i>Haliastur indus</i>	Brahminy Kite	Accipitridae	-	+	I	LC
3	<i>Nisaetus cirrhatus</i>	Crested Hawk Eagle	Megalaemidae	-	+	I	LC
4	<i>Pavo cristatus</i>	Indian Peafowl	Phasianidae	+	+	I	LC
5	<i>Strix leptogrammica</i>	Brown Wood Owl	Strigidae	-	+	I	LC

Source: Based on actual sightings and information gathered from locals during the primary field survey.

Abbreviations: LC: Least Concern, NE: Not Evaluated, DD: Data Deficient, VU: Vulnerable, NT: Near Threatened, EN: Endangered.

As per the Wildlife Protection (Amendment) Act, 2022, there are total 19 species listed under Schedule I (Including 10 Mammals, 04 Reptiles and 05 Avi Fauna).







Government of Goa
Office of The Dy. Conservator of Forests
Working Plan Division
"Goa Van Bhavan"
Altinho Panaji Goa - 403 001

No: - DCF(WP)/Tech/Digi/Vol-I/75/2025-26/751

Dated: - 10/10/2025

✓ To,

The Sr. Manager,
JSW, Steel Limited,
JSW Centre, Bandra Kurla Complex,
Bandra (East), Maharashtra, Mumbai-400051.

Sub: - Authenticated Map showing distance indicating the shortest distance between the ESZ and WLS from the mine lease boundary of Codli Mineral Block-XII located in Codli Village, Dharbandora Taluka, South Goa District, Goa.

Ref: - dated 15/09/2025.

Sir,

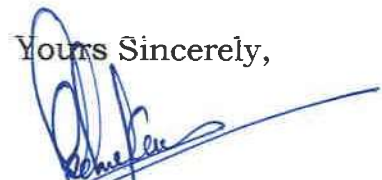
With reference to the above cited subject, please find enclosed herewith Map showing distance indicating the shortest distance between the Eco-Sensitive Zone and Wildlife Sanctuary from the mine lease boundary of Codli Mineral Block-XII located in Codli Village, Dharbandora Taluka, South Goa District (**Annexure-I**).

This is issued as per your request and may not be treated as NOC for any purpose.

Submitted for information and necessary action.

Yours Sincerely,

Encl: - As above.


Dy. Conservator of Forests,
Working Plan Division,
Panaji-Goa.

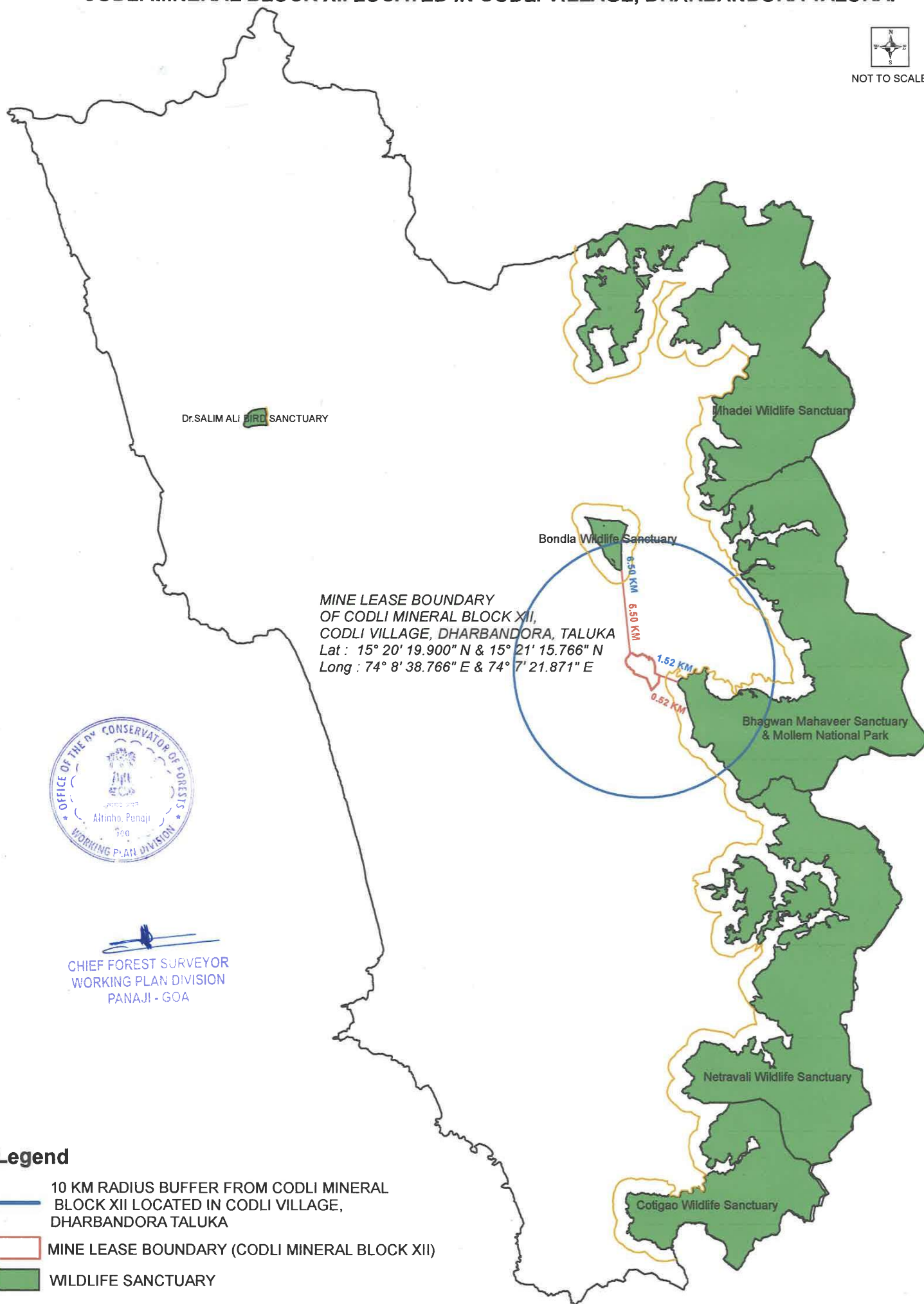
Phone No.: - 0832-2492529

"स्वच्छ भारत नितळ गोंय"
Towards greener & Cleaner Goa

STATE MAP OF GOA SHOWING DISTANCE INDICATING THE SHORTEST DISTANCE BETWEEN THE ECO SENSITIVE ZONE & WILDLIFE SANCTUARY FROM MINE LEASE BOUNDARY OF CODLI MINERAL BLOCK XII LOCATED IN CODLI VILLAGE, DHARBANDORA TALUKA.



NOT TO SCALE



CHIEF FOREST SURVEYOR
 WORKING PLAN DIVISION
 PANAJI - GOA

Legend

- 10 KM RADIUS BUFFER FROM CODLI MINERAL BLOCK XII LOCATED IN CODLI VILLAGE, DHARBANDORA TALUKA
- MINE LEASE BOUNDARY (CODLI MINERAL BLOCK XII)
- WILDLIFE SANCTUARY
- ECO SENSITIVE ZONE BOUNDARY LINE



Branch Office: 707, 7th Floor, Gera's Imperium II
Patto Centre, Panaji, Goa -403001
CIN : L27102MH1994PLC152925
Website : www.jsw.in

Ref: JSW/WLCP/48-26

Date: 14.08.2026

To,
The Chief Engineer,
Water Resources Department,
Sinchai Bhavan, Near Police Station,
Alto-Porvorim, Goa 403521

Subject: Subject: Submission of Hydrogeology Report along with Form-1 (Pit Registration) for approval and issuance of NOC for Pit Dewatering – Block-XII Codli Mineral Block

Reference: Terms of Reference (ToR) issued by the Ministry of Environment, Forest and Climate Change, Government of India, vide File No. J-11015/49/2025-IA.II (NCM), dated 18.05.2026.

Dear Sir/Madam,

With reference to the above subject and reference, we would like to inform you that JSW Steel Limited has applied to the Ministry of Environment, Forest and Climate Change (MoEF&CC) for Environmental Clearance for the proposed Block-XII Codli Mineral Block, having an auctioned block area of 377.0881 ha, with proposed Iron Ore production capacity of 3.50 Million TPA, OB/Waste generation of 8.21 Million TPA and total excavation of 11.71 Million TPA.

As stipulated in the approved ToR, the following conditions are applicable to the project:

Specific Condition No. 1.34:

"The project proponent shall conduct hydrological study for projects involving intersection of ground water table as per the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP."

Received 
CE, WRD, 14/08/2026
Alto-Porvorim-Goa
Pin: 403 521

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



Part of O. P. Jindal Group



Standard Terms of Reference for Mining of Minerals – Point No. 1.28:

"Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished."

In compliance with the above ToR conditions, we are hereby submitting the Hydrogeology Report along with Form-1 Application for Pit Registration for your kind review and approval. The Hydrogeology Report and Form-1 Application are enclosed herewith as Annexure-I.

In view of the above, we kindly request your good office to review and approve the submitted Hydrogeology Report and Form-1 Application and issue the necessary NOC/permission for pit dewatering for the proposed mining operation.

In case any additional information, documents or clarifications are required, we shall be pleased to furnish the same at the earliest.

We request your kind consideration and necessary action in the matter.

JSW Steel Limited

Ambarish Volvoikar

Authorized Signatory



CC to Executive Engineer WRD, Margao

- Encl.:**
1. Hydrogeology Report
 2. Application for Pit Registration





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

Date: 28.05.2026

To,
The Chief Engineer,
Water Resources Department,
Sinchai Bhavan, Near Police Station,
Alto-Porvorim, Goa 403521

Subject: Request for High Flood Level (HFL) Data and Flood Plain Certificate for Mining Project

Reference: TOR File No. J-11015/49/2025-IA.II(NCM) issued by MoEF&CC on 18.05.2026

Respected Sir,

This is to bring to your kind notice that the Terms of Reference (ToR) for the Codli Mineral Block (Block-XII) has been issued by the Ministry of Environment, Forest & Climate Change (MoEF&CC) on 18.05.2026 during the Expert Appraisal Committee (EAC) consideration.

As part of the ToR conditions, the following specific conditions have been stipulated:

1. TOR Point No. 1.3:

“Certificate from concerned District Magistrate/Executive Engineer from the State Water Resources Department (or) any officer authorized by the State Government in this regard shall be submitted stating that mining activity is not located within flood plain of Dudhsagar/Khandepar River corresponding to one in 25 years flood as per Ministry's O.M. dated 14/02/2022.”

2. TOR Point No. 1.9:

PP needs to obtain the HFL data of the nala and Dudhsagar/Khandepar River from Irrigation Department. No mining shall be proposed within the HFL of Dudhsagar/Khandepar River.”

3. TOR Point No. 1.10(e):

“The Project Proponent shall consult the Goa Water Resources Department or an institute of national repute to obtain the High Flood Level (HFL) data for the Khandepar River and the seasonal nallah flowing within the mining lease area.”

Received 29/05/26
CE, WRD,
Alto-Porvorim-Goa
Pin: 403 521



Part of O. P. Jindal Group

Office of the Assistant Engineer
Sub Div. III, Works Div. XII,
WATER RESOURCES DEPT.
DHARBANDORA - GOA



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

In view of the above, we kindly request your good office to provide:

- High Flood Level (HFL) data of the Khandepar River for the past 25 years;
- Necessary certificate stating that the proposed mining activities are located outside the HFL/flood plain area based on the approved mining plan and UPL coordinates submitted by us.

The above information and certification are essential for processing the Environmental Clearance (EC) application of the project before MoEF&CC.

We shall be grateful for your kind support and early action in this regard.

FOR JSW STEEL LTD.


(Authorized Signatory)

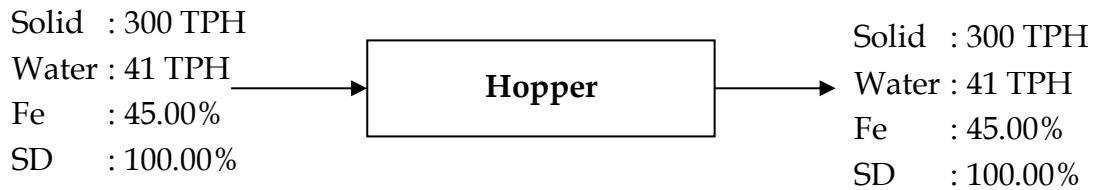


Encl: Approved TOR Letter
Surface Plan
KML file

CC to Executive Engineer WRD, Margao
Asst Engineer, WRD Dharbandora

Basis: 300 TPH of Low-Grade Wet Iron Ore having 12% Moisture

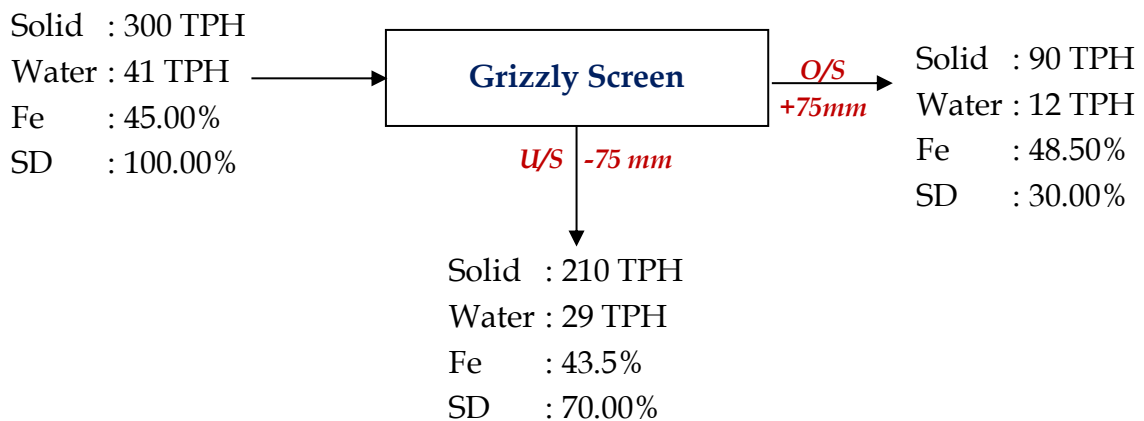
1. Hopper



2. Feeder



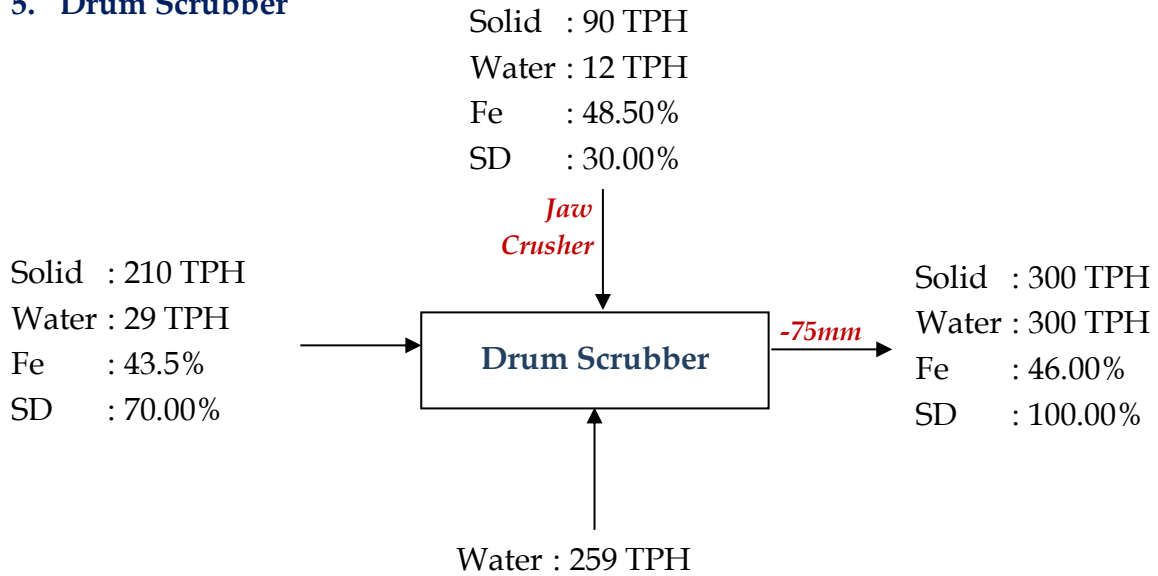
3. Grizzly Screen



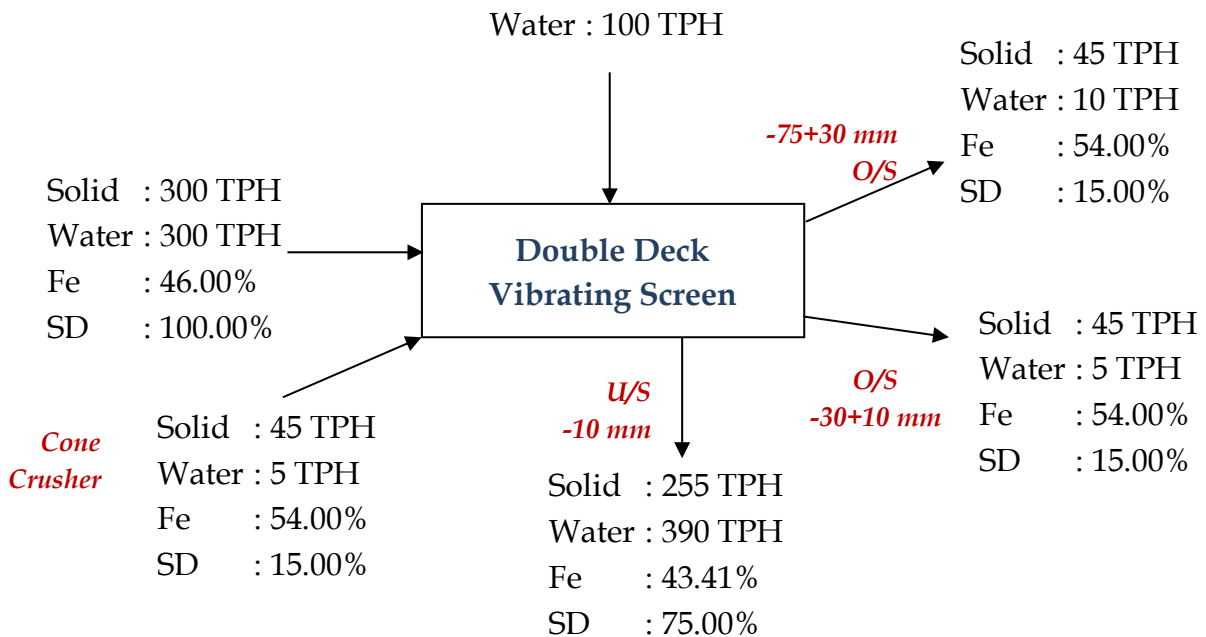
4. Jaw Crusher



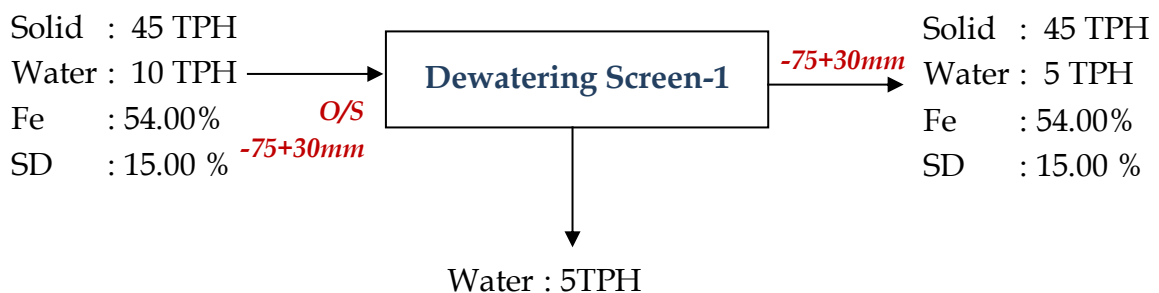
5. Drum Scrubber



6. Double Deck Vibrating Screen



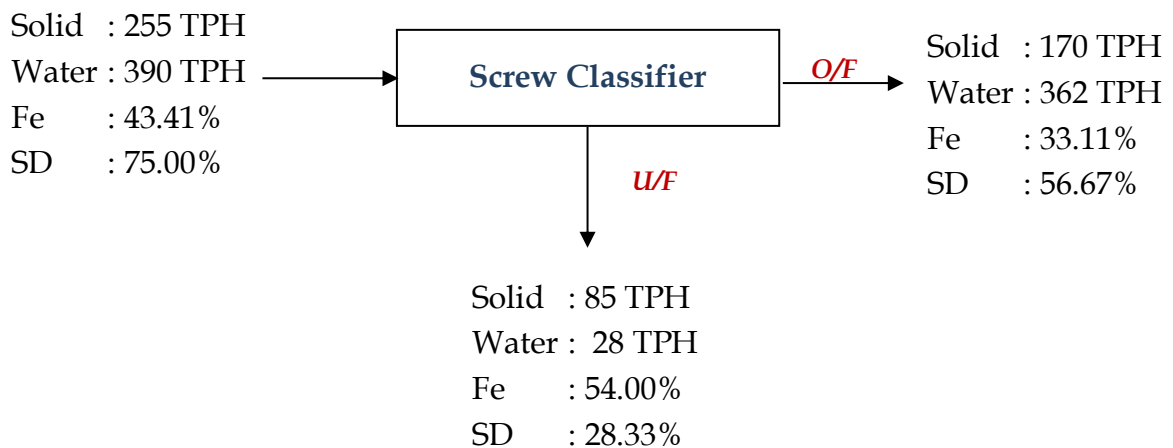
7. Dewatering Screen-1



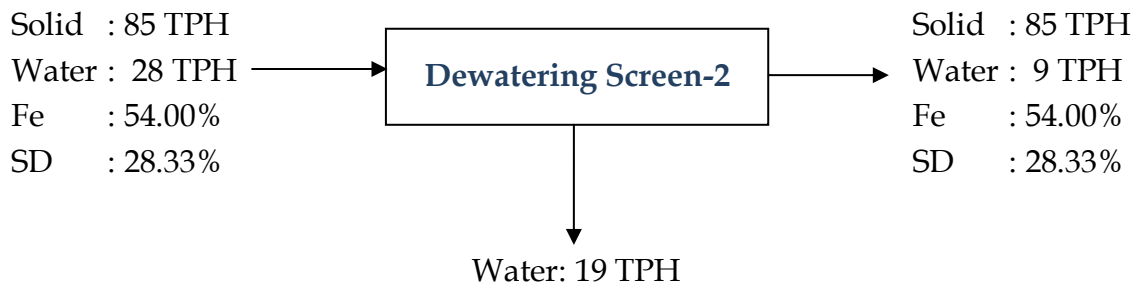
8. Cone Crusher



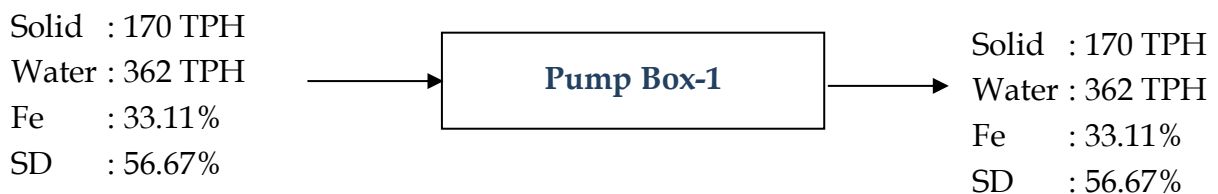
9. Screw Classifier



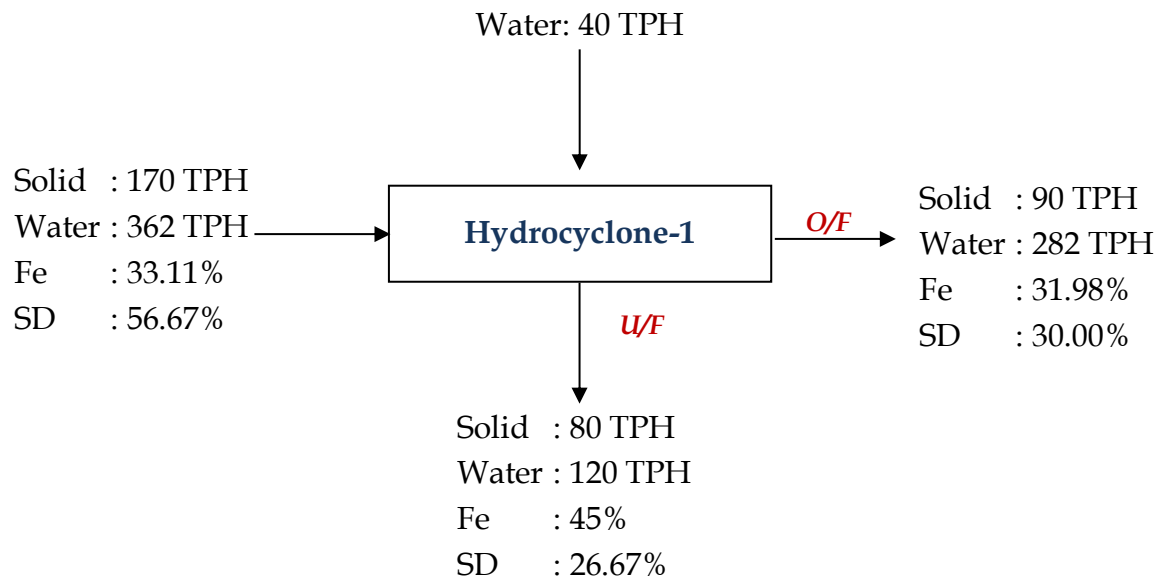
10. Dewatering Screen-2



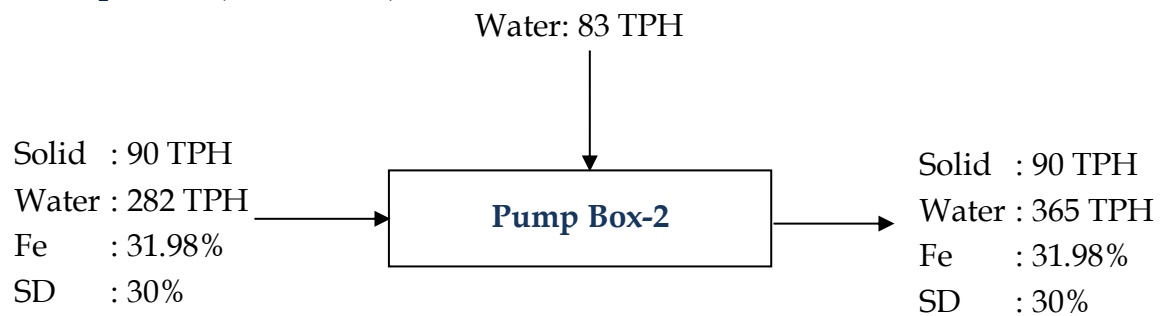
11. Pump Box-1 (for SC O/F)



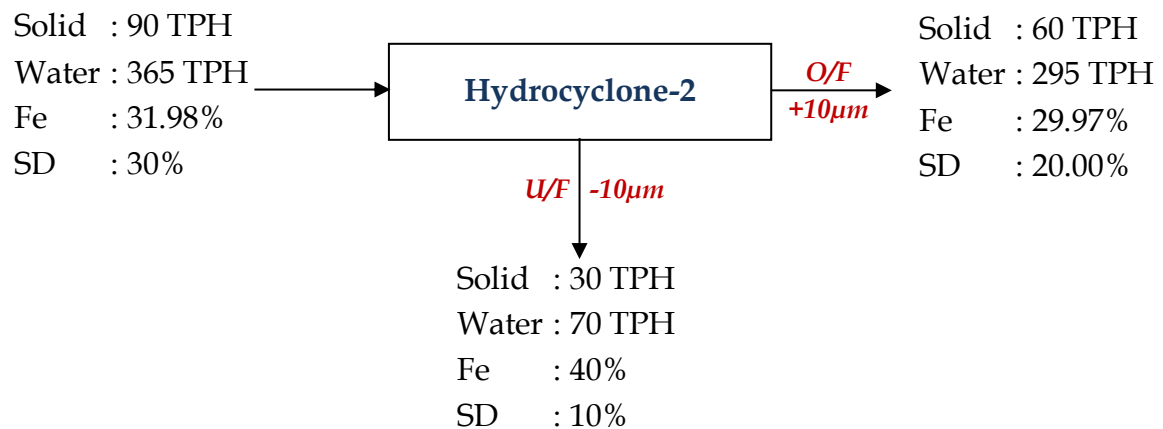
12. Hydrocyclone-1



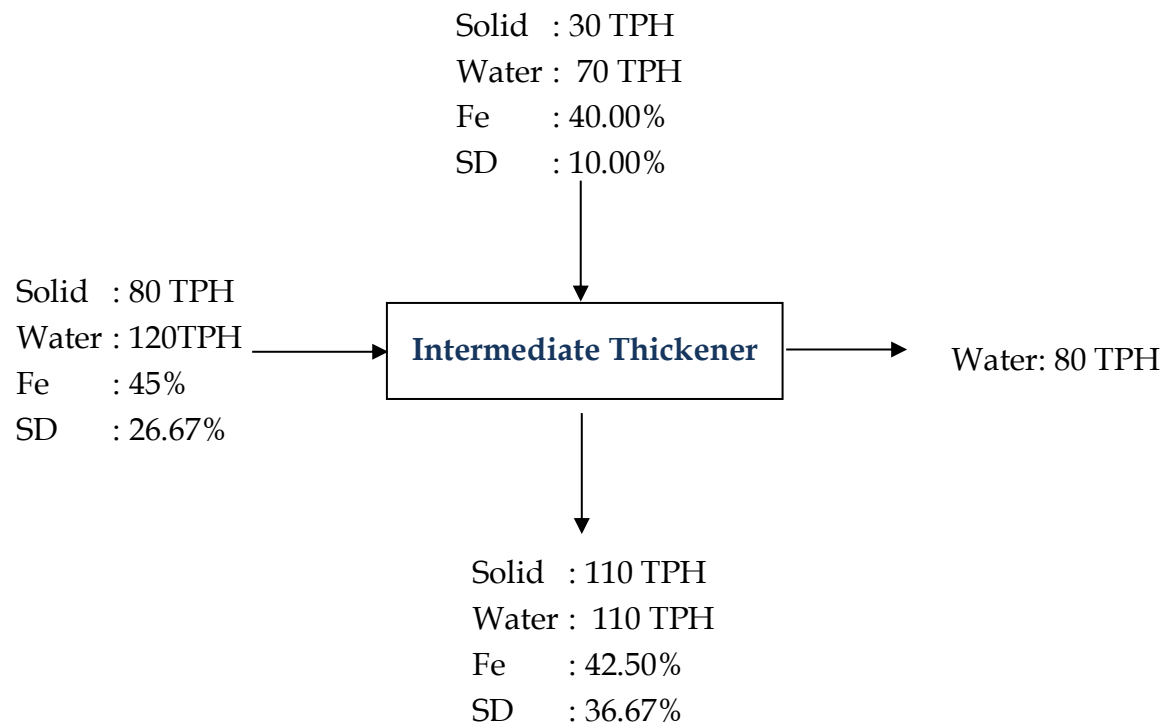
13. Pump Box-2 (for HC O/F)



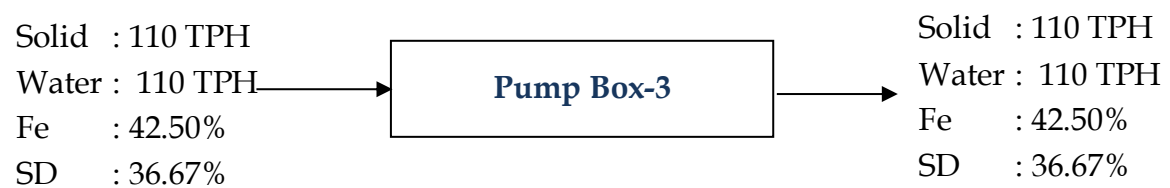
14. Hydrocyclone-2



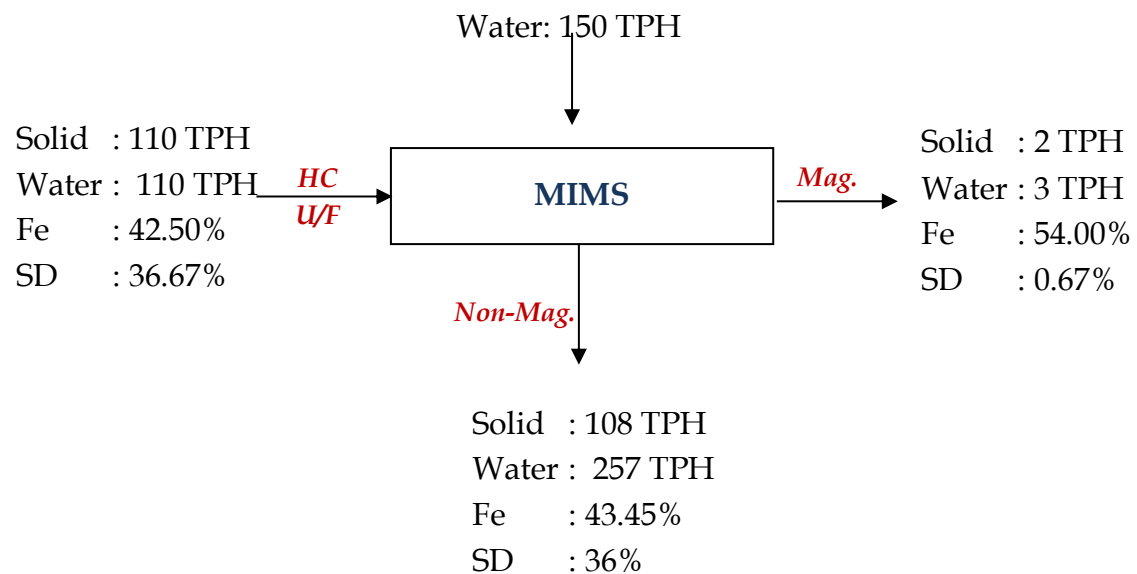
15. Intermediate Thickener



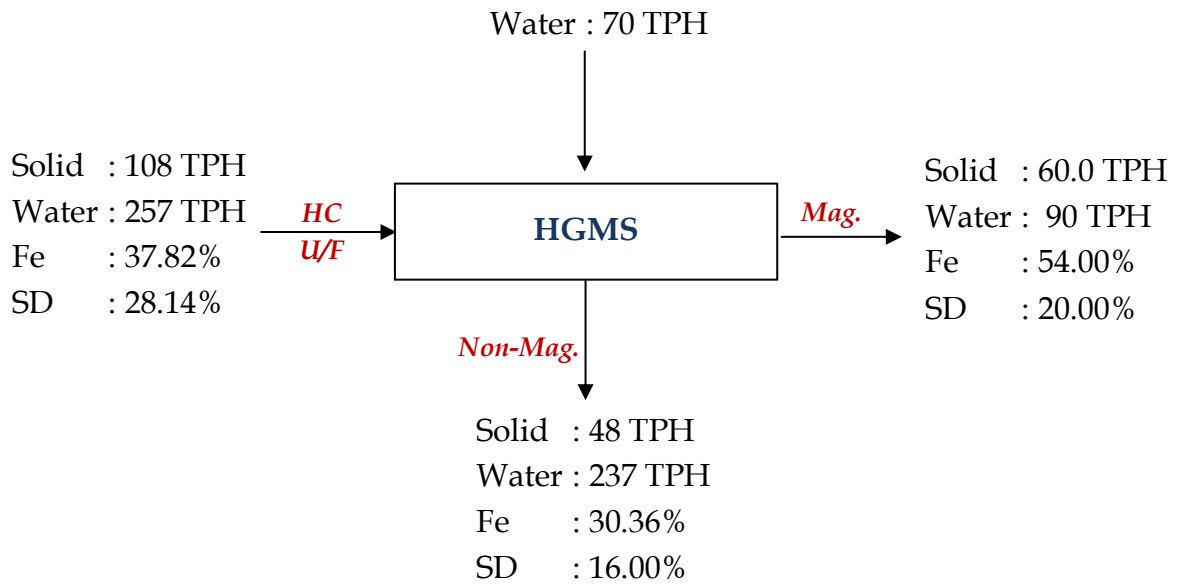
16. Pump Box-3



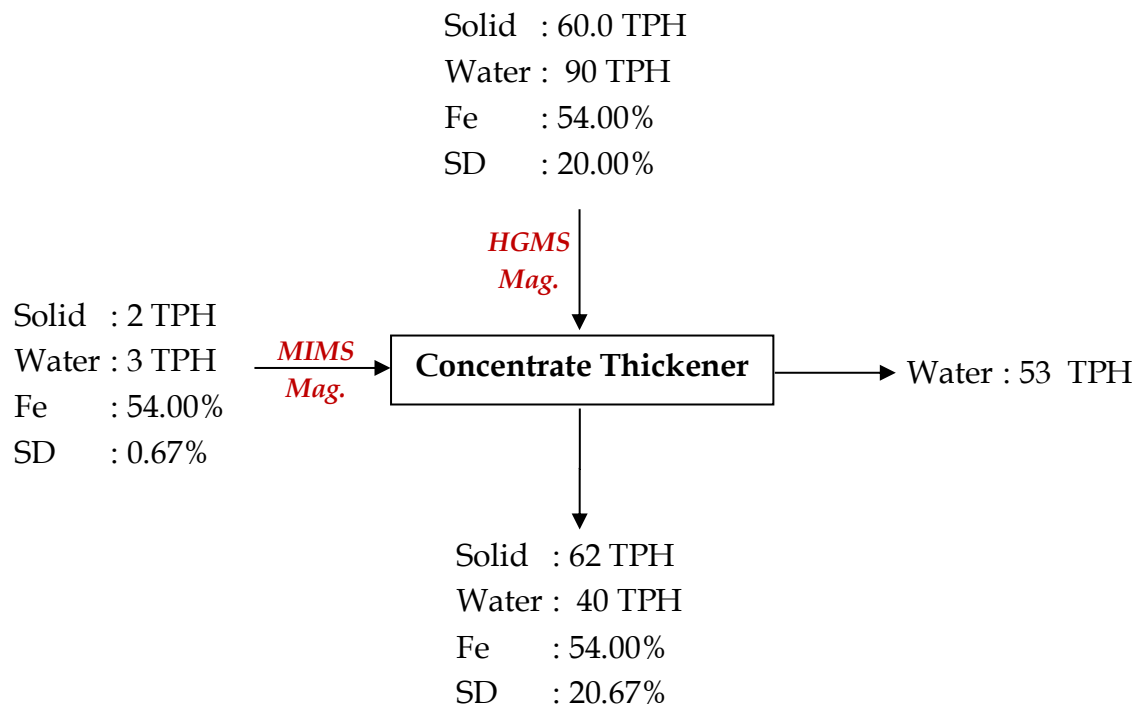
17. Medium Intensity Magnetic Separator (MIMS)



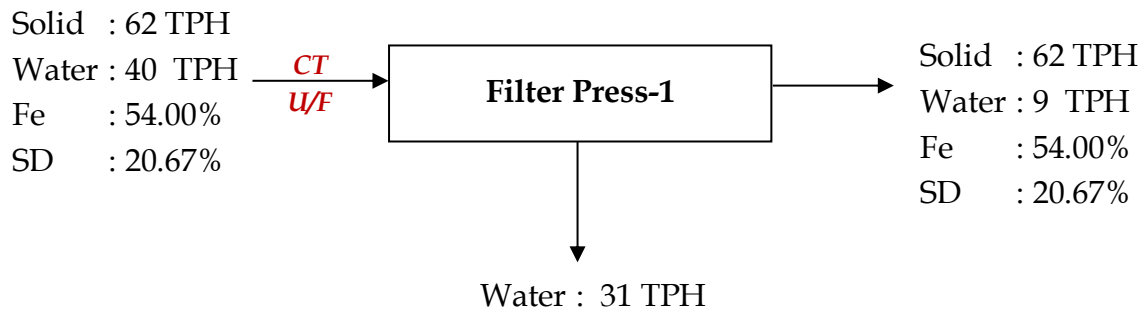
18. High Gradient Magnetic Separator (HGMS)



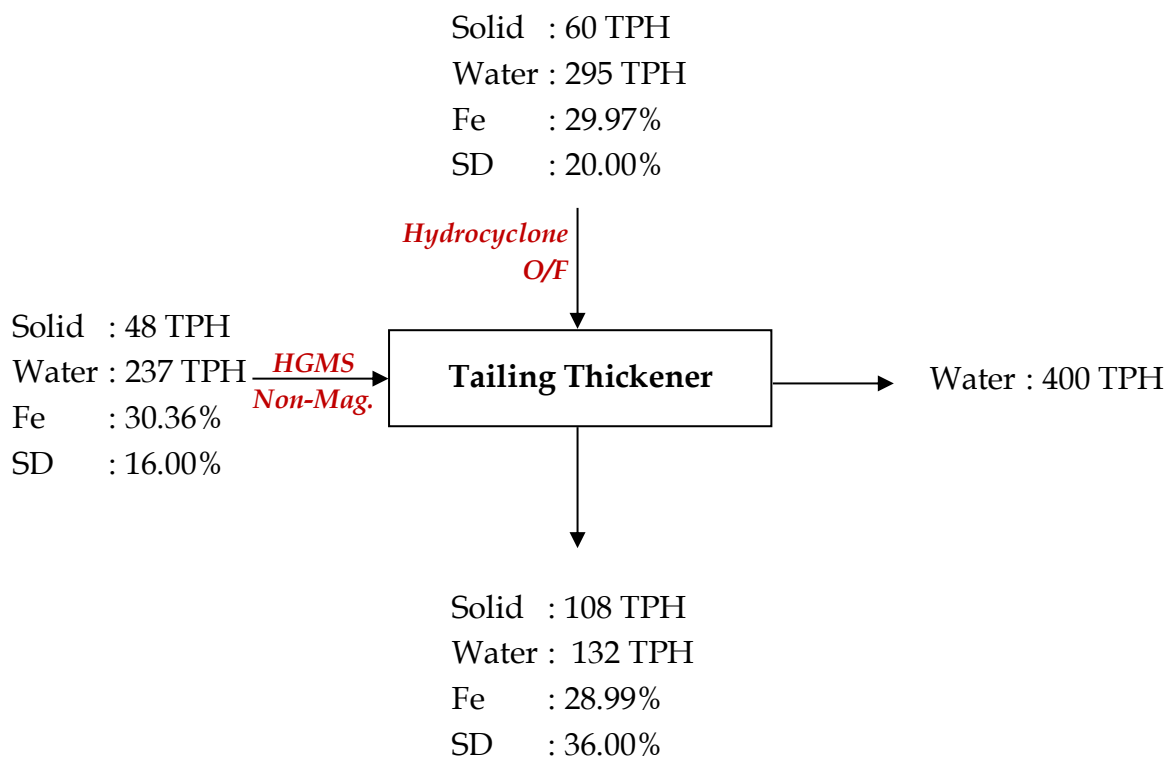
19. Concentrate Thickener



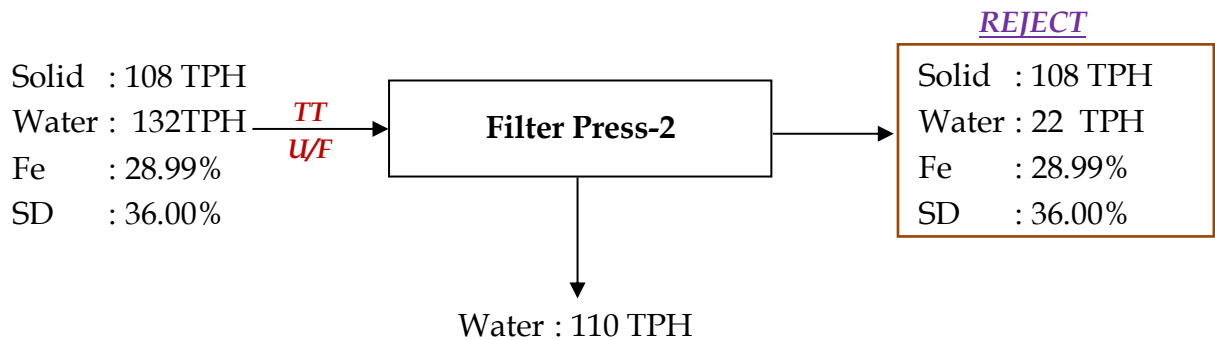
20. Filter Press-1



21. Tailing Thickener



22. Filter Press-2



Water Balance of the Process Per Hour Basis

(a) Addition of Water

<i>Sl. No.</i>	<i>Details</i>	<i>Amount of water, (m³)</i>
1	Moisture in the Feed	41
2	Drum scrubber	259
3	Double deck vibrating screen	100
4	Hydrocyclone 1	40
5	Pump Box 2	83
6	MIMS	150
7	HGMS	70
	Total	743

(b) Recovery of Water

<i>Sl. No.</i>	<i>Details</i>	<i>Amount of water, (m³)</i>
1	Dewatering screen 1	5
2	Dewatering screen II	19
3	Intermediate thickener	80
4	Concentrate thickener	53
5	Concentrate Filter Press	31
6	Tailings thickener	400
7	Tailings filter press	110
	Total	698

(c) Water carrying by the Products

<i>Sl. No.</i>	<i>Details</i>	<i>Amount of water, (m³)</i>
1	-30+10 mm	5
2	-10 mm fines	9
3	Concentrate filter cake	9
4	Tailings filter cake	22
	Total	45

(d) Make-up Water Requirement of the Process

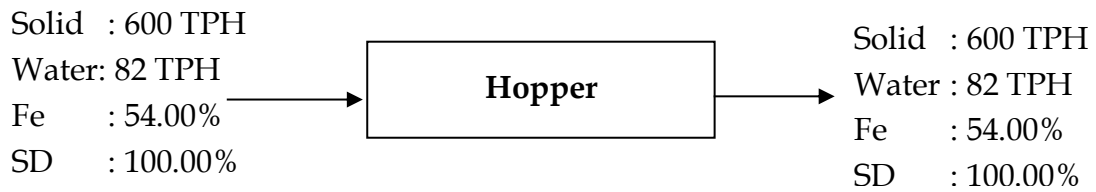
<i>Sl. No.</i>	<i>Details</i>	<i>Amount of water, (m³)</i>
1	Water carrying by the products	45
2	For evaporation and handling loss (@2% of water handling)	14
	Total	59

The makeup water requirement is 59 m³ per hour or 196 litre per tonnes of feed.

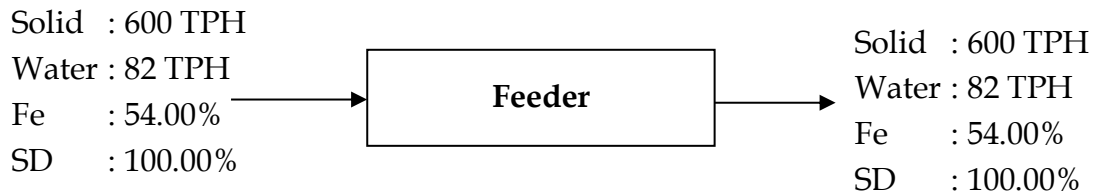
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Basis: CODLI 600 TPH of Dry Iron Ore having 12.0 % Moisture

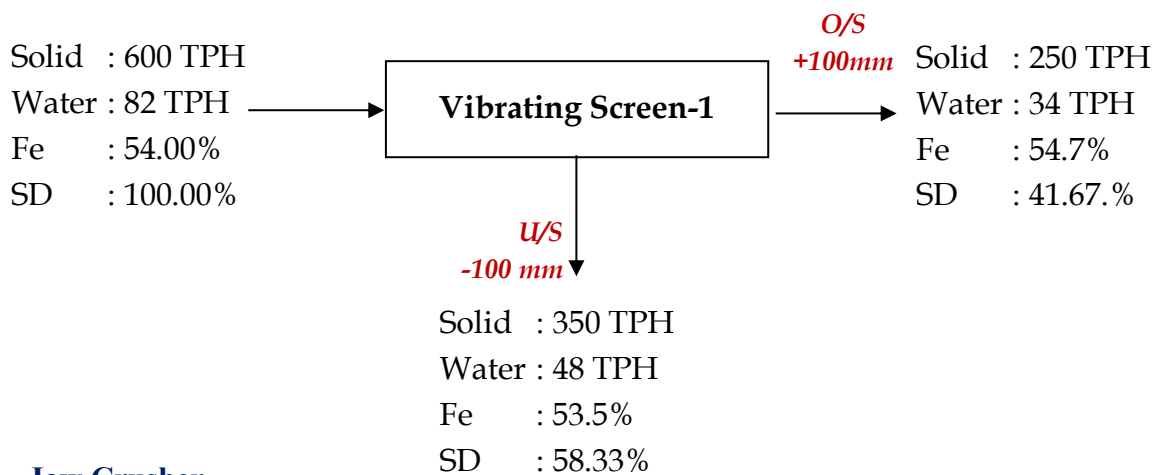
1. Hopper



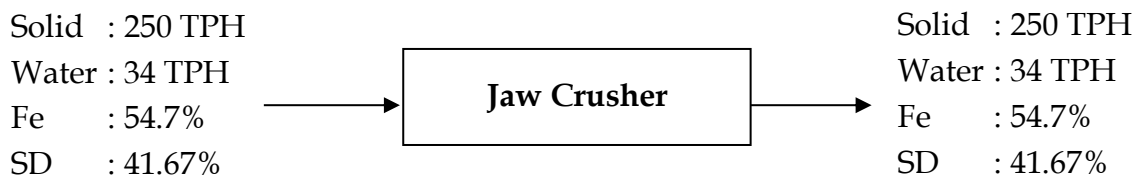
2. Feeder



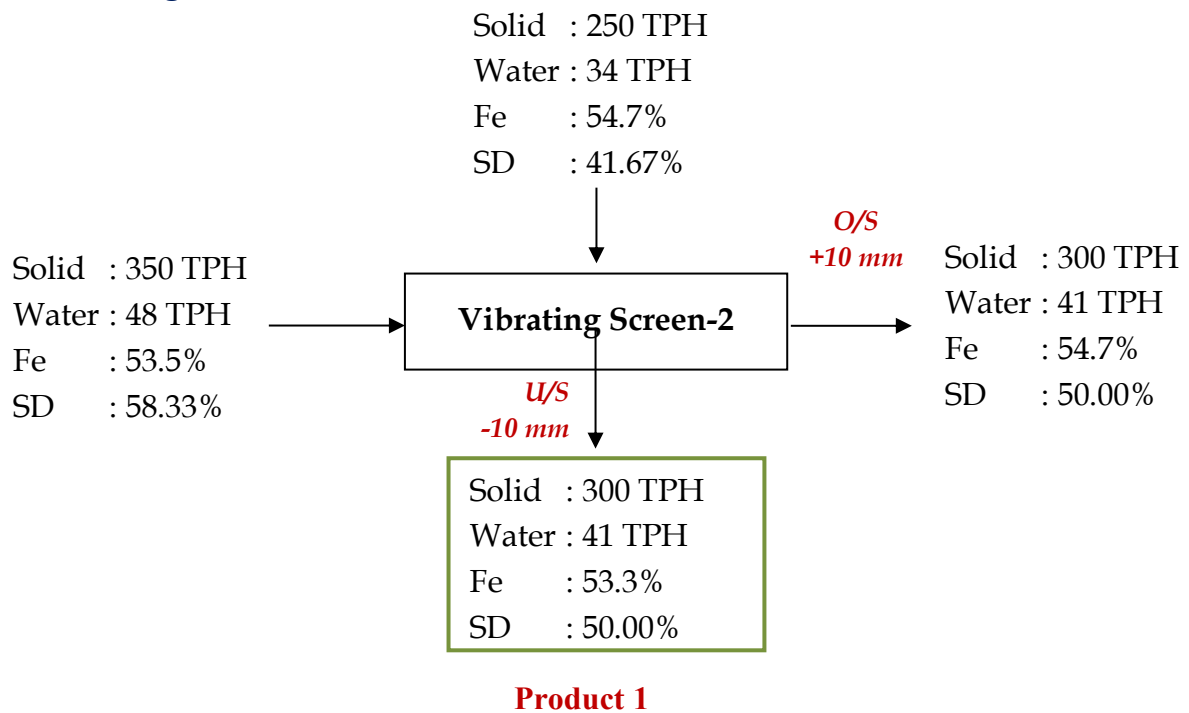
3. Grizzly Vibratory Screen 1



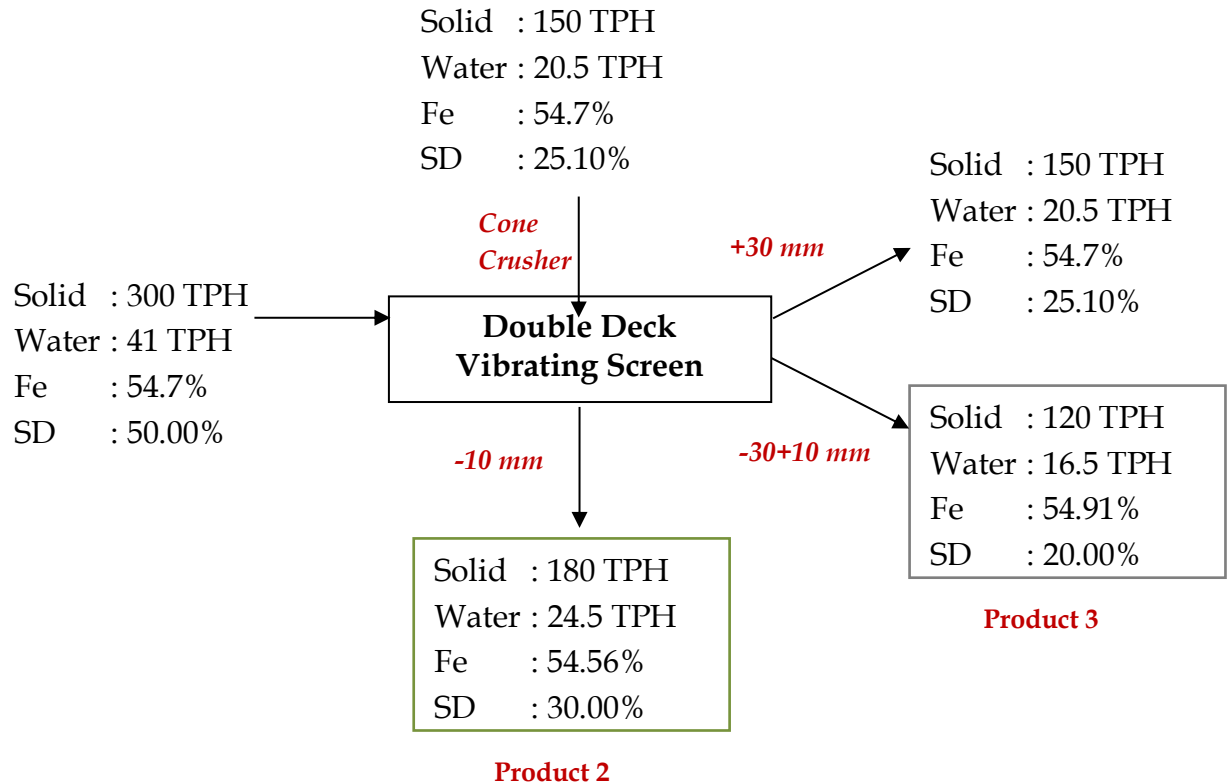
4. Jaw Crusher



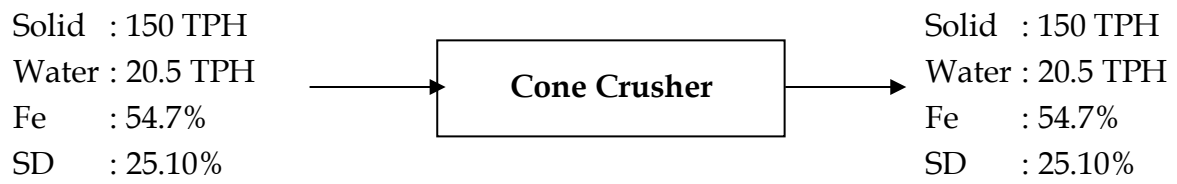
5. Vibrating Screen 2



6. Double Deck Vibrating Screen



7. Cone Crusher



Annexure - X - Detailed Ambient Air Quality Monitoring Tables

Location: Mine Site

Unit: (µg/m³)

Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
01.03.2025	9.1	18.1	8.1	16.7	9.2	18.3	45.7	25.9	0.28
02.03.2025	9.7	19.0	8.5	17.2	8.8	17.6	46.8	26.4	0.25
08.03.2025	9.7	19.0	8.5	17.3	9.2	18.3	48.0	27.0	0.28
09.03.2025	10.0	19.5	7.9	16.4	9.5	18.7	48.0	27.1	0.29
15.03.2025	9.6	18.9	8.9	17.8	8.4	17.2	46.9	26.5	0.26
16.03.2025	10.1	19.6	8.4	17.1	9.2	18.3	48.8	27.4	0.27
22.03.2025	10.2	19.7	8.7	17.6	9.0	18.0	49.1	27.6	0.29
23.03.2025	10.0	19.4	8.0	16.6	8.6	17.4	46.3	26.2	0.26
29.03.2025	10.0	19.4	8.6	17.5	8.3	17.0	46.9	26.5	0.28
30.03.2025	9.9	19.2	8.1	16.7	8.4	17.1	45.6	25.8	0.30
05.04.2025	10.0	19.5	9.1	18.1	8.6	17.4	48.6	27.4	0.25
06.04.2025	9.8	19.2	8.6	17.3	9.0	18.0	48.0	27.0	0.28
12.04.2025	9.5	18.6	8.4	17.1	8.3	16.9	45.1	25.6	0.29
13.04.2025	9.2	18.3	8.5	17.2	7.9	16.4	43.6	24.8	0.27
19.04.2025	9.9	19.3	9.0	17.9	8.1	16.7	46.9	26.5	0.26
20.04.2025	9.6	18.8	8.6	17.5	9.0	17.9	47.4	26.7	0.30
26.04.2025	8.9	17.9	8.9	17.8	8.6	17.4	45.6	25.8	0.26
27.04.2025	10.1	19.6	8.5	17.3	8.5	17.3	47.4	26.7	0.28
03.05.2025	9.3	18.4	8.3	17.0	8.0	16.5	43.8	24.9	0.30
04.05.2025	8.7	17.6	8.4	17.1	8.6	17.5	44.1	25.1	0.27
10.05.2025	9.2	18.3	8.2	16.8	8.3	17.0	44.1	25.1	0.27
11.05.2025	10.0	19.4	8.3	17.0	8.7	17.5	46.9	26.5	0.30
17.05.2025	9.9	19.3	8.5	17.3	9.6	18.9	49.6	27.8	0.25
18.05.2025	10.1	19.5	9.0	17.9	9.7	18.9	50.9	28.5	0.27
24.05.2025	7.4	15.7	7.6	15.9	7.9	16.4	37.6	21.8	0.30
25.05.2025	8.6	17.4	7.3	15.6	6.5	14.4	42.4	24.2	0.27

	NO ₂	SO ₂	PM10	PM2.5	CO
Minimum	14.4	6.5	37.6	21.8	0.25
Maximum	19.7	10.2	50.9	28.5	0.30
95 Percentile	19.48	10.05	49.44	27.77	0.30
98 Percentile	19.58	10.11	50.23	28.16	0.30

Location: Village Codli

Unit: ($\mu\text{g}/\text{m}^3$)

Location: Village Court							Unit: (µgm³)		
Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
02.03.2025	12.4	22.2	10.1	20.0	10.7	20.6	52.7	29.9	0.29
03.03.2025	12.8	22.5	8.7	18.7	10.6	20.4	51.7	29.0	0.27
09.03.2025	13.0	22.8	9.2	19.1	12.1	21.8	53.5	30.6	0.27
10.03.2025	12.5	22.3	10.0	19.9	10.9	20.8	52.8	30.0	0.30
16.03.2025	13.2	22.9	10.1	20.0	11.6	21.4	54.0	31.0	0.25
17.03.2025	12.4	22.1	9.4	19.4	10.0	19.9	51.5	28.9	0.27
23.03.2025	13.0	22.7	9.4	19.3	10.5	20.3	52.3	29.6	0.30
24.03.2025	12.5	22.2	10.0	19.9	10.4	20.3	52.4	29.6	0.25
30.03.2025	12.7	22.4	9.6	19.5	10.1	20.0	51.9	29.2	0.29
31.03.2025	12.6	22.3	9.9	19.8	11.0	20.8	52.8	30.0	0.29
06.04.2025	12.7	22.4	10.3	20.2	11.2	21.0	53.5	30.5	0.26
07.04.2025	13.1	22.8	10.9	20.8	10.4	20.2	53.6	30.7	0.27
13.04.2025	11.5	21.3	10.2	20.1	9.1	19.0	50.6	28.1	0.30
14.04.2025	13.4	23.1	10.7	20.5	10.5	20.4	53.8	30.8	0.27
20.04.2025	12.2	22.0	10.5	20.4	11.1	20.9	53.1	30.2	0.28
21.04.2025	12.7	22.5	10.5	20.3	10.6	20.4	53.1	30.2	0.29
27.04.2025	13.2	22.9	10.3	20.2	10.3	20.2	53.1	30.2	0.26
28.04.2025	12.4	22.2	10.1	20.0	9.7	19.6	51.8	29.1	0.26
04.05.2025	10.6	20.5	10.1	20.0	10.5	20.4	50.9	28.4	0.30
05.05.2025	12.7	22.4	10.2	20.1	9.6	19.5	52.0	29.3	0.26
11.05.2025	12.9	22.7	9.9	19.8	10.5	20.4	52.7	29.9	0.27
12.05.2025	12.5	22.3	10.5	20.4	12.5	22.2	54.5	31.4	0.29
18.05.2025	13.1	22.8	11.1	20.9	12.4	22.1	55.4	32.2	0.26
19.05.2025	12.7	22.4	11.9	21.7	11.8	21.6	48.9	26.6	0.27
25.05.2025	10.4	20.2	10.1	20.0	9.3	19.2	45.2	23.5	0.29
26.05.2025	8.1	18.1	6.6	16.7	5.1	15.3	41.5	20.3	0.26

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	15.3	5.1	41.5	20.3	0.25
Maximum	23.1	13.4	55.4	32.2	0.30
95 Percentile	22.81	13.09	54.38	31.33	0.30
98 Percentile	22.89	13.18	54.96	31.82	0.30

Location: Within 500 meters

Unit: ($\mu\text{g}/\text{m}^3$)

Location: within 500 meters							Unit: (µg/m ³)		
Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m ³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
05.03.2025	9.8	15.0	7.6	12.8	8.1	13.4	44.2	25.1	0.29
06.03.2025	10.1	15.4	6.2	11.5	8.0	13.3	43.2	24.5	0.27
12.03.2025	10.4	15.7	6.7	11.9	9.4	14.7	45.1	25.6	0.27
13.03.2025	9.9	15.2	7.4	12.7	8.3	13.6	44.4	25.2	0.30
19.03.2025	10.5	15.8	7.5	12.8	9.0	14.2	45.6	26.0	0.25
20.03.2025	9.7	15.0	6.9	12.2	7.5	12.7	42.9	24.3	0.27
26.03.2025	10.3	15.6	6.9	12.1	7.9	13.2	43.8	24.9	0.30
27.03.2025	9.8	15.1	7.5	12.7	7.8	13.1	43.9	24.9	0.25
02.04.2025	10.0	15.3	7.0	12.3	7.5	12.8	43.4	24.6	0.29
03.04.2025	9.9	15.2	7.3	12.6	8.4	13.7	44.4	25.2	0.29
09.04.2025	10.0	15.3	7.8	13.0	8.6	13.9	45.1	25.6	0.26
10.04.2025	10.4	15.7	8.3	13.6	7.8	13.0	45.2	25.7	0.27
16.04.2025	8.9	14.2	7.6	12.9	6.6	11.8	42.0	23.7	0.30
17.04.2025	10.7	16.0	8.1	13.4	8.0	13.2	45.4	25.8	0.27
23.04.2025	9.5	14.8	7.9	13.2	8.5	13.7	44.7	25.4	0.28
24.04.2025	10.0	15.3	7.9	13.1	8.0	13.2	44.6	25.4	0.29
30.04.2025	10.5	15.8	7.7	13.0	7.7	13.0	44.7	25.4	0.26
01.05.2025	9.7	15.0	7.5	12.8	7.1	12.4	43.2	24.5	0.26
07.05.2025	8.0	13.3	7.5	12.8	7.9	13.2	42.3	24.0	0.30
08.05.2025	10.0	15.3	7.7	12.9	7.1	12.3	43.5	24.7	0.26
14.05.2025	10.3	15.6	7.3	12.6	8.0	13.2	44.3	25.1	0.27
15.05.2025	9.9	15.2	7.9	13.2	9.8	15.1	46.2	26.3	0.29
24.05.2025	10.4	15.7	8.5	13.8	9.7	15.0	40.1	22.6	0.26
22.05.2025	10.0	15.3	9.2	14.5	4.2	9.4	38.1	21.4	0.27
28.05.2025	7.8	13.1	7.6	12.8	4.9	10.1	36.1	20.2	0.29
29.05.2025	9.1	14.3	7.4	12.7	5.6	10.8	34.1	19.0	0.26

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	9.4	4.2	34.1	19.0	0.25
Maximum	16.0	10.7	46.2	26.3	0.30
95 Percentile	15.70	10.41	45.57	25.92	0.30
98 Percentile	15.78	10.49	45.91	26.13	0.30

Location: Village Dabal

Unit: ($\mu\text{g}/\text{m}^3$)

Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
03.03.2025	12.3	21.0	10.5	18.1	10.9	18.8	61.3	34.7	0.29
04.03.2025	12.6	21.5	9.3	16.3	10.8	18.6	59.6	33.8	0.27
10.03.2025	12.8	21.7	9.7	16.9	12.0	20.5	62.8	35.4	0.27
11.03.2025	12.4	21.1	10.3	17.9	11.1	19.1	61.6	34.8	0.30
17.03.2025	12.9	21.9	10.4	18.0	11.6	19.9	63.6	35.9	0.25
18.03.2025	12.3	20.9	9.9	17.2	10.4	17.9	59.2	33.6	0.27
24.03.2025	12.8	21.7	9.9	17.2	10.7	18.5	60.7	34.4	0.30
25.03.2025	12.4	21.0	10.4	17.9	10.7	18.4	60.7	34.4	0.25
31.03.2025	12.5	21.3	10.0	17.4	10.4	18.0	59.9	34.0	0.29
01.04.2025	12.4	21.2	10.3	17.8	11.2	19.2	61.6	34.8	0.29
07.04.2025	12.5	21.3	10.6	18.3	11.3	19.4	62.7	35.4	0.26
08.04.2025	12.9	21.8	11.1	19.1	10.6	18.4	62.9	35.5	0.27
14.04.2025	11.6	19.8	10.5	18.1	9.6	16.7	57.6	32.7	0.30
15.04.2025	13.1	22.2	10.9	18.8	10.8	18.6	63.3	35.7	0.27
21.04.2025	12.1	20.7	10.8	18.5	11.2	19.3	62.0	35.1	0.28
22.04.2025	12.5	21.3	10.7	18.5	10.8	18.6	62.0	35.0	0.29
28.04.2025	12.9	21.9	10.6	18.3	10.6	18.3	62.0	35.1	0.26
29.04.2025	12.3	20.9	10.4	18.0	10.1	17.5	59.7	33.8	0.26
05.05.2025	10.9	18.7	10.4	18.0	10.7	18.5	58.2	33.0	0.30
06.05.2025	12.5	21.3	10.5	18.2	10.0	17.4	60.2	34.1	0.26
12.05.2025	12.7	21.6	10.2	17.7	10.8	18.6	61.4	34.7	0.27
13.05.2025	12.4	21.1	10.7	18.5	12.4	21.0	64.6	36.4	0.29
19.05.2025	12.9	21.8	11.2	19.3	12.3	20.9	54.5	31.1	0.26
20.05.2025	12.5	21.3	11.9	20.3	7.6	13.6	51.1	29.4	0.27
26.05.2025	10.6	18.4	10.4	18.0	8.2	14.5	47.8	27.6	0.29
27.05.2025	11.7	20.0	10.3	17.9	8.8	15.5	44.5	25.9	0.26

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	13.6	7.6	44.5	25.9	0.25
Maximum	22.2	13.1	64.6	36.4	0.30
95 Percentile	21.81	12.85	63.56	35.85	0.30
98 Percentile	21.92	12.92	64.12	36.15	0.30

Location: Village Sangod

Unit: ($\mu\text{g}/\text{m}^3$)

Location: Village Sangod							Unit: (µg/m³)		
Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
04.03.2025	9.2	14.7	7.2	12.5	7.7	13.1	43.3	27.7	0.29
05.03.2025	9.6	15.1	6.0	11.1	7.6	12.9	42.2	26.6	0.27
11.03.2025	9.8	15.3	6.4	11.5	8.9	14.4	44.2	28.7	0.27
12.03.2025	9.3	14.8	7.1	12.3	7.9	13.3	43.4	27.9	0.30
18.03.2025	9.9	15.5	7.2	12.4	8.5	13.9	44.7	29.2	0.25
19.03.2025	9.2	14.7	6.6	11.8	7.1	12.4	42.0	26.4	0.27
25.03.2025	9.7	15.3	6.6	11.8	7.5	12.8	42.9	27.4	0.30
26.03.2025	9.3	14.8	7.1	12.4	7.5	12.7	42.9	27.4	0.25
01.04.2025	9.5	15.0	6.7	11.9	7.2	12.4	42.4	26.9	0.29
02.04.2025	9.4	14.9	7.0	12.2	8.0	13.3	43.5	27.9	0.29
08.04.2025	9.5	15.0	7.4	12.7	8.1	13.5	44.1	28.6	0.26
09.04.2025	9.8	15.4	7.9	13.3	7.4	12.7	44.3	28.8	0.27
15.04.2025	8.4	13.8	7.3	12.5	6.3	11.4	41.0	25.4	0.30
16.04.2025	10.1	15.7	7.7	13.0	7.6	12.9	44.5	29.0	0.27
22.04.2025	9.0	14.5	7.5	12.8	8.0	13.4	43.7	28.2	0.28
23.04.2025	9.5	15.0	7.5	12.8	7.6	12.9	43.7	28.2	0.29
29.04.2025	9.9	15.5	7.4	12.6	7.4	12.6	43.7	28.2	0.26
30.04.2025	9.2	14.7	7.2	12.4	6.8	12.0	42.3	26.7	0.26
06.05.2025	7.6	13.0	7.2	12.4	7.5	12.8	41.4	25.8	0.30
07.05.2025	9.5	15.0	7.3	12.6	6.8	12.0	42.6	27.0	0.26
13.05.2025	9.7	15.2	7.0	12.2	7.6	12.9	43.3	27.8	0.27
14.05.2025	9.3	14.8	7.5	12.8	9.3	14.8	45.3	29.8	0.29
20.05.2025	9.8	15.4	8.1	13.4	9.2	14.7	39.1	23.4	0.26
21.05.2025	9.5	15.0	8.8	14.2	4.1	9.0	37.1	21.4	0.27
27.05.2025	7.4	12.7	7.2	12.5	4.8	9.7	35.0	19.3	0.29
28.05.2025	8.6	14.0	7.1	12.3	5.4	10.5	33.0	17.2	0.26

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	9.0	4.1	33.0	17.2	0.25
Maximum	15.7	10.1	45.3	29.8	0.30
95 Percentile	15.40	9.83	44.66	29.15	0.30
98 Percentile	15.48	9.90	45.01	29.50	0.30

Location: Village Darbandora

Unit: ($\mu\text{g}/\text{m}^3$)

Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
06.03.2025	12.1	18.3	10.4	15.6	10.8	16.3	56.1	31.6	0.29
07.03.2025	12.4	18.8	9.3	13.9	10.7	16.1	54.6	30.7	0.27
13.03.2025	12.6	19.1	9.6	14.5	11.9	17.9	57.4	32.4	0.27
14.03.2025	12.2	18.5	10.2	15.4	11.0	16.6	56.3	31.8	0.30
20.03.2025	12.7	19.2	10.3	15.5	11.5	17.3	58.2	32.9	0.25
21.03.2025	12.1	18.3	9.8	14.8	10.3	15.5	54.2	30.5	0.27
27.03.2025	12.6	19.0	9.8	14.8	10.6	16.0	55.6	31.3	0.30
28.03.2025	12.2	18.4	10.3	15.5	10.6	15.9	55.6	31.3	0.25
03.04.2025	12.4	18.7	9.9	14.9	10.3	15.5	54.9	30.9	0.29
04.04.2025	12.3	18.5	10.2	15.3	11.0	16.6	56.3	31.8	0.29
10.04.2025	12.3	18.7	10.5	15.9	11.2	16.9	57.3	32.4	0.26
11.04.2025	12.7	19.1	11.0	16.6	10.5	15.9	57.5	32.5	0.27
17.04.2025	11.4	17.2	10.4	15.7	9.5	14.4	52.8	29.6	0.30
18.04.2025	12.9	19.5	10.8	16.3	10.7	16.1	57.9	32.7	0.27
24.04.2025	12.0	18.1	10.6	16.0	11.1	16.7	56.7	32.0	0.28
25.04.2025	12.4	18.7	10.6	16.0	10.7	16.1	56.7	32.0	0.29
01.05.2025	12.7	19.2	10.5	15.8	10.5	15.8	56.7	32.0	0.26
02.05.2025	12.1	18.3	10.3	15.6	10.0	15.1	54.6	30.7	0.26
08.05.2025	10.7	16.2	10.3	15.5	10.6	16.0	53.3	29.9	0.30
09.05.2025	12.3	18.7	10.4	15.7	9.9	15.0	55.1	31.0	0.26
15.05.2025	12.5	19.0	10.1	15.3	10.7	16.1	56.2	31.7	0.27
16.05.2025	12.2	18.5	10.6	16.0	12.2	18.4	59.0	33.4	0.29
22.05.2025	12.7	19.1	11.1	16.7	12.1	18.3	50.1	27.9	0.26
23.05.2025	12.3	18.6	11.7	17.7	7.6	11.4	47.2	26.1	0.27
29.05.2025	10.5	15.9	10.3	15.6	8.2	12.3	44.2	24.3	0.29
30.05.2025	11.6	17.4	10.2	15.4	8.8	13.2	41.3	22.5	0.26

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	11.4	7.6	41.3	22.5	0.25
Maximum	19.5	12.9	59.0	33.4	0.30
95 Percentile	19.13	12.66	58.08	32.83	0.30
98 Percentile	19.23	12.73	58.58	33.14	0.30

Location: Village Konsen

Unit: ($\mu\text{g}/\text{m}^3$)

Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m ³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
03.03.2025	9.4	16.5	7.5	14.1	8.0	14.7	48.6	23.9	0.29
04.03.2025	9.7	17.0	6.3	12.5	7.8	14.5	47.4	23.0	0.27
10.03.2025	9.9	17.2	6.7	13.0	9.1	16.1	49.7	24.7	0.27
11.03.2025	9.5	16.7	7.3	13.9	8.1	14.9	48.8	24.0	0.30
17.03.2025	10.0	17.4	7.4	14.0	8.7	15.6	50.3	25.1	0.25
18.03.2025	9.3	16.5	6.9	13.3	7.4	13.9	47.1	22.8	0.27
24.03.2025	9.9	17.2	6.9	13.3	7.7	14.4	48.2	23.6	0.30
25.03.2025	9.4	16.6	7.4	13.9	7.7	14.3	48.2	23.6	0.25
31.03.2025	9.6	16.8	7.0	13.4	7.4	14.0	47.6	23.2	0.29
01.04.2025	9.5	16.7	7.3	13.8	8.2	15.0	48.8	24.1	0.29
07.04.2025	9.6	16.8	7.6	14.3	8.3	15.2	49.6	24.6	0.26
08.04.2025	9.9	17.3	8.1	14.9	7.7	14.3	49.8	24.8	0.27
14.04.2025	8.6	15.5	7.5	14.1	6.6	12.9	45.9	22.0	0.30
15.04.2025	10.2	17.6	7.9	14.7	7.8	14.5	50.1	24.9	0.27
21.04.2025	9.2	16.3	7.8	14.4	8.3	15.1	49.1	24.3	0.28
22.04.2025	9.6	16.9	7.7	14.4	7.8	14.5	49.1	24.3	0.29
28.04.2025	10.0	17.4	7.6	14.2	7.6	14.2	49.1	24.3	0.26
29.04.2025	9.4	16.5	7.4	14.0	7.1	13.5	47.4	23.1	0.26
05.05.2025	7.9	14.6	7.4	14.0	7.8	14.4	46.3	22.3	0.30
06.05.2025	9.6	16.8	7.5	14.1	7.0	13.5	47.8	23.3	0.26
12.05.2025	9.8	17.1	7.2	13.7	7.8	14.5	48.7	24.0	0.27
13.05.2025	9.5	16.6	7.8	14.4	9.4	16.6	51.0	25.6	0.29
19.05.2025	9.9	17.3	8.3	15.1	9.3	16.5	43.7	20.4	0.26
20.05.2025	9.6	16.8	8.9	15.9	4.5	10.2	41.3	18.7	0.27
26.05.2025	7.7	14.3	7.4	14.0	5.1	11.0	38.9	17.0	0.29
27.05.2025	8.8	15.7	7.3	13.9	5.7	11.8	36.5	15.3	0.26

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	10.2	4.5	36.5	15.3	0.25
Maximum	17.6	10.2	51.0	25.6	0.30
95 Percentile	17.27	9.94	50.25	25.07	0.30
98 Percentile	17.36	10.01	50.65	25.35	0.30

Location: Village Kalay

Unit: ($\mu\text{g}/\text{m}^3$)

Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
03.03.2025	13.4	23.4	12.0	20.3	12.3	21.1	62.5	37.4	0.64
04.03.2025	13.6	24.0	11.1	18.3	12.3	20.9	61.3	36.5	0.56
10.03.2025	13.8	24.3	11.4	18.9	13.2	22.9	63.5	38.1	0.58
11.03.2025	13.5	23.6	11.9	20.1	12.5	21.4	62.7	37.5	0.66
17.03.2025	13.9	24.5	12.0	20.2	12.9	22.3	64.1	38.5	0.51
18.03.2025	13.4	23.4	11.6	19.3	11.9	20.1	61.0	36.3	0.58
24.03.2025	13.7	24.2	11.5	19.3	12.2	20.7	62.1	37.1	0.67
25.03.2025	13.4	23.5	11.9	20.1	12.2	20.6	62.1	37.1	0.53
31.03.2025	13.6	23.8	11.6	19.5	12.0	20.2	61.6	36.7	0.63
01.04.2025	13.5	23.7	11.8	19.9	12.5	21.5	62.7	37.5	0.65
07.04.2025	13.6	23.8	12.1	20.5	12.6	21.7	63.5	38.1	0.56
08.04.2025	13.8	24.4	12.5	21.4	12.1	20.6	63.7	38.2	0.59
14.04.2025	12.8	22.2	12.0	20.3	11.3	18.8	59.9	35.6	0.67
15.04.2025	14.0	24.8	12.3	21.0	12.2	20.8	63.9	38.4	0.56
21.04.2025	13.3	23.1	12.2	20.8	12.6	21.6	63.0	37.8	0.61
22.04.2025	13.6	23.9	12.2	20.7	12.3	20.9	63.0	37.7	0.64
28.04.2025	13.9	24.5	12.1	20.5	12.1	20.5	63.0	37.8	0.54
29.04.2025	13.4	23.4	12.0	20.2	11.7	19.6	61.4	36.6	0.56
05.05.2025	12.3	20.9	11.9	20.2	12.2	20.8	60.3	35.8	0.66
06.05.2025	13.6	23.8	12.0	20.4	11.7	19.5	61.7	36.8	0.53
12.05.2025	13.7	24.2	11.8	19.9	12.2	20.8	62.6	37.4	0.57
13.05.2025	13.5	23.6	12.2	20.7	13.4	23.5	64.8	39.0	0.64
19.05.2025	13.8	24.4	12.6	21.6	13.4	23.4	65.9	39.8	0.56
20.05.2025	13.5	23.8	13.1	22.7	13.0	22.5	57.8	34.0	0.57
26.05.2025	12.1	20.6	12.0	20.2	11.5	19.1	53.2	30.8	0.65
27.05.2025	10.7	17.4	9.8	15.4	8.9	13.3	48.6	27.5	0.54

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	13.3	8.9	48.6	27.5	0.51
Maximum	24.8	14.0	65.9	39.8	0.67
95 Percentile	24.37	13.81	64.63	38.90	0.66
98 Percentile	24.49	13.86	65.35	39.41	0.67

Location: Village Shigao

Unit: ($\mu\text{g}/\text{m}^3$)

Location: Village Shigao							Unit: (µg/m³)		
Dates	Clock Hours						24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
05.03.2025	11.0	16.4	9.1	14.1	9.6	14.6	54.3	32.2	0.29
06.03.2025	11.4	16.8	7.9	12.6	9.4	14.5	52.6	31.2	0.27
12.03.2025	11.6	17.0	8.2	13.0	10.7	16.0	55.7	33.1	0.27
13.03.2025	11.1	16.5	8.9	13.9	9.8	14.9	54.5	32.4	0.30
19.03.2025	11.7	17.2	9.0	14.0	10.3	15.5	56.5	33.6	0.25
20.03.2025	11.0	16.4	8.5	13.3	9.0	13.9	52.2	30.9	0.27
26.03.2025	11.5	17.0	8.4	13.3	9.4	14.4	53.7	31.8	0.30
27.03.2025	11.1	16.4	9.0	13.9	9.3	14.3	53.7	31.9	0.25
02.04.2025	11.3	16.7	8.6	13.5	9.0	14.0	53.0	31.4	0.29
03.04.2025	11.2	16.5	8.9	13.8	9.8	14.9	54.5	32.4	0.29
09.04.2025	11.3	16.7	9.2	14.2	10.0	15.1	55.6	33.1	0.26
10.04.2025	11.6	17.1	9.8	14.9	9.3	14.3	55.8	33.2	0.27
16.04.2025	10.3	15.5	9.1	14.1	8.2	13.0	50.7	30.0	0.30
17.04.2025	11.9	17.4	9.5	14.6	9.4	14.5	56.2	33.4	0.27
23.04.2025	10.9	16.2	9.4	14.4	9.9	15.0	55.0	32.7	0.28
24.04.2025	11.3	16.7	9.4	14.4	9.4	14.5	54.9	32.6	0.29
30.04.2025	11.7	17.2	9.2	14.2	9.2	14.2	55.0	32.7	0.26
01.05.2025	11.0	16.4	9.0	14.0	8.7	13.6	52.7	31.2	0.26
07.05.2025	9.5	14.5	9.0	14.0	9.4	14.4	51.3	30.3	0.30
08.05.2025	11.3	16.7	9.1	14.1	8.6	13.5	53.2	31.5	0.26
14.05.2025	11.5	16.9	8.8	13.8	9.4	14.4	54.3	32.3	0.27
15.05.2025	11.1	16.5	9.4	14.4	11.1	16.5	57.4	34.2	0.29
24.05.2025	11.6	17.1	9.9	15.0	11.0	16.3	47.8	28.1	0.26
22.05.2025	11.3	16.6	10.6	15.8	6.0	10.4	44.6	26.1	0.27
28.05.2025	9.3	14.3	9.0	14.0	6.6	11.2	41.5	24.1	0.29
29.05.2025	10.4	15.6	8.9	13.9	7.3	11.9	38.3	22.1	0.26

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	10.4	6.0	38.3	22.1	0.25
Maximum	17.4	11.9	57.4	34.2	0.30
95 Percentile	17.08	11.63	56.41	33.57	0.30
98 Percentile	17.17	11.71	56.94	33.91	0.30

Location: Village Panchvadi

Unit: ($\mu\text{g}/\text{m}^3$)

Clock Hours							24 Hours PM10	24 Hours PM2.5	CO (mg/m³)
Dates	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
01.03.2025	11.0	18.2	9.5	16.5	11.2	18.5	55.6	32.7	0.28
02.03.2025	11.9	19.3	10.0	17.1	10.5	17.6	57.2	33.6	0.25
08.03.2025	11.9	19.3	10.2	17.2	11.1	18.4	58.9	34.5	0.28
09.03.2025	12.4	19.9	9.3	16.1	11.6	18.9	58.9	34.5	0.29
15.03.2025	11.8	19.2	10.6	17.8	10.0	17.1	57.3	33.6	0.26
16.03.2025	12.5	20.0	10.0	17.0	11.2	18.5	60.0	35.1	0.27
22.03.2025	12.6	20.2	10.4	17.6	10.8	18.0	60.5	35.3	0.29
23.03.2025	12.3	19.9	9.5	16.4	10.3	17.4	56.5	33.2	0.26
29.03.2025	12.3	19.8	10.3	17.4	9.9	16.8	57.4	33.7	0.28
30.03.2025	12.1	19.6	9.6	16.5	10.0	17.0	55.6	32.7	0.30
05.04.2025	12.4	19.9	11.0	18.2	10.2	17.3	59.8	35.0	0.25
06.04.2025	12.1	19.6	10.2	17.3	10.9	18.1	58.9	34.5	0.28
12.04.2025	11.5	18.9	10.0	17.0	9.8	16.8	54.8	32.3	0.29
13.04.2025	11.1	18.4	10.1	17.1	9.2	16.0	52.8	31.2	0.27
19.04.2025	12.2	19.7	10.8	18.0	9.5	16.4	57.4	33.7	0.26
20.04.2025	11.7	19.1	10.3	17.4	10.8	18.0	58.1	34.0	0.30
26.04.2025	10.8	18.0	10.7	17.8	10.2	17.3	55.5	32.7	0.26
27.04.2025	12.5	20.0	10.2	17.2	10.2	17.2	58.1	34.0	0.28
03.05.2025	11.3	18.6	9.8	16.8	9.4	16.3	53.0	31.3	0.30
04.05.2025	10.4	17.5	10.0	17.0	10.3	17.4	53.5	31.6	0.27
10.05.2025	11.2	18.5	9.6	16.5	9.9	16.9	53.3	31.5	0.27
11.05.2025	12.3	19.8	9.8	16.8	10.4	17.5	57.3	33.6	0.30
17.05.2025	12.2	19.7	10.2	17.2	11.8	19.2	61.1	35.7	0.25
18.05.2025	12.4	20.0	10.8	18.0	11.8	19.2	63.0	36.7	0.27
24.05.2025	8.6	15.3	8.8	15.5	9.2	16.1	44.2	26.6	0.30
25.05.2025	10.2	17.3	8.4	15.1	7.2	13.6	51.0	30.2	0.27

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	13.6	7.2	44.2	26.6	0.25
Maximum	20.2	12.6	63.0	36.7	0.30
95 Percentile	19.93	12.38	60.94	35.59	0.30
98 Percentile	20.05	12.47	62.05	36.19	0.30

Location: Village Sanvordem

Unit: ($\mu\text{g}/\text{m}^3$)

Clock Hours							24 Hours PM10	24 Hours PM2.5	CO (mg/m ³)
Dates	0-8		8-16		16-24				
	SO2	NO2	SO2	NO2	SO2	NO2			
06.03.2025	13.7	25.0	12.0	21.9	12.5	22.7	69.4	38.6	0.69
07.03.2025	14.0	25.6	10.9	19.9	12.3	22.4	67.6	37.8	0.60
13.03.2025	14.2	25.9	11.3	20.5	13.5	24.5	71.0	39.3	0.63
14.03.2025	13.8	25.2	11.9	21.6	12.6	23.0	69.7	38.7	0.71
20.03.2025	14.3	26.1	12.0	21.8	13.1	23.9	71.9	39.7	0.55
21.03.2025	13.7	25.0	11.5	20.9	11.9	21.7	67.1	37.6	0.62
27.03.2025	14.2	25.8	11.5	20.8	12.3	22.3	68.8	38.3	0.71
28.03.2025	13.8	25.1	11.9	21.7	12.2	22.2	68.8	38.3	0.57
03.04.2025	14.0	25.4	11.6	21.1	12.0	21.8	67.9	37.9	0.68
04.04.2025	13.9	25.2	11.8	21.5	12.7	23.1	69.7	38.7	0.70
10.04.2025	14.0	25.4	12.2	22.1	12.8	23.3	70.9	39.2	0.60
11.04.2025	14.3	26.0	12.6	22.9	12.2	22.2	71.2	39.3	0.63
17.04.2025	13.1	23.8	12.0	21.9	11.2	20.4	65.4	36.8	0.72
18.04.2025	14.5	26.4	12.4	22.6	12.3	22.4	71.5	39.5	0.60
24.04.2025	13.6	24.7	12.3	22.3	12.7	23.2	70.2	38.9	0.66
25.04.2025	14.0	25.4	12.3	22.3	12.3	22.4	70.1	38.9	0.69
01.05.2025	14.3	26.1	12.1	22.1	12.1	22.1	70.2	38.9	0.58
02.05.2025	13.7	25.0	12.0	21.8	11.7	21.2	67.7	37.8	0.60
08.05.2025	12.4	22.5	11.9	21.7	12.3	22.3	66.1	37.1	0.71
09.05.2025	14.0	25.4	12.1	21.9	11.6	21.1	68.2	38.0	0.58
15.05.2025	14.2	25.8	11.8	21.5	12.3	22.4	69.5	38.6	0.62
16.05.2025	13.8	25.2	12.3	22.3	13.8	25.1	72.9	40.1	0.69
22.05.2025	14.3	26.0	12.7	23.2	13.7	24.9	62.2	35.4	0.60
23.05.2025	13.9	25.4	13.3	24.3	9.3	16.9	58.6	33.9	0.61
29.05.2025	12.2	22.2	12.0	21.8	9.9	17.9	55.1	32.3	0.70
30.05.2025	13.2	24.0	11.9	21.6	10.4	19.0	51.6	30.8	0.58

	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	CO
Minimum	16.9	9.3	51.6	30.8	0.55
Maximum	26.4	14.5	72.9	40.1	0.72
95 Percentile	25.97	14.27	71.79	39.62	0.71
98 Percentile	26.09	14.33	72.39	39.88	0.72

Annexure - XI

BASELINE MONITORING AND SAMPLING PHOTOGRAPHS

AMBIENT AIR QUALITY MONITORING PHOTOGRAPHS	
 Latitude: 15.350379 Longitude: 75.830193 Elevation: 911.166 m Accuracy: 12.5 m Time: 19-03-2025 12:26 Note: Mine site	 Latitude: 15°20'26" Longitude: 74°17'11" Elevation: 513119.48 m Accuracy: 5.669 m Time: 10-05-2025 Note: Village Codli
 Latitude: 15°19'44" Longitude: 74°5'31" Elevation: 614415.89 m Accuracy: 5.075 m Time: 19-03-2025 Note: Within 500 meters	 Latitude: 15°19'44" Longitude: 74°5'31" Elevation: 614415.89 m Accuracy: 5.075 m Time: 19-03-2025 Note: Within 500 meters
 Latitude: 15°21'17" Longitude: 76°14'03" Elevation: 567947.03 m Accuracy: 6.081 m Time: 07-04-2025 Note: Village Sangod	 Latitude: 15°23'40" Longitude: 74°1' Elevation: 5217149.9 m Accuracy: 7.723 m Time: 07-04-2025 Note: Village Darbandora
 Latitude: 15°19'44" Longitude: 74°5'31" Elevation: 614415.89 m Accuracy: 5.075 m Time: 19-03-2025 Note: Within 500 meters	 Latitude: 15°19'21" Longitude: 74°1'21" Elevation: 562018.44 m Accuracy: 1.261 m Time: 19-03-2025 Note: Village Kale
 Latitude: 15°19'44" Longitude: 74°5'31" Elevation: 614415.89 m Accuracy: 5.075 m Time: 19-03-2025 Note: Within 500 meters	 Latitude: 15°17'11" Longitude: 74°4'45" Elevation: 260616.33 m Accuracy: 5.464 m Time: 06-03-2025 Note: Village Panchvadi
 Latitude: 15°16'7" Longitude: 74°2'28" Elevation: 123419.3 m Accuracy: 8.534 m Time: 16-05-2025 Note: Village Sanvardem	

NOISE LEVEL MONITORING PHOTOGRAPHS	
 Latitude: 11.346367 Longitude: 78.130776 Elevation: 45.051865 m Accuracy: 9.2 m Time: 18-01-2023 Note: Mine site	 Latitude: 10°20'26" Longitude: 76°7'13" Elevation: 55.9+13.3 m Accuracy: 9.665 m Time: 10-08-2023 Note: Village Codli
Mine site	Village Codli
 Latitude: 15°19'44" Longitude: 74°19'50" Elevation: 472±8.05 m Accuracy: 8.720 m Time: 16-05-2025 Note: Within 500 meters	 Latitude: 0°21'28" Longitude: 72°16'34" Elevation: 56.34±10.4 m Accuracy: 12.9 m Time: 12-05-2025 Note: Village Dabal
Within 500 meters	Village Dabal
 Latitude: 10°21'16" Longitude: 76°59' Elevation: 55.64±8.61 m Accuracy: 8.180 m Time: 23-05-2025 Note: Village Sangod	 Latitude: 10°23'48" Longitude: 76°11'09" Elevation: 56.34±10.4 m Accuracy: 12.9 m Time: 24-05-2025 Note: Village Darbandora
Village Sangod	Village Darbandora
 Latitude: 10°20'52" Longitude: 76°47' Elevation: 60.6±13.0 m Accuracy: 12.11 m Time: 24-05-2025 Note: Village Konsen	 Latitude: 10°18'15" Longitude: 74°12'12" Elevation: 56.95±7.94 m Accuracy: 5.486 m Time: 11-05-2025 Note: Village Kale
Village Konsen	Village Kale
 Latitude: 10°19'53" Longitude: 76°17'56" Elevation: 60.44±4.1 m Accuracy: 11.48 m Time: 25-05-2025 Note: Village Shigao	 Latitude: 10°17'12" Longitude: 76°17'56" Elevation: 7.04±2.0 m Accuracy: 4.0 m Time: 16-05-2025 Note: Village Panchvadi
Village Shigao	Village Panchvadi
 Latitude: 10°18'5" Longitude: 76°19'36" Elevation: -0.56±7 m Accuracy: 8.5 m Time: 20-05-2025 Note: Village Sanvardem	
Village Sanvardem	

SURFACE WATER SAMPLING PHOTOGRAPHS



Dudhsagar River



Kale Nala



Udnai Nala



Panduranga Nala



Ragada Nala



Sanguem or Zuvari River



Paroda River



Jamboli Nala

GROUND WATER SAMPLING PHOTOGRAPHS



Mine site



Village Codli



Village Kirlapal



Village Karmane



Village Dabal



Village Kajumal



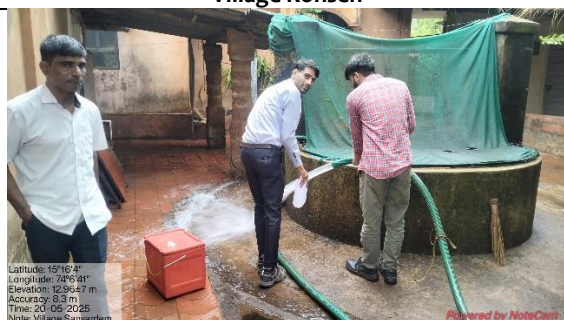
Village Darbandora



Village Konsen



Village Panchvadi



Village Sanvardem

SOIL QUALITY SAMPLING PHOTOGRAPHS

 Latitude: 15°20'28" Longitude: 74°7'49" Elevation: 7171.10 m Accuracy: 10.1 m Time: 20-05-2025 Note: Mine site	 Latitude: 15°20'23" Longitude: 74°7'22" Elevation: 4339.65 m Accuracy: 84.9 m Time: 22-05-2025 Note: Village codli
Mine site	Village Codli
 Latitude: 15°19'36" Longitude: 74°7'22" Elevation: 3124.5 m Accuracy: 7.5 m Time: 21-05-2025 Note: Village Kirlapal	 Latitude: 15°19'12" Longitude: 74°9'7" Elevation: 4508.169 m Accuracy: 5.22 m Time: 22-05-2025 Note: Village Karmare
Village Kirlapal	Village Karmare
 Latitude: 15°21'28" Longitude: 74°5'34" Elevation: 4749.645 m Accuracy: 0.053 m Time: 24-05-2025 Note: Village Dabal	 Latitude: 15°21'32" Longitude: 74°9'58" Elevation: 5776.6774 m Accuracy: 5.353 m Time: 22-05-2025 Note: Village Kajumal
Village Dabal	Village Kajumal
 Latitude: 15°23'46" Longitude: 74°7'7" Elevation: 5042.13 m Accuracy: 5.0 m Time: 21-05-2025 Note: Village Darbandora	 Latitude: 15°21'5" Longitude: 74°4'16" Elevation: 5033.482 m Accuracy: 8.93 m Time: 22-05-2025 Note: Village Konsen
Village Darbandora	Village Konsen
 Latitude: 15°17'10" Longitude: 74°4'45" Elevation: 2447.13 m Accuracy: 5.4 m Time: 20-05-2025 Note: Village Panchvadi	 Latitude: 15°16'15" Longitude: 74°5'45" Elevation: 1663.8 m Accuracy: 5.5 m Time: 20-05-2025 Note: Village Sanvardem
Village Panchvadi	Village Sanvardem



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J.M. ENVIROLAB PVT. LTD.

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: J. M. EnviroNet Pvt. Ltd.
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No.: JME/A/250311042-052
Date of Reporting: 07/06/2025

Project: M/s. JSW Steel Limited
Proposed Codli Mineral Block-XII (ML Area: 377.0881 ha) with Installation of Beneficiation Plant in the ML area of located at Village: Codli, Tehsil: Dharbandora, South Goa District, (Goa).

P.O. No. JMEPL/LAB/Baseline/2025-02/08
Monitoring Period: March to May, 2025

Sample Description: AMBIENT AIR QUALITY MONITORING
Sampled by: JMELPL TEAM
Contact Person: Mr. Vikash Perru

Equipment Used: RDS, FPS & BS
Protocol Used: CPCB Guidelines/IS-5182

AIR QUALITY MONITORING RESULTS

S. No.	Sampling Locations	Parameters									
		PM _{2.5} (µg/m ³)		PM ₁₀ (µg/m ³)		Nitrogen Dioxide (µg/m ³)		Sulphur Dioxide (µg/m ³)		Carbon Monoxide (mg/m ³)	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1.	Mine Site	28.5	21.8	50.9	37.6	19.7	14.4	10.2	6.5	BDL	BDL
2.	Village Codli	32.2	20.3	55.4	41.5	23.1	15.3	13.4	5.1	BDL	BDL
3.	Within 500 meters	26.3	19.0	46.2	34.1	16.0	9.4	10.7	4.2	BDL	BDL
4.	Village Dabal	36.4	25.9	64.6	44.5	22.2	13.6	13.1	7.6	BDL	BDL
5.	Village Sangod	29.8	17.2	45.3	33.0	15.7	9.0	10.1	4.1	BDL	BDL
6.	Village Darbandora	33.4	22.5	59.0	41.3	19.5	11.4	12.9	7.6	BDL	BDL
7.	Village Konsen	25.6	15.3	51.0	36.5	17.6	10.2	10.2	4.5	BDL	BDL
8.	Village Kalay	39.8	27.5	65.9	48.6	24.8	13.3	14.0	8.9	0.67	0.51
9.	Village Shigao	34.2	22.1	57.4	38.3	17.4	10.4	11.9	6.0	BDL	BDL
10.	Village Panchvadi	36.7	26.6	63.0	44.2	20.2	13.6	12.6	7.2	BDL	BDL
11.	Village Sanvardem	40.1	30.8	72.9	51.6	26.4	16.9	14.5	9.3	0.72	0.55
Detection Limit		4.0		0.5							
NAAQS*		60 (24 Hourly)		100 (24 Hourly)		80 (24 Hourly)		80 (24 Hourly)		4 (1 Hourly)	

S. No.	Sampling Location	Parameters								
		Benzo (a) pyrene (ng/m ³)	Ozone (µg/m ³)		Lead (µg/m ³)	Ammonia (µg/m ³)		Benzene (µg/m ³)	Arsenic (ng/m ³)	Nickel (ng/m ³)
		Max.	Max.	Min.	Max.	Max.	Min.	Max.	Max.	Max.
1.	Mine Site	BDL	19.6	9.1	BDL	14.2	7.8	BDL	BDL	BDL
2.	Village Codli	BDL	20.2	10.2	BDL	19.1	10.1	BDL	BDL	BDL
3.	Within 500 meters	BDL	15.0	7.4	BDL	21.0	10.4	BDL	BDL	BDL
4.	Village Dabal	BDL	22.0	13.7	BDL	24.3	11.5	BDL	BDL	BDL
5.	Village Sangod	BDL	18.4	11.5	BDL	18.6	7.3	BDL	BDL	BDL
6.	Village Darbandora	BDL	15.1	7.0	BDL	22.2	8.5	BDL	BDL	BDL
7.	Village Konsen	BDL	11.4	5.6	BDL	24.3	15.0	BDL	BDL	BDL
8.	Village Kale	BDL	25.7	13.5	BDL	29.0	16.4	BDL	BDL	BDL
9.	Village Shigao	BDL	17.2	10.1	BDL	21.2	10.1	BDL	BDL	BDL
10.	Village Panchvadi	BDL	20.0	8.4	BDL	26.7	13.3	BDL	BDL	BDL
11.	Village Sanvardem	BDL	26.0	15.9	BDL	19.0	7.0	BDL	BDL	BDL
Detection Limit		0.5	1.0		0.02	1.0		1.0	0.5	1.0
NAAQS*		1 (Annual)	180 (1 Hourly)		1 (24 Hourly)	400 (24 Hourly)		5 (Annual)	6 (Annual)	20 (Annual)

*NAAQS – National Ambient Air Quality Standards; Schedule-VII, [Rule 3 (3B)], [Part-II-sec.-3(i)] 18.11.2009

End of Report

Page 1 of 1

Ritika Saini
Ritika Saini
Tested by

Deepak Singh Yadav
Deepak Singh Yadav
Checked by

Sita Ram Yadav
Sita Ram Yadav
Authorized Signatory

Note:

- This test report has been at your request and test results pertain to the tested sample received.
- This reports is for your reference only and not to be used for any legal purpose.
- Any discrepancy in the test report or any remarks regarding the test results shall be brought to our knowledge within 7 days of the issue of this report.
- Total liability or any claim in case of dispute is limited to the invoice raised by the laboratory.
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Reg. Office & Lab.

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E-mail: jmenvirolab@hotmail.com | www.jmenvironet.org

Corporate Office

Emaar Digital Greens, Tower-B, Unit No.1517,
Golf Course Ext. Road, Sector-61,
Gurugram-122011(Haryana)



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J.M. ENVIROLAB PVT. LTD.

CIN No. :U74220HR2011PTC085756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector- 61, Gurugram- 122001 (Haryana)

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **AMBIENT NOISE LEVEL MONITORING**

Contact Person: **Mr. Vikash Perru**

Report No.: **JME/AN/250524038-048**

Reporting Date: **27/05/2025**

Receipt Date: **24/05/2025**

Sample Collected by: **JMELPL TEAM**

Protocol Used: **CPCB Guidelines /IS-9989**

AMBIENT NOISE LEVEL MONITORING RESULTS

S. No.	Locations	Date of Monitoring	Day Time (06:00 AM to 10:00 PM)	Night Time (10:00 PM to 06:00 AM)
			Leq in dB(A)	Leq in dB(A)
1.	Mine Site	19/05/2025	47.2	38.1
2.	Village Codli	10/05/2025	50.4	39.6
3.	Within 500 meters	14/05/2025	46.2	38.7
4.	Village Dabal	12/05/2025	51.9	40.6
5.	Village Sangod	23/05/2025	48.3	38.8
6.	Village Darbandora	16/05/2025	51.8	40.7
7.	Village Konsen	21/05/2025	49.6	38.1
8.	Village Kale	08/05/2025	53.8	42.9
9.	Village Shigao	06/05/2025	51.0	40.5
10.	Village Panchvadi	04/05/2025	51.6	41.2
11.	Village Sanvardem	02/05/2025	56.8	44.4

CPCB NOISE STANDARDS

Category of Zones	Leq in dB(A)	
	Day	Night
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence Zone	50	40

- Day Time is from 6.00 AM to 10.00 PM.
- Night Time is reckoned between 10.00 PM to 6.00 AM
- Silence Zone is defined as an area up to 100m around premises of Hospitals, Educational Institutions and Courts. Use of vehicle horn, loudspeaker and bursting of crackers is banned in these zones.

Note: Mixed categories of areas be declared as one of the four above mentioned categories by the competent Authority and the corresponding standards shall apply

****End of Report****

Page 1 of 1

Rishi Saini
Rishi Saini
Tested by

Deepak Singh Yadav
Deepak Singh Yadav
Checked by

Sham Ram Yadav
Sham Ram Yadav
Authorized Signatory

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Reg. Office & Lab.

424, Ground Floor, Udyog Vihar,
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 E-mail: jmenvirolab@hotmail.com | www.jmenvironet.org

Corporate Office

Emaar Digital Greens, Tower-B, Unit No.1517,
 Golf Course Ext. Road, Sector-61,
 Gurugram-122011(Haryana)



30 years of success

J.M. ENVIROLAB PVT. LTD.

CIN No. :U74220HR2011PTC085756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area:
377.0881 ha) with Installation of Beneficiation Plant in
the ML area of located at Village: Codli, Tehsil:
Dharbandora, South Goa District, (Goa).

Sample Description: **SOIL**
Sample Collected by: **JMELPL TEAM**
Contact Person: **Mr. Vikash Perru**

Report No. : **JME/S/250522001-003**
Reporting Date: **29/05/2025**
Analysis Completion Date: **29/05/2025**

Analysis Start Date: **22/05/2025**
Receipt Date: **22/05/2025**
Sampling Date: **20/05/2025**
Sampling Type: **Composite**

Protocol Used: **IS-2720/USDA**

SOIL ANALYSIS REPORT

S. No.	Parameters	Unit	Sampling Locations		
			Mine Site	Village- Panchavadi	Village- Sanvardem
1.	pH (at 25°C) (1:2.5 soil water sus.)	-	5.63	7.17	7.21
2.	Conductivity (1:2 soil water sus)	mS/cm	0.06	0.07	0.09
3.	Soil Texture	-	Clay	Clay	Loamy Sand
a)	Sand	%	15.0	16.0	73.0
b)	Silt	%	21.0	18.0	17.0
c)	Clay	%	64.0	66.0	10.0
4.	Colour	-	Brown	Brown	Reddish Brown
5.	Bulk Density	gm/cc	1.22	1.18	1.63
6.	Porosity	%	51.97	52.80	36.33
7.	Water Holding Capacity	%	49.94	50.22	25.63
8.	Chloride	mg/kg	513.42	410.21	539.10
9.	Potassium	kg/hect	132.74	122.44	94.43
10.	Sodium	mg/kg	49.38	44.72	29.75
11.	Calcium	mg/kg	370.52	414.25	224.02
12.	Magnesium as Mg	mg/kg	199.85	125.68	150.17
13.	Organic Matter	%	0.69	1.08	0.72
14.	Organic Carbon	%	0.40	0.63	0.42
15.	Available Nitrogen as N	kg/hect	231.22	218.91	187.08
16.	Available Phosphorus	kg/hect	9.03	33.48	14.85
17.	Zinc as Zn	mg/kg	44.12	58.68	35.33
18.	Manganese as Mn	mg/kg	1697.68	1702.74	2486.98
19.	Lead as Pb	mg/kg	27.82	16.35	44.63
20.	Cadmium as Cd	mg/kg	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)
21.	Chromium as Cr	mg/kg	13.59	27.52	26.03
22.	Copper as Cu	mg/kg	39.32	74.07	33.47

BDL- Below Detection Limit, DL- Detection Limit

Page 1 of 1

End of Report

Kavita
Kavita Mandal
Tested by

Abhishek
Abhishek Tiwari
Checked by

Raj Kumar
Raj Kumar Yadav
Authorized Signatory

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Corporate Office

Emaar Digital Greens, Tower-B, Unit No.1517,
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J.M. ENVIROLAB PVT. LTD.

CIN No.: U74220HR2011PTC085756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No. : **JME/S/250523004-005**
 Reporting Date: **30/05/2025**
 Analysis Completion Date: **30/05/2025**

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Analysis Start Date: **23/05/2025**
 Receipt Date: **23/05/2025**
 Sampling Date: **21/05/2025**
 Sampling Type: **Composite**

Sample Description: **SOIL**

Sample Collected by: **JMELPL TEAM**

Contact Person: **Mr. Vikash Perru**

Protocol Used: **IS-2720/USDA**

SOIL ANALYSIS REPORT

S. No.	Parameters	Unit	Sampling Location	
			Village- Darbandora	Village- Kirlapal
1.	pH (at 25°C) (1:2.5 soil water sus.)	-	5.54	5.52
2.	Conductivity (1:2 soil water sus)	mS/cm	0.08	0.05
3.	Soil Texture	-	Silt Loam	Clay
a)	Sand	%	20.0	12.0
b)	Silt	%	74.0	30.0
c)	Clay	%	6.0	58.0
4.	Colour	-	Reddish Brown	Brown
5.	Bulk Density	gm/cc	1.43	1.26
6.	Porosity	%	43.25	49.60
7.	Water Holding Capacity	%	40.33	44.47
8.	Chloride	mg/kg	787.92	403.50
9.	Potassium	kg/hect	133.51	110.81
10.	Sodium	mg/kg	39.73	44.52
11.	Calcium	mg/kg	286.84	329.92
12.	Magnesium as Mg	mg/kg	150.75	193.09
13.	Organic Matter	%	1.17	1.04
14.	Organic Carbon	%	0.68	0.60
15.	Available Nitrogen as N	kg/hect	255.54	219.91
16.	Available Phosphorus	kg/hect	17.23	14.11
17.	Zinc as Zn	mg/kg	44.77	29.03
18.	Manganese as Mn	mg/kg	1638.41	785.10
19.	Lead as Pb	mg/kg	8.57	22.77
20.	Cadmium as Cd	mg/kg	BDL (DL 5.0)	BDL (DL 5.0)
21.	Chromium as Cr	mg/kg	25.72	21.29
22.	Copper as Cu	mg/kg	40.01	31.93

BDL- Below Detection Limit, DL- Detection Limit

Page 1 of 1

End of Report

Kavita
Kavita Mandal
 Tested by

Abhishek
Abhishek Tiwari
 Checked by

ENVIROLAB PVT. LTD.
 Authorised Signatory
Rajkumar
Authorized Signatory

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Corporate Office

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J.M. ENVIROLAB PVT. LTD.

CIN No. :U74220HR2011PTC085758

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No. : **JME/S/250524010-013**
 Reporting Date: **31/05/2025**
 Analysis Completion Date: **31/05/2025**

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Analysis Start Date: **24/05/2025**
 Receipt Date: **24/05/2025**
 Sampling Date: **22/05/2025**
 Sampling Type: **Composite**

Sample Description: **SOIL**

Sample Collected by: **JMELPL TEAM**

Contact Person: **Mr. Vikash Perru**

Protocol Used: **IS-2720/USDA**

SOIL ANALYSIS REPORT

S. No.	Parameters	Unit	Sampling Location			
			Village- Codli	Village- Karmane	Village- Kajumal	Village- Konsen
1.	pH (at 25°C) (1:2.5 soil water sus.)	-	5.99	5.66	6.07	5.56
2.	Conductivity (1:2 soil water sus)	mS/cm	0.09	0.10	0.04	0.04
3.	Soil Texture	-	Sandy Loam	Clay	Sandy Loam	Silt loam
a)	Sand	%	62.0	14.0	60.0	21.0
b)	Silt	%	32.0	22.0	33.0	74.0
c)	Clay	%	6.0	64.0	7.0	5.0
4.	Colour	-	Brown	Brown	Brown	Dull Yelloish Brown
5.	Bulk Density	gm/cc	1.57	1.19	1.57	1.45
6.	Porosity	%	37.70	52.59	37.45	42.46
7.	Water Holding Capacity	%	31.56	51.60	30.49	37.96
8.	Chloride	mg/kg	401.72	325.02	298.01	563.02
9.	Potassium	kg/hect	122.09	188.09	77.73	114.54
10.	Sodium	mg/kg	39.64	54.33	34.70	34.79
11.	Calcium	mg/kg	289.14	288.24	247.97	365.76
12.	Magnesium as Mg	mg/kg	130.25	164.93	175.23	175.43
13.	Organic Matter	%	0.59	0.99	0.88	1.23
14.	Organic Carbon	%	0.34	0.57	0.51	0.71
15.	Available Nitrogen as N	kg/hect	208.57	246.81	210.55	261.35
16.	Available Phosphorus	kg/hect	10.43	12.97	9.22	13.04
17.	Zinc as Zn	mg/kg	34.83	49.95	43.47	26.69
18.	Manganese as Mn	mg/kg	1151.32	1364.30	2617.65	196.38
19.	Lead as Pb	mg/kg	11.77	29.78	38.74	13.35
20.	Cadmium as Cd	mg/kg	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)	BDL (DL 5.0)
21.	Chromium as Cr	mg/kg	9.04	24.01	8.51	8.58
22.	Copper as Cu	mg/kg	28.06	35.54	32.13	40.04

BDL- Below Detection Limit, DL- Detection Limit

Page 1 of 1

End of Report

Kavita
Kavita Mandal
 Tested by

Abhishek
Abhishek Tiwari
 Checked by

Rajkumar
Rajkumar Yadav
 Authorized Signatory

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TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No. : **JME/S/250524010**
Reporting Date: **31/05/2025**
Analysis Completion Date: **31/05/2025**

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Analysis Start Date: **26/05/2025**
Receipt Date: **26/05/2025**
Sampling Date: **24/05/2025**
Sampling Type: **Composite**

Sample Description: **SOIL**

Sample Collected by: **JMELPL TEAM**

Contact Person: **Mr. Vikash Perru**

Protocol Used: **IS-2720/USDA**

SOIL ANALYSIS REPORT

S. No.	Parameters	Unit	Village Dabal
1.	pH (at 25°C) (1:2.5 soil water sus.)	-	6.94
2.	Conductivity (1:2 soil water sus)	mS/cm	0.16
3.	Soil Texture	-	Clay
a)	Sand	%	13
b)	Silt	%	21
c)	Clay	%	66
4.	Colour	-	Brown
5.	Bulk Density	gm/cc	1.36
6.	Porosity	%	45.60
7.	Water Holding Capacity	%	40.38
8.	Chloride	mg/kg	623.49
9.	Potassium	kg/hect	357.22
10.	Sodium	mg/kg	54.82
11.	Calcium	mg/kg	1038.65
12.	Magnesium as Mg	mg/kg	226.89
13.	Organic Matter	%	1.21
14.	Organic Carbon	%	0.78
15.	Available Nitrogen as N	kg/hect	316.15
16.	Available Phosphorus	kg/hect	26.80
17.	Zinc as Zn	mg/kg	36.82
18.	Manganese as Mn	mg/kg	2117.25
19.	Lead as Pb	mg/kg	13.57
20.	Cadmium as Cd	mg/kg	BDL (DL 5.0)
21.	Chromium as Cr	mg/kg	8.72
22.	Copper as Cu	mg/kg	15.50

BDL- Below Detection Limit, DL- Detection Limit

Page 1 of 1

End of Report

Kavita
Kavita Mandal
Tested by

Abhishek
Abhishek Tiwari
Checked by

ENVIROLAB PVT. LTD.
Authorized Signatory
Rajkumar Yadav
Authorized Signatory

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Corporate Office

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J.M. ENVIROLAB PVT. LTD.

CIN No. :U74220HR2011PTC065756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No. : **JME/GW/250522001-002**
 Reporting Date: **29/05/2025**
 Analysis Completion Date: **29/05/2025**
 Analysis Start Date: **22/05/2025**
 Receipt Date: **22/05/2025**
 Sampling Date : **20/05/2025**
 Sampling Type: **Grab**

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **GROUND WATER**

Sample Collected by: **JMELPL TEAM**
 Contact Person: **Mr. Vikash Perru**

Sampling Protocol Used: **As per JMELPL/STOP/04**
Issued No. 2 Dated 15.06.2025

WATER ANALYSIS REPORT

S. No.	Parameters	Unit	Sampling Locations		Specification as per IS 10500- 2012	
			Mine Site	Village Sanvarede	Requirement Acceptable Limit	Permissible Limit in the Absence of Alternate Source
1.	pH (at 25°C)	-	7.26	6.61	6.5-8.5	No Relaxation
2.	Colour	Hazen Unit	BDL (DL 1.0)	BDL (DL 1.0)	5	15
3.	Turbidity	NTU	BDL (DL 1.0)	BDL (DL 1.0)	1	5
4.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
5.	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable
6.	Total Hardness as CaCO ₃	mg/l	52.0	70.4	200	600
7.	Calcium as Ca	mg/l	11.2	14.9	75	200
8.	Alkalinity as CaCO ₃	mg/l	45.6	52.2	200	600
9.	Chloride as Cl	mg/l	12.23	24.3	250	1000
10.	Cyanide as CN	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	0.05	No Relaxation
11.	Magnesium as Mg	mg/l	5.8	8.1	30	100
12.	Total Dissolved Solids	mg/l	96.00	134.0	500	2000
13.	Sulphate as SO ₄	mg/l	5.41	12.06	200	400
14.	Fluoride as F	mg/l	0.36	0.29	1.0	1.5
15.	Nitrate as NO ₃ -N	mg/l	1.87	1.34	45	No Relaxation
16.	Iron as Fe	mg/l	0.26	0.23	1.0	No Relaxation
17.	Aluminium as Al	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	0.03	0.2
18.	Boron	mg/l	BDL (DL 0.20)	BDL (DL 0.20)	0.50	2.4
19.	Phenolic Compounds	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	0.001	0.002
20.	Anionic Detergents as MBAS	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	0.2	1
21.	Hexa Chromium as Cr ⁺⁶	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	--	--
22.	Chromium as Cr	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	0.05	No Relaxation
23.	Zinc as Zn	mg/l	BDL(DL 0.0005)	BDL(DL 0.0005)	5	15
24.	Copper as Cu	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	0.05	1.5
25.	Manganese as Mn	mg/l	BDL(DL 0.01)	BDL(DL 0.01)	0.1	0.3
26.	Cadmium as Cd	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	0.003	No Relaxation
27.	Lead as Pb	mg/l	BDL (DL 0.008)	BDL (DL 0.008)	0.01	No Relaxation
28.	Arsenic as As	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	0.01	No Relaxation
29.	Mercury as Hg	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	0.001	No Relaxation
30.	Sodium as Na	mg/l	8.0	11.0	--	--
31.	Potassium as K	mg/l	1.0	6.0	--	--
32.	Phosphate as PO ₄	mg/l	BDL(DL 0.02)	BDL(DL 0.02)	--	--
33.	Nickel	mg/l	BDL(DL 0.005)	BDL(DL 0.005)	0.02	No Relaxation
34.	Conductivity	µS/cm	140.0	218.0	--	--
35.	Total Suspended Solid	mg/l	BDL(DL 1.0)	BDL (DL 1.0)	--	--

BDL – Below Detection Limit, DL- Detection Limit

End of Report

Page 1 of 1

Srishti
Srishti Mehta
 Tested by

Abhishek
Abhishek Tiwari
 Checked by

Rajkumar
Rajkumar Yadav
 Authorized Signatory

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 Gurugram-122011(Haryana)



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CIN No. :U74220HR2011PTC085756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No. : **JME/GW/250523003**
 Reporting Date: **30/05/2025**
 Analysis Completion Date: **30/05/2025**
 Analysis Start Date: **23/05/2025**
 Receipt Date: **23/05/2025**
 Sampling Date : **21/05/2025**
 Sampling Type: **Grab**

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **GROUND WATER**

Sampling Protocol Used: **As per JMELPL/STOP/04**
Issued No. 2 Dated 15.06.2025

Sample Collected by: **JMELPL TEAM**
 Contact Person: **Mr. Vikash Perru**

WATER ANALYSIS REPORT

S. No.	Parameters	Unit	Village Darbandora	Specification as per IS 10500- 2012	
				Requirement Acceptable Limit	Permissible Limit in the Absence of Alternate Source
1.	pH (at 25°C)	-	6.89	6.5-8.5	No Relaxation
2.	Colour	Hazen Unit	BDL (DL 1.0)	5	15
3.	Turbidity	NTU	BDL (DL 1.0)	1	5
4.	Odour	-	Agreeable	Agreeable	Agreeable
5.	Taste	-	Agreeable	Agreeable	Agreeable
6.	Total Hardness as CaCO ₃	mg/l	82.0	200	600
7.	Calcium as Ca	mg/l	16.8	75	200
8.	Alkalinity as CaCO ₃	mg/l	60.2	200	600
9.	Chloride as Cl	mg/l	20.7	250	1000
10.	Cyanide as CN	mg/l	BDL (DL 0.02)	0.05	No Relaxation
11.	Magnesium as Mg	mg/l	9.7	30	100
12.	Total Dissolved Solids	mg/l	123.0	500	2000
13.	Sulphate as SO ₄	mg/l	8.65	200	400
14.	Fluoride as F	mg/l	0.23	1.0	1.5
15.	Nitrate as NO ₃ -N	mg/l	0.32	45	No Relaxation
16.	Iron as Fe	mg/l	0.15	1.0	No Relaxation
17.	Aluminium as Al	mg/l	BDL (DL 0.03)	0.03	0.2
18.	Boron	mg/l	BDL (DL 0.20)	0.50	2.4
19.	Phenolic Compounds	mg/l	BDL (DL 0.001)	0.001	0.002
20.	Anionic Detergents as MBAS	mg/l	BDL (DL 0.02)	0.2	1
21.	Hexa Chromium as Cr ⁶⁺	mg/l	BDL (DL 0.03)	--	--
22.	Chromium as Cr	mg/l	BDL (DL 0.002)	0.05	No Relaxation
23.	Zinc as Zn	mg/l	BDL(DL 0.0005)	5	15
24.	Copper as Cu	mg/l	BDL (DL 0.02)	0.05	1.5
25.	Manganese as Mn	mg/l	BDL(DL 0.01)	0.1	0.3
26.	Cadmium as Cd	mg/l	BDL (DL 0.002)	0.003	No Relaxation
27.	Lead as Pb	mg/l	BDL (DL 0.008)	0.01	No Relaxation
28.	Arsenic as As	mg/l	BDL (DL 0.002)	0.01	No Relaxation
29.	Mercury as Hg	mg/l	BDL (DL 0.001)	0.001	No Relaxation
30.	Sodium as Na	mg/l	7.0	--	--
31.	Potassium as K	mg/l	3.0	--	--
32.	Phosphate as PO ₄	mg/l	BDL(DL 0.02)	--	--
33.	Nickel	mg/l	BDL(DL 0.005)	0.02	No Relaxation
34.	Conductivity	µS/cm	202.0	--	--
35.	Total Suspended Solid	mg/l	BDL (DL 1.0)	--	--

BDL – Below Detection Limit, DL- Detection Limit

Page 1 of 1

End of Report

Saishte
Tested by

Abhishek Tiwari
Checked by

Rajkumar Yadav
Authorized Signatory

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424, Ground Floor, Udyog Vihar,
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 E-mail: jmenvirolab@hotmail.com | www.jmenvironet.org

Corporate Office

Emaar Digital Greens, Tower-B, Unit No.1517,
 Golf Course Ext. Road, Sector-61,
 Gurugram-122011(Haryana)



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J.M. ENVIROLAB PVT. LTD.

CIN No. :U74220HR2011PTC085756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **GROUND WATER**

Sample Collected by: **JMELPL TEAM**
 Contact Person: **Mr. Vikash Perru**

Report No. : **JME/GW/250524005-008**
 Reporting Date: **31/05/2025**
 Analysis Completion Date: **31/05/2025**
 Analysis Start Date: **24/05/2025**
 Receipt Date: **24/05/2025**
 Sampling Date : **22/05/2025**
 Sampling Type: **Grab**

Sampling Protocol Used: **As per JMELPL/STOP/04**
Issued No. 2 Dated 15.06.2025

WATER ANALYSIS REPORT

S. No.	Parameters	Unit	Sampling Locations				Specification as per IS 10500- 2012	
			Village Codli	Village Kirlapal	Village Karmane	Village Kajumal	Requirement Acceptable Limit	Permissible Limit in the Absence of Alternate Source
1.	pH (at 25°C)	-	6.91	6.85	6.80	6.93	6.5-8.5	No Relaxation
2.	Colour	Hazen Unit	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	5	15
3.	Turbidity	NTU	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	1	5
4.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5.	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6.	Total Hardness as CaCO ₃	mg/l	40.0	58.0	45.0	144.0	200	600
7.	Calcium as Ca	mg/l	8.4	12.6	10.3	39.68	75	200
8.	Alkalinity as CaCO ₃	mg/l	31.65	47.47	31.1	130.4	200	600
9.	Chloride as Cl	mg/l	14.68	12.10	14.2	12.23	250	1000
10.	Cyanide as CN	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	0.05	No Relaxation
11.	Magnesium as Mg	mg/l	4.6	6.43	4.7	10.91	30	100
12.	Total Dissolved Solids	mg/l	68.0	102.0	86.0	167.0	500	2000
13.	Sulphate as SO ₄	mg/l	2.82	3.8	1.85	2.93	200	400
14.	Fluoride as F	mg/l	0.07	0.54	0.36	0.16	1.0	1.5
15.	Nitrate as NO ₃ -N	mg/l	0.88	1.35	0.43	0.86	45	No Relaxation
16.	Iron as Fe	mg/l	0.58	0.33	0.19	0.42	1.0	No Relaxation
17.	Aluminium as Al	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	0.03	0.2
18.	Boron	mg/l	BDL (DL 0.20)	BDL (DL 0.20)	BDL (DL 0.20)	BDL (DL 0.20)	0.50	2.4
19.	Phenolic Compounds	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	0.001	0.002
20.	Anionic Detergents as MBAS	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	0.2	1
21.	Hexa Chromium as Cr ⁶⁺	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	--	--
22.	Chromium as Cr	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	0.05	No Relaxation
23.	Zinc as Zn	mg/l	BDL(DL 0.0005)	BDL(DL 0.0005)	BDL(DL 0.0005)	BDL(DL 0.0005)	5	15
24.	Copper as Cu	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	0.05	1.5
25.	Manganese as Mn	mg/l	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	0.1	0.3
26.	Cadmium as Cd	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	0.003	No Relaxation
27.	Lead as Pb	mg/l	BDL (DL 0.008)	BDL (DL 0.008)	BDL (DL 0.008)	BDL (DL 0.008)	0.01	No Relaxation
28.	Arsenic as As	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	0.01	No Relaxation
29.	Mercury as Hg	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	0.001	No Relaxation
30.	Sodium as Na	mg/l	6.0	5.0	4.0	3.0	--	--
31.	Potassium as K	mg/l	1.0	1.0	1.0	BDL(DL 1.0)	--	--
32.	Phosphate as PO ₄	mg/l	BDL(DL 0.02)	BDL(DL 0.02)	BDL(DL 0.02)	BDL(DL 0.02)	--	--
33.	Nickel	mg/l	BDL(DL 0.005)	BDL(DL 0.005)	BDL(DL 0.005)	BDL(DL 0.005)	0.02	No Relaxation
34.	Conductivity	µS/cm	102.0	150.0	136.0	237.0	--	--
35.	Total Suspended Solid	mg/l	BDL (DL 1.0)	BDL (DL 1.0)	BDL(DL 1.0)	BDL (DL 1.0)	--	--

BDL - Below Detection Limit, DL- Detection Limit

End of Report

Page 1 of 1

Shabti Mehta
 Tested by

Abhishek Tiwari
 Checked by

Rajkumar Yadav
 Authorized Signatory

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TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **GROUND WATER**

Sample Collected by: **JMELPL TEAM**
 Contact Person: **Mr. Vikash Perru**

Report No. : **JME/GW/250526008-009**
 Reporting Date: **31/05/2025**
 Analysis Completion Date: **31/05/2025**
 Analysis Start Date: **26/05/2025**
 Receipt Date: **26/05/2025**
 Sampling Date : **24/05/2025**
 Sampling Type: **Grab**

Sampling Protocol Used: **As per JMELPL/STOP/04**
Issued No. 2 Dated 15.06.2025

WATER ANALYSIS REPORT

S. No.	Parameters	Unit	Sampling Locations		Specification as per IS 10500- 2012	
			Village Konsen	Village Dabal	Requirement Acceptable Limit	Permissible Limit in the Absence of Alternate Source
1.	pH (at 25°C)	-	7.11	6.60	6.5-8.5	No Relaxation
2.	Colour	Hazen Unit	BDL (DL 1.0)	BDL (DL 1.0)	5	15
3.	Turbidity	NTU	BDL (DL 1.0)	BDL (DL 1.0)	1	5
4.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable
5.	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable
6.	Total Hardness as CaCO ₃	mg/l	218.0	35.0	200	600
7.	Calcium as Ca	mg/l	61.50	7.93	75	200
8.	Alkalinity as CaCO ₃	mg/l	221.5	31.65	200	600
9.	Chloride as Cl	mg/l	12.23	16.57	250	1000
10.	Cyanide as CN	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	0.05	No Relaxation
11.	Magnesium as Mg	mg/l	15.66	3.69	30	100
12.	Total Dissolved Solids	mg/l	255.0	98.0	500	2000
13.	Sulphate as SO ₄	mg/l	4.56	5.43	200	400
14.	Fluoride as F	mg/l	0.22	0.11	1.0	1.5
15.	Nitrate as NO ₃ -N	mg/l	0.92	0.43	45	No Relaxation
16.	Iron as Fe	mg/l	0.24	0.33	1.0	No Relaxation
17.	Aluminium as Al	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	0.03	0.2
18.	Boron	mg/l	BDL (DL 0.20)	BDL (DL 0.20)	0.50	2.4
19.	Phenolic Compounds	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	0.001	0.002
20.	Anionic Detergents as MBAS	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	0.2	1
21.	Hexa Chromium as Cr ⁶⁺	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	--	--
22.	Chromium as Cr	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	0.05	No Relaxation
23.	Zinc as Zn	mg/l	BDL (DL 0.0005)	BDL (DL 0.0005)	5	15
24.	Copper as Cu	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	0.05	1.5
25.	Manganese as Mn	mg/l	BDL (DL 0.01)	BDL (DL 0.01)	0.1	0.3
26.	Cadmium as Cd	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	0.003	No Relaxation
27.	Lead as Pb	mg/l	BDL (DL 0.008)	BDL (DL 0.008)	0.01	No Relaxation
28.	Arsenic as As	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	0.01	No Relaxation
29.	Mercury as Hg	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	0.001	No Relaxation
30.	Sodium as Na	mg/l	13.0	11.0	--	--
31.	Potassium as K	mg/l	2.0	1.0	--	--
32.	Phosphate as PO ₄	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	--	--
33.	Nickel	mg/l	BDL (DL 0.005)	BDL (DL 0.005)	0.02	No Relaxation
34.	Conductivity	µS/cm	370.0	152.0	--	--
35.	Total Suspended Solid	mg/l	BDL (DL 1.0)	BDL (DL 1.0)	--	--

BDL – Below Detection Limit, DL- Detection Limit

End of Report

Page 1 of 1

Prishu Mehta
 Tested by

Abhishek Tiwari
 Checked by

Raj Kumar Yadav
 Authorized Signatory

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Corporate Office

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CIN No. :U74220HR2011PTC085756

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TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No. : **JME/GW/250529010**
 Reporting Date: **05/06/2025**
 Analysis Completion Date: **05/06/2025**
 Analysis Start Date: **29/05/2025**
 Receipt Date: **29/05/2025**
 Sampling Date : **27/05/2025**
 Sampling Type: **Grab**

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **GROUND WATER**

Sampling Protocol Used: **As per JMELPL/STOP/04**
Issued No. 2 Dated 15.06.2025

Sample Collected by: **JMELPL TEAM**
 Contact Person: **Mr. Vikash Perru**

WATER ANALYSIS REPORT

S. No.	Parameters	Unit	Village Panchvadi	Specification as per IS 10500- 2012	
				Requirement Acceptable Limit	Permissible Limit in the Absence of Alternate Source
1.	pH (at 25°C)	-	6.41	6.5-8.5	No Relaxation
2.	Colour	Hazen Unit	BDL (DL 1.0)	5	15
3.	Turbidity	NTU	BDL (DL 1.0)	1	5
4.	Odour	-	Agreeable	Agreeable	Agreeable
5.	Taste	-	Agreeable	Agreeable	Agreeable
6.	Total Hardness as CaCO ₃	mg/l	40.0	200	600
7.	Calcium as Ca	mg/l	3.97	75	200
8.	Alkalinity as CaCO ₃	mg/l	36.92	200	600
9.	Chloride as Cl	mg/l	11.68	250	1000
10.	Cyanide as CN	mg/l	BDL (DL 0.02)	0.05	No Relaxation
11.	Magnesium as Mg	mg/l	7.03	30	100
12.	Total Dissolved Solids	mg/l	72.0	500	2000
13.	Sulphate as SO ₄	mg/l	8.04	200	400
14.	Fluoride as F	mg/l	0.21	1.0	1.5
15.	Nitrate as NO ₃ -N	mg/l	0.18	45	No Relaxation
16.	Iron as Fe	mg/l	0.14	1.0	No Relaxation
17.	Aluminium as Al	mg/l	BDL (DL 0.03)	0.03	0.2
18.	Boron	mg/l	BDL (DL 0.20)	0.50	2.4
19.	Phenolic Compounds	mg/l	BDL (DL 0.001)	0.001	0.002
20.	Anionic Detergents as MBAS	mg/l	BDL (DL 0.02)	0.2	1
21.	Hexa Chromium as Cr ⁺⁶	mg/l	BDL (DL 0.03)	--	--
22.	Chromium as Cr	mg/l	BDL (DL 0.002)	0.05	No Relaxation
23.	Zinc as Zn	mg/l	BDL (DL 0.0005)	5	15
24.	Copper as Cu	mg/l	BDL (DL 0.02)	0.05	1.5
25.	Manganese as Mn	mg/l	BDL(DL 0.01)	0.1	0.3
26.	Cadmium as Cd	mg/l	BDL (DL 0.002)	0.003	No Relaxation
27.	Lead as Pb	mg/l	BDL (DL 0.008)	0.01	No Relaxation
28.	Arsenic as As	mg/l	BDL (DL 0.002)	0.01	No Relaxation
29.	Mercury as Hg	mg/l	BDL (DL 0.001)	0.001	No Relaxation
30.	Sodium as Na	mg/l	10.0	--	--
31.	Potassium as K	mg/l	2.0	--	--
32.	Phosphate as PO ₄	mg/l	BDL(DL 0.02)	--	--
33.	Nickel	mg/l	BDL(DL 0.005)	0.02	No Relaxation
34.	Conductivity	µS/cm	104.0	--	--
35.	Total Suspended Solid	mg/l	BDL (DL 1.0)	--	--

BDL – Below Detection Limit, DL- Detection Limit

End of Report

Page 1 of 1

Srishti
Srishti Mehta
 Tested by

Abhishek
Abhishek Tiwari
 Checked by

Rajkumar
Rajkumar Yadav
 Authorized Signatory

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Corporate Office

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CIN No.: U74220HR2011PTC085756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **SURFACE WATER**

Sample Collected by: **JMELPL TEAM**
 Contact Person: **Mr. Vikash Perru**

Report No. : **JME/SW/250529013-016**
 Reporting Date : **05/06/2025**

Analysis Completion Date: **05/06/2025**
 Analysis Start Date: **29/05/2025**
 Receipt Date : **29/05/2025**

Sampling Date : **27/05/2025:**
 Sampling Type : **Grab**

Protocol Used : **IS:3025 & APHA 23rd**
Edition 2017

WATER ANALYSIS REPORT

S. No.	Parameters	Unit	Sample Locations			
			DudhSagar River	Kalay Nala	Udnai Nala	Panduranga Nala
1.	pH (at 25°C)	--	7.65	6.88	6.88	6.79
2.	Colour	Hazen Unit	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
3.	Turbidity	NTU	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
4.	Odour	--	Agreeable	Agreeable	Agreeable	Agreeable
5.	Total Hardness as CaCO ₃	mg/l	40	30	25.0	15.0
6.	Calcium as Ca	mg/l	10.86	7.93	5.95	3.97
7.	Alkalinity as CaCO ₃	mg/l	42.2	27.6	19.82	15.82
8.	Chloride as Cl	mg/l	4.89	4.89	6.45	3.26
9.	Residual free Chlorine	mg/l	BDL (DL 0.2)	BDL (DL 0.2)	BDL (DL 0.2)	BDL (DL 0.2)
10.	Cyanide as CN	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)
11.	Magnesium as Mg	mg/l	3.73	2.48	2.46	1.24
12.	Total Dissolved Solids	mg/l	71.0	52	48	24
13.	Sulphate as SO ₄	mg/l	1.3	3.04	3.74	1.3
14.	Fluoride as F	mg/l	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)
15.	Nitrate as NO ₃	mg/l	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)	BDL (DL 0.05)
16.	Iron as Fe	mg/l	0.38	0.23	0.73	0.27
17.	Aluminium as Al	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)
18.	Boron	mg/l	BDL (DL 0.20)	BDL (DL 0.20)	BDL (DL 0.20)	BDL (DL 0.20)
19.	Phenolic Compounds	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)
20.	Anionic Detergents as MBAS	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)
21.	Hexa Chromium as Cr ⁺⁶	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)
22.	Zinc as Zn	mg/l	0.02	0.04	0.02	0.20
23.	Copper as Cu	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)
24.	Manganese as Mn	mg/l	BDL (DL 0.01)	BDL (DL 0.01)	BDL (DL 0.01)	BDL (DL 0.01)
25.	Lead as Pb	mg/l	BDL (DL 0.008)	BDL (DL 0.008)	BDL (DL 0.008)	BDL (DL 0.008)
26.	Selenium as Se	mg/l	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)
27.	Arsenic as As	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)
28.	Mercury as Hg	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)
29.	Phosphate as Po ₄	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)
30.	Total Suspended Solid	mg/l	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
31.	Biochemical Oxygen Demand	mg/l	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
32.	Chemical Oxygen Demand	mg/l	4.0	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
33.	Sodium as Na	mg/l	3.0	3.0	5.0	3.0
34.	Potassium as K	mg/l	1.0	1.0	1.0	BDL (DL 1.0)
35.	Conductivity	µs/cm	108.0	78.0	74.0	38.0
36.	Nickel	mg/l	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)
37.	Dissolve Oxygen	mg/l	7.8	7.5	7.6	7.7
38.	Total Coliform	MPN/100 ml	110	94	70	48

BDL – Below Detection Limit, DL- Detection Limit

End of Report

Page 1 of 1

Srishti Mehta
Srishti Mehta
 Tested by

Abhishek Tiwari
Abhishek Tiwari
 Checked by

Rakul Yadav
Rakul Yadav
 Authorized Signatory

Note:

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Reg. Office & Lab.

424, Ground Floor, Udyog Vihar,
 Phase-IV, Gurugram-122015 (Haryana)
 E-mail: jmenvirolab@hotmail.com | www.jmenvironet.org

Corporate Office

Emaar Digital Greens, Tower-B, Unit No.1517,
 Golf Course Ext. Road, Sector-61,
 Gurugram-122011(Haryana)



30 years of success

J.M. ENVIROLAB PVT. LTD.

CIN No. :U74220HR2011PTC085756

Approved from MoEF&CC & Certified - ISO 9001:2015, ISO 14001:2015, ISO 45001:2018

TEST REPORT

Issued to: **J. M. EnviroNet Pvt. Ltd.**
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Project: **M/s. JSW Steel Limited**
Proposed Codli Mineral Block-XII (ML Area: 377.0881
ha) with Installation of Beneficiation Plant in the ML
area of located at Village: Codli, Tehsil: Dharbandora,
South Goa District, (Goa).

Sample Description: **SURFACE WATER**

Sample Collected by: **JMELPL TEAM**
 Contact Person: **Mr. Vikash Ferru**

Report No. : **JME/SW/250529017-020**
 Reporting Date : **05/06/2025**

Analysis Completion Date: **05/06/2025**
 Analysis Start Date: **29/05/2025**
 Receipt Date : **29/05/2025**

Sampling Date : **27/05/2025:**
 Sampling Type : **Grab**

Protocol Used : **IS:3025 & APHA 23rd**
Edition 2017

WATER ANALYSIS REPORT

S. No.	Parameters	Unit	Sample Locations			
			Ragada Nala	Sanguem or Zuvari River	Paroda River	Jamboli Nala
1.	pH (at 25°C)	--	6.72	6.72	6.78	6.91
2.	Colour	Hazen Unit	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)
3.	Turbidity	NTU	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)
4.	Odour	--	Agreeable	Agreeable	Agreeable	Agreeable
5.	Total Hardness as CaCO ₃	mg/l	15	64	45	20
6.	Calcium as Ca	mg/l	3.97	11.9	13.89	5.95
7.	Alkalinity as CaCO ₃	mg/l	17.1	50.37	31.1	22.37
8.	Chloride as Cl	mg/l	4.34	20.46	16.12	7.34
9.	Residual free Chlorine	mg/l	BDL (DL 0.2)	BDL (DL 0.2)	BDL (DL 0.2)	BDL (DL 0.2)
10.	Cyanide as CN	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)
11.	Magnesium as Mg	mg/l	1.24	8.33	2.51	1.25
12.	Total Dissolved Solids	mg/l	34.0	101.0	74.0	47.0
13.	Sulphate as SO ₄	mg/l	2.15	7.5	6.09	1.42
14.	Fluoride as F	mg/l	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	0.10
15.	Nitrate as NO ₃	mg/l	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)
16.	Iron as Fe	mg/l	0.27	0.50	0.46	0.24
17.	Aluminium as Al	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)
18.	Boron	mg/l	BDL (DL 0.20)	BDL (DL 0.20)	BDL (DL 0.20)	BDL (DL 0.20)
19.	Phenolic Compounds	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)
20.	Anionic Detergents as MBAS	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)
21.	Hexa Chromium as Cr ⁺⁶	mg/l	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)	BDL (DL 0.03)
22.	Zinc as Zn	mg/l	0.05	0.02	0.03	0.02
23.	Copper as Cu	mg/l	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)	BDL (DL 0.02)
24.	Manganese as Mn	mg/l	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)	BDL(DL 0.01)
25.	Lead as Pb	mg/l	BDL (DL 0.008)	BDL (DL 0.008)	BDL (DL 0.008)	BDL (DL 0.008)
26.	Selenium as Se	mg/l	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)
27.	Arsenic as As	mg/l	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)	BDL (DL 0.002)
28.	Mercury as Hg	mg/l	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)	BDL (DL 0.001)
29.	Phosphate as Po ₄	mg/l	BDL(DL0.02)	BDL(DL0.02)	BDL(DL0.02)	BDL(DL0.02)
30.	Total Suspended Solid	mg/l	BDL(DL 1.0)	2.0	BDL(DL 1.0)	BDL(DL 1.0)
31.	Biochemical Oxygen Demand	mg/l	BDL(DL 1.0)	2.8	1.3	BDL(DL 1.0)
32.	Chemical Oxygen Demand	mg/l	BDL(DL 1.0)	16.0	10.0	BDL(DL 1.0)
33.	Sodium as Na	mg/l	4.0	9.0	6.0	5.0
34.	Potassium as K	mg/l	1.0	2.0	1.0	2.0
35.	Conductivity	µs/cm	53.0	151.0	111.0	72.0
36.	Nickel	mg/l	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)	BDL (DL 0.005)
37.	Dissolve Oxygen	mg/l	7.8	7.5	7.1	7.3
38.	Total Coliform	MPN/100 ml	84	170	140	70

BDL – Below Detection Limit, DL- Detection Limit

End of Report

Srishti
Srishti Mehta
 Tested by

Abhishek
Abhishek Tiwari
 Checked by

Rajkumar
Rajkumar Yadav
 Authorized Signatory

- Note:
1. This test report has been at your request and test results pertain to the tested sample received.
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TEST REPORT

Issued to: J. M. EnviroNet Pvt. Ltd.
Emaar Digital Greens, Tower- B,
Unit No. 1517, Golf Course Ext. Road,
Sector-61, Gurugram- 122001 (Haryana)

Report No.: JME/A/250324001
Date of Reporting: 29/03/2025

Project: M/s. JSW Steel Limited
Proposed Codli Mineral Block-XII (ML Area:
377.0881 ha) with Installation of Beneficiation Plant in
the ML area of located at Village: Codli, Tehsil:
Dharbandora, South Goa District, (Goa).

Sample Receipt Date: 24/03/2025
Date of Monitoring: 22/03/2025

Sample Description: PM10
Sampled by: JMELPL TEAM
Contact Person: Mr. Vikash Perru

Equipment Used: RDS
Protocol Used: JMELPL/STOP/04

MINERALOGICAL COMPOSITION

S. No.	IONS	Units	CONCENTRATION
1.	Free Silica (SiO ₂)	%	1.7
2.	Calcium (Ca)	µg/m ³	1.4
3.	Magnesium (Mg)	µg/m ³	BDL (DL 1.0)
4.	Iron (Fe)	µg/m ³	4.6
5.	Aluminium (Al)	µg/m ³	2.5
6.	Sodium (Na)	µg/m ³	BDL (DL 1.0)
7.	Potassium (K)	µg/m ³	BDL (DL 1.0)
8.	Manganese (Mn)	µg/m ³	1.6
9.	Chromium (Cr)	µg/m ³	BDL (DL 1.0)
10.	Nickel (Ni)	µg/m ³	BDL (DL 1.0)
11.	Zinc (Zn)	µg/m ³	BDL (DL 1.0)
12.	Copper (Cu)	µg/m ³	BDL (DL 1.0)
13.	Cobalt (Co)	µg/m ³	BDL (DL 1.0)
14.	Lead (Pb)	µg/m ³	BDL (DL 0.02)
15.	Mercury (Hg)	µg/m ³	BDL (DL 1.0)
16.	Cadmium (Cd)	µg/m ³	BDL (DL 1.0)

Note: BDL- Below Detectable Limit, DL- Detection Limit

Page 1 of 1

End of Report

Deepak Singh Yadav
Tested by

Abhishek Tiwari
Checked by

Authorized Signatory
Raj Kumar Yadav

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Corporate Office

Emaar Digital Greens, Tower-B, Unit No.1517,
Golf Course Ext. Road, Sector-61,
Gurugram-122011(Haryana)



O/C



Branch Office: 707, 7th Floor, Gera's Imperium II
Patto Centre, Panaji, Goa -403001
CIN : L27102MH1994PLC152925
Website : www.jsw.in

Ref: JSW/WLCP/45-26

Date: 10-08-2026

To,
The Deputy Conservator of Forests
South Division,
Margao (Goa) – 403601.

Subject: Request regarding Authentication of Wildlife Conservation Plan in respect of Block-XII Codli Mineral Block

Reference: Terms of Reference (ToR) issued by the Ministry of Environment, Forest and Climate Change, Government of India, vide File No. J-11015/49/2025-IA.II (NCM), dated 18.05.2026.

Dear Sir/Madam,

With reference to the aforesaid subject and reference matter, we would like to mention that JSW Steel Limited has applied to MoEF&CC for Environmental Clearance w.r.t: - Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) under EIA Notification, 2006.

Chyga
11/8/26
Office of the

Pr. Chief Conservator of Forests
Altinho, Panaji - Goa 403 001

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



Part of Jindal Group



As per ToR Points mentioned are below: -

Specific Conditions:

Point no. 1.26: *"Site Specific Wildlife Conservation Plan shall be prepared and approved by the DFO/ PCCF Wildlife for the Schedule – I species present within the ML area"*

Standard Terms of Reference for (Mining of minerals):

Point no. 1.16: *"A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted."*

Point no. 1.18: *"A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost"*

Standard Terms of Reference for (Mineral beneficiation):

Point no. 1.28: *"A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost"*





In this regard, we are herewith submitting the Wildlife Conservation Plan for approval **(Enclosed as Annexure I)** of the same from your good office.

We earnestly request you to kindly approve the Wildlife Conservation Plan. In case any additional information or clarifications are required, we shall be pleased to provide to you.

Thank you for your time and consideration.

Sincerely,

JSW Steel Limited

Ambarish Volvoikar

Authorized Signatory



CC: PCCF and Chief Wildlife Warden, Van Bhawan, Altinho, Panaji, Goa-403001

Encl.:

1. **Annexure I:** Wildlife Conservation Plan.



WILDLIFE CONSERVATION PLAN

FOR SCHEDULE-I SPECIES FOUND

IN 10 KM OF RADIUS

OF

PROPOSED BLOCK-XII CODLI MINERAL BLOCK,

AUCTIONED BLOCK AREA: 377.0881 HA

With

**Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total
Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary
Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH)
and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput
Capacity 3.50 Million TPA**

At

**Village: Codli, Taluka: Dharbandora,
District: South Goa (Goa)**

PROJECT PROPONENT



JSW Steel Limited

JSW CENTRE, BANDRA KURLA COMPLEX,
BANDRE (EAST), MUMBAI MUMBAI,
MAHARASHTRA, BKC GROUND, 400051
E- Mail: baswaraj.dalgade@jsw.in

Prepared By



J.M. EnviroNet Pvt. Ltd.

(Registered EIA Consultant Organization from
NABET-QCI)

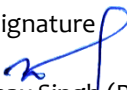
Emmar Digital Greens, Tower – B, Unit No.
1517, Golf Course Ext. Road, Sector – 61,
Gurugram (Haryana) – 122 011
E-Mail: Jmenviron@Hotmail.Com

DECLARATION

The Wildlife Conservation Plan 10 km radius of Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa). The study was carried out by the field team in core and buffer zone and relevant data were collected during the ground truthing. The Final Report is prepared under the guidance of EB & SC expert Mr. Akshay Singh (Retd. IFS) from J.M. EnviroNet Pvt. Ltd.

Client	JSW Steel Limited.
Report Prepared by	J.M EnviroNet Pvt. Ltd. Emmar Digital Greens, Tower B, Unit 1517, Golf Course Ext. Road, Sector 61, Gurgaon, Haryana-122011.
Ecology and Biodiversity Expert	Mr. Akshay Singh (Retd. IFS)- QCI-NABET Approved Functional Area Expert (FAE) in Ecology and Biodiversity (EB) and Soil Conservation (SC).

Expert Signature


Mr. Akshay Singh (Retd. IFS)

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EXECUTIVE SUMMARY

M/s JSW Steel Limited Proposed “Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha” with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

The total project cost is estimated Rs. 500 Crores.

This Wildlife Conservation Plan has been prepared in reference to the Terms of Reference (ToR) issued by the Ministry of Environment, Forest and Climate Change, Government of India, vide File No. J-11015/49/2025-IA.II (NCM), dated 18.05.2026.

The study area of the project falls within an ecologically sensitive landscape containing important wildlife habitats and forest areas. As per the authenticated map obtained from the Office of the Deputy Conservator of Forests, Working Plan Division, Panaji, Goa, the following protected areas are located within the 10 km study radius of the project site:

- Bhagvan Mahavir Wildlife Sanctuary at approximately 1.52 km in the south-east direction.
- Bondla Wildlife Sanctuary at approximately 6.5 km in the NNW direction.

The study area exhibits a rich diversity of flora, including Trees, Shrubs, Herbs, Grasses and Climber. The presence of various tree species from families like Fabaceae, Anacardiaceae, Moraceae, Meliaceae and others contributes to the ecological complexity. Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026, there are 114 floral species were recorded within the 10 km radius study area. These include 75 Tree species, 15 Shrub species, 16 Herb species, 6 Grass species and 2 Climber species.

Overall, 101 species were recorded within the 10 km radius study area. Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026), these species include 18 of Species Mammals, 60 Species of Birds, 08 Species of Reptiles, 4 Species of Amphibians, 8 Species of Butterflies and 03 Aquatic Species. Also, based on the secondary information including Management Plan of Bhagwan-Mahavir NP & WLS, there are Tiger (*Panthera tigris*), Gour (*Bos gaurus*) etc. present within the WLS area.

There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur / Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk

Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site.

MITIGATION MEASURES:

- Major conservation and mitigation measures proposed under the Wildlife Conservation Plan include:
- Plantation of native tree species and strengthening of greenbelt development over 102.43 ha area with 256075 saplings.
- Grassland and rangeland management for improvement of wildlife habitat.
- Wildlife corridor improvement and habitat enrichment measures.
- Soil and moisture conservation works.
- Establishment of solar tube wells/waterholes and development of small water retention structures.
- Fire prevention and mitigation measures within and around the project area.
- Awareness generation, training and capacity-building programmes for workers and local communities.
- Measures to minimize human-wildlife conflict in nearby Village and forest fringe areas.
- An Environment Cell comprising qualified environmental professionals and wildlife experts will be constituted for effective implementation and monitoring of the Wildlife Conservation Plan in coordination with the Forest Department. Periodic monitoring of flora, fauna, plantation survival and habitat improvement measures will be carried out during the operational phase of the project.
- Regular environmental and wildlife monitoring programmes will be undertaken during the operational phase of the project. Monitoring of flora and fauna, plantation survival rate, wildlife movement, habitat quality, water availability and effectiveness of conservation measures will be carried out periodically in consultation with the Forest Department and wildlife experts.
- The Company has allocated a total budget of Rs. 50.90 lakhs for implementation of the Wildlife Conservation Plan. The allocated budget will be utilized for execution of habitat improvement measures, plantation activities, water conservation structures, awareness programmes, wildlife monitoring and other conservation initiatives proposed under the plan.



CHAPTER 1

INTRODUCTION

1.1 BRIEF NOTE ON THE PROJECT, NATURE AND ITS LOCATION WITH SUPPORTING MAPS, PHOTOS AND FIGURES ETC.:

The main objective of this study is to understand the presence and behaviour of the floral and faunal diversity of the study area with respect to terrestrial and aquatic flora and fauna with special emphasis on Rare, Endangered and Threatened species and to observe, document and prepare a conservation strategy for conservation of schedule -I species from the anthropogenic activities within 10 km radius impact zone of Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) by M/s. JSW Steel Limited.

JSW Steel, the flagship business of the diversified US\$ 23 billion JSW Group. As one of India's prominent business houses, JSW Group has interests in energy, infrastructure, cement, paints, sports and venture capital. JSW Steel, certified by Great Places to Work in 2021, JSW Steel has established itself as an organization with a robust cultural foundation. Over the last three decades, it has evolved from a single manufacturing unit to become India's leading integrated Steel plant with a capacity of 35.7 MTPA in India and the USA. Its next phase of growth will take its total capacity to 38.5 MTPA by FY25.

The Company's manufacturing unit in Vijayanagar, Karnataka is the largest single-location steel-producing facility in India, boasting a capacity of 17.5 MTPA (5 MTPA capacity at Vijayanagar under commissioning). JSW Steel has always been at the forefront of research and innovation, maintaining a strategic collaboration with global leader JFE Steel of Japan. This enabling JSW to access new and state-of-the-art technologies to produce and offer high-value special steel products to its customers. These products are extensively used across industries and applications including construction, infrastructure, automobile, electrical applications and appliances. JSW Steel is widely recognized for its excellence in business and sustainability practices. Some of these recognitions include World Steel Association's Steel Sustainability Champion (consecutively from 2019 to 2022), Leadership Rating (A-) in CDP (2020 & 2021), Deming Prize for TQM for its facilities at Vijayanagar (2018) and Salem (2019). It is part of the S&P Dow Jones Sustainability Index (DJSI) for Emerging Markets (2021) and S&P Global's Sustainability Yearbook (consecutively for 2020 and 2021).

1.1.1 SCOPE OF WORK:

This Wildlife Conservation Plan has been prepared in reference to the Terms of Reference (ToR) issued by the Ministry of Environment, Forest and Climate Change, Government of India, vide File No. J-11015/49/2025-IA.II (NCM), dated 18.05.2026, **enclosed as Annexure V.**

1.1.2 PROJECT DESCRIPTION:

STUDY AREA:

The study area considered is an area of 10 km radius (aerial distance) from the Mine site, located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Core Area: 377.0881 ha.

Buffer Area: 40164.16 ha Within 10 Km radius from Mine boundary.

STATUS OF FOREST CLEARANCE: The application for Forest Clearance has been submitted on the **PARIVESH Portal** for an area of 65.9686 ha on 23.02.2026, for signing of lease document and diversion of forest land to non-forest purpose and its Proposal No. FP/GA/MIN/QRY/569926/2026.

1.1.3 DETAILS OF PROJECTS:

TABLE 1 DETAILS OF PROJECTS

S. No.	Particular	Details
A.	Nature of the Project	Fully Mechanized Opencast Mining Method
B.	Size of the Project	
1.	Mining Lease Area	Out of total 377.0881 ha land; 65.9686 ha is Forest Land, 236.3482 ha is Government land, 58.9087 ha is Private land and 15.8626 ha is Alvara land.
C.	Location Details	
1.	Village	Codli
2.	Taluka	Dharbandora
3.	District	South Goa
4.	State	Goa
5.	Latitude	15°21'15.638" N to 15°19'42.607" N
6.	Longitude	74°7'10.922" E to 74°8'39.034" E
7.	Open series No./ Toposheet No.	Core Zone: D43C3_48I/3 Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
D.	Cost Details	
1.	Total Project Cost	500 Crores

Source: PFR

TABLE 2 ENVIRONMENTAL SETTINGS OF THE AREA

(with approx. aerial distance from ML Boundary & direction from the centre of the ML Boundary)

S. No.	Particular	Details
1	Nearest Town/City	➤ Sanvordem (~7.5 km in SSW)
2	Nearest Highway	➤ NH-748 (~3.0 km in NNE direction) ➤ SH-7 Adjacent in WNW direction
3	Nearest Railway Station	➤ Sanvordem Chuch Railway Station (~7.8 km in SSW)
4	Nearest Airport	➤ Dabolim International Airport (~30.0 km in WNW)
5	National Park, Wildlife Sanctuary, Biosphere Reserves, Wildlife corridors, Tiger/Elephant Reserves,	There are no Biosphere reserve or corridor present within 10 of study area. 2 Wildlife sanctuaries are present that are:

S. No.	Particular	Details
	within 10 km radius of the project site	➤ Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE). ➤ Bondla Wildlife Sanctuary (~6.5 Km in NNW) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW). As per the authenticated map of the WLS & ESZ from the Deputy Conservator of Forests, Working Plan Division, Panaji, Goa, vide Letter No. DCF(WP)Tech/Digi/Vol-I/75/2025-26/751 dated 10.10.2025, enclosed as Annexure II.
6	Reserved / Protected Forest within 10km radius study area	➤ Unclassified Forest filling in Core Zone ➤ Reserved Forest (~0.5 km in ENE direction) ➤ Reserved Forest (~1.0 km in West direction) ➤ Reserved Forest (~2.5 km in West direction) ➤ Reserved Forest (~4.0 km in South direction) ➤ Reserved Forest (~6.5 km in WSW direction) ➤ Reserved Forest (~7.0 km in NNE direction) ➤ Reserved Forest (~8.0 km in WSW direction) ➤ Reserved Forest (~8.5 km in NW direction) ➤ Reserved Forest (~ 9.0 km in West direction)
7	Water body within 10 km radius of study area	➤ Khandepar River Adjacent in North ➤ Kale Nala (~ 0.7 km in ESE direction) ➤ Udnai nala ~1.5 km in West direction) ➤ Panduranga Nala (~5.0 km in SW direction) ➤ Ragada Nala (~7.0 km in NNE direction) ➤ Sanguem/Zuvari River (~8.0 km in South direction) ➤ Jamboli Nala (~9.0 km in NE direction) ➤ Paroda River (~9.0 km in SSW direction)
8	Seismic Zone	➤ Zone – III as per IS: 1893 (Part-I): 2025

Source: Site visit & Pre-Feasibility Report

1.1.4 LOCATION OF THE PROJECT:

The Mine site is located at Village: Codli Taluka: Dharbandora, District: South Goa District, (Goa). The maps showing general location of the mine site is as given below-

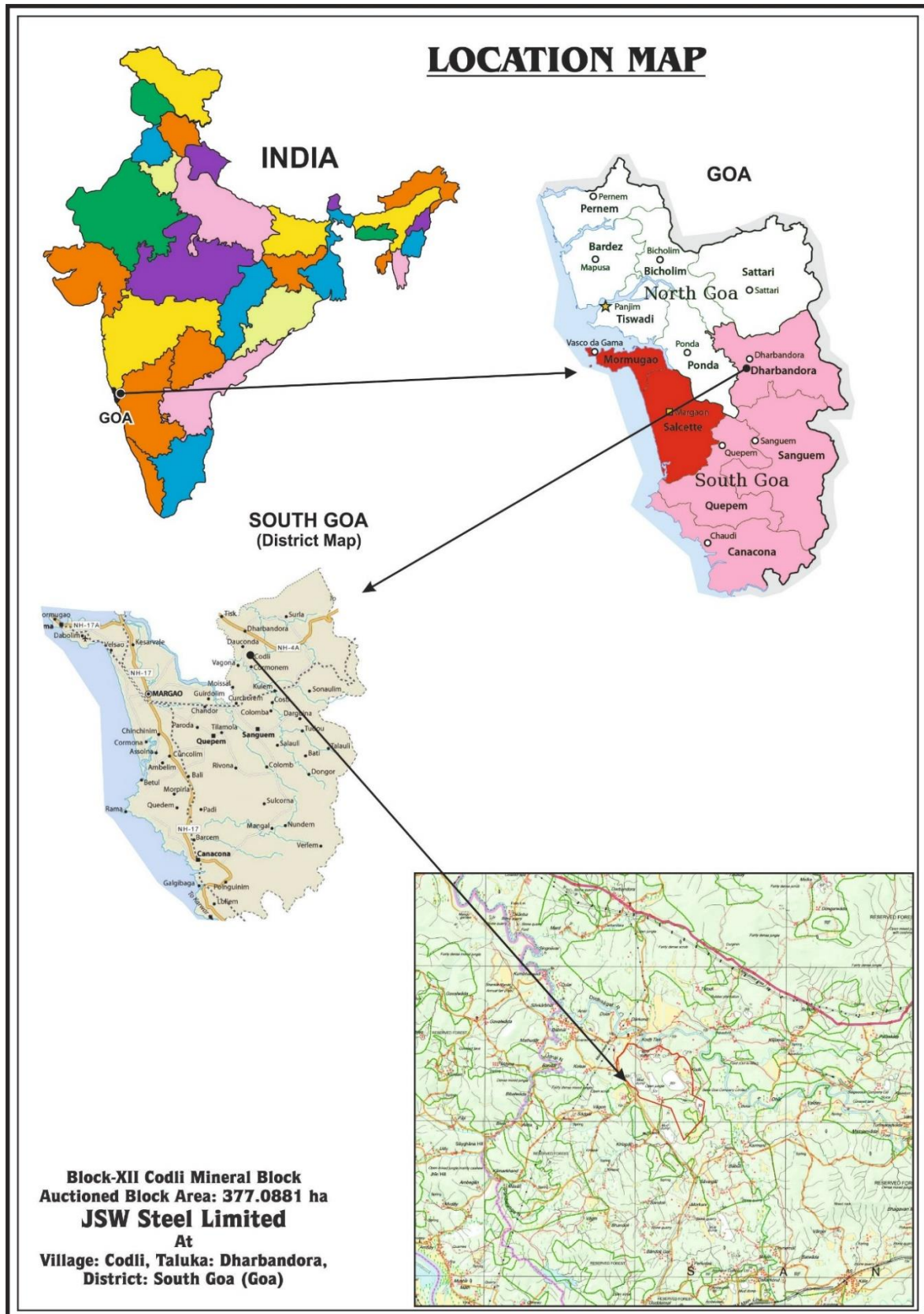


FIGURE 1 LOCATION MAP (SHOWING GENERAL LOCATION OF THE MINE SITE)



FIGURE 2 GOOGLE EARTH IMAGE OF THE PROJECT SITE

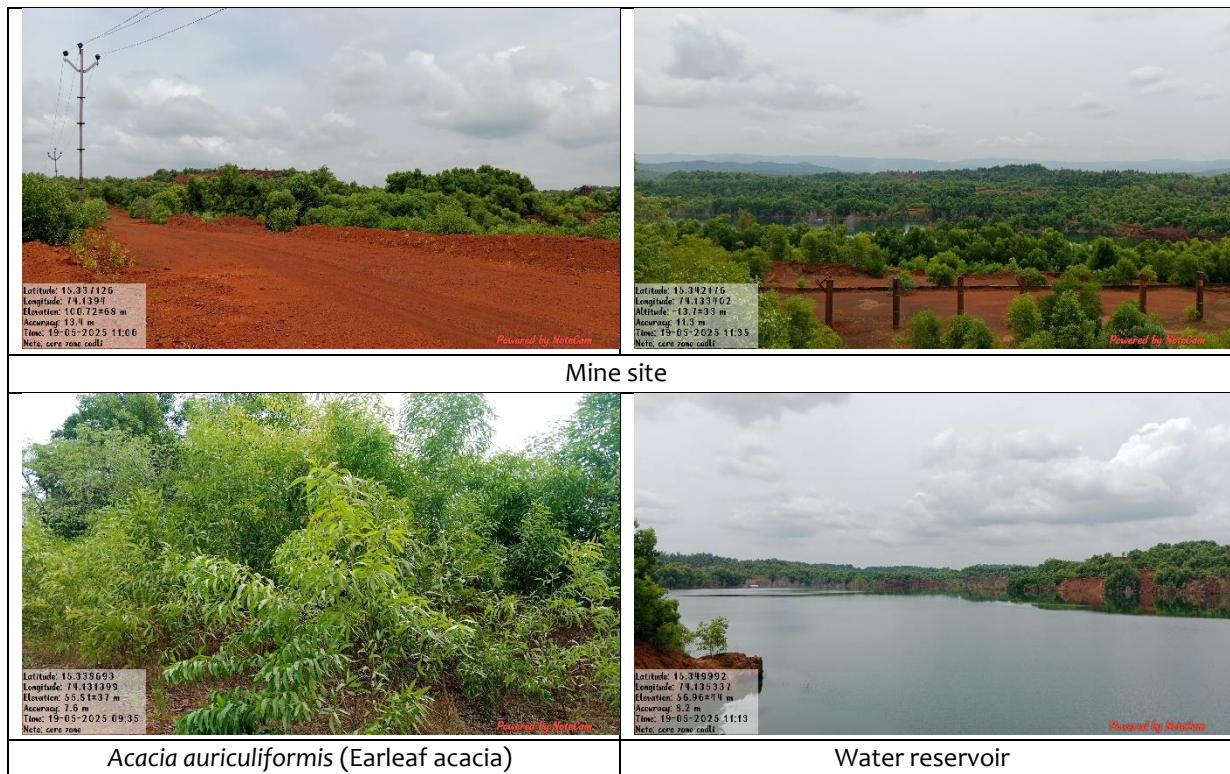


FIGURE 3 MINE SITE PHOTOGRAPHS

1.2 GEOGRAPHICAL DETAILS INCLUDING TOPOGRAPHY, CLIMATE, LANDSCAPE PROFILE IN TUNE WITH THE LATEST SURVEY OF INDIA TOPO -SHEET, PROPOSED AND EXISTING INFRASTRUCTURE INCLUDING ROADS, HOUSING, DRAINAGE NETWORK, SLOPE AND ASPECT ETC.:

1.2.1 TOPOGRAPHY:

Codli Mineral block is situated in the central crest portion of Daucona Codli hillock. The area is gently sloping towards NNE & SSW. The mining lease is disposed in a general northwest-southeast direction. Almost entire lease hold area is broken-up and put to use for mining and allied operations. The highest elevation within Mining Lease is on rehabilitated dump towards the southwest part at 109m MSL and the lowest portion at - 76m MSL towards the northeast part of the lease which was achieved during mining operation in the past and now it is partly filled with silt & water.

1.2.2 CLIMATE & RAINFALL:

CLIMATE

The area is characterized by extreme climate with very hot (38°C) summer and very cold winter (16°C). It experiences tropical and humid climate which shows three distinct seasons viz. summer, rainy and winter. The summer is hot and humid starting from March and continues till end of May. May is the hottest month of this region. The rainy season lasts from early June to end of September. October and November are the post monsoon months followed by a cold winter which lasts till end of February.

RAINFALL

The annual average rainfall in the region is around 3412.7 mm (average of last 10 years rainfall data from 2015-2024) varying from minimum 2480.7 mm in 2018 to maximum 4787.8 mm in 2024.

TABLE 3 RAINFALL DATA OF SOUTH GOA DISTRICT (10 YEARS)

Year	Rainfall (In mm)
2015	2591.6
2016	2984.4
2017	2593.3
2018	2480.7
2019	4315.7
2020	4262.5
2021	3685.1
2022	2835.5
2023	3590.9
2024	4787.8
Average	3412.7

Source: Customize Rainfall Information System, IMD Hydromet Division

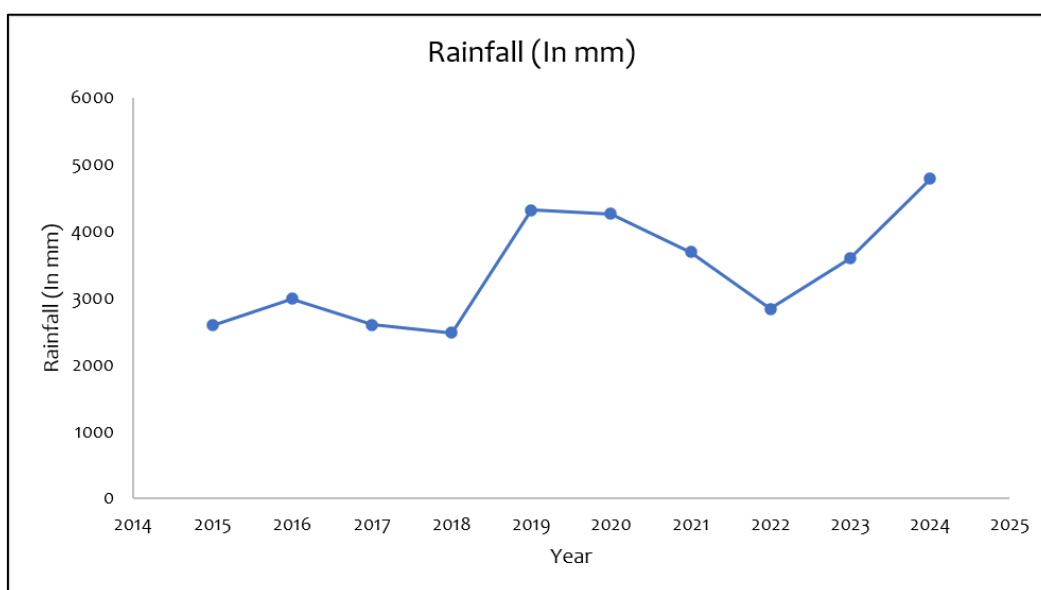


FIGURE 4 GRAPH SHOWING THE RAINFALL PATTERN

1.2.3 DRAINAGE PATTERN:

The area is characterised by dendritic type of drainage pattern; there are no perennial surface water bodies within the Mineral Block. The Khandepar River flows towards northern part of the block, flowing from NE to SW. However, the block area is devoid of any perennial surface water body. Monsoon run-off is channelized and collected into settling ponds / pits through a network of drains.



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



Wildlife Conservation Plan

1.2.4 AGRICULTURAL CROPS:

Goa, being a coastal state in India, shares a similar agricultural profile across its northern and southern districts, characterized by a tropical monsoon climate and lateritic soils. The Major Field crops cultivated in South Goa.

Rice is the most important crop in Goa. Due to warm humid climate rice is mainly grown here and it is grown in the coastal region. After rainy season, rice, chilies, onions crops are grown in Goa. Cash crops are also grown in Goa. Mainly plantation of Cashew, Coconut, Mangoes, Areca palm, Kokum and Jack fruit is done in Goa. Details about types of crops and climate is given in following table:

TABLE 4 DESCRIPTION ABOUT TYPES OF CROPS IN GOA

S. No.	Parameters		Description
1.	Climate	Rainfall	In the months of June, July, August, September
2.	Crops	Kharif crop	Rice, Ragi (locally called nachani),
		Rabi crops	Rice, horse-gram (kulith), black gram (udid)
		Cash crops	Coconut, Cashew-nut, Coconut, Mango, Jackfruit, Banana, Pineapple

Source -<https://southgoa.nic.in/about-district/>

<https://www.mapsofindia.com/maps/goa/goaagriculture.htm>

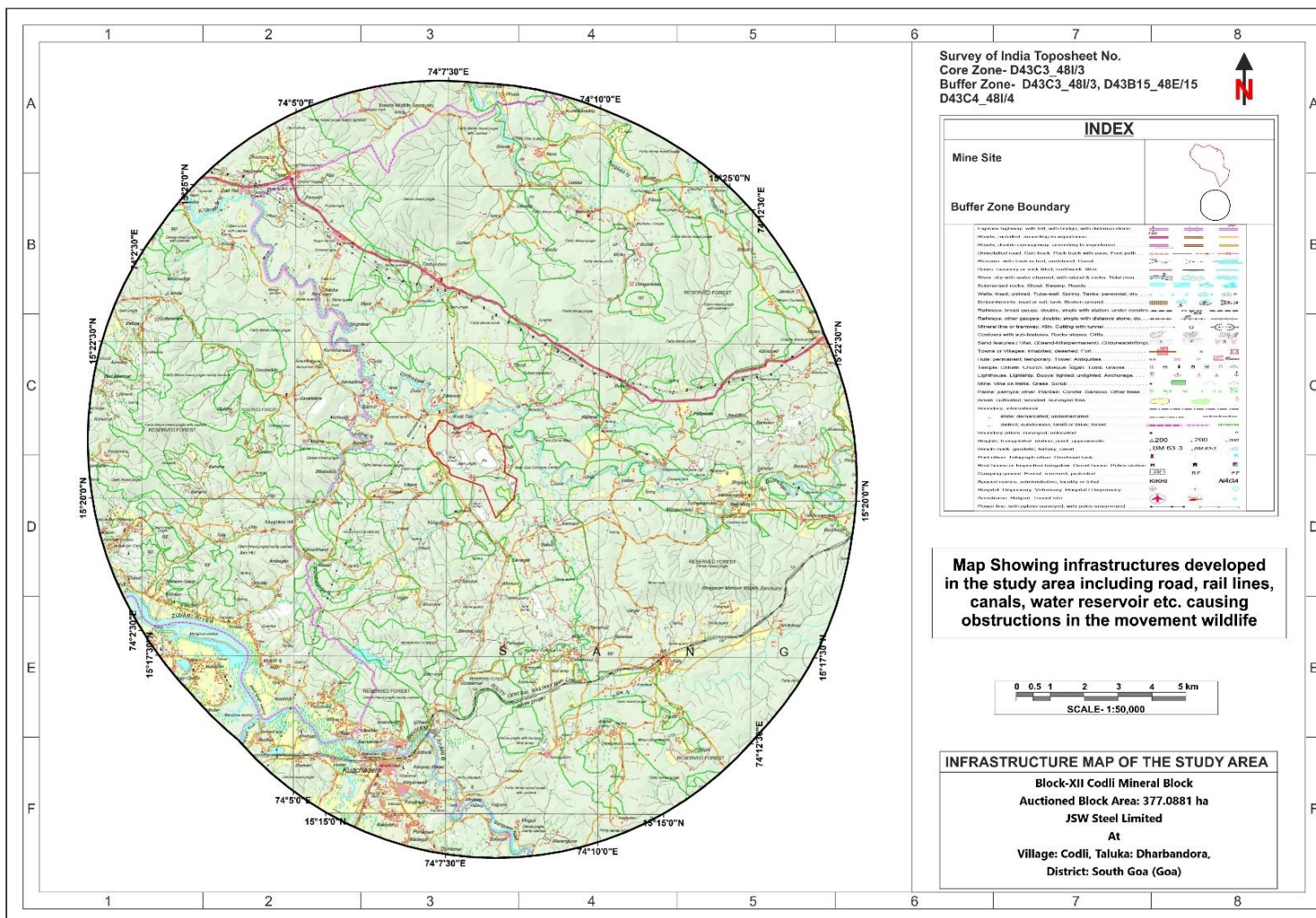


FIGURE 5 INFRASTRUCTURE MAP OF THE STUDY AREA



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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1.3 HUMAN HABITATION, DEMOGRAPHIC PROFILE INCLUDING LAND USE AND LAND COVER AND DEPENDENCY ON THE FOREST RESOURCES:

1.3.1 DEMOGRAPHY PROFILE OF THE STUDY AREA:

A detailed socio-economic survey was conducted in the study area (buffer zone) within 10 km radius of Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) in order to identify the impact of the proposed mine project on nature and inhabitant. To get an overview of the villagers and their perspectives about the proposed mine, different demographic parameters and social aspects such population density, sex ratio, literacy rate, worker ratio etc. has been identified, analyzed, studied together. These impacts may be beneficial or detrimental. If detrimental, anticipated suggestions/measures are advocated in order to have collective development.

TABLE 5 SOCIOECONOMIC & DEMOGRAPHIC PROFILE OF GOA STATE, SANGUEM & STUDY AREA

S. NO.	PARTICULAR	STUDY AREA
1.	Area (sq. km.)	398
2.	No. Of households	23611
3.	Total Population	101136
4.	Sex Ratio (Females per 1000 Males)	986
5.	Schedule Caste	1334
6.	Schedule Tribe	13858
7.	Literacy Rate (%)	86.23
8.	Working Population (%)	40223
9.	Non-working Population (%)	60913

Source: Census of India, 2011, (censusindia.gov.in)



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



Wildlife Conservation Plan

TABLE 6 VILLAGE WISE DEMOGRAPHIC DETAILS OF THE STUDY AREA

S. No.	Village Name	No of House Holds	Total Population	Sex Ratio	Male literate	Female literate	Total workers	Main workers	Marginal workers	Non-workers
1	Cormonem	152	645	802	282	200	238	213	25	407
2	Bandoli	231	1060	1070	346	342	453	277	176	607
3	Codli	884	3801	944	1627	1325	1533	1191	342	2268
4	Santona	343	1403	899	562	430	577	491	86	826
5	Camarconda	173	793	1008	318	265	309	158	151	484
6	Moissal	2	8	600	4	3	4	4	0	4
7	Antoriem	----- Un- inhabited -----								
8.	Darbandora	672	2991	1003	1229	1031	1279	977	302	1712
9	Rumbrem	131	646	1153	222	228	283	132	151	363
10	Ponchavadi	931	4295	1007	1758	1602	1568	1255	313	2727
11	Piliem	944	4058	935	1628	1302	1729	1345	384	2329
12	Calem	574	2683	1039	1074	960	911	754	157	1772
13	Sigao	405	1724	961	695	575	783	489	294	941
14	Sangod	236	1083	944	438	371	418	328	90	665
15	Nirancal	406	1772	1014	734	635	640	1132	488	152
16	Comproi	150	620	1060	261	228	226	203	23	394
17	Conxem	39	186	979	77	60	75	55	20	111
18	Costi	196	881	751	420	251	394	364	30	487
19	Muguli	119	508	1258	190	184	249	125	124	259
20	Dudal	97	446	948	169	131	226	108	118	220
21	Coranginim	9	32	1286	14	13	11	8	3	21
22	Xic-Xelvona	28	125	866	60	48	46	41	5	79



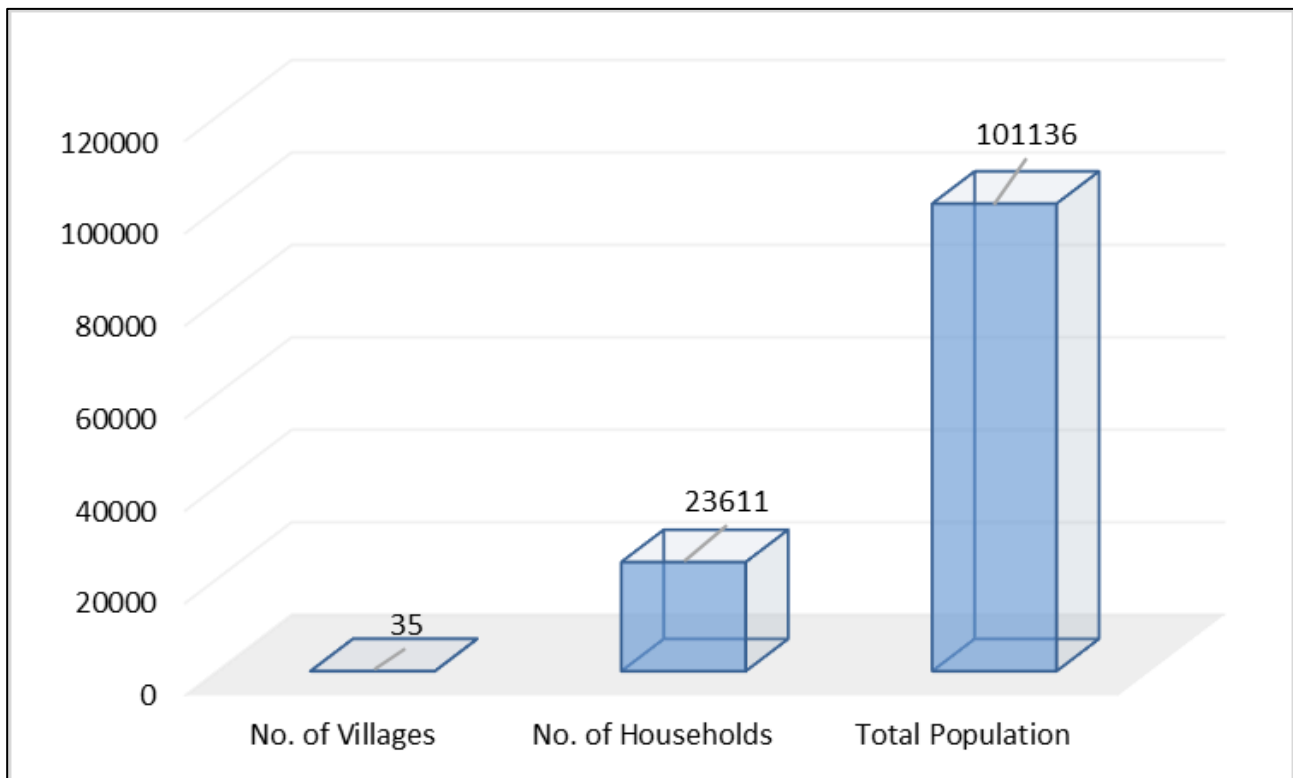
Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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S. No.	Village Name	No of House Holds	Total Population	Sex Ratio	Male literate	Female literate	Total workers	Main workers	Marginal workers	Non-workers
23	Xelvona	418	1725	983	750	685	658	384	274	1067
24	Odar	143	569	1004	245	232	207	180	27	362
25	Molem	383	1715	942	672	548	681	407	274	1034
26	Colem	995	4195	1005	1695	1520	1695	1016	679	2500
27	Sancordem	273	1233	976	521	439	514	439	75	719
28	Macasana	503	1972	1241	723	849	487	436	51	1485
29	Curcholem-Cacora (M CI)	5667	22730	959	9597	8469	9133	7645	1488	13597
30	Sanvordem (CT)	1187	5103	1000	2028	1816	2143	1872	271	2960
31	Aglote	247	1109	959	700	663	812	650	162	960
32	Siroda	3197	14041	1039	5806	5384	5372	4264	1108	8669
33	Curchirem	435	2043	978	760	611	822	423	399	1221
34	Codar	3197	14041	1039	296	244	302	226	76	431
35	Usgao (CT)	2867	12436	952	5291	4452	4970	4197	773	7466
Total		23611	101136	986	31544	27558	30576	23415	7161	70560

Source: Census 2011



Source: Census of India, 2011

FIGURE 6 GRAPHICAL REPRESENTATION OF NO. OF HOUSEHOLDS AND TOTAL POPULATION OF STUDY AREA

1.3.2 LAND USE / LAND COVER STUDY:

Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of mine site should be prepared to encompass pre-operational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.

METHODOLOGY:

The land use/land cover map is prepared by adopting the interpretation techniques of the Satellite image in combination with collateral data such as Survey of India topographical maps. Image classification is done by using visual interpretation techniques and digital classification through image processing software. The various activities for preparation of LULC include pre-processing, rectification, image enhancements and classifying the satellite data for assessing the change in land use land cover due to proposed developmental activities.

The imagery is interpreted and ground checked for corrections. The final map is prepared after ground truthing. The different land use/land cover categories in the study area was carried out based on the NRSC land use / land cover classification system.

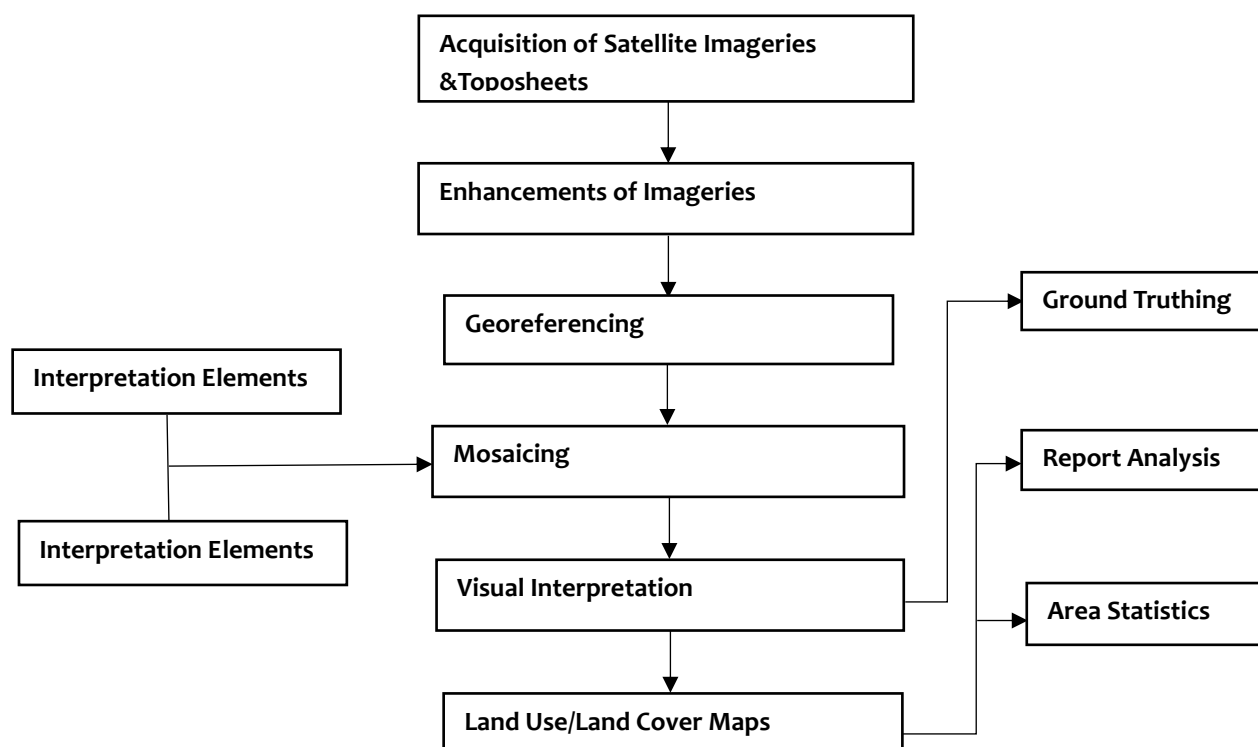


FIGURE 7 METHODOLOGY FLOWCHART FOR LULC CLASSIFICATION AND MAPPING

- Preliminary / primary data collection of the study area
 - Satellite data procurement from NRSC Hyderabad
- Secondary data collection from authorized bodies
 - Survey of India Toposheet (SOI)
 - Cadastral / Khasra map
 - GPS Coordinates of Mine Boundary
 - Mining Maps (as a part of Mining Plan) approved by IBM, Goa
- Processing of satellite data using ERDAS Imagine 9.2 and to prepare the Land use and Land cover maps (e.g. Forest, agriculture, settlements, wasteland, water bodies etc.) by digital image processing (DIP) technique.
 - Geo-Referencing of the Survey of India Toposheet
 - Geo-Referencing of satellite Imagery with the help of Geo-Referenced Toposheets
 - Geo-Referenced Khasara Maps
 - Enhancement of the Satellite Imagery
 - Base Map layer creation (Roads, Railway, Village Names and others Secondary data etc.)
 - Data analysis and Classification using Digital interpretation techniques.
 - Ground truth studies or field Verification.
 - Error fixing / Reclassification
 - Final Map Generation

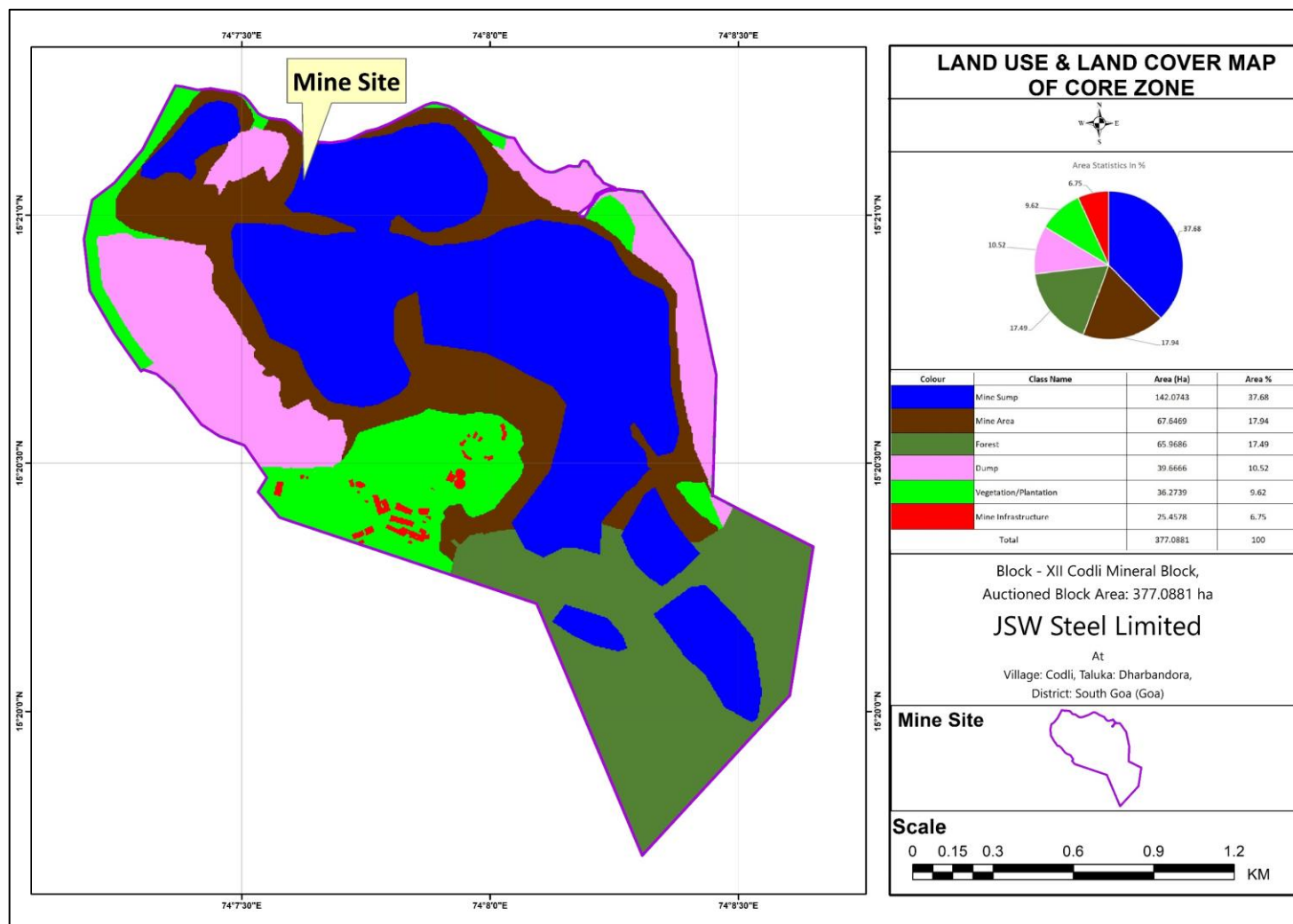


FIGURE 8 LAND USE / LAND COVER MAP OF THE CORE AREA



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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TABLE 7 LAND USE / LAND COVER DETAILS OF CORE ZONE

S. No.	Legend	Area (In Ha)	Area (In %)
1	Mine Sump	142.0743	37.68
2	Mine Area	67.6469	17.94
3	Forest	65.9686	17.49
4	Dump	39.6666	10.52
5	Vegetation/Plantation	36.2739	9.62
6	Mine Infrastructure	25.4578	6.75
Total		377.0881	100

Source: LU/LC Map for core zone

INTERPRETATION OF THE LAND USE/LAND COVER STUDY

The study of the data from the above table indicates that:

- Core area mainly comprises of Mine Sump (142.0743 ha), Mine Area (67.6469 ha), Forest (65.9686), Dump (39.6666 ha), Vegetation/Plantation (36.2739 ha) and Mine Infrastructure (25.4578 ha) with 37.68%, 17.94 %, 17.49%, 10.52%, 9.62% and 6.75 % of area falling under respectively.
- There is no National Park, Wild Life Sanctuary, Biosphere Reserve, Protected & Reserved Forest etc. within the core area.

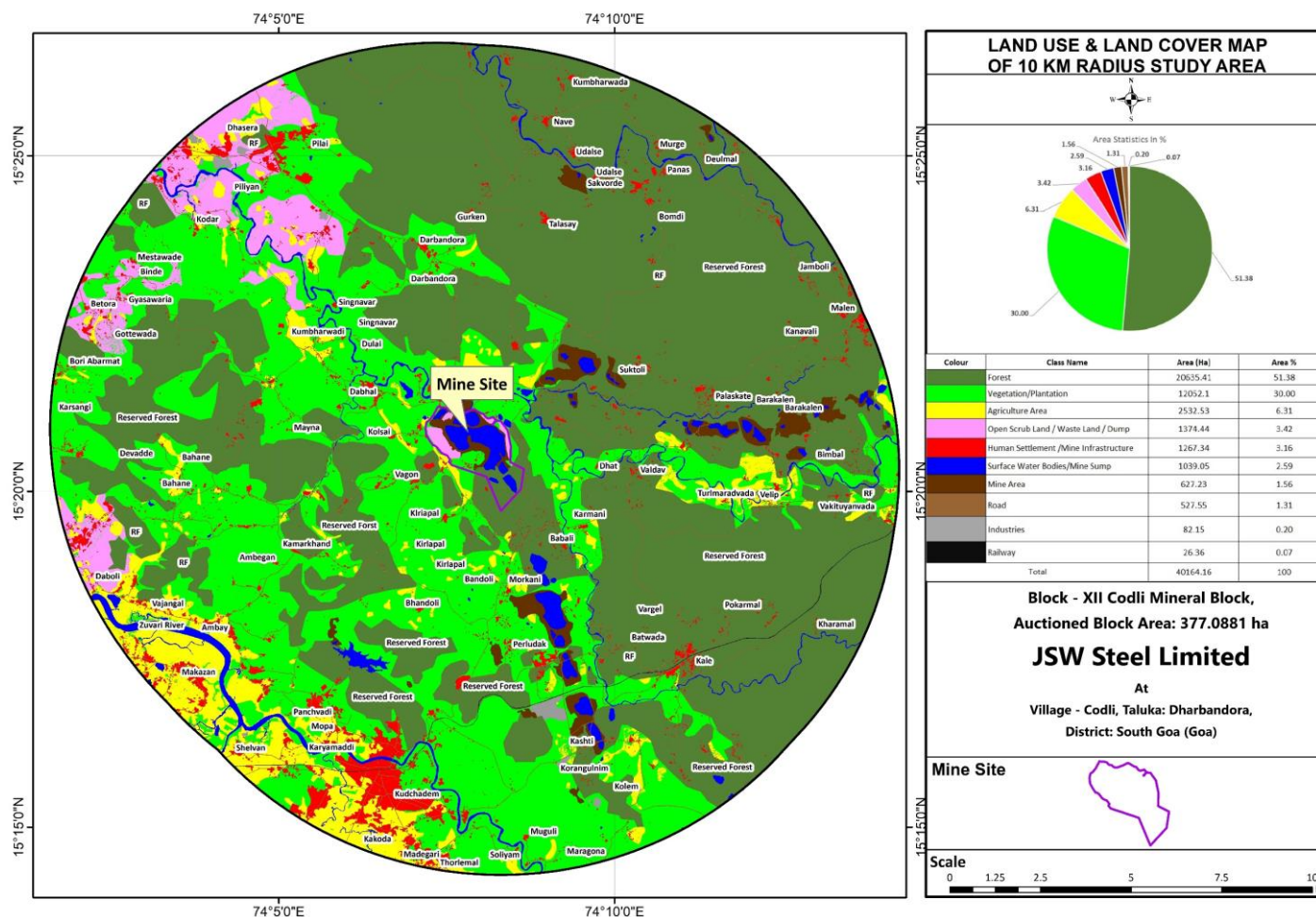


FIGURE 9 LAND USE LAND COVER MAP OF 10 KM RADIUS STUDY AREA

INTERPRETATION OF THE LULC DATA:

The following LULC Classes are present in the study area (10 km radius area):

Forest, Agriculture Area, Human Settlement, Open Scrub/Waste land, Surface Water bodies/Mine Sump, Vegetation/Plantation, Mine Area, Road and Industries as per NRSC Guideline.

TABLE 8 LAND USE LAND COVER DETAILS OF 10 KM RADIUS STUDY AREA

S. No.	Legend	Area (In ha)	Area (In %)
1	Forest	20635.41	51.38
2	Vegetation/Plantation	12052.1	30.00
3	Agricultural Area	2532.53	6.31
4	Open Scrub Land/Waste Land/Dump	1374.44	3.42
5	Human Settlement/Mine Infrastructure	1267.34	3.16
6	Surface Water Bodies/Mine Sump	1039.05	2.59
8	Mine Area	627.23	1.56
9	Road	527.55	1.31
10	Industries	82.15	0.20
11	Railway	26.36	0.07
Total		40164.16	100

Source: LULC Map

- The 10 km radius study area mainly comprises of Forest 51.38%, Vegetation/Plantation of 30.00%, Agricultural Area of 06.31%, Open Scrub/Waste Land/Dump accounting of 3.42% of the total study area.
- The Surface Water Bodies/Mine Sump comprises of 2.59% of the total study area.
- 3.16% of the total study area is occupied by the Human Settlement/Mine Infrastructure. Rest, of the area is occupied by Mine area (1.56%), Industries (0.20%), Road (1.31%) and Railway (0.07%).

1.3.3 DEPENDENCY ON THE FOREST RESOURCES:

The local villagers residing in and around the study area are moderately dependent on forest resources to meet their day-to-day subsistence needs. Forests provide essential resources such as fuelwood, small timber, fodder and non-timber forest produce (NTFPs) including Leaves, Flowers, Fruits, Honey, Medicinal plants and edible forest products. These resources contribute to household energy requirements, livestock rearing, traditional healthcare and supplementary income.

Fuelwood collection remains the primary dependency, especially among economically weaker households. Grazing of cattle in nearby forest patches is also commonly practiced. However, dependence on forest resources is largely subsistence-oriented and non-commercial in nature.

The forest plays an important role in supporting rural livelihoods, and sustainable use practices along with awareness programs are essential to minimize pressure on forest ecosystems while ensuring livelihood security for the local communities.





CHAPTER 2

BIODIVERSITY ASSESSMENT

2.1 BIODIVERSITY SURVEY AND DOCUMENTATION WITHIN THE JURISDICTION OF 10 SQ. KMS. SURROUNDING THE PROJECT SITE:

The study area within a 10 km radius around the proposed mine site (including both core and buffer zones) is essential for assessing the potential impacts of project activities on wildlife and their habitats. Understanding the current environmental conditions is also vital for effective environmental management and the planning of mitigation measures. To evaluate the baseline environmental quality of the area, a field assessment has been conducted, focusing on the environmental components and their potential impact on the biological environment.

BIOLOGICAL ENVIRONMENT OF STUDY AREA:

Study Area:

An area of 10 km radius (aerial distance) from the ML boundary is considered as study area, also known as buffer zone. The area of mine site (within the ML boundary) is considered as core zone. The Mining Lease (ML) area is located in the Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

The primary objective of the current study is to conduct an observation, documentation and evaluation of the environmental impact within a 10 km radius study area of the mine Site. The survey conducted also focuses on describing the terrestrial and aquatic flora and fauna, with particular emphasis on identifying and studying Rare, Endangered and Threatened species in the study area.

This ecosystem is dynamic with both rich floral and faunal biodiversity with respect to its diversity of species composition and visible succession stages. An ecosystem can be studied from different angles. This report has endeavoured to explore the various aspects of the study area to understand mostly the structural aspects of this forest ecosystem and associated ones. For this study sampling technique was followed as provided below. Understanding these impacts is vital for developing effective mitigation strategies that aim to minimize harm to biodiversity and promote ecological resilience. This report focuses on the assessment of biodiversity within 10 km radius study area of the mine site and explores the potential impacts arising from the project activities. Furthermore, it aims to propose mitigation measures that can help conserve and protect biodiversity, ensuring the sustainable coexistence of the industrial project and the surrounding natural environment.

The present study was undertaken with the following objectives:

- i. To Carry out Primary field survey of flora & fauna and ecologically sensitive natural habitats in the study area.
- ii. To understand the spectrum of domesticated and wild biodiversity of the study area.
- iii. To study the likely impacts of the project on the local biodiversity and to suggest mitigation measure, if required, for threatened biota.
- iv. To assess the nature and distribution of vegetation (Terrestrial and Aquatic) in and around the Mine area.
- v. To enumerate Endemic, Rare, Endangered and Threatened (RET Species), separately for core and buffer area, based on primary field surveys and clearly indicating the Schedule of fauna present as per Wildlife



Protection Act, 1972 and amendment in Wildlife Protection Act, 2022. In case any Scheduled- I fauna occur in the study area, the conservation plan along with budgetary provisions for their conservation is to be prepared in consultation with the State Forest and Wildlife Department.

APPROACH:

To conduct a thorough study of the flora and fauna in the designated area, we embarked on several field visits, meticulously documenting our findings in a qualitative checklist.

To ensure the accuracy and comprehensiveness of our study, consultation was done with a wide range of primary and secondary sources including the Forest Working Plan, previous biodiversity studies and local experts.

The study was conducted with the involvement of experts and their findings were derived through a well-defined methodology and systematic sampling procedures, ensuring accuracy and reliability in the conclusions presented.

This report is been prepared under the expert guidance of Mr. Akshay Singh (Retd. IFS), NABET-Accredited Expert in Ecology & Biodiversity (EB) and Soil Conservation (SC).

The field team comprises Mr. Vinod Kumar Yadav (M.Sc. Zoology) and other field members (From J.M. EnviroNet Pvt. Ltd.) for ground-truthing.

Methodology for Biological Study (Flora and Fauna) and Conservation Plan Study:

The ecosystem is highly dynamic, characterized by rich floral and faunal biodiversity, reflected in its diverse species composition and evident stage of ecological succession. An ecosystem can be studied from different angles. The sampling methodology adopted for this study is detailed in the following section.

An ecological survey of the study area for understanding the fauna was conducted, particularly with reference to listing of species and assessment of the existing baseline ecological conditions in the study area; in following manner.

- Random Sampling Method
- Direct Count Method
- Road Side Count Method
- Call Count Method
- Quadrat Method
- Interviewing local Village

QUADRAT METHOD:

A quadrat is a frame that is laid down to mark out a specific area of the community to be sampled. Within the quadrat frame, the occurrence of plants is recorded using an appropriate measure of abundance. Quadrats may be square, rectangular or circular and they may be of any appropriate size. The quadrat method can be used in virtually any vegetation type to quantify the plant community.

When sampling vegetation using quadrats, different measures of abundance can be quantified to assess the influence or “importance” of each species in that quadrat. For example:

Counts – a simple tally of the number of individuals of a species.

Cover – the percent (%) area of the quadrat occupied by a plant species.

Density – estimated by quantifying the number of individuals of a species per unit area.

Frequency – the proportion of quadrats sampled in which the species is represented.

Quadrat size and shape:

The appropriate size of the quadrat depends on the layer or type of vegetation being sampled.

For example:

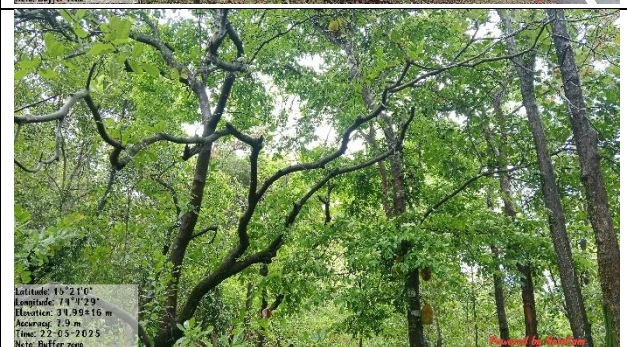
Vegetation Type	Dimensions	Area (M ²)
Tree	10 X 10	100
Shrub & Herb	5 X 5	25
Grass	1 X 1	1

TABLE 9 PHOTOGRAPHS OF SURVEY LOCATIONS





Quadrat sampling





Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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FIGURE 10 MAP SHOWING SURVEY LOCATIONS

Biodiversity Analysis using index: Species diversity will be calculated by using Shannon and Wiener (1963) formula as follows:

$$H = - \sum_{i=1}^S P_i \ln P_i$$

Where:

- H = Shannon-Wiener Diversity Index
- S = Total no. of species in the community (species richness)
- p_i = Proportion of individuals belonging to species i relative to the total number of individuals in the community.
 $p_i = n_i / N$
 n_i = No. of individuals of species i
N = Total number of individuals of all species
- ln = Natural logarithm

TABLE 10 SPECIES-WISE SHANNON DIVERSITY INDEX (H)

S. No.	Species	No. of individual (Species Richness) within 10 quadrats	Pi	ln (Pi)	Pi*ln (Pi)
1	<i>Acacia auriculiformis</i>	30	0.17	-1.75	-0.30
2	<i>Anacardium occidentale</i>	25	0.14	-1.93	-0.28
3	<i>Artocarpus heterophyllus</i>	18	0.10	-2.26	-0.24
4	<i>Azadirachta indica</i>	5	0.03	-3.54	-0.10
5	<i>Cocos Sp.</i>	30	0.17	-1.75	-0.30
6	<i>Ficus religiosa</i>	4	0.02	-3.77	-0.09
7	<i>Mangifera indica</i>	15	0.09	-2.45	-0.21
8	<i>Syzygium cumini</i>	10	0.06	-2.85	-0.16
9	<i>Ziziphus mauritiana</i>	16	0.09	-2.38	-0.22
10	Other	20	0.12	-2.16	-0.25
Total					-2.16
Shannon Diversity Index (H)=					2.16

Diversity Level (H):

$$H = - (-2.16)$$

$$H = 2.16$$

The Shannon Index value of 2.16 indicates moderate diversity in study area.

The following formulae were used to calculate the density, abundance and frequency (%) of floral species.

$$\text{Density of Species} = \frac{\text{Total no. of individuals of the species in all quadrats}}{\text{Total area of all quadrats studied}}$$

$$\% \text{ Frequency of Species} = \frac{\text{No. of quadrants in which the species is present}}{\text{Total No. of quadrats studied}} \times 100$$

$$\text{Abundance of Species} = \frac{\text{Total no. of individuals of the species in all quadrats}}{\text{Total no. of quadrats in which the species is present}}$$

TABLE 11 SPECIES-WISE DENSITY, ABUNDANCE AND FREQUENCY OF FLORA SPECIES

S. No.	Species	No. of individual within 10 quadrats	Quadrats Occurred	Species Density	Species Abundance	Frequency (%)
1	<i>Acacia auriculiformis</i>	30	6	0.03	5	60
2	<i>Anacardium occidentale</i>	25	10	0.025	2.5	100
3	<i>Artocarpus heterophyllus</i>	18	8	0.018	2.25	80
4	<i>Azadirachta indica</i>	5	5	0.005	1	50
5	<i>Cocos Sp.</i>	30	10	0.03	3	100
6	<i>Ficus religiosa</i>	4	4	0.004	1	40
7	<i>Mangifera indica</i>	15	7	0.015	1.5	70
8	<i>Syzygium cumini</i>	10	8	0.01	1	80
9	<i>Ziziphus mauritiana</i>	16	8	0.016	1.6	80
10	Other	20	10	0.02	2	100

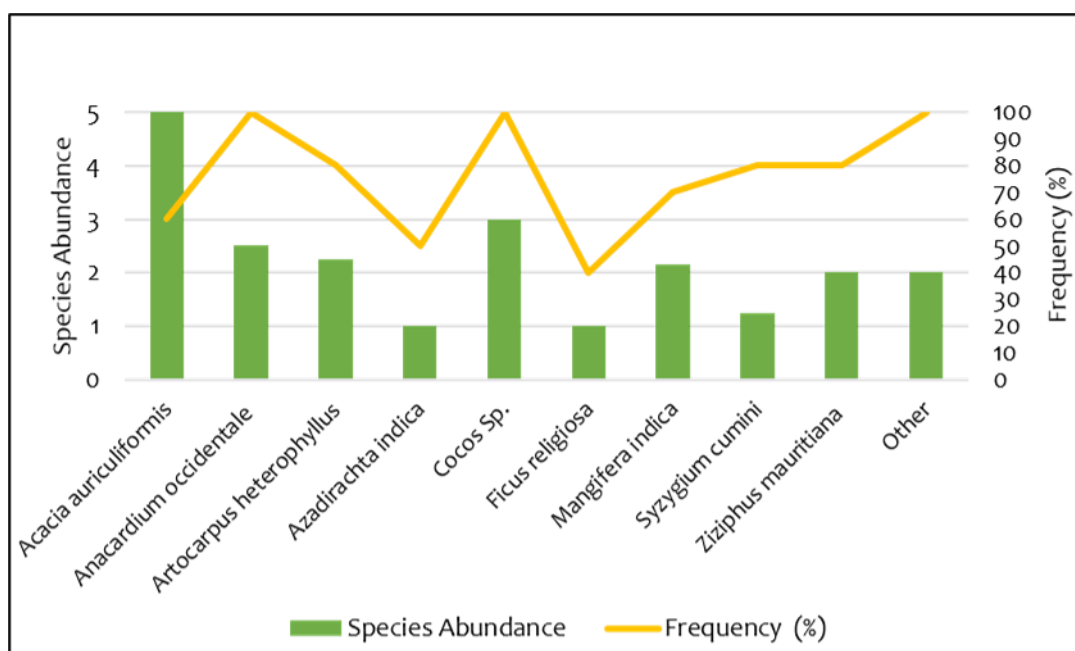


FIGURE 11 GRAPH SHOWING OF SPECIES ABUNDANCE AND FREQUENCY (%)

Screening IUCN and other sources for species Conservation status: Besides measuring these parameters, other biodiversity aspects in the form of endemic status, keystone species, threatened status and IUCN, Red-data books of the Botanical Survey of India (BSI), have been verified for their conservation status (<https://www.iucnredlist.org/>).

A keystone species: It is a species that has a disproportionately large effect on its environment relative to its abundance. Such species are described as playing a critical role in maintaining the structure of an ecological community, affecting many other organisms in an ecosystem and helping to determine the types and numbers of various other species in the community. The IUCN Species Programme of the IUCN Species Survival Commission (SSC), has for more than four decades been assessing the conservation status of species, subspecies, varieties and even selected sub populations on a global scale in order to highlight taxa threatened with extinction and therefore promote their conservation.

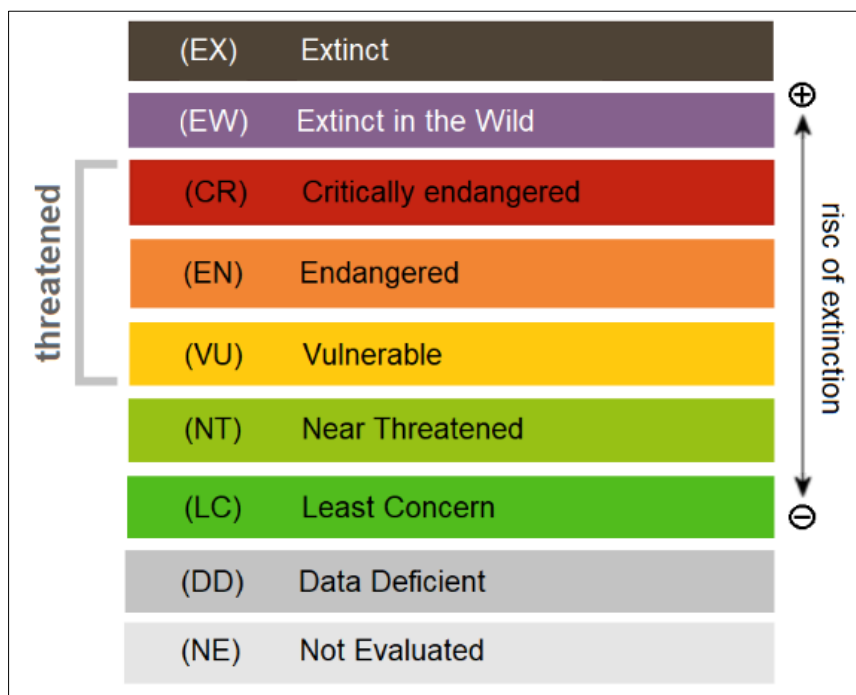


FIGURE 12 IUCN CATEGORIES SHOWING THREATENED SPECIES CATEGORIES

The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria.

This system is designed to determine the relative risk of extinction and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction (i.e., those listed as Critically Endangered, Endangered and Vulnerable).

The IUCN Red List also includes information on plants and animals that are categorised as Extinct or Extinct in the Wild; on taxa that cannot be evaluated because of insufficient information (i.e. Data Deficient); and on plants and animals that are either close to meeting the threatened thresholds or that would be threatened if not considered for an ongoing taxon-specific conservation programme (i.e. Near Threatened).

Forest Cover of the Study Area:

The forests of Goa form the part of Western Ghats, the region which have been internationally recognized as Biodiversity Hotspot of the world owing to its rich flora and fauna. Most of the forests in Goa are located in the Eastern region of the state. Forests in Goa are diverse ecosystems that include tropical evergreen, semi-evergreen and moist deciduous forests. These forest types support a rich variety of flora and fauna, contributing to the ecological significance of the region.

Forest Types:

The area under different Forest Types in the Study Area (as per the Champion & Seth Forest Classification, 1968) based on the Forest Cover Map (FCM), ISFR-2023, given in the below table.

TABLE 12 FOREST TYPES IN THE STUDY AREA

S. No.	Forest Type
1	1A/C4 West Coast tropical evergreen forest
2	2A/C2 West Coast semi-evergreen forest
3	3B/C2 Southern moist mixed deciduous forest
4	4B/TS2 Mangrove Forest
5	5/E7 Laterite thorn forest
6	TOF/ Plantation

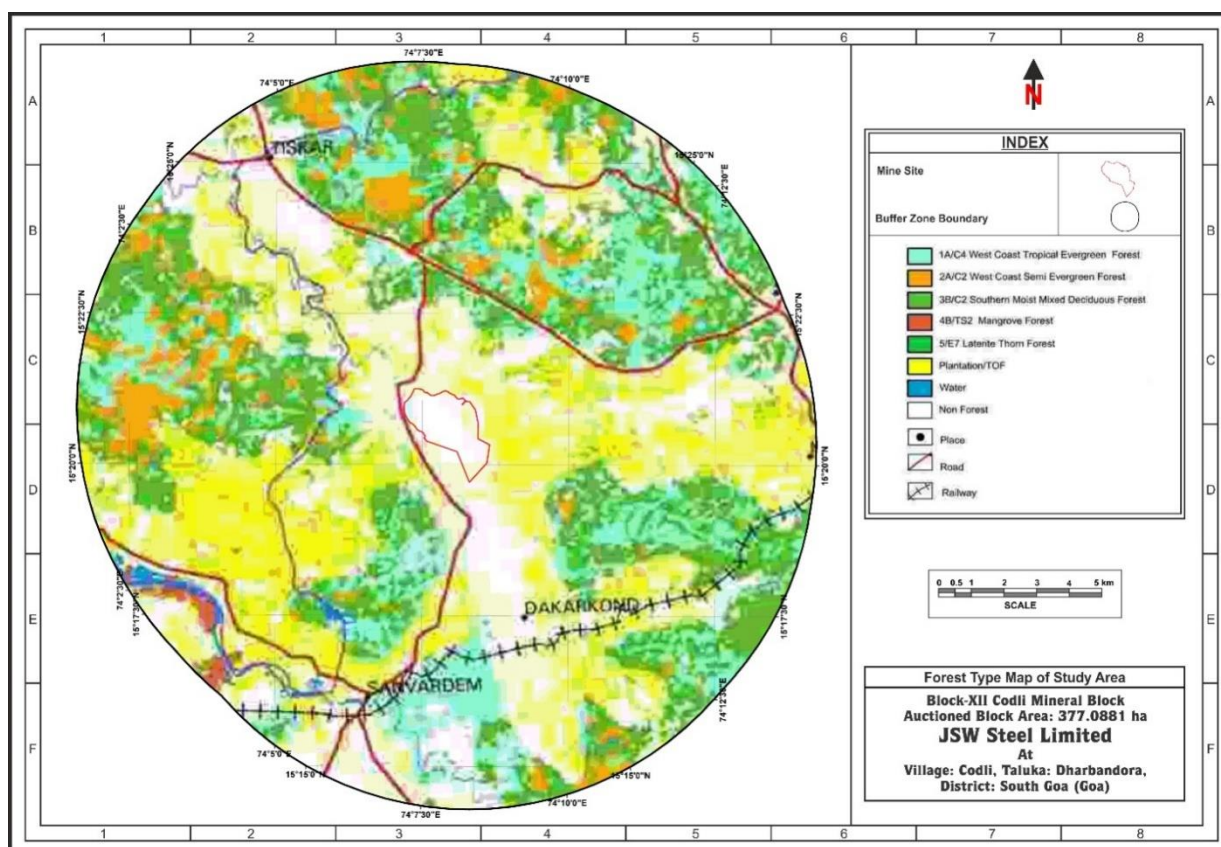


FIGURE 13 FOREST COVER MAP OF THE STUDY AREA

The classification of forest cover in Goa as per the India State of Forest Report 2023 (Volume II) is given below. The report classifies forest cover into various density classes: Very Dense Forest (VDF), Moderately Dense Forest (MDF) and Open Forest (OF).

Details of forest cover classification are given in the below tables and chart.

TABLE 13 FOREST CLASS STATISTICS OF THE STUDY AREA

S. No.	Forest Class	Area in Ha.	Area %
1	Water Bodies	1276	3.18
2	Non-Forest	10,700.00	26.64
3	Open Forest Cover (OF)	14769	36.77
4	Moderately Dense Forest (MDF)	9842	24.50
5	Very Dense Forest (VDF)	3579	8.91
Total		40166	100.00

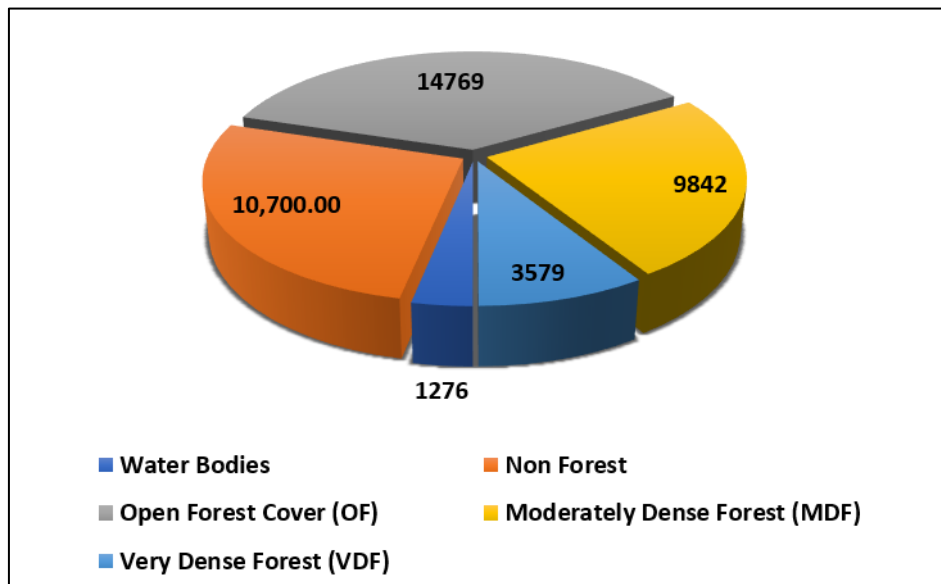


FIGURE 14 GRAPH SHOWING THE FOREST COVER OF THE STUDY AREA

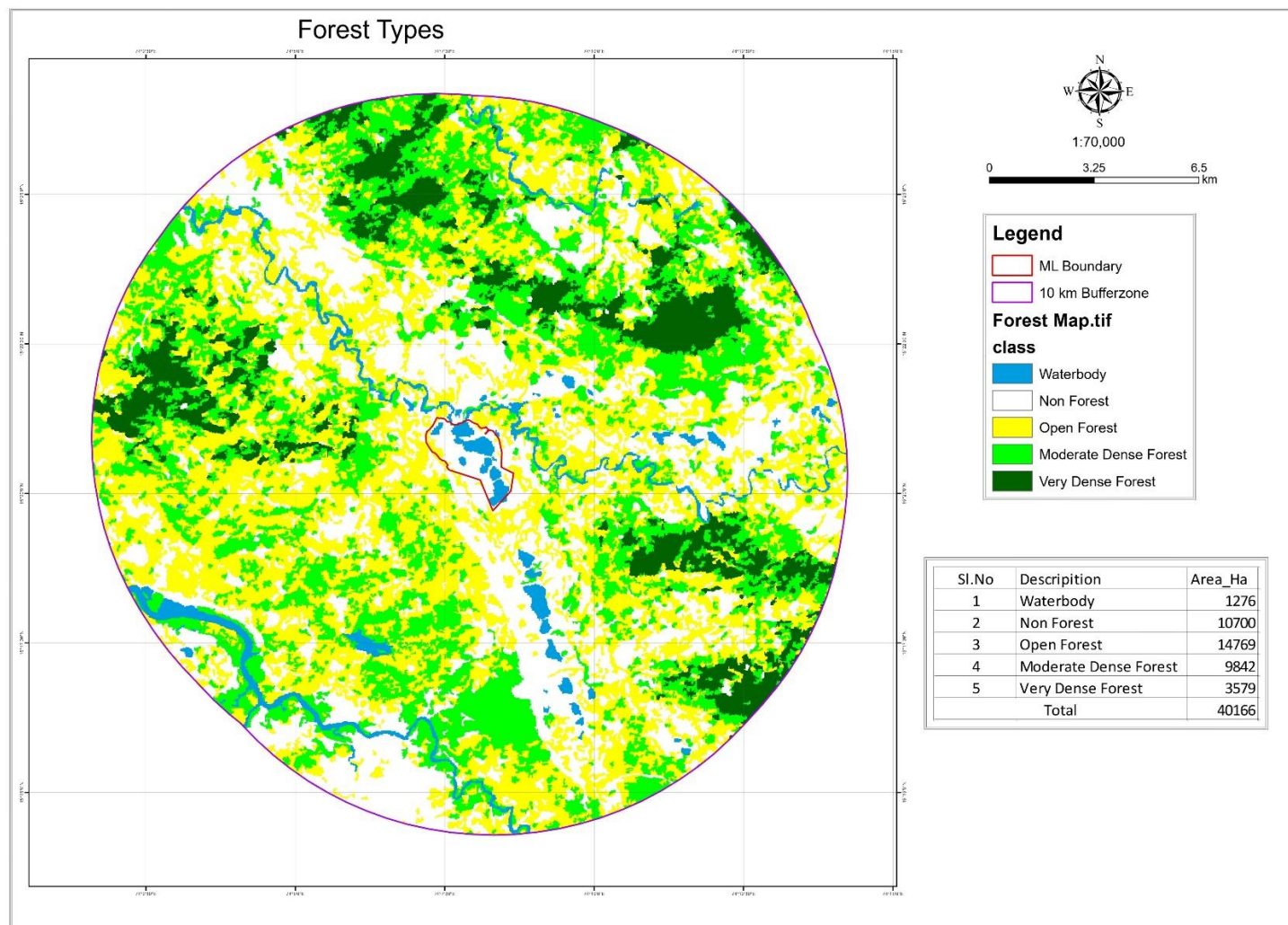


FIGURE 15 MAP SHOWING THE FOREST COVER OF THE STUDY AREA

PROTECTED AREAS IN THE GOA:

Around 20% of total geographical area of the state is dedicated for the proliferation of wildlife as the state of Goa has 6 Wildlife Sanctuaries and 1 National Park. These protected areas are provided with complete protection of the flora and fauna found in the state, helping to conserve its unique and rich biodiversity.

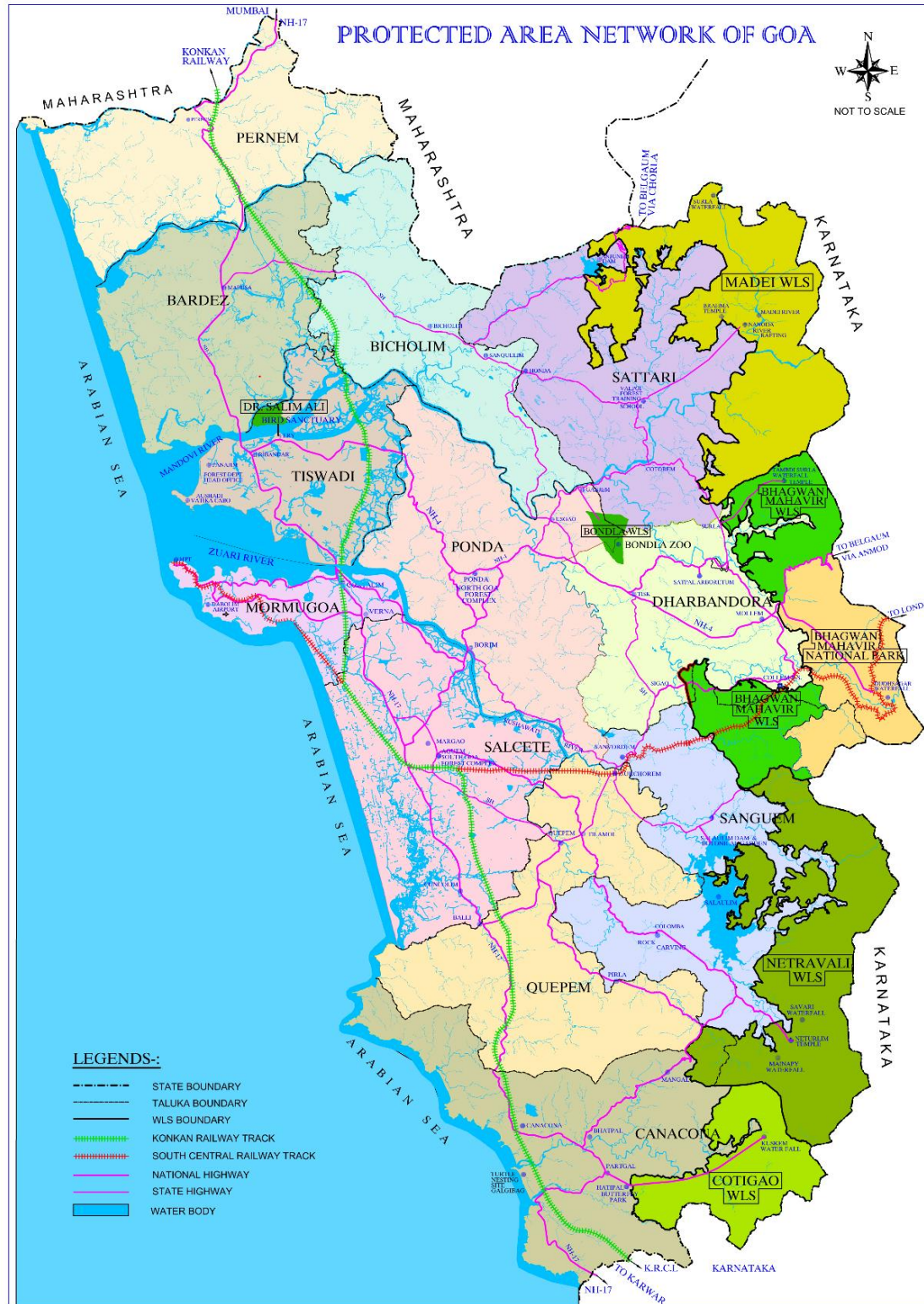


FIGURE 16 PROTECTED AREA NETWORK OF GOA



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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WILDLIFE SANCTUARIES:

Bondla Wildlife Sanctuary is present at ~6.5 km in NNW direction and Bhagwan Mahavir WLS are present at ~1.52 km in SE direction from the project site.

BONDLA WILDLIFE SANCTUARY:

Bondla Wildlife sanctuary is one of seven 'protected areas' in the state of Goa. It is situated in North-eastern region of Goa, covering an area of 7.98 square kilometres.

The Sanctuary is mostly covered with moist deciduous forest with small patches of semi-evergreen forest and cane along streams. The dominant trees in this Sanctuary are *Terminalia crenulata* (the state tree of Goa) and Rosewood. Although this Sanctuary encompasses small area, it is an ideal habitat for wildlife such as Leopard, Jungle Cat, Wild boar, Porcupine, Pangolin & a variety of insects, amphibians, reptiles & birds.

BHAGWAN MAHAVIR WLS & NATIONAL PARK:

Bhagwan Mahavir Wildlife Sanctuary and National Park is spread over an area of 240 Sq km. The Wildlife Sanctuary itself, is spread across an area of 133 sq km while the National Park occupies an area of 107 sq km.

Flora and Fauna

The forest is predominantly semi-evergreen and evergreen type and is abode to a rich diversity of flora and fauna. The notable large mammals are Leopard, Sloth Bear, Gaur and Sambar etc. and Tigers are reported occasionally in Bhagwan Mahavir WLS & NP, there is no scientific proof that the PA has got any resident population of tigers This sanctuary is also home for rich diversity of birds and butterflies.

BHAGWAN MAHAVIR WILDLIFE SANCTUARY:

Area in sq. km: 133

Location (Taluka): Sanguem, Dharbandora

Bhagwan Mahavir Sanctuary is a 133 sq km protected natural habitat located in the Western Ghats of India, on the Goa-Karnataka border. Touted to be Goa's largest wildlife reserve, it is home to the famous Dudhsagar Falls, Mollem National Park, Tambdi Surla Temple and Devil's Canyon among other attractions. It houses a variety of plants, birds and animals.

The forest of these Protected Areas intercepts rainfall and helps recharge ground water aquifer and protects rivers and streams against siltation by minimising soil erosion and has a well-knit network of streams spreading throughout which are perennial or semi perennial or seasonal in nature, feeding Zuvari river, Mandovi river and its canals.

2.2 IDENTIFICATION AND DEMARCATION OF WILDLIFE CORRIDORS PLOTTED ON THE GIS PLATFORMS BASED ON PRIMARY AND SECONDARY DATA AS AVAILABLE:

Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa, wildlife corridors have not been recorded within the project site. However, Bhagwan Mahavir Wildlife Sanctuaries (WLS) is located at approximately ~1.52 Km in SE and Bondla Wildlife Sanctuary ~6.5 Km in NNW form the project site.



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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2.3 IDENTIFY AND DEMARCATATE THE RESERVE FORESTS, PROTECTED FORESTS, PRIVATE FORESTS, ESA'S, ESZ'S, NO DEVELOPMENT ZONES (NDZ) ON CADASTRAL SCALE (1:4000) WITHIN 10 SQ. KMS. RADIUS SURROUNDING THE PROJECT SITE:

Reserve Forests, Protected Forests, Private Forests, Eco-Sensitive Areas (ESAs), Eco-Sensitive Zones (ESZs) and No Development Zones (NDZs) within 10 km radius of the project site were identified and demarcated on map. The demarcation was carried out using GIS platforms based on authenticated secondary data sources such as Forest Department records, Notifications, Revenue cadastral maps and published spatial datasets, supplemented by primary field reconnaissance. The mapped outputs form the basis for assessing potential impacts on wildlife habitats and for formulating appropriate conservation and mitigation measures.

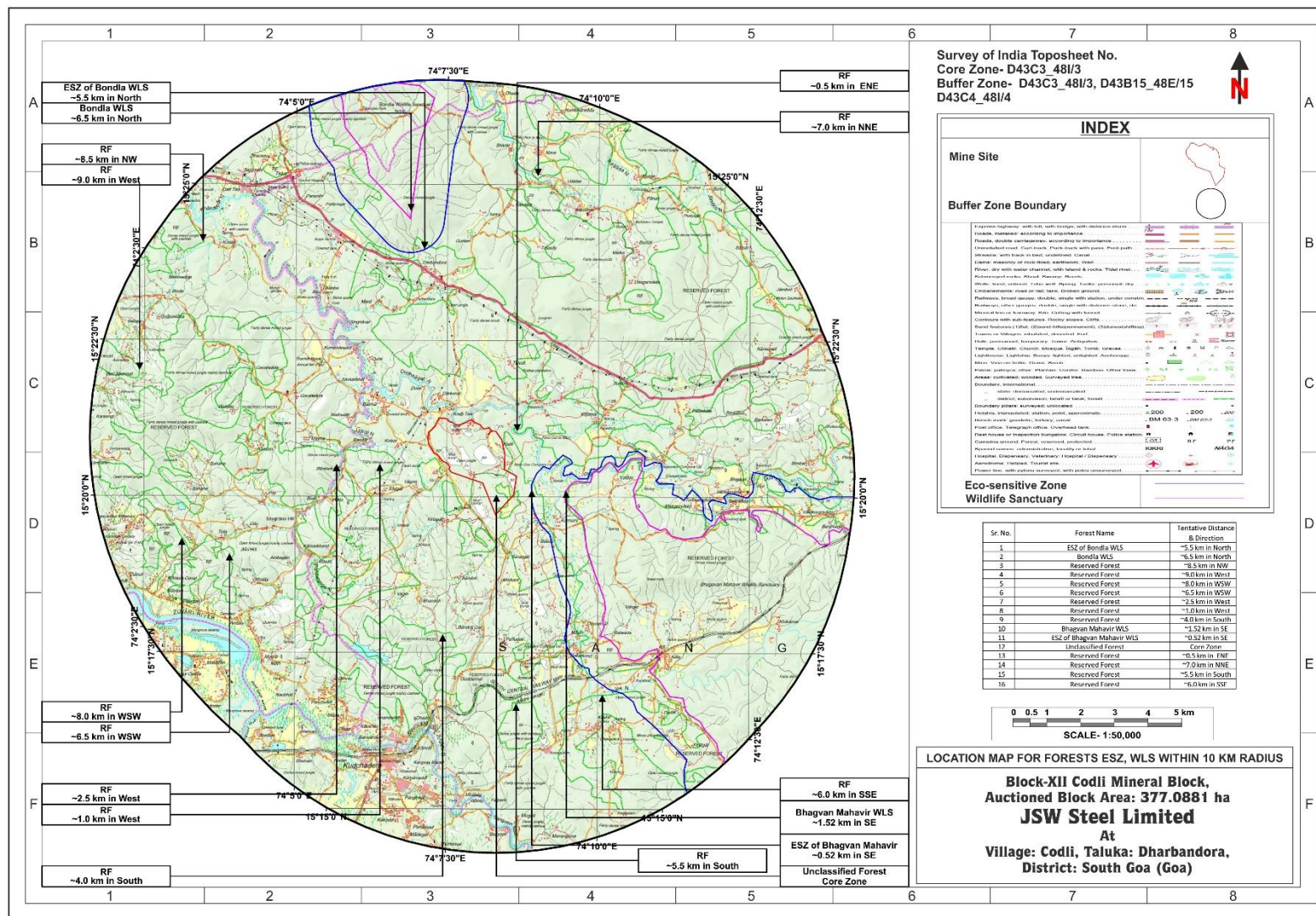


FIGURE 17 LOCATION MAP FOR FORESTS ESZ, WLS WITHIN 10 KM RADIUS

2.4 ASSESSMENT OF RET (RARE, ENDANGERED AND THREATENED) SPECIES FOUND WITHIN 10 SQ. KMS. RADIUS SURROUNDING THE PROJECT SITE USING STANDARD PROTOCOLS:

Rare, Endangered and Threatened (RET) species, as per the IUCN Red List categories of Endangered, Vulnerable and Near Threatened are found within the study area. These species are typically associated with Wildlife Sanctuary and semi-natural habitats and reflect the ecological importance of the landscape. While several RET species are known to occur across the region, some exhibit rare or localized distribution, primarily restricted to relatively undisturbed forest patches. The occurrence of RET species within the study area is largely based on secondary information, indirect evidence and habitat suitability assessments.

TABLE 14 RET SPECIES FOUND WITHIN THE STUDY AREA

S. No.	Scientific Name	Common Name	IUCN Status
Flora			
1	<i>Cinnamomum zeylanicum</i>	Tikhi	EN
2	<i>Dalbergia latifolia</i>	Sisham	VU
3	<i>Garcinia indica</i>	Bhiran	VU
4	<i>Myristica malabarica</i>	Kayphal	VU
5	<i>Syzygium caryophyllatum</i>	Bhedas	VU
6	<i>Tectona grandis</i>	Saylo, Teak	EN
Fauna			
1	<i>Bos gaurus</i>	Gaur / Indian Bison	VU
2	<i>Macaca radiata</i>	Bonnet Macaque	VU
3	<i>Melursus ursinus</i>	Sloth bear	VU
4	<i>Panthera pardus</i>	Leopard	VU
5	<i>Crocodylus palustris</i>	Marsh crocodile	VU
6	<i>Cuon alpinus</i>	Wild dog (Dhole)	EN

Note: VU: Vulnerable, EN: Endangered

FLORAL DIVERSITY:

The study area exhibits a rich diversity of flora, including Trees, Shrubs, Herbs, Grasses and Climber. The presence of various tree species from families like Fabaceae, Anacardiaceae, Moraceae, Meliaceae and others contributes to the ecological complexity.

Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026) there are 114 floral species were recorded within the 10 km radius study area. These include 75 Tree species, 15 Shrub species, 16 Herb species, 6 Grass species and 2 Climber species.

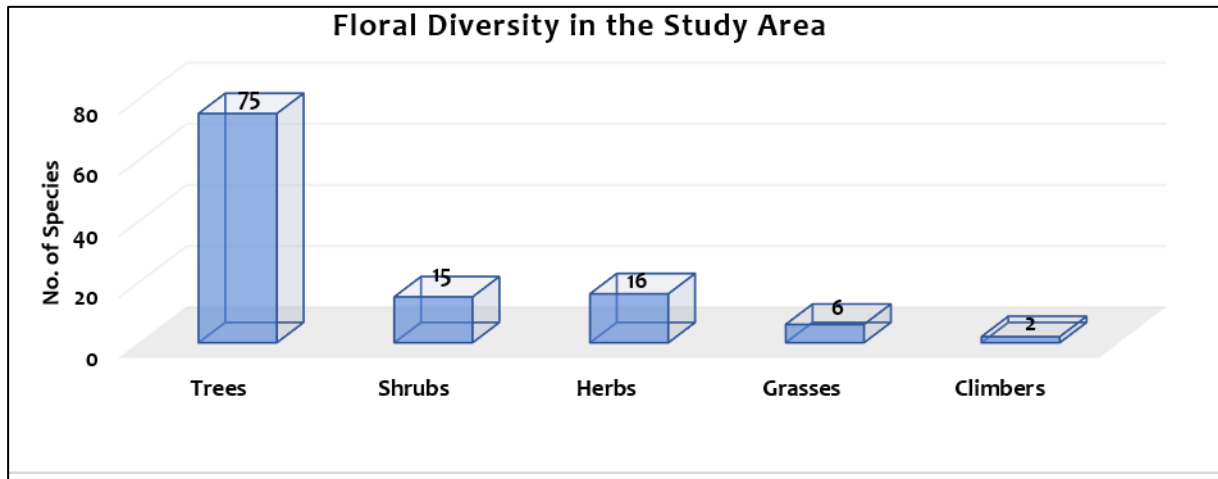


FIGURE 18 GRAPH SHOWING THE FLORAL DIVERSITY IN STUDY AREA

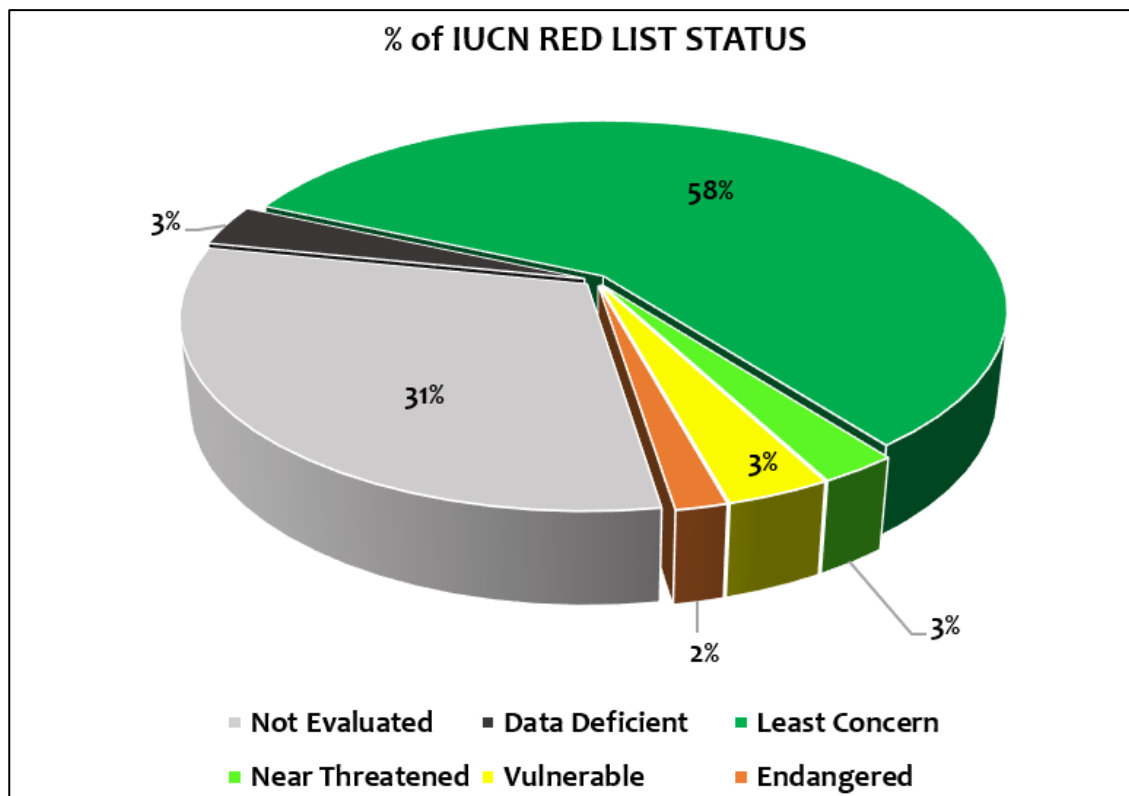


FIGURE 19 CHART SHOWING THE IUCN STATUS OF FLORAL DIVERSIT

FAUNAL DIVERSITY:

Overall, 101 species were recorded within the 10 km radius study area. Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026), these species include 18 of Species Mammals, 60 Species of Birds, 08 Species of Reptiles, 4 Species of Amphibians, 8 Species of Butterflies and 03 Aquatic Species. based on the secondary information including Management Plan of Bhagwan-Mahavir NP & WLS, there are Tiger (*Panthera tigris*), Gour (*Bos gaurus*) etc. present within the WLS area.

There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur / Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site. List of flora & fauna and location map is being **enclosed as Annexure- I**.

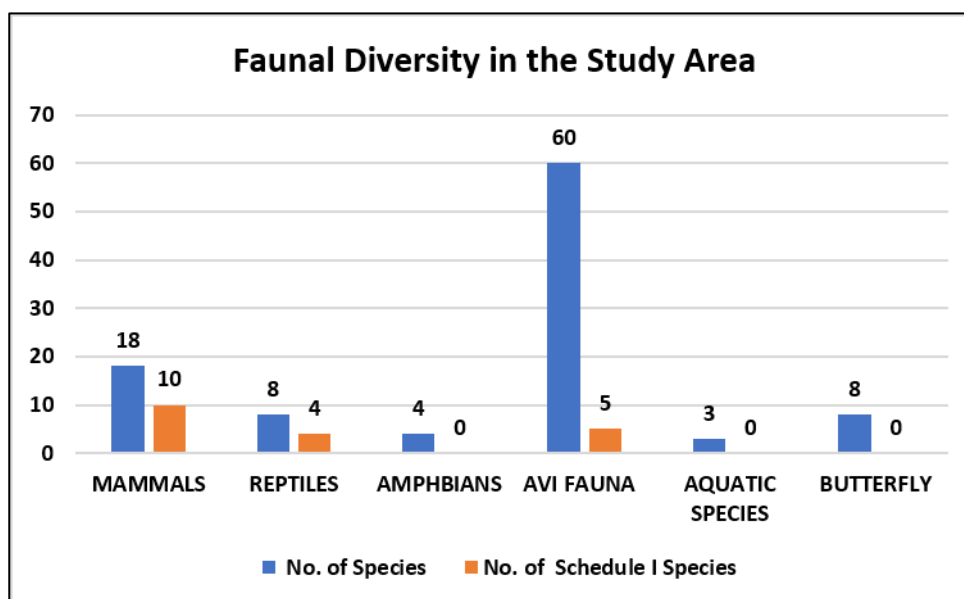


FIGURE 20 GRAPH SHOWING THE FAUNAL DIVERSITY IN STUDY AREA

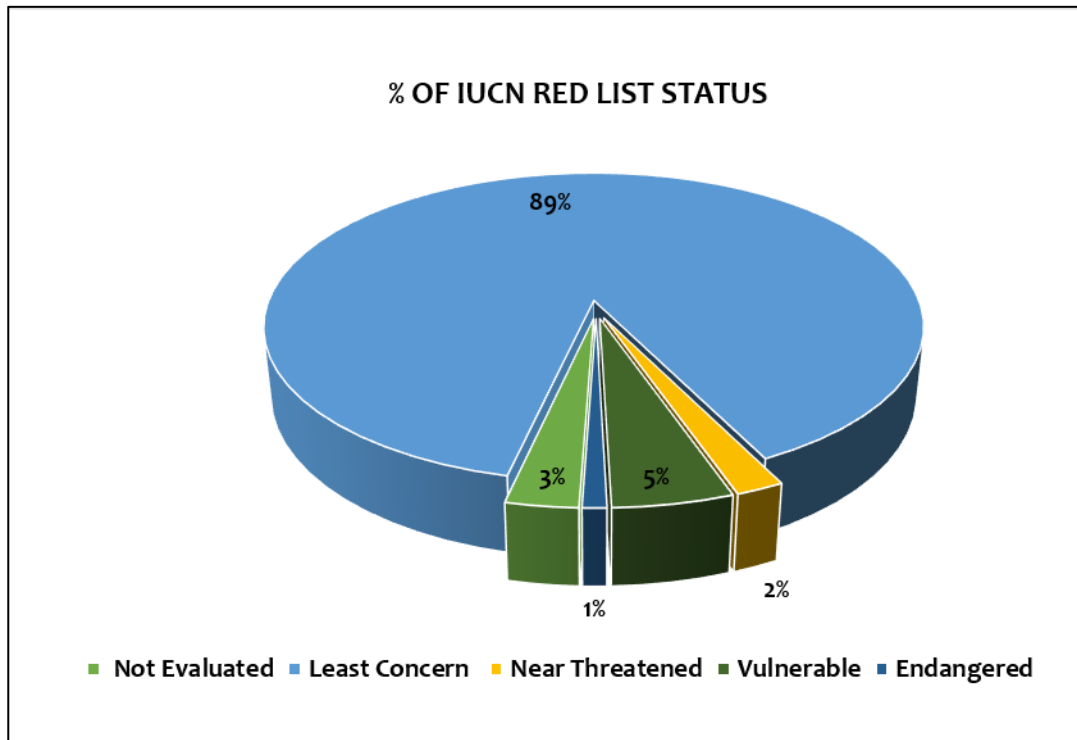


FIGURE 21 CHART SHOWING THE IUCN STATUS OF FAUNAL DIVERSITY

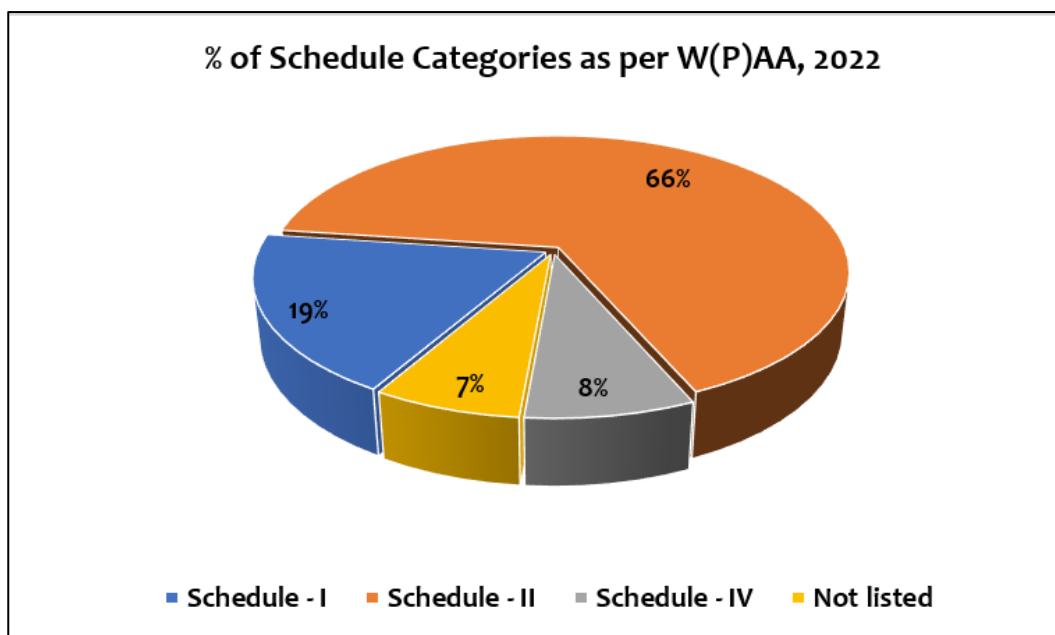
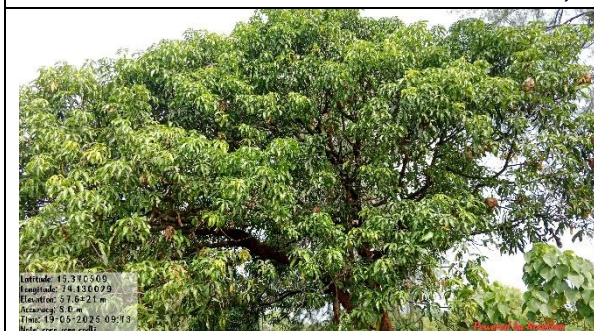


FIGURE 22 CHART SHOWING THE % OF SCHEDULE CATEGORIES OF FAUNAL DIVERSITY



Acacia auriculiformis (Earleaf acacia)



Mangifera indica (Aam)



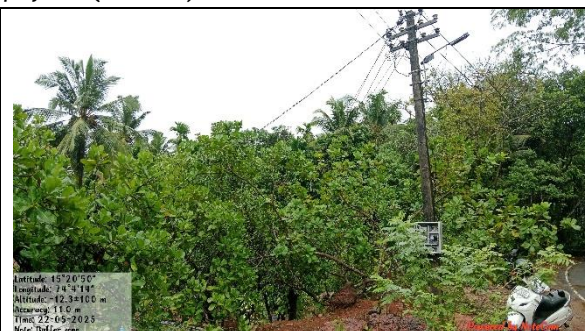
Ziziphus mauritiana (Indian jujube)



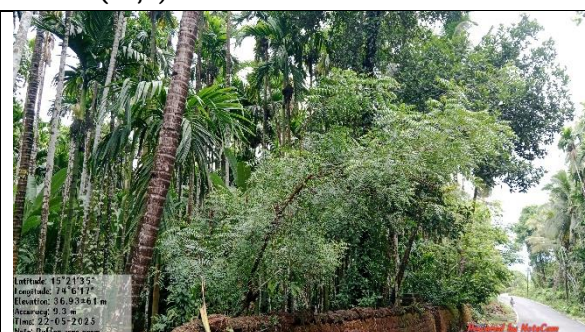
Cocos Sp. (Coconut)



Artocarpus heterophyllus (Jackfruit)

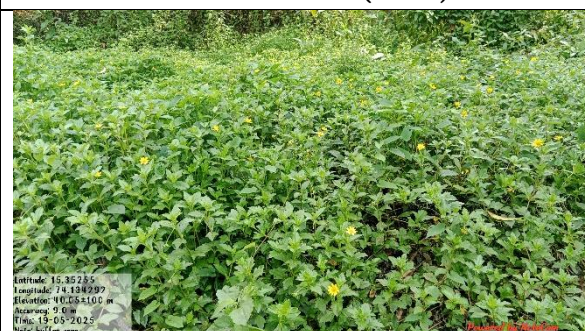
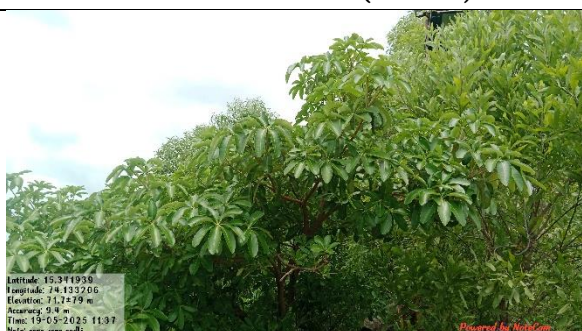


Anacardium occidentale (Kaju)



Bambusa arundinacea (Bambos)

Azadirachta indica (Neem)



Alstonia scholaris (Satan tree)

Sphagneticola trilobata (Wedelia)



Cynodon dactylon (Dub)



Calotropis gigantea (Aak)



Vanellus indicus (Red-wattled lapwing)



Corvus splendens (House Crow)



Copsychus saularis (Oriental magpie-robin)



Columba livia (Rock dove)



Mine Site



FIGURE 23 PHOTOGRAPHS TAKEN DURING SITE VISIT



CHAPTER 3

WILDLIFE AND HABITAT IMPROVEMENT MANAGEMENT STRATEGIES

3.1 PROJECT IMPACTS AND REMEDIAL MEASURES:

- **CLEARLY IDENTIFY AND ASSESS POTENTIAL ENVIRONMENTAL AND ECOLOGICAL IMPACTS OF THE PROJECT ON WILDLIFE AND HABITATS:**

The proposed project activities change in the biodiversity of an area and further directly, indirectly and cumulatively in addition to those of induced in nature. The project activities involve development of approach roads, haulage roads, excavation, constructions & demolitions, storage & transportation of construction materials, loading and unloading etc. All these activities are likely to have some impacts over the surrounding biota. These may depend on the severity and periodicity of impacts on:

✓ **Air Pollution:**

Air pollution can adversely affect both flora and fauna within the study area by altering physiological processes and degrading habitat quality.

IMPACT:

Flora: pollutants such as particulate matter (PM), sulfur dioxide (SO₂), nitrogen oxides (NO_x) and ozone (O₃) can deposit on leaf surfaces, block stomata and interfere with photosynthesis, respiration and transpiration. Prolonged exposure may lead to chlorosis, necrosis, reduced growth and lower productivity, ultimately affecting vegetation composition and ecosystem stability.

Fauna: air pollutants can cause respiratory stress, reduced immunity and behavioral changes, particularly in birds and small mammals. Pollutants may also accumulate through the food chain, indirectly impacting higher trophic levels. Additionally, degradation of vegetation due to air pollution can result in loss of habitat and food resources, thereby affecting species diversity and distribution. Overall, continuous exposure to elevated pollution levels may lead to a decline in ecological health and biodiversity in the region.

MEASURES:

- No drilling and blasting are proposed in this mine.
- Deploying modern fuel-efficient machines.
- Eliminating dust at source by maintaining roads in good condition by deploying motor grader and by spraying of water.
- Development of green cover along the haul roads.
- Emissions levels of the mining machinery are kept under check by carrying out timely maintenance as per manufactures recommendations.
- Arrangements for wheel wash during exit of trucks from mine.
- Preventing overloading of trucks and properly covering the cargo with tarpaulin before the truck goes out of mine.

- Dedicated manpower to clean the ore spillage on the public road by manual sweeping and washing.
- Dust suppression on mines through water sprinkling.
- Use of mechanized road sweeping machine for cleaning the public road.

✓ **Water Pollution:**

No perennial river/stream falls within the lease area. Nearest Khandepar River Adjacent in North and some other water bodies (Rivers/Nallahs) are present within the study area namely; Kale Nala (~ 0.7 km in ESE direction), Udnai nala ~1.5 km in West direction), Panduranga Nala (~5.0 km in SW direction), Ragada Nala (~7.0 km in NNE direction), Sanguem/Zuvari River (~8.0 km in South direction), Jamboli, Nala (~9.0 km in NE direction) and Paroda River (~9.0 km in SSW direction)

IMPACT:

Nearest River is Khandepar River Adjacent in North direction, which may get impacted due to mining operations. Apart from this, the overall adverse impact is expected to be minimal, as the other water bodies are located at a considerable distance from the mining area.

Surface run-off generated from mining activities, particularly during the monsoon season, may influence the surrounding flora and fauna by altering natural drainage patterns and affecting nearby Khandepar River Adjacent in North direction. Run-off from the mine area and internal dumps, even when managed through garland drains and settling ponds, may carry suspended solids that increase turbidity and siltation in receiving water bodies. This can reduce light penetration and adversely affect aquatic vegetation, thereby disturbing primary productivity and habitat conditions. Increased sediment load may also impact benthic organisms and fish by clogging gills, smothering habitats and reducing oxygen availability. Terrestrial flora near drainage channels may experience reduced soil quality due to deposition of sediments, which can affect plant growth. Faunal species dependent on these habitats, including birds and small mammals, may face indirect impacts due to changes in water quality and food availability

MEASURES:

- Retaining Wall & Garland drains will be constructed around the working mine pits waste dump to channelize rain water flowing into working mine pit.
 - Catch drains and siltation ponds will also be constructed within the area to check flow of surface runoff as well as to prevent siltation of natural courses.
 - The rainwater falling directly into the mine pits will be stored and used for plantation & dust suppression.
 - Periodical monitoring of ground water quality will be carried out.
- ✓ **Noise Pollution:** Presently existing noise levels are likely to be altered due to various project activities such as excavation, loading and unloading and the movement of vehicles and machinery.
- Noise generated from mining activities, operation of heavy machinery and movement of vehicles may have localized impacts on flora and fauna within and around the project area. While flora is generally

less sensitive to noise, prolonged exposure may indirectly affect plant growth by altering soil microfauna and pollinator activity. Fauna, particularly birds, mammals and reptiles are more sensitive to elevated noise levels, which may cause disturbance, stress and behavioral changes such as avoidance of the area, disruption in feeding and breeding patterns, and temporary displacement. Continuous or high-intensity noise may also interfere with communication and navigation in wildlife. However, these impacts are expected to be short-term and confined to the vicinity of the mining operations, as noise levels attenuate with distance. With the implementation of appropriate mitigation measures such as maintenance of equipment, and development of greenbelt barriers, the overall impact on flora and fauna is anticipated to be minimal.

MEASURES:

- No drilling & Blasting area proposed.
- Regular maintenance of all HEMM and vehicles will be carried out to maintain minimum noise.
- Proper lubrication, fitting of effective silencers will be carried out.
- Acoustic enclosures will be provided to DG sets.
- Innovative approaches will be carried in machinery designs with inbuilt mechanism to reduce noise emission.
- Operators will be provided with personal hearing protective devices, earmuffs and plugs.
- Development of Greenbelt/plantation in and around the lease area will be developed.
- Personal protective equipment will be provided to all employees working at noisy sites.
- Regular noise monitoring will be carried out.

✓ Soil Degradation & Erosion:

IMPACT:

Probable impact due to project activities involves the removal of vegetation cover and movement of heavy machinery, which collectively contribute to soil degradation and increased soil erosion in and around the project area.

No Top Soil is present within the ML Area, therefore, no impact on soil is envisaged due to mining operation and Beneficiation plant process.

The mine working will involve removal of overburden/waste which will be dumped separately and will be simultaneously used in backfilling.

MEASURES:

The following protection measures will be taken:

- Fugitive dust due to mining activities will mainly be confined within mine area and will not impact soil of buffer zone.
- The rainwater falling directly into the mine sump will be stored and used for plantation & dust suppression.
- At conceptual stage Greenbelt and Plantation will be carried out along ML Boundary, on backfilled area, on Dump Plantation.

- Water sprinkling will be done along the haul roads to control the fugitive emission.

Hence, no major impact on soil of the study area is envisaged due to the proposed mining activities.

In assessing the impacts on the biological environment, it is crucial to comprehensively evaluate various activities associated with the proposed project. These activities could have diverse effects on both flora and fauna. To identify these impacts, it is essential to examine all potential sources capable of creating substantial effects and understand the overall outcomes expected from these activities.

TABLE 15 IMPACT EVALUATION FOR BIOLOGICAL RESOURCES

Impact Evaluation Element	Change in the biological resources of the area due to proposed mineral block and generation of emissions			
Potential Effect/ Concern	Loss of habitat, Impact on health of biological receptors due to area and line sources of air emissions including fugitive dust emissions during operation activities.			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
			√	
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
	√			
Duration	Short – term		Long- term	
	√			
Intensity	Low		Medium	High
	√			
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
				√
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

TABLE 16 SIGNIFICANCE OF IMPACT ON BIOLOGICAL ENVIRONMENT

ISSUES	OBSERVATIONS
Proximity to national park / wildlife sanctuary/ reserve forest/mangroves/ coastline/Wetland/sea	➤ Bondla Wildlife Sanctuary (~6.5 km in North) and ESZ of Bondla WLS (~5.5 km in North), ➤ Bhagwan Mahavir Wildlife Sanctuary (~1.52 km in SE) and ESZ of Bhagwan Mahavir WLS (~0.52 km in SE direction.) ➤ Core zone consists of 65.9686 ha of Forest land.
Activities of the project affects the breeding/nesting sites of birds and animals.	Species of Birds & animals may get affected due to generation of dust and noise & Mining activities, movement of vehicles, etc. The butterfly species may get effected due to lack of availability of the host plant as there may be deposition of dust on the host plants present in the nearby area.
Located near an area populated by rare or endangered species	Most of the faunal species listed in the inventory (of the study area) are majorly local species and seasonal migratory species.
Risk of fall/slip or cause death to wild animals due to project activities	Project activities pose a potential risk of injury or death of wild animals due to accidental encounters with excavation sites, steep pits or heavy machinery. The rescue squad of Forest department will be informed if any such incident occurs.
Project likely to effect migration routes	The project will not likely to have impact on the migration routes as the mining and beneficiation activities are confined within the ML area. Proper mitigation/protection measures will be adopted during the operational phase of the project to minimize the impacts.
Project likely to effect flora of an area, which have medicinal value.	No such significantly important medicinal value species are present within the mineral block area.

• **SUGGEST SPECIFIC REMEDIAL MEASURES TO MITIGATE NEGATIVE IMPACTS, SUCH AS HABITAT RESTORATION, POLLUTION CONTROL, AND DISTURBANCE MINIMIZATION:**

To mitigate potential adverse impacts of the project on wildlife and associated habitats, a combination of preventive, control and restorative measures will be implemented. Habitat restoration measures will include reclamation of disturbed areas through soil stabilization and plantation of native and site-specific species to enhance habitat quality and ecological continuity. Existing natural drainage features will be maintained and water conservation structures will be developed to support local biodiversity.

Pollution control measures will focus on effective management of air, noise and water pollution through dust suppression, controlled use of machinery, maintenance of vehicles, and proper handling and disposal of wastes. Noise-generating activities will be restricted to daytime hours and greenbelt development will be undertaken to act as a buffer against dust and noise.

Disturbance minimization will be manage the regulating vehicular movement and preventing unauthorized entry into surrounding forest areas. Awareness and training programs will be conducted for project personnel on wildlife protection and safe practices. Implementation of these remedial measures is expected to significantly reduce project-related impacts and support the long-term conservation of wildlife and habitats in the area.

CONTROL OF AIR POLLUTION:

Loading & unloading: Continuous Water spray over the areas, proper maintenance of machinery & equipment as per manufactures specification, avoiding over loading of trucks.

Haul Road: Water spray on mine haul roads, speed restriction, proper maintenance of roads & blacktopping of permanent roads, proper maintenance of machinery & equipment as per manufacturers specification.

Mining area: Wide green belt surrounding ML area. Proper maintenance of machinery & equipment. Introducing the state-of-the-art dust suppression system, fixing permanent pipe sprinklers along the haul road in the mine lease area Plantation of trees on the either side of the haul roads to minimize dust emission High canopy plantation (local species like Cashew, Peepal, Arjun & Bamboo etc.) shall be carried out to reduce dust emission.

Transportation: No overloading of trucks, speed restriction, transport by covered vehicles, plantation along the road side proper maintenance of machinery & equipment as per manufactures specification, PUC for transport vehicle, maintenance of surrounding transport roads.

Following mitigation measures will be adopted to mitigate air pollution generated due to the mine activities:

- Regular water sprinkling on haulage roads & at loading & unloading site to arrest dust from becoming air borne.
- Speed limit will be enforced to reduce airborne fugitive dust from vehicular traffic.
- Pollution under control (PUC) checking of transport vehicles will be done in every six months for periodical monitoring.
- Gaseous emissions from HEMM will be kept within limits by proper maintenance of all machineries.
- Fugitive dust emissions will be monitored and records will be maintained properly.
- Personal protective equipment such as Dust masks will be provided to the workers & operators working in dusty zones.
- Regular Ambient Air Quality Monitoring will be carried out.
- Greenbelt of 7.5 m width will be developed along the lease periphery and the same will be maintained.
- Regular road cleaning through road sweeping machine will be done as per the requirement.
- Fugitive dust pollution suppression will be carried out by means of water spraying.
- Well maintained trucks conforming to the norms laid down by the state transport authority and having valid Pollution under Control Certificate (PUC) will be engaged for transporting raw material and product.



- Major part of transportation route for finished product is tarred. Remaining small portion of the route for transportation of mineral will be maintained by motor grader and water sprinkled by water tanker for dust suppression.

CONTROL OF NOISE POLLUTION:

The noise generated from mining activities is not expected to reach the nearby areas. Further, mining will be carried out by Ripper-dozer combination without Drilling, hence, there will be no generation of noise & vibration due to these activities. Greenbelt will be developed all along the ML periphery.

Following management/mitigation measures will be adopted to control noise levels:

- No drilling & Blasting area proposed.
- Regular maintenance of all HEMM and vehicles will be carried out to maintain minimum noise.
- Proper lubrication, fitting of effective silencers will be carried out.
- Acoustic enclosures will be provided to DG sets.
- Innovative approaches will be carried in machinery designs with inbuilt mechanism to reduce noise emission.
- Operators will be provided with personal hearing protective devices, earmuffs and plugs.
- Development of Greenbelt/plantation in and around the lease area will be developed.
- Personal protective equipment will be provided to all employees working at noisy sites.
- Regular noise monitoring will be carried out.

CONTROL OF WATER POLLUTION:

- Recirculation of process water, thereby significantly reducing discharge volumes.
- Provision of adequate treatment units for the removal of suspended solids and pH neutralization, where necessary.
- Removal of oil and grease from contaminated water using appropriate separation technologies.

These integrated measures aim to ensure environmentally responsible water management throughout the mining and beneficiation process.

CONTROL OF WATER POLLUTION:

The following steps will be taken to reduce pollution level:

- Retaining Wall & Garland drains will be constructed around the working mine pits waste dump to channelize rain water flowing into working mine pit.
- Catch drains and siltation ponds will also be constructed within the area to check flow of surface runoff as well as to prevent siltation of natural courses.
- The rainwater falling directly into the mine pits will be stored and used for plantation & dust suppression.
- Periodical monitoring of ground water quality will be carried out.
- Attempts will be made to use high-capacity dumpers to reduce traffic density.
- The present road condition is good for proposed movement of traffic.

- However, take necessary steps to strengthen and maintain the road condition and traffic movements during the operation.

CONTROL OF POLLUTION DUE TO INCREASE IN TRAFFIC:

3.2 RET (RARE, ENDANGERED, THREATENED) SPECIES SPECIFIC CONSERVATION PLAN:

The project area includes forest land that will be utilized for mining purposes. Wildlife conservation and management is complex and need to be considered with respect to multifaceted factors such as food-web, resources competitions, anthropogenic, forest fragmentation and sociological issues such community livelihoods, culture, ethics and forest dependency so on. As per the amendment in Wildlife Protection Act, 1972 dated 20th Dec., 2022 (which came into force from 1st April, 2023) there are 19 Schedule - I species found within 10 km radius study area.

HIGHLIGHT SPECIES OF CONSERVATION CONCERN IN THE PROJECT AREA GIVEN IN BELOW TABLE:

TABLE 17 LIST OF SCHEDULE-I SPECIES IN THE CORE & BUFFER ZONE OF PROJECT SITE

S. N	SCIENTIFIC NAME	COMMON NAME	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
MAMMALS						
1	<i>Bos gaurus</i>	Gaur / Indian Bison	-	+	I	VU
2	<i>Canis aureus</i>	Golden jackel	+	+	I	LC
3	<i>Cuon alpinus</i>	Wild dog (Dhole)	-	+	I	EN
4	<i>Hystrix indica</i>	Indian Crested Porcupine	-	+	I	LC
5	<i>Macaca radiata</i>	Bonnet Macaque	-	+	I	VU
6	<i>Melursus ursinus</i>	Sloth bear	-	+	I	VU
7	<i>Moschiola indica</i>	Mouse deer	-	+	I	LC
8	<i>Panthera pardus</i>	Leopard	+	+	I	VU
9	<i>Ratufa indica</i>	Malabar giant squirrel	-	+	I	LC
10	<i>Urva edwardsii</i>	Grey Mongoose	+	+	I	LC
REPTILES						
1	<i>Crocodylus palustris</i>	Marsh crocodiles	-	+	I	VU
2	<i>Naja naja</i>	Indian Cobra	-	+	I	LC
3	<i>Ptyas mucosa</i>	Rat Snake	-	+	I	LC
4	<i>Varanus bengalensis</i>	Monitor Lizard	-	+	I	NT
AVI FAUNA						
1	<i>Accipiter badius</i>	Shikra	+	+	I	LC
2	<i>Haliastur indus</i>	Brahminy Kite	-	+	I	LC
3	<i>Nisaetus cirrhatus</i>	Crested Hawk Eagle	-	+	I	LC
4	<i>Pavo cristatus</i>	Indian Peafowl	+	+	I	LC
5	<i>Strix leptogrammica</i>	Brown Wood Owl	-	+	I	LC

Source: Based on actual sightings and information gathered from locals and Management-Plan-of- Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026).

Abbreviations: LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered.

- **PROVIDE SPECIFIC MANAGEMENT STRATEGIES FOR EACH RET SPECIES (E.G., HABITAT PROTECTION, MONITORING, BREEDING PROGRAMS):**

1 *Bos gaurus* (Gaur/Indian Bison):

DISTRIBUTION AND HABITAT:

Geographic Range: The Indian Bison Found in Indian subcontinent and Southeast Asia, with its geographical ranges extending from India, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Cambodia, Laos, Vietnam, and Malaysia.

Preferred Habitat: The gaur primarily inhabits hilly forests, characterized by large, undisturbed tracts of forest, particularly evergreen and semi-evergreen forests. **PHYSICAL DESCRIPTION:**

Size: Adult Males can Stand up to 2.2 meters (7 feet) tall and weigh between 840 kg to 1,500 kg.



Appearance:

Indian Bison have dark brown to black coat with white or pale “stockings” on their legs, and large, curved horns that can reach up to 115 centimeters (45 inches) in length.

DIET:

Indian Bison are Herbivores, feeding on grasses, leaves, shoots, fruits and bark, playing a crucial role in maintaining plant diversity in their ecosystem.

CONSERVATION STATUS AND THREATS:

IUCN Red List: The Indian Bison is classified as Vulnerable. It has a stable population and a wide distribution. The main threats to Indian Bison include habitat loss and degradation due to deforestation, urbanization and agricultural expansion. And Poaching, Disease spread from livestock.

CONSERVATION MEASURES:

Conservation efforts for Indian Bison involve protecting their natural habitats, implementing sustainable land-use practices and reducing human-wildlife conflicts. This can include creating protected areas, establishing corridors to connect fragmented habitats and promoting responsible logging and land management practices. Educating local communities about the importance of porcupines and promoting coexistence measures can help reduce conflicts. Enforcing hunting regulations and implementing measures to prevent road accidents, such as wildlife crossings or speed reduction zones, are also important for their conservation.

Conservation efforts focus on habitat protection and management. In areas where they are threatened by hunting, regulations are in place to control hunting and trade.

2 *Canis aureus* (Golden Jackal):

DISTRIBUTION AND HABITAT:

The Golden Jackal is widely distributed throughout the Indian subcontinent and occurs across most parts of India, including Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Uttar Pradesh, Chhattisgarh, Odisha, Karnataka, Telangana, Andhra Pradesh, West Bengal, Assam, and several other states. It inhabits a wide variety of landscapes including scrublands, grasslands, open forests, agricultural fields, wetlands, riverine habitats, village outskirts, and degraded forest areas. The species is highly adaptable and is commonly found in human-modified landscapes, provided adequate food and cover are available.



PREFERRED HABITAT:

Golden Jackal inhabits a wide variety of landscapes including scrublands, grasslands, open forests, agricultural fields, wetlands, village outskirts, and degraded forest areas. The species is highly adaptable and is commonly found in human-modified landscapes, provided adequate food and cover are available.

PHYSICAL DESCRIPTION:

The Golden Jackal is a medium-sized wild canid with a slender body, long legs, pointed muzzle, erect ears, and a bushy tail. Its coat colour varies seasonally and geographically, ranging from golden-yellow or tawny to greyish-brown, often with darker hairs on the back. The underparts are generally lighter in colour.

size:

Body Length: 70-105 cm.

Tail Length: 20–30 cm.

Weight: Adults weigh between 6-12 kg (13.2–26.5 lbs).

DIET:

Feeding Habits: Carnivorous, with a diverse diet including ungulates (e.g., smaller mammals (e.g., hares, monkeys), birds, reptiles and occasionally insects.

CONSERVATION STATUS AND THREATS:

The IUCN Red List classifies the Golden Jackal as Least Concern (LC) owing to its wide distribution, large population, and high ecological adaptability. The major threats to the jackal include:

Habitat Loss and Fragmentation: Expanding agriculture, deforestation, urbanization and infrastructure development are causing significant loss and fragmentation of leopard habitats.

Human-Wildlife Conflict: Natural habitats shrink and prey becomes scarce and due to predation and poultry and small livestock.

Disease Transmission: Disease Transmission from Domestic and Feral Dogs (rabies, canine distemper and parvovirus.)

Road Accidents: Increasing traffic in and around protected areas poses a threat to Golden jackal through road

accidents, leading to injury and mortality.

CONSERVATION MEASURES:

Protected Areas: Efforts to conserve leopards include establishing and maintaining protected areas and wildlife reserves.

Habitat Protection and Management: Conservation and restoration of scrublands, grasslands, wetlands, and open forest habitats.

Mitigating Human-Wildlife Conflict: Implementing strategies to reduce human-wildlife conflict is essential for the long-term survival of Jackals. This includes raising awareness among local communities about Jackals behaviour and safety measures.

Prey Base Management: Implementing conservation measures to ensure healthy and viable populations of Jackal prey species is crucial. This includes regulating hunting, protecting prey habitats.

Monitoring and Research: Regular population assessments, monitoring Jackal movements and behaviour through camera trapping and radio-collaring and undertaking genetic studies are essential for understanding population trends and informing conservation strategies.

Awareness and Education: Raising public awareness about the ecological importance of leopards and the threats they face is crucial for garnering support for conservation efforts.

- Community awareness programmes to reduce human-jackal conflicts and discourage retaliatory killing.
 - Install sign boards along the mining / civil roads in the wildlife landscape about cautioning the divers to go slowly and watchfully to prevent hitting the wildlife.
 - Install the sign boards / Posters about importance of wildlife and how to prevent any instances of attack.
- Monitoring and facilitating:
- Establish a network of informers / watchers to monitor the movement of wildlife provide communication gadgets such as walkie talkie to them.
 - Use camera traps to monitor the regular movement of Jackals.

3 *Cuon alpinus* (Wild dog (Dhole))

DISTRIBUTION AND HABITAT:

The Dhole is an animal native to Central Asia and South and Southwest Asia. Its range spreads from the Altai Mountains in Manchuria southwards through the forested areas of Burma and India.

Natural Habitats: The Dhole mainly lives open spaces and is often found on the jungle roads, jungle clearings, river beds and paths, resting during the day and wild dog also inhabits dense forest steppes, hills and thick jungles on the plains.

Human-modified Landscapes: Plantations (especially coconut and fruit orchards), agricultural areas and increasingly, urban and peri-urban settlements. They are often found in close proximity to human dwellings, including temples and tourist spots, where they frequently receive food handouts. While adaptable, their reliance on human-provided food in some areas can lead to dependency and





potential conflict.

PHYSICAL DESCRIPTION:

The dhole is a canine of average size. It is different from other dog family members with its thicker muzzle, one fewer molar tooth in its lower jaw on each side, and extra teats. Its fur is thick and dense, with the color ranging from pale golden yellow to dark reddish-brown to greyish brown. The dhole's underparts, such as its throat, chest, belly, the insides of its legs, and its paws, are paler or white.

dhole's eyes are amber-colored. Its rounded ears have paler or white fur, and its bushy tail has a tip of a darker color, mostly black. On its back, there is often a patch of darker fur. In general, dholes that live in northern regions have lighter and longer fur than those in southern regions.

DIET:

Dholes are omnivores; packs feast on mammals, anything from rodents to deer and including wild pigs, wild goats, hares, sheep, and monkeys. They can also eat insects, and lizards. Dholes eat fruit and vegetable matter more readily than other canids. In captivity, they eat various kinds of grasses, herbs, and leaves, seemingly for pleasure rather than just when ill.

CONSERVATION STATUS AND THREATS:

The IUCN Red List currently classifies the Wild dog as Endangered. This status reflects significant population declines observed across their range, driven by a combination of factors:

Habitat Loss and Fragmentation: Rapid urbanization, agricultural expansion, deforestation and infrastructure development (e.g., roads, dams) lead to the destruction and fragmentation of their natural habitats. This reduces available foraging grounds and isolates populations.

Road Accidents: Their presence on roadsides, often due to food availability from human handouts, makes them highly susceptible to vehicle collisions, leading to significant mortality.

CONSERVATION MEASURES:

Habitat Protection and Restoration:

Protected Areas: Strengthening the protection and management of existing national parks, wildlife sanctuaries and reserve forests where Dhole's occur.

Corridors: Identifying and establishing wildlife corridors to connect fragmented habitats, allowing for genetic exchange and movement of populations.

Awareness Programs: Educating local communities about Dhole's behaviour, the importance of avoiding direct feeding and strategies to minimize conflict.

Research and Monitoring:

Regular monitoring of Wild Dog (Dhole's) populations to assess their numbers, distribution and health.

Research into their feeding habits, social dynamics and interaction with humans to develop more effective conflict mitigation strategies. Conducts research on primate ecology and habitat use, informing site-specific conservation strategies.

Community Engagement:

Involving local communities in conservation initiatives, including promoting responsible tourism that minimizes

negative impacts. Developing sustainable livelihood options that reduce reliance on activities that lead to habitat degradation.

4 *Hystrix indica* (Indian Porcupine):

DISTRIBUTION AND HABITAT:

Geographic Range: The Indian Porcupine is found across the Indian subcontinent, including India, Nepal, Bhutan, Bangladesh and parts of Sri Lanka. They also inhabit parts of Pakistan.

Preferred Habitat: They are versatile and can live in a variety of habitats, including forests, grasslands and scrublands. They are also found in agricultural areas and can adapt to human-modified landscapes.



PHYSICAL DESCRIPTION:

Size: Adult Indian Porcupines typically measure 60–90 cm in body length, with an additional 20–30 cm for the tail. They weigh between 5–15 kg.

Appearance: They have a distinctive appearance with a coat covered in quills and spines. Their fur is typically brown or black, with varying patterns of white or yellowish quills. The quills are sharp and serve as a defense mechanism against predators.

DIET:

Indian Porcupines are primarily herbivorous. Their diet includes roots, tubers, fruits, leaves and bark. They are known to feed on agricultural crops and can sometimes cause damage to crops.

CONSERVATION STATUS AND THREATS:

IUCN Red List: The Indian Porcupine is classified as Least Concern. It has a stable population and a wide distribution.

The main threats to porcupines include habitat loss and degradation due to deforestation, urbanization and agricultural expansion. They are also hunted for their meat, quills and for perceived threats to crops or property. Road accidents are another significant threat, as porcupines are often hit by vehicles when crossing roads.

CONSERVATION MEASURES:

Conservation efforts for porcupines involve protecting their natural habitats, implementing sustainable land-use practices and reducing human-wildlife conflicts. This can include creating protected areas, establishing corridors to connect fragmented habitats and promoting responsible logging and land management practices. Educating local communities about the importance of porcupines and promoting coexistence measures can help reduce conflicts. Enforcing hunting regulations and implementing measures to prevent road accidents, such as wildlife crossings or speed reduction zones, are also important for their conservation.

Conservation efforts focus on habitat protection and management. In areas where they are threatened by hunting, regulations are in place to control hunting and trade.

5 *Macaca radiate* (Bonnet Macaque):

DISTRIBUTION AND HABITAT:

The Bonnet Macaque is native to peninsular India, primarily found across the southern states of Telangana Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra and Tamil Nadu.

This species exhibits remarkable habitat adaptability, thriving in a wide range of environments:

Natural Habitats: Indian Evergreen high forests, moist and dry deciduous forests and woodlands.

Human-modified Landscapes: Plantations (especially coconut and fruit orchards), agricultural areas and

increasingly, urban and peri-urban settlements. They are often found in close proximity to human dwellings, including temples and tourist spots, where they frequently receive food handouts. While adaptable, their reliance on human-provided food in some areas can lead to dependency and potential conflict.



PHYSICAL DESCRIPTION:

The Bonnet Macaque is generally grey-brown or golden-brown. And a medium-sized primate Males are larger than females. Males typically have a head-body length of 51.5–60 cm and weigh 5.4–11.6 kg. Females are 34.5–52.5 cm long and weigh 2.9–5.5 kg. Their tails are long, often exceeding their body length, measuring 48–69 cm and are used for balance.

The most notable characteristic is the "bonnet" of hair on the crown of their head, a whorl of hair radiating outwards that gives them their name.

DIET:

Bonnet Macaques are omnivorous and opportunistic feeders with a varied diet, reflecting their adaptability to diverse habitats

Natural Diet: Primarily frugivorous, their diet in natural habitats includes a wide variety of fruits, nuts, seeds, flowers, buds, young leaves, tree bark and roots from numerous plant species. They also consume invertebrates like termites, larvae, caterpillars, occasionally birds' eggs and small vertebrates. They have also been observed eating moist soil.

Human-Commensal Diet: In areas close to human settlements, their diet often includes food given by people, raided crops (e.g., cereals, coconut, areca nut) and scavenging from markets and waste. This commensal relationship, while providing food, can lead to nutritional imbalances and increased human-wildlife conflict.

CONSERVATION STATUS AND THREATS:

The IUCN Red List currently classifies the Bonnet Macaque as Vulnerable. This status reflects significant population declines observed across their range, driven by a combination of factors:

Habitat Loss and Fragmentation: Rapid urbanization, agricultural expansion, deforestation and infrastructure development (e.g., roads, dams) lead to the destruction and fragmentation of their natural habitats. This



reduces available foraging grounds and isolates populations.

Human-Wildlife Conflict: As habitats shrink, macaques increasingly forage in human-dominated areas, leading to crop raiding, property damage and competition for resources. This often results in retaliatory killings by farmers and local residents, including poisoning, trapping and direct persecution.

Road Accidents: Their presence on roadsides, often due to food availability from human handouts, makes them highly susceptible to vehicle collisions, leading to significant mortality.

Competition with Rhesus Macaques: In some northern parts of their range, the Bonnet Macaque faces competition from the more aggressive Rhesus Macaque (*Macaca mulatta*), which is expanding its range southward due to habitat changes and human influence. This inter-species competition can displace Bonnet Macaque populations.

Disease Transmission: Close proximity to humans can also increase the risk of disease transmission between macaques and humans.

CONSERVATION MEASURES:

Habitat Protection and Restoration:

Protected Areas: Strengthening the protection and management of existing national parks, wildlife sanctuaries and reserve forests where Bonnet Macaques occur.

Corridors: Identifying and establishing wildlife corridors to connect fragmented habitats, allowing for genetic exchange and movement of populations.

Food Tree Plantations: In areas with human interaction, planting fruit-bearing trees can provide alternative food sources, reducing reliance on human handouts and mitigating conflict.

Awareness Programs: Educating local communities about macaque behaviour, the importance of avoiding direct feeding and strategies to minimize conflict.

Waste Management: Improving waste management in urban and temple areas to reduce attractive food sources for macaques.

Research and Monitoring:

Regular monitoring of Bonnet Macaque populations to assess their numbers, distribution and health. Research into their feeding habits, social dynamics and interaction with humans to develop more effective conflict mitigation strategies. Conducts research on primate ecology and habitat use, informing site-specific conservation strategies.

Community Engagement:

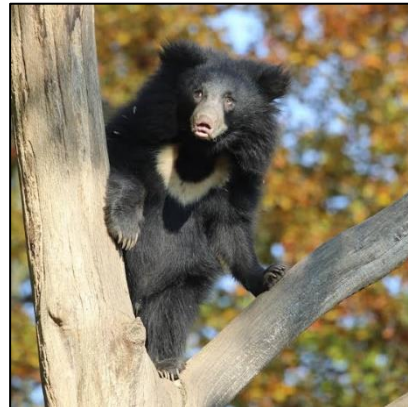
Involving local communities in conservation initiatives, including promoting responsible tourism that minimizes negative impacts on macaques. Developing sustainable livelihood options that reduce reliance on activities that lead to habitat degradation.

6 *Melursus ursinus* (Sloth bear):

DISTRIBUTION AND HABITAT:

Geographical Range: The Sloth bear is endemic to the Indian Subcontinent. Sloth bears are present in India, Nepal, Sri Lanka, some area of Bhutan and sloth bears are distributed from the southern tip of the Western Ghats Mountains to the foothills of the Himalayas.

Preferred Habitats: Sloth bears are primarily a lowland species and are found in a wide variety of habitats on the Indian Subcontinent. On Indian mainland, their habitat may include wet or dry tropical deciduous forests, savannas, scrublands, grasslands, and evergreen forest.



PHYSICAL DESCRIPTION:

The sloth bear (*Melursus ursinus*) is characterized by its long, shaggy black coat and a distinctive white or cream-colored chest marking that resembles a "U" or "Y" shape. It has a long, flexible snout and large nostrils, which are adaptations for feeding on termites and ants. The sloth bear also has long, sickle-shaped claws on its front feet, which are used for digging into termite mounds. Its body structure is awkward, with large feet and a relatively short tail, making it unique among bear species.

Size: body length 140 cm to 190 cm.

Weight: 80 to 175 kg (176 to 386 lbs) for males, 55 to 95 kg (121 to 209 lb) for females.

Life Span: 25 to 28 years in wild and up to 40 years in captivity.

DIET:

Main Diet: The sloth bear is omnivorous and consumes large amounts of vegetable matter, particularly fruit. Sloth bears rarely prey on other mammals as well as eggs, carrion, fruit, and other plant matter according to season. They feed on the fallen flowers of mahua (*Machuca indica*) and mango, sugar cane, maize from farms, pods of Cassia fistula, and fruits of the jack tree (*Artocarpus heterophyllus*). Sloth bears may opportunistically feed on carrion.

Myrmecophagous: Termites, Odontotermes, Microtermes, Hypotermes, large red ants, black ants, beetles (Mostly dung beetles), Bees, Honey, bees wax.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Classified as Vulnerable, Sloth bears are widespread and abundant, although they face some threats from habitat loss and human conflict.

Habitat Loss: Destruction and fragmentation of their natural habitats due to urbanization, agricultural expansion and deforestation are significant threats. This loss of habitat disrupts their natural living spaces and can lead to population declines.

Illegal Wildlife Trade: Poaching of sloth bears is primarily conducted for the commercial trade in bear parts.

Human-Wildlife Conflict: Such incidents tend to occur where people frequently use bear habitat or where the habitat has become severely degraded. In some parts of India, such as North Bilaspur, reduced cover and food

resources outside protected areas have led to increased bear-human conflicts, including frequent mauulings. Ultimately, bears that attack or threaten people are often destroyed. The relationship of sloth bears and humans can be costly for both species. Bear-human interactions include attacks on humans and retaliatory attacks by humans. Poaching is mainly conducted for the trade in bear body parts.

Captivity: the capture of live cubs for use as dancing bears still remains a threat to the bears in parts of India.

CONSERVATION MEASURES:

To ensure the protection and conservation of the Indian Rat Snake, several measures and strategies can be implemented:

Habitat Preservation: Establish and protect conservation areas, reserves and wildlife corridors to maintain the Sloth bears natural habitats. Initiatives to prevent habitat destruction and fragmentation are crucial for their survival.

Awareness and Education: Conduct educational programs and campaigns to raise awareness about the importance of Sloth Bears in the ecosystem. Educating local communities and the public about the role and significance of these can help dispel misconceptions and reduce human-Bear conflict.

Legal Protection: Enforce and strengthen wildlife protection laws to prevent illegal trade, poaching and deliberate killings of these. Implement penalties for those engaging in the illegal pet trade or causing harm to the species.

Mitigating Human-Wildlife Conflict: Develop and promote strategies to reduce human-Bears encounters.

Road Safety Measures: Implement measures to reduce Sloth bear's mortality due to road accidents, such as the creation of wildlife passages or warning signs in bear-crossing areas.

By incorporating these conservation measures, it is possible to support the preservation of Sloth Beras population and ensure their long-term survival in their natural habitats. Collaboration between government agencies, conservation organizations, researchers and local communities is vital for the success of these initiatives.

7 *Moschiola indica* (Mouse deer):

DISTRIBUTION AND HABITAT:

Geographical Range: India, in the Deccan peninsula including Eastern and Western Ghats, Central India, Gangetics plains except West Bengal and the Terai region bordering India and Nepal. It is reported from most of the protected areas from the above landscapes; however, presence in Nepal remains questionable with no recent reports (Duckworth and Timmins 2015). Baral and others (2009) suggest the likely presence of the species in Chitwan though no recent records are available.



Preferred Habitats: They inhabit dense forested areas in tropical evergreen rainforests and deciduous forests that have dense understory. Fruits form an important component of the diet and the animals play an important ecological role as seed dispersers, besides forming a prey base for small and large carnivores (Prater 1971). They

inhabit a variety of forest types that include tropical deciduous, moist evergreen and semi evergreen forests up to around 1,850 m elevation (Prater 1971). Recent studies indicate that the understory vegetation structure and availability of cover from predators dictates habitat choice suggest that they prefer areas that provide them with high-energy foods such as fungi, tubers and fallen fruits and cover that provides protection from predators. A camera trap study from Mudumalai documents their frugivorous nature and the role they play in seed

dispersal (Prasad, 2009).

PHYSICAL DESCRIPTION:

The Indian Mouse Deer is one of the smallest hoofed mammals (ungulates) in the world. Adults typically measure 45–60 cm in body length, stand 25–35 cm at the shoulder, and weigh approximately 2–4 kg. It has a compact body, slender legs, a short neck, and a small head with large dark eyes and rounded ears. The coat is brown to reddish-brown with characteristic white longitudinal stripes and rows of white spots along the flanks, providing excellent camouflage on the forest floor. Unlike true deer, it lacks antlers; males instead possess elongated upper canine teeth that protrude slightly and may be used during territorial interactions.

DIET:

The Indian Mouse Deer is an omnivorous browser with a predominantly herbivorous diet. It feeds on fallen fruits, tender leaves, shoots, flowers, seeds, buds, grasses, and herbs. It also consumes fungi and occasionally supplements its diet with insects and other small invertebrates. By feeding on fruits and dispersing seeds through its movements, the species contributes to forest regeneration and ecosystem functioning.

BEHAVIOUR:

The elusive nature of the species has resulted in availability of limited information about the species. Literature based on studies of other members of the family suggests that males maintain large home ranges that include the home ranges of several females. Intra-sexual overlap of home ranges has not been recorded. They communicate through scent marks and vocalizations. Vocalizations signal intent to approach and are followed by answer calls. A female in estrous is sought out by a male that follows her while making cry-like vocalizations.

REPRODUCTION:

females reach first estrous at 145 days and unlike other ungulates, there is a single successful mounting. A single fawn is born after a gestation period of 154 days (range 150 – 163 days) and weaned at four months of age. The species shows post-partum estrous and becomes receptive within four to six hours after fawning resulting in an inter-birth interval that ranged from 150 to 170 days.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Listed as Least Concern, monitor lizards are widespread, but local populations may be threatened by habitat loss and hunting.

Habitat Destruction: Deforestation, agricultural expansion and urbanization are leading to habitat fragmentation, which poses a threat to populations.

Hunting and Poaching: for bushmeat, particularly in some rural and forest-fringe areas.

Road Mortality: resulting from expanding transportation networks through forest landscapes.

CONSERVATION MEASURES:

Legal Protection: Mouse deer are protected under Schedule I of the Indian Wildlife Protection Act, which provides them with the highest level of protection against hunting and trade.

Habitat Protection: Conserve and restore evergreen, semi-evergreen, moist deciduous, and dry deciduous forests with dense undergrowth. Maintain habitat connectivity through ecological corridors to facilitate movement between fragmented forest patches.

Community Awareness: Raising awareness among local communities about the ecological role of mouse deer and reducing unnecessary human-wildlife conflict is key to their conservation.

8 *Panthera pardus* (Leopard):

DISTRIBUTION AND HABITAT:

The leopard is a highly adaptable and widely distributed large cat found across much of Africa and Asia. It exhibits significant variation in coat color and size depending on its geographic location and habitat.

Asia: Ranges from the Indian subcontinent, including India, Sri Lanka, Nepal and Bhutan, extending into Southeast Asia, including parts of Myanmar, Thailand, Laos, Cambodia and Vietnam. Northernmost range extends into China and the Russian Far East.



Leopards are found in a wide range of habitats, including rainforests, grasslands, woodlands, mountains and even arid and semi-arid regions. Their adaptability allows them to survive in diverse environments.

PREFERRED HABITAT:

General Preferences: Highly adaptable and can inhabit a wide range of environments.

Specific Habitats: Savannas, grasslands, forests (both tropical and subtropical) and mountainous regions. They are also found in mangrove swamps and rocky outcrops.

Adaptability: Leopards can live near human settlements and are found in areas with varied vegetation types, including modified landscapes and agricultural areas.

PHYSICAL DESCRIPTION: Males are generally larger than females. Leopards have a powerful build, a broad head, strong jaws and sharp retractable claws, making them excellent hunters and climbers. Their specialized shoulder blades allow for strong climbing muscles. They are primarily nocturnal and solitary animals, known for their stealth and agility. They can run at speeds up to 58 km/h. Leopards are opportunistic carnivores with a broad diet, preying on a variety of animals ranging from small mammals, birds and reptiles to larger ungulates. They are also known to scavenge and sometimes prey on domestic animals in human-dominated landscapes. They often cache their kills in trees to protect them from other predators.

size:

Body Length: 90–190 cm (35–75 inches), excluding the tail.

Tail Length: 60–100 cm (24–39 inches).



Weight: Males weigh between 60–90 kg (132–198 lbs), while females weigh between 30–60 kg (66–132 lbs).

DIET:

Feeding Habits: Carnivorous, with a diverse diet including ungulates (e.g., deer, antelope), smaller mammals (e.g., hares, monkeys), birds, reptiles and occasionally insects.

Hunting Style: Opportunistic hunters that use stealth and strength to ambush prey. They often use their excellent climbing skills to stalk prey from trees or to hide their kills from scavengers.

CONSERVATION STATUS AND THREATS:

The IUCN Red List classifies Vulnerable. The leopard population is declining due to habitat loss, human-wildlife conflict and poaching.

Habitat Loss and Fragmentation: Expanding agriculture, deforestation, urbanization and infrastructure development are causing significant loss and fragmentation of leopard habitats.

Poaching and Illegal Wildlife Trade: Leopards are heavily poached for their skins, bones and other body parts, which are traded illegally for ornamental purposes and traditional medicine. High demand and weak law enforcement in many areas exacerbate this threat.

Human-Wildlife Conflict: Natural habitats shrink and prey becomes scarce, leopards increasingly venture into human-dominated areas in search of food, often preying on livestock and domestic animals. This leads to retaliatory killings by humans, further impacting leopard populations.

Declining Prey Populations: Unsustainable hunting of wild ungulates, a primary food source for leopards, is causing a decline in prey availability in many regions. This forces leopards to seek alternative food sources, increasing the likelihood of conflict with humans.

Trophy Hunting: In some regions, legal trophy hunting, if poorly regulated, can lead to overhunting and contribute to population declines.

Road Accidents: Increasing traffic in and around protected areas poses a threat to leopards through road accidents, leading to injury and mortality.

CONSERVATION MEASURES:

Protected Areas: Efforts to conserve leopards include establishing and maintaining protected areas and wildlife reserves.

Habitat Protection and Management: Protecting existing leopard habitats through the establishment and effective management of protected areas, wildlife corridors and buffer zones is crucial. Efforts to prevent deforestation, regulate land use and mitigate habitat fragmentation are essential.

Anti-Poaching: Anti-poaching measures, improving law enforcement to combat illegal wildlife trade and increasing penalties for wildlife crimes are vital.

Mitigating Human-Wildlife Conflict: Implementing strategies to reduce human-wildlife conflict is essential for the long-term survival of leopards. This includes raising awareness among local communities about leopard behaviour and safety measures, improving livestock protection, providing compensation for livestock losses and translocating problem individuals when necessary.

Prey Base Management: Implementing conservation measures to ensure healthy and viable populations of

leopard prey species is crucial. This includes regulating hunting, protecting prey habitats and controlling poaching of ungulates.

Monitoring and Research: Regular population assessments, monitoring leopard movements and behavior through camera trapping and radio-collaring and undertaking genetic studies are essential for understanding population trends and informing conservation strategies.

Awareness and Education: Raising public awareness about the ecological importance of leopards and the threats they face is crucial for garnering support for conservation efforts.

- Create awareness among the people of Village within 10 kms from the Project area about the importance of Leopards, reasons for conflicts and preventive measures etc.
- Install sign boards along the mining / civil roads in the wildlife landscape about cautioning the drivers to go slowly and watchfully to prevent hitting the wildlife.
- Install the sign boards / Posters about importance of wildlife and how to prevent any instances of attack.
- Monitoring and facilitating:
 - Identify the Leopards regular path or movements in different seasons and alert the people in this corridor.
 - Establish a network of informers / watchers to monitor the movement of wildlife including Leopards; provide communication gadgets such as walkie talkie to them.
 - Appoint the watchers or facilitators to help the victims of attack get suitable treatment or compensation. In case of attack on livestock, help the People to get suitable compensation for loss of their livestock / domestic animals in Leopard attack.
 - Clear the thick bushes and invasive weeds of Lantana, Ipomoea, Eupatorium etc., in and around the Village to prevent the leopards from hiding in it. Also clear the bushes along the roads side in the Leopard corridor.
 - Establish a rapid response team to rush to the spot of Leopard attack and help the victims to get first aid and suitable treatment.
 - Use camera traps to monitor the regular movement of Leopards.

9 *Ratufa indica* (Malabar Giant squirrel):

DISTRIBUTION AND HABITAT:

Malabar Giant Squirrel is a small to medium-sized Mammal who is distributed Northern and central Western Ghats - roughly from the Mumbai / Konkan region into northern Karnataka and adjacent hills. The Malabar Giant Squirrel (*Ratufa indica*) is primarily found in peninsular India, particularly in the Western Ghats, Eastern Ghats, and Satpura Range. It inhabits tropical deciduous, semi-deciduous, and moist evergreen forests at altitudes ranging from 180 to 2,300 meters. This species is arboreal, spending most of its time in trees and often building nests in tall, mature trees to avoid predators. Its distribution is



fragmented due to habitat degradation and it is known for its colourful coat and diurnal activity

PHYSICAL DESCRIPTION:

The Malabar Giant Squirrel (*Ratufa indica*) is one of the largest tree squirrels in the world and is endemic to the forests of the Indian subcontinent. This striking arboreal mammal is renowned for its vibrant, multi-coloured coat, which varies among subspecies and typically includes rich shades of deep reddish-brown, maroon, rust, orange, cream, buff, and black. Its distinctive colouration provides effective camouflage within the dappled light of the forest canopy, helping it avoid predators. Adults generally measure 25–50 cm in head-and-body length, with an equally long, bushy tail measuring 20–60 cm, and weigh approximately 1.5–2.5 kg. The species has a rounded head with small ears, large dark eyes that provide excellent vision, and strong, curved claws adapted for gripping bark and climbing. Its powerful forelimbs and hindlimbs enable rapid movement through the canopy, while its long, bushy tail acts as a counterbalance during climbing and jumping.

DIET:

Giant squirrels spend most of their time in trees, where they gather their food. Giant squirrels are omnivorous, feeding on fruits, flowers, nuts, bark, bird eggs, and insects. They feed by standing on the hind legs and using their hands to handle food. Giant squirrels also use their large tail as a counter-weight, improving their balance.

BEHAVIOUR:

Giant squirrels are typically solitary animals, being seen only rarely in pairs during the breeding season. They are wary animals and usually keep well hidden in vegetation. They are most active during the day & Giant squirrels have small home ranges.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Listed as Least Concern due to their wide distribution and adaptability to various habitats, including urban areas.

Habitat Loss and Degradation: As human populations expand, natural habitats such as woodlands and forests are increasingly converted for agriculture, urbanization and infrastructure development. This leads to a reduction in suitable habitats.

Urbanization: While giant can adapt to some level of urbanization, high-density development can lead to habitat fragmentation and reduced prey availability.

CONSERVATION MEASURES:

Habitat Protection and Restoration: Protecting existing natural habitats and promoting afforestation and reforestation efforts can help maintain suitable environments for giant squirrels.

Sustainable Agricultural Practices: Reduced pesticide uses and promoting integrated pest management can minimize the impact of toxins on populations and their prey.

Awareness and Education Programs: Educating local communities about the ecological importance and the threats they face can help reduce persecution and promote conservation.

Monitoring and Research: Long-term monitoring and scientific research are essential for assessing the population status, habitat quality, and conservation needs of the Malabar Giant Squirrel (*Ratufa indica*). Standardized surveys should be conducted periodically to estimate population abundance, density,

distribution, and occupancy across its range. Monitoring should focus on key indicators such as nest (drey) abundance, sighting frequency, breeding activity, habitat connectivity, and changes in canopy cover. habitat degradation.

10 *Urva edwardsii* (Grey Mongoose):

DISTRIBUTION AND HABITAT:

The Indian Grey Mongoose is widely distributed across South Asia and parts of the Middle East, including India, Pakistan, Sri Lanka, Nepal and Iran. They thrive in a variety of environments such as forests, grasslands, scrublands, agricultural areas and even urban and suburban regions. Their adaptability to different habitats makes them a common sight in both rural and urban landscapes.



PHYSICAL DESCRIPTION:

The Indian grey mongoose is a relatively small, agile carnivore. It has a slender body, short legs and a long, bushy tail. Its fur is typically a grayish-brown color, with darker markings on the face and legs. They have sharp claws and teeth, well-suited for digging and predation.

DIET:

The Indian grey mongoose is a carnivore, primarily feeding on small mammals, birds, reptiles, amphibians and insects. They are particularly well-known for their ability to hunt and kill venomous snakes, such as cobras. They achieve this by their agility, quick reflexes and a thick coat that protects them from snake bites.

CONSERVATION STATUS AND THREATS:

The Indian Grey Mongoose is listed as Least Concern by the IUCN Red List. Despite being common and widespread, they face threats from habitat loss and fragmentation, as well as hunting for their fur and for use in traditional medicine. However, their adaptability to a range of habitats helps maintain stable population levels in many areas.

The primary threats to the Indian Grey Mongoose include habitat loss due to deforestation and urban expansion. Additionally, they are often hunted for their fur and body parts, which are used in traditional medicine. In some regions, they are also persecuted due to their occasional predation on poultry and other small domestic animals.

CONSERVATION MEASURES:

Habitat Protection: Preserve natural habitats through the establishment of protected areas and conservation efforts.

Community Education: Increase public awareness about the ecological importance of Mongooses. Promote coexistence strategies in urban areas to mitigate conflicts.

Awareness campaigns: Educating the public about the importance of these animals and the threats they face.

Research and Monitoring: Conduct studies to better understand Mongoose behavior and their role in

maintaining ecological balance. Regular monitoring helps in implementing targeted conservation actions.

11 *Crocodylus palustris* (Marsh Crocodile):

DISTRIBUTION IN INDIA AND HABITAT:

The *Crocodylus palustris*, commonly known as the mugger crocodile, is native to freshwater habitats from south-eastern Iran to the Indian subcontinent. And commonly found these regions Bangladesh, India, Islamic Republic of Iran, Nepal, Pakistan, Sri Lanka, possibly areas of Indo-China.

preferred habitats: Freshwater rivers, lakes and marshes. Prefer slow-moving, shallower areas. They have also adapted to live in reservoirs, irrigation canals, and other man-made bodies of freshwater in India and Sri Lanka. Occasionally reported from saltwater lagoons.



PHYSICAL DESCRIPTION:

Colour generally light tan in juveniles, with black cross-banding on body and tail. Adults are generally grey to brown, with little banding remaining. This is a medium to large species (4 to 5 m). The snout is the broadest of any member of the *Crocodylus* genus, giving the mugger a more alligatorine appearance. and having 65-68 total number of teeth.

DIET:

Juveniles take crustaceans, insects and small fish generally. Adults eat larger fish, amphibians, reptiles (mainly snakes and possibly turtles), birds and mammals (e.g monkeys). Large adults have been known to take deer and buffalo on occasions.

BREEDING: Females reach sexual maturity at around 1.7 to 2.0 m in length (usually around 6 years old), while males mature at about 2.6 m (10 years old). Nests are holes excavated during the dry season (from December to February). Location of the nest varies considerably (even within burrows on rare occasions, which is unusual as they are not normally associated with breeding activities), but they are most commonly found on sloping banks. The female usually lays 25 to 30 eggs (although this may range from 10 to 48 eggs). However, captive specimens have sometimes been observed laying two clutches per year, but this has yet to be observed under natural conditions. Eggs hatch after a relatively short period, usually 55 to 75 days, and the juveniles are around 30cm long at hatching. Research into the effects of temperature upon sex of the embryo (Temperature-dependant Sex Determination - TSD) has revealed male-only embryos at 32.5°C, with a greater percentage of females produced below and above this. Female-only embryos are produced between 28°C and 31°C. While the female usually guards the nest, opens it and transports hatchlings to the water in her mouth, the male has been observed undertaking this task in captivity.

CONSERVATION STATUS AND THREATS:

IUCN Red List: The Marsh Crocodiles is currently listed as Vulnerable on the IUCN Red List of Threatened Species.

Habitat Loss and Degradation: Conversion of wetlands, mangroves and coastal areas for urbanization,



industrialization and agriculture (e.g., expansion of paddy fields into natural wetlands) is a significant threat. Drainage of marshes and alteration of natural river systems.

Water Resources Development : Construction of dams, barrages, canals, and reservoirs that alter river flow, reduce nesting habitats, and fragment populations.

Pollution: Industrial and polluted contaminated water, pesticides can reduce water quality and affect them.

Human- Crocodiles Conflict: Retaliatory killing following attacks on humans or livestock. Deliberate removal or translocation of crocodiles from conflict areas.

Fishing Net : Accidental entanglement in fishing nets. & Injuries from hooks and conflicts with fishermen due to damage to fishing gear.

CONSERVATION MEASURES:

Habitat Protection and Restoration:

Wetland Conservation: Implement strict protection measures for existing wetlands, estuaries and mangrove ecosystems, which are crucial Marsh Crocodiles habitats.

Awareness and Education:

Public Awareness Campaigns: Educate local communities, especially those living near coastal and wetland areas, about the ecological importance of Marsh Crocodiles and the need for their conservation.

Pollution Control:

Water Quality Improvement: Implement measures to control industrial and domestic waste discharge into rivers and coastal waters to maintain healthy aquatic ecosystems for fish and crabs.

Population Monitoring: Conduct regular surveys and monitoring of Marsh Crocodiles populations in Goa to understand their numbers, breeding success and identify any localized declines

Human–crocodile conflict mitigation: Implement awareness and education programs in crocodile-prone communities. Install warning signs, barriers, and designated safe water-access points, develop rapid response teams for rescue, translocation (when necessary), and conflict management, provide compensation schemes for livestock losses where applicable.

Law enforcement: Enforce wildlife protection laws to prevent poaching, illegal trade, and habitat encroachment, strengthen surveillance in key crocodile habitats.

12 *Naja naja* (Cobra):

DISTRIBUTION AND HABITAT:

The Indian Cobra is widely distributed across the Indian subcontinent, including India, Pakistan, Bangladesh, Sri Lanka and parts of Nepal and Bhutan.

Preferred Habitats: Indian Cobras are highly adaptable and can be found in a wide range of habitats, including forests, agricultural fields, wetlands, scrublands, grasslands and even human settlements. They are often encountered near water sources, such as rivers and agricultural canals.



PHYSICAL DESCRIPTION:

The Indian Cobra is a medium-sized snake known for its distinct characteristics such as a wide black band on the underside of the neck and a hood marking design with half-rings on either side. It has a smooth-scaled body with color variations ranging from black to dark brown to creamy white. The snake can grow from 1.8 to 2.2 meters in length. Indian Cobras are found in various habitats, including open forest edges, fields and areas near human settlements with water sources. This snake species is highly venomous, with its venom containing powerful neurotoxins and cardiotoxins.

DIET:

Cobras primarily feed on rodents but also consume small mammals, birds, bird eggs, frogs, toads, lizards and even other venomous snakes. The Indian Cobra helps control rodent populations.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Listed as Least Concern, but populations face pressure from habitat destruction, illegal trade and human-wildlife conflict.

The Indian cobra is not considered an endangered species, but there are some threats to the species. These include killing them out of fear or for human consumption and road kill. The Indian cobra is also the snake used by Indian snake charmers. Its toxic venom is also necessary in the production of Antivenom and other research including pain-killers and anticancer drugs, some of it harvested illegally in regions of India and other countries within its range. They are also hunted for their skin bearing the distinctive hood markings which is then used in the leather industry. The Indian cobra is one of the many venomous snakes exploited for making traditional Chinese medicines and also snake vine.

Habitat Loss: Deforestation, urbanization and agricultural expansion reduce the natural habitats of Indian Cobras.

Human-Cobra Conflict: Indian Cobras are often killed due to fear or as retaliation for preying on poultry or entering homes.

Illegal Trade: Indian Cobras are captured for their venom (used in anti-venom production), skin and use in traditional medicine or as exotic pets, though trade is regulated under CITES.

CONSERVATION MEASURES:

Legal Protection: Listed under Schedule I of the Wildlife Protection Act, prohibiting hunting and trade. Conservation efforts include habitat protection, public education about snake ecology and training snake rescuers to safely relocate cobras from urban areas.

Snake Charmer Practices: Efforts are being made to regulate snake charmers in India to prevent the mistreatment of cobras and reduce illegal wildlife trade.

Conservation efforts involve habitat preservation, raising awareness among local communities about snake behavior and safety measures and implementing measures to reduce human-snake conflicts. These measures include educating people about the importance of these snakes in maintaining the balance of ecosystems and promoting coexistence.

Collaboration between local communities, conservation organizations and government agencies plays a vital role in the conservation of both species. By working together and implementing effective conservation strategies, we can ensure the long-term survival of the King Cobra and the Indian Cobra, safeguard their habitats and maintain the ecological balance of their respective regions.

13 *Ptyas mucosa* (Rat Snake):

DISTRIBUTION AND HABITAT:

The Indian rat snake is widely distributed extremely common throughout India.

Preferred Habitats: Rat Snakes are highly adaptable and can be found in diverse habitats such as forests, grasslands, wetlands, agricultural fields and human settlements. They prefer areas near water sources, such as ponds, rivers and lakes, but are also found in urban environments. Hide in dark places like rat holes, termite mounds and under rocky caves.



PHYSICAL DESCRIPTION:

These snakes typically range from 5 to 7 feet in length, though some individuals can grow larger. They exhibit a slender and agile build, with a glossy, sleek appearance and smooth scales. Their coloration varies and can be olive-green, brown, or a combination of both, often with darker spots or striping along the body.

DIET:

As their name implies, these snakes primarily prey on rodents, including rats, mice and other small mammals. Additionally, they may feed on birds, their eggs, as well as amphibians and reptiles. They are efficient hunters and help control rodent populations in both rural and urban areas.

BEHAVIOR:

Males known to be territorial and establish boundaries through fights often misread as mating dances. These snakes are diurnal, meaning they are active during the day. They are typically shy and non-aggressive, preferring to escape or avoid confrontation when encountering threats. When feeling threatened, they may

hiss, inflate their bodies or strike as a defensive behavior.

REPRODUCTION:

Indian Rat Snakes reproduce by laying eggs. The females lay elongated eggs and these eggs are incubated until they hatch.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Classified as Least Concern, Indian Rat Snakes are widespread and abundant, although they face some threats from habitat loss and human conflict.

Habitat Loss: Destruction and fragmentation of their natural habitats due to urbanization, agricultural expansion and deforestation are significant threats. This loss of habitat disrupts their natural living spaces and can lead to population declines.

Snake Skin Trade: Though illegal, Rat Snakes are sometimes targeted for their skin, which is used in the leather industry.

Human Encounters: Encounters with humans can lead to fear or misunderstanding, resulting in these snakes being killed due to mistaken identity or perceived threat.

Illegal Wildlife Trade: Indian Rat Snakes are sometimes captured and traded illegally for the exotic pet trade, leading to a reduction in their wild populations.

Pesticides and Pollution: Exposure to pesticides and environmental pollutants can harm the snakes directly or indirectly by affecting their prey base.

Road Mortality: Snakes are often victims of roadkill as they may cross roads and highways, leading to fatalities.

CONSERVATION MEASURES:

To ensure the protection and conservation of the Indian Rat Snake, several measures and strategies can be implemented:

Habitat Preservation: Establish and protect conservation areas, reserves and wildlife corridors to maintain the snake's natural habitats. Initiatives to prevent habitat destruction and fragmentation are crucial for their survival.

Awareness and Education: Conduct educational programs and campaigns to raise awareness about the importance of Indian Rat Snakes in the ecosystem. Educating local communities and the public about the role and significance of these snakes can help dispel misconceptions and reduce human-snake conflict.

Legal Protection: Enforce and strengthen wildlife protection laws to prevent illegal trade, poaching and deliberate killings of these snakes. Implement penalties for those engaging in the illegal pet trade or causing harm to the species.

Mitigating Human-Snake Conflict: Develop and promote strategies to reduce human-snake encounters, such as constructing snake-friendly fencing and promoting responsible waste disposal practices to limit habitat disturbance.

Road Safety Measures: Implement measures to reduce snake mortality due to road accidents, such as the creation of wildlife passages or warning signs in snake-crossing areas.

By incorporating these conservation measures, it is possible to support the preservation of the Indian Rat

Snake population and ensure their long-term survival in their natural habitats. Collaboration between government agencies, conservation organizations, researchers and local communities is vital for the success of these initiatives.

14 *Varanus bengalensis* (Monitor Lizard):

DISTRIBUTION AND HABITAT:

The Monitor lizard is widely distributed across the Indian subcontinent, including India, Sri Lanka, Nepal, Bangladesh, Pakistan and parts of Southeast Asia.

Preferred Habitats: Monitors thrive in a wide range of habitats, including forests, grasslands, scrublands, mangroves, agricultural areas and even urban environments. They are frequently found near water sources such as rivers, lakes, ponds and wetlands but can also adapt to drier environments.



PHYSICAL DESCRIPTION:

They have robust, muscular bodies with long tails that account for about two-thirds of their total length. Their scales are rough and vary in color from grey-brown to olive-brown, with a lighter underbelly. Juveniles tend to have more pronounced markings, such as bands and spots, which fade as they mature. Bengal Monitors are large lizards that can grow up to 1.5 meters in length.

DIET:

Monitor lizards are carnivorous and feed on a variety of prey, including insects, small mammals, birds, reptiles, amphibians and eggs. They are also scavengers and will consume carrion when available. They have been known to raid bird nests and prey on poultry in rural areas.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Listed as Near Threatened, monitor lizards are widespread, but local populations may be threatened by habitat loss and hunting.

CITES Status: Appendix I, meaning all international trade of Monitor lizards or their body parts is banned except under exceptional circumstances.

Habitat Destruction: Deforestation, agricultural expansion and urbanization are leading to habitat fragmentation, which poses a threat to Bengal Monitor populations.

Hunting and Poaching: Monitor lizards are often hunted for their skin, which is used to make leather products. In some regions, they are also hunted for their meat, which is considered a delicacy and for traditional medicine practices. Additionally, they are killed for perceived threats to poultry.

Human-Wildlife Conflict: In rural areas, monitor lizards are sometimes killed due to their predation on poultry or fear of them entering homes.

CONSERVATION MEASURES:

Legal Protection: Monitor lizards are protected under Schedule I of the Indian Wildlife Protection Act, which provides them with the highest level of protection against hunting and trade.

Habitat Protection: Conservation efforts include protecting and restoring natural habitats, especially forested and wetland areas, to ensure monitor lizards have sufficient space and resources.

Community Awareness: Raising awareness among local communities about the ecological role of monitor lizards and reducing unnecessary human-wildlife conflict is key to their conservation.

15 *Accipiter badius* (Shikra):

DISTRIBUTION AND HABITAT:

The Shikra is a small to medium-sized raptor is widely distributed across parts of Africa, the Middle East and South Asia, including India, Pakistan, Sri Lanka and Southeast Asia. widely distributed across Asia. It is a familiar sight in a variety of habitats, from open woodlands, savannas, scrublands, agricultural areas and even urban environments with sufficient tree cover. They are often found in parks and gardens, adapting well to human-altered landscapes.



PHYSICAL DESCRIPTION:

Shikra is characterized by its relatively short, rounded wings and a long tail, adaptations that provide agility for hunting in dense vegetation. Adults exhibit sexual dimorphism in plumage. The male typically has a pale grey back and head, with fine rufous barring on the underparts. Its call is a sharp "pi-hew" or "kik-ki". Several subspecies are recognized across its range, varying slightly in size and plumage. Their eyes are strikingly red in adults and yellow in juveniles.

DIET:

Shikra's are opportunistic hunters, feeding on small birds, mammals, reptiles and large insects. They are skilled in catching prey mid-flight or by surprise attacks from perches.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Listed as Least Concern due to their wide distribution and adaptability to various habitats, including urban areas.

Habitat Loss and Degradation: As human populations expand, natural habitats such as woodlands and forests are increasingly converted for agriculture, urbanization and infrastructure development. This leads to a reduction in suitable nesting and foraging areas for Shikra's.

Pesticide Use: The widespread use of pesticides in agriculture can indirectly affect Shikra's through the contamination of their prey (small birds, rodents, lizards, insects). Bioaccumulation of pesticides can lead to reduced reproductive success and even mortality.

Nest Destruction: Nests can be destroyed intentionally or unintentionally during habitat clearing or other human activities.

Electrocution: Like many other birds of prey, Shikra's are susceptible to electrocution when perching or flying near power lines.

Urbanization: While Shikra's can adapt to some level of urbanization, high-density development can lead to habitat fragmentation and reduced prey availability.

CONSERVATION MEASURES:

Habitat Protection and Restoration: Protecting existing natural habitats and promoting afforestation and reforestation efforts can help maintain suitable environments for Shikra's.

Sustainable Agricultural Practices: Reduced pesticide use and promoting integrated pest management can minimize the impact of toxins on Shikra's populations and their prey.

Awareness and Education Programs: Educating local communities about the ecological importance of raptors and the threats they face can help reduce persecution and promote conservation.

Mitigation of Infrastructure Impacts: Implementing measures to reduce bird electrocutions, such as insulating power lines and designing bird-friendly infrastructure, can help minimize mortality.

Monitoring and Research: Continued monitoring of Shikra populations and research on their ecology and threats are essential for developing effective conservation strategies.

16 *Haliastur indus* (Brahminy Kite):

Distribution in India and Habitat:

The Brahminy Kite is a widespread and resident species throughout the Indian subcontinent, including Sri Lanka, Nepal, Pakistan, Bangladesh and Myanmar. It is commonly found across India, from the plains to elevations of about 2000 meters in the Himalayas.

Its preferred habitats are closely associated with water bodies; coastal areas, wetlands and rivers, including estuaries, mangrove swamps and floodplains. They are also found near lakes, marshes and even rice paddies. While they are common in coastal regions, they also venture inland, particularly along waterways.



PHYSICAL DESCRIPTION:

The Brahminy Kite is a medium-sized raptor, easily identifiable by its distinctive and contrasting plumage.

Adults: Possess a rich chestnut-brown body, wings and upper tail. The head, neck and breast are striking white, with fine dark longitudinal streaks. The wingtips are black and the tail is relatively short and rounded (unlike the forked tails of other kites like the Black Kite). Its legs are short and un-feathered, the eyes are dark and the hooked bill is lemon yellow.

Juveniles: Are a more uniform dark brown and mottled, gradually acquiring the adult plumage with age. They can be distinguished from Black Kites by their paler overall appearance, shorter wings and rounded tail.

Size: They typically measure 43-50 cm in length, with a wingspan of 116-130 cm and weigh between 380-600 grams. Females are slightly larger than males.

DIET:

The Brahminy Kite is primarily a carnivore and scavenger, with a versatile diet reflecting its opportunistic feeding habits:

Mainly scavengers: They predominantly feed on dead fish and crabs, especially in wetlands and marshlands.

Opportunistic hunters: They also hunt live prey, including small mammals like hares, bats, snakes, frogs and

large insects (such as grasshoppers and beetles). They are adept at snatching live prey or carrion from the surface of water, ground, or treetops.

Kleptoparasitism: They are known to engage in kleptoparasitism, stealing food from other fish-hunting birds like gulls and even Ospreys. They have also been observed taking advantage of dolphins herding fish to the surface. Occasionally, they may feed on honey or even cooked food offerings in human-dominated areas.

CONSERVATION STATUS AND THREATS:

IUCN Red List: The Brahminy Kite is currently listed as Least Concern on the IUCN Red List of Threatened Species.

Habitat Loss and Degradation: Conversion of wetlands, mangroves and coastal areas for urbanization, industrialization and agriculture (e.g., expansion of paddy fields into natural wetlands) is a significant threat.

Pollution: Over-use of pesticides, particularly in agricultural areas adjacent to their foraging grounds, can lead to secondary poisoning. Water pollution from industrial and domestic waste can reduce their prey base (fish and crabs).

Persecution: Although generally tolerated due to cultural beliefs (associated with Vishnu in Hindu mythology), localized persecution might occur, though it is less common for this species compared to some other raptors.

Reduced Food Availability: Increased human hygiene and improved waste management, while beneficial for public health, can reduce the availability of carrion that they often scavenge in urban settings.

Disturbance: Human activities and development projects in coastal and wetland areas can disturb breeding sites and foraging grounds.

CONSERVATION MEASURES:

Habitat Protection and Restoration:

Wetland Conservation: Implement strict protection measures for existing wetlands, estuaries and mangrove ecosystems, which are crucial Brahminy Kite habitats.

Mangrove Regeneration: Actively promote and support mangrove plantation and restoration projects, particularly in coastal areas of Goa.

Integrated Land Use Planning: Incorporate biodiversity conservation into land-use planning, preventing the conversion of critical habitats.

Awareness and Education:

Public Awareness Campaigns: Educate local communities, especially those living near coastal and wetland areas, about the ecological importance of Brahminy Kites and the need for their conservation.

Responsible Tourism: Promote responsible birdwatching and ecotourism practices that do not disturb nesting or roosting birds.

Pollution Control:

Pesticide Regulation: Advocate for the reduced use of harmful pesticides in agricultural areas, promoting organic farming practices to protect their food sources and prevent secondary poisoning.

Water Quality Improvement: Implement measures to control industrial and domestic waste discharge into rivers and coastal waters to maintain healthy aquatic ecosystems for fish and crabs.

Population Monitoring: Conduct regular surveys and monitoring of Brahminy Kite populations in Goa to understand their numbers, breeding success and identify any localized declines. Organizations like BNHS and WII can play a crucial role in designing and executing such studies.

17 *Nisaetus cirrhatus* (Crested Hawk Eagle):

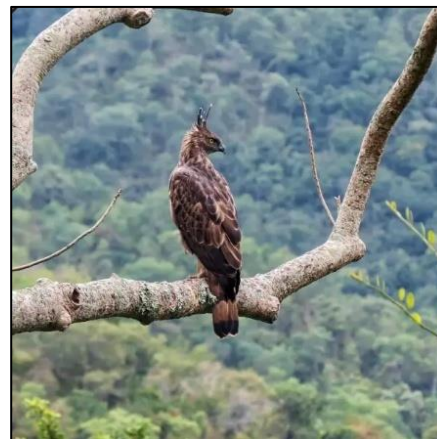
DISTRIBUTION:

Nisaetus cirrhatus is a widespread resident throughout much of India, it is widely distributed in Peninsular India, South Gujarat, East Rajasthan and South Gangetic plain to West Bengal and central India. It is found across various states and territories, from the Himalayan foothills to the southern tip of the country.

HABITAT: They can be found from sea-level up to elevations of 2200 meters. with its mix of evergreen and moist deciduous forests, laterite plateaus and coastal vegetation, *Nisaetus cirrhatus* can be expected to utilize these diverse habitats.

PHYSICAL DESCRIPTION:

Its name "Changeable" refers to the wide range of plumage variations, from pale to dark morphs and the presence or absence of a crest. Generally, they are dark brown above with heavily streaked dark on whitish underparts. Adult Changeable hawk-eagles are typically dark brown above and boldly streaked below with a strong bill, a variably sized, often floppy crest or no crest, rather short wings, a quite long, thinly-barred tail and long feathered legs. Most juvenile Changeable hawk-eagles are dark brown above but with far more conspicuous white edges on the mantle and wings than the adults, in some cases, the median coverts are largely white and greater and even lesser coverts are largely scaled with white. The juvenile has a light brown tail with about seven thin dark bars and a whitish tip. Adults have yellow to orange-yellow eyes, while those of the juvenile are grey-brown to pale greenish. Adults have a cere that's grey to pale greenish yellow and juveniles' ceres are dull greyish, while all ages have yellow feet. As in most birds of prey, females are larger than males.



DIET:

Nisaetus cirrhatus is a carnivorous and opportunistic predator with a varied diet, reflecting its adaptable nature. It preys on a wide range of animals-

Birds: Small to medium-sized birds, up to the size of chickens, pigeons, partridges and doves.

Mammals: Squirrels, rats, hares and occasionally larger prey like monkeys (e.g., Rhesus Macaque) and tree shrews. They have also been recorded scavenging on carcasses of larger mammals like Nilgai, Snakes, lizards and Frogs.

They typically hunt from a concealed perch within the forest or along forest edges, swooping down to catch prey on the ground, though birds are also caught in trees.

CONSERVATION STATUS AND THREATS:

IUCN Red List: The Changeable Hawk-Eagle is currently classified as Least Concern by the IUCN. This



classification is due to its very large range and a population trend that is considered stable, although localized declines may occur in some areas.

Habitat Loss and Fragmentation: This is the most substantial threat, driven by rapid urbanization, agricultural expansion and infrastructural development (roads, dams, mining). Loss of dense forest cover, which is critical for their nesting and hunting, directly impacts their populations.

Human Disturbances: Increased human activity in their habitats, including deforestation, logging and human-wildlife conflict, can disrupt breeding and foraging.

Environmental Pollutants: General environmental pollutants, including pesticides and other chemicals, can impact raptor populations through the food chain.

Climate Change: While the direct impact on this species is not fully understood, climate change can lead to shifts in prey availability and habitat suitability.

CONSERVATION MEASURES:

Habitat Protection and Restoration:

Forest Conservation: Strict protection of existing forested areas, especially mature forests that provide crucial nesting sites and hunting grounds. This includes deciduous, evergreen and gallery forests in Goa.

Sustainable Land Use Planning: Integrating biodiversity concerns into urban and rural planning to minimize habitat fragmentation and degradation.

Afforestation and Reforestation: Planting native tree species to expand and connect fragmented forest patches, creating corridors for movement and increasing suitable habitat.

Protection of Water Bodies: Maintaining the health of rivers, streams and wetlands, as these often support gallery forests and a rich prey base.

Research and Monitoring:

Population Surveys: Regular, systematic surveys to monitor population trends, breeding success and distribution specifically within Goa's diverse habitats, including nesting preferences, home range and prey availability, to inform targeted conservation efforts.

Public Awareness Campaigns: Educating local communities, particularly those living near forested areas, about the importance of raptors and the role of the Changeable Hawk-Eagle in the ecosystem.

Reducing Persecution: Addressing misconceptions about raptors and discouraging any form of hunting or trapping.

18 *Pavo cristatus* (Indian Peafowl):

DISTRIBUTION AND HABITAT:

The Indian Peafowl is native to the Indian subcontinent, including India, Sri Lanka, Pakistan, Nepal and Bhutan. It has also been introduced to other parts of the world, including various islands and countries. It inhabits a variety of environments, including dry and moist deciduous forests, open woodlands, grasslands and even agricultural areas. It is highly adaptable and often found near human habitation.

PHYSICAL DESCRIPTION:

The peacock or Indian peafowl is a well-known and iconic bird, recognized as the national bird of India. The term "peacock" is commonly used to refer to both males and females, with males being called peacocks and females referred to as peahens. The male peacock is renowned for its spectacular and vibrant appearance, with long, glossy green tail feathers that can make up more than 60% of its total body length. These feathers display a stunning combination of blue, golden green and copper-colored eye spots. The male's elaborate tail feathers play a crucial role in courtship displays and mating rituals. In contrast, females have a more-subtle appearance with a fan-like crest, whitish face and throat, chestnut brown crown and hind neck, metallic green upper breast and mantle, white belly, brown back, rump and tail and dark brown primaries. Peafowl typically inhabit deciduous forests near streams, roosting on tall trees and foraging in the undergrowth. The size, coloration and number of eyespots on the male's tail feathers determine their dominance within the peacock hierarchy and females are believed to be attracted to males with the longest and most colorful tail feathers



DIET:

Indian Peafowls are omnivorous, feeding on a varied diet that includes seeds, fruits, insects, small mammals and even small reptiles. They forage on the ground, using their strong legs and sharp beaks to search for food.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Listed as **Least Concern**, the Indian Peafowl is widespread and abundant. Although it faces some threats, including habitat loss and hunting, its adaptable nature and successful introduction to new areas have helped maintain stable populations.

No direct impact on the Peafowl due to the mining activity because of no movement found in the mine site area; it is only found in buffer area.

Habitat Loss: Rapid urbanization, agricultural expansion and deforestation have led to the loss and fragmentation of the Indian Peafowl's natural habitats, impacting their breeding and foraging grounds.

Illegal Trade: The dazzling plumage of the peacock makes it a target for illegal trade, with demand for feathers and live birds in the pet trade contributing to population decline.

Poaching: Despite legal protections, poaching for meat and body parts persists, driven by traditional beliefs and cultural practices.

Predation: Increased predation, particularly of chicks, by natural predators and domestic animals poses a threat to the survival of the species.

Water Pollution: Pollution of water sources, where peafowls often forage, can lead to the contamination of their food and water supply, impacting their health.

Hunting: In some areas, Indian Peafowls are hunted for their feathers and meat, which can pose a threat to local populations.

CONSERVATION MEASURES:

Protected Areas: The species benefits from protection in various wildlife reserves and national parks. Laws and regulations often prohibit hunting and capture.

Habitat Management: Efforts to maintain and restore natural habitats help support the population of Indian Peafowls. Conservation programs also focus on educating local communities about the importance of protecting this iconic bird.

Anti-Poaching Measures: Strengthening law enforcement efforts to combat poaching through increased patrols, wildlife crime units and penalties for offenders.

Community Involvement: Engaging local communities in conservation efforts through awareness programs, providing alternative livelihoods and promoting responsible tourism.

Regulation of Trade: Enforcing strict regulations against the illegal trade of peafowl feathers and live birds, with a focus on raising awareness about the consequences of such activities.

Research and Monitoring: Conducting research on the behavior, ecology and population dynamics of Indian Peafowls to inform conservation strategies, coupled with robust monitoring programs.

19 *Strix leptogrammica* (Brown Wood Owl):

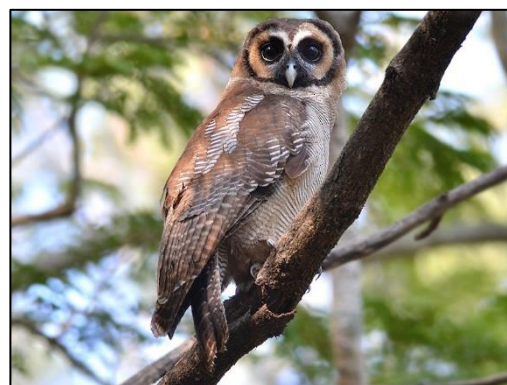
DISTRIBUTION AND HABITAT:

The Brown Wood Owl is native to the Indian subcontinent, including India and Sri Lanka west to southern China and Taiwan, south to Java and Borneo in Indonesia.

Preferred Habitat: Heavy tropical forest along the sea coast, in lowlands and in lower hills. Lowland primary forest in the Sunda region. Ranges from sea-level up to about 500 meter elevation.

PHYSICAL DESCRIPTION:

The facial disc is fulvous or rufous-brown with a narrow but distinct black rim, and a blackish zone around the eyes. The eyebrows are whitish-buffish or pale orange-buff. Eyes are dark brown. The cere is bluish-grey and the bill greenish-horn with a bluish base. The head is blackish-brown with a rufous tint, and separated from the mantle by a prominent cinnamon-buff or fulvous nuchal collar. The mantle and back are chestnut-brown, and rather densely barred dark brown to blackish. The primaries are barred chestnut and dark brown, while the secondaries and wing-coverts are fulvous, barred with dark tawny-brown. The tail is similarly barred, and tipped whitish. The throat has a narrow, white horizontal zone, contrasting with the brown neck. The upper breast



has a rufous or chestnut-brown pectoral band, barred blackish or dark brown. The rest of the underparts are creamy-buff, densely barred brown. Tarsi are feathered to the base of the toes, which are pale leaden with dull grey claws.

Size: Length 34-45cm. Wing length 286-400 mm. Tail length 151-299 mm. Weight 800-1100 gm. Females are larger than males.

Voice : The song of the male is a single hoot, quickly followed by a vibrating note which lasts about 0.75s - "who-whoowwwwwooh". This phrase may be repeated at intervals of several seconds. There is also a tri-syllabic phrase "who to-whoowwwwwoh", with the first note very faint.

DIET:

Feeds on small mammals such as rats, mice and shrews. Also takes small birds, frogs, and reptiles. Fish have also been reported.

CONSERVATION STATUS AND THREATS:

IUCN Red List: Listed as Least Concern, the Brown Wood Owl is widespread and abundant. Although it faces some threats, including habitat loss and hunting, its adaptable nature and successful introduction to new areas have helped maintain stable populations.

Habitat Loss: Rapid urbanization, agricultural expansion and deforestation have led to the loss and fragmentation of Brown Wood Owl natural habitats, impacting their breeding and foraging grounds.

Decline in prey availability: Reduction in populations of small mammals, birds, reptiles, amphibians, and insects due to pesticide use, habitat changes, and ecosystem disturbance can limit food availability.

Infrastructure developments: Expansion of roads through forest habitats can increase disturbance, fragment habitats, and create collision risks.

Pollution: Pesticide and chemical contamination Use of agricultural chemicals can indirectly affect the species by reducing prey populations and causing bioaccumulation of toxins.

CONSERVATION MEASURES:

Protected Areas: The species benefits from protection in various wildlife reserves and national parks. Laws and regulations often prohibit hunting and capture.

Habitat Management: Efforts to maintain and restore natural habitats help support the population of Indian Brown Wood Owl. Conservation programs also focus on educating local communities about the importance of protecting this bird.

Anti-Poaching Measures: Strengthening law enforcement efforts to combat poaching through increased patrols, wildlife crime units and penalties for offenders.

Community Involvement: Engaging local communities in conservation efforts through awareness programs, providing alternative livelihoods and promoting responsible tourism.

Research and Monitoring: Conducting research on the behaviour, ecology and population dynamics of Brown Wood Owl to inform conservation strategies, coupled with robust monitoring programs.

• **INCORPORATE HABITAT CONNECTIVITY AND SAFE CORRIDORS TO SUPPORT RET SPECIES MOVEMENT:**

Habitat connectivity will be duly considered during project planning to minimize fragmentation of natural landscapes. Existing vegetation and natural features will be retained as far as practicable to support ecological continuity. Project layout and activities will be designed to avoid creating barriers to wildlife movement. Human activities and vehicular movement will be regulated to reduce disturbance. These measures will help facilitate safe movement of wildlife, including RET species in the surrounding area.

The forest department is responsible for conservation of wildlife in the protected areas and the project proponent can support the department by providing some funds for implementing some of the initiatives. some of the measures for protection of environment within the core zone, would be the responsibility of the project proponent and will be carried out as per requirement.

Habitat restoration is a critical endeavour aimed at rehabilitating degraded or destroyed ecosystems to their natural state or as close to it as possible. Two key strategies in this process are afforestation and native vegetation replantation. These methods not only help in ecological recovery but also contribute to biodiversity conservation and the provision of essential ecosystem services.

AFFORESTATION:

Afforestation is the process of planting trees on land that has not historically been forested or converting non-forested land into forest areas. This makes afforestation a proactive approach to expanding forest cover.

Target Areas: Degraded lateritic plateaus, abandoned mining sites (where applicable), highly eroded slopes and barren public lands that were historically forested or have the potential to support forest ecosystems.

3.3 HABITAT IMPROVEMENT MEASURES THROUGH SPATIAL DISTRIBUTION / THEMATIC MAPPING:

3.3.1 PLANTATIONS:

- At conceptual stage Greenbelt and Plantation will be carried out on 102.43 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled, 6.87 ha on Dump Plantation and 26.16 ha under plantation.
- Company will put best efforts to maintain and fruit bearing species will be planted in consultation with local forest Department and as per CPCB guidelines.
- The company will ensure that there will be no adverse impact on the biological environment due to the existing and proposed project. Water sprinkling is practiced to suppress the dust within mine premises. Proper air pollution control equipment is being/will be installed to avoid contamination of ambient air environment.
- Native, site-specific and climate-resilient plant species shall be selected in accordance with the local forest type to enhance habitat quality and support native wildlife. Plantation sites shall be strategically located to improve habitat continuity, strengthen buffer areas and enhance connectivity between fragmented natural habitats, thereby facilitating movement, foraging and shelter opportunities for fauna. The plantation strategy shall avoid invasive or exotic species and shall be aligned with Forest Department guidelines to ensure ecological compatibility and conservation objectives.



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



Wildlife Conservation Plan

3.3.2 RESTORATION OF GRASSLANDS AND RANGELAND MANAGEMENT:

- Grassland restoration and rangeland management will be carried out in forest areas, Wildlife Sanctuaries (WLS) coordination with the Forest Department. Degraded grasslands will be improved by removing invasive plants, protecting the area from excessive disturbance and supporting the natural growth of native grasses. Where natural recovery is slow, locally suitable grass species will be reintroduced. Grazing will be regulated through controlled or rotational use, wherever permitted, so that grasslands get adequate time to recover and maintain healthy vegetation cover. Regular field monitoring will be done to check grass growth, ground cover, and signs of erosion and management practices will be modified as needed. These measures will help maintain healthy grasslands, improve forage availability and support wildlife habitats within forest and protected areas.

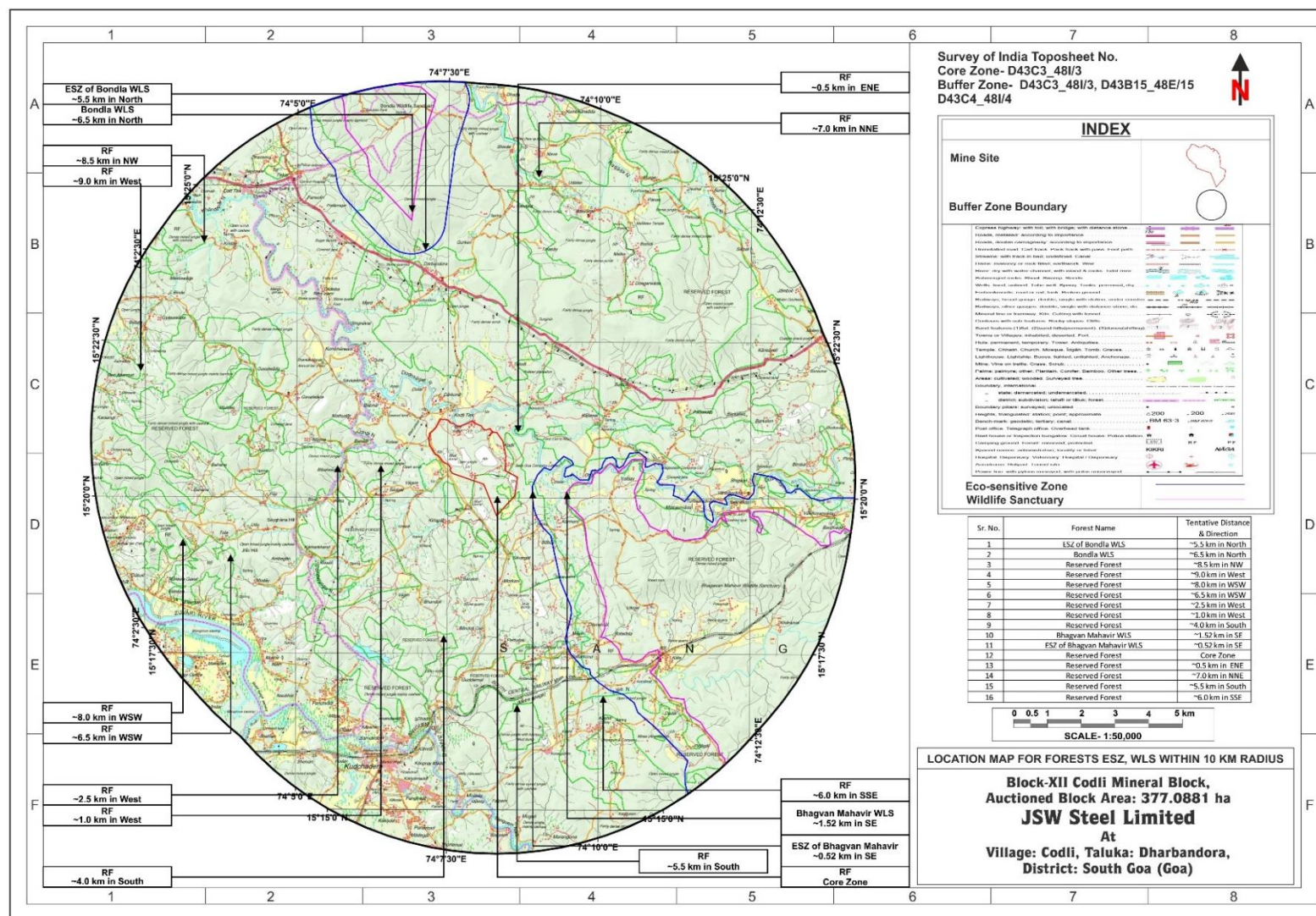


FIGURE 24 HABITATION IMPROVEMENT WITHIN FOREST, WLS IN CONSULTATION OF FOREST DEPARTMENT

3.3.3 CREATION OF WATERHOLES IN STRATEGIC LOCATIONS BASED ON ANIMAL VISITATION DATA:

- Creation of waterholes shall be undertaken at ecologically suitable and strategic locations within forest areas, Wildlife Sanctuaries (WLS) in consultation with the Forest Department. The selection of waterhole sites shall be based on animal movement patterns and visitation data generated through field-based evidence such as camera trap records, direct sightings, indirect signs (pugmarks, dung) and other wildlife monitoring inputs. These data shall be analyzed to identify areas with high wildlife use, seasonal water scarcity and movement corridors requiring water support. Waterholes shall be designed and maintained to ensure availability of water during dry and lean seasons, while avoiding habitat disturbance and human-wildlife conflict. Periodic monitoring of waterhole usage by wildlife and assessment of seasonal water availability shall be carried out and adaptive management measures shall be adopted to ensure sustained support to wildlife populations and overall habitat quality.
- Animals and birds need a regular water source during hot summer wild animals and birds stay outside forest in search of water source for quenching thirst. It is therefore, proposed to construct water holes/check-dams, anicuts, Talai (small reservoirs) and water ponds in the forested area at buffer zone at convenient points. These water holes would be sufficient to store the water to meet drinking requirement of animals and birds. The water holes should be provided with cement concrete bedding, side walls with stone pitching and grass should be grown in gap for gripping while animals enter into the water holes.

These water holes are cleaned at regular intervals to remove leaf litter, de-silting and refilling water. Few shades are provided around water holes for animal resting during summer season. Fruit bearing trees shall be grown around water holes to provide nesting habitat and food for birds and shade for wild animals. Project proponent will provide funds to forest department to undertake the development of water holes in the study area.

3.3.4 SOIL AND MOISTURE CONSERVATION (SMC) STRUCTURES BASED ON LANDSCAPE APPROACH:

- Soil and moisture conservation (SMC) measures shall be planned and implemented using a landscape-level approach to improve habitat quality and ecological stability within forest areas, Wildlife Sanctuaries (WLS) in coordination with the Forest Department. Based on this assessment, appropriate SMC structures such as contour trenches, continuous contour trenches (CCTs), staggered trenches, loose boulder check dams, gully plugs, earthen bunds and vegetative barriers shall be introduced at suitable locations.
- Priority for SMC interventions shall be given to degraded hill slopes, upper catchment areas, drainage lines and zones exhibiting high runoff, soil loss, and moisture stress. These structures shall be designed to slow down surface runoff, reduce soil erosion, enhance infiltration, and improve soil moisture availability, thereby facilitating natural regeneration of native vegetation and supporting plantation and grassland restoration efforts. Construction of SMC structures shall be undertaken in an environmentally sensitive manner to avoid disturbance to wildlife movement paths and natural drainage systems. Periodic monitoring and maintenance shall be carried out to assess structural

stability, sediment accumulation and vegetation response, and adaptive modifications shall be made as required to ensure long-term effectiveness and sustained ecological benefits at the landscape scale.

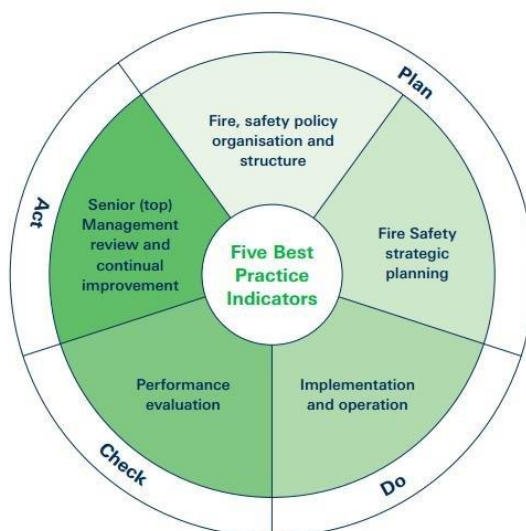
3.3.5 MANAGEMENT OF WILDLIFE CORRIDORS:

- There are no designated wildlife corridors within the study area. However, measures shall be undertaken to ensure the protection, connectivity and ecological integrity of wildlife populations within the adjoining forests, Wildlife Sanctuaries (WLS) wildlife habitat within the study area, including plantations, grasslands and water sources, shall be managed to avoid fragmentation and minimize disturbances that affect wildlife movement in surrounding protected areas. Periodic monitoring of wildlife presence and activity shall be carried out through field surveys, camera traps and indirect evidence to ensure that the area continues to support the broader ecological landscape. Adaptive management measures shall be implemented as necessary to maintain habitat quality and support the long-term conservation objectives of nearby WLS.
- Critical corridors shall be identified using a combination of spatial modelling techniques, GIS-based connectivity analysis and local ecological knowledge, including inputs from field surveys, camera trap data, and community observations. Once identified, measures shall be implemented to prevent fragmentation and degradation of these corridors. Habitat restoration, such as afforestation of degraded patches, grassland restoration and soil-moisture conservation, shall be carried out to improve structural continuity. Anthropogenic disturbances, including illegal logging, unplanned roads, and encroachments, shall be minimized, and legal safeguards reinforced through coordination with Forest Department authorities. Periodic monitoring of corridor use by wildlife using camera traps, pugmark surveys, and telemetry data shall guide adaptive management interventions to maintain functional connectivity, reduce human-wildlife conflict, and support ecological integrity across the landscape.

3.3.6 FIRE PREVENTION AND MITIGATION MEASURES:

Generally, fire occurs generally in summer season. The local people to take smoking bidi and cigarettes into the forest and throw them there which cause fire. The dry grass catches the fire and in no time, fire spreads in the area. However, fire accidents in forest are severe, it destroys the forest as well as the habitat of wild animals. Fire kills the innocent wild animals and their cubs and chinks specially in nesting and breeding season. Fire management is an important component of habitat-management. It is the most disastrous in the forest as it results in much harm to the wild flora and fauna. It causes damage to the habitat of the wild animals destroying its food and shelter, forest crop, regeneration, productivity of forest and soil. Hence, wildlife is caused excessive loss by the fire by burning their eggs, young ones and the habitat. As a result, the equilibrium of the nature becomes upset. Fire may be intentional or natural. Actually, all forest fires are man-made so as to facilitate grazing, collection of forest produces etc.

Forest fire is caused both naturally as well as by the human binges. Forest fire in late winter and early summer is a major threat to the wildlife. Severity, frequency and expanse of the fire affect the wildlife, ground and shrub flora, small animals, soil erosion and regeneration of the vegetation. Most of the animals hiding in the litter are burnt to death, causing great loss to the biodiversity. Burning of the litter exposes the soil surface to the torrential monsoonal rains causing significant erosion of the soil, making it thin and thinner and exposing the bed rock, which is unable to support a good growth of



vegetation. Anthropogenic causes will be minimized through forming a fire line around the forest area. To add to the prevention of fire local persons will be employed as fire guards, during the fire prone season. The team will be instructed to fight the fire as soon as it is detected. Watch towers will also be constructed to detect forest fire. Awareness program against forest fire will also be run in adjoining Village.

The incidence of forest fires in the country is on the increase, and more areas are affected every year. Considering the severe nature of the problem, it is necessary to make some significant improvements in the forest fire management strategy.

Education and environmental improvement: It can help prevent human-caused fires.

It will comprise silvicultural activities, engineering projects, community involvement, education and enforcement.

Removal of surface litter: Dry leaves from the ground spread fire quickly once they catch fire. They should be removed periodically involving the government as well as local populations.

Establishment of watch towers: It can detect fires in remote places, allowing staff to be warned early.

Awareness: Nomadic people should be aware not to carry fire-starting substances into woods and to ensure that any fires created for cooking, driving away wild animals, and so on are thoroughly extinguished.

Advanced equipment: The use of advanced fire extinguishing equipment to suppress forest fires in inaccessible places is required.

It is beneficial where transporting water is difficult.

Well-equipped personnel: The establishment of special Forest Fire control rooms staffed by trained and well-equipped personnel to allow for immediate action and coordination would be helpful in this regard.

Use of Technology: Remote sensing technology is to be given due importance in fire detection.

A National Fire Danger Rating System (NFDRS) and Fire Forecasting System are to be developed for successful fire management and administration.

Fire lines should also be cleared along permanent features like roads, nallas and footpaths at suitable intervals to prevent forest fire from spreading, in case it breaks out.

People should be trained with forest fire fighting measures and equipped with necessary materials like-

- **Shovels:** For digging and clearing vegetation to create firebreaks.
- **Fire rakes/hoes:** For clearing brush and creating fire lines and for raking away burning materials.
- **Fire beaters:** For smothering flames on the ground.
- **Chain saws:** For clearing larger trees and creating firebreaks.
- **Portable fire pumps:** For pumping water from a water source to the fire.
- **Helmets:** For head protection.
- **Goggles/glasses:** For eye protection from heat, smoke and debris.
- **Respirators/masks:** For filtering smoke and harmful particles.
- **Fire-resistant clothing:** Including gloves, boots and overalls, offering protection from heat and flames.
- **Fire shelters:** Portable shelters that can protect firefighters from radiant heat and flames during a sudden fire blow-up.
- **First-aid kits:** For treating minor injuries.

3.3.7 EDUCATION TRAINING AND CAPACITY BUILDING:

Awareness Programmes:

The project should take up widespread awareness program to sensitize the locals through the media, i.e. print media (newspapers, magazines, etc.) and social media tools of all kinds in addition to radio and television on relevant subjects like biodiversity, ecological functions, conservation of wildlife and their benefits to mankind, significance of different species of animals and plants more specifically the species of conservation significance and also on how-to live-in harmony with the wildlife, in the area. Conduct Panchayat workshops, school programs and events using eco-educational packages, which would help the local community understand the interdependence of nature in ensuring survival and development, while fostering a deep sense of love and respect for the surrounding flora and fauna. Villagers should be made aware of the importance of not disturbing forest wildlife.

Close collaboration and coordination with the Forest Department will be established to facilitate the construction of essential infrastructure, allocation of veterinary funds, provision of ambulances equipped with cages and the establishment of dedicated rescue wards. These measures aim to actively contribute to the conservation and protection of wildlife.

Creating awareness among the local community is the most effective tool for wildlife safety and development. By understanding, loving and protecting wildlife, individuals contribute to a healthier environment. Awareness campaigns, educational initiatives and ethical practices are essential in preserving habitats, preventing illegal activities and minimizing human-wildlife conflicts. Engaging the community through partnerships and promoting responsible behaviour fosters a collective effort towards wildlife conservation and ensures a harmonious coexistence between humans and the natural world.

Nature Awareness Camps: Regular nature awareness camps will be organized in the area, at least once a year for a period of ten years. These camps aim to educate the local public about the importance of wildlife conservation and environmental preservation. This will be instilling a sense of responsibility and stewardship among the local community can foster a collective effort in safeguarding wildlife.

Awareness Activities: Special awareness activities will be conducted during significant events such as Wildlife Week (2nd Oct. to 8th Oct.), World Forestry Day (21st March) and World Environment Day (5th June) each year. These activities may include painting and photography competitions, essay and slogan writing contests, as well as activities focused on tree and bird identification.

Forest department carries a lot of awareness programmes in the state of goa. The project proponent through its conservation plan will support the initiative by providing funds for conducting awareness campaigns, celebrating wild life week, sponsoring prizes etc for various activities conducted by forest department.

SLOGANS AND SIGNAGE: Eye-catching slogans and signage promoting wildlife and nature conservation will be prominently displayed throughout the core zone and within buffer zone (10-kilometer radius), especially along roadsides. These visual reminders aim to encourage the public to actively participate in conservation efforts.

SIGN BOARDS:

Wild life protection will be most effective if the young once like the school children are thought and involved in it. To begin with sign boards with images of wild life will be placed near the village schools as well as at places of more occurrences or more conflicts of any particular species of the wildlife.



3.3.8 MEASURES TO ADDRESS HUMAN-WILDLIFE CONFLICTS:

- Human-wildlife conflict (HWC) mitigation shall be implementing using a scientifically informed and spatially explicit approach in consultation with the Forest Department. Conflict hotspots shall be identified through a combination of geospatial analysis, historical incident records, camera trap data, telemetry studies and field-based observations of wildlife movement and habitat use. Based on this analysis, targeted interventions shall be deployed to minimize negative interactions. These include the installation of physical barriers such as perimeter fencing, trenching and vegetative buffer zones to prevent crop raiding and livestock predation and the establishment of early warning systems incorporating community alert networks, watchtowers and real-time reporting mechanisms.
- Coexistence strategies will be promoted through evidence-based community engagement programs focusing on livestock management, safe agricultural practices and avoidance of conflict situations. Adaptive management shall be informed by ongoing monitoring of HWC incidents and spatial modeling to refine mitigation strategies, ensuring both human safety and the long-term conservation of wildlife populations and their habitats.



CHAPTER 4

ONSITE IMPLEMENTATION PLAN

4.1 INTRODUCTION:

This chapter outlines the onsite implementation plan for wildlife conservation measures at the Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha. It builds upon the findings and recommendations in Chapter 3 to ensure that conservation measures are operationally feasible, timely, and effective. The chapter details site zoning, phased strategies (short, mid and long-term), responsibilities, timelines and expected measurable outcomes for each activity.

PROJECT SITE ZONING (CORE AND BUFFER AREAS):

CORE AREA:

The core area is defined as the Auctioned Block Area: 377.0881 ha. where active mining, crushers, beneficiation Plant and associated infrastructure at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Permitted activities:

- Mining and beneficiation operations.
- Waste dumping.
- Ore transport within lease.
- Water management structures.
- Greenbelt at 7.5 m periphery of mine lease.

Restricted activities:

- Open discharge of wastewater.
- Uncontrolled waste disposal.
- Vegetation removal outside approved mining area.
- Entry of unauthorized persons.

BUFFER AREA:

Buffer areas extends up to 10 km around the lease boundary.

Permitted activities:

- Community development works.
- Plantation within forest areas, Wildlife Sanctuary with consultation of forest department.
- Water conservation for Wildlife within forest, Wildlife Sanctuary with consultation of forest department.

Restricted activities:

- Waste dumping.
- Industrial development related to mining & other work.
- Tree cutting near forest and wildlife habitations.



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



Wildlife Conservation Plan

All the activities listed herein below will begin within six months of the start of mining operations and will be completed within five years:

S. N.	Activities	Strategies	Objectives	Responsibility	Measurable Sustainability Outcomes & Its
1	Rescue and Patrolling Vehicle	6 to 12 months after the start of mining operations	Enhance mobility for wildlife rescue and patrolling	Forest Department	One 4-wheeler along with rescue equipment and 02 motorcycle for monitoring and patrolling and rescue operations.
2	Installation of sign boards & Awareness and Sensitization Programs	0 to 24 months and up to 5 years after the start of mining operations	Educate communities and workers through workshops, street plays, and school campaigns	JSW & Forest Department	Awareness among local communities regarding wildlife conservation and fire management will be increased. Attendance records of awareness programs will be maintained.
3	Birds Habitat Mitigation Measures	6 months to 24 months and up to 5 years after the start of mining operations	Improve Birds diversity	JSW & Forest Department	Protection and enhancement of natural habitats, nesting/roosting sites, native vegetation, water sources and feeding areas to minimize disturbance to birds.
4	Habitat Improvement through Plantation in Buffer Areas	0 to 24 months and up to 5 years after the start of mining operations	Rehabilitate degraded landscapes and support native flora Prevent soil erosion and improve water retention	JSW & Forest Department	Plantation, improving soil structure and landscape. Reduction in particulate matter and gaseous pollutants by maintaining fugitive and gaseous emissions within permissible limits.



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



Wildlife Conservation Plan

S. N.	Activities	Strategies	Objectives	Responsibility	Measurable Sustainability Outcomes & Its
			Act as a natural sink for air pollutants (dust, SO ₂ , NO _x , CO)		Noise levels reduced in buffer zones and nearby communities within permissible limits.
			Serve as a barrier to reduce noise		Vegetation growth contributes to climate change mitigation by reducing carbon footprint.
			Offset carbon emissions through biomass accumulation		
5	Soil Moisture Conservation Measures	6 to 12 months and upto 5 years after the start of mining operations	Enhance soil water retention and groundwater recharge to support vegetation, reduce erosion.	JSW & Forest Department	Water harvesting structure will enhance the ground water recharges. (12 months from start of mining operation) Lateritic bund (retention wall) and garland drains as per the approved mining plan will be carried out which will help in preventing soil erosion. (24 months)



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Wildlife Conservation Plan



CHAPTER 5

YEAR-WISE FINANCIAL OUTLAY

5.1 BUDGET FOR IMPLEMENTATION OF WILDLIFE CONSERVATION PLAN:

5.1.1 Conservation measures in context of schedule I species within the Buffer Zone:

Buffer zone of 10 km surrounding the project area comprises of ecologically sensitive areas as mentioned in earlier chapters. Wildlife Sanctuaries and Reserve Forests are governed by Forest and Wildlife laws and are under the able jurisdiction of the Forest Department. The Department already implements various measures to protect wildlife in these areas, which may include the following activities to ensure the conservation of wildlife:

1. Assess changes in wildlife population and habitats through surveys.
2. Implement protective measures in the Wildlife Sanctuary and Reserve Forests to restrict external impacts on wildlife.
3. Forest fire management and rehabilitation of degraded forest areas.
4. Habitat management through plantation of suitable fodder species to support herbivorous wildlife.
5. Engage local communities in conservation awareness and monitoring activities and provide employment opportunities to support ecology and biodiversity conservation.
6. Establish a robust monitoring system in collaboration with the local Forest Department for conducting wildlife census and tracking faunal species.

The above-mentioned activities are specific to areas within Wildlife Sanctuaries and forest areas and fall under the jurisdiction of the Forest Department. The Project Proponent will support the Forest Department by allocating and providing funds for implementation of such schemes for wildlife conservation.

5.1.2 Fund Allocation for Wildlife Conservation:

The Project Proponent has allocated budget to carry out various measures within the plant area such as implementation of mitigation measures, plantation development, spreading awareness and also providing support to the Forest Department for carrying out its activities, wherever feasible.

Total budget of Rs. 50.90 lakhs has been earmarked for implementation of the Wildlife Conservation Plan and mitigation measures for a period of 5 years. The budgetary allocation is presented in below table.

TABLE 18 BUDGET PROVISION FOR WILDLIFE CONSERVATION AND MANAGEMENT PLAN

S. N.	Activity	Rs. in lakhs					
		For Maintenance Costs 10 % increased every Year					Total (Rs. in lakhs)
		1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year	
Conservation measures to be undertaken by the Forest Department in the buffer area and by JSW in the core area.							
1	Habitat Improvement through Plantation of Native Tree Species in the Buffer Area.	10	2	2.3	2.53	2.78	19.61
2	Soil and Moisture Conservation	5.5	1	1.1	1.21	1.33	10.14
3	Birds Habitat Mitigation	4	1	1.1	1.21	1.33	8.64
4	01 Rescue Vehicle along with rescue equipment	10	1.0	1.10	1.21	1.33	10.00
5	Installation of sign boards & Awareness programs	2.5	0.0	0.0	0.0	0.0	2.50
Total		32	5.00	5.6	6.16	6.78	50.90

The habitat management in and around the study area must be adopted by planting suitable fodder species to enable wild herbivores to thrive upon. Following suggestions, if implemented will encourage the native fauna to return to the areas:

- A dense green belt consisting of shrubs and trees of different species must be created around the mine area and also along the roads which will act also as a dust and noise barrier.
- Awareness programs amongst the local people as well as mine staff, regarding the importance of wildlife, their habits and habitats, should be organized so that stray and displaced fauna (due to degradation and de-fragmentation of their habitat) is not killed.
- The green cover loss due to construction of roads and heavy vehicular movements will restrict the animal movements to the adjoining areas. Therefore, development of a green belt and massive afforestation program of local species and shade giving plant species in the forest area along with approach road shelter for them.
- Intense campaign amongst the local people/school children as well as project staff shall be carried out regarding the importance of regional biodiversity and need for their conservation for posterity.
- Fire lines should also be cleared along permanent features like roads, nallas and footpaths at suitable intervals to prevent forest fire from spreading, in case it breaks out.

- People should be trained with forest fire fighting measures and equipped with necessary materials like-
 - **Shovels:** For digging and clearing vegetation to create firebreaks.
 - **Fire rakes/hoes:** For clearing brush and creating fire lines and for raking away burning materials.
 - **Fire beaters:** For smothering flames on the ground.
 - **Chain saws:** For clearing larger trees and creating firebreaks.
 - **Portable fire pumps:** For pumping water from a water source to the fire.
 - **Helmets:** For head protection.
 - **Goggles/glasses:** For eye protection from heat, smoke and debris.
 - **Respirators/masks:** For filtering smoke and harmful particles.
 - **Fire-resistant clothing:** Including gloves, boots and overalls, offering protection from heat and flames.
 - **Fire shelters:** Portable shelters that can protect firefighters from radiant heat and flames during a sudden fire blow-up.
 - **First-aid kits:** For treating minor injuries.
- Obviously, all this would be done at project cost and would be apart from what the local forest department traditionally practices.
- The faunal diversity of the region plays an important role in maintaining ecological balance and ecosystem functioning. Mammals contribute to seed dispersal and trophic regulation, while avifaunal species aid in pollination, insect control and nutrient cycling. Reptiles and amphibians act as bio-indicators of environmental health and help regulate pest populations. Butterflies and Odonates are important pollinators and ecological indicators of habitat quality and freshwater ecosystem integrity. Aquatic fauna contributes to nutrient recycling and sustains food web within wetland and estuarine ecosystems.
- The diverse habitats provide breeding, nesting, feeding and sheltering grounds for numerous resident and migratory species. The ecological significance of the area is further enhanced by the presence of forest patches, vegetation, mangrove ecosystems and wetlands that support biodiversity conservation and strengthen ecosystem resilience.
- The proposed wildlife conservation plan will be implemented through the allocated budget and timely interventions will be monitored by the local authority to ensure biodiversity conservation and not harm the existing ecosystem habitats.





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To,
The Deputy Conservator of Forests
South Division,
Margao (Goa) – 403601.

Date: 03/08/2026

Subject: Updated list of Flora and Fauna

Reference: No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995

Sir

With reference to the above, we have updated the list of flora and fauna as suggested by you.

Kindly consider the revised list and accord your approval for the same.

Thank you for your kind consideration.

Yours faithfully,

For JSW Steel Limited

Ambarish Volvoikar

Authorized Signatory

CC: PCCF and Chief Wildlife Warden, Van Bhawan, Altinho, Panaji, Goa-403001

Encl.:

Annexure I: Revised List of Flora & Fauna.



Part of O. P. Jindal Group

Dispatch Clerk 03/08/2026
Office of the Dy. Conservator of Forests
South Goa Division
Margao - Goa

TABLE NO. -1
INVENTORY OF FLORAL DIVERSITY IN THE CORE & BUFFER ZONE OF PROJECT SITE
BASED ON ACTUAL SIGHTING, INPUTS FROM LOCALS

S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
Trees						
1	<i>Areca catechu</i>	Betel Nut	Arecaceae	-	+	LC
2	<i>Acacia catechu</i>	khair	Fabaceae	-	+	LC
3	<i>Acacia auriculiformis</i>	Earleaf acacia	Fabaceae	+	+	LC
4	<i>Aegle marmelos</i>	Bel	Rutaceae	-	+	NT
5	<i>Albizia odoratissima</i>	Kaloshiras	Fabaceae	+	+	LC
6	<i>Alstonia scholaris</i>	Satvan/Satan tree	Apocynaceae	+	+	LC
7	<i>Adina cordifolia</i>	Hedu	Rubiaceae	-	+	LC
8	<i>Anacardium occidentale</i>	Kaju	Anacardiaceae	+	+	LC
9	<i>Annona reticulata</i>	Custard Apple	Annonaceae	-	+	LC
10	<i>Artocarpus heterophyllus</i>	Jakfruit	Moraceae	+	+	NE
11	<i>Azadirachta indica</i>	Neem	Meliaceae	+	+	LC
12	<i>Bauhinia racemosa</i>	Apto	Fabaceae	+	+	LC
13	<i>Bombax ceiba</i>	Savar	Malvaceae	-	+	LC
14	<i>Bridelia retusa</i>	Khatem Asan	Phyllanthaceae	+	+	LC
15	<i>Buchanania lanzan</i>	Chara	Anacardiaceae	-	+	LC
16	<i>Butea monosperma</i>	Palash	Fabaceae	-	+	LC
17	<i>Callicarpa tomentosa</i>	Phalyo	Lamiaceae	-	+	LC
18	<i>Calophyllum inophyllum</i>	Undi	Calophyllaceae	-	+	LC
19	<i>Carallia brachiata</i>	Panshi, Makad bhiran	Rhizophoraceae	-	+	LC
20	<i>Careya arborea</i>	Kumbyo	Lecythidaceae	+	+	LC
21	<i>Caryota urens</i>	Birlo mad	Arecaceae	-	+	LC
22	<i>Cassia fistula</i>	Bayo, Amaltas	Fabaceae	-	+	LC
23	<i>Ceiba pentandra</i>	Savar	Malvaceae	+	+	LC
24	<i>Cinnamomum zeylanicum</i>	Tikhi	Lauraceae	+	+	EN
25	<i>Cocos Sp.</i>	Coconut	Arecaceae	+	+	NE
26	<i>Corypha umbraculifera</i>	Karetel	Arecaceae	-	+	DD
27	<i>Dalbergia latifolia</i>	Sisham	Fabaceae	-	+	VU
28	<i>Dalbergia paniculata</i>	Kuri	Fabaceae	-	+	NE
29	<i>Delonix regia</i>	Gulmohar	Fabaceae	+	+	LC
30	<i>Derris scandens</i>	Kanranj	Fabaceae	+	+	LC
31	<i>Dillenia pentagyna</i>	Karmal	Dilleniaceae	-	+	NE
32	<i>Diospyros montana</i>	Goiunda, Govimelu	Ebenaceae	-	+	NE
33	<i>Ficus bengalensis</i>	Vad	Moraceae	-	+	NE
34	<i>Ficus glomerata</i>	Rumad	Moraceae	-	+	LC
35	<i>Ficus hispida</i>	Kalaumbar	Moraceae	-	+	LC
36	<i>Ficus religiosa</i>	Pipal	Moraceae	+	+	LC
37	<i>Flacourtia jangomas</i>	Jangli Jagam	Salicaceae	-	+	NE
38	<i>Flacourtia montana</i>	Chafra	Salicaceae	-	+	NT
39	<i>Garcinia gummigutta</i>	Dhar ambo	Clusiaceae	-	+	LC
40	<i>Garcinia indica</i>	Bhiran	Clusiaceae	-	+	VU
41	<i>Gmelina arborea</i>	Shivan	Lamiaceae	-	+	LC
42	<i>Grewia tiliifolia</i>	Dhaman	Malvaceae	+	+	LC



S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
43	<i>Helicteres isora</i>	Kivan	Malvaceae	-	+	LC
44	<i>Holarrhena antidysenterica</i>	Kudo	Apocynaceae	+	+	LC
45	<i>Holoptelea integrifolia</i>	Vamolo	Ulmaceae	-	+	LC
46	<i>Lagerstroemia lanceolata</i>	Nano	Lythraceae	+	+	LC
47	<i>Lagerstroemia parviflora</i>	Taman	Lythraceae	-	+	LC
48	<i>Lannea coromandelica</i>	Moi	Anacardiaceae	-	+	LC
49	<i>Mallotus philippensis</i>	Bems, Sendri	Euphorbiaceae	-	+	LC
50	<i>Mangifera indica</i>	Aam	Anacardiaceae	+	+	DD
51	<i>Manilkara hexandra</i>	Kirni	Sapotaceae	-	+	LC
52	<i>Melia azedarach</i>	Firnage nimb	Meliaceae	-	+	LC
53	<i>Mitragyna parvifolia</i>	Kalamb	Rubiaceae	-	+	LC
54	<i>Myristica fragrans</i>	Jayphal	Myristicaceae	-	+	DD
55	<i>Myristica malabarica</i>	Kayphal	Myristicaceae	-	+	VU
56	<i>Pterocarpus marsupium</i>	Asan	Fabaceae	+	+	NT
57	<i>Saraca indica</i>	Ashoka	Fabaceae	+	+	LC
58	<i>Schleichera oleosa</i>	Kasamb	Sapindaceae	-	+	LC
59	<i>Semecarpus anacardium</i>	Biboi	Anacardiaceae	-	+	LC
60	<i>Spondias mangifera</i>	Ambado	Anacardiaceae	-	+	LC
61	<i>Sterculia guttata</i>	Kulinder	Malvaceae	-	+	LC
62	<i>Sterculia urens</i>	Dhavoruk, Pandruk	Malvaceae	-	+	LC
63	<i>Sterculia villosa</i>	Aployo suplo	Malvaceae	-	+	LC
64	<i>Syzygium caryophyllatum</i>	Bhedas	Myrtaceae	-	+	VU
65	<i>Syzygium cumini</i>	Jamun	Myrtaceae	+	+	LC
66	<i>Tamarindus indica</i>	Chinch, Imli	Fabaceae	-	+	LC
67	<i>Tectona grandis</i>	Saylo, Teak	Lamiaceae	-	+	EN
68	<i>Terminalia arjuna</i>	Arjun	Combretaceae	+	+	LC
69	<i>Terminalia bellirica</i>	Goting	Combretaceae	+	+	LC
70	<i>Terminalia paniculata</i>	Kindal	Combretaceae	-	+	LC
71	<i>Terminalia chebula</i>	Hirda	Combretaceae	-	+	LC
72	<i>Terminalia tomentosa</i> (<i>crenulata</i>)	Marat (Matti)	Combretaceae	-	+	NE
73	<i>Vitex altissima</i>	Bavalgi	Lamiaceae	-	+	LC
74	<i>Xylia xylocarpa</i>	Zambo	Fabaceae	+	+	LC
75	<i>Zanthoxylum rhetsa</i>	Tirphal	Rutaceae	-	+	LC
Shrubs						
1	<i>Adhatoda vasica</i>	Aduso	Acanthaceae	-	+	NE
2	<i>Annona muricata</i>	Soursop	Annonaceae	-	+	LC
3	<i>Calotropis gigantea</i>	Rui/ Aak	Asclepiadaceae	+	+	NE
4	<i>Carissa carandas</i>	Karvanda, Kanda	Apocynaceae	-	+	DD
5	<i>Cassia tora</i>	Taykhilo	Fabaceae	+	+	NE
6	<i>Clerodendrum indicum</i>	Bharmgi	Verbenaceae	-	+	LC
7	<i>Hemidesmus indicus</i>	Dudhshiri	Apocynaceae	-	+	NE
8	<i>Ixora brachiata</i>	Gurani tree	Rubiaceae	+	+	LC
9	<i>Lobelia nicotianaefolia</i>	Baknal	Campanulaceae	-	+	NE
10	<i>Lantana camara</i>	Tick berry	Verbenaceae	+	+	NE
11	<i>Microcos paniculata</i>	Asale, Chivara	Malvaceae	-	+	LC

S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
12	<i>Moullava spicata</i>	Wagati, Vakeri	Fabaceae	-	+	NE
13	<i>Pothos scandens</i>	Bemdarli	Araceae	-	+	NE
14	<i>Vitex negundo</i>	Nimgud	Lamiaceae	-	+	LC
15	<i>Ziziphus mauritiana</i>	Indian jujube	Rhamnaceae	+	+	LC
Herbs						
1	<i>Achyranthes aspera</i>	Aghado	Amaranthaceae	-	+	NE
2	<i>Asparagus racemosus</i>	Shatavari	Liliaceae	-	+	NE
3	<i>Alternanthera sessilis</i>	Kanchari	Amaranthaceae	-	+	LC
4	<i>Ananas comosus</i>	Pineapple	Bromeliaceae	-	+	NE
5	<i>Boerhavia diffusa</i>	Punarnava	Nyctaginaceae	-	+	NE
6	<i>Canscora diffusa</i>	Bhui neem	Gentianaceae	-	+	NE
7	<i>Centella asiatica</i>	Gundhurichi bhaji	Apiaceae	-	+	LC
8	<i>Eclipta alba</i>	Mako	Asteraceae	-	+	LC
9	<i>Mentha arvensis</i>	Ortelamv	Lamiaceae	-	+	LC
10	<i>Ocimum omericanum</i>	Ramtulas	Lamiaceae	-	+	NE
11	<i>Ocimum sanctum</i>	Tulas	Lamiaceae	+	+	NE
12	<i>Leucas aspera</i>	Tumbo	Lamiaceae	-	+	NE
13	<i>Rauvolfia serpentina</i>	Atki	Apocynaceae	-	+	LC
14	<i>Smilax zeylanica</i>	Ghot vel or Kaval kamti	Smilacaceae	-	+	NE
15	<i>Sphagneticola trilobata</i>	Wedelia	Asteraceae	+	+	NE
16	<i>Sida cordifolia</i>	Indian country mallow	Malvaceae	+	+	NE
Grasses						
1	<i>Bambusa arundinacea</i>	Velu/bambo	Poaceae	-	+	NE
2	<i>Themeda cymbaria</i>	Karad	Poaceae	+	+	NE
3	<i>Themeda triandra</i>	Karad	Poaceae	-	+	NE
4	<i>Cynodon dactylon</i>	Haryali, Dub	Poaceae	-	+	NE
5	<i>Dendrocalamus strictus</i>	Velu/bambo	Poaceae	+	+	NE
6	<i>Saccharum officinarum</i>	Sugarcane	Poaceae	-	+	NE
Climbers						
1	<i>Piper nigrum</i>	Black pepper	Piperaceae	-	+	NE
2	<i>Epipremnum aureum</i>	Money plant	Araceae	-	+	NE

TABLE NO. -2
INVENTORY OF FAUNAL DIVERSITY IN THE CORE & BUFFER ZONE OF PROJECT SITE
 BASED ON ACTUAL SIGHTING, INPUTS FROM LOCALS

S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
MAMMALS							
1	<i>Axis axis</i>	Spotted Deer	Cervidae	+	+	II	LC
2	<i>Funambulus palmarum</i>	Indian palm squirrel	Sciuridae	-	+	IV	LC
3	<i>Lepus nigricollis</i>	Black-naped Hare	Leporidae	+	+	II	LC
4	<i>Pteropus giganteus</i>	Indian Flying fox	Pteropodidae	-	+	II	NT



S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
5	<i>Rattus rattus</i>	Common House Rat	Muridae	+	+	IV	LC
6	<i>Suncus murinus</i>	Grey Musk Shrew	Tupaiaidae	+	+	-	LC
7	<i>Sus scrofa</i>	Indian Wild Boar	Suidae	-	+	II	LC
8	<i>Tatera indica</i>	Indian Gerbil	Muridae	-	+	-	LC
REPTILES							
1	<i>Bungarus caeruleus</i>	Indian Krait	Elapidae	-	+	II	LC
2	<i>Calotes versicolor</i>	Indian Garden Lizard	Agamidae	-	+	IV	LC
3	<i>Hemidactylus brooki</i>	Brooki's Gecko	Gekkonidae	-	+	IV	LC
4	<i>Hemidactylus frenatus</i>	Common House Gecko	Gekkonidae	+	+	IV	LC
AMPHIBIANS							
1	<i>Duttaphrynus melanostictus</i>	Indian toad	Bufonidae	+	+	IV	LC
2	<i>Euphlyctis cyanophlyctis</i>	Indian skipper frog	Dicroglossidae	-	+	IV	LC
3	<i>Hoplobatrachus tigerinus</i>	Indian bull frog	Dicroglossidae	+	+	II	LC
4	<i>Sphaerotheca breviceps</i>	Indian burrowing frog	Dicroglossidae	-	+	IV	LC
AVI FAUNA							
1	<i>Athene brama</i>	Spotted owl	Strigidae	-	+	II	LC
2	<i>Acridotheres fuscus</i>	Jungle Myna	Sturnidae	+	+	II	LC
3	<i>Acridotheres tristis</i>	Common Myna	Sturnidae	+	+	II	LC
4	<i>Aegithina tiphia</i>	Common Iora	Aegithinidae	+	+	II	LC
5	<i>Alcedo atthis</i>	Common Kingfisher	Alcedinidae	-	+	II	LC
6	<i>Apus affinis</i>	House Swift	Apodidae	-	+	II	LC
7	<i>Ardeola grayii</i>	Indian Pond Heron	Ardeidae	+	+	II	LC
8	<i>Bubulcus ibis</i>	Cattle Egret	Ardeidae	+	+	II	LC
9	<i>Ceryle rudis</i>	Pied Kingfisher	Alcedinidae	+	+	II	LC
10	<i>Charadrius dubius</i>	Little Ringed Plover	Charadriidae	+	+	II	LC
11	<i>Cinnyris asiaticus</i>	Purple Sun Bird	Nectariniidae	+	+	II	LC
12	<i>Clamator jacobinus</i>	Pied Cuckoo	Cuculidae	-	+	II	LC
13	<i>Columba livia</i>	Blue Rock Pigeon	Columbidae	+	+	-	LC
14	<i>Copsychus fulicata</i>	Indian Robin	Muscicapidae	-	+	II	LC
15	<i>Copsychus saularis</i>	Oriental Magpie Robin	Muscicapidae	+	+	II	LC
16	<i>Corvus macrorhynchos</i>	Large-billed Crow	Corvidae	+	+	II	LC
17	<i>Corvus splendens</i>	House Crow	Corvidae	+	+	-	LC



S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
18	<i>Cyornis tickelliae</i>	Tickell's Blue Flycatcher	Muscicapidae	-	+	II	LC
19	<i>Dendrocitta vagabunda</i>	Rufous Treepie	Corvidae	+	+	II	LC
20	<i>Dicrurus caerulescens</i>	White Bellied Drongo	Dicruridae	-	+	II	LC
21	<i>Dicrurus macrocercus</i>	Black Drongo	Dicruridae	+	+	II	LC
22	<i>Dicrurus paradiseus</i>	Greater Racket-tailed Drongo	Dicruridae	-	+	II	LC
23	<i>Dinopium benghalense</i>	Black-rumped Flameback	Picidae	-	+	II	LC
24	<i>Elanus caeruleus</i>	Black winged kite	Elanidae	-	+	II	LC
25	<i>Fulica atra</i>	Eurasian Coot	Rallidae	-	+	II	LC
26	<i>Gallinula chloropus</i>	Common moorhen	Rallidae	-	+	II	LC
27	<i>Galloperdix spadicea</i>	Red Spurfowl	Phasianidae	-	+	II	LC
28	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	Alcedinidae	+	+	II	LC
29	<i>Hirundo smithii</i>	Wire Tailed Swallow	Hirundinidae	-	+	II	LC
30	<i>Leptocoma minima</i>	Crimson backed Sunbird	Nectariniidae	-	+	II	LC
31	<i>Lonchura punctulata</i>	Scaly-breasted munia	Estrildidae	-	+	II	LC
32	<i>Megalaima haemacephala</i>	Coppersmith Barbet	Megalaimidae	-	+	II	LC
33	<i>Merops orientalis</i>	Green Bee-eater	Meropidae	+	+	II	LC
34	<i>Milvus migrans</i>	Black Kite	Accipitridae	-	+	II	LC
35	<i>Oriolus kundoo</i>	Golden oriole	Oriolidae	-	+	II	LC
36	<i>Oriolus xanthornus</i>	Black Headed Oriole	Oriolidae	-	+	II	LC
37	<i>Orthotomus sutorius</i>	common tailorbird	Cisticolidae	-	+	II	LC
38	<i>Passer domesticus</i>	House Sparrow	Passeridae	+	+	II	LC
39	<i>Perdica asiatica</i>	Jungle bush quail	Phasianidae	-	+	II	LC
40	<i>Pericrocotus flammeus</i>	Scarlet Minivet	Campephagidae	-	+	II	LC
41	<i>Pitta brachyura</i>	Indian Pitta	Pittidae	-	+	II	LC
42	<i>Ploceus philippinus</i>	Baya Weaver	Ploceidae	-	+	II	LC
43	<i>Prinia inornata</i>	Plain Prinia	Cisticolidae	-	+	II	LC
44	<i>Prinia socialis</i>	Ashy prinia	Cisticolidae	+	+	II	LC
45	<i>Psittacula cyanocephala</i>	Plum-headed parakeet	Psittacidae	-	+	II	LC
46	<i>Psittacula krameri</i>	Rose Ringed Parakeet	Psittacidae	+	+	II	LC



S.N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
47	<i>Pycnonotus cafer</i>	Red Vented Bulbul	Pycnonotidae	+	+	II	LC
48	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	Pycnonotidae	+	+	II	LC
49	<i>Saxicola caprata</i>	Pied Bushchat	Muscicapidae	-	+	II	LC
50	<i>Streptopelia chinensis</i>	Spotted Dove	Columbidae	+	+	II	LC
51	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	Threskiomithidae	-	+	II	LC
52	<i>Tringa hypoleucos</i>	Common Sandpiper	Scolopacidae	-	+	II	LC
53	<i>Upupa epops</i>	Hoopoe	Upupidae	+	+	II	LC
54	<i>Vanellus indicus</i>	Red-wattled Lapwing	Charadriidae	+	+	II	LC
55	<i>Vanellus malabaricus</i>	Yellow Wattled Lapwing	Charadriidae	+	+	II	LC
AQUATIC SPECIES							
1	<i>Aplocheilichthys lineatus</i>	Striped panchax	Aplocheilidae	-	+	-	LC
2	<i>Puntius filamentosus</i>	Black spot barb	Cyprinidae	-	+	-	LC
3	<i>Rasbora labiosa</i>	Slender rasbora	Danionidae	-	+	-	LC
BUTTERFLY							
1	<i>Appias lycinda</i>	Chocolate albatross	Pierinae	-	+	II	NE
2	<i>Ariadne merione</i>	Common castor	Nymphalidae	-	+	II	NE
3	<i>Euploea core</i>	Common Indian Crow	Nymphalidae	+	+	II	LC
4	<i>Eurema hecabe</i>	Common grass Yellow	Pieridae	+	+	II	LC
5	<i>Hypolimnas misippus</i>	Danaid Eggfly	Nymphalidae	+	+	II	LC
6	<i>Idea malabarica</i>	Malabar Tree Nymph	Nymphalidae	-	+	II	LC
7	<i>Papilio demoleus</i>	Lime butterfly	Papilionidae	+	+	II	NE
8	<i>Troides minos</i>	Southern birdwing	Papilionidae	+	+	II	LC

TABLE NO. -3
INVENTORY OF SCHEDULE-I SPECIES IN THE CORE & BUFFER ZONE OF PROJECT SITE
BASED ON ACTUAL SIGHTING, INPUTS FROM LOCALS

S.N.	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
MAMMALS							
1	<i>Bos gaurus</i>	Gaur / Indian Bison	Bovidae	-	+	I	VU
2	<i>Canis aureus</i>	Golden Jackel	Canidae	+	+	I	LC
3	<i>Cuon alpinus</i>	Wild dog (Dhole)	Canidae	-	+	I	EN
4	<i>Hystrix indica</i>	Indian Crested Porcupine	Hystriidae	-	+	I	
5	<i>Macaca radiata</i>	Bonnet Macaque	Cercopithecidae	-	+	I	



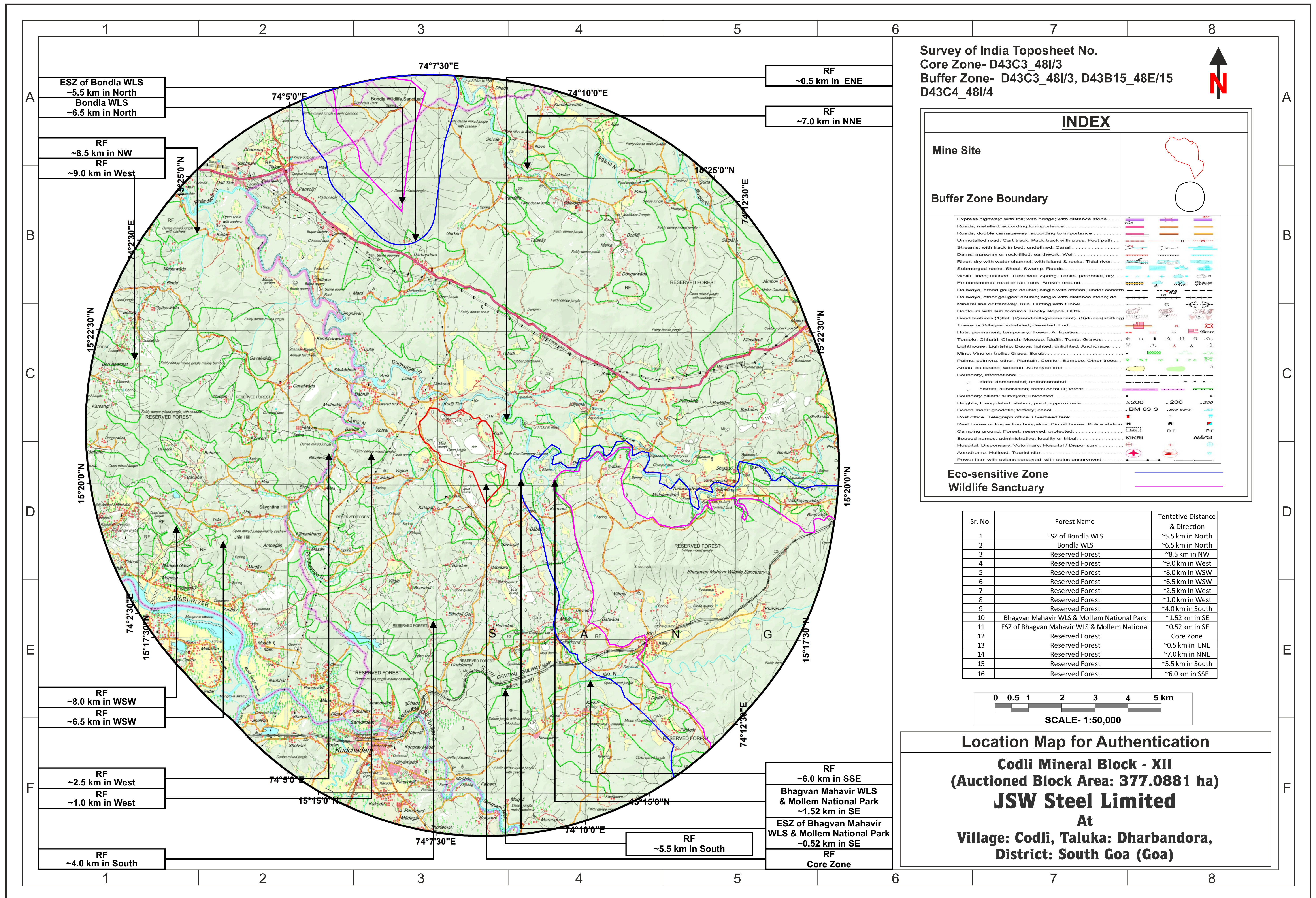
S.N.	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
6	<i>Melursus ursinus</i>	Sloth bear	Ursidae	-	+	I	VU
7	<i>Moschiola indica</i>	Mouse deer	Tragulidae	-	+	I	LC
8	<i>Panthera pardus</i>	Leopard	Felidae	+	+	I	VU
9	<i>Ratufa indica</i>	Malabar giant squirrel	Sciuridae	-	+	I	LC
10	<i>Urva edwardsii</i>	Grey Mongoose	Herpestidae	+	+	I	LC
REPTILES							
1	<i>Crocodylus palustris</i>	Marsh crocodiles	Crocodylidae	-	+	I	VU
2	<i>Naja naja</i>	Indian Cobra	Elapidae	-	+	I	LC
3	<i>Ptyas mucosa</i>	Rat Snake	Colubridae	-	+	I	LC
4	<i>Varanus bengalensis</i>	Monitor Lizard	Varanidae	-	+	I	NT
AVI FAUNA							
1	<i>Accipiter badius</i>	Shikra	Accipitridae	+	+	I	LC
2	<i>Haliastur indus</i>	Brahminy Kite	Accipitridae	-	+	I	LC
3	<i>Nisaetus cirrhatus</i>	Crested Hawk Eagle	Megalaemidae	-	+	I	LC
4	<i>Pavo cristatus</i>	Indian Peafowl	Phasianidae	+	+	I	LC
5	<i>Strix leptogrammica</i>	Brown Wood Owl	Strigidae	-	+	I	LC

Source: Based on actual sightings and information gathered from locals during the primary field survey.

Abbreviations: LC: Least Concern, NE: Not Evaluated, DD: Data Deficient, VU: Vulnerable, NT: Near Threatened, EN: Endangered.

As per the Wildlife Protection (Amendment) Act, 2022, there are total 19 species listed under Schedule I (Including 10 Mammals, 04 Reptiles and 05 Avi Fauna).







Government of Goa
Office of The Dy. Conservator of Forests
Working Plan Division
"Goa Van Bhavan"
Altinho Panaji Goa - 403 001

No: - DCF(WP)/Tech/Digi/Vol-I/75/2025-26/751

Dated: - 10/10/2025

✓ To,
The Sr. Manager,
JSW, Steel Limited,
JSW Centre, Bandra Kurla Complex,
Bandra (East), Maharashtra, Mumbai-400051.

Sub: - Authenticated Map showing distance indicating the shortest distance between the ESZ and WLS from the mine lease boundary of Codli Mineral Block-XII located in Codli Village, Dharbandora Taluka, South Goa District, Goa.

Ref: - dated 15/09/2025.

Sir,

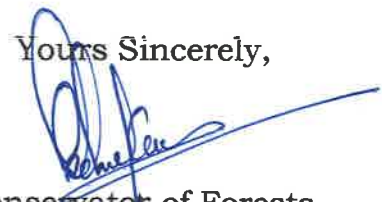
With reference to the above cited subject, please find enclosed herewith Map showing distance indicating the shortest distance between the Eco-Sensitive Zone and Wildlife Sanctuary from the mine lease boundary of Codli Mineral Block-XII located in Codli Village, Dharbandora Taluka, South Goa District (**Annexure-I**).

This is issued as per your request and may not be treated as NOC for any purpose.

Submitted for information and necessary action.

Yours Sincerely,

Encl: - As above.


Dy. Conservator of Forests,
Working Plan Division,
Panaji-Goa.

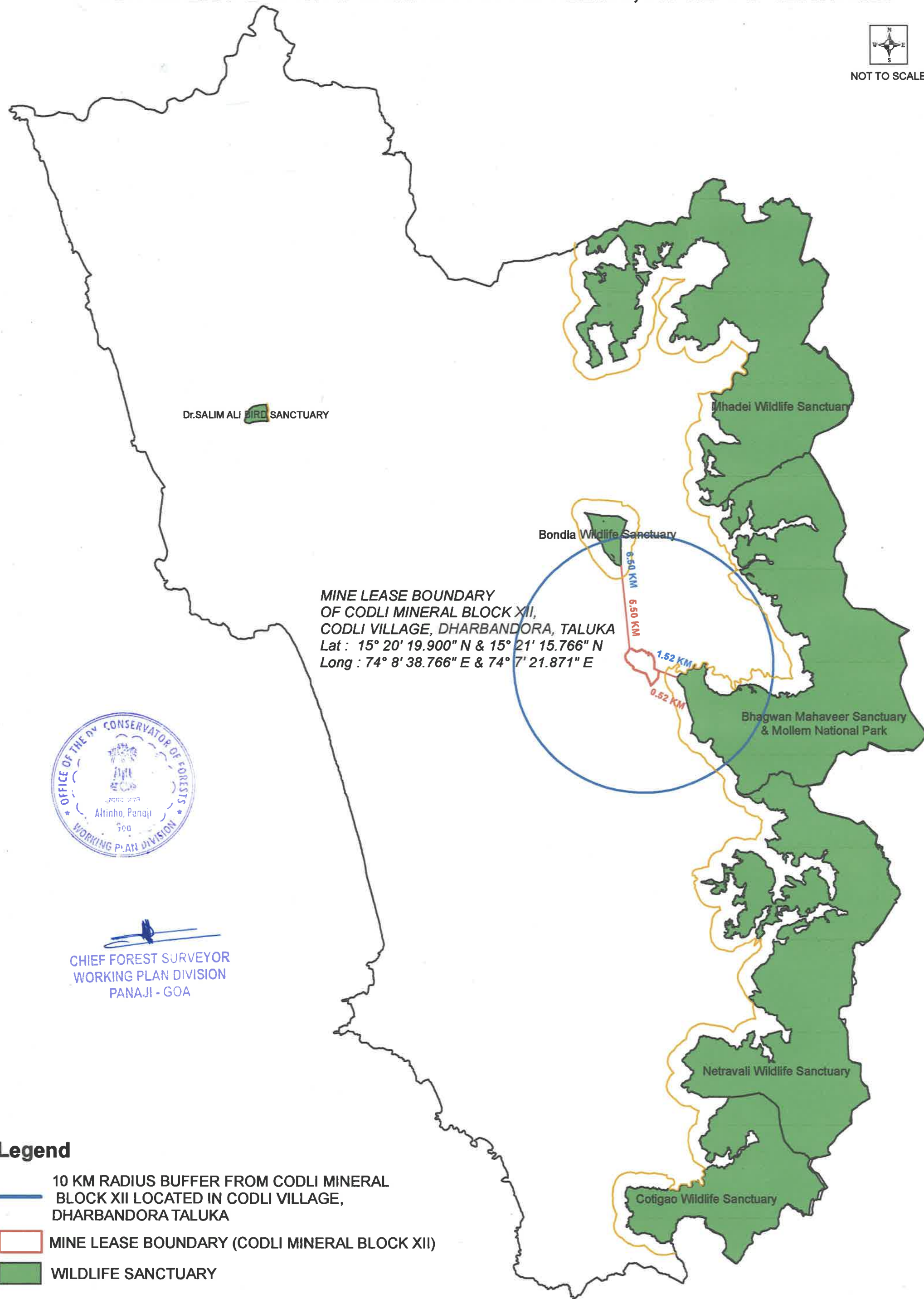
Phone No.: - 0832-2492529

"स्वच्छ भारत नितळ गोंय"
Towards greener & Cleaner Goa

STATE MAP OF GOA SHOWING DISTANCE INDICATING THE SHORTEST DISTANCE BETWEEN THE ECO SENSITIVE ZONE & WILDLIFE SANCTUARY FROM MINE LEASE BOUNDARY OF CODLI MINERAL BLOCK XII LOCATED IN CODLI VILLAGE, DHARBANDORA TALUKA.



NOT TO SCALE



CHIEF FOREST SURVEYOR
 WORKING PLAN DIVISION
 PANAJI - GOA



GOVERNMENT OF GOA
Office of the Principal Chief Conservator of Forests
"Goa Van Bhawan" Forest Department
Altinho, Panaji, Goa

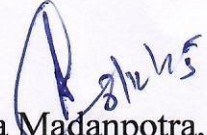
Ph: - 0832-2492548, 2492231

Email: dcfme-forest.goa@nic.in

No. 6-13-(103)-2025-26-FD/ **3828**

Dated: 08/12/2025.

Please find enclosed herewith the minutes of the meeting of the Project Screening Committee-I (PSC) held under the chairmanship of the Additional Principal Chief Conservator of Forests (Nodal officer) FCA on 05.12.2025 at 11.00 AM in Goa Van Bhawan, Altinho, Panjim for information & necessary action.


(Aditya Madanpotra, IFS)
DCF (Monitoring & Evaluation)
& Member Secretary (PSC).

Distribution:

1. The Conservator of Forests (Cons.)/ O/o. PCCF (Goa), Panjim
2. The District Collector, (South), Margao Goa.
3. The Dy. Conservator of Forests (South Goa) Division, Margao.
4. Mr. Baswaraj Mahadevppa Dalgade (AGM-Projects), JSW Steel Ltd., 507, 5th Floor, Gera Imperium-II, Patto, Panaji-Goa-403001. (User Agency).

Copy for information to

1. The Additional Principal Chief Conservator of Forests / Nodal Officer, (VSESA) Chairperson, PSC, O/o. PCCF (Goa), Panaji.
2. The Director of Mines & Geology, Institute Menezes Braganza Hall, Panaji-Goa as special invitee.
3. PA to PCCF, Goa Forest Department for kind information of the PCCF.

"Swachh Bharat, Swachh Goa"
"Clean India, Clean Goa"

MINUTES OF THE MEETING OF THE PROJECT SCREENING COMMITTEE-I, DEPARTMENT OF FORESTS (GOA) HELD ON 05.12.2025 UNDER THE CHAIRMANSHIP OF SH. K RAMESH KUMAR, IFS, APCCF / NODAL OFFICER, VSESA.

The meeting was attended by the following officers:

1. Sh. K Ramesh Kumar, IFS (APCCF / NO, VSESA) - Chairman
2. Sh. Naveen Kumar, IFS CF (C) - Member
3. Sh. Santosh Kumar Reddy, IFS DCF (South) - Member
4. Sh. Rohan A. Loliyekar, (Dy. Collector, Rev) - Representative of the District Collector, South
5. Sh. Jaiwant A. Kamat (Surveying Officer)- DMG- Special Invitee
6. Sh. Ambrish Volvoikar (User Agency) - Representative of the Project Proponent
7. Sh. Aditya Madanpotra, IFS DCF (M&E) - Member Secretary

“Application for approval of forest land under clause (iii) of sub-section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for signing of lease agreement in respect of Codli Block-XII in Sy. No. 46(p) & 54(p) of Codli Village of Dharbandora Taluka in South Goa District & Division in favour of JSW Steel Ltd”.

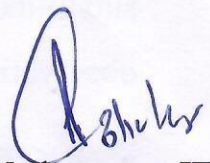
Welcoming the participants, the Chairman asked the Project Proponent (PP) to make a presentation on the compliance made by them in pursuance to the observations made in the PSC-I meeting held on 24.10.2025.

The Observations made in PSC-I meeting, held on 24.10.2025 and the replies submitted by the User Agency were deliberated in detail and the following observations were made by the PSC.

- a. NOC from the private owners if not already obtained shall be uploaded by the User Agency as additional document stating that the entire lease land is free from all encumbrances.

- b. A letter from Director of Mines & Geology, Govt. of Goa giving details of earlier lessee of the area, to be submitted by the User Agency.
 - c. A Certificate regarding the proposal does not affect historical monuments/Wildlife Sanctuary or National Park by the Competent Authority to be submitted by the User Agency.
 - d. Approved Mining Plan to be uploaded by the User Agency in the portal.
 - e. A report from the mining authorities on Iron Ore mining in the State of Goa, including reserves, mines capacity, projected future requirements etc. to be submitted by the User Agency.
2. The User Agency while replying on the observations made by the Committee on point (a) stated that the communication has been made with DMG for early reply. Further, PP made submission that an inspection by the DCF (S) has been planned for scrutiny of the area which is non-forest area involved in the proposal. The Chairman advised that the representative of DMG also should attend the site inspection and the same is agreed by the representative of DMG.
3. The User Agency also has affirmed that no additional area would be required for transportation purpose of the material.
4. Taking into consideration that, the User Agency has complied in submitting the required documents desired in the PSC meeting held on 24.10.2025 and upon satisfactory clarification of the User Agency on the above observations, the Committee unanimously agreed to recommend the proposal for further processing by the DCF (South) Division as per the provisions laid out in VSESA, 1980 and the User Agency is directed to comply with uploading all the remaining documents as observed by the PSC, in PARIVESH portal at the earliest.

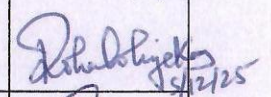
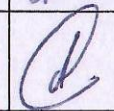
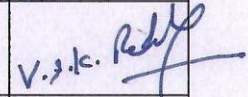
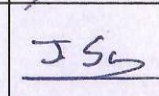
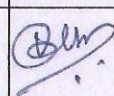
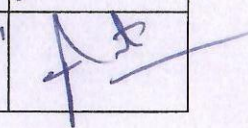
The meeting ended with vote of thanks to the Chair.



(Aditya Madanpotra, IFS)
DCF (Monitoring & Evaluation)
& Member Secretary (PSC).

The Meeting of the Project Screening Committee-I held on 05/12/2025 at 11:00 am under the chairmanship of the Additional Principal Chief Conservator of Forest/ Nodal Officer, VSESA in the Conference hall of Goa Van Bhawan Althino Panaji- Goa

Attendance Sheet

Sr No	Name of the Officer	Designation	Name of the Department	Mobile No	Email	Signature
1	NAVEEN KUMAR P	CF(C)	F.D	779898 6115		
2	ROHAN A. LOIYEKAR	DC (Revenue)	Collectorate	9158564324		
3	Aditya Madanpohar	DCF M&E	Forest	2798986116		
4	SANTOSH KUMAR REDDY V	DCF (South)	FORST	9491871958		
5	AMBARISH VOLVOINAR	JSW	Mining	9823998352		
6	Jiten Sahoo	JSW	Forest	9438081715		
7	Vasant Kanelkar	DMG Geologist	DMG	9923444640		
8	Jaiwant A. Kamat	Surveying officer	DMG	7875556464	dir.mine.goa@nic.in	



GOVERNMENT OF GOA
Office of the Principal Chief Conservator of Forests
“Goa Van Bhawan” Forest Department
Altinho, Panaji, Goa

Ph: - 0832-2492548, 2492231

Email: dcfme-forest.goa@nic.in

No. 6-13-(103)-2025-26-FD/4931

Dated: 24/02/2026.

Please find enclosed herewith the minutes of the meeting of the Project Screening Committee-II (PSC) held under the chairmanship of the Additional Principal Chief Conservator of Forests (Nodal officer) FCA on 19.02.2026 at 11.00 AM in Goa Van Bhawan, Altinho, Panjim for information & necessary action.

DCF (Monitoring & Evaluation)
& Member Secretary (PSC)/LO.

Distribution:

1. The Conservator of Forests (Cons.)/ O/o. PCCF (Goa), Panjim
2. The District Collector, (South), Margao Goa.
3. The Dy. Conservator of Forests (South Goa) Division, Margao.
4. Mr. Baswaraj Mahadevppa Dalgade (AGM-Projects), JSW Steel Ltd., 507, 5th Floor, Gera Imperium-II, Patto, Panaji-Goa-403001. (User Agency).

Copy for information to

1. The Additional Principal Chief Conservator of Forests / Nodal Officer, (VSESA) Chairperson, PSC, O/o. PCCF (Goa), Panaji.
2. The Director of Mines & Geology, Institute Menezes Braganza Hall, Panaji-Goa as special invitee.
3. PA to PCCF, Goa Forest Department for kind information of the PCCF.

“Swachh Bharat, Swachh Goa”
“Clean India, Clean Goa”

MINUTES OF THE MEETING OF THE PROJECT SCREENING COMMITTEE-II, DEPARTMENT OF FORESTS (GOA) HELD ON 19.02.2026 UNDER THE CHAIRMANSHIP OF SH. K RAMESHKUMAR, IFS, APCCF / NODAL OFFICER, VSESA W.R.T THE PROPOSAL FOR SIGNING OF LEASE AGREEMENT IN RESPECT OF CODLI MINERAL BLOCK-XII, UNDER CLAUSE (iii) OF SUB-SECTION (1) SECTION 2 OF THE VAN (SANRAKSHAN EVAM SAMVARDHAN) ADHINIYAM, 1980 IN FAVOUR OF JSW STEEL LTD.

The meeting was attended by the following officers:

1. Sh. K Ramesh Kumar, IFS (APCCF / NO, VSESA) - Chairman
2. Sh. Naveen Kumar, IFS CF (C) - Member
3. Sh. Santosh Kumar Reddy, IFS DCF (South) - Member
4. Sh. Rohan A. Loliyekar, (Dy. Collector, Rev) - Representative of the District Collector, South
5. Sh. Nitin K. Atoskar (Geologist)- DMG- Special Invitee
6. Sh. Y. Nagendra (User Agency) - Representative of the Project Proponent
7. Sh. Aditya Madanpotra, IFS DCF (M&E) - Member Secretary

Welcoming the participants, the Chairperson requested the Project Proponent (PP) to make a presentation on the instant proposal i.e. “Application for approval of forest land under clause (iii) of Sub-Section (1), Section (2) of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for signing of lease agreement in respect of Codli Block-XII in Sy. No. 46(p) & 54(p) of Codli Village of Dharbandora Taluka in South Goa District & Division in favour of JSW Steel Ltd”.

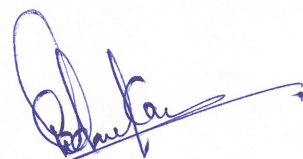
The deliberations held and decisions taken are as under:

1. The compliances towards the observation made by the PSC during its meetings held on 14.10.2025 and 05.12.2025 were reviewed, the replies submitted by the User Agency were taken into record.

2. The User Agency apprised the Committee that, they will submit the proposal under Section-2 (ii) of VSESA, 1980 parallelly.
3. The Project Proponent informed that a joint inspection was carried out in presence of DCF (South), representative of Revenue, DMG and JSW Ltd. to ascertain that the mineral block is free from all encumbrances.
4. The Committee has taken on record the mandatory field inspection report of the Conservator of Forests (Conservation).
5. The Project Proponent has agreed to submit an UNDERTAKING regarding the Compensatory Afforestation land.
6. The representative of the Directorate of Mines & Geology apprised the Committee that erstwhile three mining blocks at Codli has been combined and made as Block-XII, and the mining block comprises of Forest land, Private land and Government land.
7. The representative of the Revenue Department apprised the Committee that verification of non-forest land has been completed during the joint site inspection held along with DCF (South) , DMG and JSW Steel Ltd.
8. The User Agency assured that no additional forest area would be required for dumping or other ancillary activity.

Taking into consideration that the compliances made by the Project Proponent to the observations made by PSC in its previous meetings and to the observation made during field inspections, the Committee unanimously agreed to recommend the proposal for further processing as per the provisions laid out in Van (Sanrakshan Evam Samvardhan) Adhiniyam 1980.

The meeting ended with vote of thanks to the Chair.



DCF (M&E)/ MS, PSC/LO



Government of Goa
Office of the Principal Chief Conservator of Forests
Forest Department
Goa Van Bhawan, Altinho, Panaji Goa

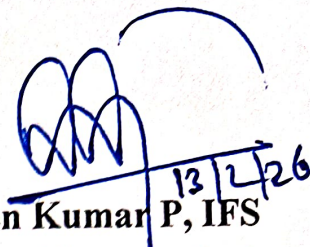
Phone No. 0832-2492520

SITE INSPECTION REPORT

1. Project application for approval of forest land under clause (iii) of sub section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for Signing of lease Agreement in respect of "Codli Mineral Block-XII" by M/s JSW Steel Ltd. under South Goa District/Division of Goa has been received on PARVISEH Portal for consideration of State Government.
2. An area of 65.9686 ha of Unclassed forest in survey no 46/3 and 54/1 in Codli village of Dharbandora taluka is proposed for signing lease agreement under clause (iii) of sub section (1) section 2 of the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for undertaking mining activity by M/s JSW Steel Ltd, was inspected by the undersigned on 11th February 2026, along with DCF (South) and representatives from JSW Steel Ltd.
3. User Agency had conducted DGPS survey and demarcated the unclassified forest area with RCC boundary pillars with serial numbers and coordinates all along the boundary except water stagnated area.
4. The area proposed for signing lease by User agency has a canopy density of about 0.4.
5. No activities has been commenced by the User Agency in the proposed lease area, however it is observed that it is an already mind out area.
6. The proposed lease area is 1.52 km away from the nearest Protected Area. The user agency has been advised to prepare Wildlife Conservation Plan, Soil Moisture Conservation Plan and Bird habitat mitigation plan for the proposed project area before applying for diversion.
7. During inspection it was informed that the proposed area is visited by wildlife such as Spotted deer, Mongoose, Leopard, reptiles, Peafowl and other birds.

8. The User Agency has been advised to identify Compensatory Afforestation land equivalent to proposed lease area in Non-Forest Land area or double the area in finalised Private Forest area in the State before applying for diversion.

9. The proposal is recommended for leasing with the above observation.



Naveen Kumar P, IFS
Conservator of Forests (Conservation)



सत्यमेव जयते

File No: J-11015/49/2025-IA.II(NCM)
Government of India
Ministry of Environment, Forest and Climate Change
IA Division



Dated: 18/05/2026



To,

Mr. BASWARAJ MAHADEVPPA DALGADE
M/s. JSW STEEL LTD
JSW CENTRE, BANDRA KURLA COMPLEX, BANDRE (EAST) , Mumbai, MAHARASHTRA,
400051
baswaraj.dalgade@jsw.in

Subject: Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited located at Village Codli, Taluka Dharbandora, District South Goa, Goa – Prescribing of Terms of Reference - reg.

Sir/Madam,

This is in reference to your application for Grant of Terms of Reference under the provision of the EIA Notification 2006-regarding in respect of project Block-XII Codli Mineral Block submitted to Ministry vide proposal number IA/GA/MIN/571910/2026 dated 14/04/2026.

2. The particulars of the proposal are as below:

(i) TOR Identification No.	TO26A0000GA5346025N
(ii) File No.	J-11015/49/2025-IA.II(NCM)
(iii) Clearance Type	TOR
(iv) Category	A
(v) Project/Activity Included Schedule No.	1(a) Mining of minerals,2(b) Mineral beneficiation
(vi) Sector	Non-Coal Mining
(vii) Name of Project	Block-XII Codli Mineral Block
(viii) Name of Company/Organization	JSW STEEL LTD
(ix) Location of Project (District, State)	SOUTH GOA, GOA
(x) Issuing Authority	MoEF&CC
(xi) Applicability of General Conditions	yes
(xii) Applicability of Specific Conditions	no

3. In view of the particulars given in Para 1 above, the project proposal, including Form-1 (Part A and B), was submitted to the Ministry for appraisal by the Expert Appraisal Committee (EAC) under the provisions of the EIA Notification, 2006, and its subsequent amendments.

4. The above-mentioned proposal has been considered by Expert Appraisal Committee of 5th EAC in the meeting held on 23rd – 24th April, 2026. The minutes of the meeting and all the Application and documents submitted [(viz. Form-1 Part A, Part B) are available on PARIVESH portal which can be accessed by scanning the QR Code above.

5. Based on aforesaid discussions and presentation made by the Project Proponent and the Consultant, the Expert Appraisal Committee (EAC) in 5th EAC meeting held on 23rd - 24th April, 2026, under the provisions of the EIA Notification, 2006 and its subsequent amendments, **recommended** the proposal for Terms of Reference (ToR) of Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited, located at Village Codli, Taluka Dharbandora, District South Goa (Goa) subject to certain specific conditions in addition to the standard ToR conditions applicable to Non-Coal mining projects and mineral beneficiation projects (Annexure III).

6. The details of the project as per the information submitted by the Project Proponent are enclosed as Annexure (II)

7. The Ministry of Environment, Forests & Climate Change (MoEF&CC) has reviewed the proposal in accordance with the Environment Impact Assessment (EIA) Notification, 2006, and its subsequent amendments. Following the acceptance of recommendations made by the Expert Appraisal Committee (EAC), the Ministry has decided to grant the Terms of Reference (ToR) for **Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited located at Village Codli, Taluka Dharbandora, District South Goa, Goa**, under the provisions of the EIA Notification, 2006, and its amendments, subject to certain specific conditions in addition to the standard ToR conditions applicable to Non-Coal mining projects and mineral beneficiation projects.

8. The Ministry reserves the right to stipulate additional conditions, if found necessary.

9. The Terms of Reference (ToR) granted to the aforementioned project are under the provisions of the EIA Notification, 2006. This does not tantamount to approvals, consents, or permissions that are required to be obtained under any other Act, Rule, or Regulation. The Project Proponent is obligated to obtain approvals and clearances under any other applicable Acts, Regulations, or Statutes for the project.

10. You are requested to kindly submit the final EIA/EMP, prepared as per the Terms of Reference (ToRs), to the Ministry for consideration of the proposal for environmental clearance within 4 years, as per the extant rules of the Ministry notified from time to time.

11. The consultants involved in the preparation of the EIA/EMP report, after accreditation with the Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET), are required to include a certificate in this regard in the EIA/EMP reports. This certificate should also cover the data provided by other organizations/laboratories, including their status of approvals and other relevant information.

12. This issues with the approval of the Competent Authority.

Copy to:

- i. **The Secretary**, Ministry of Mines, Government of India, Shastri Bhawan, New Delhi.
- ii. **The Secretary**, Department of Mines and Geology, Ground Floor of Institute Menezes Braganza, Government of Goa.
- iii. **The Director**, Department of Environment and Climate Change (DoE and CC), Government of Goa.
- iv. **The Secretary**, Department of Forests, Government of Goa, Goa Van Bhavan, Goa.
- v. **Director General**, Directorate General of Mines Safety, Hirapur, Dhanbad, Jharkhand, 826001
- vi. **The Chief Wildlife Warden**, Goa Van Bhavan, Forest Department, Altinho, Panaji Goa. 403001.
- vii. **The Deputy Director General of Forests (C)**, Ministry of Environment Forest and Climate Change, Integrated Regional Office, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, Koramangala II Block, Bangalore - 560034.
- viii. **The Member Secretary**, Central Pollution Control Board, Parivesh Bhawan, CBD-Cum-Office Complex, East Arjun Nagar, New Delhi-110 032.
- ix. **The Member Secretary**, Central Ground Water Authority, 18/11, Jam Nagar House, Man Singh Road, New Delhi-110011.
- x. **The Member Secretary**, Goa State Pollution Control Board, Nr. Pilerne Industrial Estate, Opp. Saligao Seminary, Saligao, Goa 403511.
- xi. **The Controller General**, Indian Bureau of Mines, Indira Bhavan, Civil Lines, Nagpur- 440 001.
- xii. **The District Collector**, South Goa District, Government of Goa.
- xiii. **Guard File.**
- xiv. **PARIVESH Portal.**

Copy To

1. The Member Secretary, CGWA, 18/11 Jamnagar House Man Singh Road, Central, Delhi, cgwa@nic.in
2. The Member Secretary, CPCB, Parivesh Bhawan Cbd-Cum-Office Complex East Arjun Nagar, East, Delhi, mscb.cpcb@nic.in
3. The District Collector, DC Office, Collectorate Of South Goa District Mathany Saldanha Administrative Complex Near Ktc Bus Stand Margao South Goa District Goa, South Goa, Goa, cols.goa@nic.in
4. The Deputy Director General, Regional Office, Deputy Director General Of Forests (C) Ministry Of Environment Forest And Climate Change Integrated Regional Office Ground Floor East Wing New Secretariat Building Civil Lines Nagpur-440001., N/A, N/A, apccfcentral-ngp-mef@gov.in
5. The Member Secretary, SPCB/PCC, Nr. Pilerne Industrial Estate Opp. Saligao Seminary Saligao-Bardez, North Goa, Goa, ms-gspcb.gov@nic.in

Annexure 1

Specific Terms of Reference s for (Mining Of Minerals)

1. Specific Conditions

S. No	Terms of Reference
1.1	Project proponent shall comply with the directions of the Hon'ble High Court of Bombay at Goa (Order dated 29.06.2024 in WP (PIL) No. 06/2024) and prepare a transportation plan in line with DMG and GSPCB recommendations.
1.2	Project proponent shall submit the status of Stage – I forest clearance for 65.9686 ha forestland involved in the project as per MoEF&CC OM dated 09/09/2011 and its amendment.
1.3	Certificate from concerned District Magistrate/Executive Engineer from the State Water Resources department (or) any officer authorized by the State Government in this regard shall be submitted stating that mining activity is not located within flood plain of Dudhsagar/ Kandevar River corresponding to one in 25 years of flood as per Ministry's O.M. dated 14/02/2022.
1.4	Project proponent shall prepare an integrated water shed management plan through reputed institute for protection and conservation of water bodies within the mine lease area and its study area Besides, PP needs to consult State Water Resource Department for protection of water bodies and follow their recommendations. The study report along with the action plan for implementing the recommendations of the report shall be submitted along with the EIA/EMP report. The study shall inter-alia include the following: a. Catchment Area Treatment (CAT) Plan to ensure protection and ecological integrity of the river. b. Impact of mining activities on the Dudhsagar/ Kandevar River and nearby nala(s), including assessment of aquatic ecology, hydrological changes, risks of disturbance, and formulation of appropriate safeguard measures in consultation with the State Water Resources Department. c. River ingress study to assess the likelihood of water inflow into the mine pit and to design suitable preventive and mitigation measures. d. Provision of embankment with stone pitching on both sides (towards and outwards of the river) shall be developed with a height of 3 m above the HFL of Dudhsagar/ Kandevar River.
1.5	PP shall submit a comprehensive transportation and material handling plan, including route map, traffic assessment, habitation impact (100 m on both sides), number of trips, vehicle capacity, road dimensions, traffic load, carrying capacity, and SOP for transportation from mine to destination.
1.6	PP shall undertake a detailed mine safety and design study (including bench geometry, slope stability, blasting, and operational safety) in consultation with DGMS and incorporate recommendations in the EIA/EMP.
1.7	PP shall explore the feasibility of a solar-powered jetty for mineral transportation.
1.8	PP shall undertake prior consultation with the Central Ground Water Authority (CGWA) and/or the State Ground Water Board (SGWB) regarding groundwater abstraction, management, and associated hydrogeological aspects of the project. The recommendations, conditions, and observations provided by the concerned authority shall be duly incorporated in the EIA-EMP report, along with a clear commitment and mechanism for their implementation and compliance.
1.9	PP needs to obtain the HFL data of the Nala and Dudhsagar/ Kandevar River from Irrigation Department. No mining shall be proposed within the HFL of Dudhsagar/ Kandevar River.
1.10	The Project Proponent (PP) shall incorporate the action plan with respect to following

S. No	Terms of Reference
	recommendations, made by the Goa State Pollution Control Board (GSPCB), as detailed below: a. A Comprehensive plan must be prepared by the Project Proponent (PP) to address the potential overflow of water from the open mining pit during heavy rainfall or other likelihood eventualities. b. Flow of groundwater also needs to be furnished. Consultations in this regard should be carried out by the PP with the Central Ground Water Authority (CGWA)/SGWB. c. Sufficient number of Garland drains, settling ponds, and silt traps will be constructed and maintained to prevent runoff, silt, and sediment from entering the river. d. Mine pit water will be analysed as per GSR 422(E) Schedule-VI of Environmental Protection Act 1986 prior to discharge; further discharge into the river shall be undertaken only after ensuring compliance with prescribed standards and as per the recommendations/permission of the State Water Resources Department (WRD). e. Regular river water quality monitoring will be carried out at upstream and downstream locations, and monitoring records shall be submitted to GSPCB & WRD every month. f. A green belt will be developed along the lease boundary facing the river, using native species, to act as a protective barrier and to safeguard the river ecosystem. g. The Project Proponent shall prepare a detailed plan, including a mandatory buffer zone or no-activity zone of suitable width, to safeguard the Khandepar River, which flows just 0.01 km from the eastern boundary of the mining lease area. GSPCB and Goa Water Resources Department (WRD) shall be consulted in this regard. h. The Project Proponent shall consult the Goa Water Resources Department or an institute of national repute to obtain the High Flood Level (HFL) data for the Khandepar River and the seasonal nallah flowing within the mining lease area. i. The primary concern to be addressed on priority is that pollutants/silt shall not directly enter the Khandepar River, and mining shall not be conducted close to the river. A buffer zone of at least 50 m shall be maintained from the lease boundary along its south-eastern end. j. Mining operations may be optimized by utilizing dewatering water for recharging the riverine system downstream and for consumptive uses, with proper coordination with the Goa WRD and adoption of suitable management practices.
1.11	PP shall implement integrated surface water, drainage, and runoff management measures including garland drains, settling ponds, silt traps, diversion of runoff to pits, and prevention of contaminated discharge into natural drains.
1.12	PP shall ensure zero discharge outside ML area by preparing a plant-specific water balance plan integrating mine water and beneficiation water demand with maximum reuse.
1.13	PP shall design and install appropriate wastewater treatment systems including ETP with oil & grease traps and ensure compliance with prescribed discharge standards.
1.14	PP shall prepare a geo-referenced (KML) layout of the beneficiation plant showing all components including crushers, screening units, tailing areas, drainage, pits, and environmental sensitivities.
1.15	PP shall justify siting of crushers and screening units considering wind direction, forest areas, and nearby habitations.
1.16	PP shall prepare a site-specific tailings/slimes management plan including in-pit disposal, embankment stability, and prevention of overflow.
1.17	PP shall prepare detailed design of slurry handling, containment systems, and emergency control

S. No	Terms of Reference
	measures.
1.18	PP shall submit a synchronized mine–beneficiation plan aligned with production capacity to avoid excess stockpiling.
1.19	PP shall explore renewable energy use and submit a detailed plan for increased adoption. PP needs to clarify through the scientific studies whether there is any chance of water ingress in the mine from Northern side (i.e. river side) of the ML area.
1.20	PP shall consult the Directorate General of Mines Safety (DGMS) on safety aspects related to potential water ingress from the river flowing along the northern side, after sharing the hydrological study with DGMS.
1.21	PP should explore the extraction of Iron Ore from BHQ through latest available technologies. Appropriate R& D should be conducted /done in this regard. Consultation with Indian Bureau of Mines should also be done in this regard along with other institutes of national repute.
1.22	PP needs to submit a detailed transportation and material handling plan as part of the EIA/EMP, covering transportation from Mine to Capxem Jetty and Proposed Railway Sidings Via SH-7 & other connecting road. The plan shall clearly indicate the mode-wise breakup of material transport (conveyor/rail/road), measures for dust suppression and pollution control, traffic management, and mitigation of impacts on nearby habitation.
1.23	Project proponent needs to submit the detailed scientific plan for constructing the retaining wall/other structures so that there is no flow of dump/ore silt outside the lease area.
1.24	The Project proponent needs to submit a detailed plan showing more use of renewable energy in the project.
1.25	Project Proponent shall submit the drone video & photographs of the ML area and transportation route proposed for this project with special focus on the sensitive receptors in the ML area and in the transportation route.
1.26	Site Specific Wildlife Conservation Plan shall be prepared and approved by the DFO/ PCCF Wildlife for the Schedule – I species present within the ML area.
1.27	Biodiversity analysis of the core zone and buffer zone of the ML area shall be done through any reputed institutions having NABET accreditation. The study report shall inter-alia include impact of mining on flora and fauna and action plan for complying with the mitigation measures shall be submitted.
1.28	The Project Proponent needs to monitor the ambient air quality and noise level at the mine lease boundary, nearest village, proposed crusher & beneficiation plant, predominant downwind direction and at other sensitive receptors. Accordingly, Project Proponent shall propose to install Continuous Ambient Air Quality Monitoring Stations within certain timeline.
1.29	The Project Proponent should prepare the EMP considering the scenario of pollution to be generated for normative and peak total excavation for assessing air pollution, noise level and ground vibration.

S. No	Terms of Reference
1.30	The Project Proponent needs to carry out the Public Hearing as per provisions of EIA Notification, 2006. PP should also submit the time bound action plan on concerns of the public through a separate budget with capital expenditure with a timeline of 3 years. The Project proponent shall ensure that the activities proposed under the public hearing shall be different from the CSR activities. PP needs to submit a tangible and monitorable action plan for meeting the public hearing commitments.
1.31	The Project Proponent needs to undertake the enumeration of the species within the mine lease area before cutting. The Project Proponent also needs to submit the compensatory afforestation plan for the number of trees to be cut in the mine lease area and also to explore the possibility of tree transplantation.
1.32	The Project Proponent needs to submit the action plan for undertaking the plantation along the 7.5m barrier, safety zone of tar road/cart tracks, electric line etc., PP should also submit the details of numbers of saplings to be planted (2500/ha), type of saplings proposed and the area to be covered under greenbelt/plantation along with the timeline and budget. The greenbelt/plantation plan shall be prepared in such a way that the ecology of the area shall be restored. Miyawaki plantation technique in atleast 20 % of the overall plantation. PP also needs to submit an action plan for development of greenbelt around crusher and beneficiation plant.
1.33	The Project Proponent shall carry out the assessment of impact due to the proposed project as per the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP.
1.34	The project proponent shall conduct hydrological study for projects involving intersection of ground water table as per the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP.
1.35	The Project Proponent shall explore the possibility of reduction of specific water requirement by optimization / technology up gradation, etc. The efforts shall be delineated in the EIA/EMP.
1.36	The Project Proponent shall prepare the scheme for mandatory recycle/re-use of water as specified by the Central Ground Water Authority for different category areas.
1.37	The Project Proponent needs to submit the plan for Socio economic development of the neighborhood's habitats based on the need-based survey along with the time bound action plan in consultation with the local people. Inclusive development with initiatives focused on employment generation, educational support, healthcare facilities for the local communities be planned.
1.38	The Project Proponent shall provide the details of Special Pollution Control/ Abatement devices that have been installed/ proposed to be installed within the ML area and how does the technology compare with the best available technology in the field.
1.39	PP should ensure that all the documents including the approved Mining plan and EIA /EMP should be in consonance with each other.
1.40	The Project Proponent needs to prepare the installation plan for permanent fixed water sprinkling system along the Haul roads. Installation of fog canons at necessary locations in the project should also be planned.

S. No	Terms of Reference
1.41	The Project Proponent needs to prepare plan to develop the treatment facility for wastewater within the ML area.
1.42	The Project Proponent needs to submit employment-based skill development plan for the local people, and thrust should be to provide employment to local people after imparting training.
1.43	PP needs to project & submit yearwise back filling plan.
1.44	The Project Proponent (PP) shall conduct a pit slope stability study through a reputed institute, covering all safety aspects, including the height and angle of slopes of OB dumps, and incorporate the findings along with a compliance commitment in the EIA/EMP report.
1.45	PP need to assess impact on nearby villages, traffic, and state highway due to mining operations including blasting and transportation. Necessary consultation/ permissions from DGMS may be taken in this regard. PP needs to take mitigation measures including dust suppression, traffic management, noise reduction, and health safeguards based on public hearing/ stakeholder consultations.
1.46	PP is required to conduct a cumulative impact assessment including the adjacent mines. This assessment should encompass key factors, including water requirements, air, water, noise pollution levels, power consumption, transportation logistics, waste management practices, and the combined emissions load from projects effects on flora & fauna, etc. EMP should be prepared accordingly.
1.47	Since the volume of OB dumps is increasing manifold, catchment area treatment plan can be prepared in consultation with reputed institute. Planning should be such that there are no chances of silt flow outside the ML area. Catch drains, Siltation ponds, retaining walls, gabions structures, check dams, etc. shall be planned accordingly and submitted with locations, drawing/ layouts.
1.48	PP should plan and submit pollution control measures at Railway Sidings as per CPCB guidelines including permanent water sprinkling system, greenbelt development, metal windcreens, etc.
1.49	Project Proponent should clearly bring out that what is the specific diesel consumption ~ (Liters/Tonne of total material handled) and steps to be taken for reduction of the same. The year-wise target for reduction in the specific diesel consumption needs to be submitted. PP shall also explore the possibility of using e-vehicles/LPG/CNG-based machinery and HEMM trucks for the operation and transportation of limestone.
1.50	Project proponent is advised to implement the 'Ek Ped Maa Ke Naam' Campaign which was launched on 5th June 2024 on the occasion of the World Environment Day to increase the forest cover across the Country. This plantation drive is other than Green belt development.
1.51	Necessary coordination shall be made with concerned SPCB (who is responsible for

S. No	Terms of Reference
	Compliance of OM dated 14.01.2025 & 08.10.2025) regarding streamlining the implementation of GSR 702 and GSR 703 dated 12.11.2024 through which projects requiring prior EC were exempted from requirement of CTE.

Standard Terms of Reference for (Mining of minerals)

1.

S. No	Terms of Reference
1.1	Year-wise production details since 1994 should be given, clearly stating the highest production achieved in any one year prior to 1994. It may also be categorically informed whether there had been any increase in production after the EIA Notification 1994 came into force, w.r.t. the highest production achieved prior to 1994
1.2	A copy of the document in support of the fact that the Proponent is the rightful lessee of the mine should be given
1.3	All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee
1.4	All corner coordinates of the mine lease area, superimposed on a High Resolution Imagery/toposheet, topographic sheet, geomorphology and geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone)
1.5	Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics
1.6	Details about the land proposed for mining activities should be given with information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority
1.7	It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the EIA Report
1.8	Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided

S. No	Terms of Reference
1.9	The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period
1.10	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given
1.11	Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given
1.12	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees
1.13	Status of forestry clearance for the broken up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished
1.14	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated
1.15	The vegetation in the RF / PF areas in the study area, with necessary details, should be given
1.16	A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted
1.17	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/ Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished
1.18	A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan alongwith budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost

S. No	Terms of Reference
1.19	Proximity to Areas declared as Critically Polluted or the Project areas likely to come under the Aravali Range, (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered
1.20	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority)
1.21	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report
1.22	One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season) ; December-February (winter season)]primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given
1.23	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map
1.24	The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated
1.25	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided
1.26	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided
1.27	Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided
1.28	Based on actual monitored data, it may clearly be shown whether working will intersect

S. No	Terms of Reference
	groundwater. Necessary data and documentation in this regard may be provided. In case the working will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia, shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished
1.29	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out
1.30	Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and bgl. A schematic diagram may also be provided for the same
1.31	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution
1.32	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines
1.33	Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report
1.34	Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report
1.35	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed
1.36	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations
1.37	Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation
1.38	Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if

S. No	Terms of Reference
	any, occupational health impacts besides other impacts specific to the proposed Project
1.39	Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project
1.40	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given
1.41	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out
1.42	A Disaster management Plan shall be prepared and included in the EIA/EMP Report
1.43	Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc
1.44	Besides the above, the below mentioned general points are also to be followed:- a) All documents to be properly referenced with index and continuous page numbering. b) Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated. c) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project. d) Where the documents provided are in a language other than English, an English translation should be provided. e) The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted. f) While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed. g) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation. h) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable. i) The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area

Standard Terms of Reference for (Mineral beneficiation)

1.

S. No	Terms of Reference
1.1	The alternate sites considered, the relative merits and demerits and the reasons for selecting the proposed site for the Beneficiation Plant should be indicated.

S. No	Terms of Reference
1.2	Details of the technology and process involved for beneficiation should be given. .
1.3	Location of the proposed Plant w.r.t. the source of raw material and mode of transportations of the ore from mines to the beneficiation plant should be justified.
1.4	Treatment of run of mine (ROM) and or of the fines/waste dump should be spelt out.
1.5	Estimation of the fines going into the washings should be made and its management described.
1.6	Details of the equipment, settling pond etc. should be furnished.
1.7	Detailed material balance should be provided.
1.8	Sources of raw material and its transportation should be indicated. Steps proposed to be taken to protect the ore from getting air borne should be brought out.
1.9	Management and disposal of tailings and closure plan of the tailing pond, if any after the project is over, should be detailed in a quantified manner.
1.10	The water requirement for the project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the project should also be indicated.
1.11	A copy of the document in support of the fact that the Proponent is the rightful lessee of the unit should be given.
1.12	All documents including EIA and public hearing should be compatible with one another in terms of the production levels, waste generation and its management and technology and should be in the name of the lessee.
1.13	All corner coordinates of the Unit, superimposed on a High Resolution Imagery/Toposheet should be provided. Such an Imagery of the proposed Unit should clearly show the land use and other ecological features of the study area (core and buffer zone).
1.14	It should be clearly indicated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the EIA Report.
1.15	Issues relating to Safety should be detailed. The proposed safeguard measures in each case should also be provided. Disaster management plan shall be prepared and included in the EIA/EMP Report.
1.16	The study area will comprise of 10 km zone around the Plant.
1.17	Cumulative impact study of both Beneficiation Plant with suggested mitigation measures as per the

S. No	Terms of Reference
	study should be described.
1.18	Location of Railway siding with its handling capacity and safety measures should be indicated.
1.19	Option to provide only silo for storage of minerals instead of open stacking to avoid fugitive dust should be explored and arrangements finalized justified.
1.20	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.
1.21	Details of the land for any Over Burden Dumps outside the lease, such as extent of land area, distance from lease, its land use, R&R issues, if any, should be given.
1.22	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the Project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for representative of the State Forest Department to assist the Expert Appraisal Committees.
1.23	Status of forestry clearance for the broken up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.
1.24	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.
1.25	The vegetation in the RF / PF areas in the study area, with necessary details, should be given.
1.26	A study shall be got done to ascertain the impact of the Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly detailed mitigative measures required, should be worked out with cost implications and submitted.
1.27	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Tiger/Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.
1.28	A detailed biological study of the study area [core zone and buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan alongwith budgetary provisions for

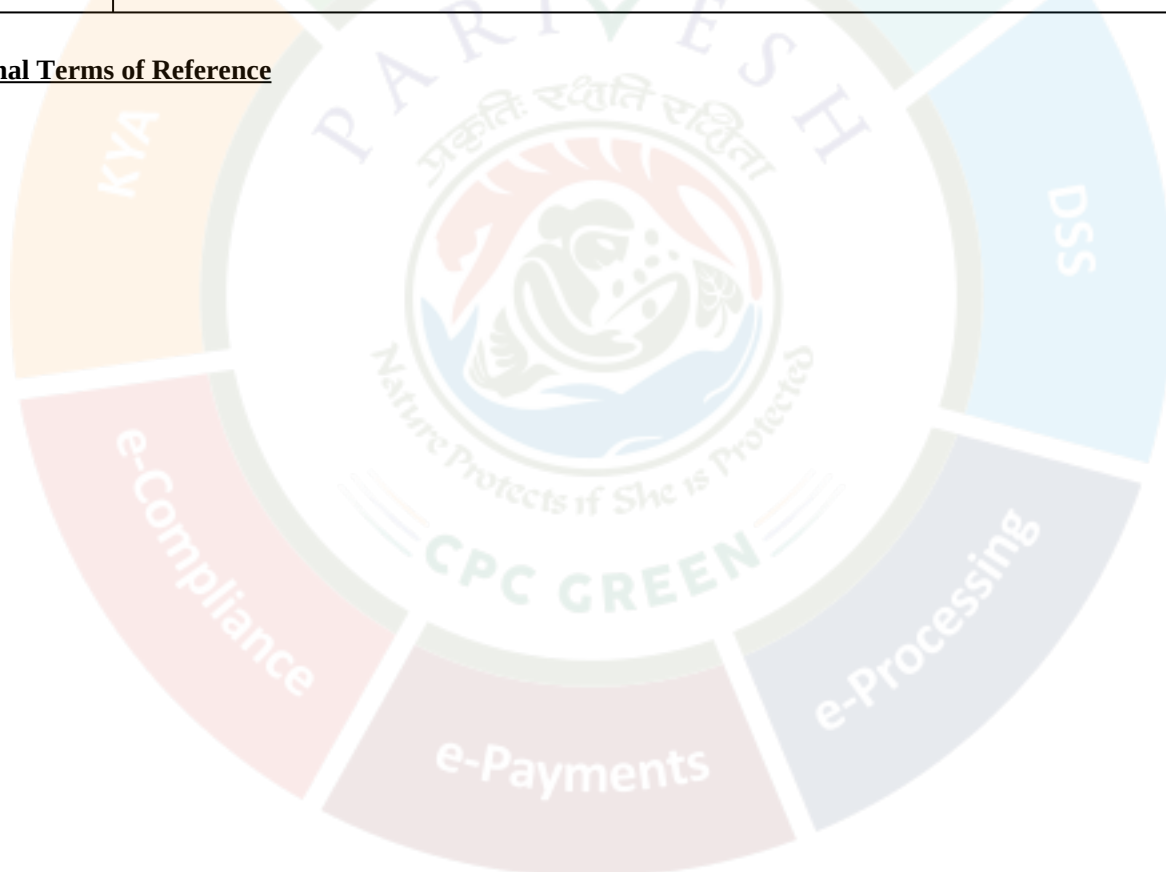
S. No	Terms of Reference
	their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.
1.29	Proximity to Areas declared as 'Critically Polluted' shall also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB/CPCB shall be secured and furnished to the effect that the proposed activities could be considered.
1.30	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the unit w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).
1.31	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects, should be discussed in the report.
1.32	One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season) ; December-February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the unit in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.
1.33	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.
1.34	The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.
1.35	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be secured and copy furnished. .
1.36	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.
1.37	Impact of the project on the water quality, both surface and groundwater should be assessed and necessary safeguard measures, if any required, should be provided.

S. No	Terms of Reference
1.38	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out.
1.39	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the project. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to the pollution.
1.40	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered.
1.41	Details of the onsite shelter and facilities to be provided to the workers should be included in the EIA report.
1.42	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area should be detailed.
1.43	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.
1.44	Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.
1.45	Public hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.
1.46	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the project should be given.
1.47	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.
1.48	A brief background of the Project, its financial position, Group Companies and legal issues etc should be provided with past and current important litigations if any.
1.49	Benefits of the Project, if the project is implemented should be outlined. The benefits of the projects shall clearly indicate environmental, social, economic, employment potential, etc.
1.50	Besides the above, the below mentioned general points are also to be followed:- a) All documents to be properly referenced with index and continuous page numbering. b) Where data are presented in

S. No	Terms of Reference
	the report especially in Tables, the period in which the data were collected and the sources should be indicated. c) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the project. d) Where the documents provided are in a language other than English, an English translation should be provided. e) The Questionnaire for environmental appraisal of project as devised earlier by the Ministry shall also be filled and submitted. f) While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should also be followed. g) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation. h) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified Report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project by the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.

Additional Terms of Reference

N/A



Annexure-II

Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited located at Village Codli, Taluka Dharbandora, District South Goa, Goa.

The details of the project: -

The details of the project as ascertained from the document submitted by the Project Proponent are given as under:

i. Project details:

Name of the Proposal	Block-XII Codli Mineral Block with Iron ore production of 3.50 MTPA, OB/Waste of 8.21 MTPA (total excavation: 11.71 MTPA), along with installation of 4 crushers (3 primary crushers of 1 × 250 TPH and 2 × 90 TPH, and 1 secondary crusher of 150 TPH) and a 600 TPH dry processing/screening plant, along with 2 × 300 TPH wet beneficiation plant with throughput capacity of 3.50 MTPA, in the auctioned block area of 377.0881 ha by M/s JSW Steel Limited, located at Village Codli, Taluka Dharbandora, District South Goa (Goa).	
Location	Village	Codli
	Taluka	Dharbandora
	District	South Goa
	State	Goa
	Latitudes	15 ⁰ 21'15.638" N to 15 ⁰ 19'42.607" N
	Longitudes	74 ⁰ 7'10.922" E to 74 ⁰ 8'39.034" E
	SoI Topo sheet No.	Core Zone: D43C3_48I/3 Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
Company's Name	JSW Steel Limited	
Accredited Consultant and certificate no.	J.M. EnviroNet Pvt. Ltd. Accredited EIA Consultant by NABET (QCI) Certificate No. NABET/EIA/23-26/SA 0250, dated 25.07.2025 which is valid up to 07.08.2026.	
KML file	KML has been uploaded in Form 1 & same is enclosed.	
Seismic zone	Zone-III as per IS:1893 (Part-I): 2002 & 2025	

ii. Category details:

Category of the project	Category “A” (>250 ha)
Schedule No	Project or Activity 1 (a) for Mining of Minerals and 2 (b) for Mineral Beneficiation. - Iron Ore production capacity of 3.50 Million Tonnes Per Annum (MTPA) of iron ore and 8.21 Million TPA of Overburden (OB)/waste, involving a total excavation of 11.71 Million TPA. - The project includes installation of Mineral Handling and Processing Facilities comprising 04 Crushers, i.e., 03 Primary Crushers (1 × 250 TPH and 2 × 90 TPH) and 01 Secondary Crusher (150 TPH). - In addition, a 600 TPH Dry Processing/ Screening Plant and 2 × 300 TPH Wet Beneficiation Plants are proposed to achieve a total throughput capacity of 3.50 Million TPA
Mining lease Area (MLA) (in ha.)	377.0881 ha
General Conditions (if any)	None

iii. Details of Mine Lease in Chronological Manner:

S. No.	Prospecting License/ Letter of Intent (LoI)/ Grant of Mine lease and Lr No	Date of the Grant	Name of the Mineral & (Major/ Minor)	Period of Grant	Granted by	Mine Lease Area in Ha
1.	Letter of Intent (LoI) was issued through e-auction process conducted by the Govt. of Goa.	10.12.2024	Iron Ore (Major Mineral)	3 years (up to 09.12.2027)	Govt. of Goa	377.0881 ha

iv. Land Use/Land Cover of the Mine Lease Area:

Type of Land	As per RoR	As per DGPS
Private land	74.7713 ha	--
Government land	236.3482 ha	--
Forest Land	65.9686 ha	--

Type of Land	As per RoR	As per DGPS
Total Mining lease area (MLA), Ha	377.0881 ha	--
Private land for crusher, workshop & other infrastructure outside the MLA	No infrastructure is proposed outside the ML area.	
Additional information (if any)	Out of total 377.0881 ha land; 65.9686 ha is Forest Land, 236.3482 ha is Government land, 58.9087 ha is Private land and 15.8626 ha is Alvara land.	

Land use pattern						
Pre Mining	Parameter			Area in ha		
	Forest land			65.9686		
	Government Non-Forest			311.1195 (Govt. and Pvt. Land)		
	Water bodies			-		
	Tenancy Land including agricultural, settlement etc			-		
	Total Area			377.0881		
During Mining and post mining	S.N.	Description	Post Mining Land Use (In Ha)			
			Plantation/ Re-grassing	Water Body	Civil Use	Total
	1.	Excavation (Voids)- Water Reservoir	-	249.2021	-	249.2021
		Reclamation (Backfilled)	51.9500	-	-	51.9500
	2.	Area under Dump (Rehabilitated)	6.8700	-	-	6.8700
	3.	Area comes under utility services	-	-	14.5597	14.5597
	4.	Mineral Separation Plant	-	-	10.8981	10.8981
	5.	Greenbelt	17.4500	-	-	17.4500
	6.	Tailing Dam	26.1582	-	-	26.1582
	Total		102.4283	249.2021	25.4578	377.0881

v. Mining plan details:

Mining Plan including Progressive Mine Closure Plan (approved by Indian Bureau of Mines/DMG)	Letter No.	MCDR-MPC0FE/6/2025-GOA-IBM_RO_GOA
	Date	06.08.2025
	Mineral & (Major/Minor)	Iron Ore (Major Mineral)
	Mine Lease Area, Ha	377.0881 ha
	Validity	5 years from the date of Mining Lease Registration
Additional information (if any)	Mining Plan along with Progressive Mine Closure Plan has been approved by IBM, Goa Vide their letter No. MCDR-MPC0FE/6/2025-GOA-IBM_RO_GOA dated 06.08.2025.	
Mining Parameters	Quantitative Description	
Method of Mining	Fully Mechanized Opencast Mining Method.	
Drilling/Blasting	No Drilling and Blasting will be carried out.	
Geological Reserves	48.50 Million Tonnes	
Mineable Reserves	27.32 Million Tonnes	
Breakup of Total Excavation (Topsoil/OB/SB/IB/Mineral Rejects/ Waste, MTPA)	Iron Ore: 3.50 Million TPA OB/Waste: 8.21 Million TPA Total Excavation: 11.71 Million TPA	
Life of mine	8 years as per Mineable Reserves 14 years as per Reserves and Resources	
Mine Bench Height & Bench Width	Bench height: 7 m Bench Width: 9 m	
No. of Mine Benches	15 Benches at Conceptual Stage	
Existing Depth, m bgl	It is a proposed mining project. Hence, not applicable.	
Ultimate Depth of Mining, m bgl	At Conceptual Stage: 164.48 m	
Ground Water Table, m bgl	19 m bgl	
Details of ground water intersection	The water table in the core zone is 19 m bgl. During Plan period, the working depth will be 112 m and ultimate working depth will be 164.48 m. Hence, the ground water will be intersected. Prior permission will be taken from competent authority before such intersection.	
Individual bench slope	80°	
Overall pit slope	<38°	

Details of existing/ proposed Crusher	Primary Crusher: 1 x 250 TPH & 2 x 90 TPH Secondary Crusher: 150 TPH
Mineral Beneficiation	Dry Processing/Screening Plant: 600 TPH Wet Beneficiation Plant: 2 x 300 TPH
RoM output size	-500 mm
Transportation details including capacity of dumper/tipper, mode of transport and distance	The Iron Ore will be transported from Mine to Capxem Jetty and Proposed Railway Sidings Via SH-7 & other connecting road with capacity of truck is 10.5 tons.
Generation of Topsoil/OB & its Management during plan period & conceptual period.	• There are no top soil present in the ML area. • At present, there are six dumps within the mine, out of which four are active waste dumps containing ~ 8.96 Million tonnes of waste spread over an area of 32.23 hectares. The remaining two are stabilized dumps, which together hold about 2.976 Million tonnes of waste across an area of 22.55 hectares at the mine site. • During the plan period, ~23.43 million tonnes of overburden (OB) and waste will be generated. This material will be disposed of in the existing waste dump (D4) as well as in two proposed new dumps, namely D4A and D7, covering a total dump area of 46.84 hectares. • At conceptual period, ~68.0 Million Tonnes of waste will be generated which will be used in backfilling in the mined-out area.
Generation of Mineral Rejects/ Waste & its Management during plan period & conceptual period	-

vi. Water requirement

Total water requirement	Total Water Requirement is 1716 KLD	Fresh Water	1716 KLD
		Treated water	-
Source	The total water requirement for the project is 1716 KLD, primarily met from pit water, i.e., rainwater harvested within the mine. The water will be utilized for the beneficiation plant, domestic use, water sprinkling on roads, firefighting, greenbelt/plantation, and dust suppression.		
Permission for withdrawal/ intersection along with details of grant and its validity	This proposal is for ToR. Details will be incorporated in EIA/EMP Report.		

vii. Nearest village/ town/ highway/ interstate boundary/ railway station/ water bodies/ monument/forest

Particulars	Particular's Name	Distance & Directions
Village	Codli	(Adjacent in North)
Town	Sanvordem	~7.5 km in SSW
Highway	SH-7	Adjacent in WNW
Interstate Boundary	Goa-Karnataka State Boundary	~14.20 Km in SW Direction
Railway Station/Railway line	Sanvordem Chuch Railway Station	~7.8 km in SSW
Water Bodies	Kandepar River, Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Sanguem or Zuvari River, Jamboli Nala, Paroda River	Adjacent to ~9.0 Km in the study Area
Forest	Unclassified Forest and Reserve Forest	Core zone, ~0.5 Km in ENE, ~1.0 Km in West ~2.5 Km in West, ~4.0 Km in South, ~6.5 Km in WSW, ~7.0 Km in NNE, ~8.0 Km in WSW, ~8.5 Km in NW, ~9.0 Km in West.

viii. Presence of Environmentally Sensitive areas in the study area

Forest Land / Protected Area / Environmental Sensitivity Zone	Yes/No	Details of Certificate/ letter issued by the concerned Department mentioning the Lr no, date of grant and remarks
Forest Land within the mine lease area and (if yes) status of Forest Clearance	Yes	Block - XII Codli Mineral Block comprises of 65.9686 ha Forest Land. Online Application for obtaining the Forest Clearance has been submitted on Parivesh 2.0 Web Portal on 23.02.2026.
National Park	No	There are No National Park within 10 Km Study Area
Wildlife Sanctuary	Yes	- Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE) - Bondla Wildlife Sanctuary (~5.5 Km in NNW)
Elephant/Tiger Reserve	No	
Eco-Sensitive Zone (ESZ) /Eco-Sensitive Area (ESA)	Yes	ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE)

		ESZ Bondla Wildlife Sanctuary (~6.5 Km in NNW) Map Authenticated from DCF, Goa Indicating shortest Distance Between ESZ & WLS From ML Boundary on 10.10.2025.
Coastal Regulation Zone (CRZ)	No	-
Schedule-I species (No.s and name of schedule-I species with authenticated letter)	-	Details regarding Schedule-I species will be provided in the EIA/EMP report.
Wildlife Conservation Plan	-	

ix. Green belt/plantation details:

Proposed area for green belt/plantation and no. of saplings proposed	102.43 ha & 256075 saplings
Budget for green plant & plantation till the end of life of mine.	5.12 Crores
Budget for nursery	10 Lakhs
Details of existing plantation and its survival rate	It's a greenfield project.
No. of tree cuts in the mine lease area and compensatory afforestation	Approx. 4000, Tree enumeration is under process. Details will be incorporated in EIA after finalization of Tree enumeration.
Particulars for Green belt/plantation	Area covered (in Ha)
7.5 m barrier & non-mineralized zone	17.4500
500 m safety zones of nearest habitation villages	-
50 m safety zone of nallah, roads, electric lines	-

x. Baseline detail

Baseline Data (Air / Water / Noise / Soil / Hydro geological study/ Traffic Study/ others)	
Period of baseline data collection	March to May, 2025
Season (Summer/Pre-monsoon/Post-monsoon/Winter)	Summer Season
Predominant Wind direction (From)	North-West

Ambient Air Quality (no. of locations) and results	11
Noise level (no. of locations) and results	11
Water Quality (no. of locations) and results	Ground water – 10 Surface water – 8
Soil Quality (no. of locations) and results	10

xi. Rehabilitation & Resettlement (R&R):

R & R details	PP reported that the total mining lease area is 377.0881 ha (Govt. revenue land – 236.3482 ha, Private land – 58.9087 ha, Alvara land – 15.8626, Forest land – 65.9686 ha). No habitation present within the Mineral Block. Hence, no displacement of human settlement is proposed.
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xii. Court case details:

Court Case, No and its present status	No Court Case or Litigation is pending
Undertaking by Project Proponent w.r.t court case	The Project Proponent has submitted the undertaking dated 18.09.2025 stating that there is no litigation pending against the project and/or any direction/ order passed by any court of law against the project and that for any such litigation whatsoever, the sole responsibilities will be borne by the company.

xiii. Affidavit/Undertaking details:

Affidavit as per Ministry's OM dated 30.05.2018	Project Proponent has submitted the Affidavit in a non-judicial stamp paper of Rs. 100 bearing no: C 223133 dated 13.03.2026 stating that the company undertakes to comply all the statutory requirement & judgment of Hon'ble Supreme Court order dated 2nd August 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of common cause versus Union of India & Ors before grant of ToR/EC.
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xiv. EDS Raised by MoEF&CC on 17.03.2026. Reply submitted by PP on 14.04.2026.

S. No.	EDS Point	Reply by Project Proponent
1.	PP needs to submit a certificate from State DMG stating that no mining activity has been undertaken by PP at the lease boundary /safety zone (7.5m) and within mine lease area.	A Certificate has been obtained from State DMG Govt. of Goa vide letter No. 03/20/2025/Major/Mines/ 3940 dated 31.03.2026 stating that no mining activity has been undertaken by JSW Steel Limited within the Lease

S. No.	EDS Point	Reply by Project Proponent
		boundary/safety zone (7.5m) in the mine lease area. Copy of the Certificate is uploaded with EDS Reply.
2.	Since the mine site is located at 0.01 Km from Dudhsagar River, PP may consult State Water Resource Department and State Pollution Control Board and obtain their recommendations for safeguarding the Dudhsagar River.	Consultation has been carried out with the Goa State Pollution Control Board. A letter was also submitted to the Chief Engineer, Water Resources Department, Goa, on 18.03.2026, seeking their recommendation for safeguarding the river. The recommendation of the Goa State Pollution Control Board, along with a copy of the letter submitted to the Water Resources Department, are uploaded with EDS Reply.

xv. Details of project cost and employment:

Particulars	(Rs. in Crores)
Project Cost	500 Crores
Employment	154 Persons

APPENDIX-I:

SOIL MOISTURE CONSERVATION PLAN

The proposed soil moisture conservation works for Block-XII Codli Mineral Block will be carried out at locations suggested by the Forest Department, Government of Goa, based on the ground conditions, slope, drainage pattern, soil condition and requirement of the forest area. The locations will be finalized in consultation with the concerned Forest Department officials before commencement of the work.

The main purpose of these works is to retain rainwater, reduce the speed of surface runoff, control soil erosion and improve soil moisture availability for natural vegetation and plantation. Since the area receives considerable rainfall during the monsoon, proper management of runoff is important for maintaining soil moisture and preventing the loss of fertile topsoil.

1. Identification of Suitable Locations:

The Forest Department will identify suitable locations where soil moisture conservation measures are required. Preference will be given to areas showing signs of surface runoff, soil erosion, small gullies, exposed soil, water flow concentration and poor moisture retention.

The identified locations may include:

- Sloping forest areas where rainwater flows rapidly during monsoon.
- Small seasonal drainage channels.
- Areas affected by sheet erosion.
- Small gullies formed due to concentrated runoff.
- Open or degraded patches within the forest.
- Plantation areas requiring additional moisture support.
- Areas having poor natural regeneration because of moisture stress.
- Locations where rainwater can be retained without disturbing the natural drainage system.
- Suitable locations near existing plantation areas for improving plant survival.
- Areas where small-scale water-retention measures can be constructed using locally available materials.

The exact location and type of structure will be decided according to the site-specific condition and in consultation with the Forest Department.

2. Contour-Based Soil Moisture Conservation:

In sloping areas, rainwater generally moves downward quickly and carries soil particles with it. Contour-based measures can reduce the speed of runoff and provide sufficient time for water to infiltrate into the soil.

At locations suggested by the Forest Department, contour trenches, staggered trenches and contour bunds may be developed depending upon the slope and soil condition.

The trenches will be laid approximately along the contour so that they intercept the flow of rainwater. The collected water will gradually percolate into the surrounding soil. This will increase soil moisture and help nearby trees, shrubs and grasses during the post-monsoon period.

The spacing and dimensions of trenches will not be kept uniform throughout the area. They will be decided according to the slope, soil depth, drainage condition and local terrain.

1. Marking of suitable contour lines.
2. Excavation of small trenches at selected locations.
3. Proper disposal of excavated soil on the downhill side where appropriate.
4. Stabilization of trench edges.
5. Plantation or grass development around erosion-prone portions.
6. Regular inspection after heavy rainfall.
7. Repair of damaged trenches wherever required.

3. Loose Boulder Check Dams:

Small seasonal drainage lines and shallow gullies may carry considerable runoff during the monsoon. At locations identified by the Forest Department, loose boulder check dams can be constructed across such small drainage channels.

The main purpose of a loose boulder check dam is not to completely stop the flow of water but to slow down the velocity of runoff. When water movement becomes slower, suspended soil particles settle behind the structure and more water gets an opportunity to infiltrate into the surrounding soil.

Locally available stones/boulders will preferably be used for these structures. The size of the structure will depend on the width and depth of the drainage channel.

Benefits:

- Reduces runoff velocity.
- Controls gully erosion.
- Helps retain soil.
- Increases local soil moisture.
- Supports natural vegetation regeneration.
- Improves groundwater recharge at a local scale.
- Provides moisture availability in the surrounding area.

4. Gully Plugging:

Small gullies may develop in areas where runoff water is concentrated. If these gullies are left untreated, they gradually become deeper and wider and may result in considerable loss of soil.

At locations suggested by the Forest Department, gully plugging will be undertaken using suitable locally available materials such as stones, branches, logs or other biodegradable material, depending on site conditions.

The purpose of gully plugging will be to reduce the velocity of water and allow sediment to accumulate naturally. With time, the gully may become more stable and vegetation can establish around the treated area.

The Forest Department will guide the selection of locations and the appropriate type of gully treatment according to the ground situation.

5. Percolation and Recharge Pits:

At suitable locations identified by the Forest Department, percolation pits/recharge pits may be developed to improve infiltration of rainwater.

These pits will be particularly useful in areas where rainwater flows over the ground surface but can be safely retained without affecting nearby trees or natural drainage.

The pits will collect rainwater temporarily and allow it to slowly move into the soil. This can improve moisture availability in the root zone and contribute to local groundwater recharge.

The location, size and number of pits will be determined based on:

- Soil characteristics.
- Ground slope.
- Rainfall and runoff condition.
- Existing vegetation.
- Depth of soil.
- Local drainage pattern.
- Availability of suitable space.

6. Vegetative Soil and Moisture Conservation

Structural measures alone may not provide long-term protection if the soil remains exposed. Therefore, the soil moisture conservation programme will also include vegetative measures at locations suggested by the Forest Department.

Native trees, shrubs and grasses suitable for the local conditions will be encouraged in open and degraded patches. Vegetation helps bind the soil through its root system and reduces the impact of raindrops on exposed soil.

Leaf litter and naturally fallen biomass will preferably be retained in suitable forest areas rather than being unnecessarily removed. The organic layer helps reduce evaporation and gradually adds organic matter to the soil.

Suggested approach

- Promote natural regeneration wherever it is already occurring.
- Protect young seedlings from grazing and physical damage.
- Plant native species in suitable gaps.
- Encourage ground-cover vegetation in erosion-prone locations.
- Avoid unnecessary soil disturbance.

- Retain leaf litter wherever appropriate.
- Maintain existing vegetation around water-retention structures.

7. Moisture Conservation in Plantation Areas:

The Forest Department may identify plantation areas where additional moisture conservation measures are required to improve the survival of planted seedlings.

At such locations, small crescent-shaped basins, contour trenches, mulching and small earthen bunds may be adopted depending upon the terrain.

Mulching with locally available organic material can be particularly useful during the dry period. It reduces direct evaporation from the soil surface and helps maintain moisture around the root zone.

Plantation activities will preferably use native and locally suitable species. The objective will not only be to increase the number of trees but also to establish a healthy vegetation cover suitable for the local ecosystem.

8. Treatment of Runoff-Prone Areas:

During the monsoon, certain locations may receive concentrated runoff from higher slopes. Such locations can be identified by observing:

- Formation of small channels.
- Deposition of soil and stones.
- Exposed roots.
- Removal of topsoil.
- Water flow marks.
- Formation of rills and gullies.
- Poor vegetation growth.

The Forest Department may prioritize these locations for treatment.

Depending on the severity of erosion, the following measures may be adopted:

Site condition	Proposed measure
Mild surface runoff	Vegetative cover and mulching
Sheet erosion	Contour trenches/bunds
Small rills	Small earthen/stone checks
Small gullies	Gully plugging
Seasonal drainage	Loose boulder check dam
Plantation area	Mulching and moisture basins
Open degraded patch	Native plantation and grass development
Water accumulation area	Suitable water-retention/recharge measure

The treatment will be selected according to the actual site condition rather than applying the same structure everywhere.

9. Use of Local Materials

Where technically appropriate, preference will be given to locally available natural materials for soil moisture conservation works. Stones, boulders, soil, branches, leaf litter and other suitable biodegradable materials may be used.

The use of locally available materials will reduce transportation requirements and make maintenance easier. It will also help the structures blend naturally with the surrounding landscape.

Any material or activity that may adversely affect the forest vegetation, natural drainage or wildlife movement will be avoided.

10. Protection of Existing Vegetation:

During construction of soil moisture conservation structures, care will be taken to avoid unnecessary cutting or removal of existing trees and vegetation.

The works will be located in such a manner that:

- Existing mature trees are retained.
- Natural regeneration is protected.
- Wildlife movement is not unnecessarily disturbed.
- Natural drainage is maintained.
- Construction activity remains limited to the required area.
- Soil disturbance is kept to the minimum necessary.

11. Monsoon-Based Planning:

Since soil moisture conservation measures are particularly important during the monsoon, the works should preferably be planned before the onset of the monsoon so that the structures are ready to receive rainfall.

After the first major rainfall, the treated locations should be inspected to check whether:

- Water is being retained properly.
- Any structure has been damaged.
- Excessive silt has accumulated.
- There is any unwanted diversion of water.
- Additional treatment is required.

Where required, minor repairs should be carried out before subsequent rainfall events.

12. Maintenance and Monitoring:

The success of soil moisture conservation works depends not only on construction but also on regular maintenance. The locations suggested by the Forest Department should therefore be inspected periodically.

Monitoring should include:

1. Condition of contour trenches.
2. Stability of check dams.
3. Sediment accumulation.
4. Condition of gully plugs.

5. Soil moisture condition.
6. Natural regeneration around treated sites.
7. Survival of plantation.
8. Signs of soil erosion.
9. Condition of drainage channels.
10. Requirement of repair or additional treatment.

13. Expected Benefits:

Implementation of the proposed measures at Forest Department-suggested locations is expected to provide the following benefits:

- Reduction in soil erosion.
- Reduction in surface runoff.
- Increased infiltration of rainwater.
- Improvement in soil moisture.
- Conservation of topsoil.
- Improvement in plantation survival.
- Better natural regeneration.
- Stabilization of small gullies and drainage channels.
- Improvement in vegetation cover.
- Enhancement of habitat quality.
- Local improvement in groundwater recharge.
- Better ecological condition of degraded patches.

14. Role of the Goa Forest Department:

The Goa Forest Department will play an important role in identifying and guiding the implementation of soil moisture conservation measures. The locations suggested by the Forest Department will be treated as priority areas for implementation.

Before starting the work, the project team will coordinate with the concerned Forest Department officials for:

- Identification of suitable locations.
- Selection of appropriate conservation measures.
- Finalization of site-specific dimensions.
- Selection of suitable native plantation species.
- Supervision and technical guidance.
- Monitoring of completed works.
- Maintenance requirements.



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Soil Moisture Conservation Plan



15. Proposed Implementation Approach:

The implementation will follow a simple site-based approach:

Forest Department identifies location → Joint site inspection → Assessment of slope and drainage → Selection of suitable measure → Execution → Monsoon inspection → Maintenance → Ecological monitoring

This approach will ensure that the soil moisture conservation works are practical, technically suitable and compatible with the existing forest ecosystem.

Conclusion:

The proposed Soil Moisture Conservation Plan for Block-XII Codli Mineral Block, Village Codli, Taluka Dharbandora, District South Goa, Goa, will focus on conserving rainwater and soil at locations suggested by the Forest Department. Measures such as contour trenches, loose boulder check dams, gully plugging, recharge/percolation pits, small bunds, mulching and native vegetation development will be adopted according to the actual site conditions. The emphasis will be on simple, low-impact and locally suitable measures that can be maintained over the long term.

APPENDIX-II:

BIRD HABITAT MITIGATION PLAN

1. Introduction:

Birds are an important part of the forest ecosystem. They help in seed dispersal, pollination, control of insects and maintenance of ecological balance. The forest and surrounding areas of the proposed Block-XII Codli Mineral Block provide feeding, nesting, roosting and movement opportunities for different bird species.

Mining and associated activities may temporarily disturb birds through vegetation clearance, movement of vehicles, machinery noise, dust, human movement and changes in small feeding or nesting sites. Therefore, the objective of this Bird Habitat Mitigation Plan is to reduce disturbance to birds and improve suitable habitat in the surrounding forest landscape.

The proposed measures will be implemented in consultation with the Goa Forest Department, and the locations for habitat improvement activities will be selected at sites suggested by the Forest Department after field inspection.

2. Location Selection as Suggested by the Forest Department:

The locations for bird habitat improvement will not be selected only on the basis of distance from the mining area. The Forest Department will identify suitable sites by considering the existing vegetation, water availability, natural drainage, bird movement, nesting trees, feeding areas and condition of the surrounding habitat.

Priority may be given to locations having:

- Existing mature trees suitable for nesting and roosting.
- Natural forest patches with good canopy cover.
- Areas supporting fruiting or flowering trees.
- Seasonal streams and natural water sources.
- Open patches adjoining forest areas.
- Areas where birds are regularly observed during field monitoring.
- Degraded patches that can be improved through native plantation.
- Locations suitable for small bird water points.
- Areas away from continuous human disturbance.
- Sites that can provide connectivity between existing vegetation patches.

3. Conservation of Existing Bird Habitat:

The first and most important measure will be to protect the existing habitat rather than depending only on new plantation.

Mature trees, large canopy trees, trees with natural hollows, dead standing trees where safe, fruit-bearing trees and trees commonly used by birds for nesting will be retained wherever possible.

During site activities, unnecessary removal of vegetation will be avoided. Existing vegetation along natural drainage lines and forest edges will also be protected because these areas often provide important feeding and movement routes for birds.

Where a tree is identified as an active nesting site, the area around the nest will be avoided during the breeding period as far as practically possible.

4. Native Plantation for Bird Habitat:

At suitable locations suggested by the Forest Department, native tree and shrub species will be planted to improve feeding, nesting and shelter opportunities for birds.

Plantation will not be developed as a single-species plantation. A mixed native plantation will be preferred so that different types of food and shelter are available throughout the year.

Suitable species may include:

Scientific Name	Common Name	Importance for Birds
<i>Ficus racemosa</i>	Umbar/Gular	Fruits provide food for many birds
<i>Ficus religiosa</i>	Peepal	Fruits, nesting and roosting
<i>Ficus benghalensis</i>	Banyan	Fruits and large canopy
<i>Syzygium cumini</i>	Jamun	Seasonal fruits
<i>Mangifera indica</i>	Mango	Fruits and canopy
<i>Terminalia arjuna</i>	Arjun	Shelter and nesting
<i>Madhuca longifolia</i>	Mahua	Flowers and fruits
<i>Butea monosperma</i>	Palash	Flowers attract nectar-feeding birds
<i>Careya arborea</i>	Kumbhi	Food and shelter
<i>Schleichera oleosa</i>	Kusum	Fruits and habitat value

The species selection will be based on the recommendations of the Goa Forest Department.

5. Development of Bird Feeding Habitat:

Birds require different types of food, including fruits, seeds, nectar, insects and small invertebrates. Therefore, the plantation should include species that provide food during different seasons.

Fruit-bearing native trees will be planted at selected locations. Flowering species will also be included to support nectar-feeding birds and associated insects.

The objective will be to create a natural food source rather than depending on artificial feeding.

Artificial feeding of birds will generally be avoided because it can lead to congregation, disease transmission and dependence on human-provided food.

6. Bird Water Points:

Availability of water is important during the dry season, particularly for small birds.

At suitable locations identified by the Forest Department, small bird water points may be provided. These should preferably be simple, shallow and easy to maintain.

The water points should:

- Be located under partial shade.
- Have a shallow depth suitable for small birds.
- Be placed away from heavy human movement.
- Be cleaned regularly.
- Have fresh water during periods of water scarcity.
- Avoid locations where predators can easily approach.
- Be monitored to prevent mosquito breeding and contamination.

Natural water bodies, streams and seasonal water sources will be given preference wherever available.

7. Development of Nesting Habitat:

Different bird species use different nesting sites. Some birds construct nests on branches, while others use tree cavities or dense shrubs.

Therefore, habitat improvement will include protection of:

- Mature trees.
- Trees with natural cavities.
- Dense shrubs.
- Climbers and suitable understorey vegetation.
- Large branches used for nesting.
- Existing nests during the breeding season.

Artificial nest boxes may be installed for suitable cavity-nesting species.

Nest boxes should not be installed randomly. Their location, height, orientation and number should be decided based on the bird species present in the area and local site conditions.

8. Protection of Nesting Sites During Breeding Season:

One of the practical mitigation measures will be to avoid unnecessary disturbance around active nesting locations.

During bird monitoring, if an active nest is found close to a proposed work area, the location may be marked and a suitable temporary disturbance-free zone can be maintained around it, depending on the species and site conditions.

Particular attention will be given to:

- Tree cutting activities.
- Heavy machinery movement.
- Blasting or high-noise activities.

- Night-time lighting.
- Workers' movement near nesting trees.

9. Control of Noise and Disturbance:

Noise from heavy machinery, vehicles and other mining-related activities can disturb birds, particularly during nesting.

The following measures will therefore be followed:

1. Avoid unnecessary use of horns within or near forest areas.
2. Maintain machinery in good working condition.
3. Avoid unnecessary idling of heavy vehicles.
4. Restrict unnecessary human movement in sensitive forest patches.
5. Avoid loud activities close to identified nesting locations.
6. Follow prescribed working hours wherever feasible.
7. Maintain vegetation buffers between active operations and sensitive habitat.

These measures will help reduce unnecessary disturbance without affecting normal project operations.

10. Dust and Air Pollution Control:

Dust generated from vehicle movement and mining activities can settle on vegetation and reduce the quality of feeding and nesting habitat.

Dust-control measures such as regular water sprinkling on haul roads, proper vehicle speed control, covering of material during transportation and maintenance of greenbelt areas will be followed.

Vegetation barriers can also help reduce the movement of dust towards nearby forest areas.

11. Development of Multi-Layer Bird Habitat:

For better habitat value, plantation should be developed in different layers rather than only planting large trees.

The proposed habitat can include:

Upper canopy → Medium trees → Shrubs → Grasses/ground vegetation

This structure provides different habitat niches for different birds.

For example:

- Canopy birds can use tall trees.
- Small insectivorous birds can use shrubs and lower branches.
- Ground-feeding birds can use leaf litter and grasses.
- Fruit-eating birds can use fruit-bearing trees.
- Nectar-feeding birds can use flowering plants.

A multi-layered plantation will therefore provide better habitat than a uniform plantation.

12. Protection of Natural Understorey:

Natural shrubs, grasses, climbers and leaf litter are important for birds and insects. Therefore, unnecessary clearing of understorey vegetation will be avoided in areas selected for habitat improvement.

Leaf litter should be retained as far as possible because it supports insects and other small organisms that form part of the food chain of insectivorous birds.

Natural regeneration will be encouraged wherever it is healthy and suitable.

13. Creation and Protection of Forest Edge Habitat:

Forest edges often support a mixture of trees, shrubs, grasses and open areas. Such locations can be useful feeding areas for many bird species.

At selected locations, the forest edge may be improved through native shrubs, fruiting trees and flowering plants.

However, excessive opening of forest edges will be avoided. The aim will be to create a natural transition between forest and open habitat.

14. Control of Invasive Species:

Invasive or aggressively spreading plant species can reduce the diversity of native vegetation and affect the availability of natural food resources.

Where invasive species are identified at Forest Department-suggested habitat improvement sites, their management may be undertaken as per the advice and approved practices of the Forest Department.

Native species will be encouraged in the treated areas to gradually improve habitat quality.

15. Bird Habitat Monitoring:

Bird monitoring will be an important part of the plan. Regular observations will help determine whether the habitat improvement measures are providing the expected benefits.

Monitoring can be carried out through:

- Fixed-point bird counts.
- Line transects.
- Direct observations.
- Nest observations where appropriate.
- Recording of feeding and roosting activity.
- Seasonal bird surveys.

The following information can be recorded:

Parameter	Monitoring
Bird species richness	Number of species recorded
Bird abundance	Number of individuals observed
Nesting activity	Active nests/locations
Feeding activity	Feeding sites and behaviour
Water-point use	Bird visits
Habitat condition	Vegetation and water availability
Seasonal changes	Pre-monsoon, monsoon and winter observations

The monitoring results can be compared over time to assess the effectiveness of the mitigation measures.

16. Suggested Work Programme:

S. No.	Proposed Work	Purpose	Location
1	Native mixed plantation	Feeding and nesting habitat	Location suggested by Forest Department
2	Fruit-bearing tree plantation	Food availability	Forest/plantation patches
3	Flowering tree and shrub plantation	Nectar and insect availability	Suitable forest edges
4	Bird water points	Drinking and bathing	Suitable shaded locations
5	Protection of nesting trees	Reduce disturbance	Existing forest patches
6	Nest boxes, if required	Cavity-nesting birds	Selected mature tree areas
7	Understorey development	Cover and insect habitat	Degraded/open patches
8	Invasive species management	Improve native vegetation	Identified affected areas
9	Habitat monitoring	Assess effectiveness	All treatment locations
10	Maintenance	Ensure long-term success	All developed sites

17. Expected Outcomes:

The proposed Bird Habitat Mitigation Plan is expected to:

- Improve availability of natural food resources.
- Increase availability of nesting and roosting sites.
- Improve water availability during dry periods.
- Strengthen local bird habitat.
- Support native vegetation and associated insects.
- Reduce disturbance to birds.
- Improve habitat connectivity.
- Encourage natural regeneration.
- Support seasonal and resident bird populations.
- Improve the overall ecological condition of selected forest patches.

18. Implementation and Maintenance:

The habitat improvement works will be implemented in a phased manner. Initially, the Forest Department will suggest suitable locations and a joint field inspection will be carried out.

After finalization of the locations, site-specific activities such as plantation, water-point development, habitat protection and other measures will be undertaken.



Proposed Block-XII Codli Mineral Block , Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Bird Habitat Mitigation Plan



The sites will be monitored periodically, particularly before and after the monsoon and during the dry season, to assess vegetation growth, water availability and bird use.

Any damaged structure, dead plantation or poorly performing habitat measure will be repaired or replaced as required.

19. Conclusion:

The Bird Habitat Mitigation Plan for the Proposed Block-XII Codli Mineral Block, Village Codli, Taluka Dharbandora, District South Goa, Goa, focuses on protecting existing bird habitat and improving selected forest patches through practical conservation measures.

The most important principle of the plan is to work with the existing forest ecosystem rather than create an artificial habitat. Existing mature trees, natural water sources, nesting sites, shrubs and natural regeneration will therefore receive priority.

The proposed works including native mixed plantation, fruit- and flower-bearing species, protection of nesting trees, bird water points, suitable nest boxes where required, understorey development, invasive species management and regular bird monitoring will be implemented at locations suggested by the Goa Forest Department.



BIOLOGICAL STUDY REPORT



OF

**PROPOSED BLOCK-XII CODLI MINERAL BLOCK,
AUCTIONED BLOCK AREA: 377.0881 HA**

With

**Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total
Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary
Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH)
and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput
Capacity 3.50 Million TPA**

At

**Village: Codli, Taluka: Dharbandora,
District: South Goa (Goa)**

PROJECT PROPONENT



JSW Steel Limited

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Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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BIOLOGICAL STUDY REPORT

1.0 INTRODUCTION: -

Understanding the biological environment is crucial for understanding the distribution, abundance, and diversity of living organisms in different ecosystems. It is also important for understanding the processes that govern ecosystem dynamics, such as Nutrient Cycling, Energy Flow and Succession.

The Biological environment encompasses the sum of all environment where life forms exist, including both terrestrial and aquatic ecosystems. In addition to the physical and chemical components of the environment, the biological environment also includes the habitat, which is the specific place where a particular organism lives. The habitat includes all of the features of the physical environment that are necessary for an organism to survive and thrive, such as food, water, shelter, and breeding sites.

Biodiversity or “Biological diversity” encompasses all the species of plants, animals and microorganisms and ecosystem and ecological processes of which they are parts. It is an umbrella term for the degree of nature’s variety, including both the number and frequency of ecosystems, species or genes in given assemblage. It is usually considered at three different levels: Genetic diversity, species diversity and ecosystem diversity.

Biodiversity, as defined by the Convention on Biological Diversity, 1992, refers to the variability among living organisms from all sources including terrestrial, marine & other aquatic ecosystems and the ecological complexes of which they are a part: this includes diversity within species & between species and of ecosystems. It is essential for maintaining the balance of Earth’s natural systems and for supporting human well-being, providing ecosystem services such as clean air and water, nutrient cycling, and climate regulation.

Biodiversity refers to the variety of living species on Earth, including plants, animals, bacteria and fungi. While Earth’s biodiversity is so rich that many species have yet to be discovered, many species are being threatened with extinction due to human activities, putting the Earth’s magnificent biodiversity at risk.

Understanding these impacts is vital for developing effective mitigation strategies that aim to minimize harm to biodiversity and promote ecological resilience. This report focuses on the assessment of biodiversity within 10 km radius study area of the mine site and explores the potential impacts arising from the mine activities. Furthermore, it aims to propose mitigation measures that can help conserve and protect biodiversity, ensuring the sustainable coexistence of the industries and the surrounding natural environment.

JSW Steel Limited has Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, B/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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JSW Steel, the flagship business of the diversified US\$ 23 billion JSW Group. As one of India's prominent business houses, JSW Group has interests in energy, infrastructure, cement, paints, sports and venture capital. JSW Steel, certified by Great Places to Work in 2021, JSW Steel has established itself as an organization with a robust cultural foundation. Over the last three decades, it has evolved from a single manufacturing unit to become India's leading integrated Steel plant with a capacity of 35.7 MTPA in India and the USA. Its next phase of growth will take its total capacity to 38.5 MTPA by FY25.

The Company's manufacturing unit in Vijayanagar, Karnataka is the largest single-location steel-producing facility in India, boasting a capacity of 17.5 MTPA. (5 MTPA capacity at Vijayanagar under commissioning) JSW Steel has always been at the forefront of research and innovation, maintaining a strategic collaboration with global leader JFE Steel of Japan. This enabling JSW to access new and state-of-the-art technologies to produce and offer high-value special steel products to its customers. These products are extensively used across industries and applications including construction, infrastructure, automobile, electrical applications and appliances. JSW Steel is widely recognized for its excellence in business and sustainability practices. Some of these recognitions include World Steel Association's Steel Sustainability Champion (consecutively from 2019 to 2022), Leadership Rating (A-) in CDP (2020 & 2021), Deming Prize for TQM for its facilities at Vijayanagar (2018) and Salem (2019). It is part of the S&P Dow Jones Sustainability Index (DJSI) for Emerging Markets (2021) and S&P Global's Sustainability Yearbook (consecutively for 2020 and 2021).

1.1 SCOPE OF THE STUDY:

This report has been prepared in reference to the Terms of Reference (ToR) issued by the Ministry of Environment, Forest and Climate Change, Government of India, vide File No. J-11015/49/2025-IA.II (NCM), dated 18.05.2026.

2.0 PROJECT DESCRIPTION: -

JSW Steel Limited has proposed Codli Mineral Block - XII, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa.

2.1 STATUS OF FOREST CLEARANCE: The application for Forest Clearance has been submitted on the PARIVESH Portal for an area of 65.9686 ha, on 23.02.2026, for signing of lease document and diversion of forest land to non forest purpose and its Proposal No. FP/GA/MIN/QRY/569926/2026.

2.2 STUDY AREA: -

PROJECT LOCATION:

The study was conducted to generate a database on terrestrial biodiversity, occurring in 10 km radius of mine site located at Village: Codli, Taluka: Dharbandora, South Goa District, (Goa). The details of ML area are given below: -



Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of 4 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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2.3 PROJECT DETAILS:

Details of the ML area is given below in Table 1.

TABLE 1 DETAILS OF PROJECT

S. No.	Particular	Details
A.	Nature of the Project	Fully Mechanized Opencast Mining Method
B.	Size of the Project	
1.	Mining Lease Area	Out of total 377.0881 ha land; 65.9686 ha is Forest Land, 236.3482 ha is Government land, 58.9087 ha is Private land and 15.8626 ha is Alvares land.
C.	Location Details	
1.	Villages	Codli
2.	Taluka	Dharbandora
3.	District	South Goa
4.	State	Goa
5.	Latitude	15°21'15.638" N to 15°19'42.607" N
6.	Longitude	74°07'10.922" E to 74°08'39.034" E
7.	Open series No./ Toposheet No.	Core Zone: D43C3_48I/3 Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
D.	Cost Details	
1.	Total Project Cost	500 Crores

TABLE 2 ENVIRONMENTAL SETTINGS OF THE 10 KM RADIUS STUDY AREA

(with approx. aerial distance from ML Boundary & direction from the centre of the ML Boundary)

S. No.	Particular	Details
1	Nearest Town/City	➤ Sanvordem (~7.5 km in SSW)
2	Nearest Highway	➤ NH-748 (~3.0 km in NNE direction) ➤ SH-7 Adjacent in WNW direction
3	Nearest Railway Station	➤ Collem Railway Station (~6.4 km in SE direction) ➤ Sanvordem Chuch Railway Station (~7.8 km in SSW)
4	Nearest Airport	➤ Dabolim International Airport (~30.0 km in WNW)
5	National Park, Wildlife Sanctuary, Biosphere Reserves, Wildlife corridors, Tiger/Elephant Reserves, within 10 km radius of the project site	There are no Biosphere reserve or corridor present within 10 of study area. 2 Wildlife sanctuaries are present that are: ➤ Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE). ➤ Bondla Wildlife Sanctuary (~6.5 Km in NNW) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW). As per the authenticated map of the WLS & ESZ from the Deputy Conservator of Forests, Working Plan Division, Panaji, Goa, vide Letter No. DCF(WP)Tech/Digi/Vol-I/75/2025-26/751 dated 10.10.2025.



Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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S. No.	Particular	Details
6	Reserved / Protected Forest within 10km radius study area	➤ Unclassified Forest filling in Core Zone ➤ Reserved Forest (~0.5 km in ENE direction) ➤ Reserved Forest (~1.0 km in West direction) ➤ Reserved Forest (~2.5 km in West direction) ➤ Reserved Forest (~4.0 km in South direction) ➤ Reserved Forest (~6.5 km in WSW direction) ➤ Reserved Forest (~7.0 km in NNE direction) ➤ Reserved Forest (~8.0 km in WSW direction) ➤ Reserved Forest (~8.5 km in NW direction) ➤ Reserved Forest (~9.0 km in West direction)
7	Water body within 10 km radius of study area	➤ Khandepar River Adjacent in North ➤ Kale Nala (~0.7 km in ESE direction) ➤ Udnai nala ~1.5 km in West direction) ➤ Panduranga Nala (~5.0 km in SW direction) ➤ Ragada Nala (~7.0 km in NNE direction) ➤ Sanguem/Zuvari River (~8.0 km in South direction) ➤ Jamboli Nala (~9.0 km in NE direction) ➤ Paroda River (~9.0 km in SSW direction)
8	Seismic Zone	➤ Zone – III as per IS: 1893 (Part-I): 2025

Source: Environment Setting Map

2.4 LOCATION OF THE PROJECT (MAP SHOWING GENERAL LOCATION, SPECIFIC LOCATION, PROJECT BOUNDARY & PROJECT SITE LAYOUT): -

The Mine site is located at Villages: Codli Taluka: Dharbandora, District: South Goa District, (Goa). The maps showing general location of the mine site is as given below-

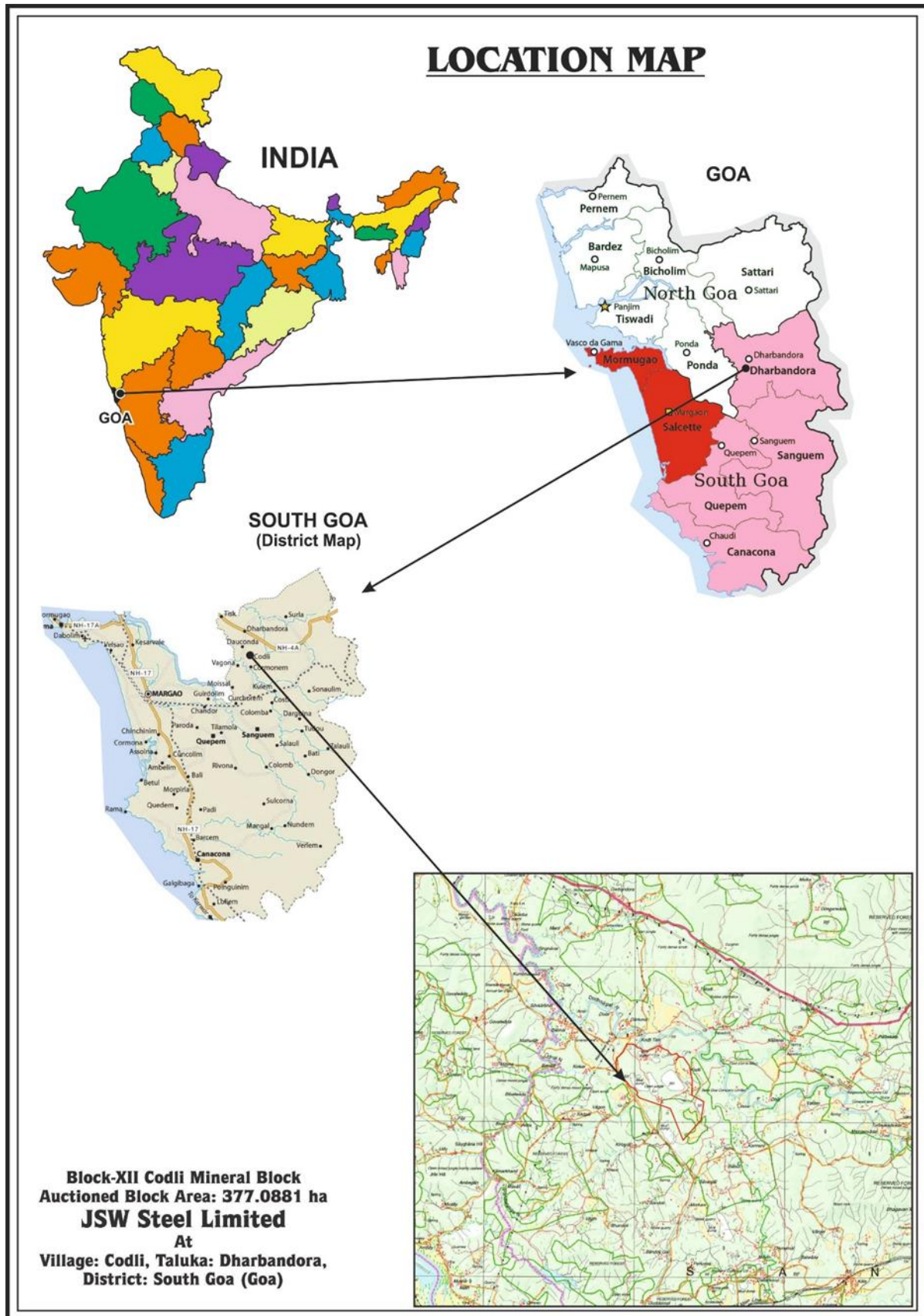


FIGURE 1 LOCATION MAP

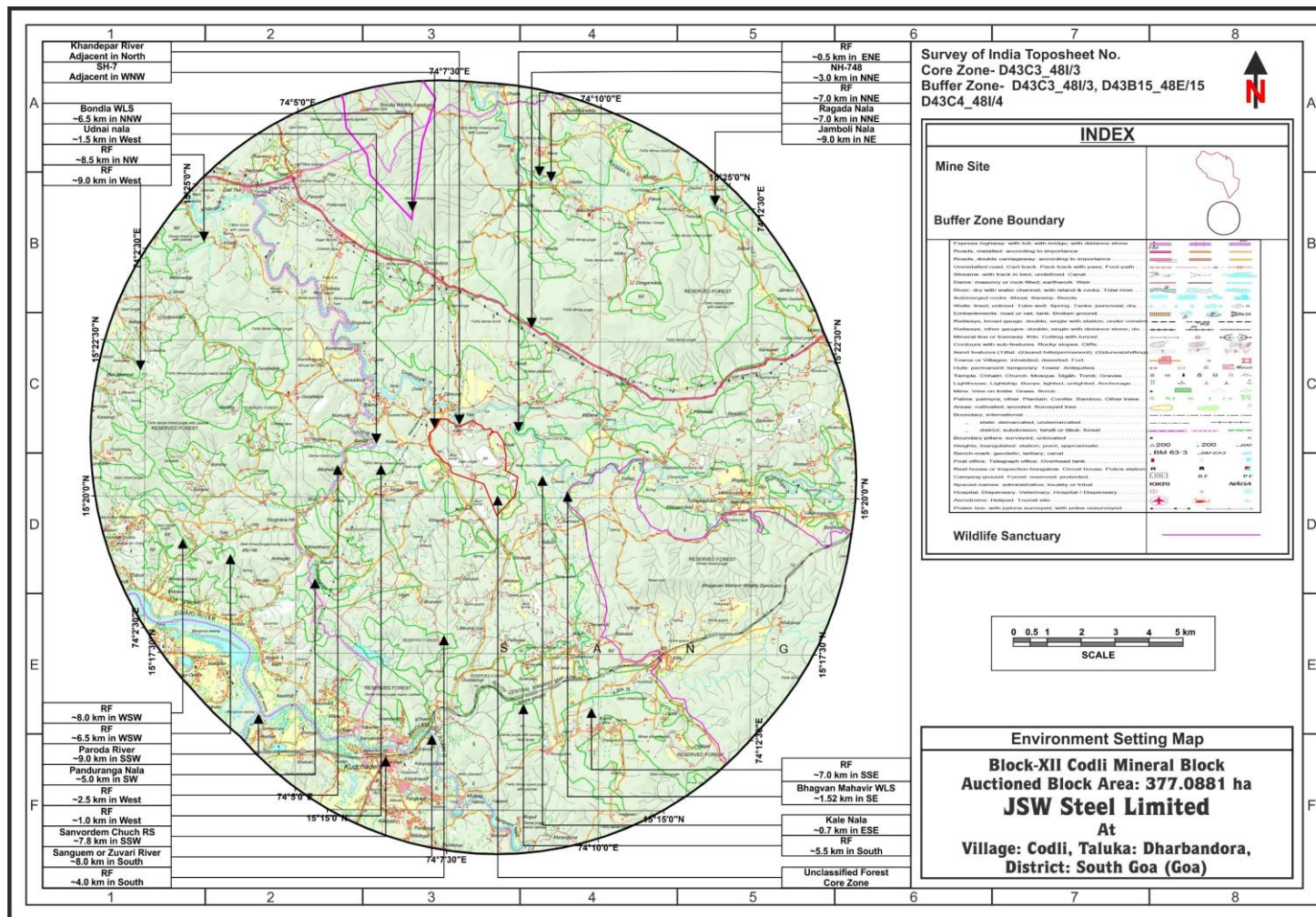


FIGURE 2 MAP SHOWING ENVIRONMENT SETTINGS OF 10 KM RADIUS FROM MINE SITE

3.0 DESCRIPTION OF STUDY AREA: -

The study area within 10 km radius around the proposed mine site (including both core and buffer zones) is essential for assessing the potential impacts of project activities on wildlife and their habitats. Understanding the current environmental conditions is also vital for effective environmental management and the planning of mitigation measures. To evaluate the baseline environmental quality of the area, a field assessment has been conducted, focusing on the environmental components and their potential impact on the biological environment.

3.1 STUDY AREA: -

An area of 10 km radius (aerial distance) from the ML boundary is considered as study area, also known as buffer zone. The area of mine site (within the ML boundary) is considered as core zone. The Mining Lease (ML) area is located in the village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

3.2 CLIMATE & RAINFALL:

The area is characterized by extreme climate with very hot (38°C) summer and very cold winter (16°C). It experiences tropical and humid climate which shows three distinct seasons viz. summer, rainy and winter. The summer is hot and humid starting from March and continues till end of May. May is the hottest month of this region. The rainy season lasts from early June to end of September. October and November are the post monsoon months followed by a cold winter which lasts till end of February.

RAINFALL:

The annual average rainfall in the region is around 3412.7 mm (average of last 10 years rainfall data from 2015-2024) varying from minimum 2480.7 mm in 2018 to maximum 4787.8 mm in 2024.

3.3 AGRICULTURE STATUS IN STUDY AREA: -

Goa being a coastal state in India, shares a similar agricultural profile across its northern and southern districts. Agriculture plays a vital role in the district's economy, the Major Field crops cultivated is Cereals (Rice, Maize), Pulses (Cowpea), Oilseed (Groundnut) and Commercial crop (Sugarcane). Additionally, variety of horticultural crops, including diverse **fruits** like mango, banana and jackfruit, a wide range of vegetables such as ladyfinger, brinjal, and chillies sugarcane primarily for local markets and commercially important spices such as black pepper and nutmeg, reflecting a varied and productive agricultural ecosystem. Coconut is another important crop seen in homestead farming. However, agricultural productivity is moderately low due to rocky soil conditions, mining-induced soil degradation and the main sources of irrigation within the buffer area are canals, Borewells, Open wells and Tanks etc. (<https://www.agri.goa.gov.in/HomePage?o>)

3.4 FOREST TYPES OF STUDY AREA: -

The forests of Goa form the part of Western Ghats, the region which have been internationally recognized as Biodiversity Hotspot of the world owing to its rich flora and fauna. Most of the Goa forests are located in the eastern region of the state. Goa forests are diverse ecosystems that include tropical evergreen, semi-evergreen and moist deciduous forests. These forest types support a rich variety of flora and fauna, contributing to the ecological significance of the region.

3.4.1 FOREST TYPES:

The area under different Forest Types in Study Area (as per the Champion & Seth Forest Classification, 1968) based on the Forest Cover Map (FCM), ISFR-2023, is presented in the following table.

TABLE 3 FOREST TYPES IN THE STUDY AREA

S. No.	Forest Type
1	1A/C4 West Coast tropical evergreen forest
2	2A/C2 West Coast semi-evergreen forest
3	3B/C2 Southern moist mixed deciduous forest
4	4B/TS2 Mangrove Forest
5	5/E7 Laterite thorn forest
6	TOF/ Plantation

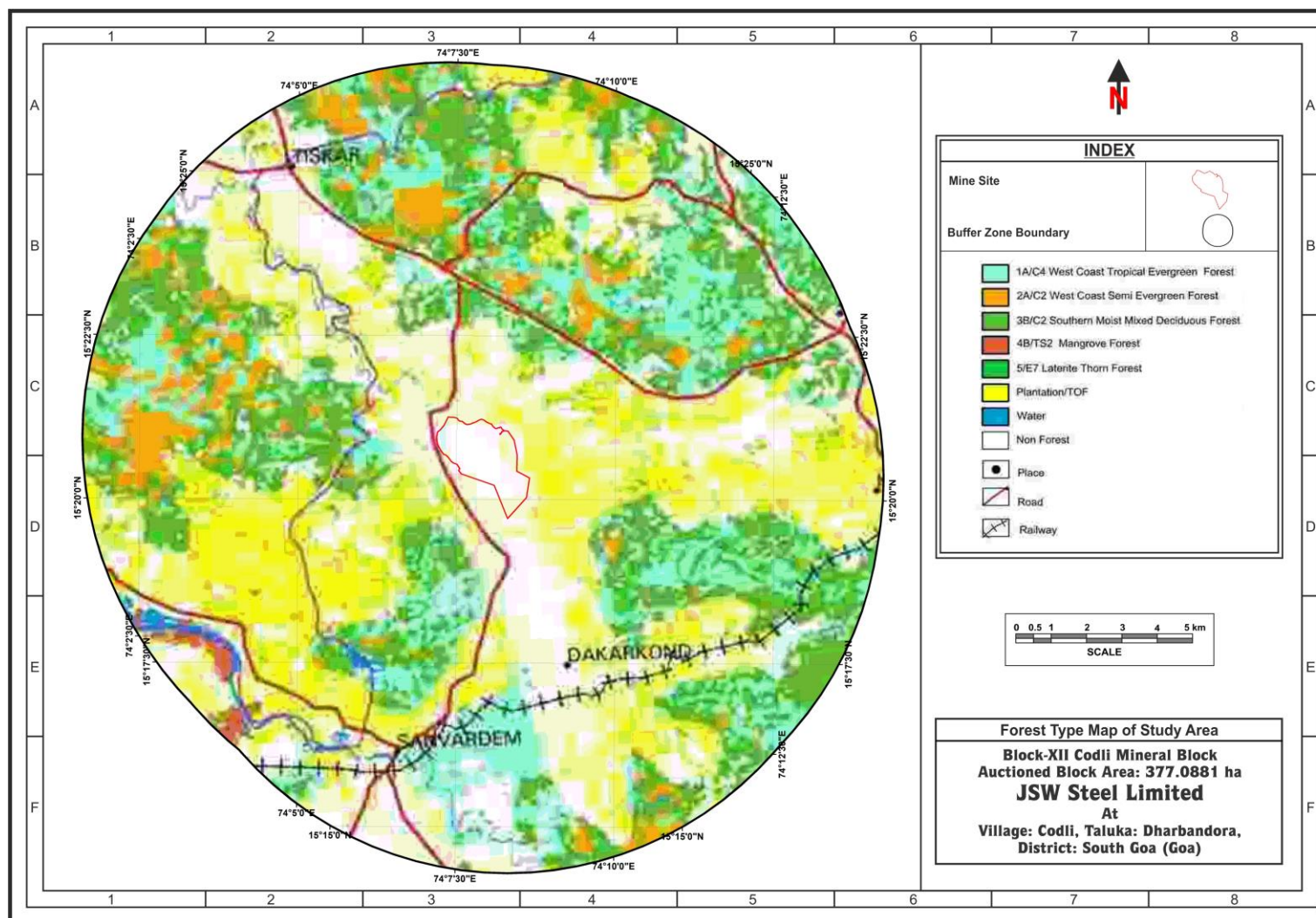


FIGURE 3 FOREST COVER MAP OF THE STUDY AREA

The classification of forest cover in Goa as per the India State of Forest Report 2023 (Volume II) is given below. The report classifies forest cover into various density classes: Very Dense Forest (VDF), Moderately Dense Forest (MDF), Open Forest (OF).

Details of forest cover classification are given in the below tables and chart.

TABLE 4 FOREST CLASS STATISTICS OF THE STUDY AREA

S. No.	Forest Class	Area in Ha.	Area %
1	Water Bodies	1276	3.18
2	Non-Forest	10,700	26.64
3	Open Forest Cover (OF)	14769	36.77
4	Moderately Dense Forest (MDF)	9842	24.50
5	Very Dense Forest (VDF)	3579	8.91
Total		40166	100.00

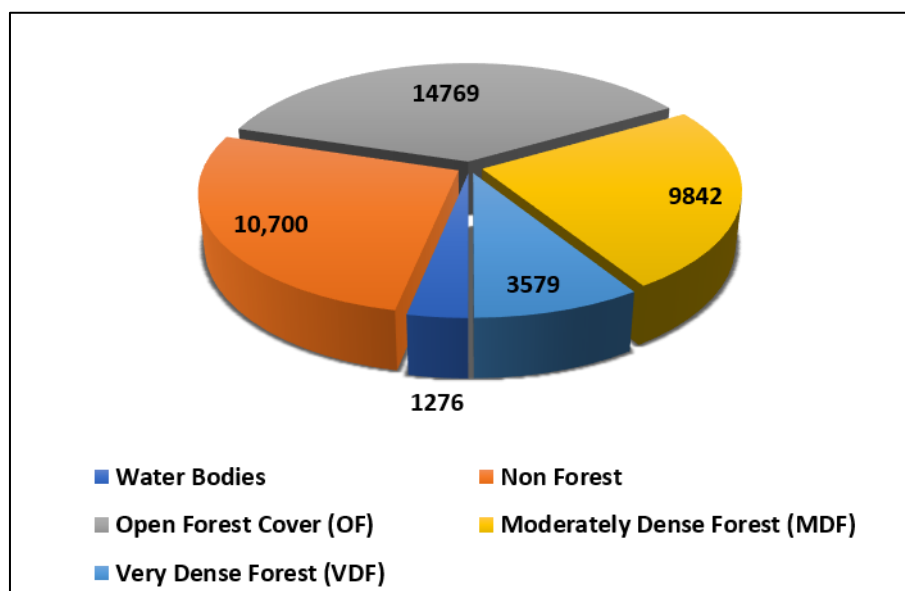


FIGURE 4 GRAPH SHOWING THE FOREST COVER OF THE STUDY AREA

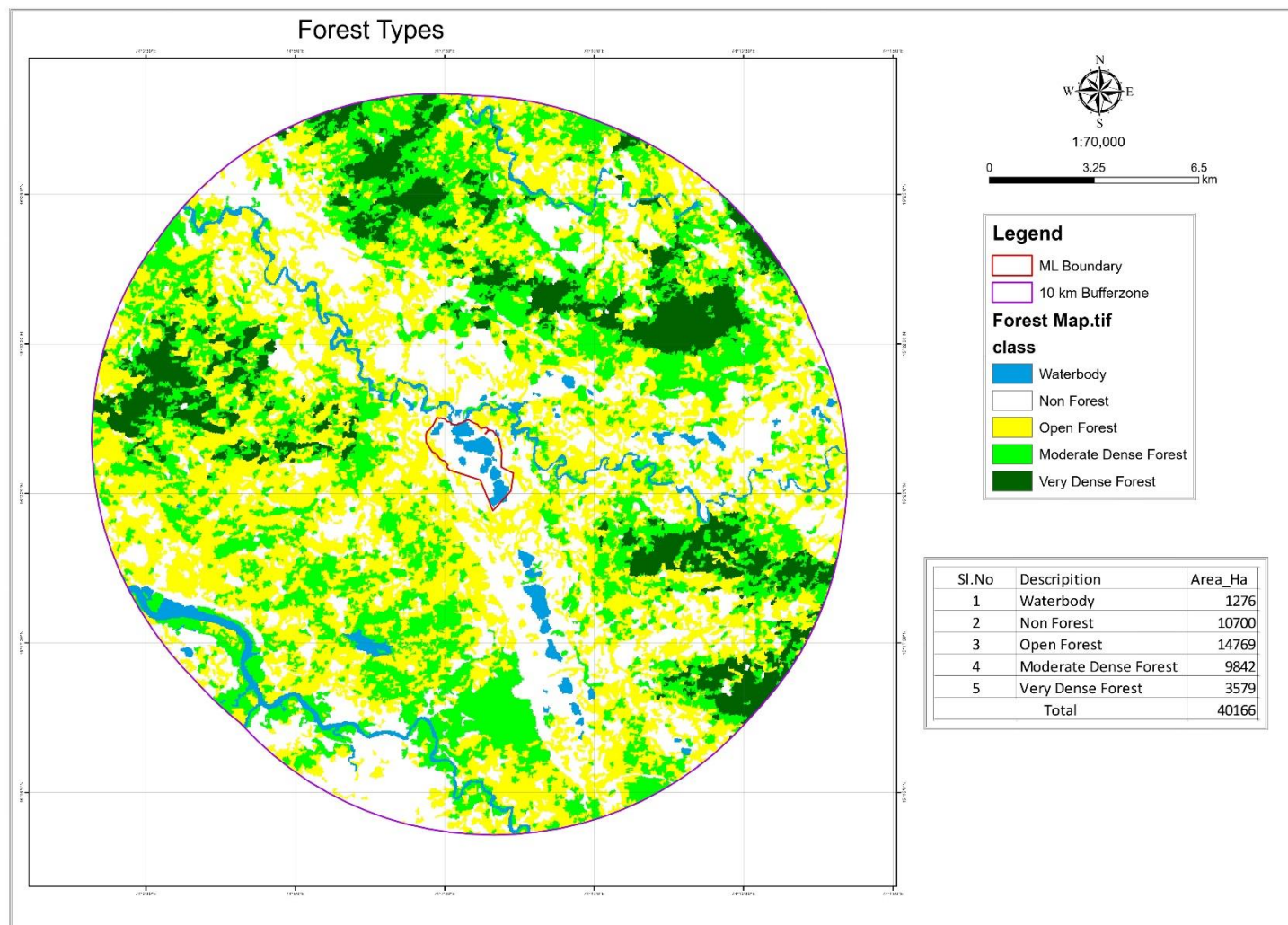


FIGURE 5 MAP SHOWING THE FOREST COVER OF THE STUDY AREA

4.0 PROTECTED AREAS IN THE GOA:

Around 20% of total geographical area of the state is dedicated for the proliferation of wildlife as the state of Goa has 6 Wildlife Sanctuaries and 1 National Park. These protected areas are provided with complete protection to the flora and fauna found in the state, helping to conserve its unique and rich biodiversity.

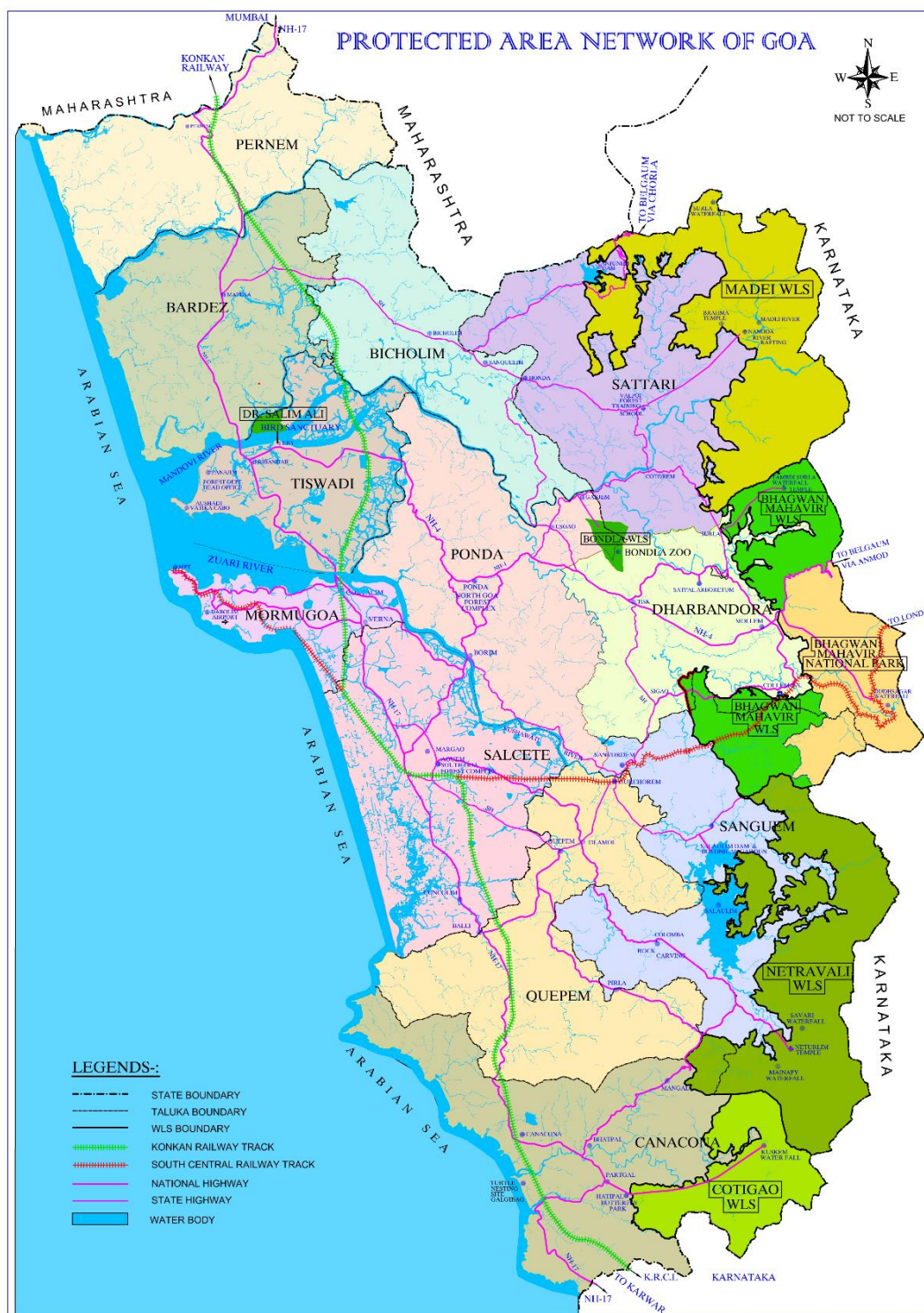


FIGURE: 6 PROTECTED AREA NETWORK OF GOA

TABLE 5 DETAILS OF WILDLIFE SANCTUARY IN THE STUDY AREA

S. N.	Name of the Wildlife Sanctuary (WLS)	Distance & direction of Mine Boundary to Boundary of WLS (km)	Distance & direction of Mine Boundary to Boundary of ESZ (km)
1.	Bondla Wildlife Sanctuary	~6.5 km in NNW	~5.5 km in NNW
2.	Bhagwan Mahavir WLS	~ 1.52 km in SE	~ 0.52 km in SE

1. **BONDLA WILDLIFE SANCTUARY:**

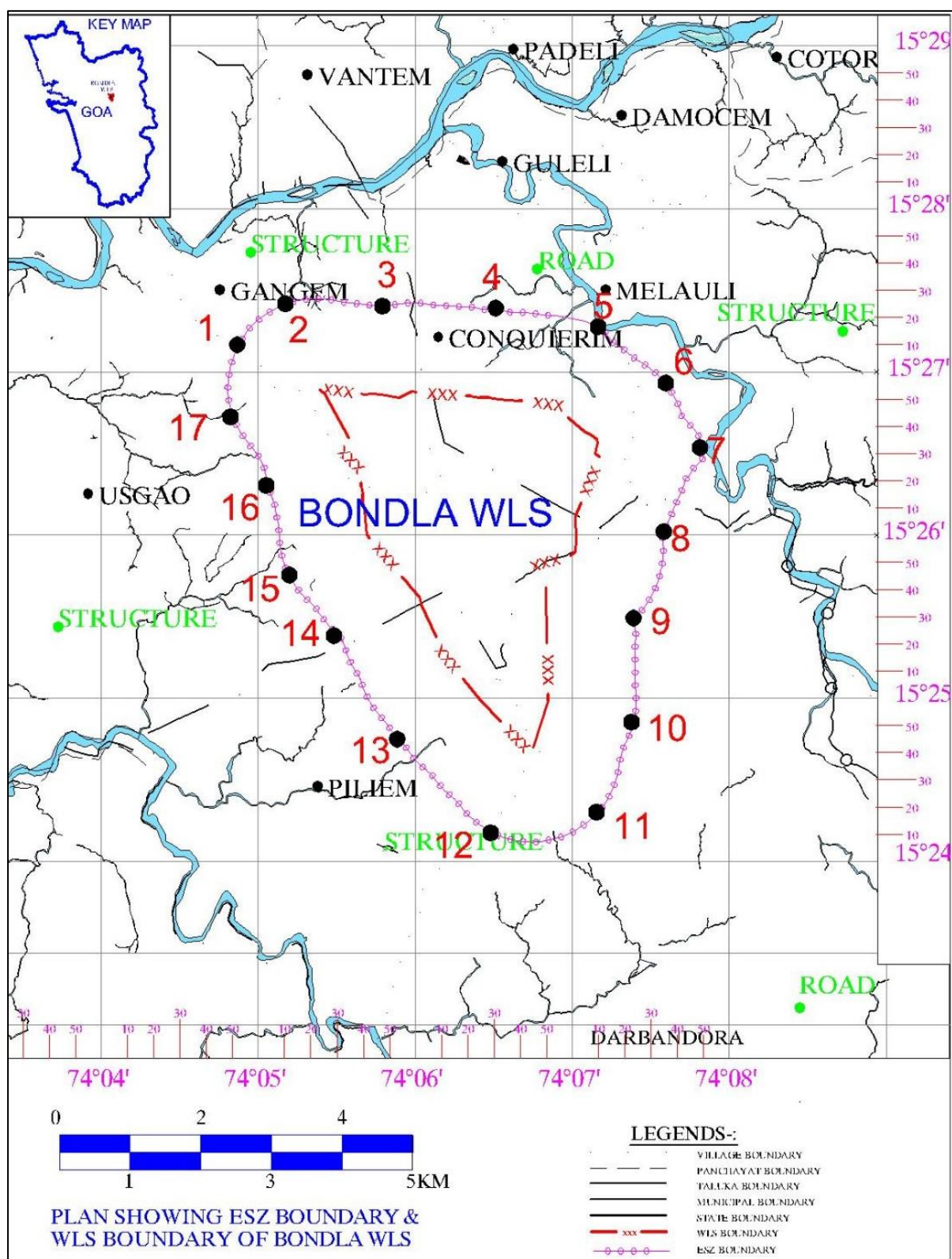
Bondla Wildlife sanctuary is one of seven 'protected areas' in the state of Goa. It is situated in North-eastern region of Goa, covering an area of 7.98 square kilometres.

The Sanctuary is mostly covered with moist deciduous forest with small patches of semi-evergreen forest and cane along streams. The dominant trees in this Sanctuary are *Terminalia crenulata* (the state tree of Goa) and Rosewood. Although this Sanctuary encompasses small area, it is an ideal habitat for wildlife such as Leopard, Jungle Cat, Wild boar, Porcupine, Pangolin & a variety of insects, amphibians, reptiles & birds.

2. **ESZ OF BONDLA WILDLIFE SANCTUARY:**

The extent of Eco-sensitive Zone is 1.0 square km uniformly all along the periphery of the boundary of the Bondla Wildlife Sanctuary within the State of Goa.

The Eco-sensitive Zone is bounded on the North by areas of the Villages Gangem, Conquirem and Melauli, on the South and West by the areas of the villages Dharbandora, Piliem and Usgaon, on the East by areas of the Villages Dharbandora and Melauli; the Ragada Nadi, a tributary of Madei River enters into the Eco-sensitive Zone on the East and passes along the Eco-sensitive Zone boundary from East towards North at few places. Distance & direction of Mine Boundary to Boundary of ESZ (km) ~5.5 km in North in the study area.



Source: <https://moef.gov.in/esz-notifications>

FIGURE 6 MAP SHOWING ECO-SENSITIVE ZONE OF BONDLA WLS

2. **BHAGWAN MAHAVIR WLS & NATIONAL PARK:**

Bhagwan Mahavir Wildlife Sanctuary and National Park is spread over an area of 240 Sq km. The Wildlife Sanctuary itself, is spread across an area of 133 sq km while the National Park occupies an area of 107 sq km.

Flora and Fauna

The forest is predominantly semi-evergreen and evergreen type and is abode to a rich diversity of flora and fauna. The notable large mammals are Leopard, Sloth Bear, Gaur and Sambar etc. and and Tigers are reported occasionally in Bhagwan Mahavir WLS & NP, there is no scientific proof that the PA has got any resident population of tigers This sanctuary is also home for rich diversity of birds and butterflies.

BHAGWAN MAHAVIR WILDLIFE SANCTUARY:

Area in sq. km: 133

Location (Taluka): Sanguem, Dharbandora

Bhagwan Mahavir Sanctuary is a 133 sq km protected natural habitat located in the Western Ghats of India, on the Goa-Karnataka border. Touted to be Goa's largest wildlife reserve, it is home to the famous Dudhsagar Falls, Mollem National Park, Tambdi Surla Temple and Devil's Canyon among other attractions. It houses a variety of plants, birds and animals.

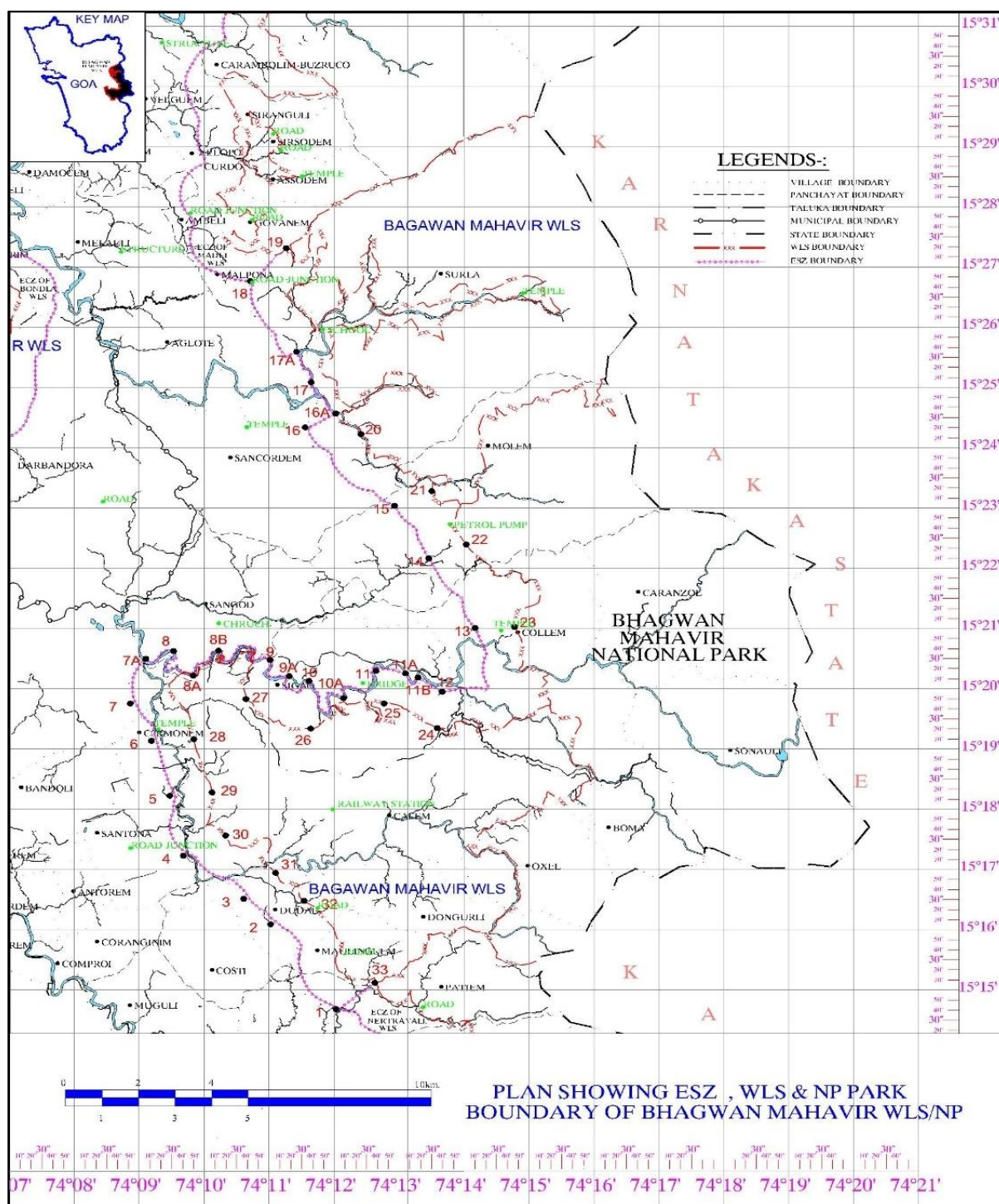
The forest of these Protected Areas intercepts rainfall and helps recharge ground water aquifer and protects rivers and streams against siltation by minimising soil erosion and has a well-knit network of streams spreading throughout which are perennial or semi perennial or seasonal in nature, feeding Zuvari river, Mandovi river and its canals.

8) **ESZ OF BHAGWAN MAHAVIR WLS:**

Conserve and protect the area around the Bhagwan Mahaveer Wildlife Sanctuary and National Park as Eco-sensitive Zone from ecological and environmental.

The extent of Eco-sensitive Zone shall be 1 km of land or the water body whichever is nearer to the boundary of the Bhagwan Mahaveer Wildlife Sanctuary in the State of Goa.

The Eco-sensitive Zone is bounded on the North by the boundary of Madei Wildlife Sanctuary, on the South by the boundary of Netravali Wildlife Sanctuary, on the East by the boundary of Bhagwan Mahaveer Wildlife Sanctuary and National Park and on the West by areas of the villages of Dharbandora Taluka, Sattari Taluka and Sanguem Taluka; the Dudhsagar river, originating from the Bhagwan Mahaveer National Park passes through the Eco-sensitive Zone towards West along the Eco-sensitive Zone boundary and Bhagwan Mahavir Sanctuary boundary. Distance & direction of Mine Boundary to Boundary of ESZ (km) ~ 0.52 km in SE in the study area.



Source: <https://moef.gov.in/esz-notifications>

FIGURE 7 MAP SHOWING ECO-SENSITIVE ZONE OF BHAGWAN MAHAVEER WLS

5.0 METHODOLOGY FOR BIOLOGICAL STUDY: -

5.1 OBJECTIVES OF THE STUDY:

The primary objective of the current study is to conduct an observation, documentation and evaluation of the environmental impact within a 10 km radius study area of the mine Site. The survey conducted also focuses on describing the terrestrial and aquatic flora and fauna, with particular emphasis on identifying and studying Rare, Endangered and Threatened species in the study area.

The present study was undertaken with the following objectives:

- To Carry out Primary field survey of flora and fauna and ecologically sensitive natural habitats in the study area.
- To understand of forest composition and block in the study area
- To understand the spectrum of domesticated and wild biodiversity of the study area.
- To study the likely impacts of the proposed project on the local biodiversity and to suggest mitigation measure, if required, for threatened biota.
- To assess the nature and distribution of vegetation (Terrestrial and Aquatic) in and around the mine area.
- To enumerate Endemic, Rare, Endangered and Threatened (RET Species), separately for core and buffer area, based on primary field surveys and clearly indicating the Schedule of fauna present as per Wildlife Protection Act, 1972 and amendment in Wildlife Protection Act, 2022. In case any Scheduled- I fauna occur in the study area.

Devise management and conservation measures for biodiversity and environmental quality

5.2 BASIC FRAMEWORK FOR DATA COLLECTION:

The ecosystem is highly dynamic, characterized by rich floral and faunal biodiversity, reflected in its diverse species composition and evident stage of ecological succession. An ecosystem can be studied from different angles.

The study was conducted with the involvement of experts and their findings were derived through a well-defined methodology and systematic sampling procedures, ensuring accuracy and reliability in the conclusions presented.

This report is been prepared under the expert guidance of Mr. Akshay Singh (Retd. IFS), NABET-Accredited Expert in Ecology & Biodiversity (EB) and Soil Conservation (SC).

The field team comprises Mr. Vinod Kumar Yadav (M.Sc. Zoology) and other field members (From J.M. EnviroNet Pvt. Ltd.) for ground-truthing.

The sampling methodology adopted for this study is detailed in the following section. An ecological survey of the study area for understanding the fauna of the study area was conducted particularly with reference to listing of species and assessment of the existing baseline ecological conditions in the study area in following manner.

- Random Sampling Method
- Direct Count Method

- Road Side Count Method
- Call Count Method
- Quadrat Method
- Interviewing local Village

QUADRAT METHOD:

A quadrat is a frame that is laid down to mark out a specific area of the community to be sampled. Within the quadrat frame, the occurrence of plants is recorded using an appropriate measure of abundance.

The quadrat method can be used in virtually any vegetation type to quantify the plant community. When sampling vegetation using quadrats, different measures of abundance can be quantified to assess the influence or “importance” of each species in that quadrat. For example:

Counts – a simple tally of the number of individuals of a species.

Cover – the percent (%) area of the quadrat occupied by a plant species.

Density – estimated by quantifying the number of individuals of a species per unit area.

Frequency – the proportion of quadrats sampled in which the species is represented.

Quadrat size and shape:

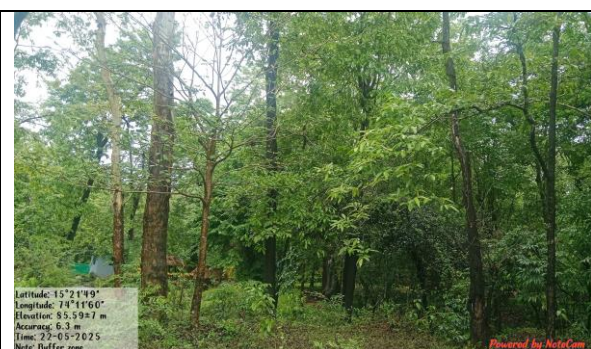
Vegetation Type	Dimensions	Area (M ²)
Tree	10 x 10	100
Shrub & Herb	5 x 5	25
Grass	1 x 1	1

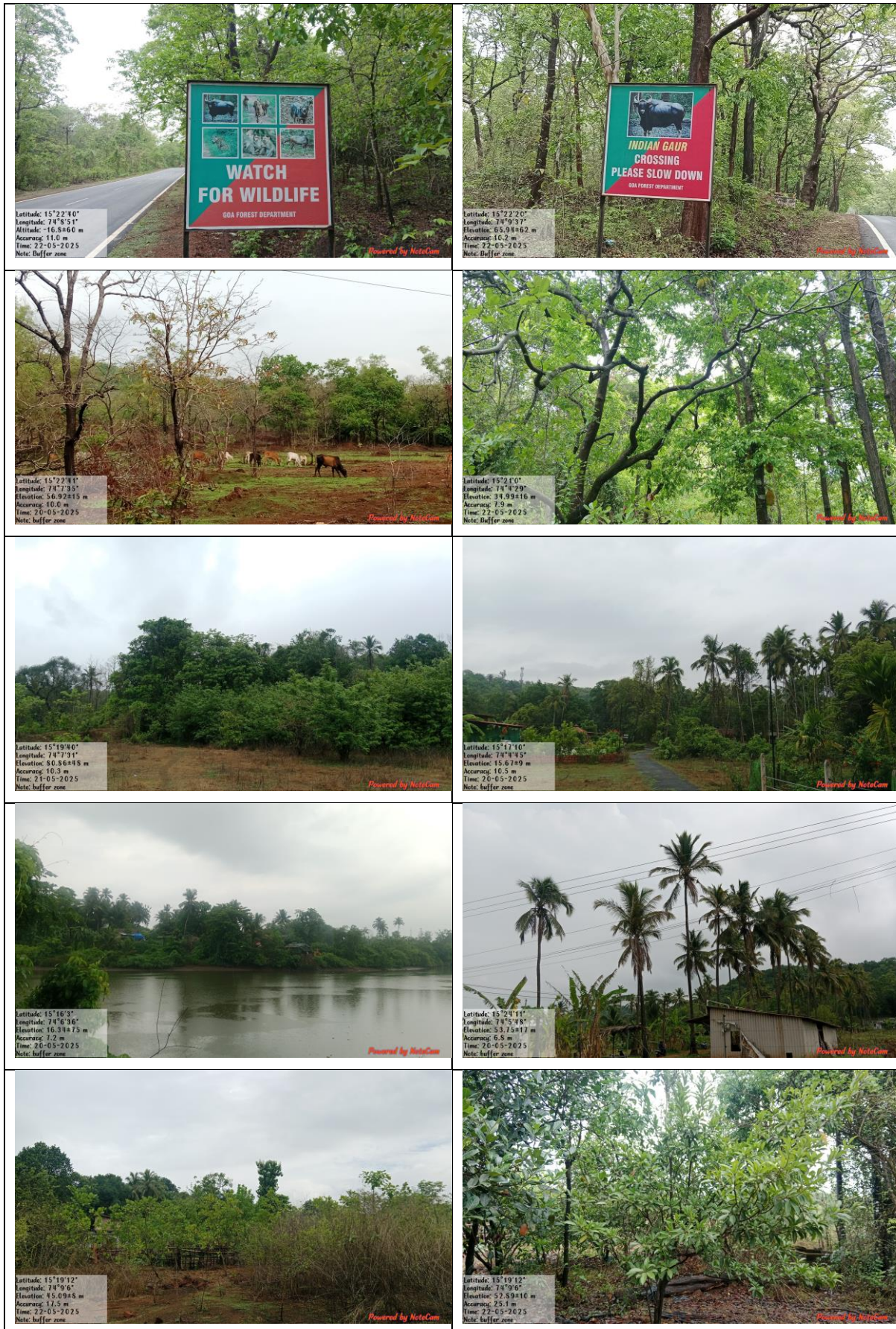
PHOTOGRAPHS OF SURVEY LOCATIONS





Quadrat sampling





S. NO.	LATITUDE	LONGITUDE
Decimal Degrees		
1	15.342176°	74.133402°
2	15.349992°	74.135337°
3	15.338693°	74.131399°
4	15.337160°	74.139400°
5	15.347345°	74.124105°
6	15.344218°	74.139217°
7	15.352900°	74.134245°
Degrees, Minutes, Seconds		
8	15°21'39.00"N	74° 6'3.00"E
9	15°21'49.00"N	74°12'0.00"E
10	15°23'43.00"N	74° 7'2.00"E
11	15°21'31.00"N	74° 9'58.00"E
12	15°22'40.00"N	74° 8'51.00"E
13	15°22'20.00"N	74° 9'37.00"E
14	15°22'41.00"N	74° 7'35.00"E
15	15°21'0.00"N	74° 4'29.00"E
16	15°19'40.00"N	74° 7'31.00"E
17	15°17'10.00"N	74° 4'45.00"E
18	15°16'3.00"N	74° 6'36.00"E
19	15°24'11.00"N	74° 5'48.00"E
20	15°19'12.00"N	74° 9'6.00"E

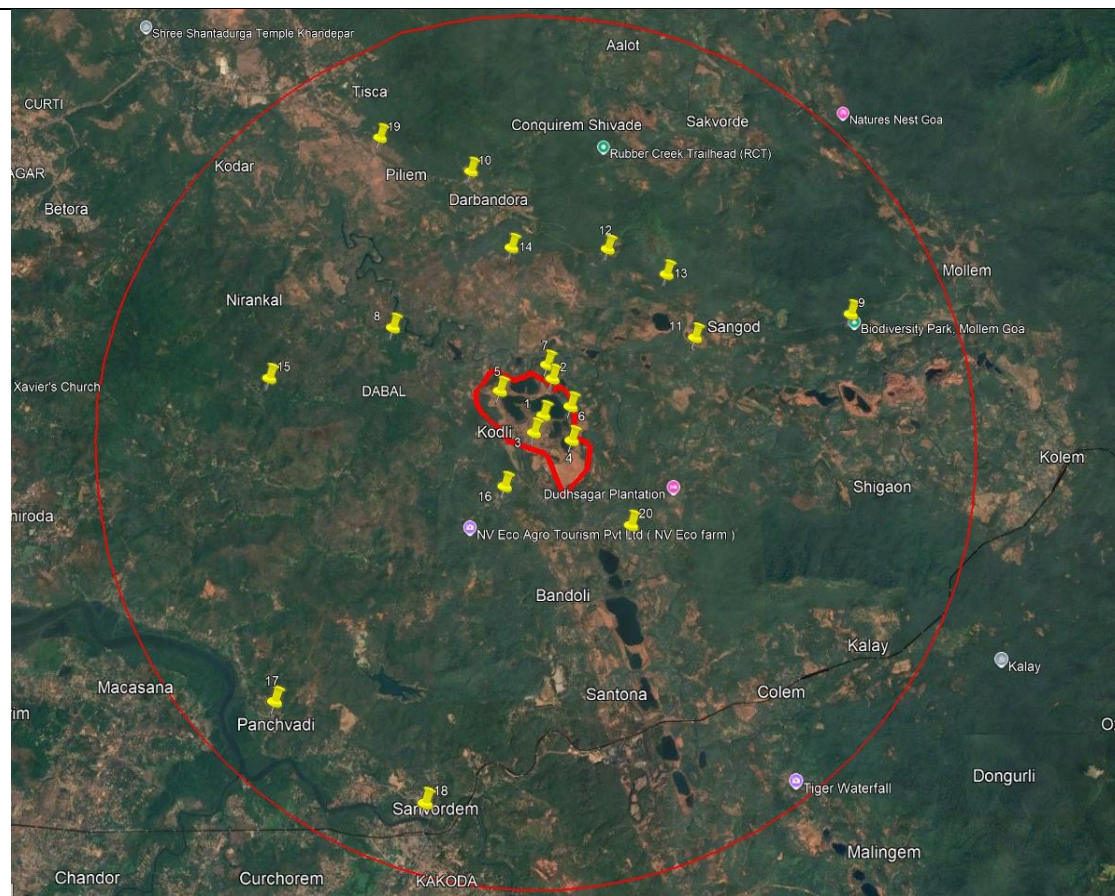


FIGURE 8 MAP SHOWING SURVEY LOCATIONS

Biodiversity Analysis using index: Species diversity will be calculated by using Shannon and Wiener (1963) formula as follows:

$$H = - \sum_{i=1}^S p_i \ln p_i$$

Where:

- H = Shannon-Wiener Diversity Index
- S = Total no. of species in the community (species richness)
- p_i = Proportion of individuals belonging to species i relative to the total number of individuals in the community.
 $p_i = n_i / N$
 n_i = No. of individuals of species i
N = Total number of individuals of all species
- ln = Natural logarithm

TABLE 6 SPECIES-WISE SHANNON DIVERSITY INDEX (H)

S.No.	Species	No. of individual (Species Richness) within 10 quadrats	Pi	ln (Pi)	Pi*ln (Pi)
1	<i>Acacia auriculiformis</i>	30	0.17	-1.75	-0.30
2	<i>Anacardium occidentale</i>	25	0.14	-1.93	-0.28
3	<i>Artocarpus heterophyllus</i>	18	0.10	-2.26	-0.24
4	<i>Azadirachta indica</i>	5	0.03	-3.54	-0.10
5	<i>Cocos Sp.</i>	30	0.17	-1.75	-0.30
6	<i>Ficus religiosa</i>	4	0.02	-3.77	-0.09
7	<i>Mangifera indica</i>	15	0.09	-2.45	-0.21
8	<i>Syzygium cumini</i>	10	0.06	-2.85	-0.16
9	<i>Ziziphus mauritiana</i>	16	0.09	-2.38	-0.22
10	Other	20	0.12	-2.16	-0.25
Total					-2.16
Shannon Diversity Index (H)=					2.16

Diversity Level (H):

$$H = - (-2.16)$$

$$H = 2.16$$

The Shannon Index value of 2.16 indicates moderate diversity in study area.

Following formulae was used for calculating the density, abundance and frequency (%) of species.

$$\text{Density of Species} = \frac{\text{Total no. of individuals of the species in all quadrats}}{\text{Total area of all quadrats studied}}$$

$$\% \text{ Frequency of Species} = \frac{\text{No. of quadrants in which the species is present}}{\text{Total No. of quadrats studied}} \times 100$$

$$\text{Abundance of Species} = \frac{\text{Total no. of individuals of the species in all quadrats}}{\text{Total no. of quadrats in which the species is present}}$$

TABLE 7 SPECIES-WISE DENSITY, ABUNDANCE AND FREQUENCY OF FLORA SPECIES

S. No.	Species	No. of individual within 10 quadrats	Quadrats Occurred	Species Density	Species Abundance	Frequency (%)
1	<i>Acacia auriculiformis</i>	30	6	0.03	5	60
2	<i>Anacardium occidentale</i>	25	10	0.025	2.5	100
3	<i>Artocarpus heterophyllus</i>	18	8	0.018	2.25	80
4	<i>Azadirachta indica</i>	5	5	0.005	1	50
5	<i>Cocos Sp.</i>	30	10	0.03	3	100
6	<i>Ficus religiosa</i>	4	4	0.004	1	40
7	<i>Mangifera indica</i>	15	7	0.015	1.5	70
8	<i>Syzygium cumini</i>	10	8	0.01	1	80
9	<i>Ziziphus mauritiana</i>	16	8	0.016	1.6	80
10	Other	20	10	0.02	2	100

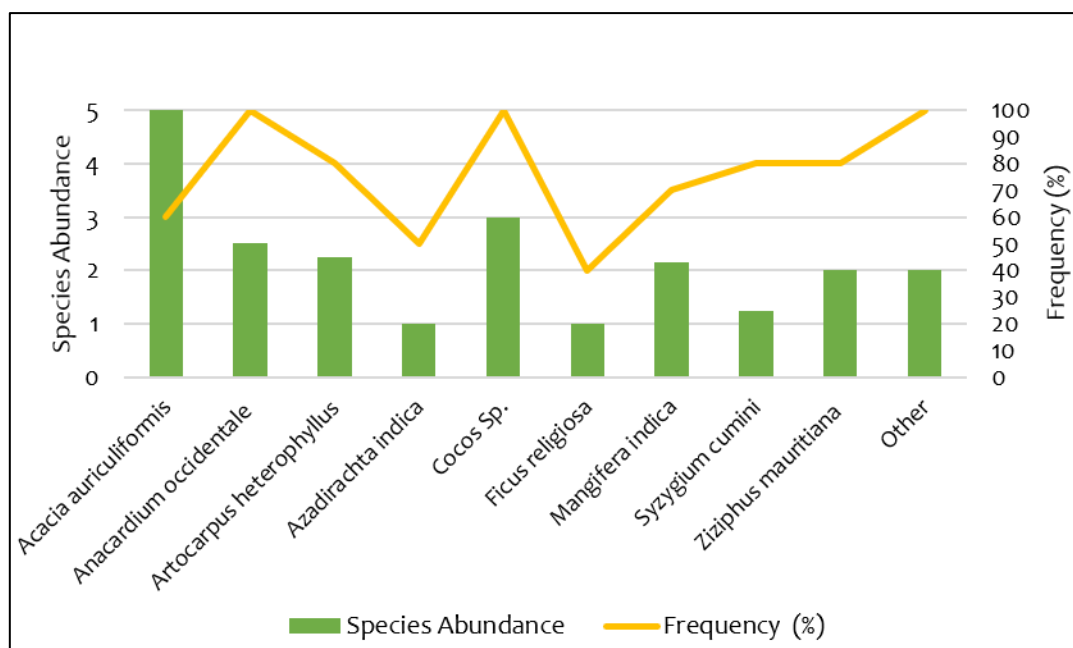


FIGURE 9 GRAPH SHOWING OF SPECIES ABUNDANCE AND FREQUENCY (%)

6.0 BIODIVERSITY IN THE STUDY AREA: -

6.1 AQUATIC BIODIVERSITY:

Primarily several water bodies like streams, ponds and small seasonal rivers and seasonal water bodies are present within 10 km radius of the study area of Codli iron ore mine (South Goa). These water bodies support a variety of aquatic Species. Notable water sources include tributaries of the Zuvari River, Khandepar River Adjacent in North and local nallahs, which serve as habitats for indigenous fish species such as (*Aplocheilus lineatus*) Striped panchax, (*Puntius filamentosus*) Black spot barb and (*Rasbora labiosa*) Slender rasbora. Aquatic invertebrates like freshwater prawns, crabs and aquatic insects indicate a moderately healthy ecosystem. Amphibians such as the *Hoplobatrachus tigerinus*, *Duttaphrynus melanostictus*, *Euphlyctis cyanophlyctis* etc. Aquatic vegetation includes floating

macrophytes (*Pistia stratiotes*, *Lemna minor*) and plants (*Cyperus spp.* etc.). However, mining activities, sediment runoff may be impact water quality, leading to habitat degradation. Regular monitoring and habitat conservation efforts are essential to protect the aquatic diversity.

6.2 FLORAL DIVERSITY:

The study area exhibits a rich diversity of flora, including Trees, Shrubs, Herbs, Grasses and Climber. The presence of various tree species from families like Fabaceae, Anacardiaceae, Moraceae, Meliaceae and others contributes to the ecological complexity.

Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026) there are 114 floral species were recorded within the 10 km radius study area. These include 75 Tree species, 15 Shrub species, 16 Herb species, 6 Grass species and 2 Climber species.

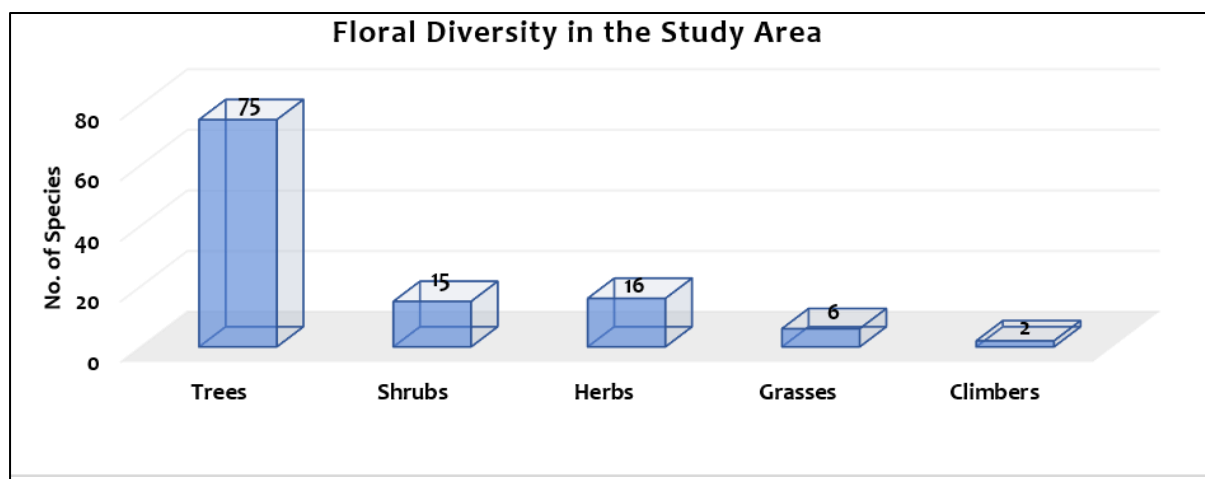


FIGURE 10 GRAPH SHOWING THE FLORAL DIVERSITY IN STUDY AREA

STATUS OF RET FLORAL SPECIES:

During the field Surveys, no rare species were recorded. However, presence of 06 species under threatened categories were found 02 Endangered species- *Cinnamomum zeylanicum* (Tikhi), *Tectona grandis* (Teak) and 04 Vulnerable species- *Dalbergia latifolia* (Sisham), *Garcinia indica* (Bhiran), *Myristica malabarica* (Kayphal) and *Syzygium caryophyllatum* (Bhedas) were recorded according to the IUCN Conservation Status.

S. No	IUCN Categories	No. of Species
1	Not Evaluated	35
2	Data Deficient	4
3	Least Concern	66
4	Near Threatened	3
5	Vulnerable	4
6	Endangered	2

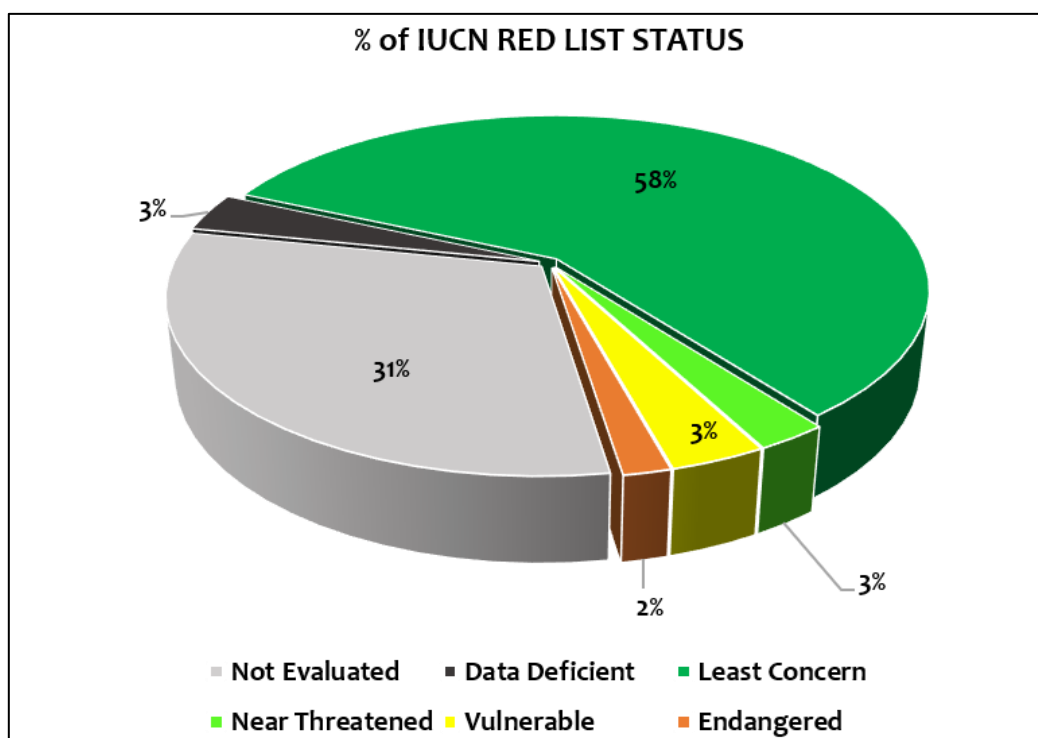


FIGURE 11 CHART SHOWING THE IUCN STATUS OF FLORAL DIVERSITY

TABLE 8 FAMILY-WISE RELATIVE DIVERSITY INDEX (RDI) OF FLORAL SPECIES

Trees				Shrubs				Herbs				Grasses & Climbers				
S. No.	Family	No. of Species	Rdi (%)	S. No.	Family	No. of Species	Rdi (%)	S. No.	Family	No. of Species	Rdi (%)	S. No.		Family	No. of Species	Rdi (%)
1	Anacardiaceae	6	8.00	1	Acanthaceae	1	6.67	1	Amaranthaceae	2	12.50	1	Grasses	Poaceae	1	12.50
2	Annonaceae	1	1.33	2	Annonaceae	1	6.67	2	Apiaceae	1	6.25	2	Climbers	Piperaceae	6	75.00
3	Apocynaceae	2	2.67	3	Apocynaceae	2	13.33	3	Apocynaceae	1	6.25	3		Araceae	1	12.50
4	Arecaceae	4	5.33	4	Araceae	1	6.67	4	Asteraceae	2	12.50					
5	Calophyllaceae	1	1.33	5	Asclepiadaceae	1	6.67	5	Bromeliaceae	1	6.25					
6	Clusiaceae	2	2.67	6	Campanulaceae	1	6.67	6	Gentianaceae	1	6.25					
7	Combretaceae	5	6.67	7	Fabaceae	2	13.33	7	Lamiaceae	4	25.00					
8	Dilleniaceae	1	1.33	8	Lamiaceae	1	6.67	8	Liliaceae	1	6.25					
9	Ebenaceae	1	1.33	9	Malvaceae	1	6.67	9	Malvaceae	1	6.25					
10	Euphorbiaceae	1	1.33	10	Rhamnaceae	1	6.67	10	Nyctaginaceae	1	6.25					
11	Fabaceae	14	18.67	11	Rubiaceae	1	6.67	11	Smilacaceae	1	6.25					
12	Lamiaceae	4	5.33	12	Verbenaceae	2	13.33									
13	Lauraceae	1	1.33													
14	Lecythidaceae	1	1.33													
15	Lythraceae	2	2.67													
16	Malvaceae	7	9.33													
17	Meliaceae	2	2.67													
18	Moraceae	5	6.67													
19	Myristicaceae	2	2.67													
20	Myrtaceae	2	2.67													
21	Phyllanthaceae	1	1.33													
22	Rhizophoraceae	1	1.33													
23	Rubiaceae	2	2.67													
24	Rutaceae	2	2.67													
25	Salicaceae	2	2.67													
26	Sapindaceae	1	1.33													
27	Sapotaceae	1	1.33													
28	Ulmaceae	1	1.33													

RELATIVE DIVERSITY INDEX (RDI) FORMULA:

$$RDI (\%) = (\text{No. of species in a family} / \text{Total No. of species recorded}) \times 100$$

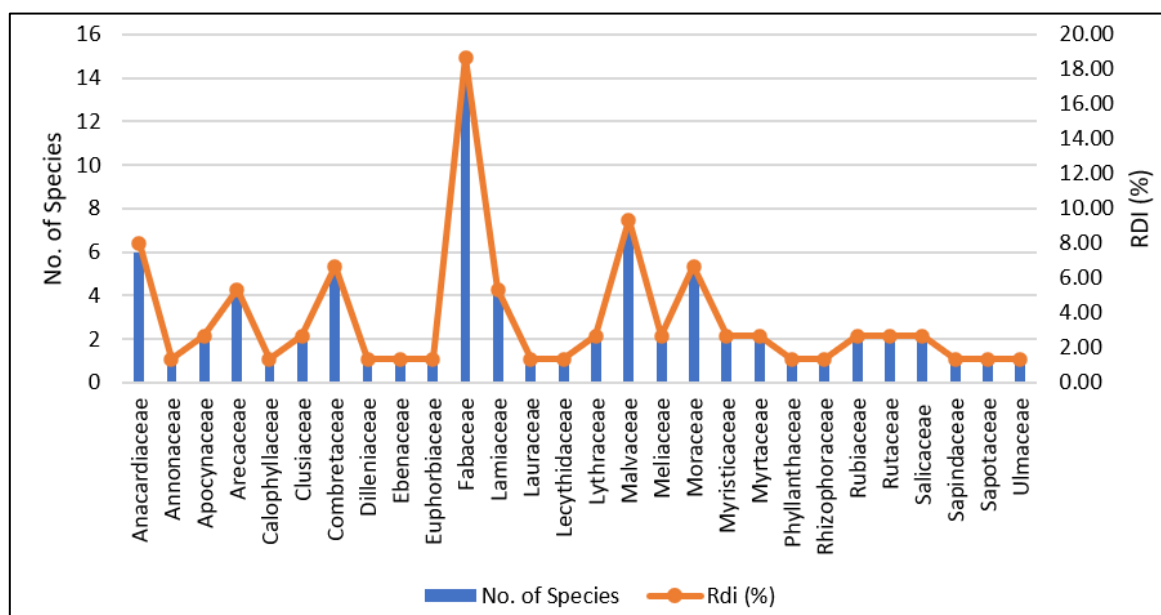


FIGURE 12 GRAPH SHOWING TREES RDI (%)

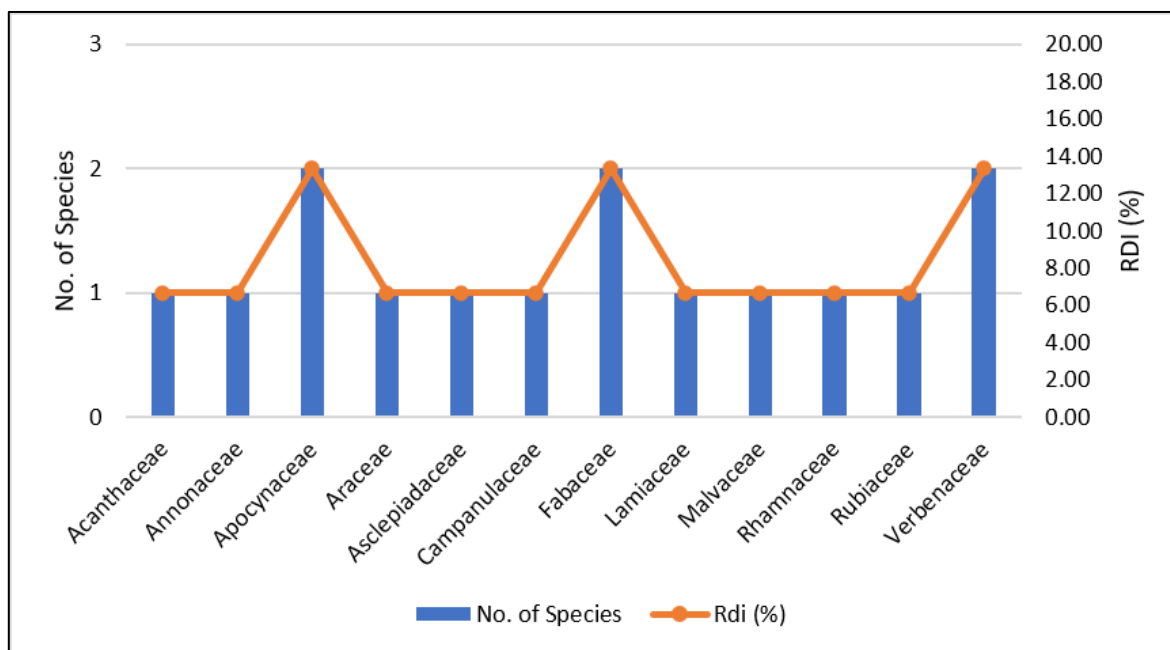


FIGURE 13 GRAPH SHOWING SHRUBS RDI (%)

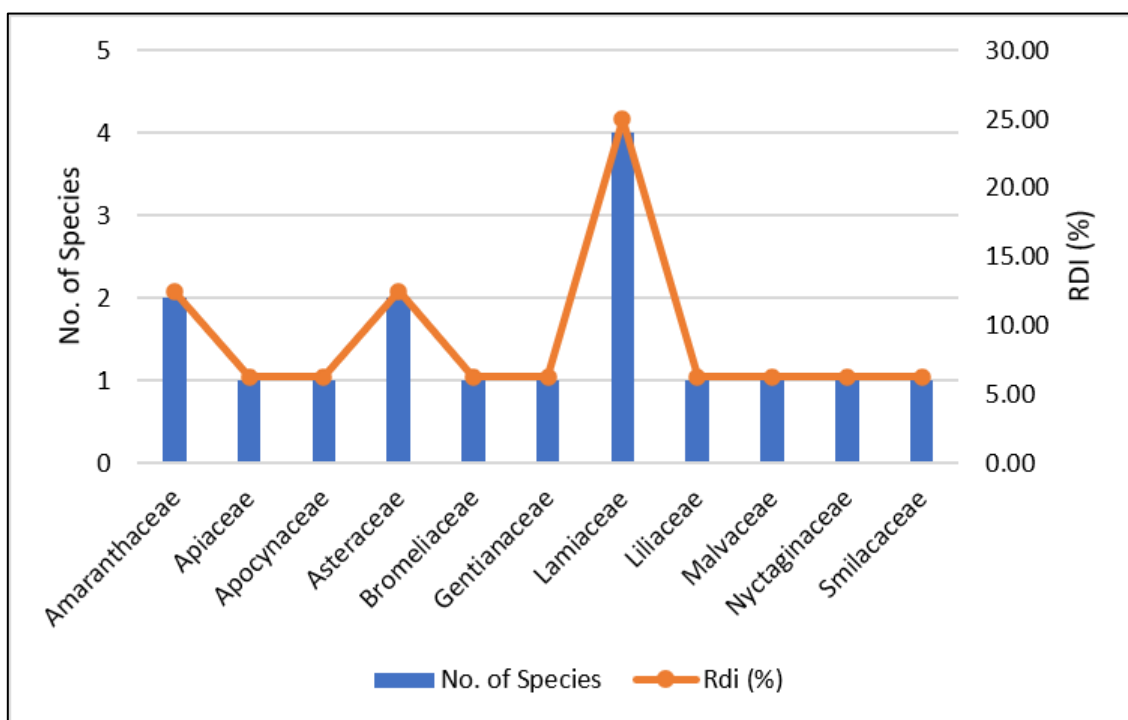


FIGURE 14 GRAPH SHOWING HERBS RDI (%)

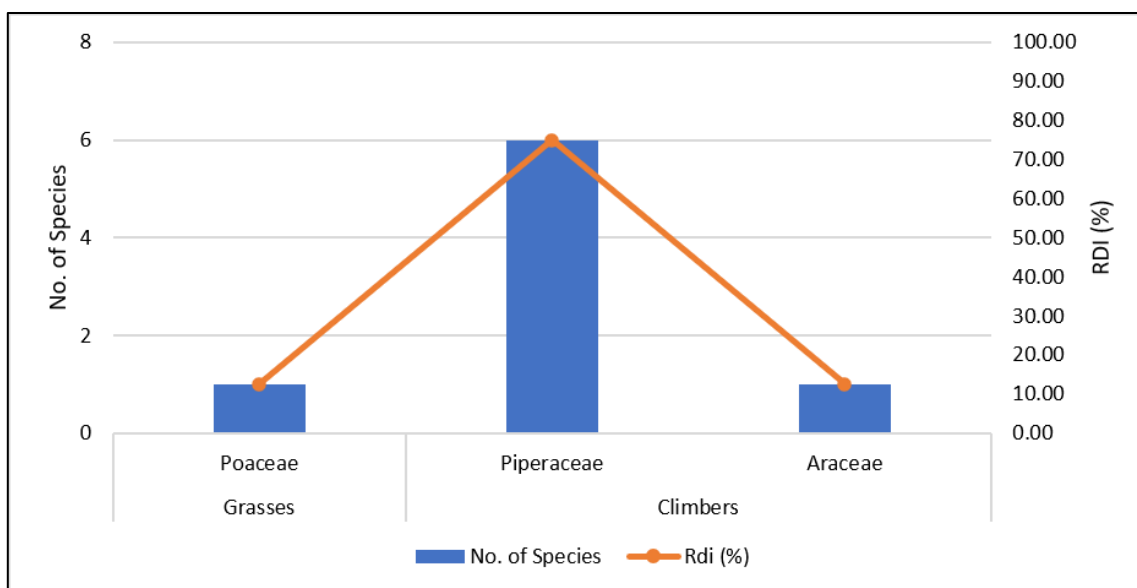


FIGURE 15 GRAPH SHOWING GRASSES & CLIMBERS RDI (%)

TABLE 9 INVENTORY OF FLORAL DIVERSITY IN THE CORE & BUFFER ZONE OF PROJECT SITE

S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
Trees						
1	<i>Areca catechu</i>	Betel Nut	Arecaceae	-	+	LC
2	<i>Acacia catechu</i>	khair	Fabaceae	-	+	LC
3	<i>Acacia auriculiformis</i>	Earleaf acacia	Fabaceae	+	+	LC
4	<i>Aegle marmelos</i>	Bel	Rutaceae	-	+	NT
5	<i>Albizia odoratissima</i>	Kaloshiras	Fabaceae	+	+	LC
6	<i>Alstonia scholaris</i>	Satvan/Satan tree	Apocynaceae	+	+	LC
7	<i>Adina cordifolia</i>	Hedu	Rubiaceae	-	+	LC
8	<i>Anacardium occidentale</i>	Kaju	Anacardiaceae	+	+	LC
9	<i>Annona reticulata</i>	Custard Apple	Annonaceae	-	+	LC
10	<i>Artocarpus heterophyllus</i>	Jakfruit	Moraceae	+	+	NE
11	<i>Azadirachta indica</i>	Neem	Meliaceae	+	+	LC
12	<i>Bauhinia racemosa</i>	Apto	Fabaceae	+	+	LC
13	<i>Bombax ceiba</i>	Savar	Malvaceae	-	+	LC
14	<i>Bridelia retusa</i>	Khatem Asan	Phyllanthaceae	+	+	LC
15	<i>Buchanania lanzan</i>	Chara	Anacardiaceae	-	+	LC
16	<i>Butea monosperma</i>	Palash	Fabaceae	-	+	LC
17	<i>Callicarpa tomentosa</i>	Phalyo	Lamiaceae	-	+	LC
18	<i>Calophyllum inophyllum</i>	Undi	Calophyllaceae	-	+	LC
19	<i>Carallia brachiata</i>	Panshi, Makad bhiran	Rhizophoraceae	-	+	LC
20	<i>Careya arborea</i>	Kumbyo	Lecythidaceae	+	+	LC
21	<i>Caryota urens</i>	Birlo mad	Arecaceae	-	+	LC
22	<i>Cassia fistula</i>	Bayo, Amaltas	Fabaceae	-	+	LC
23	<i>Ceiba pentandra</i>	Savar	Malvaceae	+	+	LC
24	<i>Cinnamomum zeylanicum</i>	Tikhi	Lauraceae	+	+	EN
25	<i>Cocos Sp.</i>	Coconut	Arecaceae	+	+	NE
26	<i>Corypha umbraculifera</i>	Karetel	Arecaceae	-	+	DD
27	<i>Dalbergia latifolia</i>	Sisham	Fabaceae	-	+	VU
28	<i>Dalbergia paniculata</i>	Kuri	Fabaceae	-	+	NE
29	<i>Delonix regia</i>	Gulmohar	Fabaceae	+	+	LC
30	<i>Derris scandens</i>	Kanranj	Fabaceae	+	+	LC
31	<i>Dillenia pentagyna</i>	Karmal	Dilleniaceae	-	+	NE
32	<i>Diospyros montana</i>	Goiunda, Govimelu	Ebenaceae	-	+	NE
33	<i>Ficus bengalensis</i>	Vad	Moraceae	-	+	NE
34	<i>Ficus glomerata</i>	Rumad	Moraceae	-	+	LC
35	<i>Ficus hispida</i>	Kalaumbar	Moraceae	-	+	LC
36	<i>Ficus religiosa</i>	Pipal	Moraceae	+	+	LC
37	<i>Flacourtia jangomas</i>	Jangli Jagam	Salicaceae	-	+	NE
38	<i>Flacourtia montana</i>	Chafra	Salicaceae	-	+	NT
39	<i>Garcinia gummigutta</i>	Dhar ambo	Clusiaceae	-	+	LC
40	<i>Garcinia indica</i>	Bhiran	Clusiaceae	-	+	VU

S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
41	<i>Gmelina arborea</i>	Shivan	Lamiaceae	-	+	LC
42	<i>Grewia tiliifolia</i>	Dhaman	Malvaceae	+	+	LC
43	<i>Helicteres isora</i>	Kivan	Malvaceae	-	+	LC
44	<i>Holarrhena antidysenterica</i>	Kudo	Apocynaceae	+	+	LC
45	<i>Holoptelea integrifolia</i>	Vamolo	Ulmaceae	-	+	LC
46	<i>Lagerstroemia lanceolata</i>	Nano	Lythraceae	+	+	LC
47	<i>Lagerstroemia parviflora</i>	Taman	Lythraceae	-	+	LC
48	<i>Lannea coromandelica</i>	Moi	Anacardiaceae	-	+	LC
49	<i>Mallotus philippensis</i>	Bems, Sendri	Euphorbiaceae	-	+	LC
50	<i>Mangifera indica</i>	Aam	Anacardiaceae	+	+	DD
51	<i>Manilkara hexandra</i>	Kirni	Sapotaceae	-	+	LC
52	<i>Melia azedarach</i>	Firnage nimb	Meliaceae	-	+	LC
53	<i>Mitragyna parvifolia</i>	Kalamb	Rubiaceae	-	+	LC
54	<i>Myristica fragrans</i>	Jayphal	Myristicaceae	-	+	DD
55	<i>Myristica malabarica</i>	Kayphal	Myristicaceae	-	+	VU
56	<i>Pterocarpus marsupium</i>	Asan	Fabaceae	+	+	NT
57	<i>Saraca indica</i>	Ashoka	Fabaceae	+	+	LC
58	<i>Schleichera oleosa</i>	Kasamb	Sapindaceae	-	+	LC
59	<i>Semecarpus anacardium</i>	Biboi	Anacardiaceae	-	+	LC
60	<i>Spondias mangifera</i>	Ambado	Anacardiaceae	-	+	LC
61	<i>Sterculia guttata</i>	Kulinder	Malvaceae	-	+	LC
62	<i>Sterculia urens</i>	Dhavoruk, Pandruk	Malvaceae	-	+	LC
63	<i>Sterculia villosa</i>	Aployno suplo	Malvaceae	-	+	LC
64	<i>Syzygium caryophyllatum</i>	Bhedas	Myrtaceae	-	+	VU
65	<i>Syzygium cumini</i>	Jamun	Myrtaceae	+	+	LC
66	<i>Tamarindus indica</i>	Chinch, Imli	Fabaceae	-	+	LC
67	<i>Tectona grandis</i>	Saylo, Teak	Lamiaceae	-	+	EN
68	<i>Terminalia arjuna</i>	Arjun	Combretaceae	+	+	LC
69	<i>Terminalia bellirica</i>	Goting	Combretaceae	+	+	LC
70	<i>Terminalia paniculata</i>	Kindal	Combretaceae	-	+	LC
71	<i>Terminalia chebula</i>	Hirda	Combretaceae	-	+	LC
72	<i>Terminalia tomentosa (crenulata)</i>	Marat (Matti)	Combretaceae	-	+	NE
73	<i>Vitex altissima</i>	Bavalgi	Lamiaceae	-	+	LC
74	<i>Xylia xylocarpa</i>	Zambo	Fabaceae	+	+	LC
75	<i>Zanthoxylum rhetsa</i>	Tirphal	Rutaceae	-	+	LC
Shrubs						
1	<i>Adhatoda vasica</i>	Aduso	Acanthaceae	-	+	NE
2	<i>Annona muricata</i>	Soursop	Annonaceae	-	+	LC
3	<i>Calotropis gigantea</i>	Rui/ Aak	Asclepiadaceae	+	+	NE
4	<i>Carissa carandas</i>	Karvanda, Kanda	Apocynaceae	-	+	DD
5	<i>Cassia tora</i>	Taykhilo	Fabaceae	+	+	NE
6	<i>Clerodendrum indicum</i>	Bharmgi	Verbenaceae	-	+	LC

S. No.	Scientific Name	Common Name	Family	Core Zone	Buffer Zone	IUCN Status
7	<i>Hemidesmus indicus</i>	Dudhshiri	Apocynaceae	-	+	NE
8	<i>Ixora brachiata</i>	Gurani tree	Rubiaceae	+	+	LC
9	<i>Lobelia nicotianaefolia</i>	Baknal	Campanulaceae	-	+	NE
10	<i>Lantana camara</i>	Tick berry	Verbenaceae	+	+	NE
11	<i>Microcos paniculata</i>	Asale, Chivara	Malvaceae	-	+	LC
12	<i>Moullava spicata</i>	Wagati, Vakeri	Fabaceae	-	+	NE
13	<i>Pothos scandens</i>	Bemdarli	Araceae	-	+	NE
14	<i>Vitex negundo</i>	Nimgud	Lamiaceae	-	+	LC
15	<i>Ziziphus mauritiana</i>	Indian jujube	Rhamnaceae	+	+	LC
Herbs						
1	<i>Achyranthes aspera</i>	Aghado	Amaranthaceae	-	+	NE
2	<i>Asparagus racemosus</i>	Shatavari	Liliaceae	-	+	NE
3	<i>Alternanthera sessilis</i>	Kanchari	Amaranthaceae	-	+	LC
4	<i>Ananas comosus</i>	Pineapple	Bromeliaceae	-	+	NE
5	<i>Boerhavia diffusa</i>	Punarnava	Nyctaginaceae	-	+	NE
6	<i>Canscora diffusa</i>	Bhui neem	Gentianaceae	-	+	NE
7	<i>Centella asiatica</i>	Gundhurichi bhaji	Apiaceae	-	+	LC
8	<i>Eclipta alba</i>	Mako	Asteraceae	-	+	LC
9	<i>Mentha arvensis</i>	Ortelamv	Lamiaceae	-	+	LC
10	<i>Ocimum omericum</i>	Ramtulas	Lamiaceae	-	+	NE
11	<i>Ocimum sanctum</i>	Tulas	Lamiaceae	+	+	NE
12	<i>Leucas aspera</i>	Tumbo	Lamiaceae	-	+	NE
13	<i>Rauvolfia serpentina</i>	Atki	Apocynaceae	-	+	LC
14	<i>Smilax zeylanica</i>	Ghot vel or Kaval kamti	Smilacaceae	-	+	NE
15	<i>Sphagneticola trilobata</i>	Wedelia	Asteraceae	+	+	NE
16	<i>Sida cordifolia</i>	Indian country mallow	Malvaceae	+	+	NE
Grasses						
1	<i>Bambusa arundinacea</i>	Velu/bambo	Poaceae	-	+	NE
2	<i>Themeda cymbaria</i>	Karad	Poaceae	+	+	NE
3	<i>Themeda triandra</i>	Karad	Poaceae	-	+	NE
4	<i>Cynodon dactylon</i>	Haryali, Dub	Poaceae	-	+	NE
5	<i>Dendrocalamus strictus</i>	Velu/bambo	Poaceae	+	+	NE
6	<i>Saccharum officinarum</i>	Sugarcane	Poaceae	-	+	NE
Climbers						
1	<i>Piper nigrum</i>	Black pepper	Piperaceae	-	+	NE
2	<i>Epipremnum aureum</i>	Money plant	Araceae	-	+	NE

Source: Based on actual sightings and information gathered from forest department & locals.

Abbreviations: LC: Least Concern, NE: Not Evaluated, DD: Data Deficient, VU: Vulnerable, NT: Near Threatened, EN: Endangered.

6.3 FAUNAL DIVERSITY:

Overall, 101 species were recorded within the 10 km radius study area. Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026), these species include 18 of Species Mammals, 60 Species of Birds, 08 Species of Reptiles, 4 Species of Amphibians, 8 Species of Butterflies and 03 Aquatic Species. Also, based on the secondary information including Management Plan of Bhagwan-Mahavir NP & WLS, there are Tiger (*Panthera tigris*), Gaur (*Bos gaurus*) etc. present within the WLS area.

There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur / Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site.

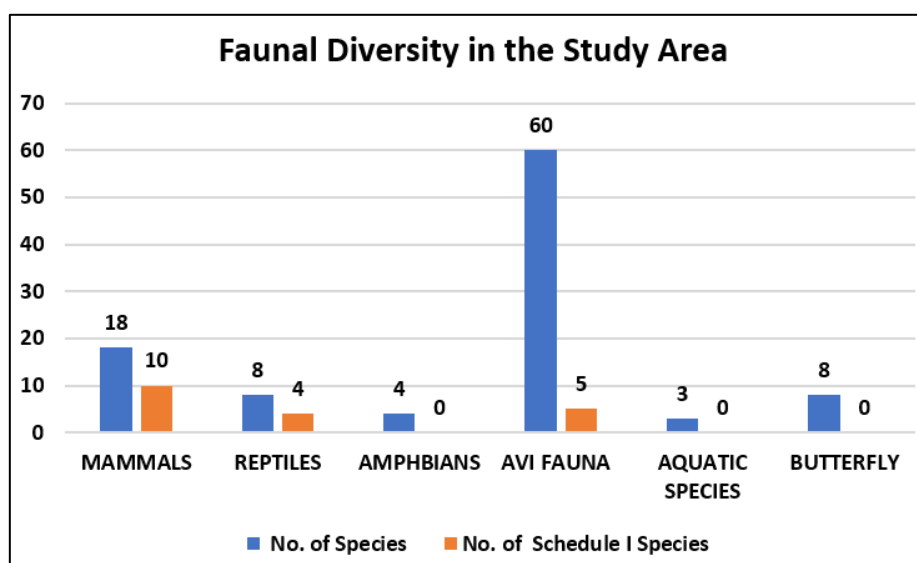


FIGURE 16 GRAPH SHOWING THE FAUNAL DIVERSITY IN STUDY AREA

STATUS OF RET FAUNAL SPECIES:

There are no rare species were recorded. However, presence of 06 species under threatened categories-including 05 Vulnerable- *Bos gaurus* (Gaur / Indian Bison), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Panthera pardus* (Leopard), *Crocodylus palustris* (Marsh crocodile) and 01 Endangered- *Cuon alpinus* (Wild dog /Dhole) were recorded according to the IUCN conservation status.

S.No.	IUCN Categories	No. of Species
1	Not Evaluated	3
2	Least Concern	90
3	Near Threatened	2
4	Vulnerable	5
5	Endangered	1

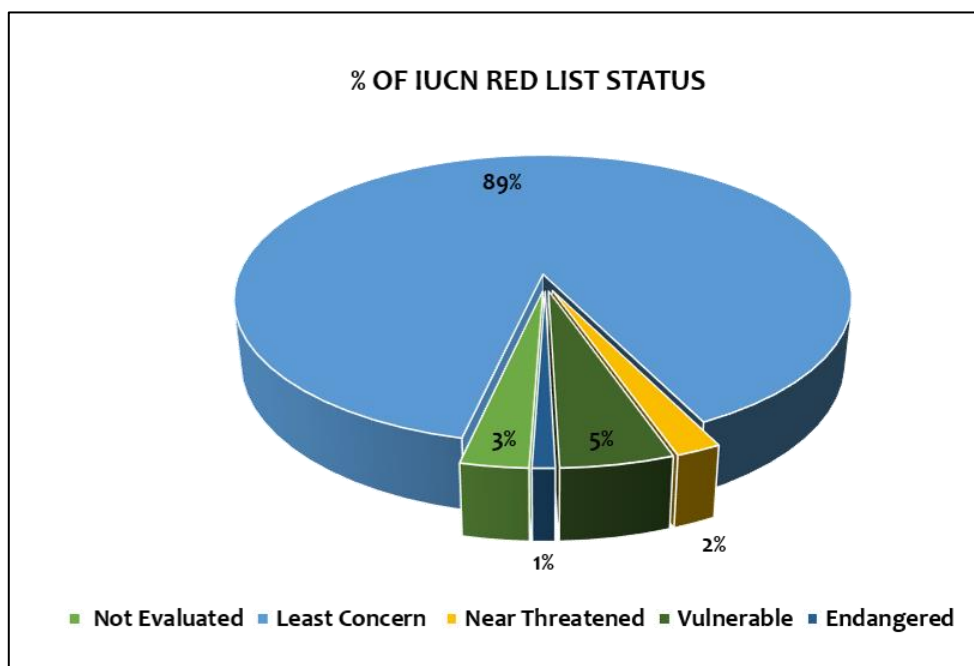


FIGURE 17 CHART SHOWING THE IUCN STATUS OF FAUNAL DIVERSITY

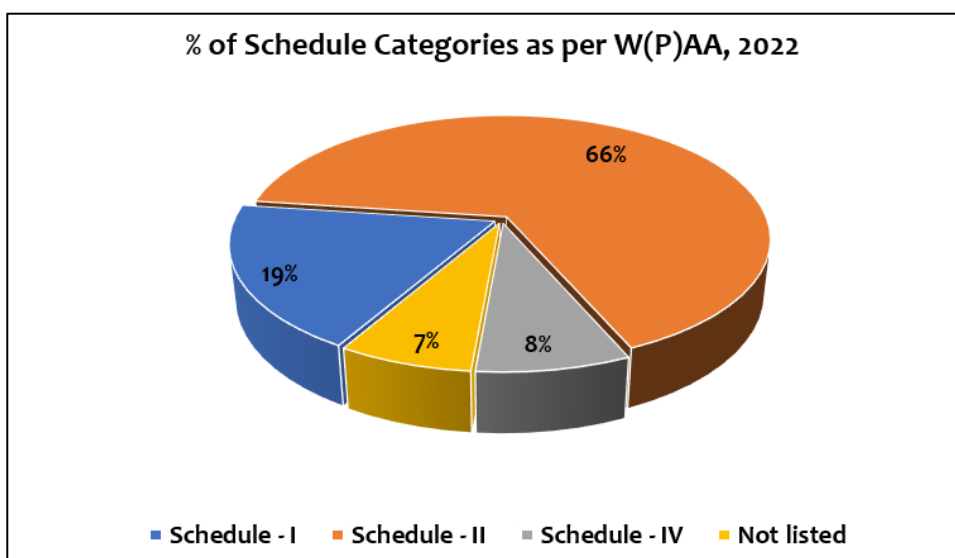


FIGURE 18 CHART SHOWING THE SCHEDULE CATEGORIES OF FAUNAL DIVERSITY



Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).



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TABLE 10 FAMILY-WISE RELATIVE DIVERSITY INDEX (RDI) OF FAUNAL SPECIES

MAMMALS				REPTILES				AMPHIBIANS				AVI FAUNA (BIRDS)				AQUATIC SPECIES				BUTTERFLIES			
S. N.	Family	No. of Species	Rdi (%)	S. N.	Family	No. of Species	Rdi (%)	S. N.	Family	No. of Species	Rdi (%)	S. N.	Family	No. of Species	Rdi (%)	S. N.	Family	No. of Species	Rdi (%)	S. N.	Family	No. of Species	Rdi (%)
1	Bovidae	1	5.56	1	Elapidae	2	25.00	1	Bufonidae	1	25.00	1	Accipitridae	3	5.00	1	Aplocheilidae	1	33.33	1	Pierinae	1	12.50
2	Canidae	2	11.11	2	Agamidae	1	12.50	2	Dicroglossidae	3	75.00	2	Aegithinidae	1	1.67	2	Cyprinidae	1	33.33	2	Nymphalinae	1	12.50
3	Cercopithecidae	1	5.56	3	Gekkonidae	2	25.00					3	Alcedinidae	3	5.00	3	Danionidae	1	33.33	3	Nymphalidae	3	37.50
4	Cervidae	1	5.56	4	Colubridae	1	12.50					4	Apodidae	1	1.67					4	Pieridae	1	12.50
5	Felidae	1	5.56	5	Crocodylidae	1	12.50					5	Ardeidae	2	3.33					5	Papilionidae	2	25.00
6	Herpestidae	1	5.56	6	Varanidae	1	12.50					6	Campephagidae	1	1.67								
7	Hystriidae	1	5.56									7	Charadriidae	3	5.00								
8	Leporidae	1	5.56									8	Cisticolidae	3	5.00								
9	Muridae	2	11.11									9	Columbidae	2	3.33								
10	Pteropodidae	1	5.56									10	Corvidae	3	5.00								
11	Sciuridae	2	11.11									11	Cuculidae	1	1.67								
12	Suidae	1	5.56									12	Dicruridae	3	5.00								
13	Tupaiidae	1	5.56									13	Elanidae	1	1.67								
14	Tragulidae	1	5.56									14	Estrildidae	1	1.67								
15	Ursidae	1	5.56									15	Hirundinidae	1	1.67								
												16	Megalaimidae	1	1.67								
												17	Meropidae	2	3.33								
												18	Muscicapidae	4	6.67								
												19	Nectariniidae	2	3.33								
												20	Oriolidae	2	3.33								
												21	Passeridae	1	1.67								
												22	Phasianidae	3	5.00								
												23	Picidae	1	1.67								
												24	Pittidae	1	1.67								
												25	Ploceidae	1	1.67								
												26	Psittacidae	2	3.33								
												27	Pycnonotidae	2	3.33								
												28	Rallidae	2	3.33								
												29	Scolopacidae	1	1.67								
												30	Sturnidae	2	3.33								
												31	Strigidae	2	3.33								
												32	Threskiornithidae	1	1.67								
												33	Upupidae	1	1.67								

RELATIVE DIVERSITY INDEX (RDI) FORMULA:

$RDI (\%) = (\text{No. of species in a family} / \text{Total No. of species recorded}) \times 100$

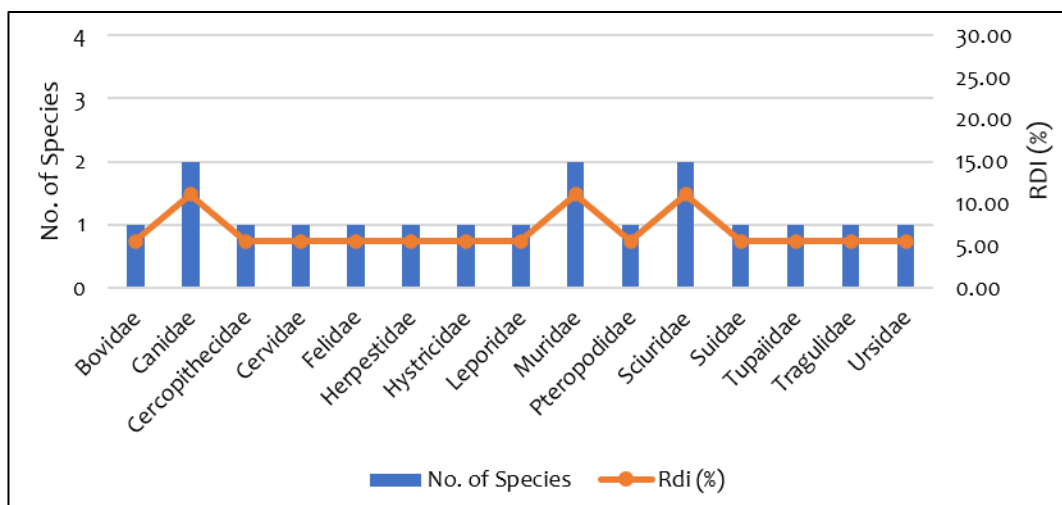


FIGURE 19 GRAPH SHOWING MAMMALS RDI (%)

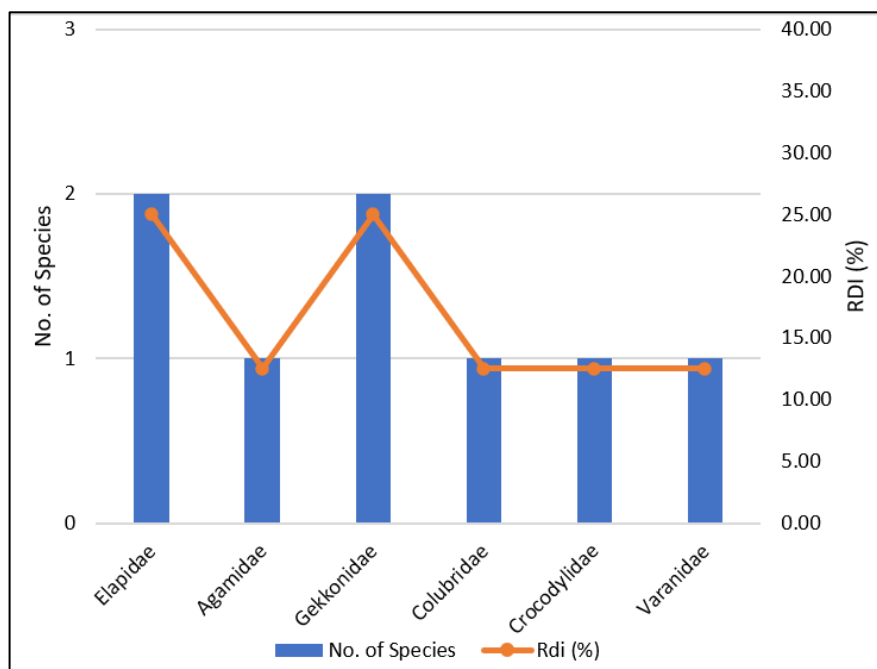


FIGURE 20 GRAPH SHOWING REPTILES RDI (%)

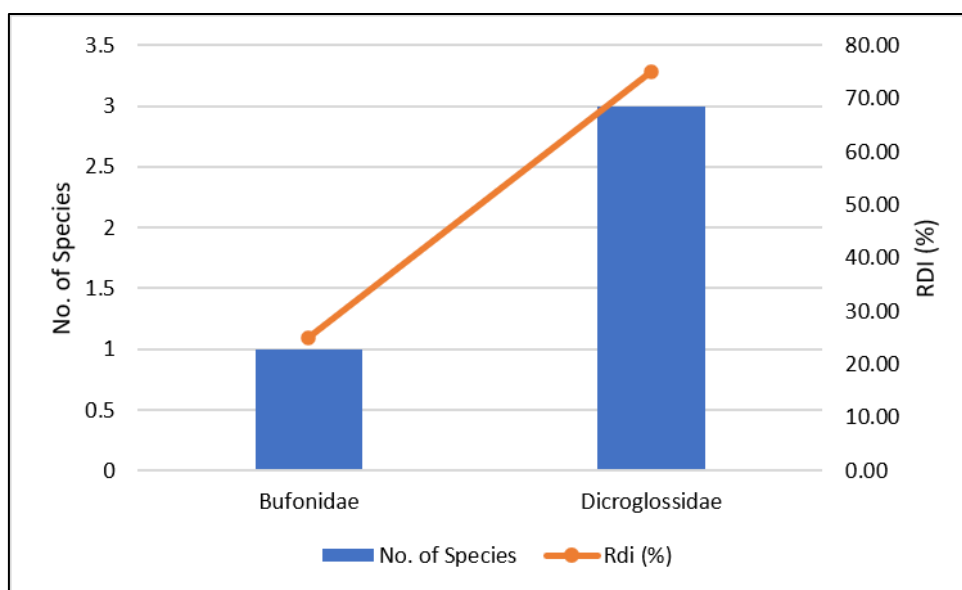


FIGURE 21 GRAPH SHOWING AMPHIBIANS RDI (%)

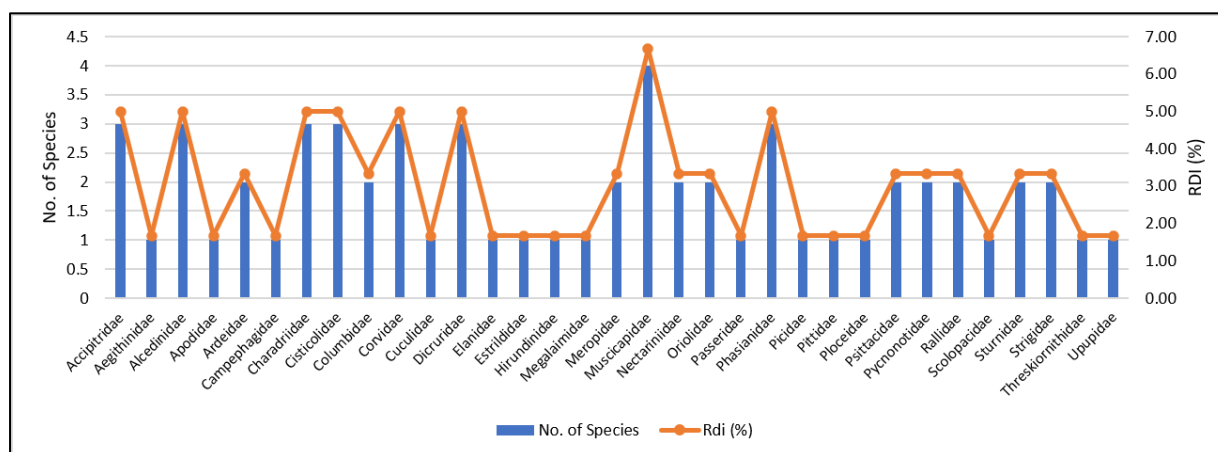


FIGURE 22 GRAPH SHOWING AVI FAUNA (BIRDS) RDI (%)

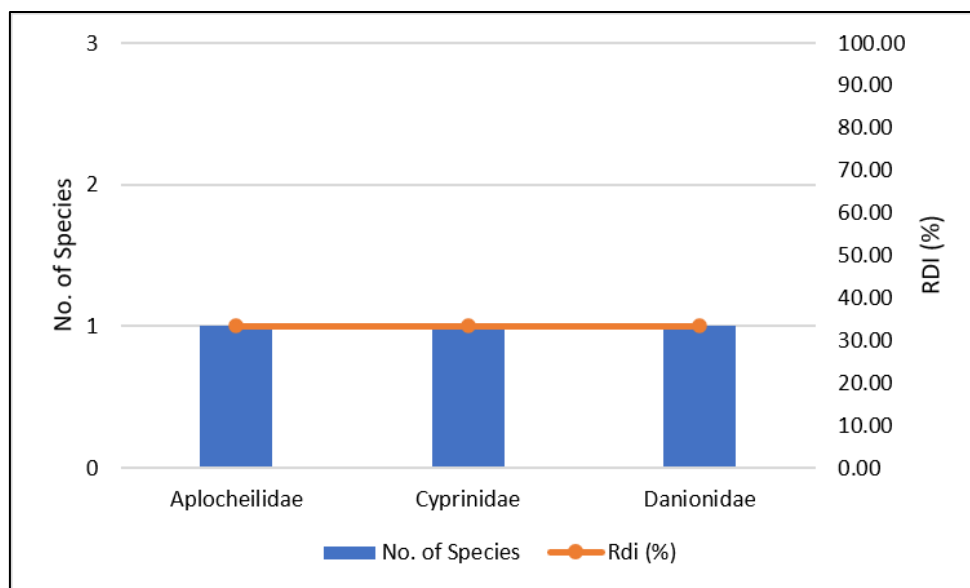


FIGURE 23 GRAPH SHOWING AQUATIC SPECIES RDI (%)

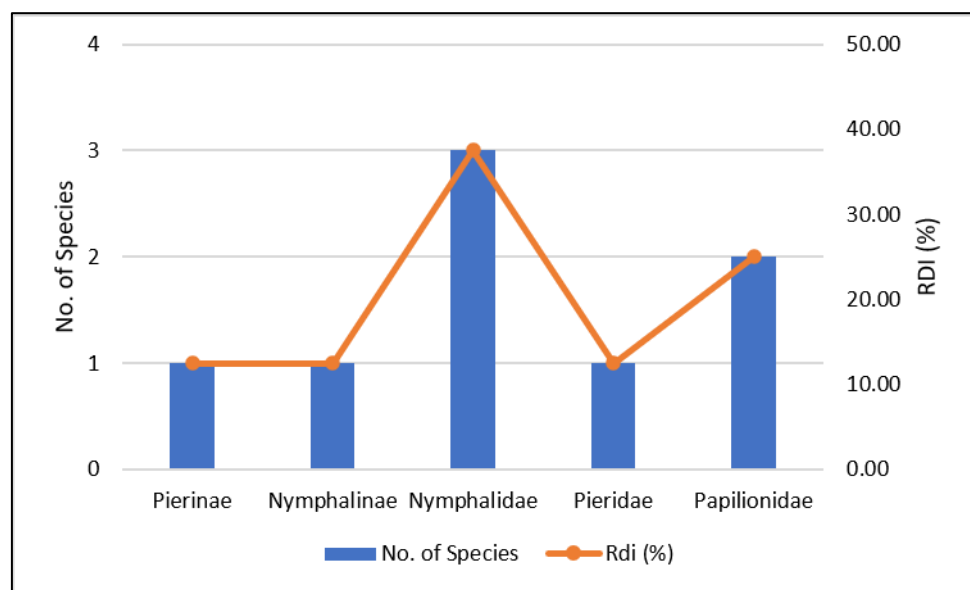


FIGURE 24 GRAPH SHOWING BUTTERFLIES RDI (%)

TABLE 11 INVENTORY OF FAUNAL DIVERSITY IN THE CORE & BUFFER ZONE OF PROJECT SITE

S. N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
MAMMALS							
1	<i>Axis axis</i>	Spotted Deer	Cervidae	+	+	II	LC
2	<i>Funambulus palmarum</i>	Indian palm squirrel	Sciuridae	-	+	IV	LC
3	<i>Lepus nigricollis</i>	Black-naped Hare	Leporidae	+	+	II	LC
4	<i>Pteropus giganteus</i>	Indian Flying fox	Pteropodidae	-	+	II	NT
5	<i>Rattus rattus</i>	Common House Rat	Muridae	+	+	IV	LC
6	<i>Suncus murinus</i>	Grey Musk Shrew	Tupaiidae	+	+	-	LC
7	<i>Sus scrofa</i>	Indian Wild Boar	Suidae	-	+	II	LC
8	<i>Tatera indica</i>	Indian Gerbil	Muridae	-	+	-	LC
REPTILES							
1	<i>Bungarus caeruleus</i>	Indian Krait	Elapidae	-	+	II	LC
2	<i>Calotes versicolor</i>	Indian Garden Lizard	Agamidae	-	+	IV	LC
3	<i>Hemidactylus brooki</i>	Brooki's Gecko	Gekkonidae	-	+	IV	LC
4	<i>Hemidactylus frenatus</i>	Common House Gecko	Gekkonidae	+	+	IV	LC
AMPHBIANS							
1	<i>Duttaphrynus melanostictus</i>	Indian toad	Bufonidae	+	+	IV	LC
2	<i>Euphlyctis cyanophlyctis</i>	Indian skipper frog	Dicroglossidae	-	+	IV	LC
3	<i>Hoplobatrachus tigerinus</i>	Indian bull frog	Dicroglossidae	+	+	II	LC
4	<i>Sphaerotheca breviceps</i>	Indian burrowing frog	Dicroglossidae	-	+	IV	LC
AVI FAUNA							
1	<i>Athene brama</i>	Spotted owlet	Strigidae	-	+	II	LC
2	<i>Acridotheres fuscus</i>	Jungle Myna	Sturnidae	+	+	II	LC
3	<i>Acridotheres tristis</i>	Common Myna	Sturnidae	+	+	II	LC
4	<i>Aegithina tiphia</i>	Common Iora	Aegithinidae	+	+	II	LC
5	<i>Alcedo atthis</i>	Common Kingfisher	Alcedinidae	-	+	II	LC
6	<i>Apus affinis</i>	House Swift	Apodidae	-	+	II	LC
7	<i>Ardeola grayii</i>	Indian Pond Heron	Ardeidae	+	+	II	LC
8	<i>Bubulcus ibis</i>	Cattle Egret	Ardeidae	+	+	II	LC
9	<i>Ceryle rudis</i>	Pied Kingfisher	Alcedinidae	+	+	II	LC

S. N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
10	<i>Charadrius dubius</i>	Little Ringed Plover	Charadriidae	+	+	II	LC
11	<i>Cinnyris asiaticus</i>	Purple Sun Bird	Nectariniidae	+	+	II	LC
12	<i>Clamator jacobinus</i>	Pied Cuckoo	Cuculidae	-	+	II	LC
13	<i>Columba livia</i>	Blue Rock Pigeon	Columbidae	+	+	-	LC
14	<i>Copsychus fulicata</i>	Indian Robin	Muscicapidae	-	+	II	LC
15	<i>Copsychus saularis</i>	Oriental Magpie Robin	Muscicapidae	+	+	II	LC
16	<i>Corvus macrorhynchos</i>	Large-billed Crow	Corvidae	+	+	II	LC
17	<i>Corvus splendens</i>	House Crow	Corvidae	+	+	-	LC
18	<i>Cyornis tickelliae</i>	Tickell's Blue Flycatcher	Muscicapidae	-	+	II	LC
19	<i>Dendrocitta vagabunda</i>	Rufous Treepie	Corvidae	+	+	II	LC
20	<i>Dicrurus Caerulescens</i>	White Bellied Drongo	Dicruridae	-	+	II	LC
21	<i>Dicrurus macrocercus</i>	Black Drongo	Dicruridae	+	+	II	LC
22	<i>Dicrurus paradiseus</i>	Greater Racket-tailed Drongo	Dicruridae	-	+	II	LC
23	<i>Dinopium benghalense</i>	Black-rumped Flameback	Picidae	-	+	II	LC
24	<i>Elanus caeruleus</i>	Black winged kite	Elanidae	-	+	II	LC
25	<i>Fulica atra</i>	Eurasian Coot	Rallidae	-	+	II	LC
26	<i>Gallinula chloropus</i>	Common moorhen	Rallidae	-	+	II	LC
27	<i>Galloperdix spadicea</i>	Red Spurfowl	Phasianidae	-	+	II	LC
28	<i>Halcyon smyrnensis</i>	White-throated Kingfisher	Alcedinidae	+	+	II	LC
29	<i>Hirundo smithii</i>	Wire Tailed Swallow	Hirundinidae	-	+	II	LC
30	<i>Leptocoma minima</i>	Crimson backed Sunbird	Nectariniidae	-	+	II	LC
31	<i>Lonchura punctulata</i>	Scaly-breasted munia	Estrildidae	-	+	II	LC
32	<i>Megalaima haemacephala</i>	Coppersmith Barbet	Megalaimidae	-	+	II	LC
33	<i>Merops orientalis</i>	Green Bee-eater	Meropidae	+	+	II	LC
34	<i>Milvus migrans</i>	Black Kite	Accipitridae	-	+	II	LC
35	<i>Oriolus kundoo</i>	Golden oriole	Oriolidae	-	+	II	LC
36	<i>Oriolus xanthornus</i>	Black Headed Oriole	Oriolidae	-	+	II	LC

S. N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
37	<i>Orthotomus sutorius</i>	common tailorbird	Cisticolidae	-	+	II	LC
38	<i>Passer domesticus</i>	House Sparrow	Passeridae	+	+	II	LC
39	<i>Perdica asiatica</i>	Jungle bush quail	Phasianidae	-	+	II	LC
40	<i>Pericrocotus flammeus</i>	Scarlet Minivet	Campephagidae	-	+	II	LC
41	<i>Pitta brachyura</i>	Indian Pitta	Pittidae	-	+	II	LC
42	<i>Ploceus philippinus</i>	Baya Weaver	Ploceidae	-	+	II	LC
43	<i>Prinia inornata</i>	Plain Prinia	Cisticolidae	-	+	II	LC
44	<i>Prinia socialis</i>	Ashy prinia	Cisticolidae	+	+	II	LC
45	<i>Psittacula cyanocephala</i>	Plum-headed parakeet	Psittacidae	-	+	II	LC
46	<i>Psittacula krameri</i>	Rose Ringed Parakeet	Psittacidae	+	+	II	LC
47	<i>Pycnonotus cafer</i>	Red Vented Bulbul	Pycnonotidae	+	+	II	LC
48	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	Pycnonotidae	+	+	II	LC
49	<i>Saxicola caprata</i>	Pied Bushchat	Muscicapidae	-	+	II	LC
50	<i>Streptopelia chinensis</i>	Spotted Dove	Columbidae	+	+	II	LC
51	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	Threskiornithidae	-	+	II	LC
52	<i>Tringa hypoleucos</i>	Common Sandpiper	Scolopacidae	-	+	II	LC
53	<i>Upupa epops</i>	Hoopoe	Upupidae	+	+	II	LC
54	<i>Vanellus indicus</i>	Red-wattled Lapwing	Charadriidae	+	+	II	LC
55	<i>Vanellus malabaricus</i>	Yellow Wattled Lapwing	Charadriidae	+	+	II	LC
AQUATIC SPECIES							
1	<i>Aplocheilichthys lineatus</i>	Striped panchax	Aplocheilichthys	-	+	-	LC
2	<i>Puntius filamentosus</i>	Black spot barb	Cyprinidae	-	+	-	LC
3	<i>Rasbora labiosa</i>	Slender rasbora	Danionidae	-	+	-	LC
BUTTERFLY							
1	<i>Appias lycinda</i>	Chocolate albatross	Pierinae	-	+	II	NE
2	<i>Ariadne merione</i>	Common castor	Nymphalinae	-	+	II	NE
3	<i>Euploea core</i>	Common Indian Crow	Nymphalidae	+	+	II	LC
4	<i>Eurema hecabe</i>	Common grass Yellow	Pieridae	+	+	II	LC
5	<i>Hypolimnas misippus</i>	Danaid Eggfly	Nymphalidae	+	+	II	LC

S. N	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
6	<i>Idea malabarica</i>	Malabar Tree Nymph	Nymphalidae	-	+	II	LC
7	<i>Papilio demoleus</i>	Lime butterfly	Papilionidae	+	+	II	NE
8	<i>Troides minos</i>	Southern birdwing	Papilionidae	+	+	II	LC

TABLE 12 INVENTORY OF SCHEDULE-I SPECIES IN THE CORE & BUFFER ZONE OF PROJECT SITE
BASED ON ACTUAL SIGHTING, INPUTS FROM LOCALS

S.N.	SCIENTIFIC NAME	COMMON NAME	FAMILY	Core Zone	Buffer Zone	Schedule as per WL (P) AA, 2022	IUCN STATUS
MAMMALS							
1	<i>Bos gaurus</i>	Gaur / Indian Bison	Bovidae	-	+	I	VU
2	<i>Canis aureus</i>	Golden Jackel	Canidae	+	+	I	LC
3	<i>Cuon alpinus</i>	Wild dog (Dhole)	Canidae	-	+	I	EN
4	<i>Hystrix indica</i>	Indian Crested Porcupine	Hystriidae	-	+	I	LC
5	<i>Macaca radiata</i>	Bonnet Macaque	Cercopithecidae	-	+	I	VU
6	<i>Melursus ursinus</i>	Sloth bear	Ursidae	-	+	I	VU
7	<i>Moschiola indica</i>	Mouse deer	Tragulidae	-	+	I	LC
8	<i>Panthera pardus</i>	Leopard	Felidae	+	+	I	VU
9	<i>Ratufa indica</i>	Malabar giant squirrel	Sciuridae	-	+	I	LC
10	<i>Urva edwardsii</i>	Grey Mongoose	Herpestidae	+	+	I	LC
REPTILES							
1	<i>Crocodylus palustris</i>	Marsh crocodiles	Crocodylidae	-	+	I	VU
2	<i>Naja naja</i>	Indian Cobra	Elapidae	-	+	I	LC
3	<i>Ptyas mucosa</i>	Rat Snake	Colubridae	-	+	I	LC
4	<i>Varanus bengalensis</i>	Monitor Lizard	Varanidae	-	+	I	NT
AVI FAUNA							
1	<i>Accipiter badius</i>	Shikra	Accipitridae	+	+	I	LC
2	<i>Haliastur indus</i>	Brahminy Kite	Accipitridae	-	+	I	LC
3	<i>Nisaetus cirrhatus</i>	Crested Hawk Eagle	Megalauidae	-	+	I	LC
4	<i>Pavo cristatus</i>	Indian Peafowl	Phasianidae	+	+	I	LC
5	<i>Strix leptogrammica</i>	Brown Wood Owl	Strigidae	-	+	I	LC

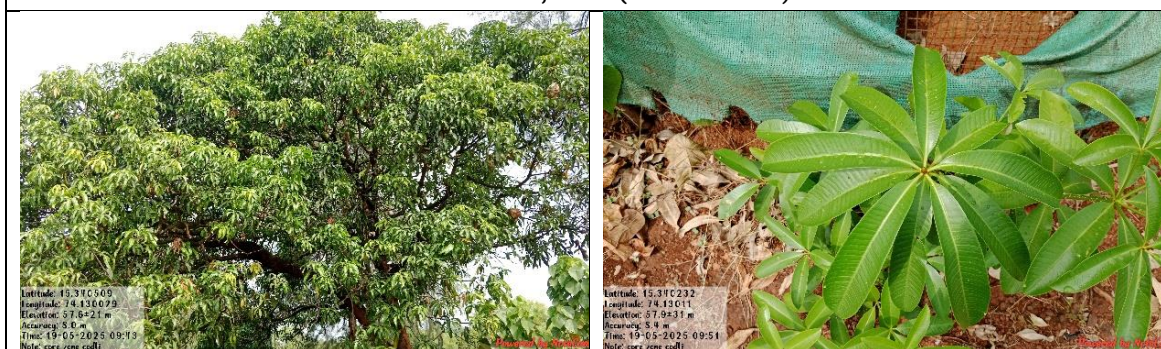
Source: Based on actual sightings and information gathered from forest department & locals.

Abbreviations: LC: Least Concern, NE: Not Evaluated, DD: Data Deficient, VU: Vulnerable, NT: Near Threatened, EN: Endangered.

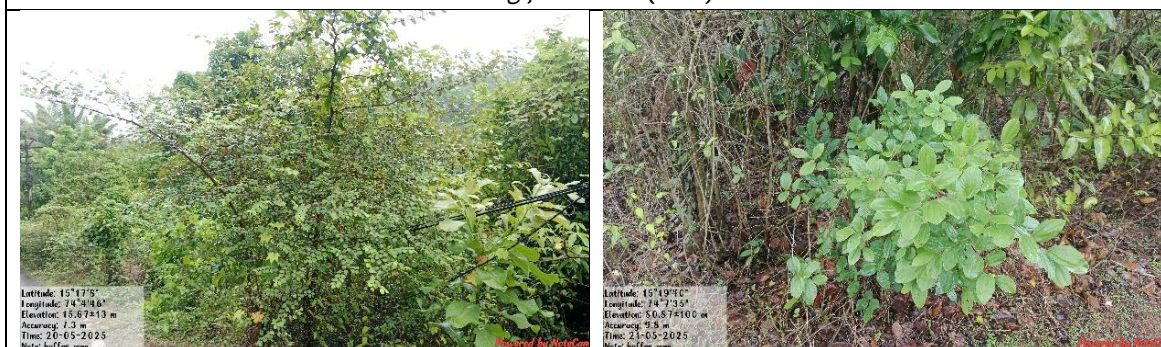
As per the Wildlife Protection (Amendment) Act, 2022, there are total 19 species listed under Schedule I (Including 10 Mammals, 04 Reptiles and 05 Avi Fauna).



Acacia auriculiformis (Earleaf acacia)



Mangifera indica (Aam)



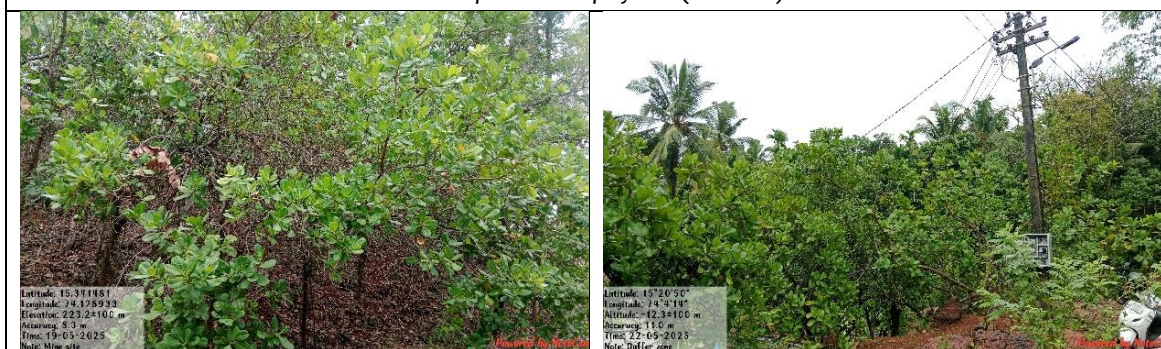
Ziziphus mauritiana (Indian jujube)



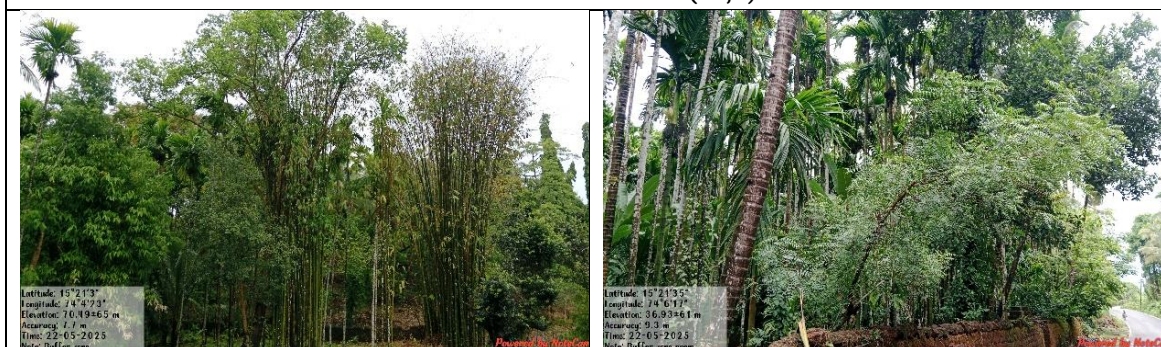
Cocos Sp. (Coconut)



Artocarpus heterophyllus (Jakfruit)



Anacardium occidentale (Kaju)



Bambusa arundinacea (Bambos)

Azadirachta indica (Neem)



Alstonia scholaris (Satan tree)

Sphagneticola trilobata (Wedelia)

 Latitude: 15.340468 Longitude: 74.130753 Elevation: 16.211600 m Accuracy: 16.1 m Time: 19-05-2025 09:55 Note: see note call	 Latitude: 15.340573 Longitude: 74.129777 Elevation: 15.511000 m Accuracy: 9.3 m Time: 19-05-2025 10:05 Note: see note call
Cynodon dactylon (Dub)	Calotropis gigantea (Aak)
 Latitude: 15.349071 Longitude: 74.130819 Elevation: 16.87150 m Accuracy: 13.4 m Time: 19-05-2025 11:19 Note: see note call	 Latitude: 15.3399 Longitude: 74.119587 Elevation: 10.0433 m Accuracy: 7.2 m Time: 19-05-2025 10:05 Note: see note call
Vanellus indicus (Red-wattled lapwing)	Corvus splendens (House Crow)
 Latitude: 15.1912 Longitude: 74.9114 Elevation: 16.59526 m Accuracy: 11.3 m Time: 22-05-2025 Note: see note call	 Latitude: 15.1912 Longitude: 74.9114 Elevation: 16.59526 m Accuracy: 10.3 m Time: 22-05-2025 Note: see note call
Copsychus saularis (Oriental magpie-robin)	Columba livia (Rock dove)
 Latitude: 15.337115 Longitude: 74.139392 Elevation: 100.72465 m Accuracy: 19.5 m Time: 19-05-2025 11:00 Note: see note call	 Latitude: 15.319565 Longitude: 74.174759 Elevation: 11.77413 m Accuracy: 5.8 m Time: 19-05-2025 11:21 Note: see note call
Mine Site	Mine Site



Water reservoir



Water reservoir

Dudhsagar River Adjacent in North

SIGN BOARDS



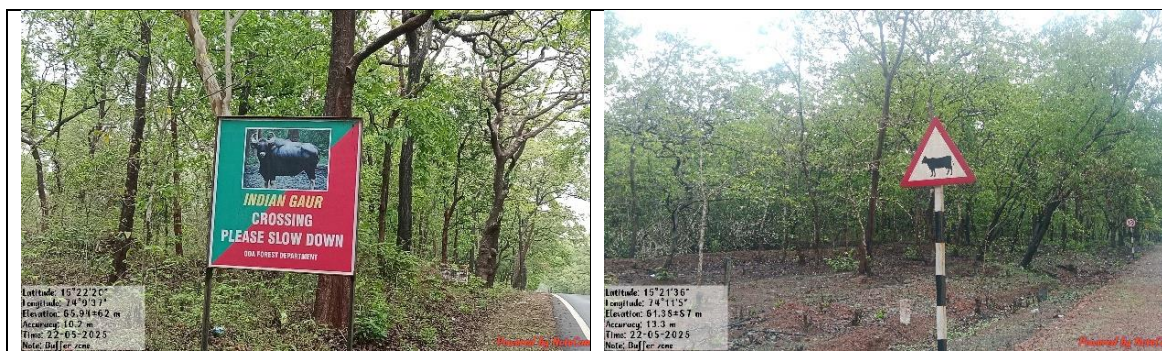


FIGURE 25 PHOTOGRAPHS CLICKED DURING FIELD SURVEY

7.0 IMPACT ASSESSMENT: -

7.1 ANTICIPATED IMPACTS ON BIODIVERSITY:

The main environmental problems associated with mining activities are disturbance to hydrological system, water, air and noise pollution which, ultimately impact upon the floral and faunal status of the study area. However, occurrence and magnitude of these impacts are entirely depending on mode of operation and technology involved in mining.

The present study determined to predict the likely impacts of mining on the surrounding environment with specific to biological attributes covering habitats/ecosystems and associated biodiversity.

Project will not expect to have a significant impact on biodiversity and does not pose a threat to the environment. Although, the core area has some part of RF forest vegetation. The company is committed to implement all necessary mitigation measures and prioritizes the protection of biodiversity. Hence, there will be no adverse impact on the forests and their Eco-Sensitive Zone. The developmental programs, policies and projects operated or managed by government or private bodies can cause potential significant changes in the physical, biological and socio-economic environment. In some cases, the changes may be beneficial while in other it may be detrimental to the environment. Accordingly, environmental impacts studies are required for systematic identification, qualification and interpretation of the anticipated changes.

Therefore, this study has been conducted to assess the impact of mining and associated activities on the diversity and distribution of wildlife. Birds and animals were studied by surveying transects along selected major stations in 10 km radius from the mine site. Based on the survey, it was inferred that the density and diversity of animals and bird species was moderate in the region. In conclusion, project activities have some impact on the diversity and distribution of birds and animals.

Impact Evaluation Element	Change in the biological resources of the area due to proposed mineral block and generation of emissions			
Potential Effect/ Concern	Loss of habitat, Impact on health of biological receptors due to area and line sources of air emissions including fugitive dust emissions during activities.			
Characteristics of Impacts				
Nature	Positive		Negative	Neutral
			√	
Type	Direct	Indirect	Cumulative	
	√			
Extent	Project Area	Local	Zonal	Regional
	√			
Duration	Short – term		Long- term	
	√			
Intensity	Low		Medium	High
	√			
Frequency	Remote (R)	Occasional (O)	Periodic (P)	Continuous (C)
				√
Significance of Impact				
Significance	Insignificant	Minor	Moderate	Major
			√	

Mining and its related activities are one of the major causes for the destruction of natural habitats for wildlife. As these activities increased in context of escalating use of natural resources to meet the demand of the market and the development of region and country, threat to wildlife has been every passing day. In addition to mining, large parts of forests and wildlife habitats are being cleared for agriculture, industry, roads and railways network, and human habitation leading to degradation, fragmentation, and loss of habitat and significant losses to the biological diversity and imperative imbalance in ecological equilibrium.

TABLE 13 IMPACT EVALUATION FOR BIOLOGICAL RESOURCES

Activity	Potential Impact	Component
Vegetation clearing	Loss of native vegetation, microhabitats and food sources	Flora, ground-dwelling fauna
Vehicular movement	Vehicular movement may cause dust generation, noise disturbance, habitat degradation and wildlife mortality (roadkills)	Small mammals, reptiles, amphibians and flora Species
Dust emission	Dust settle on plant surfaces, reducing photosynthetic activity and growth	Flora
Air pollution	May cause respiratory stress, behavioral disturbances and habitat degradation	Fauna

Activity	Potential Impact	Component
Wastewater & surface runoff	Sedimentation of aquatic systems	Aquatic diversity
Noise & vibrations	May be disturb behavior, breeding, feeding, and movement patterns, causing stress.	Mammals, Birds, Reptiles
Light pollution	Disruption of circadian rhythms and breeding behavior	Nocturnal Species (Birds, Amphibians, Reptiles and Mammals)
Human intrusion & poaching risks	Increased risk to Schedule-I species due to accessibility	All flora and fauna

7.2 IMPACT ON TERRESTRIAL FLORA:

The iron ore mining activities in the Codli region of South Goa have led to significant ecological alterations, particularly impacting terrestrial flora of the area. The clearing of vegetation for excavation, haul roads, infrastructure development and waste dumps has resulted in the loss of native plant species, including important understorey shrubs and ground flora that form the basis of the local food web. The fragmentation of habitat disrupts plant-animal interactions, such as pollination and seed dispersal, especially for endemic and slow-growing species typical of the moist deciduous and semi-evergreen forests in the region. Additionally, dust generated from mining activities settles on plant leaves, inhibiting photosynthesis and compromising plant health. Soil compaction and erosion from heavy machinery movement further degrade the substrate, limiting regeneration capacity of native species and encouraging the proliferation of invasive weeds such as *Chromolaena odorata* and *Lantana camara*. The cumulative impact reduces floristic diversity and alters species composition, threatening the ecological resilience of the landscape. Restoration efforts including progressive mine reclamation, plantation with native species and topsoil preservation are crucial to mitigate these impacts and support the recovery of native terrestrial flora.

7.3 IMPACT ON FAUNA:

Since the terrestrial fauna in the study area (10 km) are distributed away from the iron ore mining project, the impacts of mining are likely to be much low on terrestrial fauna of the region. There was no direct sighting of Wildlife in the study area.

In the present study the focus on vertebrate classes i.e. reptiles, birds and mammals for identification of impacts and future monitoring purpose. Therefore, impacts were identified on the reptiles, birds and mammals particularly.

Faunal diversity (major faunal groups such as herpeto-fauna, terrestrial avifauna and mammals) will be impacted in term of fragmentation, isolation and reduction of population.

Impacts on Reptiles: As per observations, Rare, Endangered and Threatened species of terrestrial reptiles from the study area were not reported during the study.

Due to Iron ore mining operations pose several direct and indirect threats to the native reptilian fauna, Habitat loss due to excavation, land clearing and road construction directly removes natural shelters

like burrows, rock crevices and leaf litter- essential microhabitats for thermoregulation and nesting. Soil compaction and vibration, disturb burrowing species and may lead to displacement.

Mining-induced habitat fragmentation isolates reptile populations and increasing vehicle movement within the lease area and nearby roads also causes frequent roadkill incidents, especially during the monsoon when reptiles are more active.

Impacts of Avifauna (Birds): It is noteworthy that no flocks of birds were observed around the proposed mining project. During our visit, some resident birds were noticed during roosting and feeding. Like: House Crow, Red-wattled Lapwing, Blue Rock Pigeon, Red Vented Bulbul etc.

Impacts on Mammals: During the field survey, no endangered species were recorded within the project site. However, one Vulnerable species, the Leopard (*Panthera pardus*), along with other common fauna such as the Indian Grey Mongoose, Spotted Deer and other wildlife species, were reported by the Forest Department during site inspection.

Potential impacts of mining activities on fauna may include habitat disturbance and fragmentation, increased noise and dust levels, vehicular movement and human interference, which could lead to temporary displacement of wildlife and disruption of their movement patterns. However, with the implementation of appropriate mitigation measures, these impacts are expected to remain localized and manageable.

8.0 **MANAGEMENT & CONSERVATION MEASURES FOR BIODIVERSITY: -**

It is an accepted fact that there cannot be any developmental or any activity that zero- environmental impact on its surroundings. Fact that environment is a dynamic entity and has a built-in self-renewal process that can level the extrinsic impact within reasonable limits. Moreover, biodiversity is a resilient entity of the environment and can tolerate impacts and recuperate if their renewal mechanisms remain unaffected over a long period of time with well- coordinated mitigation plans. In the extant case, stress will be laid on ensuring that the renewal dynamics of various floral and faunal taxa is not impeded due to mining activities.

The forest department is responsible for conservation of wildlife in the protected areas and the project proponent can support the department by providing some funds for implementing some of the initiatives. some of the measures for protection of environment within the core zone, would be responsibility of the project proponent and will be carried out as per requirement.

8.1 **HABITAT RESTORATION:**

Habitat restoration is a critical component of the conservation plan aimed at mitigating the ecological impacts of mining on Schedule-I species. Restoration efforts will focus on reviving degraded ecosystems and enhancing habitat quality to support the survival and movement of sensitive wildlife. Key activities include reforestation within buffer zones using native tree and shrub species, which will help restore canopy cover, improve microclimate and provide food and shelter to herbivores and avian fauna. Invasive plant species such as *Lantana camara* and *Parthenium* will be systematically removed to allow natural regeneration of indigenous flora. Efforts will also be directed towards the

restoration of grasslands through reseedling with native grasses, which are crucial for the sustenance of ungulates and ground-nesting birds. In addition, water conservation structures such as check dams, ponds and artificial reservoirs will be constructed or improve water availability for wildlife, particularly during dry seasons. Topsoil removed during excavation will be preserved and reused to maintain soil fertility and support natural succession. These habitat restoration measures are designed to rebuild ecological function, reduce edge effects and expand the effective habitat range for Schedule-I species. By restoring critical habitat elements, this strategy will contribute significantly to long-term biodiversity conservation and ecological resilience in the mining-affected landscape.

8.1.1 GREENBELT & PLANTATION DEVELOPMENT PROGRAMME: -

PURPOSE

Native species, fruit bearing trees, medicinal plants, and dense canopy trees should be chosen for green belt and plantation purposes in and around the project boundary. These species should be tolerant of pollution levels according to India's Bio-Geography zones.

Green belt shall be created not only to protect sensitive areas or to maintain ecological balance, but they also serve as efficient biological filters or sinks for particulate and gaseous emissions produced by vehicular traffic and various industrial activities.

Green belt development is an important tool for mitigating the negative effects of mining and infrastructure projects. Green belt development is recommended for air pollution containment and abatement in the environment. Properly designed green belt can be effective in reducing the impact of fugitive emissions and pollutants that are accidentally or otherwise released at ground levels.

The present plan comprises the details on field investigations. Plant species for greenbelt development are selected as per CPCB guidelines. Green belt will be developed around the periphery of project area.

A detailed survey was conducted with respect to existing vegetation diversity and density etc. in and around the study area for development of greenbelt and plantation. The greenbelt development plan has been formulated considering the parameters such as climate, soil types, topography etc.

The main objective of the greenbelt is to provide a barrier for surrounding areas to protect the environment from pollution due to the mine activities. The greenbelt helps to capture the fugitive emissions from the mine.

The following characteristics have been/will be taken into consideration while selecting plant species for green belt development and tree plantation.

- They should be fast growing and tall trees.
- The leaf surfaces should be stick and hairy
- They should be perennial, evergreen & indigenous.
- They should have thick canopy cover.
- The planting should be in appropriate alternate rows around the site to prevent lateral pollution dispersion.

- The trees should maintain regional ecological balance and conform to soil and hydrological conditions. Indigenous species should be preferred.
- They should be resistant to SPM Pollution.
- Heterogeneous tree species will be selected and planted considering soil and climate adaptability, flowering & growth characteristics, canopy structures & resistance to pollution load.

DETAILS OF GREENBELT DEVELOPMENT:

At conceptual stage Greenbelt and Plantation will be carried out on 102.43 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled, 6.87 ha on Dump Plantation and 26.16 ha under plantation. Company will put best efforts to maintain the survival and Local fruit bearing species will be planted in consultation with local forest department and as per CPCB guidelines.

The plant species will be selected as per CPCB guidelines and as per Air Pollution Tolerance Index (APTI). The company will ensure that there will be no adverse impact on the biological environment due to the existing and proposed project. Water sprinkling is practiced to suppress the dust within mine premises. Proper air pollution control equipment is being/will be installed to avoid contamination of ambient air environment.

TABLE 14 LIST OF SPECIES SUGGESTED FOR GREENBELT DEVELOPMENT

S. No	Scientific Name	Local Name	S. No	Scientific Name	Local Name
1	<i>Alstonia scholaris</i>	Satvan/Satan	9	<i>Ficus religiosa</i>	Peepal, Piplo
2	<i>Anacardium occidentale</i>	Cashew/Kaju	10	<i>Holoptelea integrifolia</i>	Vamolo/ Elm
3	<i>Azadirachta indica</i>	Neem	11	<i>Mangifera indica</i>	Mango, Aam
4	<i>Artocarpus heterophyllus</i>	Jakfruit	12	<i>Phyllanthus emblica</i>	Ambla
5	<i>Cassia fistula</i>	Amaltas	13	<i>Syzygium cumini</i>	Jamun
6	<i>Bridelia retusa</i>	Khatem Asan	14	<i>Terminalia crenulata</i>	Marat (Matti)
7	<i>Dillenia pentagyna</i>	Karmal	15	<i>Terminalia arjuna</i>	Arjun
8	<i>Ficus benghalensis</i>	Banyan, Vad	16	<i>Terminalia catappa</i>	Badam

8.2 PROTECTION OF BREEDING AND NESTING SITES:

Protecting breeding and nesting sites is vital for the reproductive success and long-term survival of Schedule-I species, which are particularly sensitive to disturbance during critical life stages. As part of the conservation strategy, systematic field surveys will be conducted to identify and potential breeding, nesting and denning sites of key species and various raptors and ground-nesting birds. To minimize disturbance, buffer zones of 100–200 meters will be established around key breeding habitats, with visual and acoustic barriers if needed. In sensitive areas, protective fencing will be installed using wildlife-friendly materials to prevent intrusion by humans or livestock, while also supporting wildlife movement in collaboration with the local forest department. Additionally, signage and awareness boards will be displayed at strategic locations to inform workers and locals about the ecological sensitivity of these zones. These measures are essential to ensure that breeding

populations are not disrupted, thereby increasing the survival rate of offspring, improving species population and contributing to the conservation.

8.3 CORRIDORS FOR SAFE MOVEMENT:

To ensure the effective conservation of Schedule-I species, the development and maintenance of wildlife corridors by the local Forest Department.

These corridors are essential for enabling safe movement between fragmented habitats, promoting genetic diversity and reducing human-wildlife conflict. Restoration of degraded areas within these corridors is undertaken through plantation of native species and removal of invasive flora. Local communities are engaged through awareness programmes and joint patrolling initiatives coordinated by the Forest Department. Regular monitoring, field surveys and adaptive management will be carried out to ensure that these corridors remain functional and safe for species movement.

8.4 WATER HOLES FOR HABITAT IMPROVEMENT:

Animals and birds need a regular water source for their daily consumption. During hot summer wild animals and birds stay outside forest in search of water source for quenching thirst. It is therefore proposed to construct water holes/check-dams, anicuts, Talai (small reservoirs) and water ponds in the forested area at buffer zone at convenient points. These water holes would be sufficient to store the water to meet drinking requirement of animals and birds. The water holes should be provided with cement concrete bedding, side walls with stone pitching and grass should be grown in gap for gripping while animals enter into the water holes.

These water holes are cleaned at regular intervals to remove leaf litter, de-silting and refilling water. Few shades are provided around water holes for animal resting during summer season. Fruit bearing trees shall be grown around water holes to provide nesting habitat and food for birds and shade for wild animals. Project proponent will provide funds to forest department to undertake water holes in the study area.

8.5 PROTECTION:

It is very important to protect the forest from biotic interference (poaching / hunting, cutting, lopping, encroachments, expansion of agriculture lands and other negative influence) caused mainly by the local population and outsiders. However, the forest department is well equipped and with full-fledged protection strategy in place, the project can complement the forest protection activities through inclusion of a list of duties in the code of conduct of the project employees, more specifically the security guards in stopping and reporting the illegal activities. Provision of communicating equipment for this purpose would also be very important. Capacity building program on protection would be of high significance. The strengthening of the man-power to support the forest guards in protection and other related activities the project can support in providing wages to the temporary guards.

8.6 COMMUNITY INVOLVEMENT:

Community Development plays a crucial role in the conservation of Schedule-I species and the effective functioning of wildlife corridors. Local communities, especially those living in and around

forest areas, are often the first to observe changes in wildlife movement and habitat conditions. Their active participation, guided by the Forest Department, enhances conservation outcomes. Awareness programs help educate communities about the ecological importance of Schedule-I species and the role corridors play in their survival. Community members can be involved in habitat restoration activities, such as tree planting and removal of invasive species, as well as in monitoring wildlife presence through participatory tools like camera traps and local reporting systems. Eco-development initiatives, facilitated with support from the Forest Department and NGOs, provide alternative livelihoods that reduce pressure on forest resources - such as promoting agroforestry, handicrafts or eco-tourism. Additionally, community forest protection committees can help manage corridor areas, prevent illegal activities like poaching or encroachment. When communities are empowered and see tangible benefits from conservation efforts, they become vital partners in protecting endangered species and maintaining landscape connectivity.

8.7 SUSTAINABLE LIVELIHOOD OPTIONS:

Promoting sustainable livelihood options is essential for balancing ecological conservation with community well-being, especially in areas adjacent to forest ecosystems and mining zones. With support from the local Forest Department, several viable livelihood strategies can be developed to reduce dependence on forest resources and enhance income generation. One key opportunity lies in eco-friendly agriculture, where farmers can adopt organic farming and agroforestry practices using existing crops like cashew, banana and coconut etc. These practices are based on the sustainable collection and processing of non-timber forest products (NTFPs) such as honey, wild fruits and medicinal plants, thereby generating income while conserving biodiversity.

Fish farming using existing water bodies, offers another income-generating avenue, especially when supported through training and cooperative models. Eco-tourism, based on the natural and cultural assets of Goa, such as river walks, birdwatching and farm visits - can be developed by training local youth as guides and encouraging homestay services. Handicrafts and value-added products made from locally available materials like bamboo and cashew shells provide creative economic alternatives, especially for women and self-help groups. These sustainable livelihood initiatives, when integrated into community-based conservation and supported through awareness, training and micro-financing by the Forest Department and local panchayat bodies, can help achieve both biodiversity conservation and socio-economic development.

8.8 AWARENESS PROGRAMMES:

The project should take up widespread awareness program to sensitize the locals through the media, i.e. print media (newspapers, magazines, etc.) and social media tools of all kinds in addition to radio and television on relevant subjects like biodiversity, ecological functions, conservation of wildlife and their conservation and their benefits to mankind, significance of different species of animals and plants more specifically the species of conservation significance and also on how-to live-in harmony with the wildlife in the area. Conduct Panchayat workshops, school programs and events using eco-

educational packages, which would help the local community understand the interdependence of nature in ensuring survival and development, while fostering a deep sense of love and respect for the surrounding flora and fauna. Villagers should be made aware of the importance of not disturbing forest wildlife.

Close collaboration and coordination with the Forest Department will be established to facilitate the construction of essential infrastructure, allocation of veterinary funds, provision of ambulances equipped with cages, and the establishment of dedicated rescue wards. These measures aim to actively contribute to the conservation and protection of wildlife.

Creating awareness among the local community is the most effective tool for wildlife safety and development. By understanding, loving, and protecting wildlife, individuals contribute to a healthier environment. Awareness campaigns, educational initiatives and ethical practices are essential in preserving habitats, preventing illegal activities, and minimizing human-wildlife conflicts. Engaging the community through partnerships and promoting responsible behavior fosters a collective effort towards wildlife conservation and ensures a harmonious coexistence between humans and the natural world.

Nature Awareness Camps: Regular nature awareness camps will be organized in the area, at least once a year for a period of ten years. These camps aim to educate the local public about the importance of wildlife conservation and environmental preservation. This will be instilling a sense of responsibility and stewardship among the local community can foster a collective effort in safeguarding wildlife.

Awareness Activities: Special awareness activities will be conducted during significant events such as International Day for Biological Diversity (May 22nd), World Forestry Day (21st March) and World Environment Day (5th June) each year. These activities may include painting and photography competitions, essay and slogan writing contests, as well as activities focused on tree and bird identification.

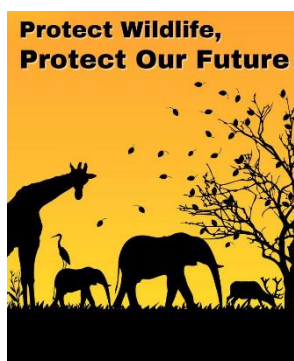
Forest department carries a lot of awareness programmes in the state of goa. The project proponent through its conservation plan will support the initiative by providing funds for conducting awareness campaigns, celebrating wild life week, sponsoring prizes etc for various activities conducted by forest department.

SLOGANS AND SIGNAGE:

Eye-catching slogans and signage promoting wildlife and nature conservation will be prominently displayed throughout the core zone and within buffer zone (10-kilometer radius), especially along roadsides. These visual reminders aim to encourage the public to actively participate in conservation efforts.

SIGN BOARDS:

Wild life protection will be most effective if the young once like the school children are thought and involved in it. To begin with sign boards with images of wild life will be placed near the village schools as well as at places of more occurrences or more conflicts of any particular species of the wildlife.



9.0 MONITORING PROGRAM:

A long-term ecological monitoring framework has been proposed to systematically assess the effectiveness of conservation actions related to Schedule-I species and habitat management. This monitoring program is designed in coordination with the local Forest Department and other relevant stakeholders and emphasizes adaptive management to respond to ecological changes over time.

- Evaluate the success of implemented conservation strategies (e.g., habitat restoration, corridor connectivity).
- Track trends in biodiversity, particularly Schedule-I and indicator species.
- Detect environmental changes due to mining or other land-use activities.

9.1 BIODIVERSITY MONITORING:

- **Fauna Surveys:** Seasonal population and distribution assessments of key species (e.g., Mammals, Reptiles and avian species).
- **Camera Traps:** Installed along corridors and restored habitats to monitor wildlife movement and behavior.
- **Bird and Invertebrate Surveys:** Indicator groups such as butterflies, dragonflies and birds surveyed biannually to track ecosystem health.

9.2 HABITAT MONITORING:

- **Vegetation:** Quadrat sampling to monitor regeneration, species composition and canopy cover in restored and natural areas.
- **GIS Mapping:** Annual updates of land use/land cover, habitat fragmentation, and corridor integrity using satellite imagery.

9.3 HUMAN ACTIVITY & THREATS ASSESSMENT:

- **Mining Impact:** Monitor dust, noise and water quality in buffer zones and sensitive habitats.
- **Livelihood Pressures:** Periodic surveys of community resource use to ensure sustainable harvesting practices.
- **Conflict Reporting:** Record human-wildlife conflict events, crop depredation, or encroachments.

9.4 CLIMATE AND ECOSYSTEM PARAMETERS:

- Record rainfall, temperature, stream flow and soil quality to understand habitat trends.

9.5 POLLUTION CONTROL:

Use dust suppression (water sprinklers on roads), covered conveyance and vibrations. For truck traffic, schedule haulage outside sensitive times and use the shortest routes; install wheel-wash units to prevent stone spillage onto roads.

NOISE LEVELS:

During mine operation noise levels will increase due to Machinery movement of HEMM. Wildlife is sensitive to higher noise levels like human beings. To reduce the noise levels during mining operations the following steps are proposed.

- Use of well-maintained loading machines with sharp bucket teeth.
- Well maintained roads. No over speeding of vehicles

AIR QUALITY:

The ambient air quality in the buffer zone shall be maintained within the CPCB limits in respect of PM₁₀, SO₂, NO₂ and CO emissions. For this the following steps are proposed.

- Regular sprinkling of water on roads
- No overloading to avoid spillage, trucks covered with tarpaulins.
- Creation of green belt around the mine area and avenue plantation with thick foliage to arrest dust.

9.6 ROLES AND RESPONSIBILITIES:

- **Forest Department:** Lead the coordination, provide technical oversight and ensure policy compliance.
- **Local Community:** Engage in data collection (e.g., birdwatching groups, patrolling) and report illegal activities.
- **Project Proponent:** Provide funding for long-term monitoring under environmental clearance conditions (as part of CSR/EMP).

9.7 CAPACITY BUILDING:

- Training of local youth and forest officials for biodiversity monitoring.
- Develop mobile-based tools for real-time data entry and alerts (e.g., for wildlife sightings or conflict incidents).

LITERATURE REVIEW:

To supplement our field research, the study also drew upon existing knowledge about the ecology and biodiversity of the region. We surveyed a variety of relevant literature to gather baseline information, including the Forest Working Plan of South Goa Division to obtain a understanding of the forest diversity within the study area. In addition, we reviewed various documents, such as existing Research Papers and the nearby projects and industries EIA document, along with relevant maps and reports. To deepen our understanding of the biology of several species, we also consulted books on flora, fauna and wildlife. By incorporating these different sources of information, we were able to construct a comprehensive and informed picture of the study area's ecology and biodiversity.

10.0 ANALYSIS TO EVALUATE THE POTENTIAL IMPACTS:

The information collected on the status of flora and fauna, including their spatial-temporal distributions, hotspots, and potential impacts of proposed development analyzed thoroughly. We used various statistical and spatial tools to identify trends and patterns in the data, which helped us draw meaningful conclusions about the state of biodiversity of the study area's biodiversity. We assessed the potential impacts of proposed development on the ecology of the study area, considering the potential risks associated with increased human activity and changes to the surrounding environment. From thorough analysis, the critical habitats and species that were particularly vulnerable to these potential impacts were identified and mitigation strategies have been recommended for these risks.

The conclusions were drawn based on analysis of the available data, considering the unique ecological characteristics of the study area and the potential impacts of proposed development. By incorporating a range of analytical tools and drawing on the expertise of various specialists, the assessment provided a comprehensive understanding of biodiversity of the study area, enabling evidence-based recommendations for its conservation and management.

11.0 LIMITATIONS OF THE STUDY

Our study based on the project information provided by the proponent and included field visits, literature surveys and consultations with local stakeholders. The limitations and challenges encountered during the study were acknowledged, particularly in assessing environmental parameters. The information presented is based on the data available at the time of the study and may be require updates as new information emerges or as the mining project progresses. Throughout the study, a high standard of professionalism and integrity, applying a rigorous approach to data collection and analysis has been maintained. The conclusions and recommendations are intended to be comprehensive and reliable.

LITERATURE REVIEW:

To supplement our field research, the study also drew upon existing knowledge about the ecology and biodiversity of the region. A variety of relevant literature to gather baseline information has been surveyed, including the Forest Working Plan of South Goa Division to obtain an understanding of the forest diversity within the study area. In addition, various documents, such as existing Research Papers and the nearby projects and industries EIA document, along with relevant maps and reports were also viewed. To deepen our understanding of the biology of several species, books on flora, fauna and wildlife were also consulted. By incorporating these different sources of information, we were able to construct a comprehensive and informed picture of ecology of the study area and biodiversity.

12.0 SUMMARY:

- Proposed Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).
- Out of total 377.0881 ha land; 65.9686 ha is Forest Land, 236.3482 ha is Government land, 58.9087 ha is Private land and 15.8626 ha is Alvara land.
- At conceptual stage Greenbelt and Plantation will be carried out on 102.43 ha (Greenbelt along ML Boundary: 17.45 ha, 51.95 ha area on backfilled, 6.87 ha on Dump Plantation and 26.16 ha under plantation. Company will put best efforts to maintain the survival and Local fruit bearing species will be planted in consultation with local forest department and as per CPCB guidelines.
- To study the floral and faunal diversity of the terrestrial and aquatic environment in the study area, a primary field survey was carried out in the 10 km radius around the mine site.
- A total of 114 floral species were recorded within the 10 km radius study area including 75 tree species, 15 shrub species, 16 herb species, 06 grass species and 02 Climber species recorded in the study area based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026).
- No rare species have been recorded however, presence of 6 species under threatened categories- including were found 02 Endangered species- *Cinnamomum zeylanicum* (Tikhi), *Tectona grandis* (Teak) and 04 Vulnerable species- *Dalbergia latifolia* (Sisham), *Garcinia indica* (Bhiran), *Myristica malabarica* (Kayphal) and *Syzygium caryophyllatum* (Bhedas) were recorded according to the IUCN Conservation Status.
- Overall, 101 species were recorded within the 10 km radius study area. Based on primary survey and secondary data (Management Plan of Bhagwan-Mahavir NP & WLS, Goa) and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026),

these species include 18 of species Mammals, 60 species of Birds, 08 species of Reptiles, 4 species of Amphibians, 8 species of Butterflies and 03 species of Aquatic species fish diversity.

- There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur / Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site.
- No rare species have been recorderd. However, presence of 06 species under threatened categories- including 05 Vulnerable- *Bos gaurus* (Gaur / Indian Bison), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Panthera pardus* (Leopard), *Crocodylus palustris* (Marsh crocodile) and 01 Endangered- *Cuon alpinus* (Wild dog /Dhole).
- There are Bhagvan Mahavir Wildlife Sanctuary (~1.52 km in SE direction) and Bondla Wildlife Sanctuary (~6.5 km in SE direction)
- Forest within 10km radius study area: -
 - Unclassified Forest filling in Core Zone
 - Reserved Forest (~0.5 km in ENE direction)
 - Reserved Forest (~1.0 km in West direction)
 - Reserved Forest (~2.5 km in West direction)
 - Reserved Forest (~4.0 km in South direction)
 - Reserved Forest (~6.5 km in WSW direction)
 - Reserved Forest (~7.0 km in NNE direction)
 - Reserved Forest (~8.0 km in WSW direction)
 - Reserved Forest (~8.5 km in NW direction)
 - Reserved Forest (~ 9.0 km in West direction)
- Various measures will be undertaken, and environment management plan will be implemented to deterrent pollution of air, noise, water & land environment. Air quality & noise level will be maintained well within the standards prescribed by the MoEF&CC and CPCB. Greenbelt development and plantation will help in creating habitats for local faunal species and to create better environment for various fauna.

13.0 CONCLUSION:

The study area displays a moderately rich and diverse vegetation in study areas. The core zone of mine area falling within Reserved Forest and surrounded by other Reserved Forest areas. The region supports diverse agriculture and a variety of flora and fauna. Precautions have been taken to prevent

wild animals from entering the ML area. The implementation of a well-designed green belt with suitable indigenous species is recommended to improve the environment and maintain the ecological balance in the area.

A total of 114 floral species and 101 faunal species were recorded during primary and secondary surveys. This includes 19 Schedule-I species under the Wildlife (Protection) Amendment Act, 2022 and several species categorized as Endangered, Vulnerable and Near Threatened by the IUCN. While the buffer zone supports ecologically important fauna such as *Panthera pardus* (Leopard) etc.

The Wildlife Conservation Plan has been prepared focusing on the conservation and management of Schedule I species recorded in the study area, in accordance with the provisions of the Ministry of Environment, Forest and Climate Change and the Wild Life (Protection) Amendment Act, 2022. The effective implementation of the proposed wildlife conservation measures, including habitat improvement, protection, monitoring and awareness activities.

The study area is located in close proximity to ecologically significant protected areas, namely Bhagwan Mahavir Wildlife Sanctuary situated approximately 1.52 km in the southeast direction and Bondla Wildlife Sanctuary ~ 6.5 km in the southeast direction. In addition, several forest patches occur within the 10 km radius study area, including unclassified forest in the core zone and multiple reserved forest patches distributed in different directions. The presence of these protected and forested landscapes indicates a rich biodiversity zone with diverse habitats supporting a wide range of floral and faunal species. These forest ecosystems provide critical habitat, breeding grounds, foraging areas and wildlife movement corridors for mammals, birds, reptiles, amphibians and numerous invertebrates. The landscape connectivity between the sanctuary areas and surrounding reserved forests enhances ecological stability and plays an important role in sustaining wildlife populations.

The proposed mining operations are likely to have localized impacts on the biological environment, mainly due to vegetation clearance, habitat fragmentation, dust emissions and anthropogenic disturbances. However, these impacts can be mitigated through well-planned conservation interventions.

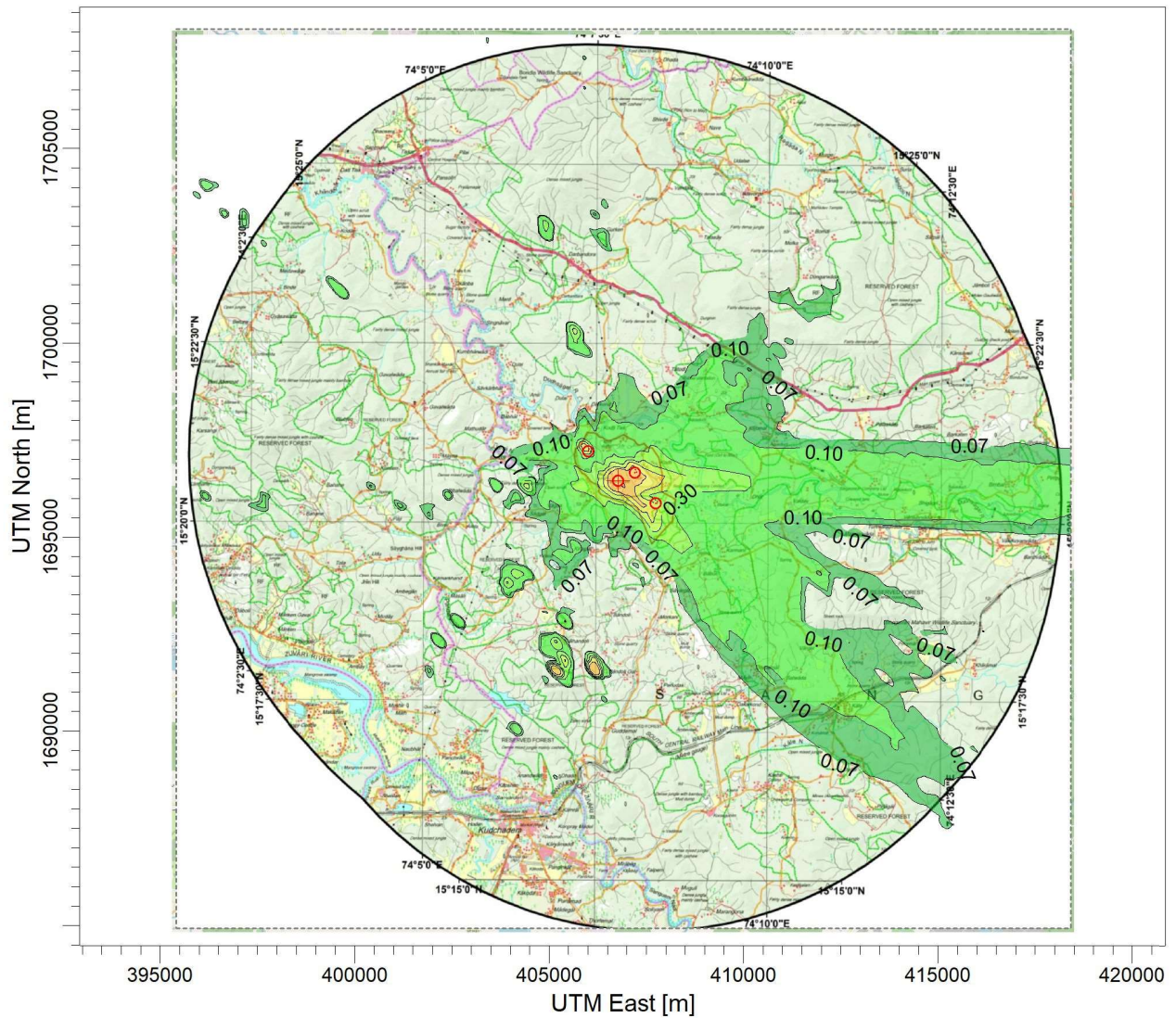
The study concludes that with effective implementation of the proposed environmental safeguards and continuous monitoring programs, the ecological integrity of the region can be maintained alongside responsible mining activities. The project proponent shall follow environmental regulations, ensure strict compliance with applicable laws, adopt adaptive management strategies and actively engage with local communities for long-term biodiversity conservation.



Annexure - XVI - Isopleths

PROJECT TITLE:

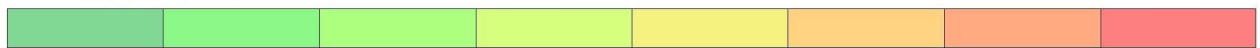
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PLOT FILE OF HIGH 10TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m³

Max: 3.38 [ug/m³] at (406913.00, 1696316.32)



0.07

0.10

0.30

0.50

0.70

1.00

3.00

3.38

COMMENTS:

PM10

SOURCES:

4

COMPANY NAME:

JSW Steel Limited

RECEPTORS:

8649

MODELER:

OUTPUT TYPE:

Concentration

SCALE:

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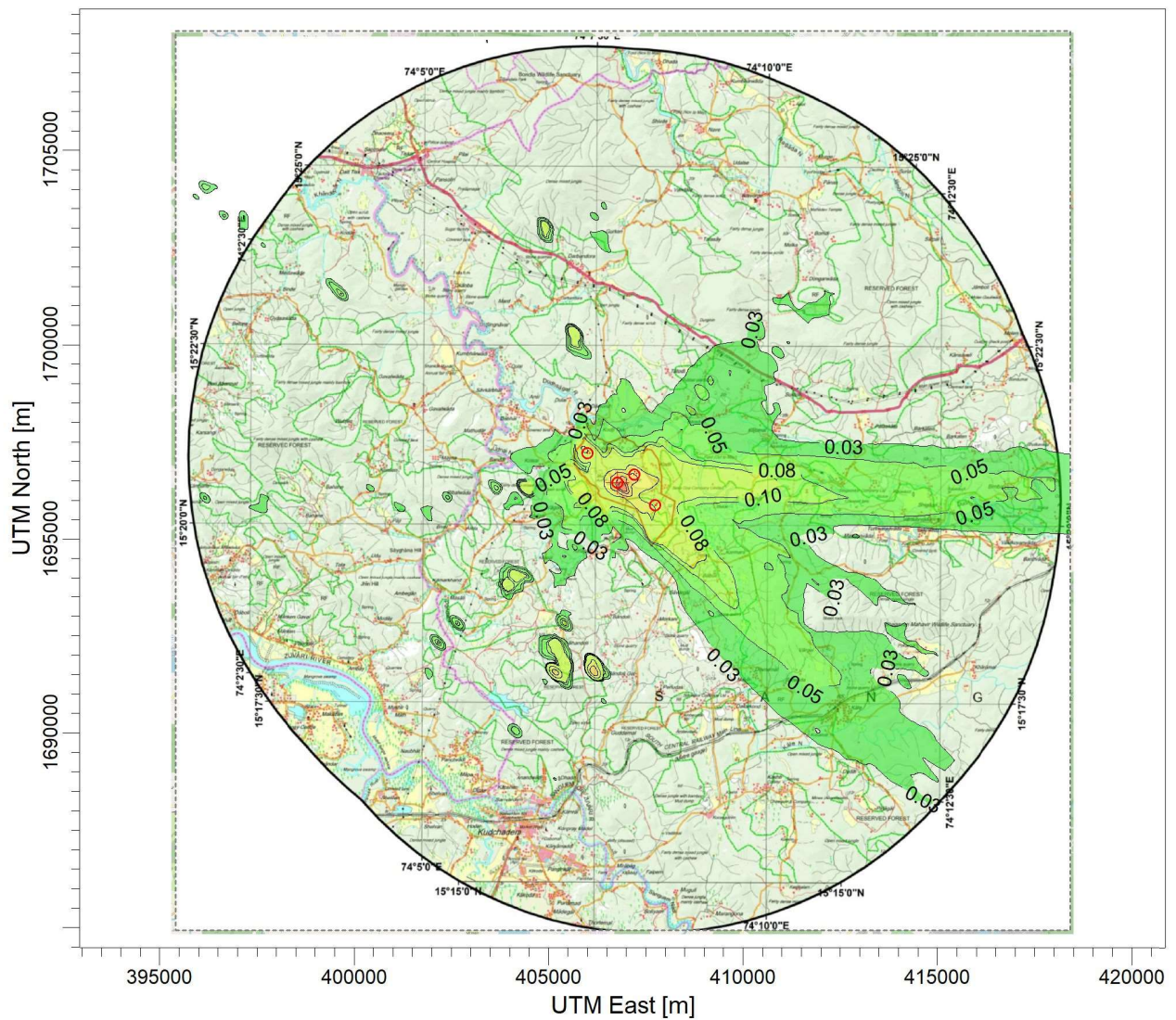
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MAX:

3.38 ug/m³

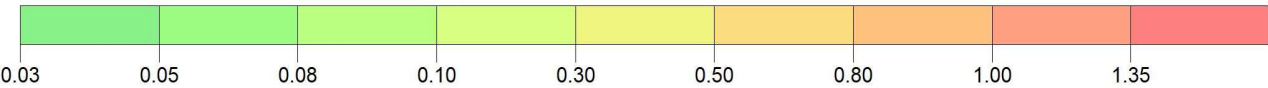
PROJECT NO.:

PROJECT TITLE:
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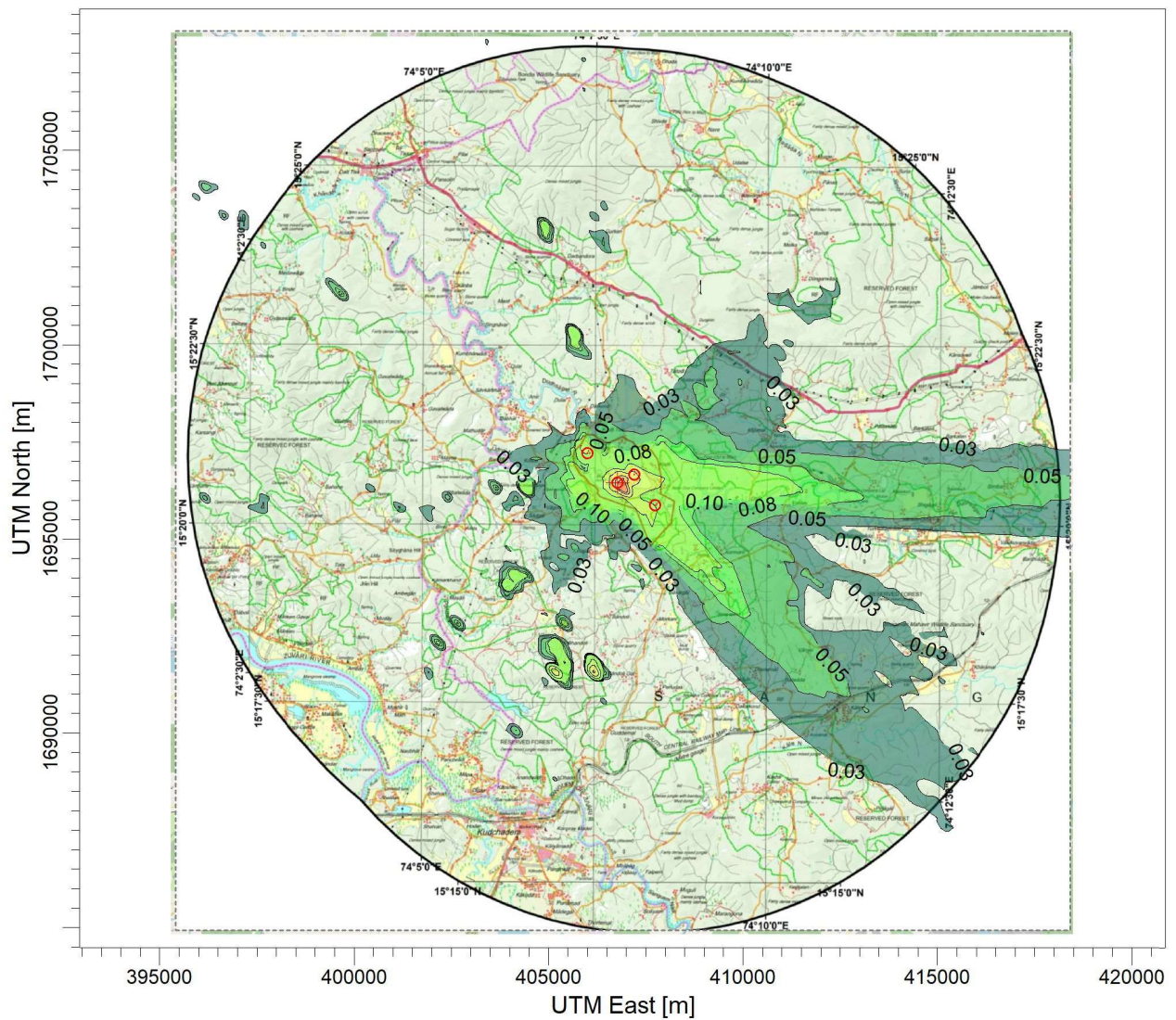
PLOT FILE OF HIGH 10TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
Max: 1.35 [ug/m^3] at (406913.00, 1696316.32)

ug/m^3



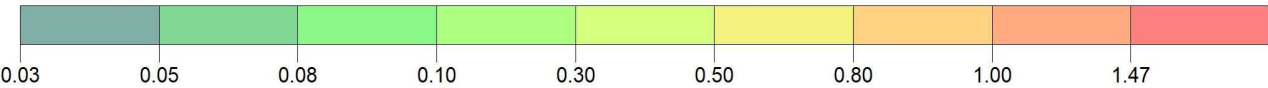
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	OUTPUT TYPE: Concentration	SCALE: 1:175,638 0  5 km	
	MAX: 1.35 ug/m^3	PROJECT NO.: 64	

PROJECT TITLE:
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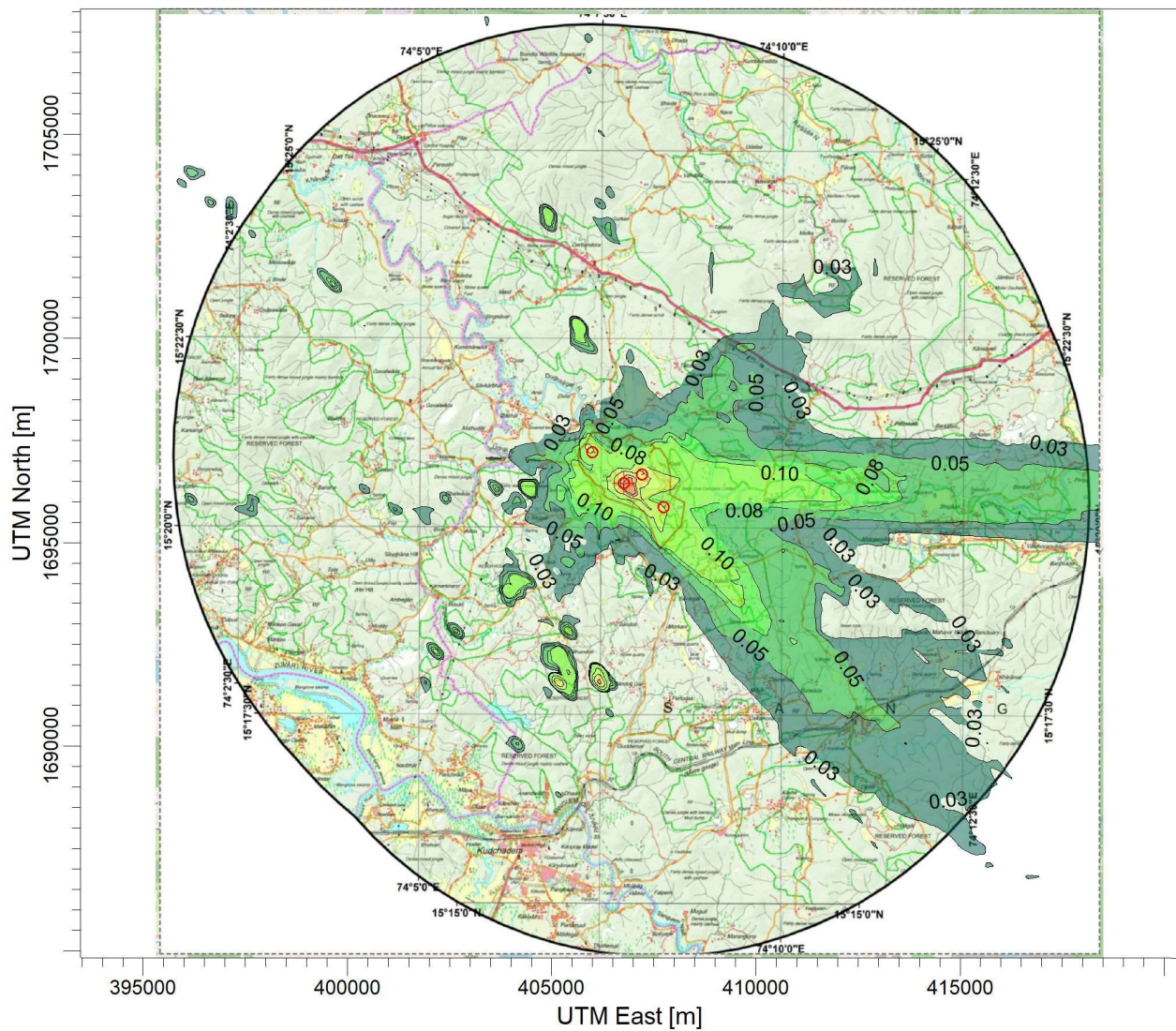
PLOT FILE OF HIGH 10TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
Max: 1.47 [ug/m^3] at (406913.00, 1696316.32)

ug/m^3



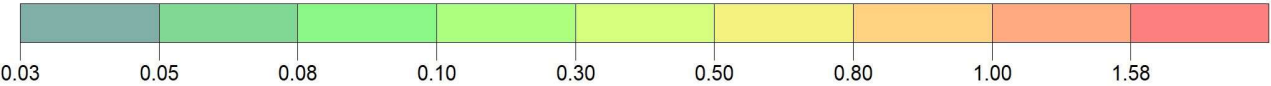
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	RECEPTORS: 8649	MODELER:	
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	MAX: 1.47 ug/m^3	PROJECT NO.: 64	

PROJECT TITLE:
D:\AQ\Mining\64. JSW Codli Mine\Aermod\Aermod.isc



PLOT FILE OF HIGH 10TH HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
Max: 1.58 [ug/m^3] at (406913.00, 1696316.32)

ug/m^3



COMMENTS: NO2	SOURCES: 4	COMPANY NAME: JSW Steel Limited	
	RECEPTORS: 8649	MODELER:	
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	MAX: 1.58 ug/m^3	PROJECT NO.: 64	

**DETAILED SCIENTIFIC AND ENGINEERING PLAN FOR
RETAINING WALL DESIGN
BLOCK-XII CODLI MINERAL BLOCK, GOA**

Project Proponent: JSW Steel Limited

Village Codli, Taluka Dharbandora, District South Goa, Goa

Mining Lease Area: 377.0881 ha

Proposed Iron Ore Production: 3.50 MTPA Maximum Waste/Overburden: 8.21 MTPA
Total Excavation: 11.71 MTPA

DOCUMENT CONTROL

Particular	Details
Project	Block-XII Codli Mineral Block
Project Proponent	JSW Steel Limited
Location	Village Codli, Taluka Dharbandora, District South Goa, Goa
Lease Area	377.0881 ha
Mineral	Iron Ore
Production Capacity	3.50 MTPA
Waste/Overburden	8.21 MTPA
Total Excavation	11.71 MTPA
Purpose	Compliance with TOR requirement relating to retaining wall / containment of dump and ore silt

EXECUTIVE SUMMARY

The Block-XII Codli Mineral Block of JSW Steel Limited is located at Village Codli, Taluka Dharbandora, District South Goa, Goa, and covers an area of 377.0881 ha. The proposed mining operation involves iron ore production of 3.50 MTPA with associated waste/overburden generation and handling of approximately 8.21 MTPA, resulting in a maximum total excavation of approximately 11.71 MTPA.

Considering the proposed handling and storage of mineral and waste material, particularly during the monsoon period, suitable engineering measures are required to prevent erosion, instability and migration of fine material with surface runoff. This report has therefore been prepared to address the TOR requirement for a detailed scientific plan for construction of retaining wall/other structures so that there is no flow of dump/ore silt outside the mining lease area.

The retaining wall is proposed as part of an integrated engineering system comprising dump-slope stabilisation, retaining/toe protection, drainage behind the wall and safe collection of runoff. The final dimensions and structural configuration shall be established from site-specific topographical and geotechnical investigations and detailed design calculations.

1. INTRODUCTION

The proposed retaining wall system is intended to provide physical containment at identified vulnerable locations along the toe of dump/ore storage areas. The system shall prevent lateral migration of dump material and reduce the possibility of sediment-laden runoff reaching the lease boundary.

The design shall be developed with due consideration to the applicable provisions of the IS 14458 series and other relevant Indian Standards. The applicable part of IS 14458 shall be selected according to the type of retaining structure adopted after site investigation and engineering assessment.

2. TOR REQUIREMENT AND COMPLIANCE

The TOR requires “*The Project Proponent to submit a detailed scientific plan for constructing the retaining wall/other suitable structures so that there is no flow of dump/ore silt outside the lease area*”.

The requirement is addressed in this report through a site-specific retaining wall design philosophy, foundation and stability requirements, drainage behind the wall, toe protection, construction specifications, inspection and maintenance requirements, and a drawing schedule. The retaining wall shall be integrated with the mine drainage and sediment-management system so that material cannot bypass the structure at its ends or through uncontrolled surface runoff.

3. SITE-SPECIFIC ASSESSMENT

A detailed DGPS/Total Station survey shall be undertaken for the proposed retaining-wall locations. The survey shall establish existing ground levels, dump crest and toe levels, slope gradients, lease boundary, natural drainage paths, roads and existing mine infrastructure.

The retaining-wall alignment shall be selected after assessment of the terrain and drainage pattern. Particular attention shall be given to low-lying areas, drainage outlets and locations where the terrain falls towards the lease boundary.

The final engineering design shall be based on verified field conditions. The indicative dimensions shown in concept drawings shall not be used for construction without site-specific design verification.

4. GEOLOGICAL AND GEOTECHNICAL DESIGN BASIS

The foundation and retained material shall be investigated to establish the engineering parameters required for design. The investigation shall include, as applicable, visual logging, trial pits/boreholes, in-situ tests and laboratory testing.

The design parameters shall include unit weight, moisture condition, cohesion, angle of internal friction, allowable bearing capacity, permeability and groundwater/seepage conditions. The properties of dump/waste material shall be assessed separately where its behaviour differs from the natural foundation material.

Parameter	Unit	Design Basis
Unit weight	kN/m ³	Site/laboratory investigation
Cohesion	kPa	Laboratory/field investigation
Angle of internal friction	degree	Laboratory/field investigation
Allowable bearing capacity	kN/m ²	Geotechnical assessment
Permeability	m/s	Laboratory/field investigation
Groundwater/seepage	—	Field observation/monitoring

5. APPLICABLE IS 14458 DESIGN PROVISIONS

The retaining wall shall be selected and designed with reference to the applicable provisions of IS 14458. IS 14458 Part 1 provides guidance for selection of retaining-wall type, while Part 2 addresses design of retaining/breast walls. Where a gabion wall is selected, the applicable provisions of Part 6 shall be considered. Where an RCC retaining wall is selected, the applicable current provision for RCC retaining-wall design shall be followed.

The retaining-wall design shall also consider relevant provisions of other applicable Indian Standards for foundations, structural concrete, loading and seismic design, as appropriate to the selected wall type and site conditions. The final design shall be prepared and checked by a competent civil/geotechnical/structural engineering professional.

6. SELECTION OF RETAINING WALL TYPE

The type of retaining wall shall be selected based on wall height, retained material, foundation conditions, slope geometry, drainage conditions, construction accessibility, material availability and long-term maintenance requirements.

Depending on the site-specific assessment, the retaining structure may comprise rubble masonry, cement masonry, gabion, reinforced gabion or RCC retaining wall. The selected wall shall be justified in the design note and shall be appropriate for the actual loading and foundation conditions.

The retaining wall shall not be considered a substitute for treatment of a major or deep-seated landslide or global slope failure. Where global instability is identified, the slope shall be separately analysed and stabilised through appropriate engineering measures.

7. RETAINING WALL DESIGN

The proposed retaining wall shall be founded on competent natural ground or suitably improved foundation strata. The foundation shall be excavated to the required depth, cleaned and properly prepared before construction. The final foundation depth and dimensions shall be established from the geotechnical investigation and design calculations.

The wall shall be designed for the self-weight of the structure, active earth pressure from the retained dump/ore/waste material, surcharge loading due to mining equipment and material storage, water pressure, seepage forces and applicable seismic effects.

The design calculations shall demonstrate satisfactory stability against sliding, overturning and excessive bearing pressure. The foundation shall be checked for allowable bearing pressure and eccentricity. The overall stability of the retained slope and wall system shall also be assessed where necessary.

The final wall height, base width, top width, foundation depth and batter shall be determined by detailed design. No indicative drawing dimension shall be treated as a construction dimension unless verified by the approved design calculation.

8. DRAINAGE BEHIND RETAINING WALL

Adequate drainage shall be provided behind the retaining wall to prevent accumulation of water and development of excessive hydrostatic pressure. A suitable drainage layer and filter arrangement shall be provided behind the wall, with geotextile or graded filter media where required to prevent migration of fine particles.

Weep holes or equivalent drainage outlets shall be provided where applicable. The drainage outlets shall discharge into a suitably protected toe-drain arrangement within the mining lease area. The drainage system shall be designed so that water does not erode the retained material or undermine the wall foundation.

9. TOE PROTECTION AND CONNECTIONS

The toe of the dump shall be protected against erosion and undercutting by a suitable retaining/toe-protection structure. The toe protection shall be properly connected to adjacent natural ground and drainage structures to prevent water bypass around the ends of the wall.

Where gabion construction is selected, the baskets shall be properly founded, connected and filled with durable stone of suitable size and quality. Where masonry or RCC construction is selected, the materials and workmanship shall comply with the approved engineering specifications.

10. GARLAND AND TOE DRAIN INTERFACE

Where required, garland drains shall be provided on the upstream side of the dump to intercept clean surface runoff and divert it away from the dump. This will reduce the amount of clean runoff entering the sediment-control system.

Runoff generated over the dump slope shall be collected by toe drains and conveyed to the approved mine drainage and sediment-management facilities. Drain dimensions, lining, gradient and freeboard shall be determined from the design discharge and hydraulic calculations.

11. SILT AND SEDIMENT CONTROL

The retaining wall shall operate as part of an integrated sediment-control arrangement. Sediment-laden runoff shall be intercepted, its velocity reduced and suspended material allowed to settle within the lease area.

Where required, silt traps and check dams shall be provided downstream of the dump toe. The structures shall be sized and located based on catchment area, channel geometry, design runoff, velocity and expected sediment load.

Collected sediment shall be periodically removed to maintain the effective capacity of the structures and shall be managed within the approved mine area in accordance with the applicable mining and environmental management provisions.

12. LEASE BOUNDARY PROTECTION

The retaining-wall alignment shall be planned with reference to the lease boundary and natural drainage directions. All locations where the terrain falls from the dump/ore area towards the lease boundary shall be identified and incorporated in the final engineering drawing.

The system shall be arranged so that there is no uncontrolled direct flow path from the dump/ore area to the outside of the lease. The wall, drainage and sediment-control structures shall be tied into one another and into stable natural ground wherever required.

13. TYPICAL RETAINING WALL DESIGN DRAWING SHEET

Indicative engineering drawing sheet for design development; final construction drawings shall be based on verified Codli Mine survey and design calculations.

TABLE 1. MASONRY RETAINING WALLS TO SELECT FOR DIFFERENT CONDITIONS

TYPE	DRY STONE	BANDED DRY STONE	CEMENT MASONRY	GABION
DIAGRAMMATIC CROSS-SECTION				
TOP WIDTH	0.6 ~ 1.0 m	0.6 ~ 1.0 m	0.5 ~ 1.0 m	1.0 m
BASE WIDTH	0.5 ~ 0.7 H	0.6 ~ 0.65 H	0.5 ~ 0.65 H	0.6 ~ 0.75 H
FRONT BATTER	Vertical	Varies	10 : 1	6 : 1
BACK BATTER	Varies	Vertical	Varies	Varies
NWARD DRIP FOUNDATION	1 : 3	1 : 3	Horizontal or 1 : 6	1 : 6
FOUNDATION DEPTH BELOW DRAW	0.5 m	0.5 ~ 1.0 m	0.5 ~ 1.0 m	0.5 m
RANGE OF HEIGHT	1 ~ 3 m	1 ~ 6 m	1 ~ 8 m	1 ~ 6 m
HILL SLOPE ANGLE	< 35°	< 35°	< 45°	< 45°
GENERAL	 - Set stones along foundation bed. - Use long band stones hand. - Hand packed stones in back fills.	 - Cement masonry bands of 50 cm thickness at 3 m c/c. - Other specifications as per dry stone wall.	 - Weep holes 15x15 cm size at 1~2 m c/c. 50 cm rubble backing for drainage.	 - Stones to be hand packed. - Stone shape important. - Blocky preferable to tabular.

Figure 14.1: Typical Retaining Wall Design and Associated Details

14. CONSTRUCTION SPECIFICATION AND METHODOLOGY

Construction shall commence only after approval of the final design drawings and calculations. The wall alignment shall be set out from the approved survey. Foundation excavation shall be carried out to the designed level and all loose, organic or unsuitable material shall be removed.

The foundation bed shall be prepared and compacted as specified. Masonry, gabion or RCC construction shall then be executed in accordance with the approved construction drawings and material specifications. Drainage/filter arrangements shall be installed concurrently with wall construction so that they are not omitted or blocked during backfilling.

Backfilling behind the wall shall be carried out in controlled layers using suitable material and appropriate compaction. Heavy equipment shall not be operated immediately adjacent to the wall unless the surcharge has been included in the design.

The completed structure shall be inspected before commissioning and any defects shall be rectified prior to exposure to major monsoon runoff.

15. INSPECTION, MONITORING AND MAINTENANCE

The retaining wall shall be inspected before the onset of monsoon and at regular intervals during the monsoon. The inspection shall include checks for cracks, settlement, tilting, bulging, seepage, erosion, foundation exposure, blockage of drainage outlets and damage to adjoining ground.

The drainage layer, weep holes and toe drains shall be kept free from blockage. Accumulated silt and debris shall be removed from the drainage and sediment-control structures before their effective capacity is reduced.

Any indication of structural distress or slope movement shall be immediately reported to the competent engineer and corrective action shall be undertaken. Inspection records, photographs and maintenance records shall be maintained as part of the environmental and mine-management documentation.

16. INTEGRATION WITH EIA/EMP

The retaining wall and associated drainage measures shall be incorporated into the Environmental Management Plan for the Codli Mineral Block. The construction, inspection, maintenance and monsoon preparedness activities shall be assigned to responsible mine and environmental personnel.

Activity	Frequency	Responsible Department	Record
Retaining-wall inspection	Monthly and before/during monsoon	Mine/Civil/Environment	Inspection register
Drain cleaning	Before monsoon and as required	Mine Operations	Maintenance record
Silt removal	As required	Environment/Mine Operations	Desilting record
Boundary inspection	During monsoon and after heavy rainfall	Environment/Mine Operations	Photographs/report

18. CONCLUSION AND TOR COMPLIANCE STATEMENT

The specific TOR requirement relating to preparation of a detailed scientific plan for construction of retaining wall/other structures to prevent flow of dump/ore silt outside the lease area has been addressed through the present report for the Block-XII Codli Mineral Block.

The proposed retaining wall shall be designed from site-specific topographical and geotechnical information and shall be integrated with appropriate drainage, toe protection and sediment-control arrangements. The design shall demonstrate adequate structural and geotechnical stability and shall provide suitable drainage behind the wall to prevent hydrostatic pressure and erosion.

The Project Proponent shall ensure that the final retaining-wall construction drawings, calculations and specifications are prepared and certified by competent engineering professionals before construction. The structures shall be inspected and maintained throughout the mine life, with particular attention before and during the monsoon.

The completed system shall be operated so that dump material, ore, waste/overburden and sediment-laden runoff are contained and managed within the mining lease area and uncontrolled migration outside the lease boundary is prevented.



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

Date: 18.03.2026

To,
The Chief Engineer,
Water Resources Department,
Sinchai Bhavan, Near Police Station,
Alto-Porvorim, Goa 403521

Subject: EDS raised by MoEF&CC For TOR application of Block -XII Codli Mineral Block

Reference: TOR Application for Block -XII Codli Mineral Block proposal no: IA/GA/MIN/571910/2026 dated 13.03.2026 and Essential details sought (EDS) raised date: 17.03.2026

Respected Sir/Madam,

This is to inform you that we have submitted our Terms of Reference (TOR) application on the PARIVESH 2.0 portal on 13.03.2026 for the proposed mining project.

In this regard, the Expert Appraisal Committee (EAC) of the Ministry of Environment, Forest and Climate Change (MoEF&CC) has raised an Essential Details Sought (EDS), wherein it has been directed that the Project Proponent (PP) shall consult the State Water Resources Department and the State Pollution Control Board and obtain their recommendations for safeguarding the river.

Further, it is submitted that as per the toposheet of Survey of India and the Digital Supporting System (DSS) of MoEF&CC, the river adjacent to the block is indicated as Dudhsagar River, however Dudhsagar is at a distance of 18.4 km from the project site. And the river adjacent to the project area is known as Khandepar River as per the Water Resources Department (WRD), Government of Goa notification dated 02.09.2021.

In view of this, we request that the river name may kindly be considered as Khandepar River for official reference.



Part of O. P. Jindal Group

Received
CE, WRD,
Alto-Porvorim, Goa
403 521
18/03/2026
637



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We would also like to state that the Khandepar river which lies at 0.01 Km from the lease boundary has been shown in the Approved Mining Plan for which 50m safety buffer has been proposed.

In view of the above, we kindly request you to provide your recommendations for safeguarding the Khandepar River at the earliest, so as to enable us to comply with the statutory requirements stipulated by MoEF&CC and to facilitate further processing of our TOR application.

We assure you that all recommendations and conditions prescribed by your esteemed departments will be strictly implemented during the execution and operation of the project.

Thanking you.

Yours faithfully,

For JSW Steel Limited


Authorized Signatory



Encl: TOR Application
Environmental Plan



Part of O. P. Jindal Group

COMPREHENSIVE HYDROGEOLOGICAL REPORT ALONG WITH GROUNDWATER MODELLING REPORT



**Block-XII Codli Mineral Block,
Auctioned Block Area: 377.0881 ha
at
Village: Codli, Taluka: Dharbandora, District:
South Goa (Goa)**

**FRESH APPLICATION FOR DEWATERING –2296 m³/day
(736 m³/day SEEPAGE + 1560 m³/day RAINFALL
ACCUMULATION)**

**ASSESSMENT BLOCK: DHARBANDORA
CATEGORY: SAFE**

PROJECT PROPONENT



M/s. JSW Steel Limited
JSW CENTRE BANDRA KURLA COMPLEX,
NEAR MMRDA GROUNDS, BANDRA (EAST),
Mumbai-400051(Maharashtra)
E-mail: baswaraj.dalgade@jsw.in

NABET ACCREDITED CONSULTANT



J.M. EnviroNet Pvt. Ltd.
(NABET CERTIFICATE NO. NABET/GWCO/IA/GW018)
Emmar Digital Greens, Tower – B, Unit No. 1517, Golf Course
Ext. Road, Sector – 61, Gurugram (Haryana)
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Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

1 SALIENT FEATURES OF THE PROPOSAL

S. No	Particulars	Information
1.	Application No.	New application
2.	Fresh or Renewal	Fresh
3.	Existing or New/ Proposed	New
4.	If Renewal, date of validity of existing/ last NOC	NA
5.	CTO/CTE Issue Date	Proposed
6.	Name of Project with Address	Block-XII Codli Mineral Block, (Auctioned Block Area: 377.0881 ha) at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)
7.	State	Goa
8.	District	South Goa
9.	Block	Dharbandora
10.	Category of Block/ Taluka (as per prevailing GWRE)	Safe (GWRA, Goa 2024)
11.	Quantum of GW applied (m ³ /day)	Dewatering Quantum: 2296 m ³ /day
12.	Quantum of GW applied (m ³ /Year)	Dewatering Quantum: 8,38,040 m ³ /year
13.	Alluvium/ non-alluvium	Non-Alluvium
14.	Ground water modelling required (Yes/No)	Yes
15.	Consultant Details with Name of Authorized Signatory (If Institution)	J M Enivronet Pvt. Ltd. Dr. Deepa Taneja
16.	In case report is prepared jointly by accredited institute and individual consultant, name details of chapters prepared by the individual consultant	NA
17.	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)	Accreditation Certificate No.: QCI/NABET/ENV/GWCO/ACO/21/51 dated 23.09.2021 Date/ Validity: 08.09.2026

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

2 ABOUT THE PROJECT

JSW Steel Limited has been successfully declared as the Preferred Bidder for the grant of the Proposed Codli Mineral Block-XII, having an auctioned block area of 377.0881 ha, located at Village: Codli, Taluka: Dharbandora, District: South Goa, State: Goa, through an e-auction conducted by the Government of Goa. The Directorate of Mines & Geology, Goa, vide letter No. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024, has issued the Letter of Intent for the mineral block for a lease period of 50 years.

JSW Steel limited is proposing Codli Mineral Block - XII, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Table 1 Details of the Project

S. No.	Particular	Details
1	Mining Lease Area	377.0881 ha (Govt. Revenue Land: 236.3482 ha, Private Land: 58.9087 ha, Alvara Land: 15.8626, Forest Land: 65.9686 ha)
2	Nature of the Project	Opencast Fully Mechanized Iron Ore Mine
3	Project Proposal	Iron Ore: 3.50 Million TPA OB/Waste: 8.21 Million TPA Total Production: 11.71 Million TPA Crusher: 1 x 250 TPH & 2 x 90 TPH - Primary Crusher & 150 TPH of Secondary Crusher Dry Beneficiation/Screening Plant: 600 TPH Wet Beneficiation Plant: 2 x 300 TPH
4	Villages	Codli
5	Tehsil/Taluka	Dharbandora
6	District	South Goa
7	State	Goa
8	Coordinates	Latitude: 15°21'15.638" N to 15°19'42.607" N Longitude: 74°07'10.922" E to 74°08'39.034" E
9	Toposheet No.	Core Zone: D43C3_48I/3

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

		Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
10	Nearest water bodies	There is total 8 water bodies present within 10 km of study area: 1. Khandepar River Adjacent in North direction 2. Kale Nala ~0.7 km in ESE direction 3. Udnai Nala ~1.5 km in West direction 4. Panduranga Nala ~5.0 km in SW direction 5. Ragada Nala ~7.0 km in NNE direction 6. Sanguem or Zuvari River ~8.0 km in South direction 7. Jamboli Nala ~9.0 km in NE direction 8. Paroda River ~9.0 km in SSW direction
11	Seismic Zone Zone – III as per IS: 1893 (Part-I): 2002	Seismic Zone Zone – III as per IS: 1893 (Part-I): 2002
12	Wildlife Sanctuary, National Park, Biosphere Reserves within 10 km radius study area	There are no National Park, Biosphere Reserve or Corridor present within 10 Km of radius study area. 2 Wildlife Sanctuaries are present: ➤ Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE Direction) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction) ➤ Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction) Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025.
13	Reserve Forests (RF) / Protected Forest (PF) within 10 km radius study area	Unclassified Forest – Core zone Reserve Forest – ~0.5 Km in ENE Direction, ~1.0 Km in West Direction, ~2.5 Km in West Direction, ~4.0 Km in South Direction, ~6.5 Km in WSW Direction, ~7.0 Km in NNE Direction, ~8.0 Km in WSW Direction, ~8.5 Km in NW Direction, ~9.0 Km in West Direction.

Scope of Work:

- Assess groundwater levels, aquifer disposition, and monitor groundwater level and quality through regular field observations.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

- Analyse water level data and prepare groundwater level and groundwater table maps using secondary data. Collect, compile, and evaluate long-term groundwater level data for the preparation of hydrographs and assessment of seasonal groundwater level fluctuations.
- Estimate mine seepage in accordance with the mining plan and evaluate yearly water availability within the mine pits.
- Analyse the physiographic and geomorphological characteristics of the study area using field investigations, GPS observations, Survey of India (SOI) toposheets, and satellite imagery.
- Study the hydrogeological conditions and aquifer system within the core and buffer zones, including assessment of groundwater quantity and quality.
- Assess surface water features, drainage characteristics, and their hydraulic interaction with the groundwater regime.
- Develop a three-dimensional numerical groundwater flow model to simulate the existing hydrogeological conditions, calibrate the model using observed groundwater levels, and predict the impacts of proposed mining activities, including mine seepage, groundwater level fluctuations, drawdown, and Radius of Influence (ROI), under the planned mining scenario.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

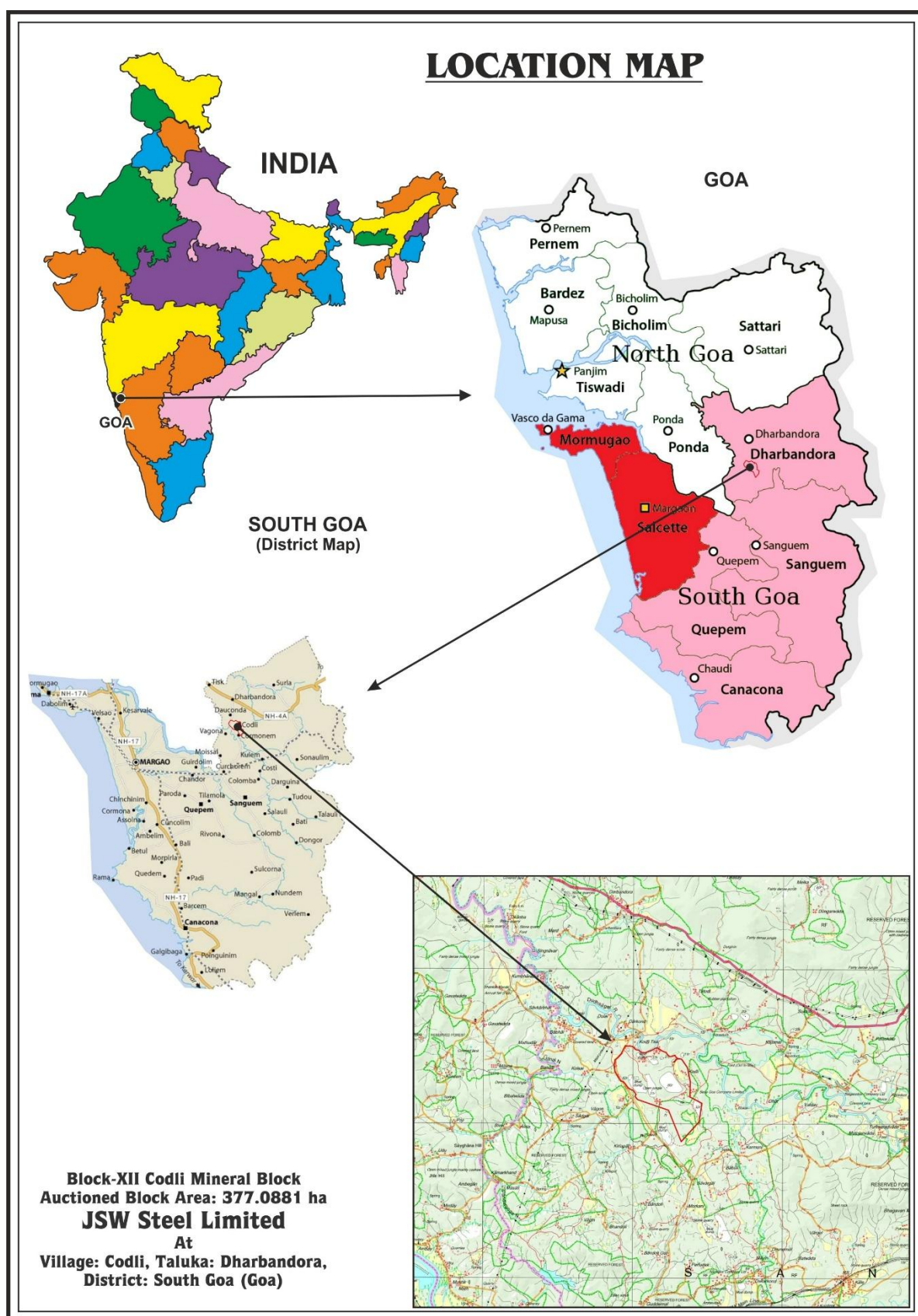


Figure 1 Location Map of the Study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

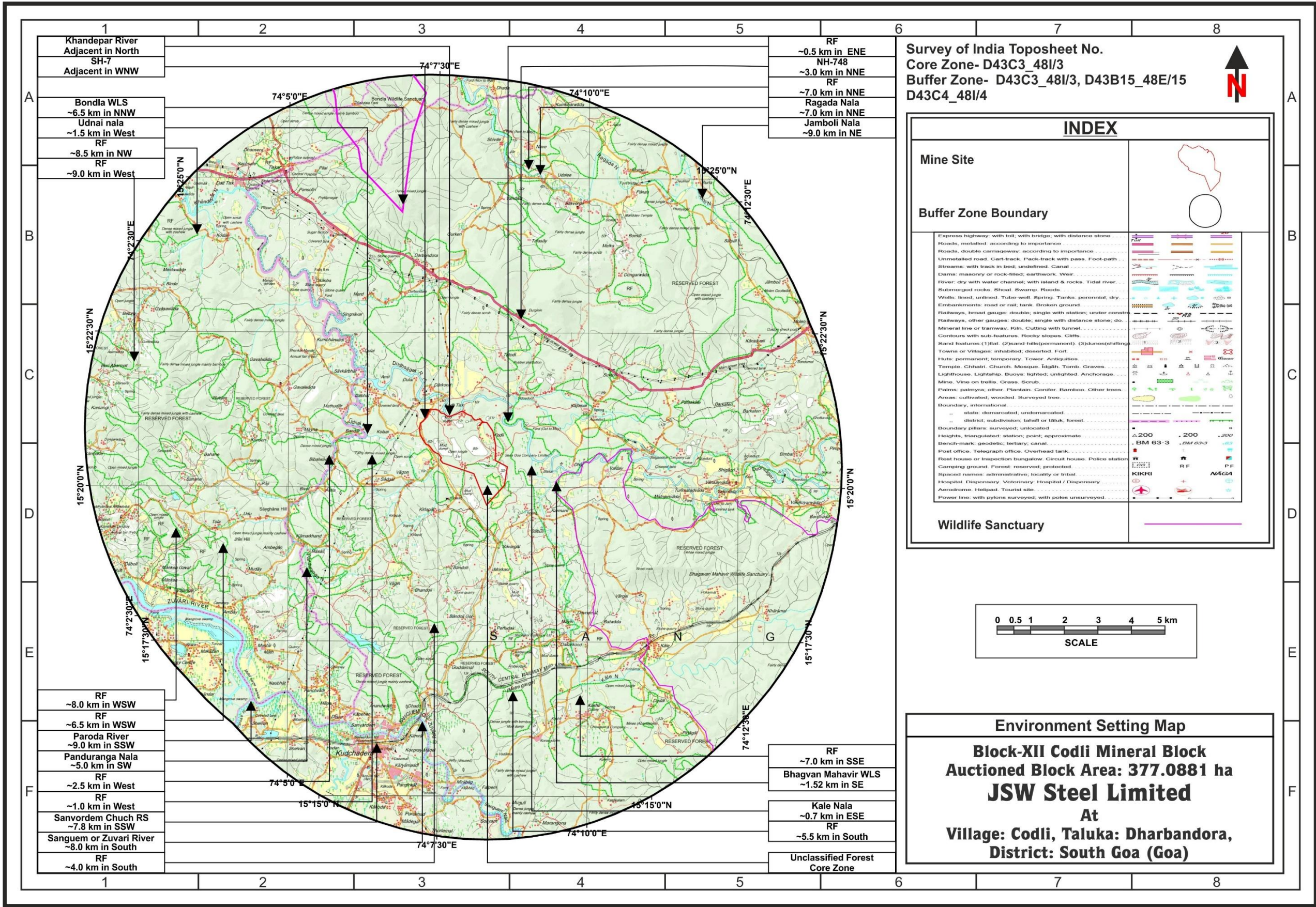


Figure 2 Environment Setting Map of the Study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

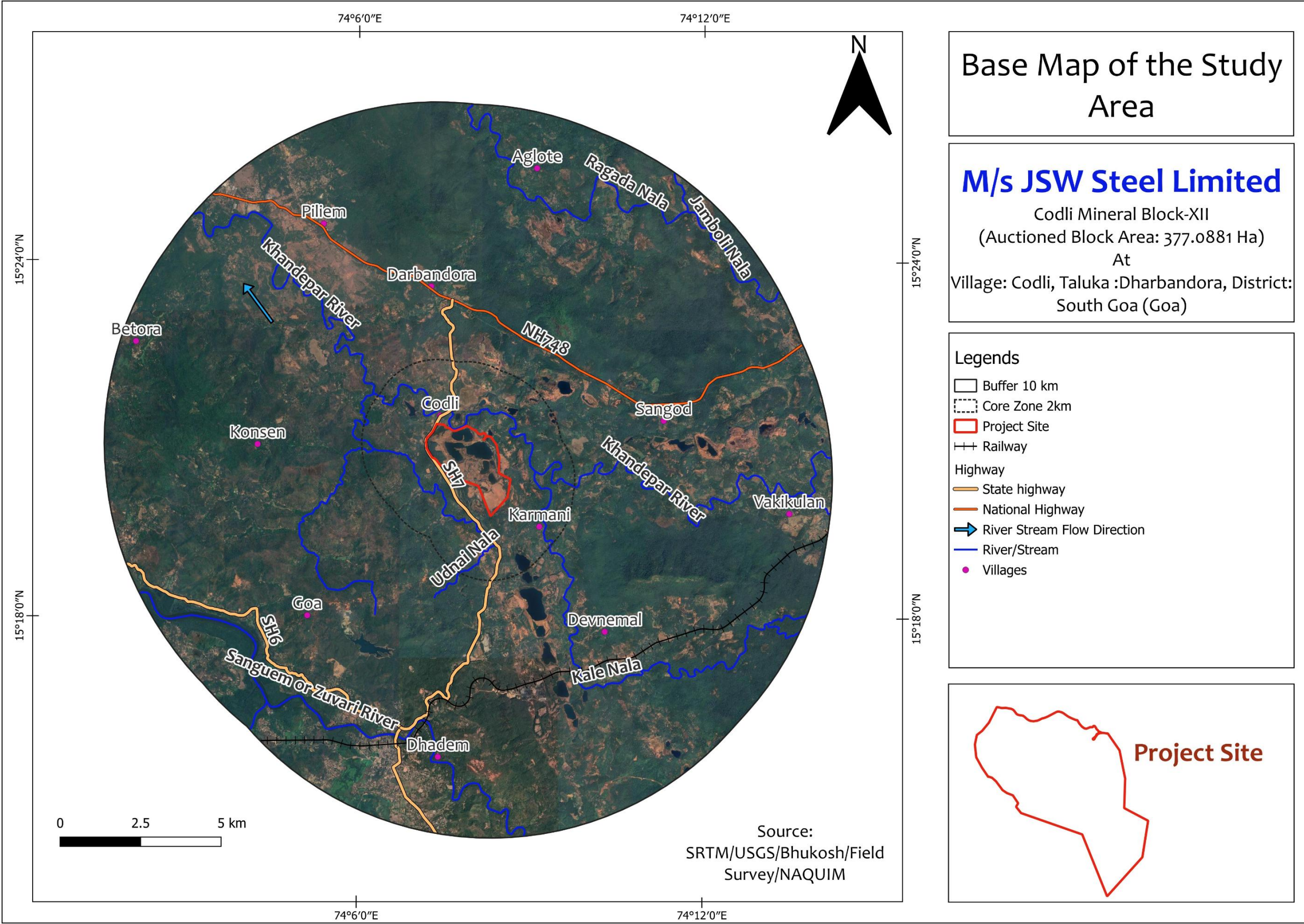


Figure 3 Base Map of the Study area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

2.1 RAINFALL DATA

The annual rainfall data for the period 2000–2024 indicate considerable inter-annual variability in rainfall over the study area. The recorded annual rainfall ranges from 2,367.6 mm in 2001 to 4,787.8 mm in 2024. Relatively high rainfall was also recorded during 2019 (4,315.7 mm) and 2020 (4,262.6 mm), whereas comparatively lower rainfall occurred during 2001, 2017 (2,593.3 mm), 2018 (2,480.6 mm), and 2015 (2,591.7 mm). The rainfall data demonstrate that the area receives substantial annual precipitation, although significant year-to-year fluctuations are evident. Such variations in rainfall influence groundwater recharge, groundwater-level fluctuations, and the overall groundwater regime of the study area. The rainfall dataset for 2000–2024 has therefore been considered for understanding the long-term rainfall pattern and its implications for groundwater conditions.

Table 2 Rainfall Data of 25 years (Source: IMD, Pune)

Year	Actual Rainfall (mm)	Year	Actual Rainfall (mm)	Year	Actual Rainfall (mm)
2000	3145.7	2010	3794.7	2020	4262.6
2001	2367.6	2011	3394.3	2021	3685.1
2002	2500.4	2012	2993.9	2022	2835.5
2003	2817.7	2013	3684.9	2023	3590.9
2004	2929.9	2014	2913.3	2024	4787.8
2005	3526.6	2015	2591.7		
2006	3484.3	2016	2984.5		
2007	3462.3	2017	2593.3		
2008	3075.7	2018	2480.6		
2009	2772.8	2019	4315.7		

*Source: IMD Pune

2.2 LAND USE/ LAND COVER OF THE SURROUNDING AREA

- To develop the Land Use & Land cover map using land coordinates of the mine area and a 10 km radius from the mine site (Buffer area).
- To Identify and mark the important Land use and Land cover features using the primary and secondary data collected.
- To evaluate the impacts on existing land use/cover features of the buffer area by the Proposed Project activities.
- To identify the mitigative measures for the sustainable use of land and to protect the buffer zone from adverse impacts.

Technical Specification of Used Satellite Imagery Data

For the preparation of the Land Use/Land Cover (LULC) thematic map of the study area, current vintage data from the Indian Remote Sensing Satellite RESOURCESAT-2A (LISS-IV) sensor has been utilized. The digital False Color Composite (FCC) imagery, procured from the National Remote

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Sensing Centre (NRSC), Hyderabad, served as the primary dataset for classification and interpretation. The Survey of India (SOI) Toposheets at 1:50,000 scale was used as reference for generating the base layers such as roads, rail network, settlement locations, and for accurate geo-referencing of the satellite imagery. Image processing, enhancement, and classification tasks were carried out using ERDAS Imagine 9.2 software.

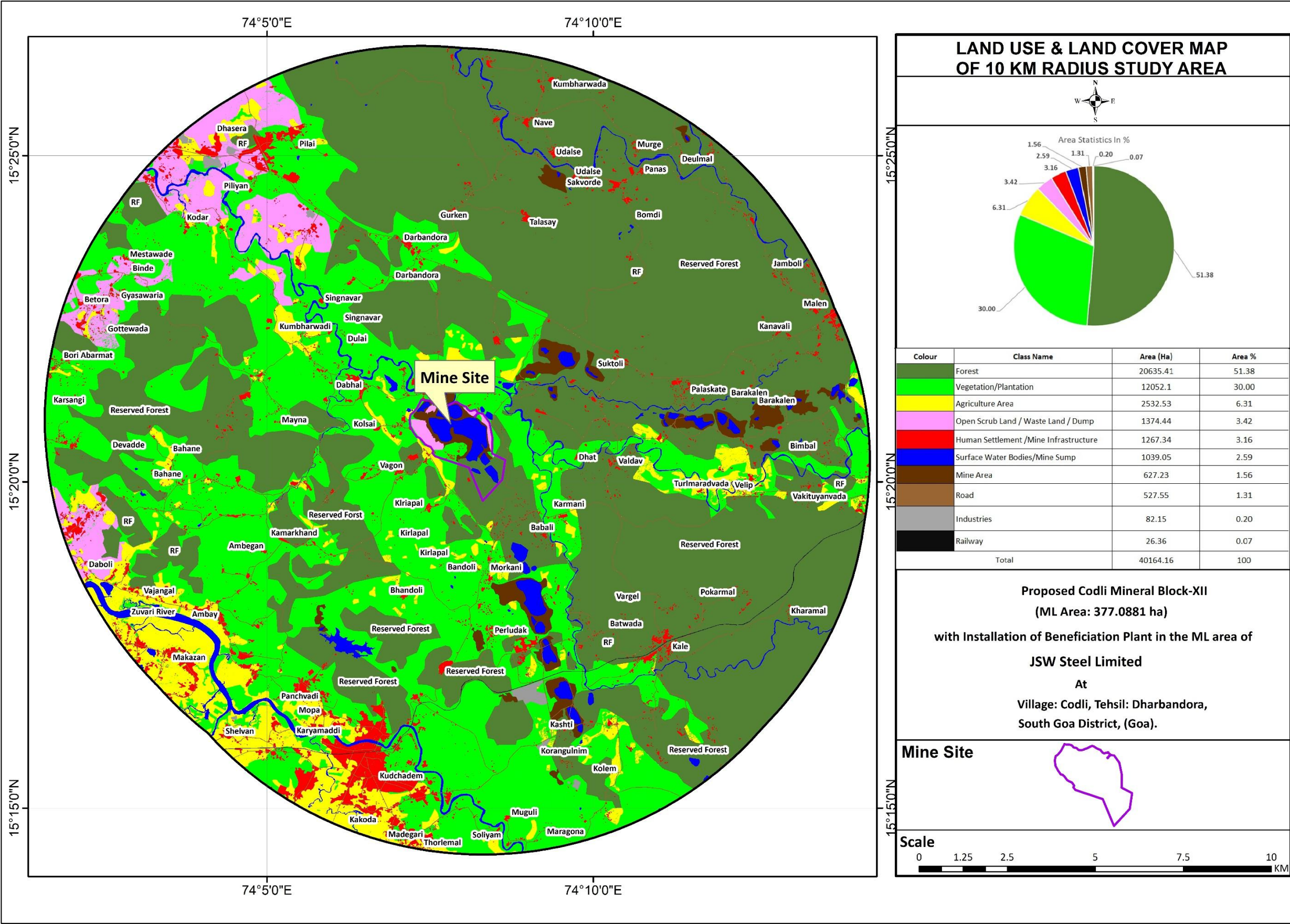
S. No.	Particular	Details
1.	Satellite Image	RESOURCESAT-2A (Sensor-Liss 4)
2.	Vintage Date	20.01.2025
3.	Satellite Data Source	NRSC, Hyderabad
4.	SOI Toposheets No	Core Zone: D43C3_48I/3 Buffer Zone: D43C3_48I/3, D43B15_48E/15, D43C4_48I/4
5.	Software Used	Earth Resources Data Analysis System (ERDAS) Imagine 9.2

The land use/land cover analysis of the 40,164.16-ha study area indicates that forest is the dominant land use category, occupying 20,635.41 ha (51.38%), reflecting the predominantly forested nature of the region. Vegetation/Plantation is the second largest category, covering 12,052.10 ha (30.00%), followed by agricultural land, which accounts for 2,532.53 ha (6.31%) of the total area. Among the remaining land use classes, open scrub land/wasteland/dump occupies 1,374.44 ha (3.42%), while human settlements and mine infrastructure cover 1,267.34 ha (3.16%). Surface water bodies, including mine sumps, constitute 1,039.05 ha (2.59%) of the study area. The existing mine area covers 627.23 ha (1.56%), and the road network occupies 527.55 ha (1.31%). Industrial land use is relatively limited, covering 82.15 ha (0.20%), whereas the railway network occupies only 25.36 ha (0.07%) of the total study area. The study area is predominantly characterized by forest and vegetation/plantation, which together account for approximately 81.38% of the total area, indicating a landscape largely covered by natural and semi-natural vegetation.

Table 3 LULC Classification

S. No.	Land Use/Land Cover Class	Area (ha)	Area (%)
1	Forest	20,635.41	51.38
2	Vegetation/Plantation	12,052.10	30
3	Agriculture Area	2,532.53	6.31
4	Open Scrub Land / Wasteland / Dump	1,374.44	3.42
5	Human Settlement / Mine Infrastructure	1,267.34	3.16
6	Surface Water Bodies / Mine Sump	1,039.05	2.59
7	Mine Area	627.23	1.56
8	Road	527.55	1.31
9	Industries	82.15	0.2
10	Railway	25.36	0.07
Total	Study Area	40,164.16	100

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)



Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

2.3 DEM / TOPOGRAPHY

Methodology

The CartoDEM Version 3 Release 1 (CartoDEM V3R1) with a spatial resolution of 30 m was downloaded from the Bhuvan Geoportal (NRSC-ISRO). The downloaded DEM was in GeoTIFF format and referenced to the WGS 84 coordinate system. The DEM was imported into QGIS (Version 3.40.14) and re-projected to the project Coordinate Reference System (CRS) using the Warp (Reproject) tool. During reprojection, the output raster resolution was maintained at 30 m × 30 m to preserve the original spatial resolution and terrain characteristics. The re-projected DEM was subsequently clipped to the study area boundary and used for the preparation of the model top elevation, terrain analysis, drainage delineation, slope assessment, and as the topographic input for the conceptual hydrogeological model and numerical groundwater flow model. The processed DEM was further verified using Survey of India (SOI) toposheets to cross-check the elevation values and contour intervals, thereby ensuring the accuracy and consistency of the topographic dataset used in the groundwater modelling study.

Buffer area

The topography of the study area was analysed using a Digital Elevation Model (DEM) to understand the terrain characteristics, drainage pattern, and elevation variations within the 10 km buffer zone and the mine lease area. The terrain is generally undulating, comprising low to moderately dissected denudational and structural hills separated by narrow valleys. Structural control and drainage incision have resulted in rugged relief with aligned ridges and valleys. A moderately dissected structural lower plateau is also present, representing remnants of an older erosional surface that has been modified by stream erosion and scarp development.

The elevation within the 10 km buffer area varies from approximately 347 m AMSL in the north-eastern part to 0 m AMSL in the south-western part, indicating an overall regional slope towards the southwest. The drainage pattern follows the natural topographic gradient, facilitating runoff from higher elevations towards the lower-lying areas.

Within the mine lease area, the existing surface elevation ranges from 109 m AMSL to -76 m AMSL. The minimum elevation of -76 m AMSL corresponds to the existing excavated mine pit and does not represent the natural ground level. The mine lease had been previously operated and extensively excavated by the erstwhile leaseholder prior to its reallocation. Therefore, the elevations shown in the approved mining plan reflect the current topographic condition of the already excavated mine pit rather than the original pre-mining terrain.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

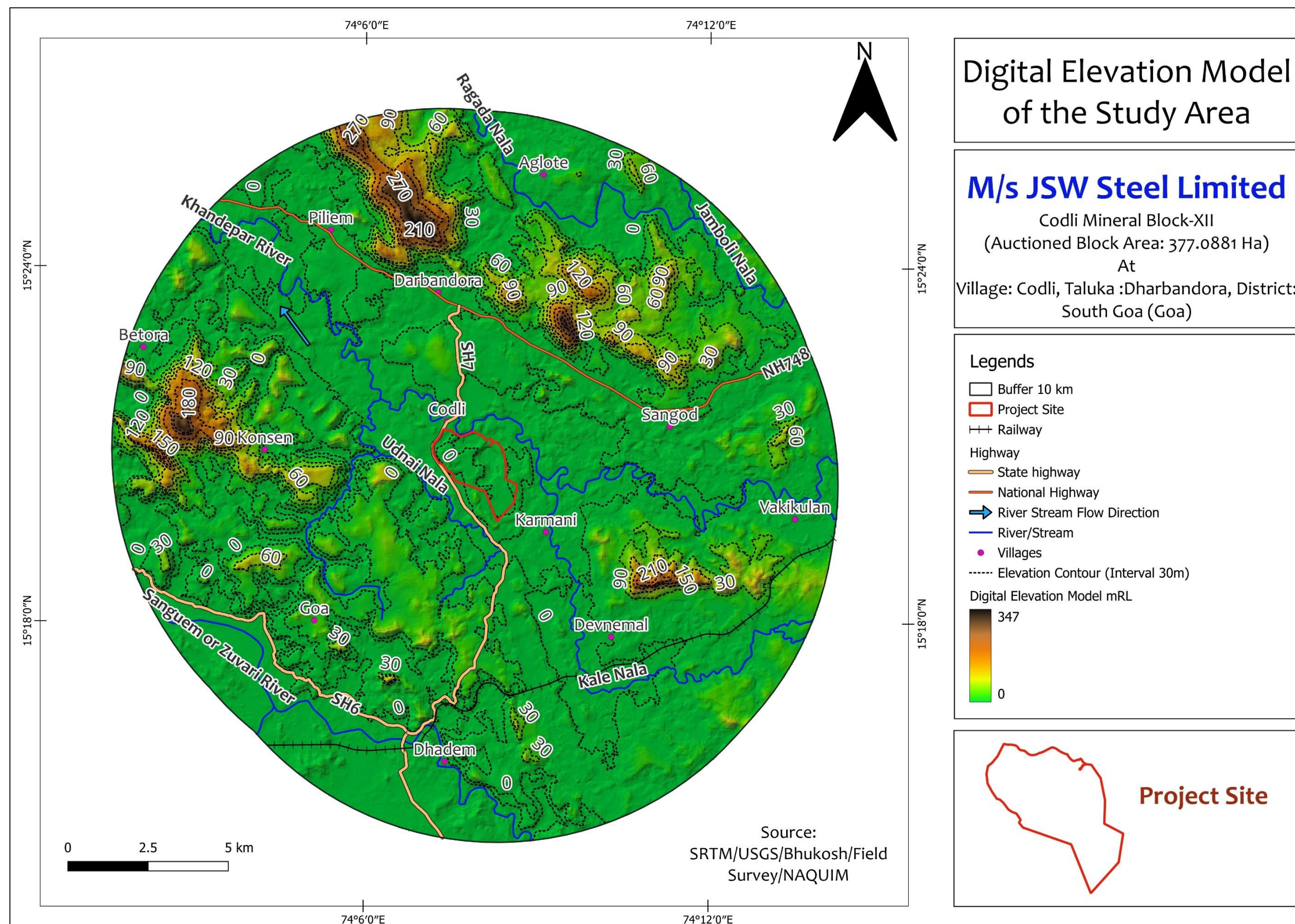


Figure 5 Digital Elevation Model of the Study Area (Source: <https://opentopography.org/>)

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

2.4 GEOMORPHOLOGY AND DRAINAGE

Regional Geomorphology

Goa is located on the slope of the Western Ghats. Some peaks of Sahyadri ranges of Western Ghats are in the Eastern part of the state. Physiographically, the state is divided into three morphological units 1) Highlands, 2) Midlands and 3) Coastal lands and geomorphology of Goa. (Source: GWRA GOA STATE 2024).

Geomorphology of Buffer area

The landform classification of the study area was carried out using the Geomorphology dataset published by the Geological Survey of India (GSI) at 1:50,000 scale. The GSI dataset is pre-classified and field-validated, with landforms categorized based on their geomorphic origin, morphology, geological structure, and dominant erosional or depositional processes. The downloaded geomorphology layer was imported into QGIS (Version 3.40.14) and re-projected to the project coordinate reference system (CRS), where required. The dataset was clipped to the study area boundary using the Clip tool, and the relevant geomorphological units were extracted. Since the dataset was already classified by GSI, no additional interpretation or reclassification of landforms was performed.

The buffer area is predominantly hilly terrain encircled by denudational and structural landforms, with younger and older coastal plains occurring mainly toward the southern and south eastern parts of the buffer area. Low and moderately dissected denudational hills and valleys extend widely across the central and western sectors, while low and moderately dissected structural hills and valleys are concentrated more toward the Northeast and southwest. The moderately dissected structural lower plateau appears as patches around the central part near Codli and Karmane, representing higher erosional remnants, whereas pediment–pediplain complexes and older coastal plains are developed mainly in the southern and southwestern margins.

Regional Drainage

The state is predominantly drained by west-flowing rivers. The high hill ranges of the Western Ghats act as the main watershed, from which numerous streams arise and flow westward to join the Arabian Sea or merge with major rivers. The Ugem and Guloli rivers of the highlands unite to form the Sanguem River, which then flows northwest and becomes the Zuari River. The Kushavati and Kumarzuva rivers are important tributaries of the Zuari, the latter joining it at Sankawali. The Sal River flows roughly parallel to the coast and enters the Arabian Sea near Betul. Most of the state lies within the basins of two major rivers, the Mandovi and the Zuari, while the Terekhol River forms

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

the northern boundary with Maharashtra. Additional smaller rivers draining the state include the Chapora, Baga, Saleri, Sal, Talpona and Galgibag. (Source: GWRA GOA STATE 2024).

Drainage of 10 km buffer Zone

Drainage analysis was carried out using the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) to understand the hydrological characteristics and surface runoff behaviour within the 10 km radius study area. Initially, the DEM was pre-processed using the Fill DEM tool to remove depressions and sinks, ensuring a hydrologically correct surface. The filled DEM was then used to derive the Flow Direction grid based on the steepest descent algorithm. Using an appropriate accumulation threshold, the drainage network was extracted and vectorised as stream channels. The streams were then systematically ordered using the Strahler Stream Ordering method, allowing classification into 1st order, 2nd order, and 3rd order streams.

The drainage map of the study area indicates a well-developed dendritic to sub-dendritic drainage network, comprising streams of first to fourth order. The study area is drained predominantly by the Khandepar River and its associated tributary streams, along with local drainage channels such as Raggad Nala, Jamboli Nala, Undnai Nala, Pandurangsa Nala, and Kale Nala. The drainage network exhibits a higher density of lower-order streams, which progressively join to form higher-order drainage channels. The Khandepar River flows predominantly from the northwest towards the southeast/east, while the local tributaries generally follow the natural topographic gradient and ultimately contribute to the major drainage system. Within the buffer zone, the drainage morphology manifests a pronounced dendritic pattern, characterized by intricately interlinked streams spanning 1st to 4th order.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

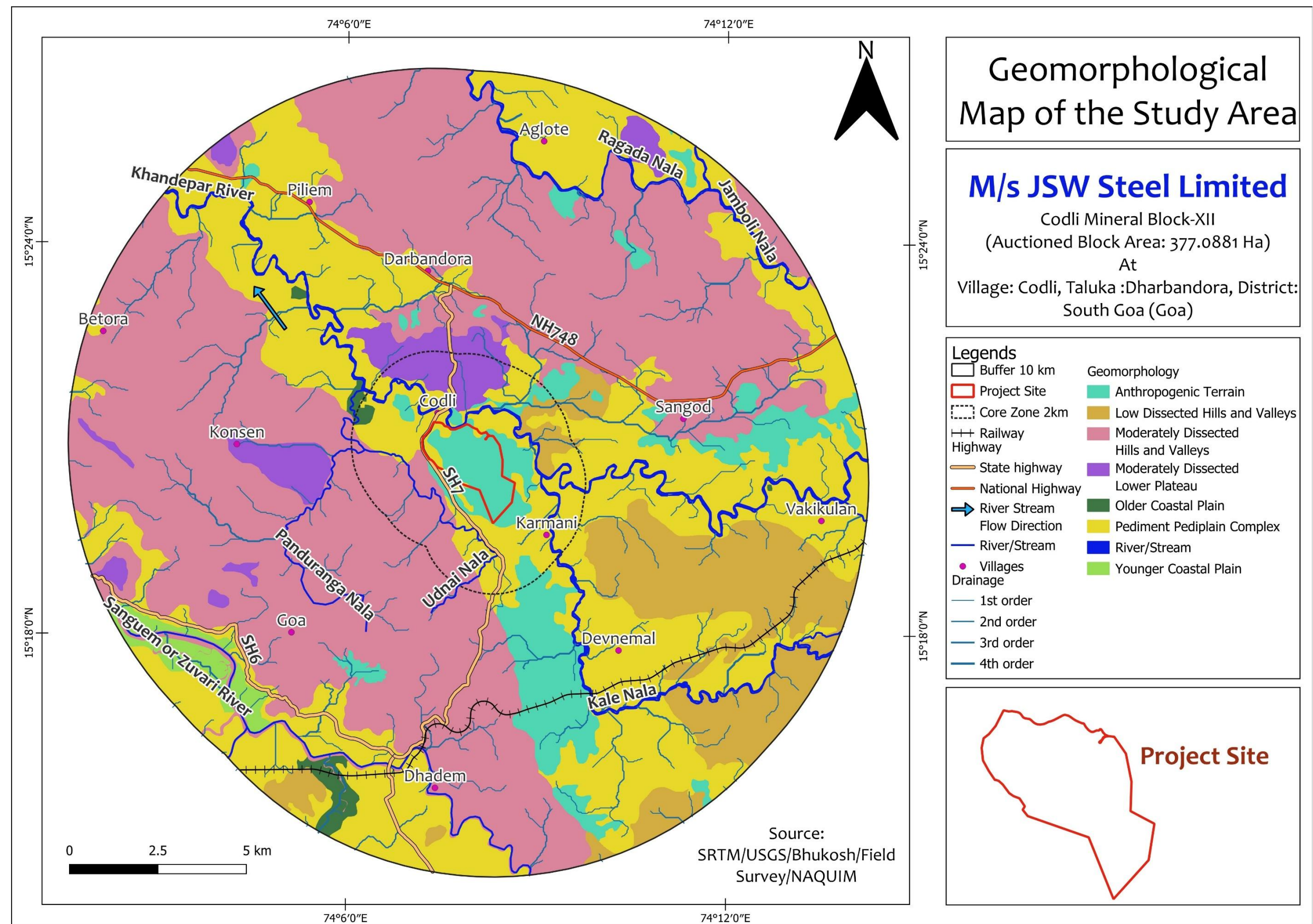


Figure 6 Geomorphology along with Drainage pattern of the Study area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

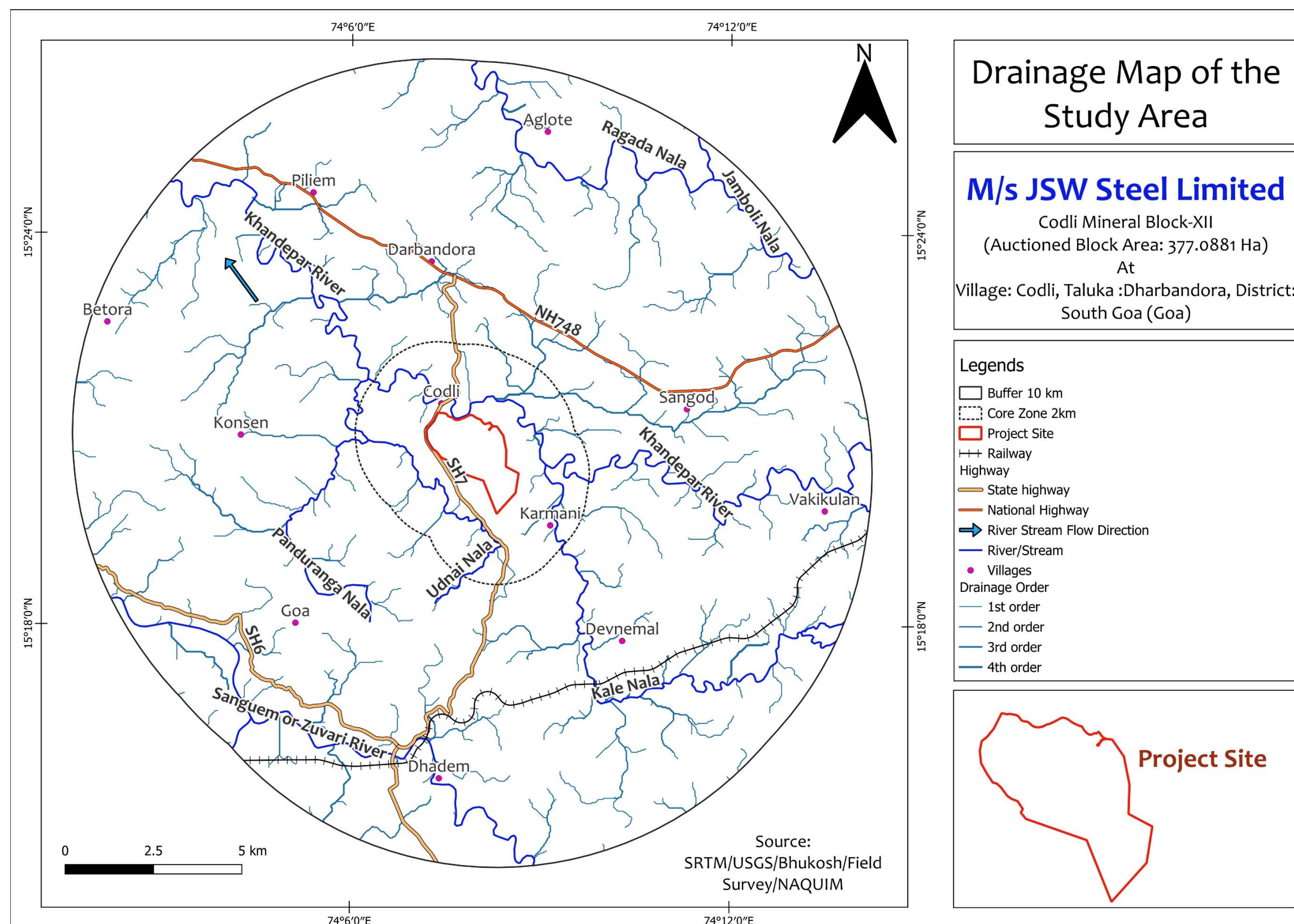


Figure 7 Drainage map of the Study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

2.5 DETAILS OF WETLANDS/ MAJOR WATER BODIES

As per the Ramsar Convention, Nanda Lake is the only Ramsar Site in the State of Goa. It is located at an aerial distance of approximately 11.5 km towards the south-west of the proposed mine site and lies outside the study area/buffer zone. Therefore, the proposed mining project is not expected to have any direct impact on the Ramsar Site.

In addition, as per the Goa State Wetland Authority (GSWA) inventory, major wetlands and water bodies in the surrounding region include Betal Temple Lake, Panchami Lake, Conex Lake, Tarvalem Lake (Water Reservoir), Cottombi Lake, Xeldem Lake, and Nanda Lake. All these wetlands and water bodies are located outside the designated buffer zone of the proposed mine site. Accordingly, no notified wetland or major water body occurs within the study area, and no direct impact on these ecologically important water bodies is anticipated from the proposed mining activities.



Figure 8 Wetland declared by Ramsar Site (Source: <https://rsis Ramsar.org> and <https://gswa.goa.gov.in/>)
The major water bodies within the core and buffer zone of the Mine Site are as follows.

1. Khandepar River Adjacent in North direction
2. Kale Nala ~0.7 km in ESE direction
3. Udnai Nala ~1.5 km in West direction
4. Panduranga Nala ~5.0 km in SW direction

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5. Ragada Nala ~7.0 km in NNE direction
6. Sanguem or Zuvari River ~8.0 km in South direction
7. Jamboli Nala ~9.0 km in NE direction
8. Paroda River ~9.0 km in SSW direction

3. HYDROGEOLOGY

3.1 GEOLOGICAL SETUP

Regional Geology

Most part of the Goa is covered by rocks belonging to Archaean Dharwar Super Group referred in Goa as Goa group represented by Barcem Formation, Vageri Formation, Bicholim Formation and Sanvordem Formation which are overlain by a younger rock. The common rock types exposed are Quartz-Sericite Schist, Quartz Chlorite Schist, Phyllite with BIF, Meta-graywacke, Argillite, Limestone, Metarhyolite and Metabasalt. The general strike of the Dharwarian rocks is NW SE. All these rocks have suffered greenschist facies metamorphism. A small portion of the area in the northern part is covered by Deccan Traps. Most of the Goan iron ore deposits are associated with iron ore formations of Bicholim group of rocks. These iron ore formations are covered by thick laterite capping of 15 to 20 m followed by lumpy ore, powdery iron ore with intercalations of manganiferous and phyllitic clay. Intensely weathered quartzites with manganiferous clay/phyllite form are seen along the foot wall of iron formation rocks. (Approved Mining plan).

Figure 9 Stratigraphic Succession of the Dharwar Super Group (After GSI)

Era	GROUP	FORMATION	LITHOLOGY
Quaternary	-	-	Beach sands and river alluvium
Pliocene to Pleistocene	-	-	Laterite and aluminous laterite
Late Cretaceous to Paleocene	Deccan Trap	-	Continental flood basalts mainly tholeiitic type with dykes
Palaeo Proterozoic to Meso Proterozoic	Closepet Granite	Chandranath Granite, Dudsagar Granite, Canacona Granite	Alkaline granites mainly also variants from monzo granite to grano diorite
Archaean to Palaeo Proterozoic	Mafic -ultramafic Layered Complex Goa Group of Dharwar Super Group	-	Pridotite-chromite-dunite-abbronorite, pyroxenite
		Vageri	Carbonate-quartz-chlorite Bicholim schist/greywacke
		Bicholim	Dolomitic limestone
			Quartz-sericite schist
			Banded Iron Formation

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			Quartz-chlorite-biotite schist inter-layered with chert, iron and Mn oxides, carbonates, metabasalt and meta-gabbro
		Sanvordem	Quartzite/greywacke with Conglomerate
		Barcem	Quartz-chlorite schist
			Meta-acid volcanic (meta- rhyodacite), quartz porphyry, tuff
			Meta-basalt, meta-gabbro and meta - anorthositic gabbro, quartzite
Archaean	Peninsular Gneiss-II	Ankola Gneiss, Anmod Ghat Gneiss	Migmatite and granites (s.1); tonalite trondjemite-granodiorite

Local Geology

The Codli Mineral block comprises rocks belonging to Bicholim Group of rocks Formation of Dharwar Supergroup. This iron ore deposit within the Codli Mineral block is part of South Goa Formation. The iron ore deposits are found in small mounds of hillocks in a generally low undulating landmass and are locally known as Codli-Daucona hillock. Based on the exploration data, the ore body has been systematically delineated both structurally and qualitatively. The deposit occurs as discrete synclinal basins with top lateritic cover often enriched with iron content in isolated pockets. Concentration of ore is due to supergene enrichment. The ore body is intercalated with phyllites, manganiferous clays and limonitic clays. Due to active mining in the area iron ore zones are exposed in the mining pits. Few of the pits which are either exhausted required concentration of ore or reached ultimate pit level are back filled with the tailings which also contain Fe concentration by the erstwhile lessees. Due to igneous activity, a number of weathered and altered intrusive bodies exist mostly in the form of clays along and across the ore body. Altered intrusive of doleritic composition show cross cutting relationship with majority of the litho-units.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

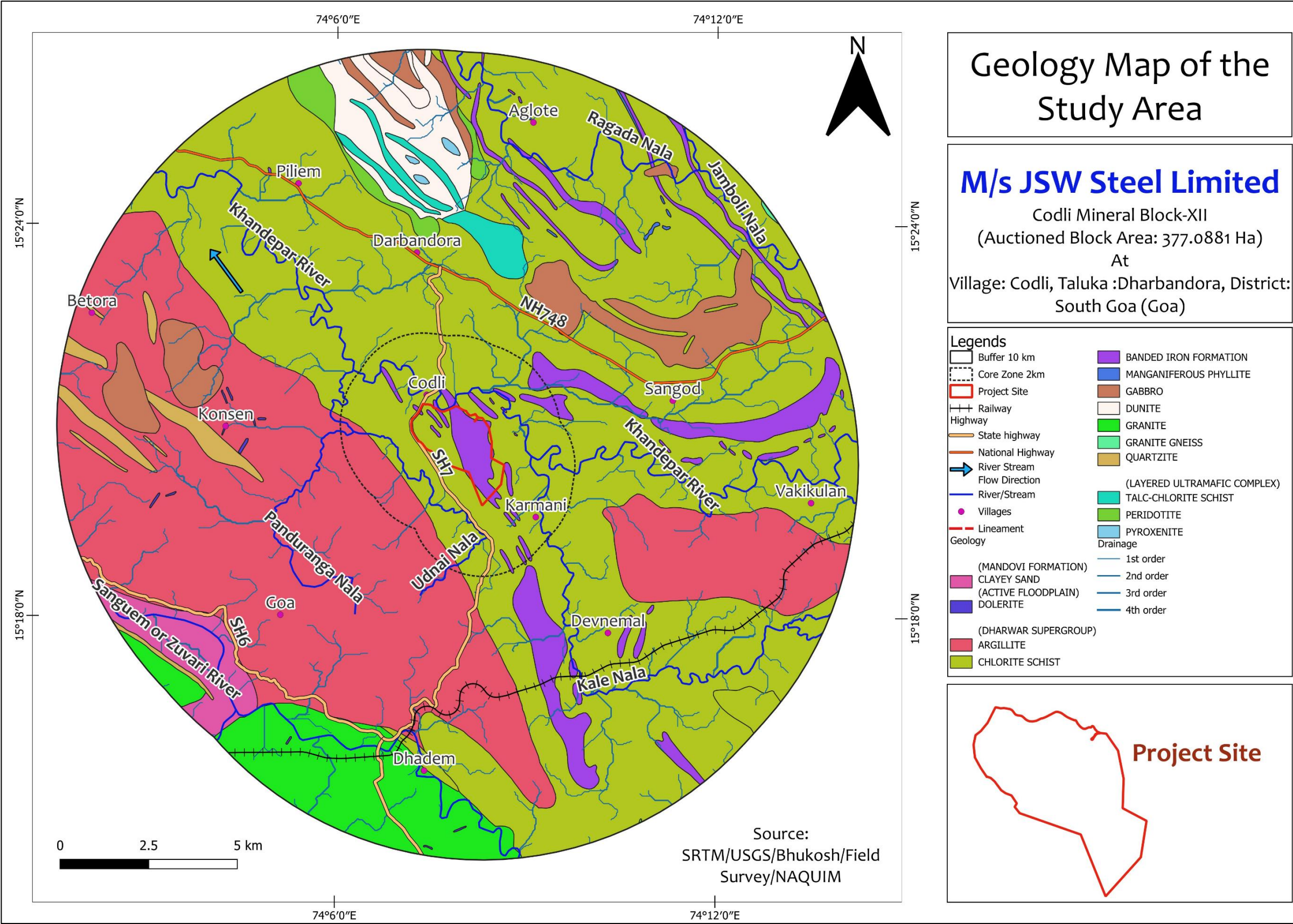


Figure 10 Geology of the study area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

3.2 GEOPHYSICAL STUDIES

The Block-XII Codli Mineral Block, covering an auctioned area of 377.0881 ha, has already been investigated through systematic borehole exploration to delineate and interpret the subsurface lithological conditions. The available borehole data provide adequate information regarding the subsurface geology and aquifer characteristics required for hydrogeological assessment and groundwater modelling. Therefore, considering the availability of sufficient subsurface information from borehole exploration, a separate geophysical survey is not considered necessary for the project.

3.3 HYDROGEOLOGICAL SETUP

Based on lithology and groundwater occurrence, the hydrogeological regime of the study area is classified into two distinct aquifer systems:

- i. Aquifer-I (Phreatic Aquifer): Aquifer-I comprises laterite and alluvial formations, including the weathered zones of meta-volcanic and metasedimentary rocks. This aquifer occurs under unconfined (phreatic) conditions and forms the primary shallow groundwater system.
- ii. Aquifer-II (Fractured Aquifer): Based on regional hydrogeological characterization and the NAQUIM (National Aquifer Mapping) report of Goa, the deeper fractured aquifer system (Aquifer-II) in the study area is represented by jointed and fractured metasedimentary rocks, including Schist, phyllitic clay formations.

3.3.1. Aquifer characteristics

As per the hydrogeological assessment carried out by the Water Resources Department, Government of Goa, in association with the Central Ground Water Board (CGWB), South Western Region, under the Department of Water Resources, River Development & Ganga Rejuvenation, Ministry of Jal Shakti, Government of India (March 2025), the study area comprises two principal aquifer systems: the Weathered Zone (Aquifer-I) and the Fractured Zone (Aquifer-II).

As per the approved Mining Plan and exploration data, the hydrogeological sequence at the mine site comprises a lateritic formation overlying phyllitic and manganiferous clay horizons. The laterite forms the upper unconfined aquifer with an average thickness of approximately 20 m. Beneath the laterite, the phyllitic and manganiferous clay units extend from about 20 m to 120 m below ground level, with an average thickness of approximately 100 m. Owing to their low permeability, these clay-rich formations act as an aquitard, restricting the vertical movement of groundwater and hydraulically separating the shallow lateritic aquifer from the underlying formations.

The study area comprises two principal aquifer zones, namely the Weathered Zone (Aquifer-I) and the Fractured Zone (Aquifer-II). The Weathered Zone (Aquifer-I) is predominantly represented by

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weathered laterite and has an approximate thickness of 20 m. The transmissivity (T) of this aquifer is estimated at approximately 200 m²/day, based on WRIS data, with a hydraulic conductivity (K) of about 10 m/day. The Fractured Zone (Aquifer-II) comprises fractured phyllitic and manganiferous clay, with a thickness ranging from approximately 20 to 120 m. The transmissivity of Aquifer-II is estimated at 17.3 m²/day, based on pumping test results, while the corresponding hydraulic conductivity is approximately 0.173 m/day.

Table 4 Aquifer Parameter

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology (Source Mining Plan)	Weathered Laterite (Unconfined aquifer)	Weathered/Fractured phyllitic and manganiferous clay
Thickness range (m)	20 m	20- 120 m
Specific Yield	3	-
T (m ² /day)	200 (WRIS)	17.735 (Pumping Test)
K (m/day)	10	0.1735

Source: WRIS/Dynamic groundwater resources Goa District 2024/Pumping test

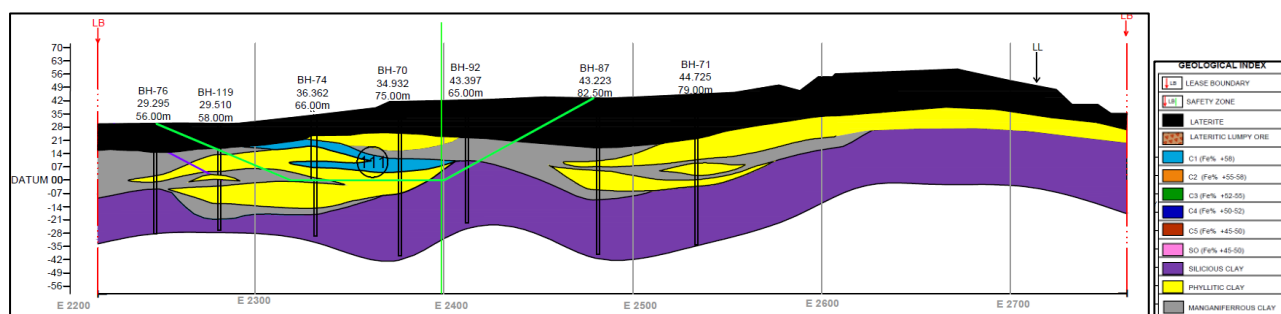


Figure 11 Cross Section of Geological Formation

Aquifer Pumping Test (Apt)

A pumping test was conducted on the borewell to determine the aquifer characteristics, groundwater potential, and sustainable yield of the well in the project area. Pumping tests are commonly carried out to evaluate important hydrogeological parameters such as transmissivity, hydraulic conductivity, and specific capacity of the aquifer. The test also helps in understanding the response of the aquifer to groundwater abstraction and the recovery behavior after pumping.

Type of Well	Borewell
Location of Well	Darbandora
Latitude	16.11666667
Longitude	74.35
Depth of Well	55

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Methodology and Formula Used for Pumping Test Analysis

The recovery test data obtained after stopping the pump was analyzed using the Jacob Recovery Method (Theis recovery method) to determine the aquifer parameters such as transmissivity and hydraulic conductivity. This method is widely used for pumping test analysis in confined and semi-confined aquifers when recovery data is available.

Before starting the pumping test, the static water level (SWL) in the borewell was measured and recorded at 7 meters below ground level (mbgl). The borewell was then pumped at a constant discharge rate of 7107 litres per hour (LPH). This discharge rate is equivalent to 1.9 litres per minute (LPM) or 170.568 cubic meters per day (m^3/day).

During the pumping phase, water level measurements were taken at different time intervals such as 1 minute, 3 minutes, 5 minutes, 10 minutes, and progressively longer intervals up to 500 minutes of continuous pumping. These measurements helped in understanding how the aquifer responds to groundwater withdrawal over time.

At the end of the pumping phase, the pump was switched off and the recovery of the water level was monitored. The recovery data was recorded at regular time intervals to observe how quickly the groundwater level returned toward its original static condition.



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Pumping Test Observation

During the pumping phase, the groundwater level in the borewell showed a gradual decline as pumping continued. At the start of the pumping test, the water level dropped rapidly due to the immediate response of the aquifer to pumping. As the pumping continued, the rate of drawdown gradually decreased, indicating stabilization of the aquifer system.

The water level declined from the initial 7 mbgl to 16 mbgl after 500 minutes of pumping, resulting in a maximum drawdown of 9.0 meters. The gradual increase in drawdown over time indicates that the aquifer was able to sustain the pumping rate without excessive decline in water level.

The stabilization trend observed in the drawdown data suggests that groundwater flow towards the well was occurring through the surrounding aquifer formation, thereby maintaining a balance between abstraction and recharge.

Table 5 Observation Table of Pumping Test

Time (min)	Water Level (mbgl)	Drawdown (m)
0	7	0
1	8.3	1.3
3	8.9	1.9
5	10.5	3.5
10	11.9	4.9
15	12.5	5.5
20	12.8	5.8
30	13	6
45	13.3	6.3
60	13.4	6.4

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90	13.68	6.68
100	13.7	6.7
120	13.8	6.8
135	13.9	6.9
150	13.9	6.9
165	13.9	6.9
170	13.9	6.9
200	14.1	7.1
230	14.4	7.4
280	14.7	7.7
320	14.8	7.8
350	15.2	8.2
370	15.4	8.4
410	15.6	8.6
450	15.9	8.9
480	15.9	8.9
500	16	9

*Field Visit

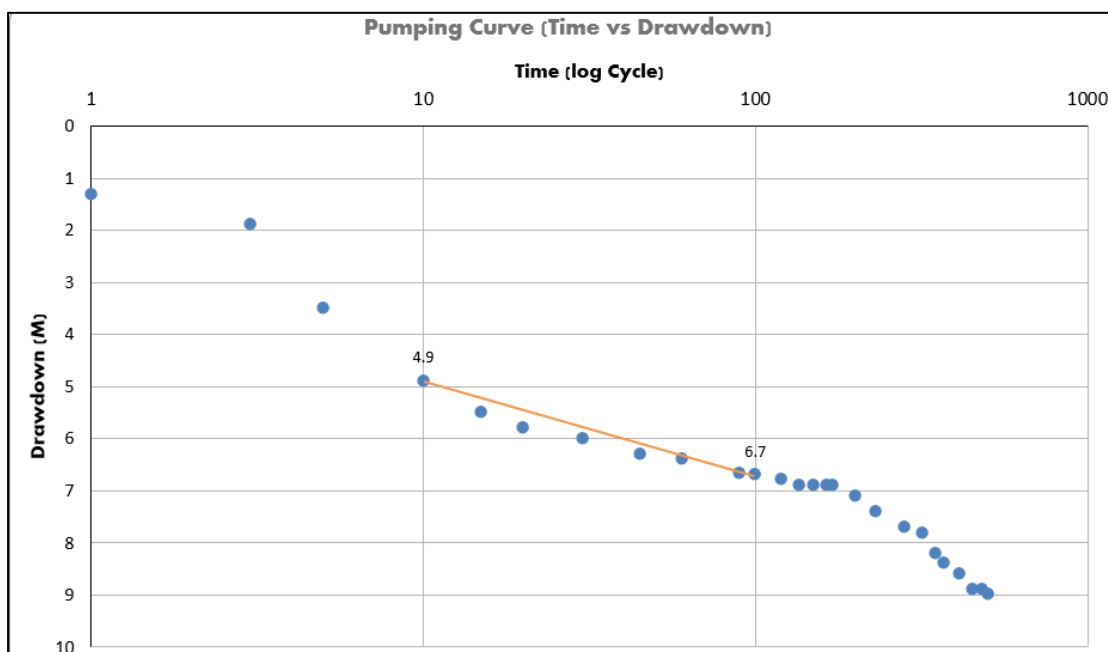


Figure 12 Time vs Drawdown (Pumping Test)

Recovery Test after pumping

After the completion of the pumping phase, the pump was switched off and the groundwater level recovery was monitored. The recovery data indicates that the water level started rising immediately after the pumping stopped.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Within the first few minutes, the water level showed rapid recovery, which indicates good hydraulic connectivity within the aquifer system. As time progressed, the recovery rate gradually slowed down as the water level approached the original static condition. The water level recovered from 16 mbgl to 7 mbgl within approximately 220 minutes, indicating that the aquifer has good recharge characteristics. The rapid recovery of the groundwater level after pumping suggests that the aquifer has adequate groundwater storage and replenishment capacity.

Table 6 Recovery Test after pumping

Time After Pump Stop (min)	Water Level (mbgl)	Residual Drawdown (m)
0	16	9
1	15.45	8.45
2	15.05	8.05
3	14.72	7.72
5	14.2	7.2
10	13.55	6.55
15	13.1	6.1
20	12.75	5.75
25	12.45	5.45
30	12.18	5.18
40	11.72	4.72
50	11.35	4.35
60	11.05	4.05
75	10.65	3.65
90	10.3	3.3
100	10.08	3.08
120	9.65	2.65
135	9.35	2.35
150	9.08	2.08
165	8.8	1.8
180	8.48	1.48
195	8.05	1.05
210	7.55	0.55
220	7	0

*Field Visit

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Figure 13 Log Time vs Residual Drawdown (Recovery Test – Jacob Method)

Method of Analysis

The pumping test data obtained from the recovery phase was analyzed using the Jacob Recovery Method, which is derived from the Theis solution for groundwater flow in confined aquifers. This method is widely used in hydrogeological investigations because it provides reliable estimates of aquifer transmissivity using recovery data.

In this method, the residual drawdown (difference between pumping water level and recovered water level) is plotted against the logarithm of time since pumping stopped. The slope of the straight-line portion of the semi-log plot (Δs per log cycle) is used to calculate the transmissivity of the aquifer.

The transmissivity is calculated using the following formula:

$$T = \frac{2.3Q}{4\pi\Delta s}$$

Where:

T = Transmissivity of aquifer (m²/day)

Q = Discharge rate of the well (m³/day)

Δs = Change in residual drawdown per log cycle (m)

π = Constant (3.1416)

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The hydraulic conductivity (K) of the aquifer is then estimated using the relation:

$$K = \frac{T}{b}$$

Based on the analysis of the pumping and recovery test data, the following aquifer parameters were estimated:

Figure 14 Aquifer Parameters

Parameter	Value
Static Water Level (mbgl)	7
Discharge Rate (LPH)	7107
Q (Litre/min)	1.9742
Q(m ³ /day)	170.568
Max Pumping WL (mbgl)	16
Maximum Drawdown (m)	9
Specific Capacity (m ³ /day/m)	18.95
Slope (Δs per log cycle)	1.8
Transmissivity (m ² /day)	17.35
Depth of Well (m)	55
Hydraulic Conductivity (m ² /day)	0.31

The specific capacity of the well was calculated by dividing the discharge rate by the maximum drawdown observed during pumping.

The pumping test results indicate that the aquifer underlying the project area has moderate groundwater yielding characteristics. The transmissivity value of 17.35 m²/day indicates that the aquifer has moderate capacity to transmit groundwater through the geological formation. Similarly, the estimated hydraulic conductivity of approximately 1.003 m/day suggests moderate permeability of the aquifer material.

The specific capacity value of 18.95 m³/day per meter of drawdown indicates that the borewell has a moderate groundwater production potential. This value suggests that the well can sustain groundwater abstraction without causing excessive drawdown.

Another important observation from the test is the rapid recovery of groundwater level within 170 minutes after stopping the pump.

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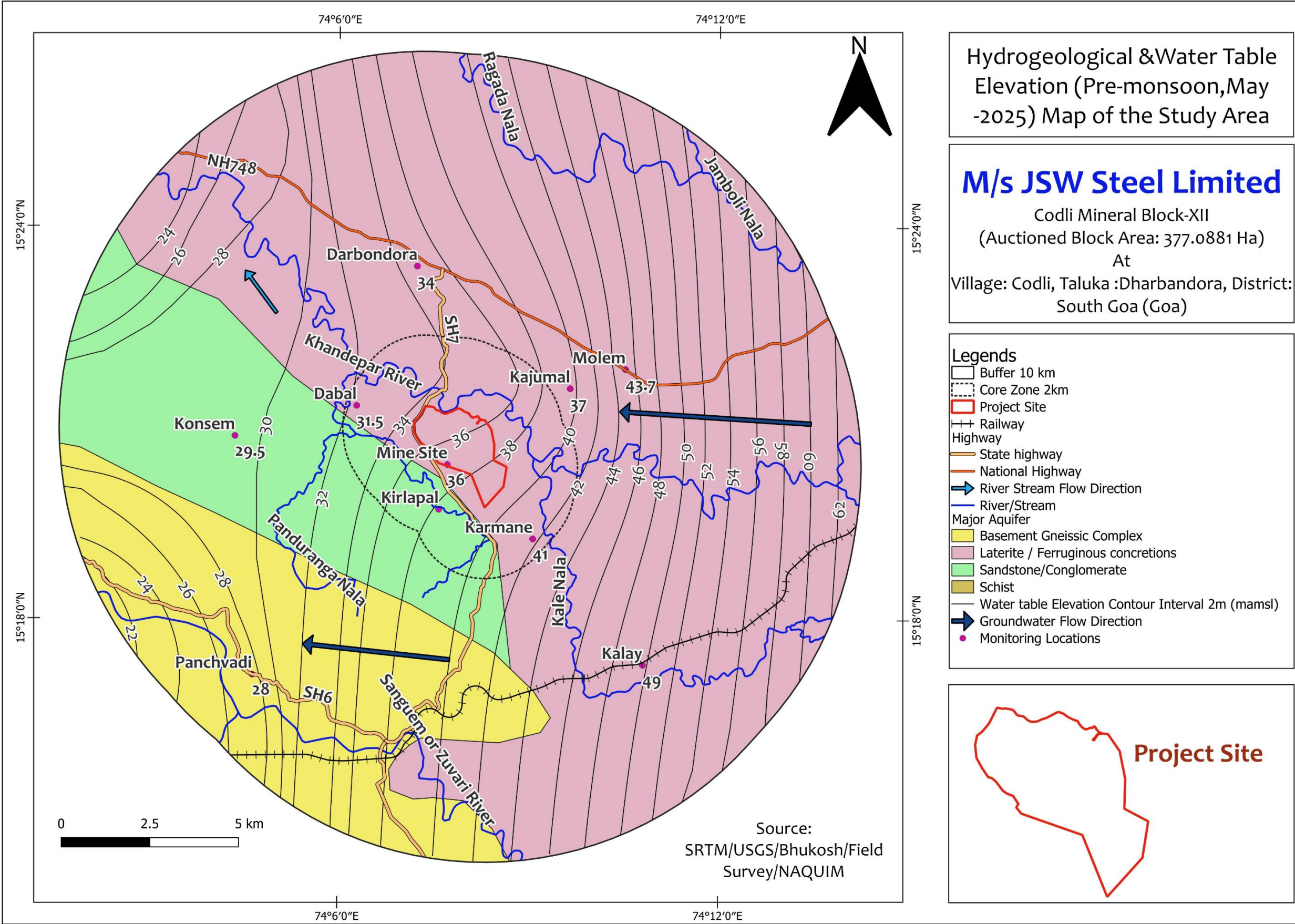


Figure 15 Hydrogeological and water table contour map (pre-monsoon, May-2025) of study area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

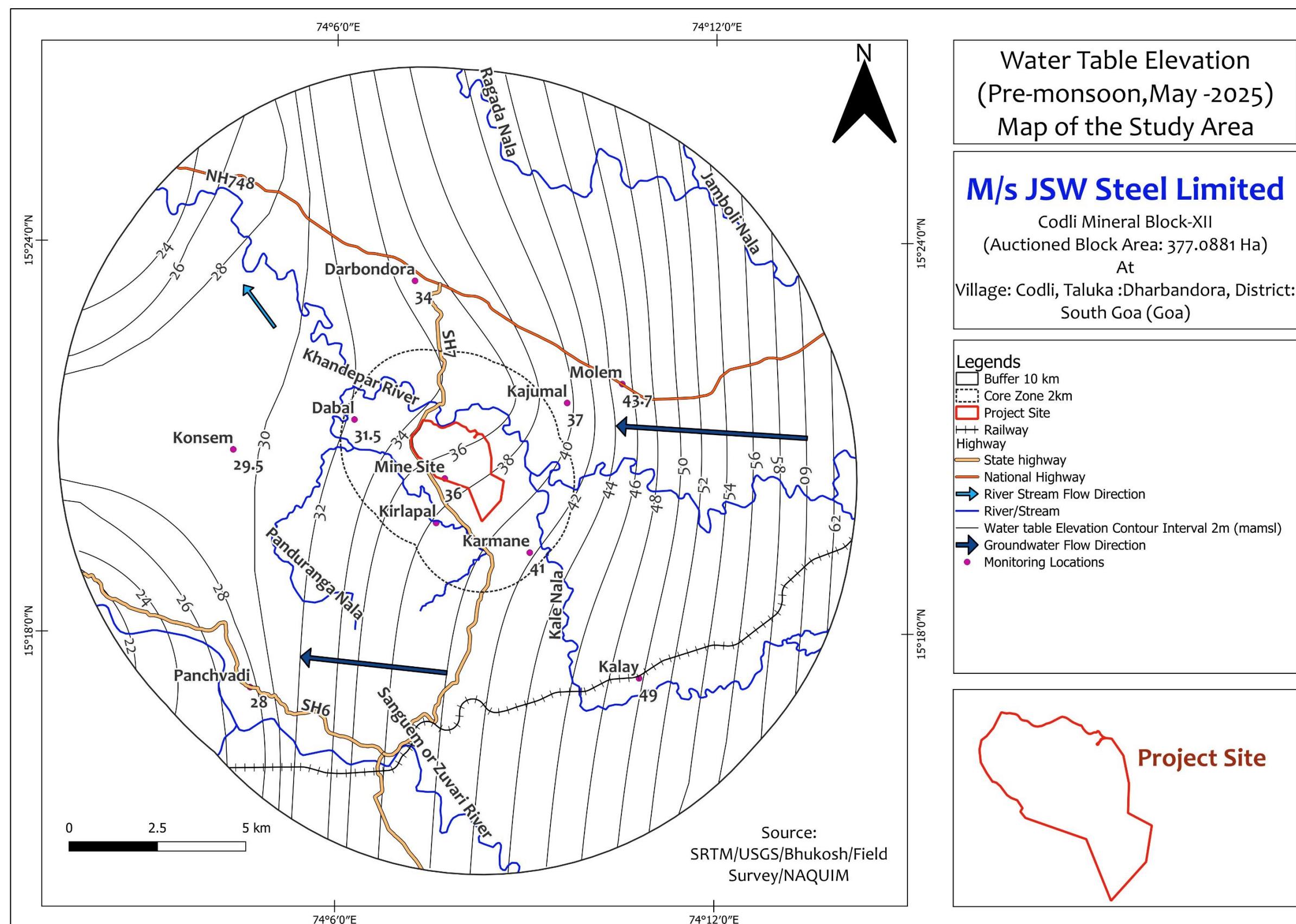


Figure 16 Water Table Contour Map (pre-monsoon, May--2025) of study area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

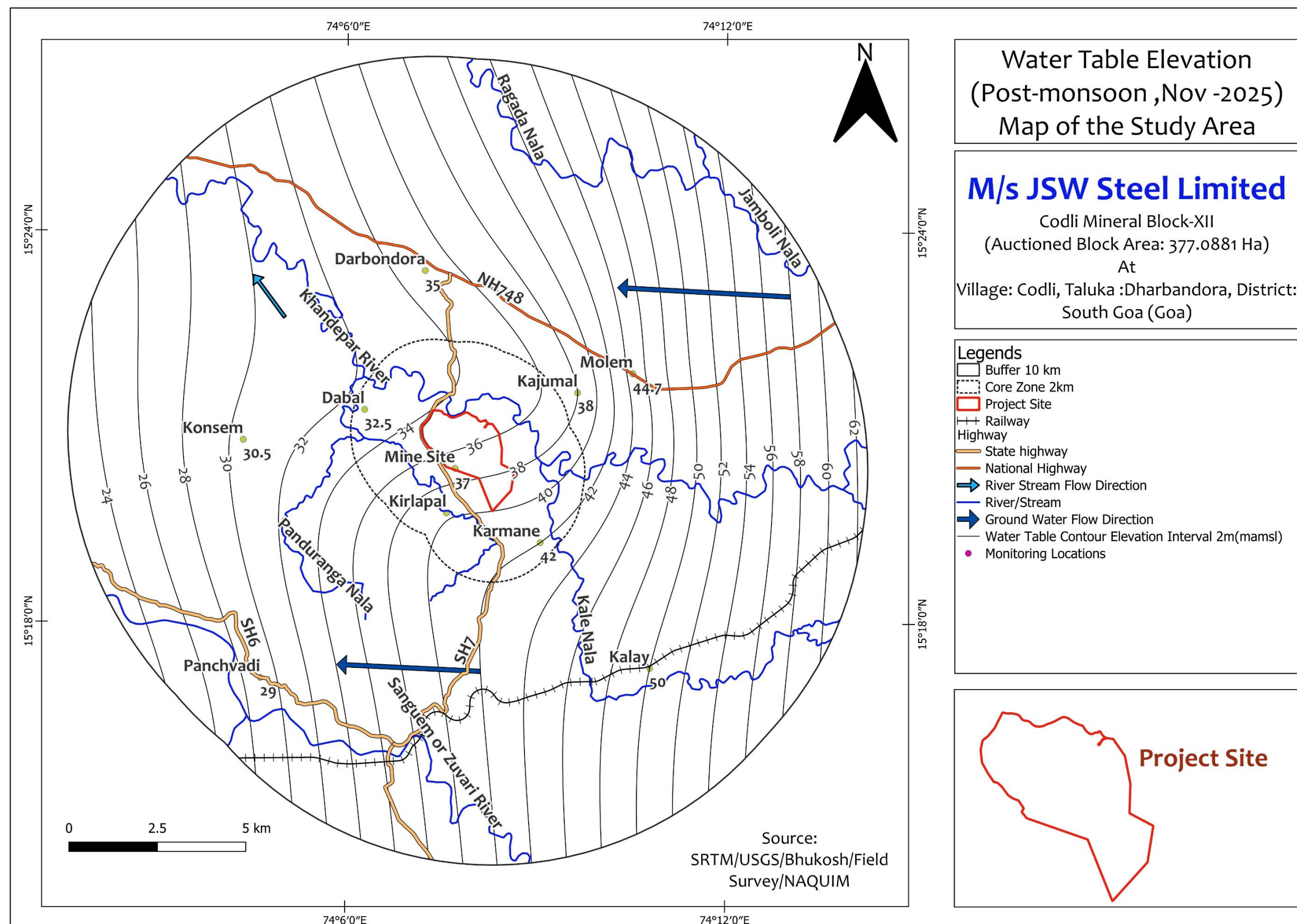


Figure 17 Water Table Contour Map (post-monsoon, Nov-2025) of study area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

3.3.2. Ground water flow and aquifer interaction with surface water bodies

The hydrogeological map given above figure no 12, 13 and 14 indicates that groundwater movement in the study area is controlled by water table elevation and regional topography. Groundwater generally flows from higher elevation zones in the south and south-east towards the north and north-west direction, following the hydraulic gradient. The water table elevation varies approximately from about 62 m amsl in the eastern part to around 26–30 m amsl in the western part of the study area.

The river–aquifer interaction simulated in the groundwater model indicates both gaining and losing conditions along the river reaches of the Khandepar River, Ragada, and Zuveri Rivers. The model results show that river leakage outflow (gaining condition) varies from approximately 4697.61 m³/day to 5522.15 m³/day, indicating groundwater discharge into the river system. Conversely, river leakage inflow (losing condition) ranges from about 1439.86 m³/day to 1116.30 m³/day, representing recharge from the river to the aquifer. Therefore, the results suggest that the river system predominantly behaves as a gaining river, while localized losing conditions also occur along certain stretches during the simulation period.

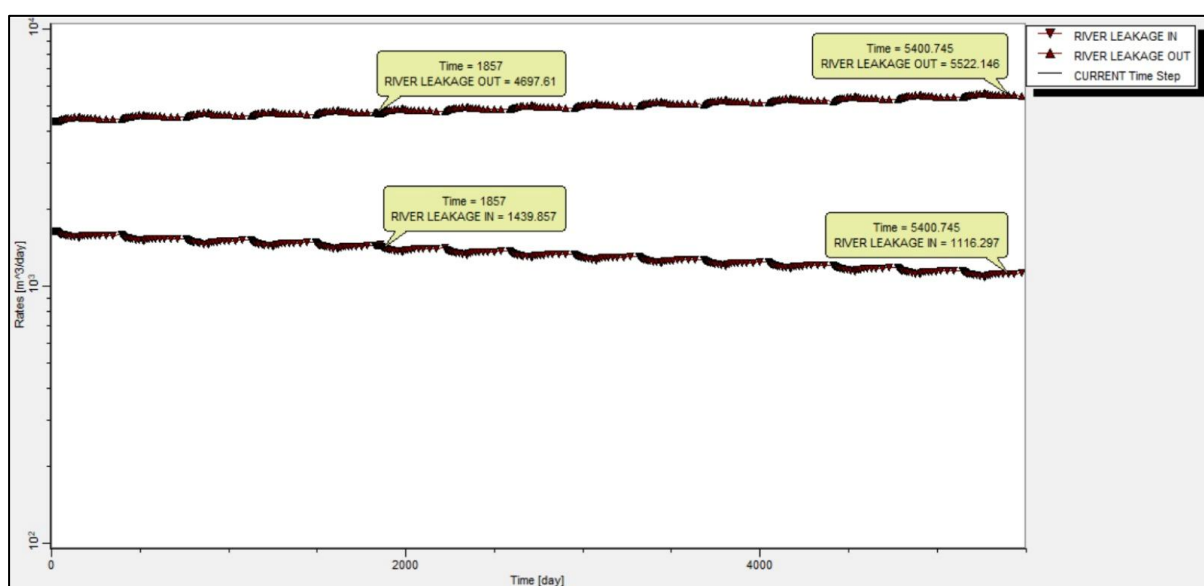


Figure 18 Aquifer Interaction with Surface Water Bodies

3.3.3 Depth to water level

Groundwater level monitoring was carried out during the pre-monsoon season (May 2025) at ten observation wells comprising both open wells and borewells within the 10 km buffer zone. The observed depth to groundwater level during the pre-monsoon period ranges from 3.0 to 16.0 m bgl, with corresponding groundwater table elevations varying from 28.0 to 49.0 m AMSL.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Since post-monsoon groundwater level observations for 2025 were not available from field monitoring, the post-monsoon groundwater level map was prepared using Central Ground Water Board (CGWB) groundwater level data. Based on the CGWB long-term groundwater level records for the area, an average seasonal groundwater level fluctuation of approximately 1.0 m was considered. Accordingly, the post-monsoon groundwater table was estimated by applying a 1.0 m rise in groundwater levels over the observed pre-monsoon (May 2025) groundwater levels. whereas during the post-monsoon period it ranges from 2.0 to 15.0 m bgl. The deepest groundwater level was observed at the Mine Site (16.0 m bgl during pre-monsoon and 15.0 m bgl during post-monsoon), while the shallowest groundwater levels were recorded at Kajumal (3.0 m bgl and 2.0 m bgl) and Dabal (3.5 m bgl and 2.5 m bgl).

Table 7 Depth to water level and water table of the 10 km buffer Zone (Summer Season, May 2025)

Station	Latitude	Longitude	Depth To Water Level Mbgl Pre Monsoon	Depth To Water Level Mbgl Post Monsoon	Elevation M RL	Water Table Mbgl Pre Monsoon Mamsl	Water Table Mbgl Post Monsoon Mamsl	Type Of Well	Depth Of Well (M)
Mine Site	74.12861	15.339444	16	15	52	36	37	Openwell	50
Darbondora	74.12056	15.39	7	6	41	34	35	Borewell	25
Panchvadi	74.0775	15.285833	9	8	37	28	29	Openwell	20
Karmane	74.15111	15.3205556	6	5	47	41	42	Openwell	20
Kajumal	74.16083	15.3588889	3	2	40	37	38	Openwell	15
Dabal	74.10472	15.354444	3.5	2.5	35	31.5	32.5	Borewell	40
Kalay	74.18006	15.2884892	7	6	56	49	50	Openwell	15
Molem	74.17535	15.3637964	6.3	5.3	50	43.7	44.7	Borewell	20
Konsem	74.07278	15.3466667	12.5	11.5	42	29.5	30.5	Openwell	20
Kirlapal	74.12639	15.3280556	13.3	12.3	52	38.7	39.7	Openwell	20

*Source: Field Visit

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

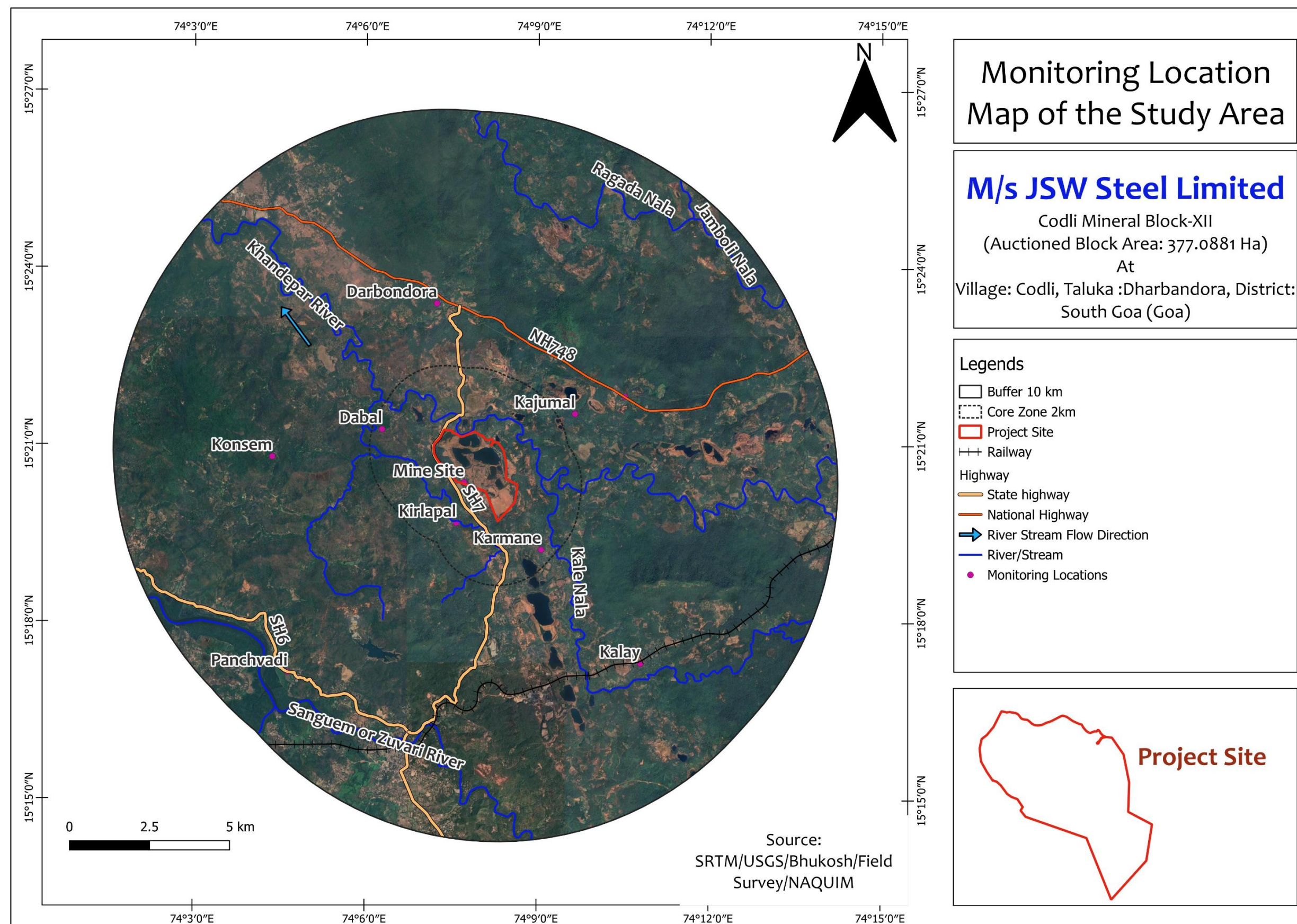


Figure 19 Monitoring location map around 10 km buffer area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

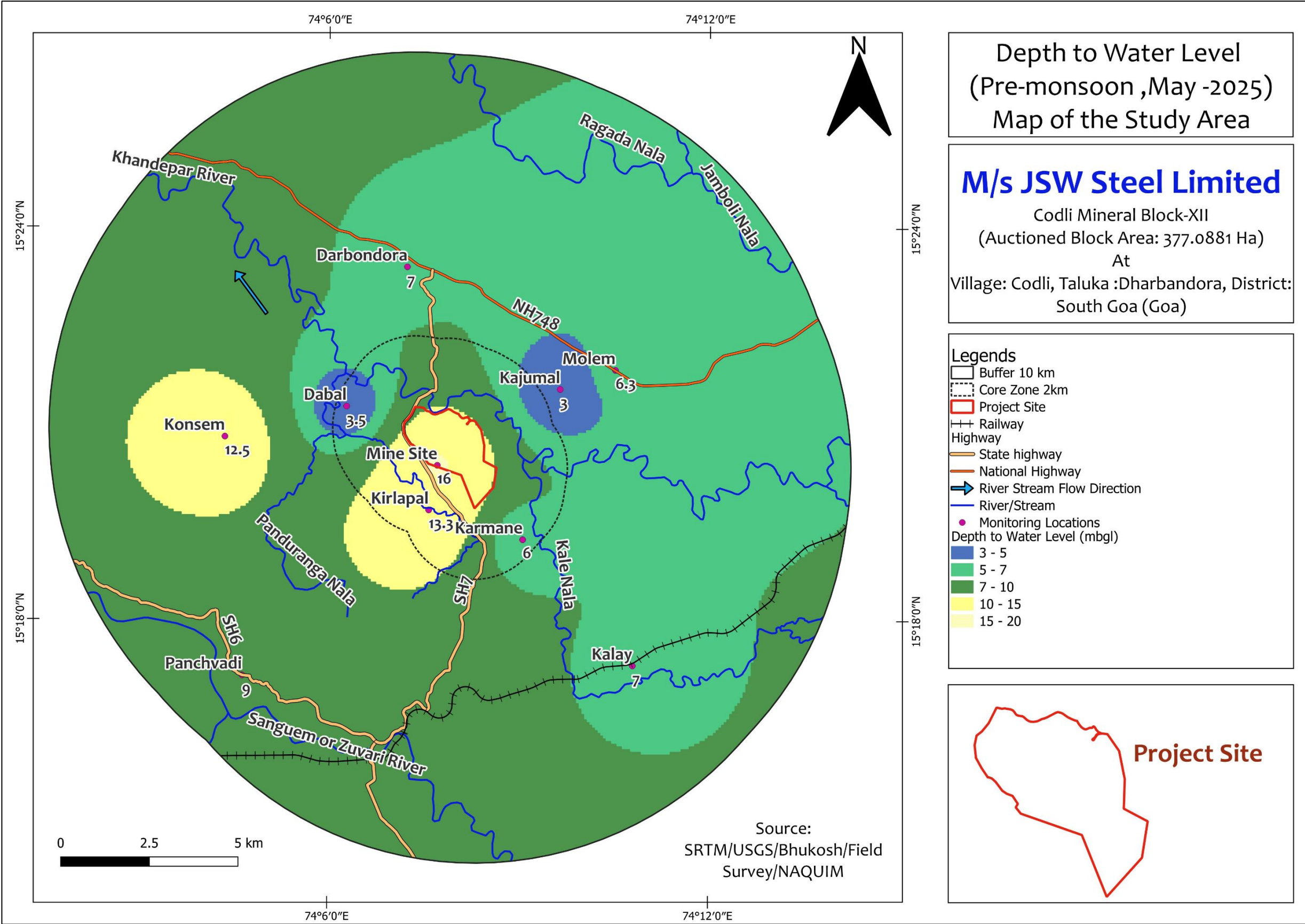


Figure 20 Depth of water level (pre- monsoon, May-2025) of study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

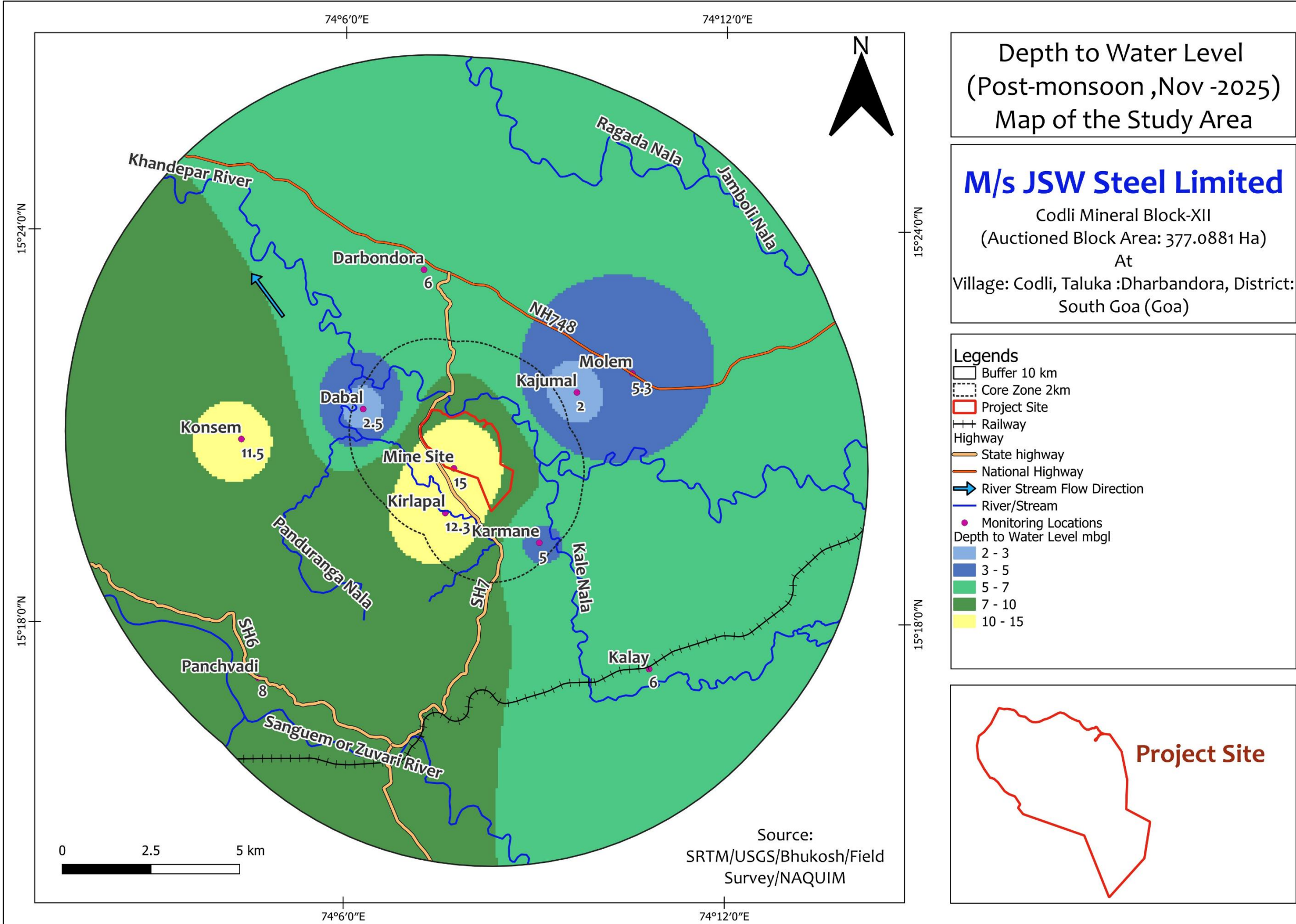


Figure 21 Depth of water level (post- monsoon, November-2025) of study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

3.3.4 Long term water level data analysis

The monitoring well at the nearest monitoring station, Colem station in South Goa District, Goa, which is approximately 10.5 kms away from the mine site towards east direction, is used to analyse long-term water data on the water level. A hydrograph of South Goa District of water level data from CGWB monitoring well in the pre-monsoon and post-monsoon seasons illustrating the trend of water. The water level was attained during the years of 2016 and 2024, from which the water level trend was determined. On seasonal data sets from the last 10 years, the statistical analysis is built. Based on the seasonal variation in groundwater level during the 10 years, trends are formed. The average seasonal values fully reflect the natural variation of the groundwater level and may be considered as a basic element in the statistical analysis of trends. Difference in the average water level of 10 years is showing a Raising trend.

Table 8 Well Monitoring Data

Years	Depth to water Level m bgl Pre-monsoon	Depth to water Level m bgl post-monsoon
2016	9	7.93
2017	8.45	7.75
2018	8.3	8.4
2019	8.95	6.23
2020	8.31	7.82
2021	8.3	8.43
2022	9.5	7.9
2023	9.31	8.4
2024	8.5	6.75
Station	Colem	
Coordinates	15.33497	74.24375

*Source: <https://gwdata.cgwb.gov.in/>

The long-term hydrograph analysis (2016–2024) of Station Colem indicates a stable groundwater regime with normal seasonal and inter-annual fluctuations. Pre-monsoon depth to water level varies approximately between 8.5 and 10.0 mbgl, while post-monsoon levels range from about 6.5 to 8.5 mbgl, consistently showing recharge response after the monsoon season. The linear trend for pre-monsoon groundwater levels shows a marginal increasing trend in depth ($y = 0.0388x + 8.5414$), indicating a very slight long-term decline; however, the magnitude of change is minimal and remains within natural variability. In contrast, the post-monsoon trend shows a marginal decreasing trend in depth ($y = -0.0262x + 7.8653$), suggesting sustained and effective recharge over the years. The consistent gap between pre- and post-monsoon water levels confirms regular monsoonal

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

replenishment of the aquifer. Therefore, the results indicate no significant long-term groundwater stress, no abnormal depletion trend, and a hydrologically balanced aquifer system in the region.

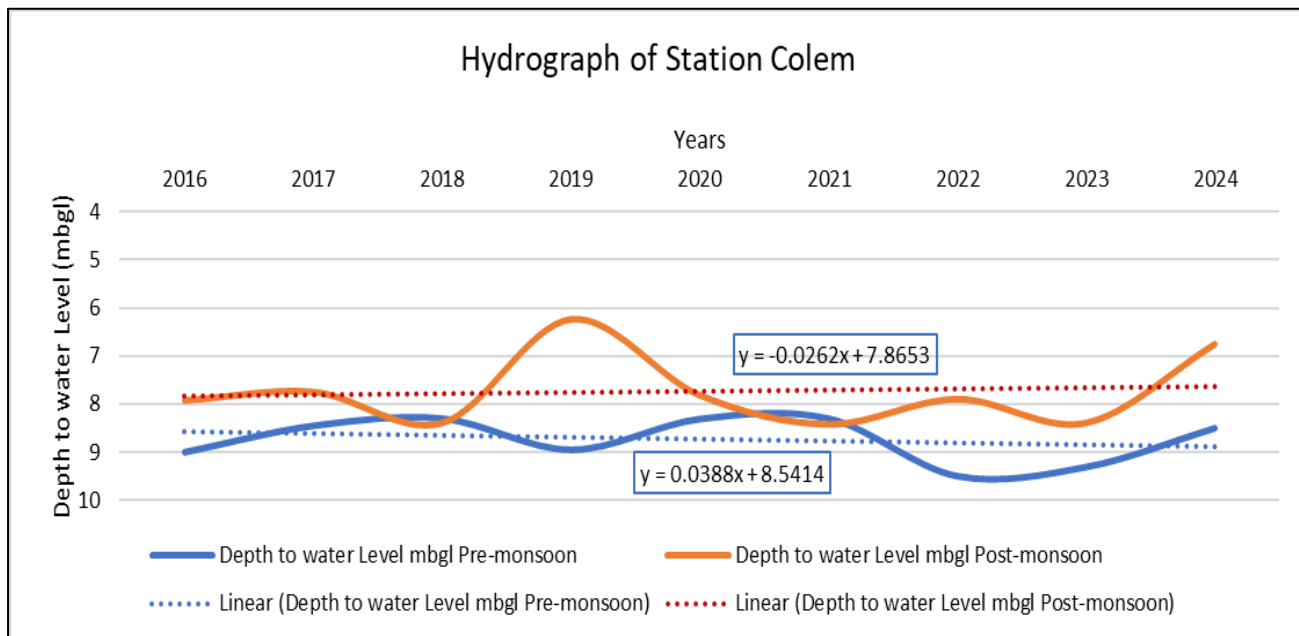


Figure 22 Hydrograph of Station Colem (~10.5 km from the mine site)



Figure 23 Location of Station Colem (~10.5 km far from mine site)

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

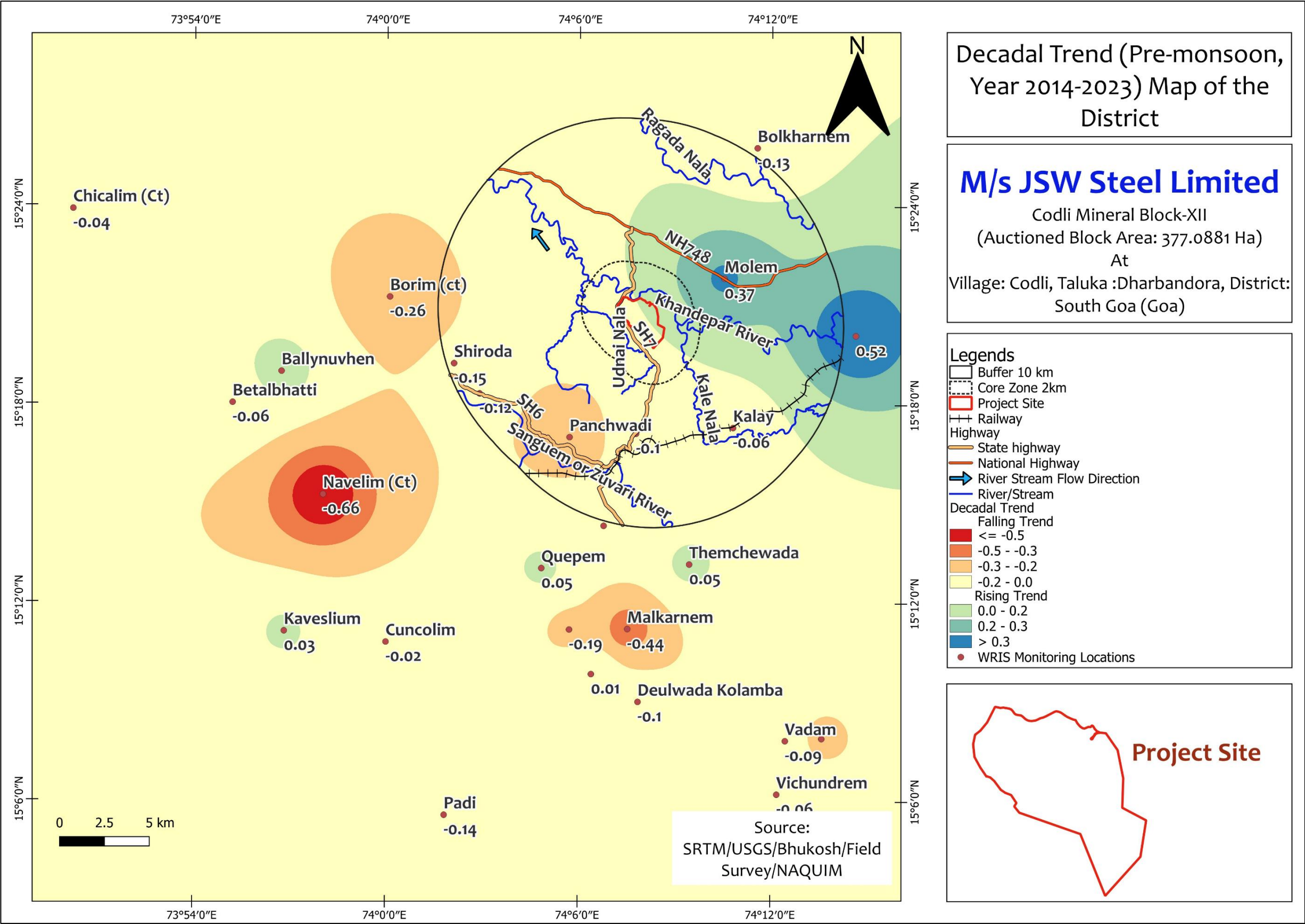
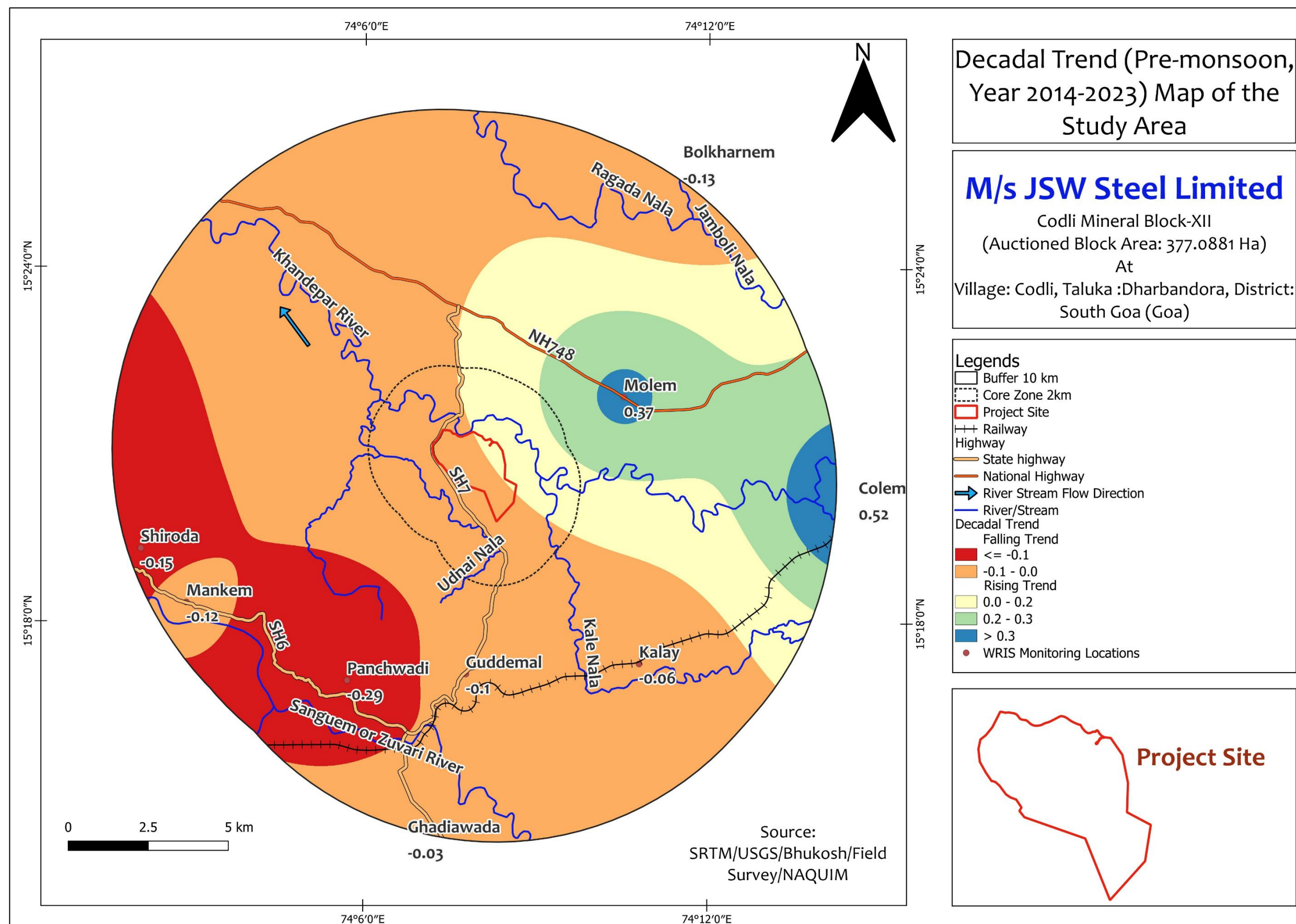


Figure 24 Decadal Water Level Trend Pre-Monsoon Season of the District

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)



Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

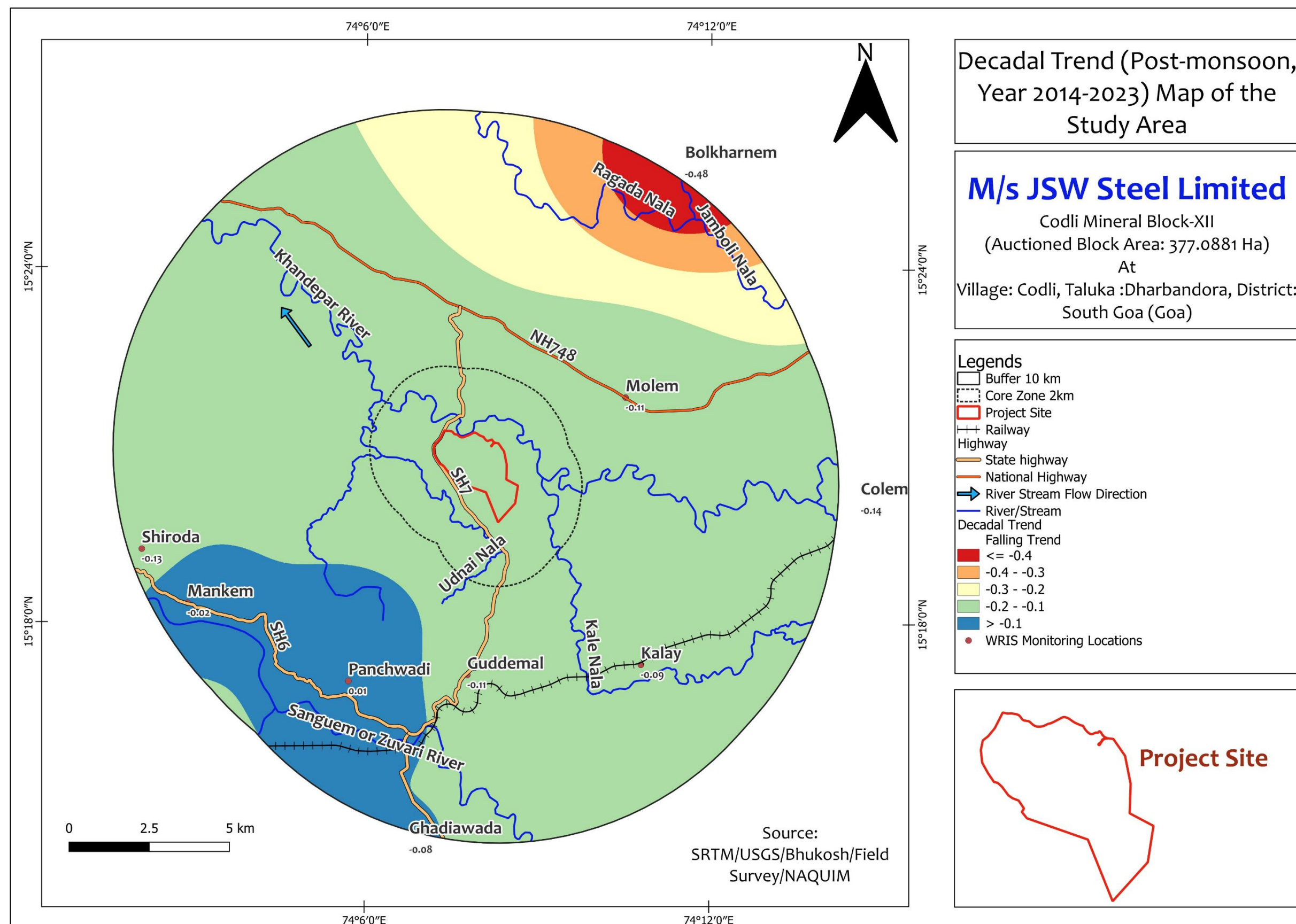


Figure 26 Decadal Water Level Trend Post-Monsoon Season of the study area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

3.3.5 Ground water quality

Ground water samples were collected from the available water resources around the proposed mine site. The samples were collected and tested from different sites. The quality of ground water was studied by collecting 10 water samples. The analysis of the samples has been carried out in J.M. EnviroLab Pvt. Ltd. located in Gurgaon, the lab is NABL certified and has approval from MoEF and state boards.

Table 9 Ground water sampling locations

Location Code	Sampling Location	Distance & direction from Mine Site
SGWS 1	Mine Site	Core area
SGWS 2	Village Codli	0.4 km in WSW direction
SGWS 3	Village Kirlapal	1.3. km in SSW direction
SGWS 4	Village Karmane	1.65 km in SE direction
SGWS 5	Villsge Dabal	1.85 km in WNW direction
SGWS 6	Village Kajumal	3.0 km in ENE direction
SGWS 7	Village Darbandora	4.0 km in North direction
SGWS 8	Village Konsen	5.4 km in West direction
SGWS 9	Village Panchvadi	7.2 km in SW direction
SGWS 10	Village Sanvardem	7.3 km in South direction

Source: Baseline survey

Water Quality Parameter Variations

The analysed groundwater samples from various locations exhibited the following ranges for key physicochemical parameters, all within permissible limits set by the Bureau of Indian Standards (BIS 10500:2012) for drinking water.

- pH: Ranged from 6.41 Panchvadi to 7.26 Mine Site.
- Total Hardness: 35.0 mg/L Dabal to 218.0 mg/L Konsen. Soft to moderately hard water.
- Calcium: 3.97 mg/L at Panchvadi to 61.50 mg/L at Konsen.
- Alkalinity: 31.1 mg/L Karmane to 221.5 mg/L Konsen. Buffers pH fluctuations, supporting stable aquatic ecosystems with no adverse environmental impact.
- Chloride: 11.68 mg/L at Panchvadi to 24.3 mg/L Sanvardem. Low levels prevent salinity issues, safe for human use and agriculture.
- Magnesium: 3.69 mg/L at Dabal to 15.66 mg/L at Konsen. Essential nutrient; concentrations pose no toxicity risk to humans or biota.
- Total Dissolved Solids (TDS): 68.0 mg/L at Codli to 255.0 mg/L at Konsen.
- Sulphate: 1.85 mg/L at Karmane) to 12.06 mg/L at Sanvardem.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

- Fluoride: 0.07 mg/L at Codli to 0.54 mg/L Kirlapal.
- Nitrate: 0.18 mg/L at Panchvadi to 1.87 mg/L at Mine Site. Far below 45 mg/L limit.
- Iron: 0.14 mg/L at Panchvadi to 0.58 mg/L at Codli..
- Sodium: 3.0 mg/L at Kajumal to 13.0 mg/L at Konsen . Low sodium content suitable for hypertensive individuals and soil permeability.
- Potassium: Below detection limit (BDL) in Kajumal to 6.0 mg/L (Sanvardem). Trace levels with no health or environmental implications.
- Conductivity: 102.0 $\mu\text{S}/\text{cm}$ (Codli) to 370.0 $\mu\text{S}/\text{cm}$ (Konsen). Correlates with TDS; low values suggest unpolluted aquifers resilient to mining influences.

All physicochemical parameters comply with BIS 10500:2012 drinking water standards, confirming suitability for human consumption without risks of gastrointestinal distress, skeletal fluorosis, or methemoglobinemia. Elevated hardness (up to 218 mg/L) and TDS (up to 255 mg/L) at Konsen may impart taste but provide nutritional benefits (Ca, Mg); regular monitoring near mine sites is recommended to detect potential acidification or metal mobilization. Environmentally, the water supports flora, fauna, and irrigation with no mining-induced stress

Analysis of Groundwater Quality

The Piper diagram indicates the hydrochemical characteristics of groundwater samples collected from the mine site and surrounding villages (Codli, Kirlapal, Karmane, Darbandora, Sanyardem, Dabal, Kajumal, Konsen and Panchvadi). The cation and anion plots show that the groundwater samples are predominantly characterized by mixed ionic composition, with variations in the relative dominance of Ca^{2+} , Mg^{2+} , $\text{Na}^{+} + \text{K}^{+}$ and $\text{HCO}_3^{-} + \text{CO}_3^{2-}$, SO_4^{2-} and Cl^{-} .

In the cation triangle, most samples plot in the central to lower-central portion, indicating that no single cation is overwhelmingly dominant throughout the study area. Ca^{2+} and Mg^{2+} generally constitute the major cationic contribution, while $\text{Na}^{+} + \text{K}^{+}$ is relatively less dominant in most samples. The anion triangle shows a comparatively greater contribution of Cl^{-} and $\text{HCO}_3^{-} + \text{CO}_3^{2-}$, with SO_4^{2-} contributing to a lesser extent. The distribution indicates spatial variation in groundwater chemistry due to differences in lithology, mineral dissolution and local hydrogeological conditions.

The central diamond field shows that the majority of samples fall within the mixed Ca–Mg– HCO_3 /Cl to Ca–Mg–Cl/ HCO_3 hydrochemical facies, rather than representing a single dominant water type. The mine-site sample also plots within this mixed-water field and does not show a distinctly anomalous hydrochemical character compared with the surrounding groundwater samples.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

The observed mixed Ca–Mg and $\text{HCO}_3\text{--Cl}$ character can be attributed to water–rock interaction and dissolution of carbonate and other mineral phases, along with possible contribution from chloride-bearing sources. The relative presence of HCO_3^- suggests interaction with carbonate minerals and/or CO_2 -bearing recharge, whereas the occurrence of Cl^- indicates additional influence from mineral dissolution and/or concentration processes. The relatively limited dominance of SO_4^{2-} suggests that sulphate minerals are not the principal control on groundwater chemistry in the investigated locations.

The Piper diagram suggests that the groundwater chemistry is heterogeneous but predominantly of mixed Ca–Mg– $\text{HCO}_3\text{--Cl}$ type, reflecting the combined influence of geological formations, mineral dissolution, groundwater–rock interaction and local recharge condition

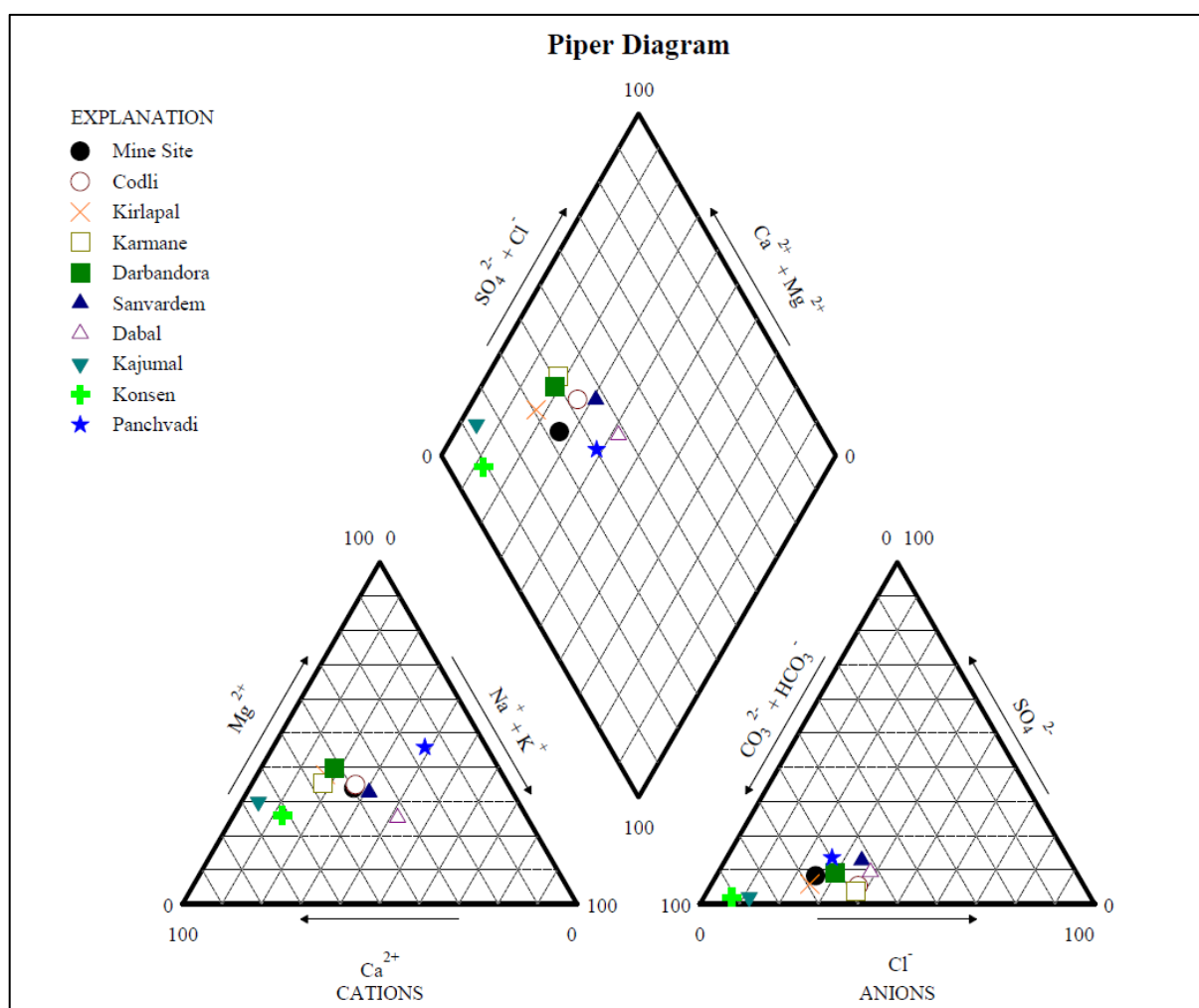


Figure 27 Hydrochemical Facies Classification

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Table 10 Ground Water Analysis Study Period: Summer Season (2025)

S. No.	Parameter	Unit	Sampling Location										Specification as per IS 10500- 2012	
			Min e Site	Villag e Codli	Village Kirlapa l	Village Karman e	Village Darbandor a	Village Sanvarde m	Villag e Dabal	Village Kajuma l	Village Konse n	Village Panchva di	Requiremen t Acceptable Limit	Permissibl e Limit in the Absence of Alternate Source
1.	pH (at 25°C)	-	7.26	6.91	6.85	6.8	6.89	6.61	6.6	6.93	7.11	6.41	6.5-8.5	No Relaxation
2.	Odour	-	Agreeable										Agreeable	Agreeable
3.	Taste	-	Agreeable										Agreeable	Agreeable
4.	Total Hardness as CaCO ₃	mg/l	52	40	58	45	82	70.4	35	144	218	40	200	600
5.	Calcium as Ca	mg/l	11.2	8.4	12.6	10.3	16.8	14.9	7.93	39.68	61.5	3.97	75	200
6.	Alkalinity as CaCO ₃	mg/l	45.6	31.65	47.47	31.1	60.2	52.2	31.65	130.4	221.5	36.92	200	600
7.	Chloride as Cl	mg/l	12.23	14.68	12.1	14.2	20.7	24.3	16.57	12.23	12.23	11.68	250	1000
8.	Magnesium as Mg	mg/l	5.8	4.6	6.43	4.7	9.7	8.1	3.69	10.91	15.66	7.03	30	100
9.	Total Dissolved Solids	mg/l	96	68	102	86	123	134	98	167	255	72	500	2000
10.	Sulphate as SO ₄	mg/l	5.41	2.82	3.8	1.85	8.65	12.06	5.43	2.93	4.56	8.04	200	400
11.	Fluoride as F	mg/l	0.36	0.07	0.54	0.36	0.23	0.29	0.11	0.16	0.22	0.21	1	1.5

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

12.	Nitrate as NO ₃ -N	mg/l	1.87	0.88	1.35	0.43	0.32	1.34	0.43	0.86	0.92	0.18	45	No Relaxation
13.	Iron as Fe	mg/l	0.26	0.58	0.33	0.19	0.15	0.23	0.33	0.42	0.24	0.14	1	No Relaxation
14.	Sodium as Na	mg/l	8	6	5	4	7	11	11	3	13	10	--	--
15.	Potassium as K	mg/l	1	1	1	1	3	6	1	BDL (DL 1.0)	2	2	--	--
16.	Conductivity	µS/cm	140	102	150	136	202	218	152	237	370	104	--	--
17.	Carbonate as CO ₃	mg/l	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)		
18.	Bicarbonate as HCO ₃	mg/l	55.6	38.6	57.9	37.9	73.4	63.7	38.6	159.1	270.2	45		

Source- Ground Water Analysis Report, JM EnviroLab Pvt. Ltd.

Note: Ground water quality was also analyzed for Colour, Turbidity, Cyanide, Aluminium, Phenolic Compounds, Boron, Anionic Detergents as MBAS, Hexa Chromium as Cr+6, Chromium as Cr, Zinc, Copper, Manganese, Cadmium, Lead, Arsenic, Mercury, Phosphate as PO₄, Nickel and Total Suspended Solid were found below detection limit.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

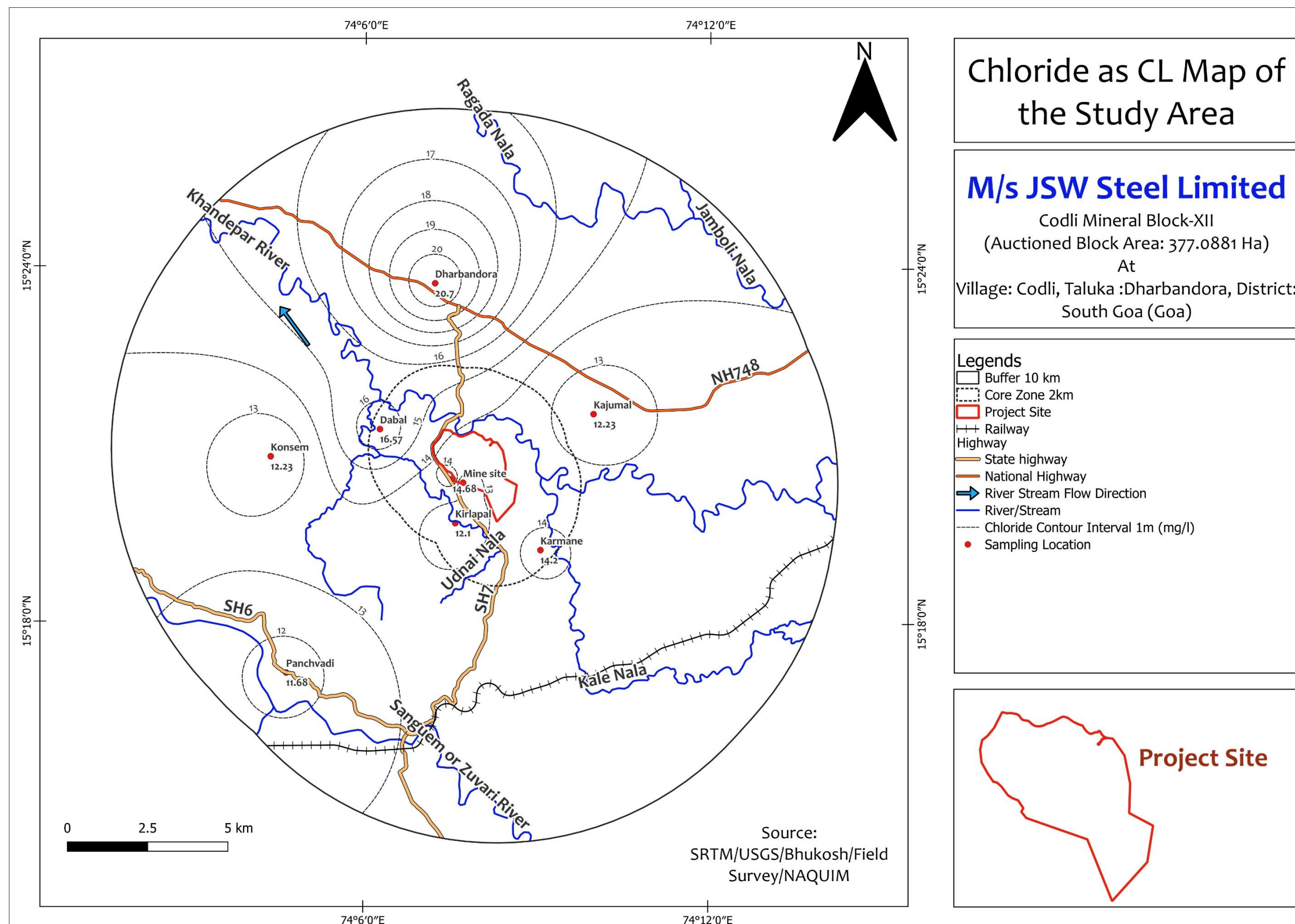


Figure 28 Chloride as CL of the Study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

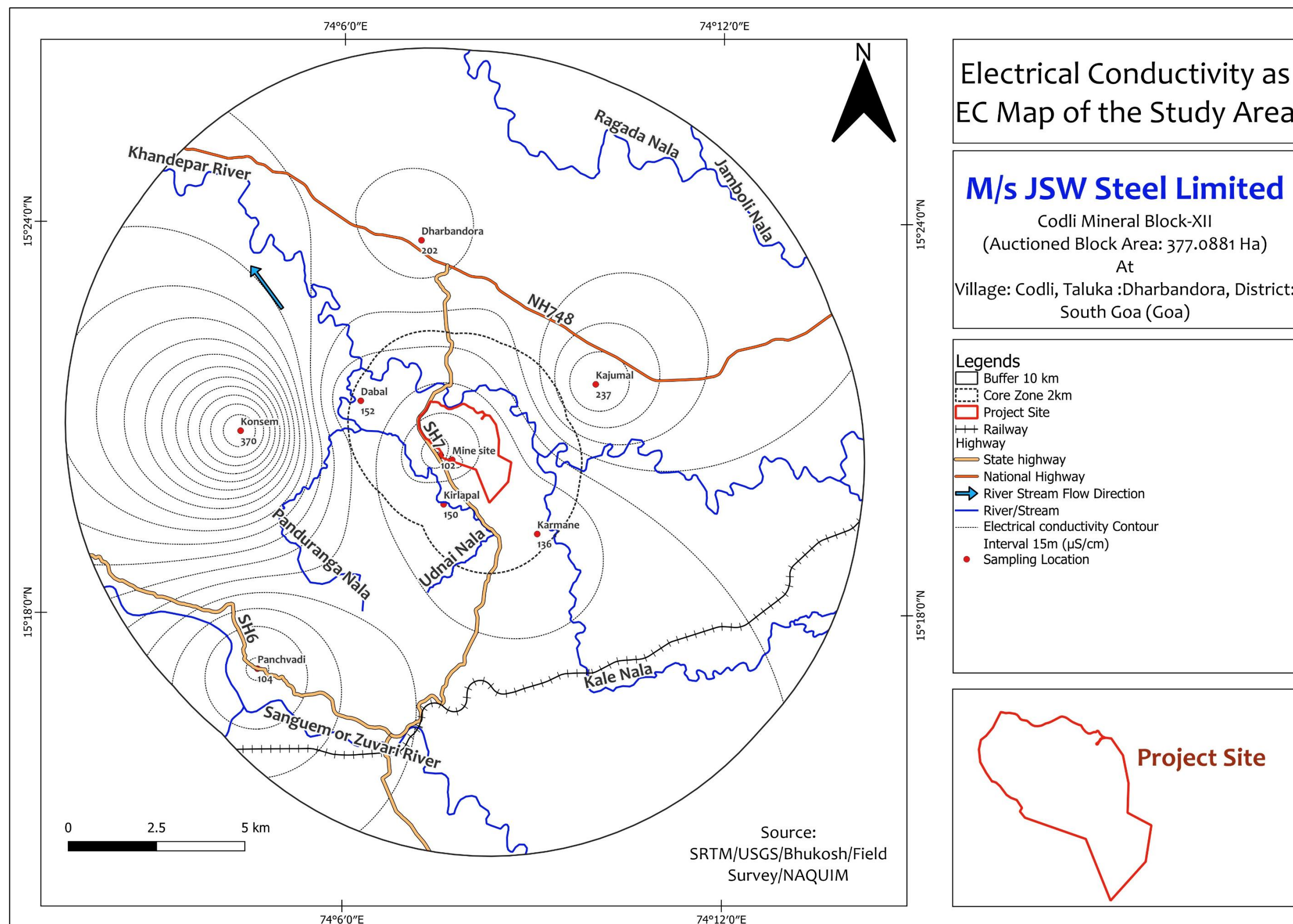


Figure 29 22 Electrical Conductivity as EC of the Study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

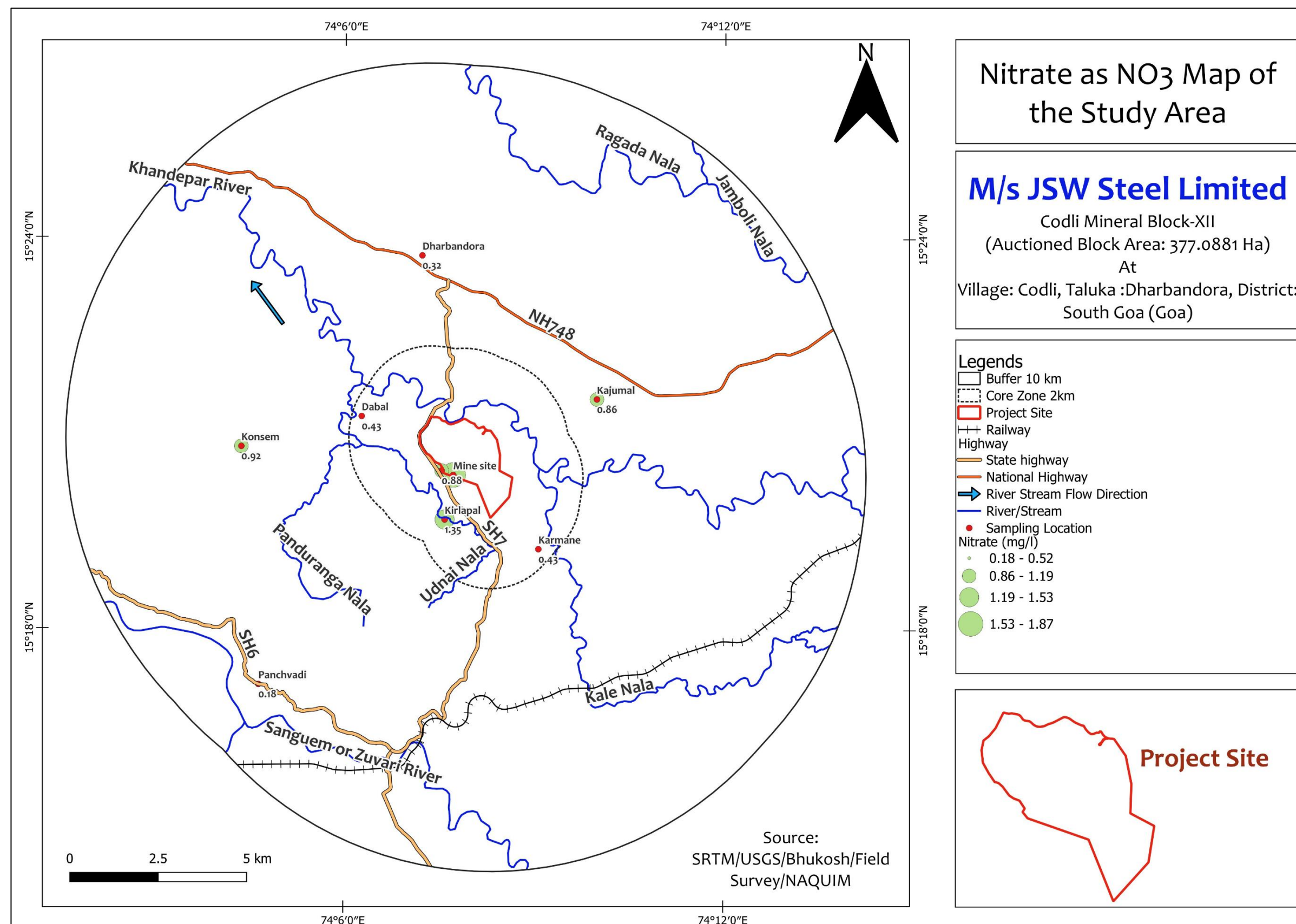


Figure 30 Nitrate as NO₃ of the Study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

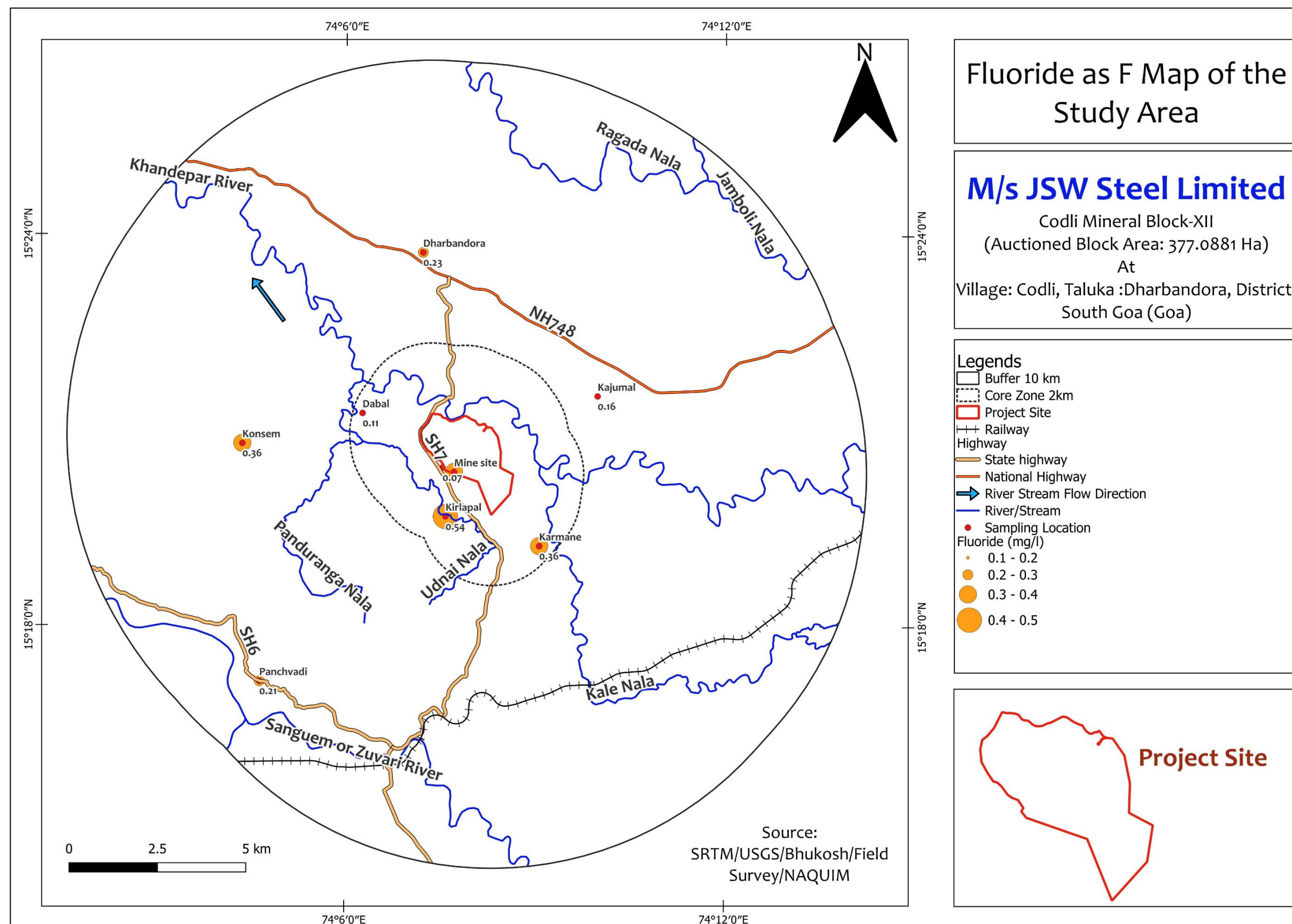


Figure 31 Fluoride as NO₃ of the Study Area

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

3.3.6 Water quality of nearby water bodies

Surface water samples were collected from the available water resources around the proposed mine site. The samples were collected and tested from different sites. The quality of surface water was studied by collecting 8 water samples. The analysis of the samples has been carried out in J.M. EnviroLab Pvt. Ltd. located in Gurgaon, the lab is NABL certified and has approval from MoEF and state boards.

Table 11 Surface Water sampling location and direction from proposed mine site

Station Code	Sampling Location	Distance & direction from proposed Mine Site
SW 1	Khandepar River	Adjacent in North direction
SW 2	Kale Nala	0.7 km in ESE direction
SW 3	Udnai Nala	1.5 km in West direction
SW 4	Panduranga Nala	5.0 km in SW direction
SW 5	Ragada Nala	7.0 km in NNE direction
SW 6	Sanguem or Zuari River	8.0 km in South direction
SW 7	Paroda River	9.0 km in SSW direction
SW 8	Jamboli Nala	9.0 km in NE direction

Source: Field Survey*

The analysis of surface water samples from nearby water bodies (e.g., Jamboli Nala, Sanguem/Zuari River) reveals natural variability in composition, with all parameters within BIS 10500:2012 and CPCB standards for surface water,

- pH: 6.72–7.65 (neutral to slightly alkaline), optimal for aquatic biota.
- Colour, Turbidity, Odour: Below detection limits (BDL; DL: 1.0 Hazen, 1.0 NTU); agreeable odour supports clear water conducive to algal/phytoplankton growth.
- Total Hardness: 15.0–64.0 mg/L; TDS: 24.0–101.0 mg/L; Alkalinity: 15.82–50.37 mg/L; Conductivity: 38–151 $\mu\text{S}/\text{cm}$ —all within limits, indicating soft, fresh water.
- Organic Load: COD: 4.0–16.0 mg/L; BOD: 1.3–2.8 mg/L—low levels reflect minimal pollution.
- Nutrients & Ions: SO_4^{2-} : 1.3–7.5 mg/L; Ca: 3.97–13.89 mg/L; Na: 3.0–9.0 mg/L; K: 1.0–2.0 mg/L; Mg: 1.24–8.33 mg/L; Fe: 0.23–0.73 mg/L; Zn: 0.02–0.2 mg/L; Cl^- : 3.26–20.46 mg/L—trace concentrations denote clean, unpolluted status.
- Dissolved Oxygen (DO): 7.1–7.8 mg/L—high saturation (>70%) ensures aerobic conditions for fish and macroinvertebrates.
- Special Cases: F^- : 0.1 mg/L (Jamboli Nala), BDL elsewhere (DL 0.05 mg/L); TSS: 2 mg/L (Sanguem/Zuari River)—negligible sedimentation.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Table 12 Surface Water Quality Result Study Period: Summer Season (May, 2025)

S.N.	Parameters	Unit	Sample Locations							
			Khandepar River SW ₁	Kale Nala SW ₂	Udnai Nala SW ₃	Panduranga Nala SW ₄	Ragada Nala SW ₅	Sanguem or Zuvari River SW ₆	Paroda River SW ₇	Jamboli Nala SW ₈
1.	pH (at 25°C)	--	7.65	6.88	6.88	6.79	6.72	6.72	6.78	6.91
2.	Odour	--	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3.	Total Hardness as CaCO ₃	mg/l	40.0	30.0	25.0	15.0	15.0	64.0	45.0	20.0
4.	Calcium as Ca	mg/l	10.86	7.93	5.95	3.97	3.97	11.9	13.89	5.95
5.	Alkalinity as CaCO ₃	mg/l	42.2	27.6	19.82	15.82	17.1	50.37	31.1	22.37
6.	Chloride as Cl	mg/l	4.89	4.89	6.45	3.26	4.34	20.46	16.12	7.34
7.	Magnesium as Mg	mg/l	3.73	2.48	2.46	1.24	1.24	8.33	2.51	1.25
8.	Total Dissolved Solids	mg/l	71.0	52.0	48.0	24.0	34.0	101.0	74.0	47.0
9.	Sulphate as SO ₄	mg/l	1.3	3.04	3.74	1.3	2.15	7.5	6.09	1.42
10.	Fluoride as F	mg/l	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	BDL(DL 0.05)	0.10
11.	Iron as Fe	mg/l	0.38	0.23	0.73	0.27	0.27	0.50	0.46	0.24
12.	Zinc as Zn	mg/l	0.02	0.04	0.02	0.20	0.05	0.02	0.03	0.02
13.	Total Suspended Solid	mg/l	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	2.0	BDL(DL 1.0)	BDL(DL 1.0)
14.	BOD	mg/l	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	2.8	1.3	BDL(DL 1.0)
15.	COD	mg/l	4.0	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	BDL(DL 1.0)	16.0	10.0	BDL(DL 1.0)
16.	Sodium as Na	mg/l	3.0	3.0	5.0	3.0	4.0	9.0	6.0	5.0
17.	Potassium as K	mg/l	1.0	1.0	1.0	BDL (DL 1.0)	1.0	2.0	1.0	2.0

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

18.	Conductivity	µs/cm	108.0	78.0	74.0	38.0	53.0	151.0	111.0	72.0
19.	Dissolve Oxygen	mg/l	7.8	7.5	7.6	7.7	7.8	7.5	7.1	7.3
20.	Total Coliform	MPN/100ml	110	90	70	50	80	170	140	70

BDL – Below Detection Limit, DL- Detection Limit

Source: Surface Water Analysis Report

Note: Surface water quality was also analyzed for Colour, Turbidity, Residual free Chlorine, Cyanide, Nitrate, Aluminium, Boron, Phenolic Compounds, Anionic Detergents, Hexa Chromium, Copper, Manganese, Lead, Selenium, Arsenic, Mercury, Phosphate and Nickel were found below detection limit.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

4. APPROVED MINE PLAN

JSW Steel Limited has been successfully declared as the “Preferred Bidder” for the grant of Proposed Codli Mineral Block-XII, Auctioned Block Area: 377.0881 ha with located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) through e-auction conducted by Government of Goa. Further, the Directorate of Mines & Geology, Goa Vide letter No. DGM/28/Auction Cell/3rd NIT/2023/2703 dated 10.12.2024 for a period of 50 Years.

Table 13 Details of Mining plan

S. No.	Particular	Details
1.	Mining Method	Fully Mechanized Opencast Method
2.	Total Geological Reserves	48.49661 million Tonnes
3.	Total Mineable reserves	27.3201 million Tones
4.	Bench Height (Maximum)	7m
5.	Bench Width (Minimum)	9 m
6.	No. of Working days	300 days
7.	Number of Working Shifts & Persons	3 Shifts & 112 P/day

5. ESTIMATION OF MINE SEEPAGE AND ADVANCED DEWATERING PLAN

5.1 ESTIMATION OF MINE SEEPAGE

Aquifer Pumping Test (Apt)

The groundwater movement in and around the project area is mainly controlled by fracture porosity metasedimentary of Dharwar Super Group of rocks. Its flow generally follows the subsurface hydraulic gradient.

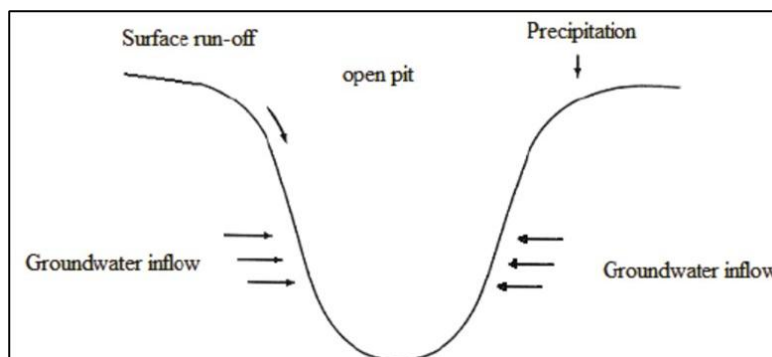
ESTIMATION OF MINE SEEPAGE MINING OPERATIONS AND GROUND WATER DYNAMICS

In the mining operations carried out below the water level, mine operators are potentially faced with two important water-related problems which includes. The amount and pressure of groundwater that could flow into an open pit and the effect of pore water pressure on the stability of an open pit high wall.

Whenever a mine is operated below the water level, water seepage occurs from the surrounding layers towards the mining excavation. In order to design an effective drainage scheme for an open below the water level can affect the operational efficiency and economic viability of the mining operation. The unexpected water flows in large scale may reduce the production, delay the time of execution and danger the total mine safety (Hanna et al., 1994). When a pit penetrates in an aquifer,

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the significant amounts of groundwater flow occur to a pit. Therefore, the large volumes of water. Therefore, the large volumes of water must be pumped to provide a dry mining condition.



As the mining operation shall grow in coming years and dewatering will take place from the mine pit, an attempt was made to assess the prevailing groundwater situation in the mine lease area so as to understand the impact of present withdrawal of groundwater on the overall groundwater regime of the area. Ground Water shall be encountered during mining activities. As soon as water level is intercepted in the mining pit, groundwater seepage commences. Mine seepage in the mining pit has been estimated using Darcy equation which states that flow is directly proportional to area of aquifer exposed in the mine pit face and hydraulic gradient of water level. Ground Water shall be encountered during mining activities. As soon as water level is intercepted in the mining pit, groundwater seepage commences. Mine seepage in the mining pit has been estimated using Darcy equation which states that flow is directly proportional to area of aquifer exposed in the mine pit face and hydraulic gradient of water level.

$$Q \propto I$$

Where, Q= Rate of Flow

I= Water level gradient

A= Cross section area of aquifer exposed in mine pit

Aquifers	Weathered Zone (Aq.-I)		Fractured Zone (Aq.-II)	
Prominent Lithology	Weathered Laterite		Fractured phyllitic and manganiferous clay	
Thickness range (m)	20 m		20- 120 m	
T (m ² /day)	200 (WRIS)		17.3 (Pumping test)	
	Seed Value	Optimised Value	Seed Value	Optimised Value
K (m/day)	10	7	0.173	0.7

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Hydraulic Gradient

The ratio of Δh and ΔL (the hydraulic head difference divided by the length of the sample or the distance separating two head locations) can be generalized into a differential called the hydraulic gradient, dh/dl . The Hydraulic head of two contours 40 m AMSL and 34 m AMSL respectively. The distance between these two head locations is 3943 m.

The formula for Hydraulic Gradient (i) is

$$I = dh/dl = h_1 - h_2 / L_1 - L_2$$

Therefore, average Hydraulic gradient (i) = 0.0015

The mine development plan shows progressive expansion of pit areas over the five-year period. In Year-1, Pit-1 covers 33.1 ha with a working depth of 84 m (63 mRL to -21 mRL). By Year-2, Pit-1 expands slightly to 35.2 ha with a maximum working depth of 91 m.

From Year-3 onward, additional pits are developed. Pit-4 becomes the major working pit with an area of 92.1 ha and a working depth of 105 m in Year-3, which further increases to 116 ha by Year-5. Pit-3 is introduced in Year-4 and Year-5 with smaller areas of 7.9 ha and 11.3 ha, respectively, and working depths of 28–42 m.

Existing (Old) Pits

The lease area comprises a total of 07 pits out of that, 04 pits are presently active and proposed for mining operations, while the remaining 03 are mined-out pits that have been backfilled by the erstwhile lessee as part of the mine closure and reclamation activities.

There is total 4 old active pits present covering an area of 157.767 ha within the mine lease. At the conceptual stage, out of total mining lease area i.e. 377.0881 ha, the total excavated area will be 301.1521 ha, out of which 51.95 ha area will be backfilled followed by plantation and remaining 249.2021 ha excavated area will be under voids.

To protect the water reservoir following measures will be adopted:

- Construction of fencing (Length: 9150 m) along the mine lease periphery and bund along the periphery of the reservoir.
- Safety sign boards will be placed on the bunds.
- Retaining wall & Garland drains will be constructed around the working mine pits and dump to channelize rain water flowing into working mine pit.
- Regular monitoring of Ground water level & its quality will be carried out.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Table 14 Working Details

Years	Pit Id	Pit Void Area (ha)	Pit void area (sq.m)	Pit Bottom Area (sq.m)	Effective Radius (m)	Perimeter (m)	Top m RL	bottom m RL	Working Depth (m)
Year1	P-1	33.1	331000	132400	325	2041	63	-21	84
Year2	P-1	35.2	352000	140800	335	2104	63	-28	91
Year3	P-1	48.6	486000	194400	393	2468	63	-14	77
	P-4	92.1	921000	368400	542	3404	56	-49	105
Year4	P-3	7.9	79000	31600	159	999	21	-7	28
	P-4	106.6	1E+06	426400	583	3661	56	-28	84
Year5	P-3	11.3	113000	45200	190	1193	21	-21	42
	P-4	116	1E+06	464000	608	3818	56	-28	84

Table 15 Wall Seepage Pre-monsoon (Aquifer 1)

Years	Pit Id	Top m RL	bottom m RL	Water Level (mbgl)	Working Depth (m)	Depth of 1st Aquifer (m)	Saturated Thickness (m)	Perimeter (m)	Hydraulic Conductivity (m/day)	Hydraulic Gradient	Seepage (cub m/day)
Year1	P-1	63	-21	19	84	20	1	2041	10	0.0015	31
Year2	P-1	63	-28	19	91	20	1	2104	10	0.0015	32
Year3	P-1	63	-14	19	77	20	1	2468	10	0.0015	37
	P-4	56	-49	19	105	20	1	3404	10	0.0015	51
Year4	P-3	21	-7	19	28	20	1	999	10	0.0015	15
	P-4	56	-28	19	84	20	1	3661	10	0.0015	55
Year5	P-3	21	-21	19	42	20	1	1193	10	0.0015	18
	P-4	56	-28	19	84	20	1	3818	10	0.0015	57

Table 16 Wall Seepage Pre-monsoon (Aquifer 2)

Years	Pit Id	Water level (m bgl)	Top m RL	bottom m RL	Working Depth (m)	Saturated Thickness (m)	Perimeter(m)	Hydraulic Conductivity (m/day)	Hydraulic Gradient	Seepage (cub m/day)
Year1	P-1	19	63	-21	84	64	2041	0.7	0.0015	137

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Year2	P-1	19	63	-28	91	71	2104	0.7	0.0015	157
Year3	P-1	19	63	-14	77	57	2468	0.7	0.0015	148
	P-4	19	56	-49	105	85	3404	0.7	0.0015	304
Year4	P-3	19	21	-7	28	8	999	0.7	0.0015	8
	P-4	19	56	-28	84	64	3661	0.7	0.0015	246
Year5	P-3	19	21	-21	42	22	1193	0.7	0.0015	28
	P-4	19	56	-28	84	64	3818	0.7	0.0015	257

Table 17 Wall Seepage Post-monsoon (Aquifer 1)

Years	Pit Id	Top m RL	bottom m RL	Water Level (mbgl)	Working Depth (m)	Depth of 1st Aquifer (m)	Saturated Thickness (m)	Perimeter (m)	Hydraulic Conductivity (m/day)	Hydraulic Gradient	Seepage (cub m/day)
Year1	P-1	63	-21	18	84	20	2	2041	10	0.0015	61
Year2	P-1	63	-28	18	91	20	2	2104	10	0.0015	63
Year3	P-1	63	-14	18	77	20	2	2468	10	0.0015	74
	P-4	56	-49	18	105	20	2	3404	10	0.0015	102
Year4	P-3	21	-7	18	28	20	2	999	10	0.0015	30
	P-4	56	-28	18	84	20	2	3661	10	0.0015	110
Year5	P-3	21	-21	18	42	20	2	1193	10	0.0015	36
	P-4	56	-28	18	84	20	2	3818	10	0.0015	115

Table 18 Wall Seepage Post-monsoon (Aquifer 2)

Years	Pit Id	Water level (m bgl)	Top m RL	bottom m RL	Working Depth (m)	Saturated Thickness (m)	Perimeter(m)	Hydraulic Conductivity (m/day)	Hydraulic Gradient	Seepage (cub m/day)
Year1	P-1	18	63	-21	84	64	2041	0.7	0.0015	137
Year2	P-1	18	63	-28	91	71	2104	0.7	0.0015	157
Year3	P-1	18	63	-14	77	57	2468	0.7	0.0015	148

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

	P-4	18	56	-49	105	85	3404	0.7	0.0015	304
Year4	P-3	18	21	-7	28	8	999	0.7	0.0015	8
	P-4	18	56	-28	84	64	3661	0.7	0.0015	246
Year5	P-3	18	21	-21	42	22	1193	0.7	0.0015	28
	P-4	18	56	-28	84	64	3818	0.7	0.0015	257

Table 19 Bottom Seepage

Years	Pit Id	Pit Bottom Area (sq.m)	Working Depth (m)	Hydraulic Conductivity (m/day)	Hydraulic Gradient	Seepage (cub m/day)
Year1	P-1	132400	84	0.07	0.0015	14
Year2	P-1	140800	91	0.07	0.0015	15
Year3	P-1	194400	77	0.07	0.0015	20
	P-4	368400	105	0.07	0.0015	39
Year4	P-3	31600	28	0.07	0.0015	3
	P-4	426400	84	0.07	0.0015	45
Year5	P-3	45200	42	0.07	0.0015	5
	P-4	464000	84	0.07	0.0015	49

Table 20 Total Seepage (wall+ bottom Seepage)

Year	Pit Id	Total Seepage of Per-Monsoon (m/day)	Total Seepage of Post-Monsoon (m/day)	Bottom Seepage (m/day)	Total Seepage (m/day)		Total Annual Seepage (m/yearly))
Year1	P-1	168	198	14	197	197	71905
Year2	P-1	189	220	15	219.5	219.5	80118
Year3	P-1	185	222	20	223.5	643	81578
	P-4	355	406	39	419.5		153118
Year4	P-3	23	38	3	33.5	407	12228
	P-4	301	356	45	373.5		136328

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Year5	P-3	46	64	5	60	452	21900
	P-4	314	372	49	392		143080

Table 21 Annual Rainfall

Year	Pit Id	Pit void area (sq.m)	Annual Rainfall (m)	Rainfall Accumulation (Cub m/year)
Year1	P-1	331000	3.41277	790739
Year2	P-1	352000	3.41277	840907
Year3	P-1	486000	3.41277	1161024
	P-4	921000	3.41277	2200213
Year4	P-3	79000	3.41277	188726
	P-4	1066000	3.41277	2546609
Year5	P-3	113000	3.41277	269950
	P-4	1160000	3.41277	2771169

*Rainfall average of 10 Year 3412.77mm/annum (Source: Customize Rainfall Information System, IMD Hydromet Division)

** 70% rainfall is considered in calculation and remining considered handling losses

Table 22 Evaporation Loss

Year	Pit Id	Pit Bottom Area (sq.m)	Evaporation (m)	Pan Coefficient	Evaporation Loss (cub m/year)
Year1	P-1	132400	2.1	0.7	194628
Year2	P-1	140800	2.1	0.7	206976
Year3	P-1	194400	2.1	0.7	285768
	P-4	368400	2.1	0.7	541548
Year4	P-3	31600	2.1	0.7	46452
	P-4	426400	2.1	0.7	626808
Year5	P-3	45200	2.1	0.7	66444
	P-4	464000	2.1	0.7	682080

*Evaporation loss- 2.1m/annum, i.e. Evaporation pan- 3.0 m/annum * 0.7 is pan Coefficient (Source: Venkataraman and Krishnamurthy, 1964)

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Table 23 Total water available

Year	Pit Id	Total Seepage (cub m/annum)	Rainfall Accumulation (Cub m/year)	Evaporation Loss (cub m/year)	Recharge Infiltration (m/year)	Total Water Available in pit After Evaporation loss (cub m/year)	Total Water Available in pit After Evaporation loss (cub m/day)	Total Water Available in pit After Evaporation loss (cub m/day)
Year1	P-1	71905	790739	194628	60385	607631	1665	1665
Year2	P-1	80118	840907	206976	64472	649576	1780	1780
Year3	P-1	81578	1161024	285768	86982	869852	2383	6896
	P-4	153118	2200213	541548	164733	1647049	4512	
Year4	P-3	12228	188726	46452	14067	140435	385	5503
	P-4	136328	2546609	626808	187806	1868322	5119	
Year5	P-3	21900	269950	66444	20430	204976	562	6118
	P-4	143080	2771169	682080	203997	2028172	5557	

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5.2 ESTIMATION OF RAINWATER QUANTUM DEWATERED

The total water available in the pit has been analytically calculation given above, In Year-1, Pit-1 will have about 1665 m³/day of water available after evaporation losses. In Year-2, this increases to 1780 m³/day due to higher rainfall and seepage contribution.

As per analytical calculations, the total rainwater that can be dewatered from the mine pits during the 2nd year of the plan period is estimated to be about 219.5 m³/day, considering an average annual rainfall of 3412.77 mm/year (Source: Customized Rainfall Information System, IMD Hydromet Division) and accounting for 70% losses during handling and wall runoff.

As per the numerical groundwater modelling, after commencement of mining operations, the seepage in Year-2 is estimated to be about 736 m³/day, which is higher than the analytical estimate and therefore has been considered for the application. The rainfall contribution calculated analytically in Year-2 is about 1560 m³/day, and the combined total water availability from seepage and rainfall is approximately 2296 m³/day.

5.3 ADVANCED DEWATERING PLAN IN CASE OF COAL/LIGNITE MINES

This section is not applicable as this is a Proposed Iron Ore mine.

5.4 GROUNDWATER MODELLING

5.4.1 MODEL CONCEPTUALIZATION

A conceptual hydrogeological model of the study area was developed based on field investigations, lithological information obtained from the approved Mining Plan and exploration data, hydrogeological information available in the Dynamic Groundwater Resources Assessment (GWRA), Goa (2024), Digital Elevation Model (DEM), groundwater level observations, and other secondary data. The conceptual model forms the basis for the development of the three-dimensional numerical groundwater flow model using Visual MODFLOW Flex 6.1.

The model domain encompasses the 10 km buffer zone around the mine lease, which adequately represents the regional hydrogeological conditions and facilitates the application of appropriate hydraulic boundary conditions. The study area is drained by the Khandepar River, Ragada River, Zuveri River, and their associated tributary nalas, which govern the regional drainage pattern and influence groundwater flow.

Boundary conditions were assigned based on the regional groundwater flow regime interpreted from groundwater level contour maps and topography. Initial groundwater heads derived from observed groundwater levels were assigned as the starting hydraulic conditions for the model. No-flow boundaries were assigned along portions of the model domain where groundwater flow is considered parallel to the model boundary. A specified flux-in boundary was assigned along the

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southeastern margin to represent regional groundwater inflow, whereas a specified flux-out boundary was assigned along the northeastern margin to simulate groundwater outflow from the model domain. These boundary conditions were selected to realistically represent the regional groundwater flow system while evaluating the impact of mine seepage.

The Digital Elevation Model (DEM) indicates that the elevation within the buffer area varies from approximately 457 m AMSL in the northern part to about -8 m AMSL in the southwestern part, resulting in an overall relief of approximately 465 m. The regional groundwater flow generally follows the topographic gradient from the elevated northern and northeastern areas towards the lower southwestern part of the study area.

Based on lithological information obtained from the approved Mining Plan, exploration data, and the GWRA Report (2024), the hydrogeological system was conceptualized as a two-layer groundwater system.

Layer 1 (0–20 m): Unconfined Lateritic Aquifer

The upper hydrostratigraphic unit comprises weathered laterite with an average thickness of approximately 20 m. This formation behaves as an unconfined aquifer, storing groundwater within its weathered and porous zone. The aquifer possesses a specific yield of 3%, transmissivity of approximately 200 m²/day (WRIS database), and an average hydraulic conductivity of 10 m/day. The potential groundwater yield of the lateritic aquifer ranges from 1.0 to 10.0 lps.

Layer 2 (20–120 m): Phyllitic and Manganiferous Clay Formation

The lower hydrostratigraphic unit consists predominantly of phyllitic and manganiferous clay formations extending from approximately 20 m to 120 m below ground level, with an average thickness of about 100 m. Owing to its predominantly clay-rich nature and relatively low hydraulic conductivity, this unit behaves as a low-permeability fractured aquifer (aquitard) that restricts vertical groundwater movement while permitting limited groundwater flow through weathered and fractured zones. The unit has an estimated transmissivity of 17.735 m²/day (GWRA, 2024) and an average hydraulic conductivity of approximately 0.173 m/day. The potential groundwater yield ranges from 0.77 to 8.8 lps.

The conceptual hydrogeological model developed using these hydrostratigraphic units, aquifer parameters, groundwater levels, topography, recharge, pumping stresses, and hydraulic boundary conditions was subsequently utilized to construct, calibrate, and validate the numerical groundwater flow model for evaluating the impact of mine seepage and predicting groundwater level changes under the proposed mining scenario.

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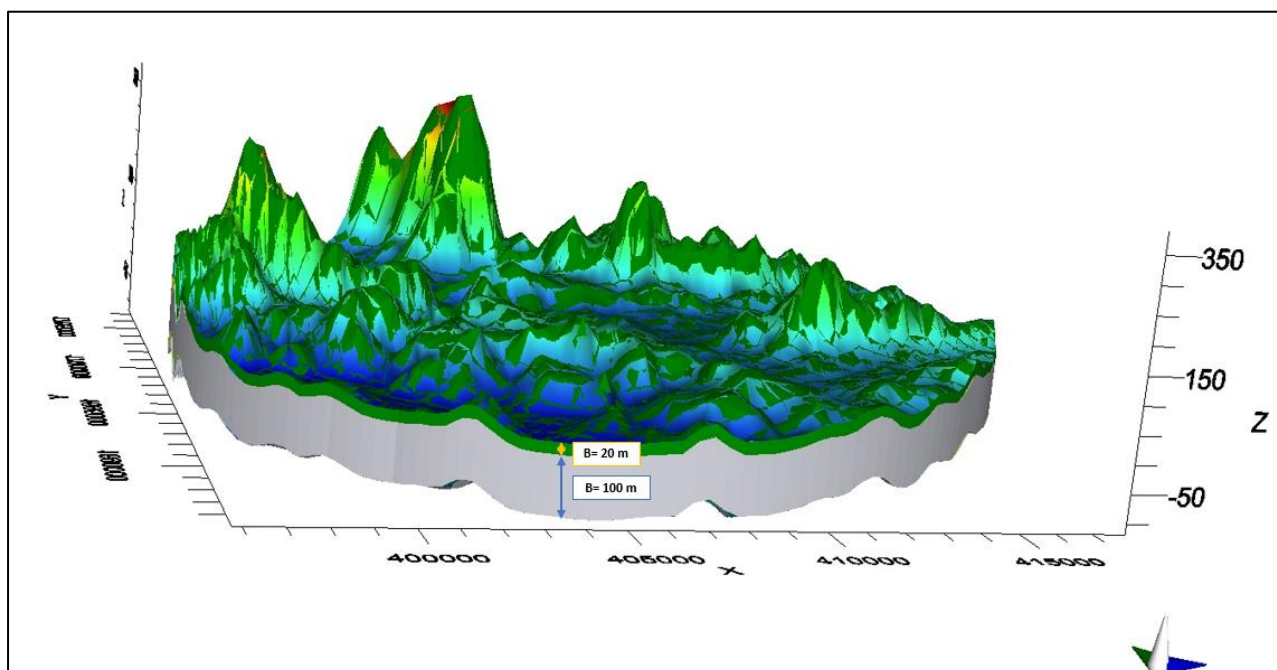


Figure 32 3D Cross Section showing Aquifer thickness in MODFLOW

5.4.2 BOUNDARY CONDITION

The boundary conditions in the model used are set by using the Initial head contours and the natural topographic features of the study area. All the boundary conditions used are shown in Figure 28.

The boundary conations applied in the model are as follows:

1. Specified Flux Boundary: The groundwater flow along the buffer zone boundary was represented in the model using a specified flux boundary condition, assuming that the overall regional flow pattern remains relatively stable over time. A flux-in boundary was considered on the southeastern side, representing groundwater inflow into the system, while a flux-out boundary was assigned on the northeastern side, representing groundwater outflow from the system.
2. No-Flow Boundary: The portion of the buffer zone where the groundwater flow direction is parallel to the model boundary has been assigned as a No-Flow boundary, as no inflow or outflow occurs across these boundaries. This assumption ensures that groundwater movement is restricted within the active model domain in those areas.
3. Recharge: The recharge across the study area has been applied to the top layer (Unconfined layer) of the model as a spatially distributed properly. The unit recharge rate was determined by dividing the total estimated recharge for the area by the number of days in each stress period-245 days for the non-monsoon and 120 days for the monsoon season, respectively.
4. Draft (Groundwater Abstraction): Groundwater abstraction (draft) within the study area was treated as a transient input varying between monsoon and non-monsoon stress periods. The

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total draft for the block, as reported in GWRA 2025 (IN-GRES dataset), was used as the reference. The daily abstraction rate was obtained by distributing the total draft over 245 non-monsoon days and 120 monsoon days. Accordingly, the average per-day pumping rate assigned to each random pumping well was:

- I. Monsoon Season: $-5.14 \text{ m}^3/\text{day}/\text{well}$
- II. Non-Monsoon Season: $-3.43 \text{ m}^3/\text{day}/\text{well}$

River Package: The Khandepar River flows generally from the north-east towards the south-west direction near the mine site area. Streams such as Ragada Nala, originate in the elevated eastern parts of the study area and flow towards the central and southern parts following the natural slope. These tributaries gradually converge and drain into the Zuvari River system in the southern and south-western part of the buffer area. The entire study area falls within the Khandepar Rivercatchment, which controls the regional drainage pattern and surface water flow regime. In the numerical groundwater flow model, the stream has been represented using the River Package, enabling simulation of dynamic interactions between surface water and the underlying aquifer system. This representation allows the river to behave as either a gaining (effluent) or losing (influent) stream, depending on the hydraulic head gradient between the river stage and the adjacent groundwater levels, thereby realistically capturing surface water-groundwater exchange processes within the study area.

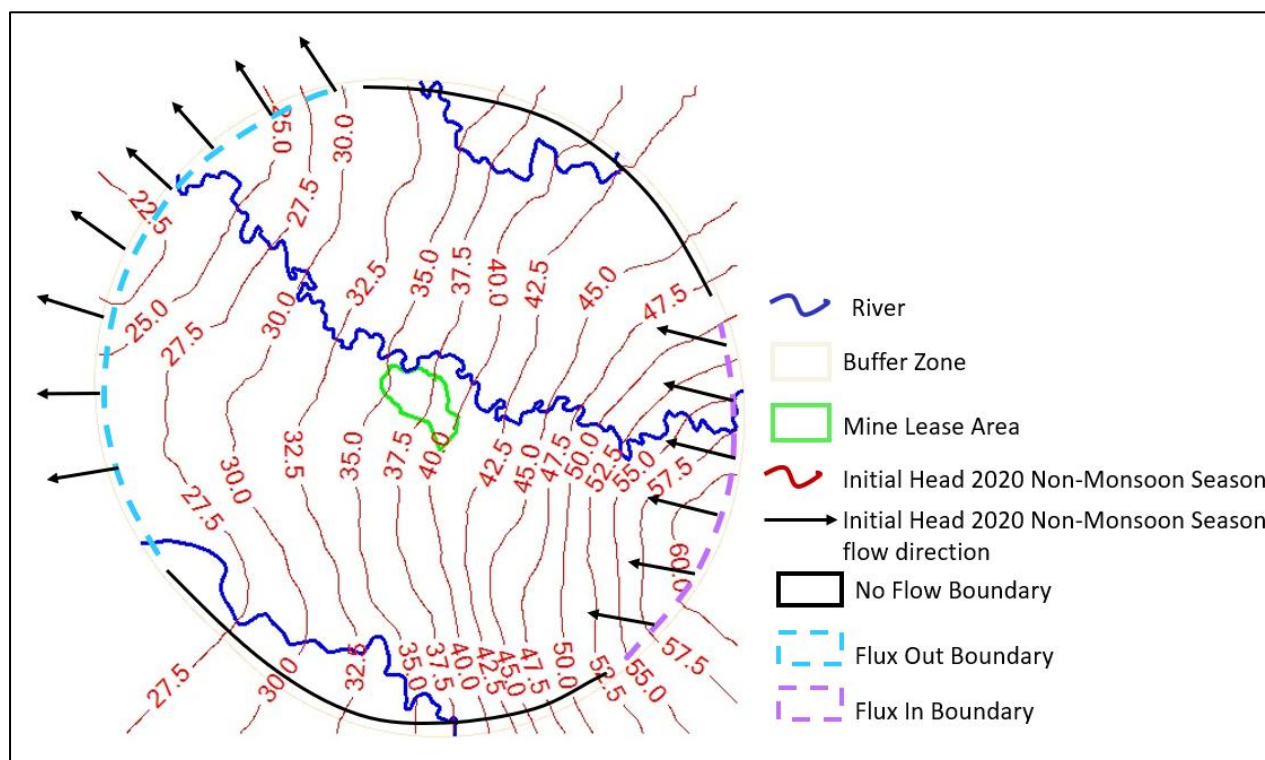


Figure 33 Boundary Conditions used to Simulate the Model

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Table 24: Stress Period Setup

Start_Time (day)	Stop_Time (day)	No. of days	Cumulative no of days	
01-05-2020	01-06-2020	31	31	
01-06-2020	01-10-2020	122	153	
01-10-2020	01-06-2021	243	396	
01-06-2021	01-10-2021	122	518	
01-10-2021	01-06-2022	243	761	
01-06-2022	01-10-2022	122	883	
01-10-2022	01-06-2023	243	1126	
01-06-2023	01-10-2023	122	1248	
01-10-2023	01-06-2024	244	1492	
01-06-2024	01-10-2024	122	1614	
01-10-2024	01-05-2025	212	1826	
01-05-2025	01-06-2025	31	1857	Observation head (Pre Monsoon)
01-06-2025	01-10-2025	122	1979	
01-10-2025	01-06-2026	243	2222	
01-06-2026	01-10-2026	122	2344	
01-10-2026	01-06-2027	243	2587	
01-06-2027	01-10-2027	122	2709	
01-10-2027	01-06-2028	244	2953	2 year from Observed Head
01-06-2028	01-10-2028	122	3075	
01-10-2028	01-06-2029	243	3318	
01-06-2029	01-10-2029	122	3440	
01-10-2029	01-06-2030	243	3683	5 year from Observed Head
01-06-2030	01-10-2030	122	3805	
01-10-2030	01-06-2031	243	4048	
01-06-2031	01-10-2031	122	4170	
01-10-2031	01-06-2032	244	4414	
01-06-2032	01-10-2032	122	4536	
01-10-2032	01-06-2033	243	4779	
01-06-2033	01-10-2033	122	4901	
01-10-2033	01-06-2034	243	5144	
01-06-2034	01-10-2034	122	5266	
01-10-2034	01-05-2035	212	5478	10 years from Observed Head

The initial hydraulic heads were interpolated from CGWB (2020) monitoring well data using the Inverse Distance Weighted (IDW) method to generate the initial potentiometric surface across the model domain. The spatial distribution of these initial heads is illustrated in Figure 30.

For model calibration, groundwater level data from approximately 8 monitoring wells (including CGWB observation wells) were used. Additionally, around 1,000 pumping wells were integrated into the model to represent cell-wise abstraction, developed through QGIS-based spatial interpolation. The Model Top within the buffer area ranges from -0.02 m to 403 m amsl, derived from USGS SRTM DEM data of 250*250 grid (refer Figure 31). The locations of pumping wells, along with the model

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

top (MT), upper aquifer bottom (UAB), and lower aquifer bottom (LAB) configurations, are shown in Figure 31. Based on field observations and satellite verification through Google Earth imagery, the river stage has been assumed to be 1 m lower than the riverbank elevation, while the riverbed bottom is considered 4 m below the river stage. The riverbed hydraulic conductivity has been assigned an optimized value corresponding to the predominantly clayey and silty riverbed lithology observed in the study area.

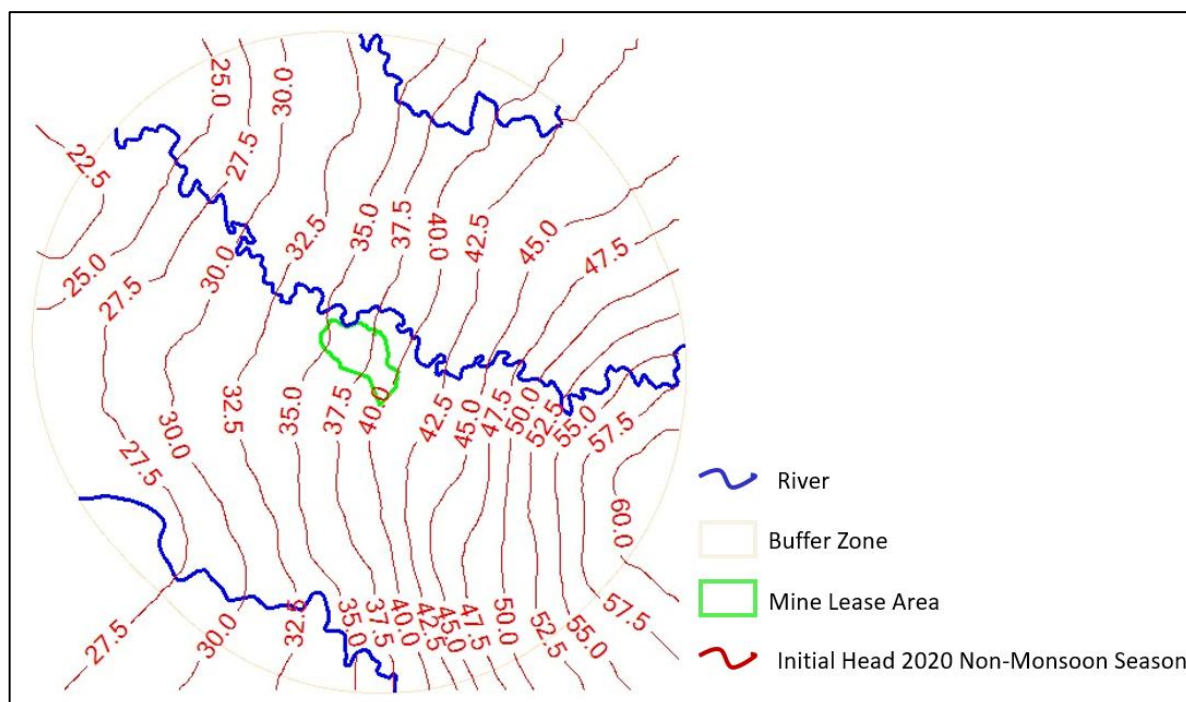


Figure 34 Initial head Contour of the Buffer Zone for November 2020

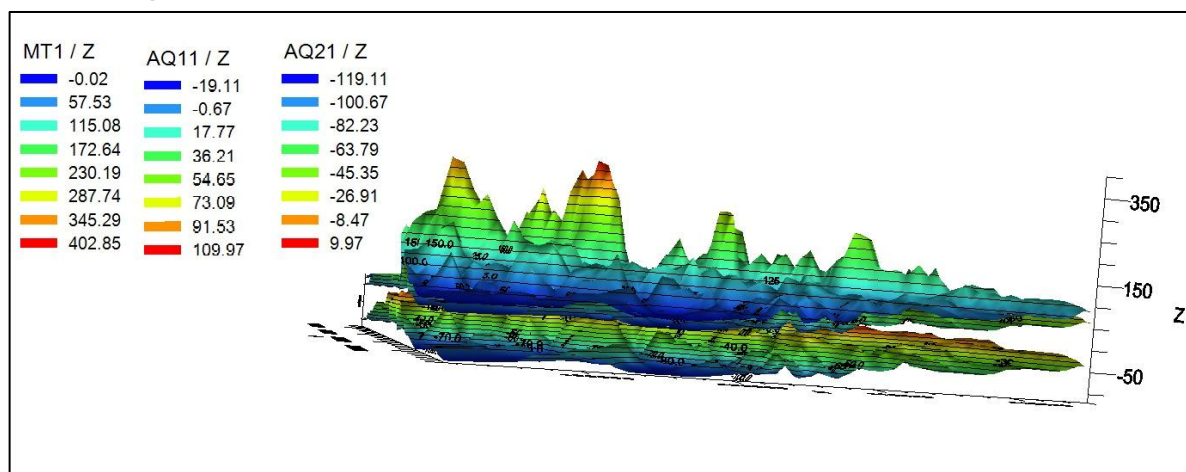


Figure 35: 3D view showing Model-top and two aquifer layers

Table 25: Salient Features for Groundwater Modelling

Parameter	Value
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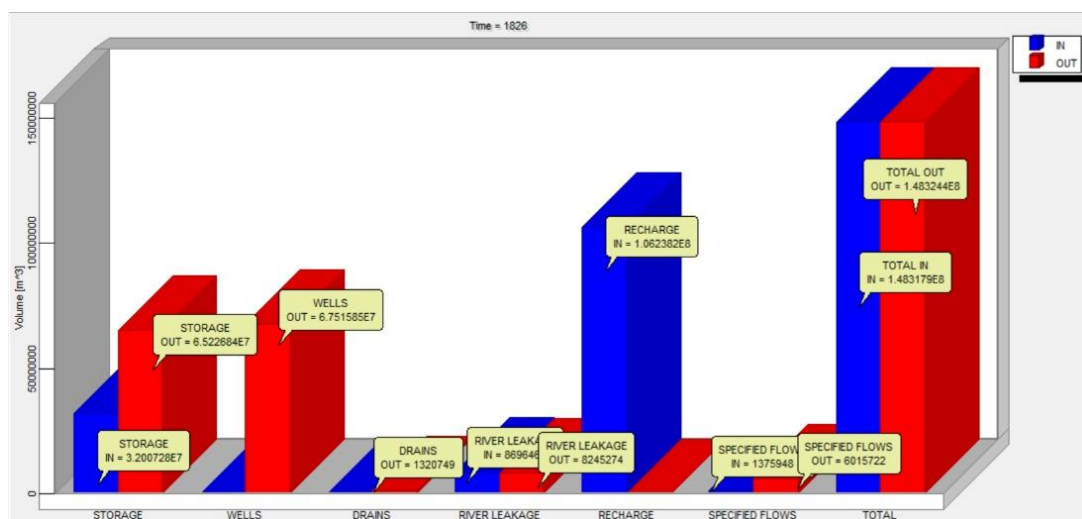
Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Grid,	Column X Row: 92 x 91 (no of grids 8,372) Grid Size: 250 m x 250 m Nos of active grid 6,433 and Nos of Inactive grid 1,939	
Model Top (m) range of elevation	-0.02 to 403 m AMSL	
Bottom of aquifer (m) range of elevation	Aquifer 1- -20 to 110 m AMSL Aquifer 2- -120 to 10 m AMSL	
Initial Heads (m amsl)	20 to 62 amsl (CGWB INDIA WRIS 2020(Pre-Monsoon) by using IDW method)	
Aquifer Type (Dynamic Groundwater Resources, Goa District 2024 and WRIS)	Aquifer 1: Unconfined (Laterite) Aquifer 2: Confined aquifer (fractured schist)	
Boundary Conditions Used	Flux in (+0.005) and flux out (-0.005) along the buffer zone boundary, No Flow Boundary	
Hydraulic Conductivity (K) (Dynamic Groundwater Resources, Goa District 2024 and WRIS/Pumping Test))	Seed Value	Aquifer layer -1: 10 m/day Aquifer layer -2: 0.17 m/day
	Optimised Value	Aquifer layer -1: 7 m/day Aquifer layer -2: 0.7 m/day
Storage Parameter	Aquifer layer -1: Specific yield = 3% (GEC 2015- Laterite)	
	Aquifer layer -2: Specific Storage = 5.17×10^{-5} (1/m)	
Recharge applied (for confined – (Laterite) as per GEC-2015)	7% of average rainfall	For Monsoon: 1.49 mm/day to 2.47 mm/day For Non-Monsoon: 0.0085 mm/day to 0.205 mm/day
Draft applied (Source: GEC Dashboard- ingres.iith.ac.in) 1000 pumping well	Monsoon: -5.14 m ³ /day /pumping well Non-monsoon: -3.43 m ³ /day/pumping well	
Proposed Draft applied for the firm (NOC)	736 KLD seepage	

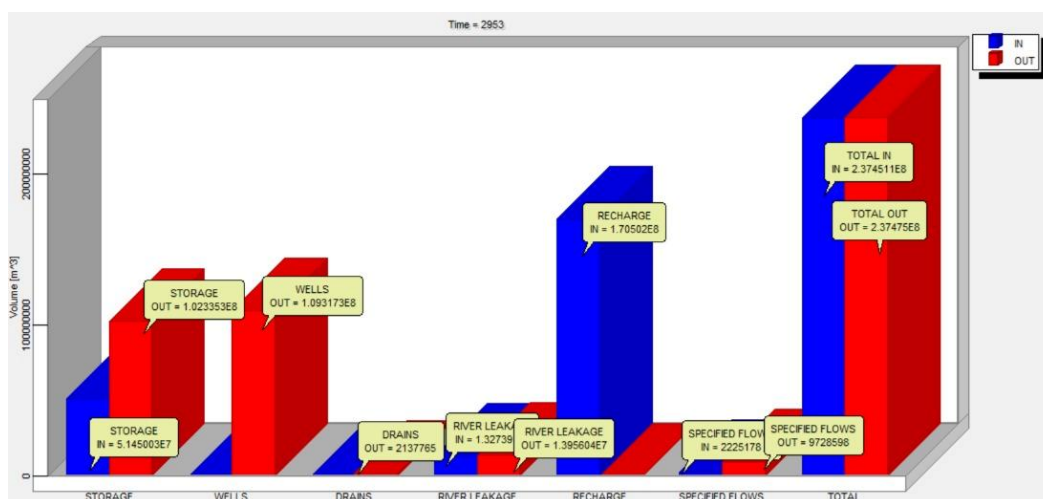
5.4.3 GROUNDWATER BUDGET

The regional groundwater budget was estimated using the Zone Budget package in Visual MODFLOW. The groundwater budget for the entire study area is summarized below. The calculated mass balance for May 2025 and May2035 is illustrated in Figure 32 According to the GWRA 2025 classification, the area currently falls under the safe assessment category. The model prediction that it will remain in the same category by 2035, as projected groundwater extraction will continue to be lower than recharge. However, to sustain and improve groundwater conditions, additional artificial recharge and conservation measures are recommended within the block. The model-generated mass balance for the buffer zone, incorporating all imported packages and their respective values for Non-Monsoon 2025, 2028 and 2035, is presented in Figures 32 (a), (b), (c), respectively.

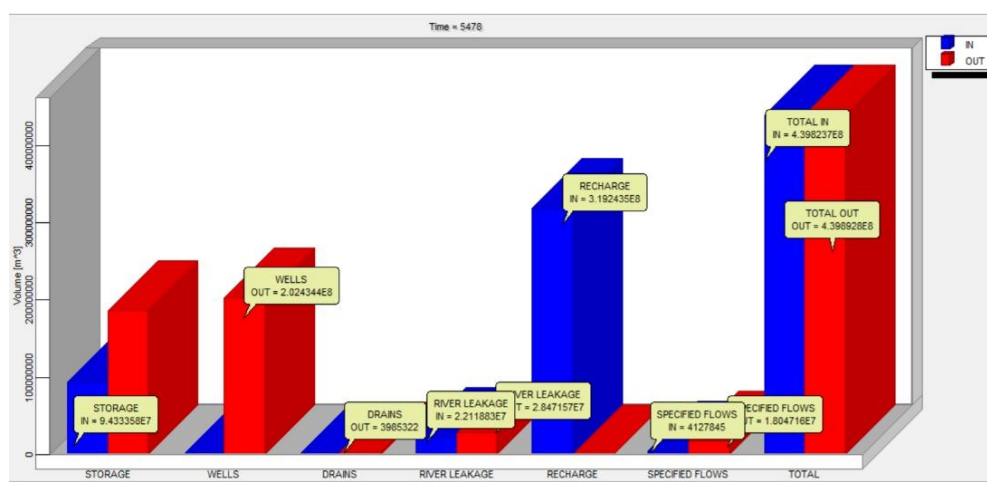
Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)



32 (A) Mass balance of the buffer of time Period 1827 (2025)



32 (B) Mass balance of the buffer of time Period 2957 (2028)



32 (D) Mass balance of the buffer of time Period 5478 (2035)

Figure 36: (a), (b), (c) and (d) Calculated mass balance of 2025, 2028 to 2035

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

The study area falls within a safe assessment block as per the CGWA/KGWA classification. Groundwater modelling results also indicate that the Stage of Groundwater Extraction in the 10 km buffer zone lies within the safe range. Using the prescribed GEC-2015 assessment methodology, the extraction stage within the model area has been computed under 70%, confirming its classification as safe under GEC-2015 norms.

$$\text{Stage of Ground Water Development} = \frac{\text{Existing gross ground water draft for all uses}}{\text{Net annual ground water availability}} \times 100$$

The simulated projections further suggest that the area is expected to remain within the safe category in the long-term, with no significant decline in groundwater availability anticipated under the modelled abstraction and recharge conditions

5.4.4 MODEL CALCULATED GROUNDWATER SEEPAGE

The groundwater seepage assessment was conducted using a calibrated numerical groundwater flow model incorporating the DRAIN package to simulate inflow into the mine pit under transient conditions. Based on the simulation results, the model-calculated groundwater seepage into the mine pit is approximately 736 KLD, representing the average groundwater inflow anticipated during mining operations. The rainfall contribution calculated analytically in Year-2 is about 1560 m³/day, and the combined total water availability from seepage and rainfall is approximately 2296 m³/day.

RATES FOR THIS TIME STEP		L**3/T

IN:		

STORAGE =		23600.8750
CONSTANT HEAD =		0.0000
WELLS =		0.0000
DRAINS =		0.0000
RIVER LEAKAGE =		3289.4912
RECHARGE =		24473.7188
SPECIFIED FLOWS =		753.5314
TOTAL IN =		52117.6172
OUT:		

STORAGE =		4.9920
CONSTANT HEAD =		0.0000
WELLS =		42224.6055
DRAINS =		735.8942
RIVER LEAKAGE =		5925.1821
RECHARGE =		0.0000
SPECIFIED FLOWS =		3294.4802
TOTAL OUT =		52185.1562
IN - OUT =		-67.5391
PERCENT DISCREPANCY =		-0.13

Figure 37 Model Calculated Groundwater Seepage

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

5.4.5 MODEL CALIBRATION

The model calibration results indicate a good agreement between the simulated and observed groundwater levels, with statistical performance indicators showing RMSE: 1.52 m, NRMSE: 7.24 %, Correlation coefficient: 0.99. The obtained RMSE and NRMSE values are well within the acceptable limits of ≤ 5 m and $\leq 10\%$, respectively, as recommended for groundwater models. These results demonstrate that the model effectively replicates the observed groundwater behaviour across the study area, confirming the accuracy and reliability of the calibration process. The corresponding scatter plot (shown below) illustrates a close alignment of data points along the 1:1 correlation line

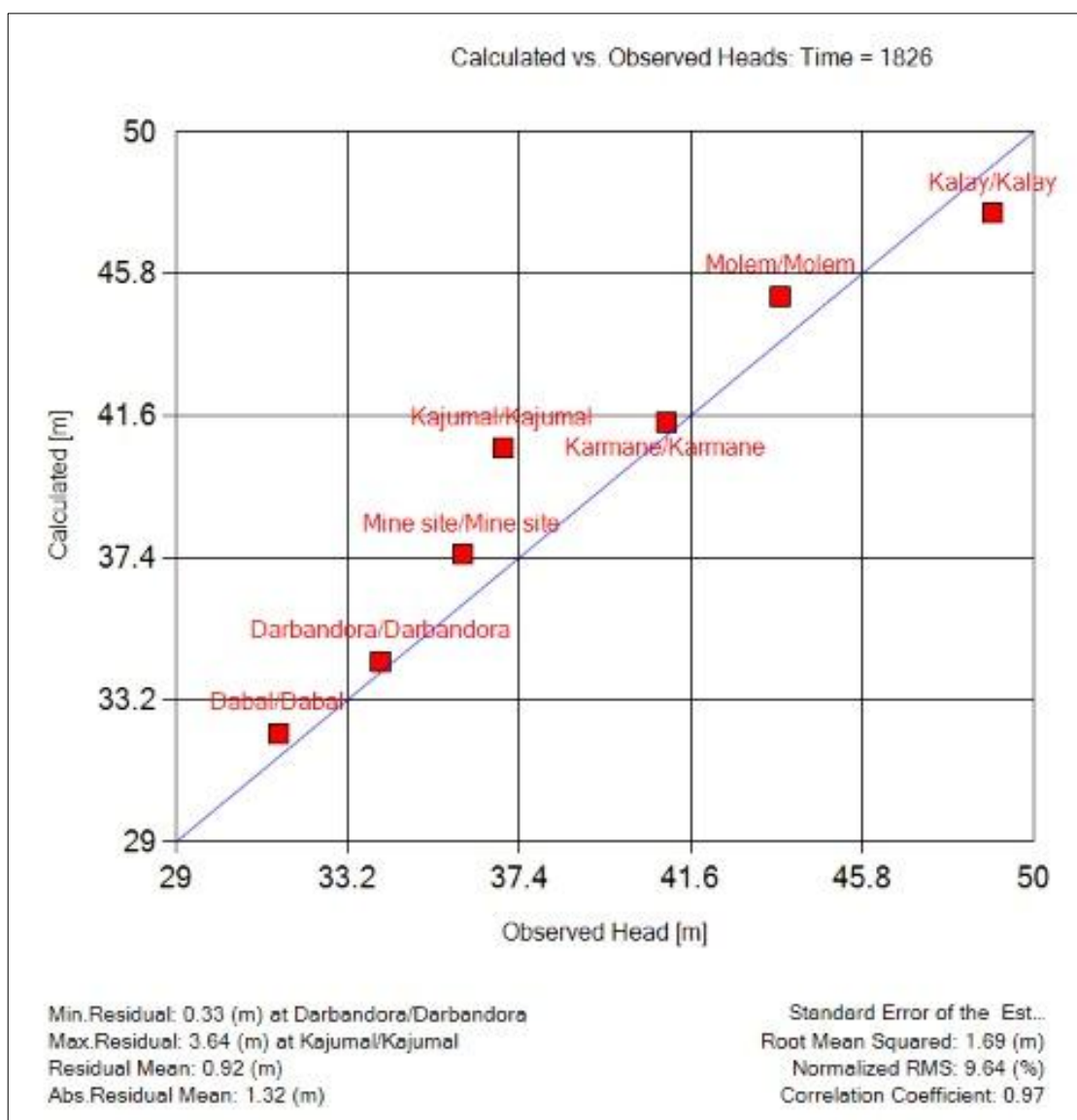


Figure 38: Observed vs Calculated calibration Graph for May 2025

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

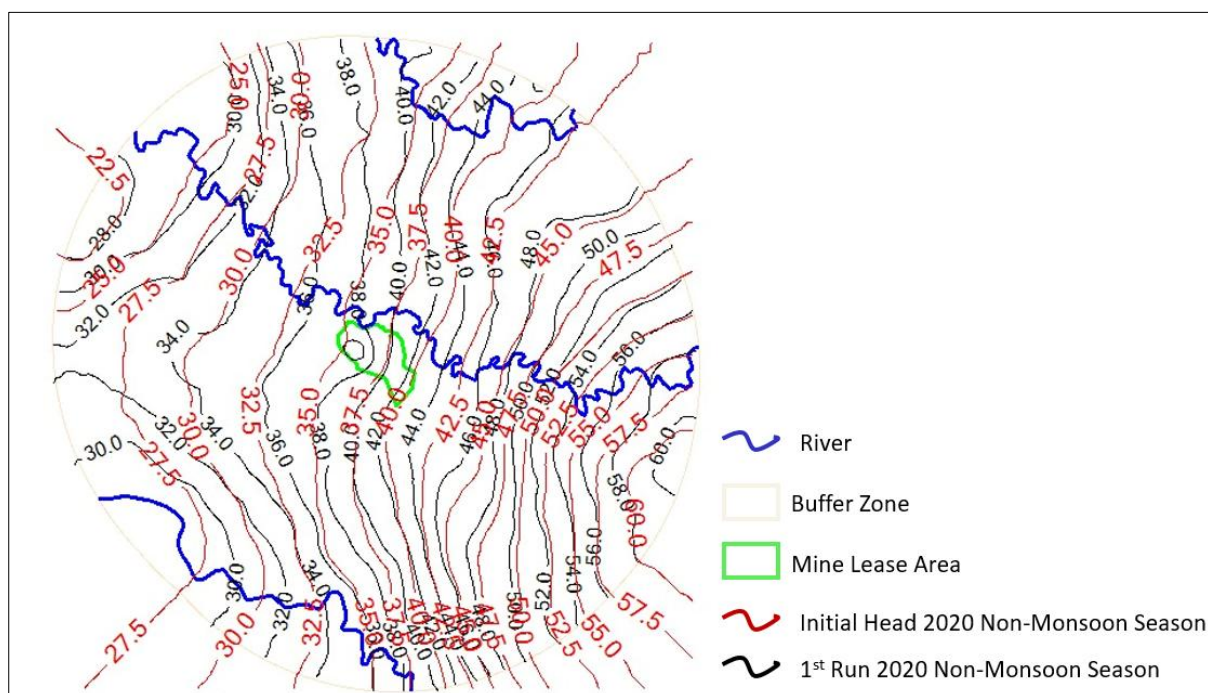


Figure 39 IPZ contour match 2020 non-monsoon with 1st Run Non-Monsoon Season

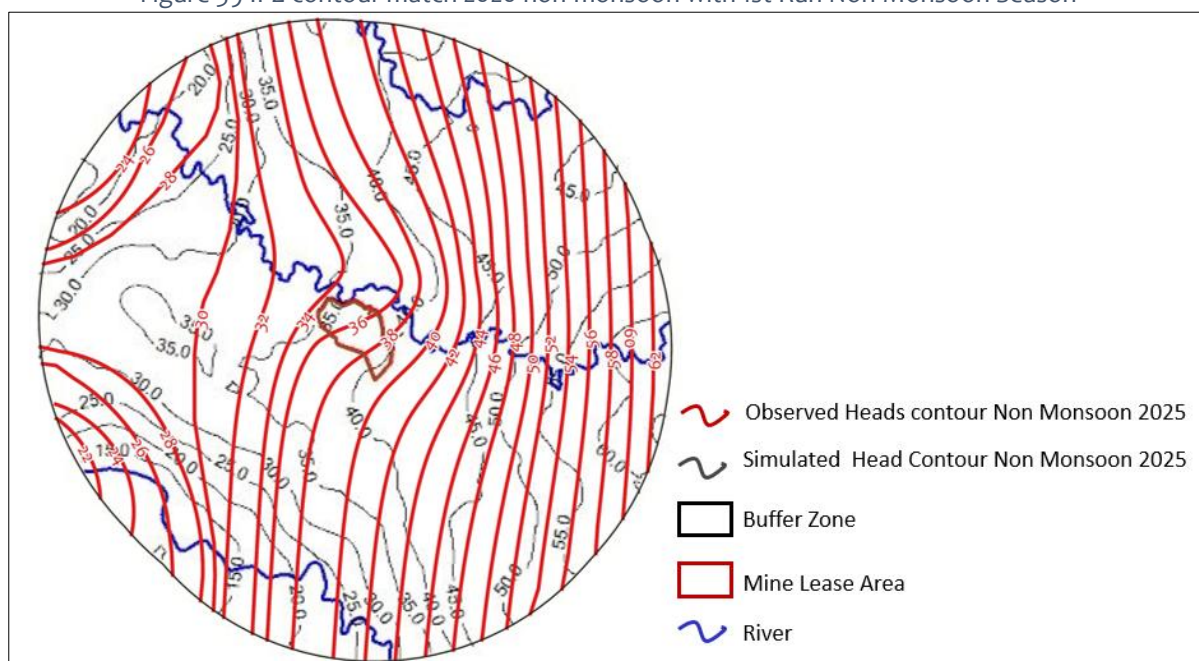


Figure 40 : Matching of Contour shape between Observed and Calculated Head for May 2025

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

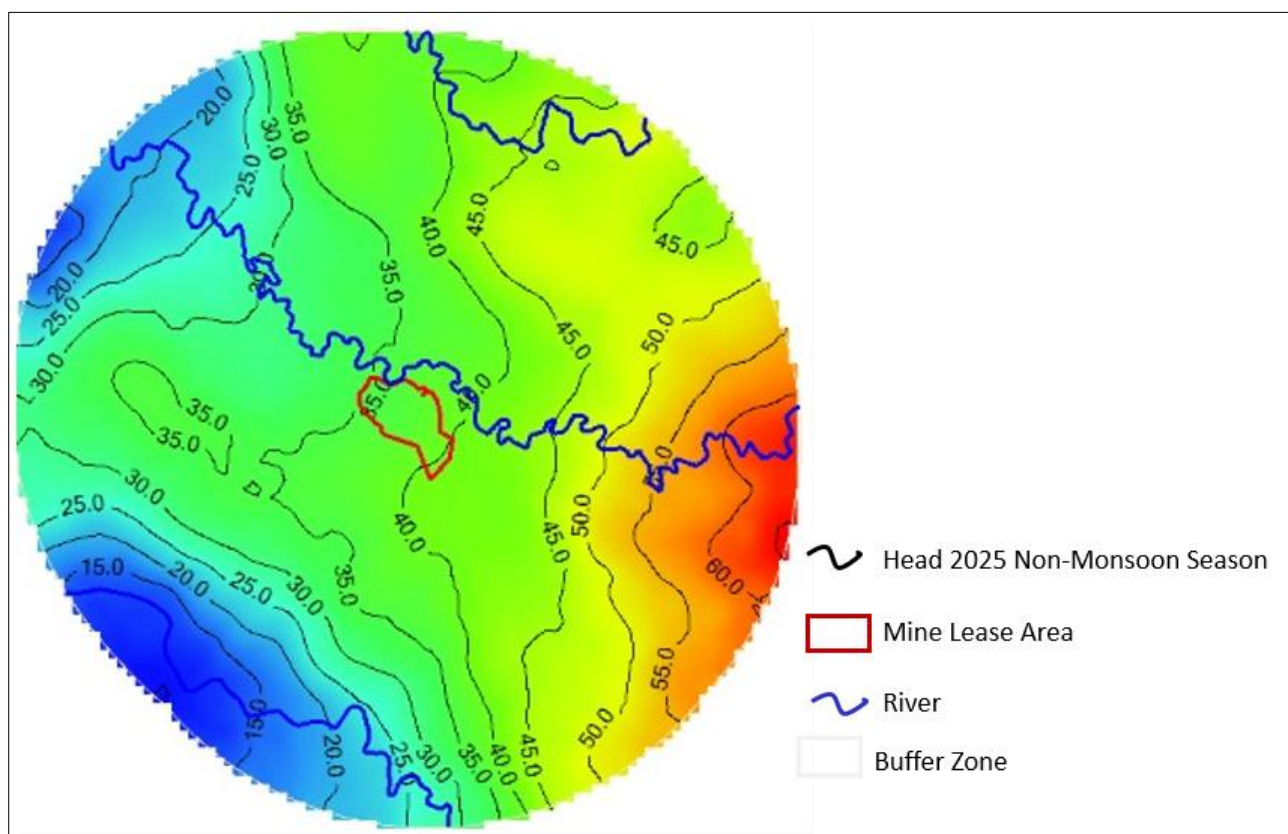


Figure 41 Modflow Calculated Head Contour of the Buffer Zone for May 2025

5.4.6 MODEL PREDICTION

Following successful model calibration, the same calibrated groundwater flow model was utilized to predict groundwater availability for May 2025. The model outputs were analyzed to assess spatial and temporal variations in groundwater levels across the study area. The simulation results were obtained in the form of spatial distribution maps of water table elevation, along with water budget maps and time-series charts representing groundwater level variations for different years.

The groundwater head contour map of the model area, plotted at a 2 m contour interval, is presented in the figure below. The model-predicted groundwater head distributions for May 2028 and May 2035 are shown in Figure 38, 39 and Figure 40, respectively.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

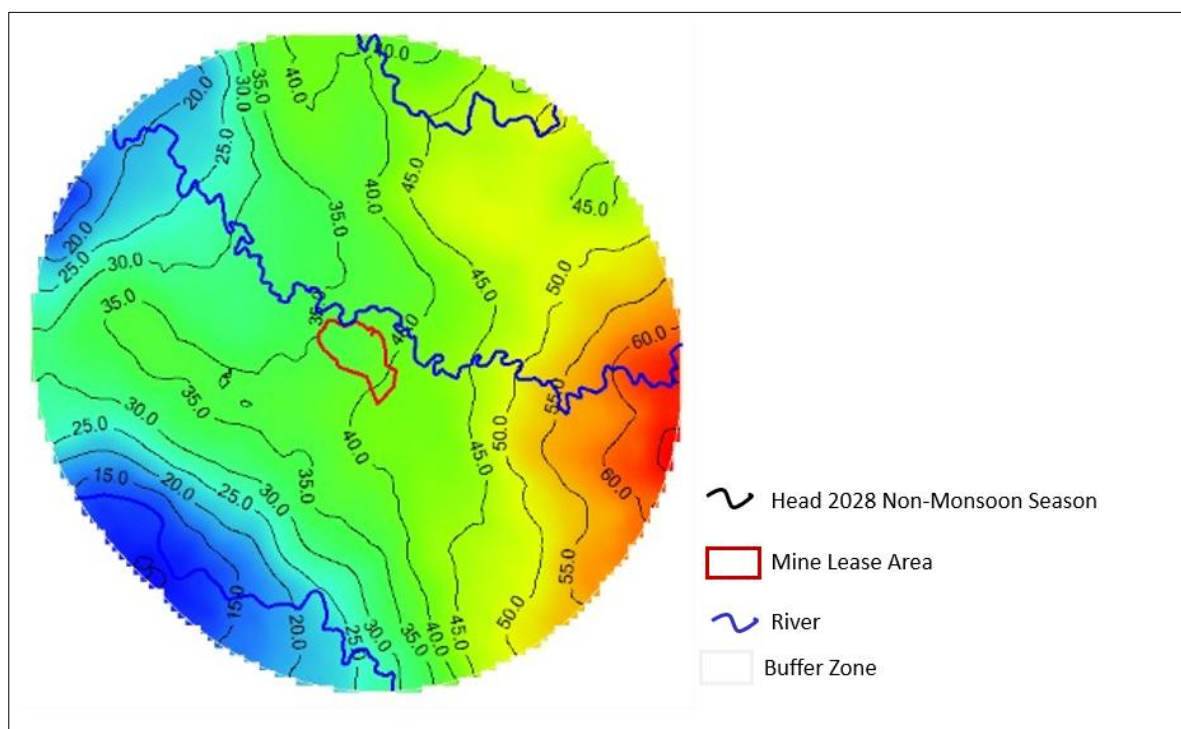


Figure 42: Predicted Groundwater Head Contour of the 10 km Buffer Zone of Non-Monsoon 2028

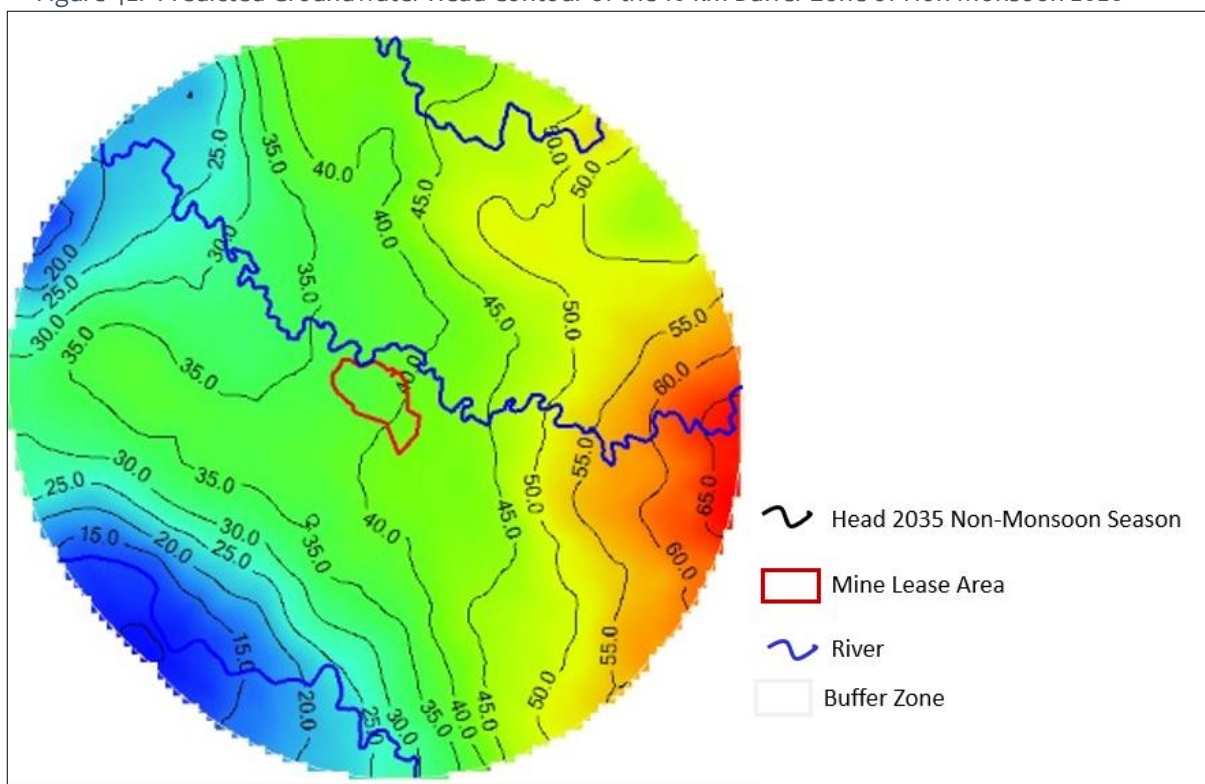


Figure 43: Predicted Groundwater Head Contour of the 10 km Buffer Zone of 2035

5.4.7 DRAWDOWN DUE TO ABSTRACTION

A drawdown map is a representation of the decline in groundwater level or hydraulic head values at various locations within the model caused by different boundary conditions such as recharge, pumping, river etc. The simulated groundwater drawdown cross-sections for the years 2025, 2028,

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

and 2035 indicate that the groundwater level decline resulting from mine seepage remains localized within the mine excavation area. The maximum simulated drawdown is approximately 2.60 m in 2025, 2.51 m in 2028, and 1.72 m in 2035.

The cross-sectional profiles show that the groundwater heads recover rapidly away from the mine pit, and the groundwater levels outside the mine lease area remain close to the initial groundwater heads. Further, the Radius of Influence (ROI) remains entirely within the mine lease boundary throughout the simulation period, indicating that the hydraulic impact of mine seepage is limited to the excavation area. The reduction in maximum drawdown from 2.60 m in 2025 to 1.72 m in 2035 suggests that the groundwater system gradually approaches a stable hydraulic condition as mining progresses.

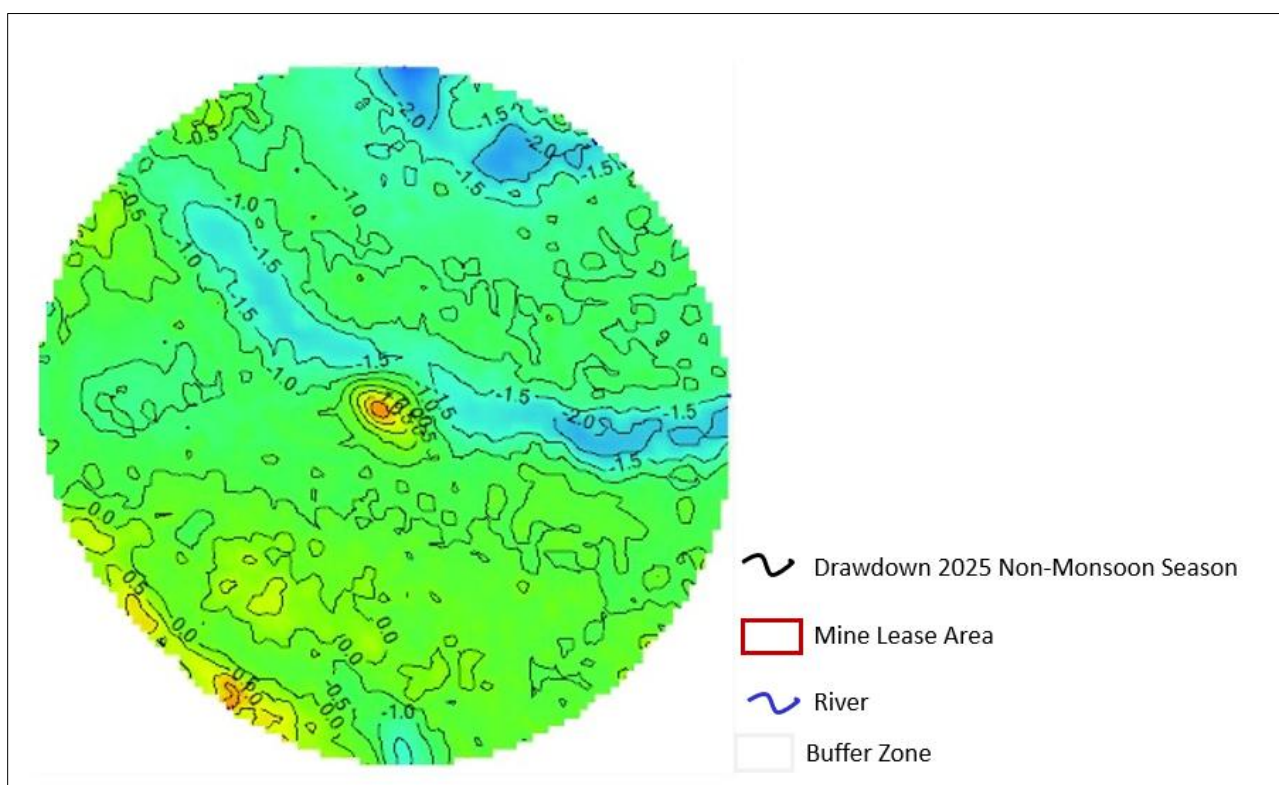


Figure 44 Drawdown of Buffer Zone of year 2025

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

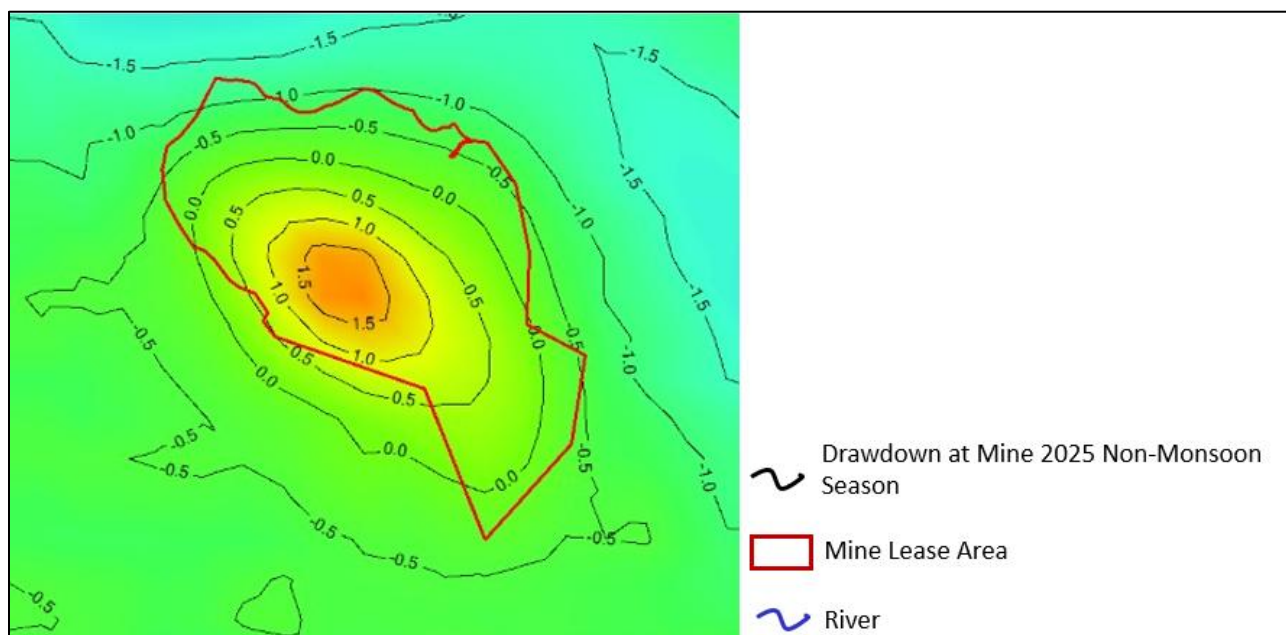


Figure 45 Drawdown at Mine Site of year 2025

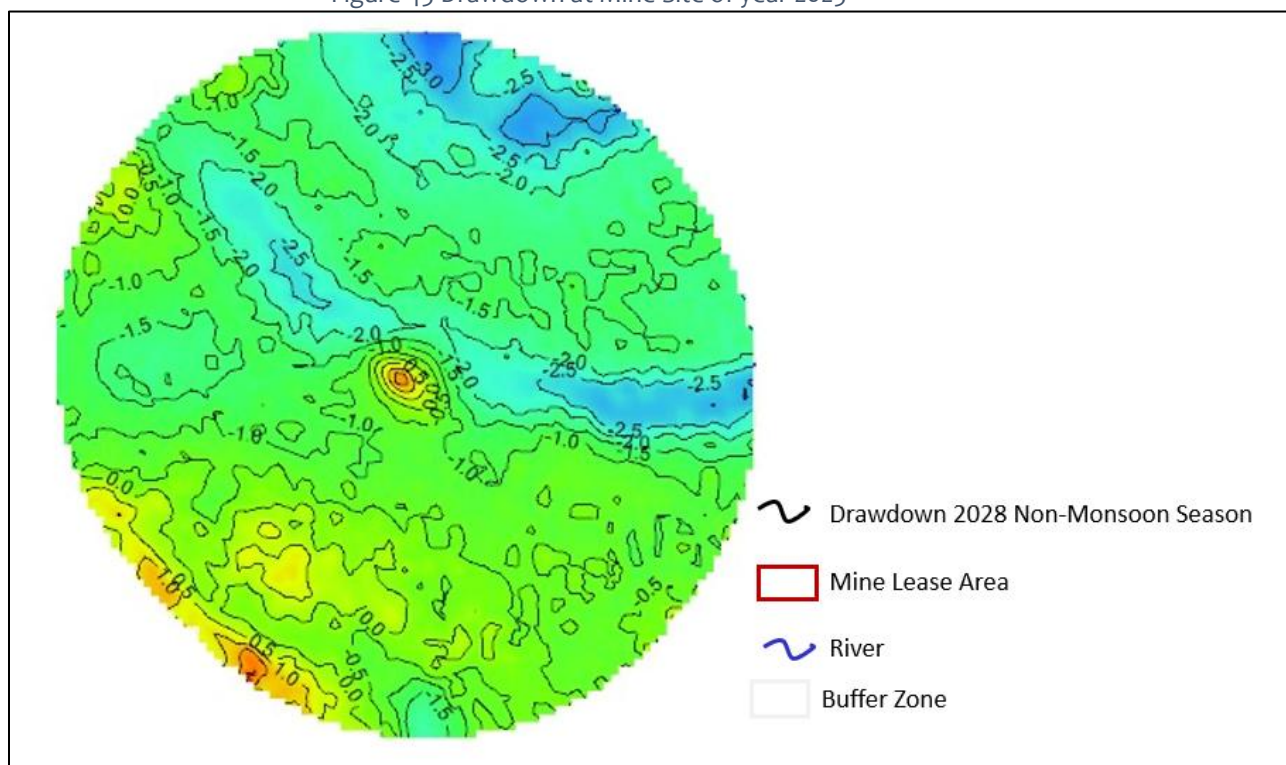


Figure 46 Drawdown of Buffer Zone of year 2028

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

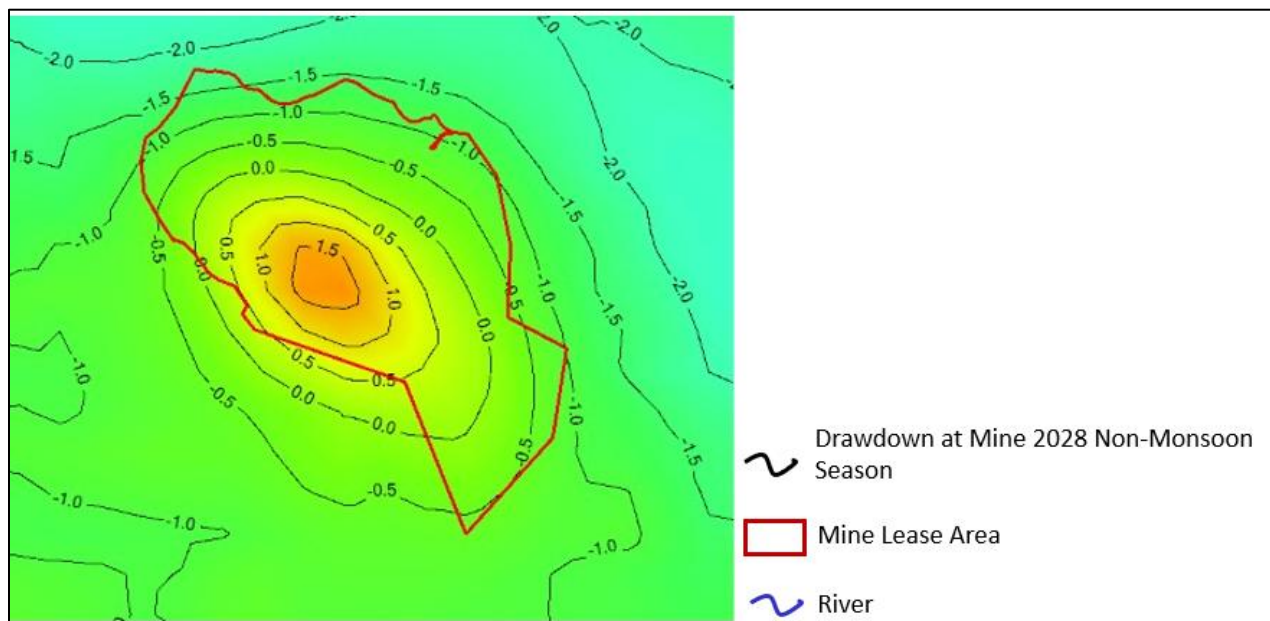


Figure 47 Drawdown at Mine Site of year 2028

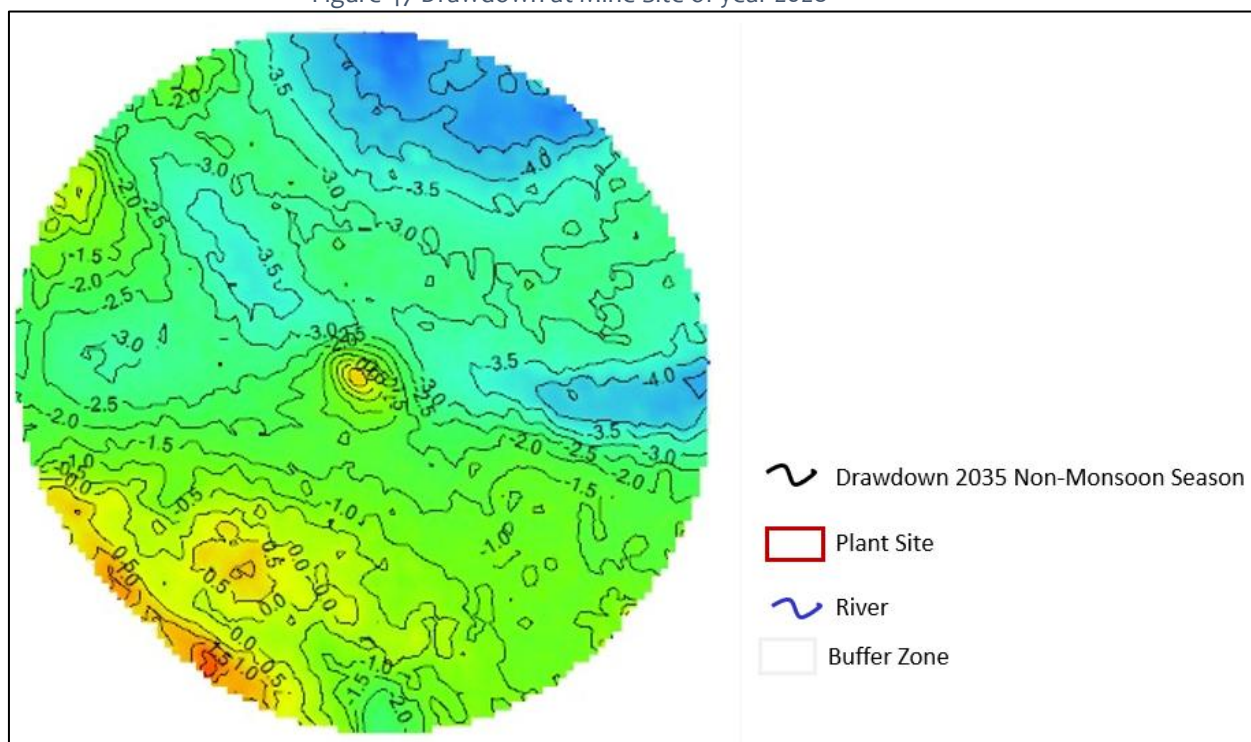


Figure 48 Drawdown of Buffer Zone of year 2035

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

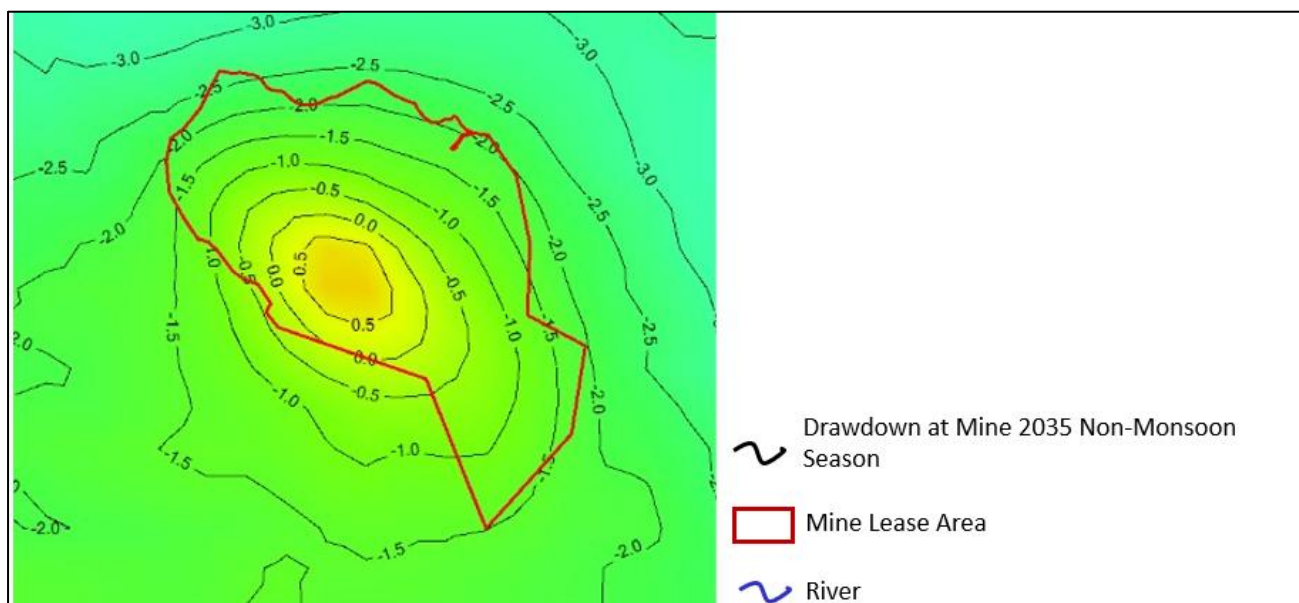


Figure 49 Drawdown of Plant Site of year 2035

The Cumulative Radius of Influence of the drawdown in the combined study area is predicted from the drawdown contours and graph generated from the run of model in 2028 and 2035 (Figure 48 to 50). The modelling results further indicate that the radius of influence (ROI) is confined within the mine boundary, as the groundwater level beyond the lease area shows negligible variation from the initial head.

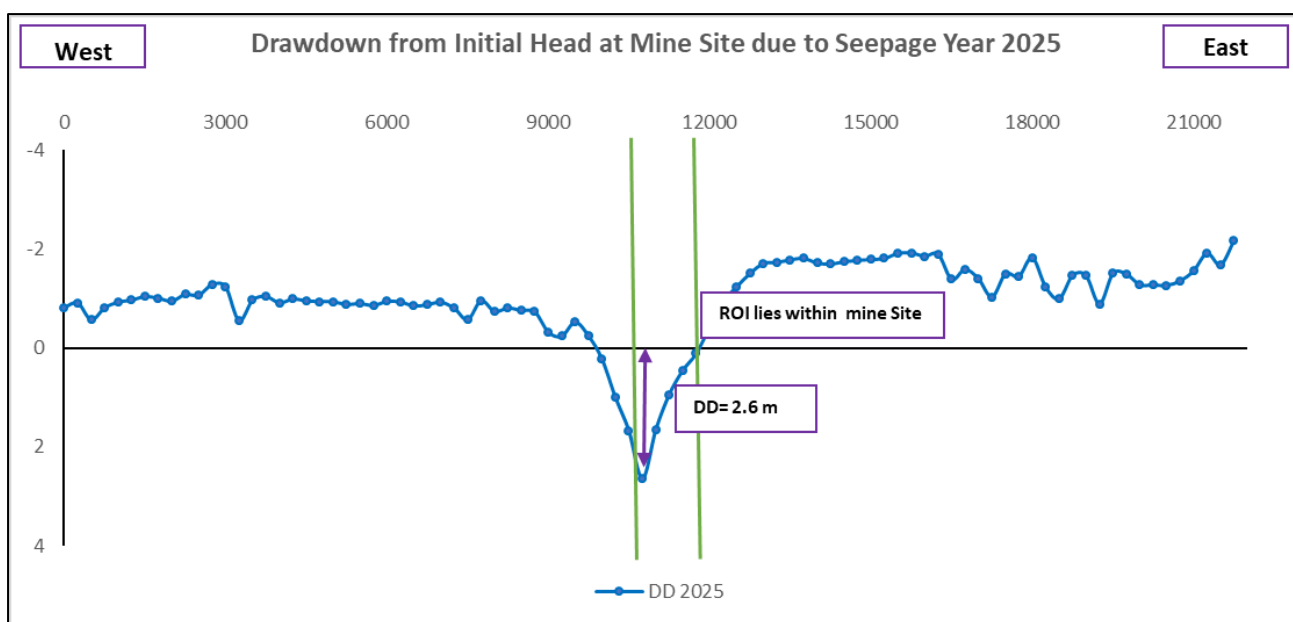


Figure 50 Radius of Influence (2025)

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

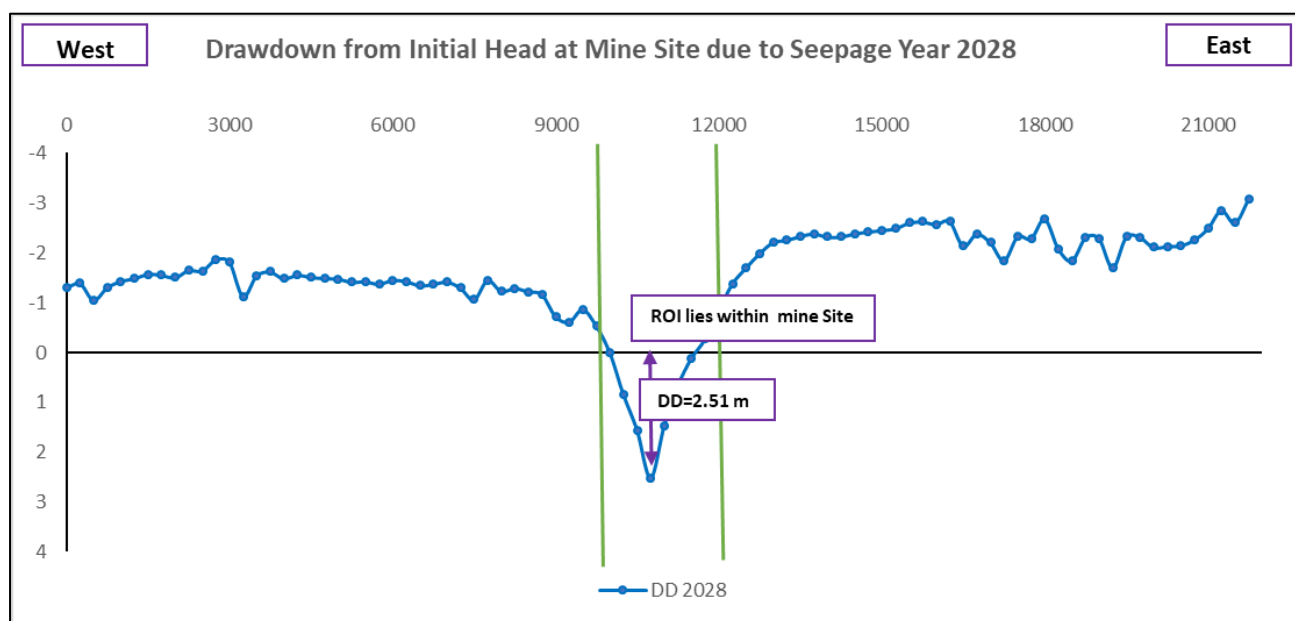


Figure 51 Radius of Influence of NoC Period (2025)

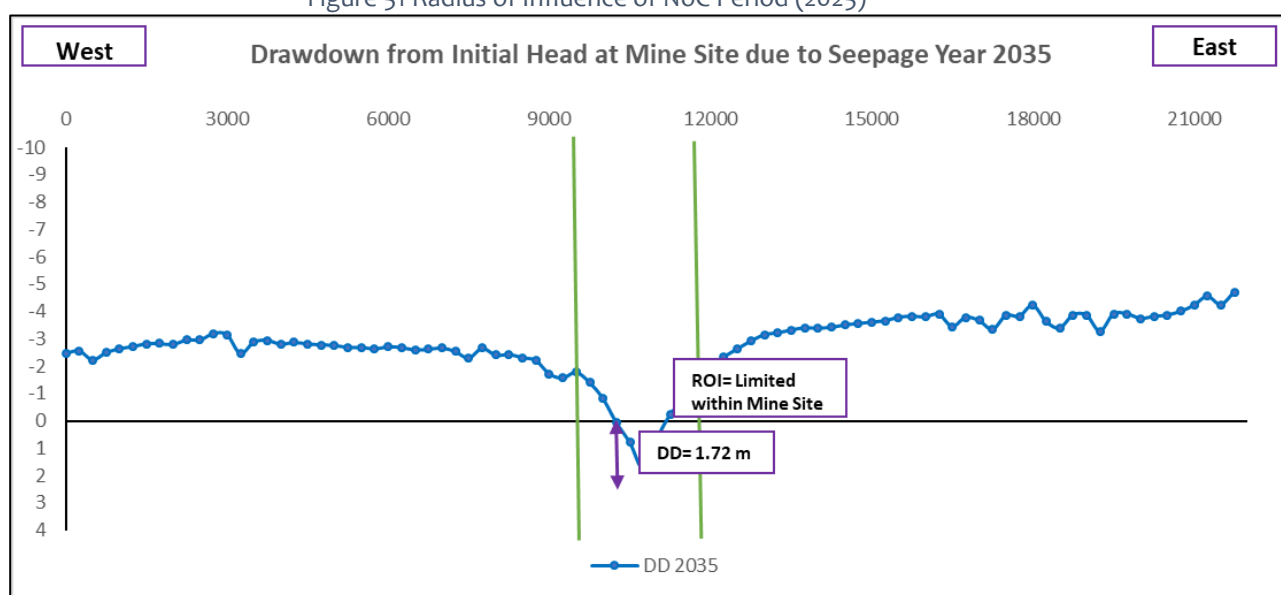


Figure 52 Radius of Influence (2035)

The hydrograph shows the comparison of calculated and observed groundwater levels over time for various locations in the study area. The lines represent the simulated groundwater Heads, and the symbols show the actual calculated heads of monitoring wells. A comparison between the regional CGWB hydrograph data of Station Colem and the groundwater model calibration results shows consistent behaviour, with both indicating stable to slightly rising groundwater levels in the region.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

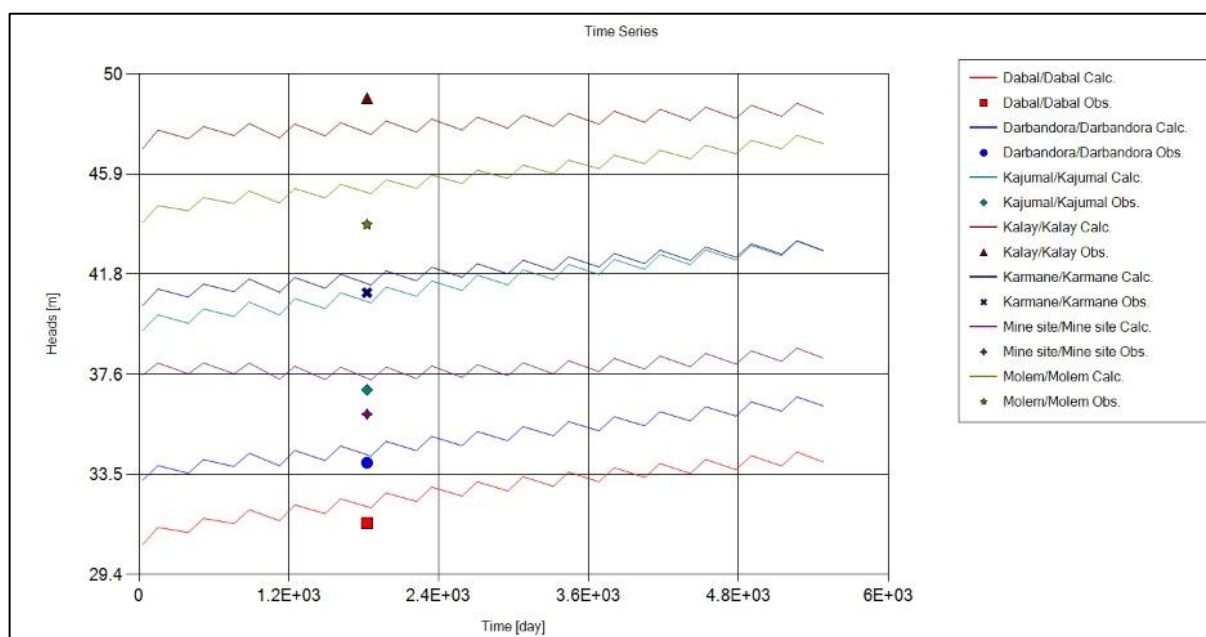


Figure 53 Model Generated Hydrograph of observation locations

6. MINE WATER MANAGEMENT

Water is required for various mining and mineral processing activities such as beneficiation, dust suppression, greenbelt development, vehicle washing, workshop operations, and domestic use. The highest water demand arises from the mineral processing circuit. To minimize fresh water consumption, the mine is designed to operate with a closed-circuit water system, wherein maximum water generated from various mineral processing units is recovered, recycled, and reused within the plant.

Table 26 Water Requirement for Mining Activities

Activity	Water Requirement (m ³ /hr)	Water Requirement (m ³ /day)
Domestic Use	1.66	20
Greenbelt Development	4.16	50
Dust Suppression	10.83	130
Vehicle Washing	4.16	50
Workshop	4.16	50
Total	25	300

Water is mainly required in the beneficiation process and is also present as inherent moisture in the feed material.

Table 27 Water Availability and Requirement in Process

Activity	Water Requirement (m ³ /hr)	Water Requirement (m ³ /day)
Moisture in Feed	41	492
Beneficiation Process	702	8424
Sub-Total	743	8916

Water generated from dewatering screens, thickeners, and filter presses is recovered and recycled back into the process, thereby reducing the requirement of fresh make-up water.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Table 28 Recovery of Water from Different Unit Operations

S. No.	Unit Operation	Amount of Water (m ³ /hr)	Amount of Water (m ³ /day)
1	Dewatering Screen-1	5	60
2	Dewatering Screen-2	19	228
3	Intermediate Thickener	80	960
4	Concentrate Thickener	53	636
5	Concentrate Filter Press	31	372
6	Tailings Thickener	400	4800
7	Tailings Filter Press	110	1320

Table 29 Water Loss from Mining and Processing

S. No.	Source	Water Loss (m ³ /hr)	Water Loss (m ³ /day)
1	Product 1 (-30 +10 mm)	5	60
2	Product 2 (-10 mm)	9	108
3	Concentrate Filter Cake	9	108
4	Tailings Filter Cake	22	264
Total Loss		45	540

The make-up water requirement is calculated after accounting for recovered and recycled water from the process units.

Table 30 Make-up Water Requirement

Description	Water Quantity (m ³ /hr)	Water Quantity (m ³ /day)
Water Availability in Process	743	8916
Water Recovery & Recycling to Plant	698	8376
Water Loss in Tailings, Products & Evaporation	59	708
Make-up Water Requirement	59	708

The proposed Iron Ore Beneficiation Plant will adopt both dry and wet beneficiation processes. The dry beneficiation process is based entirely on physical separation techniques such as crushing, screening, and dry magnetic separation. No chemical reagents or additives will be used during the beneficiation process. Consequently, no chemical wastewater or hazardous process effluent will be generated.

The proposed wet beneficiation process will involve only physical operations such as crushing, grinding, and size separation, and will not involve the use of any chemical reagents. The tailings slurry generated during the beneficiation process will be directed to thickeners and filters for dewatering and recovery of process water. The recovered water will be recycled back to the beneficiation plant, while the dewatered tailings will be disposed of in the designated abandoned mine pits/dumps. The recirculation of process water will significantly reduce the requirement for fresh water and minimize wastewater discharge.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

As per the Water Balance, the total process water circulation in the beneficiation plant is about 743 m³/hr (8,916 m³/day), out of which approximately 698 m³/hr (8,376 m³/day) of process water will be recovered and recirculated back into the beneficiation process. Thus, the overall process water recovery efficiency works out to about 93.95%, while only about 59 m³/hr (708 m³/day) of make-up water will be required to compensate for moisture retained in the products and tailings, as well as evaporation losses.

7. IMPACT OF MINE DEWATERING/ABSTRACTION AND MITIGATION MEASURES

7.1 Impact on the ground water regime

According to GWRE (Ground Water Resource Estimation) 2024, Dharbandora Block is in the safe Category. According to the groundwater resource estimation of the study area (10kms), it was found to have a groundwater extraction stage of 11 % and thus the study area (10 kms) falls under Safe category.

Methodology Used

The groundwater resources of the study were estimated by following the GEC (Groundwater Estimation Committee) 2015. The data for district groundwater resources was taken from GWRE 2024. Further, for calculating the groundwater resources of the study area (10 kms) the data for Dharbandora block is also sourced from the IN-GRES (India-Groundwater Resource Estimation System) website and distributed to the study area on a prorated basis.

Groundwater resources for buffer zone

The area of the buffer zone (10 kms) is about 40164 Ha. This buffer zone has Laterite as the unconfined aquifers. The main recharging factors in this area are recharge due to rainfall, due to return flow from the applied irrigation from surface and groundwater and recharge from the surface water bodies. Geographical area, specific yield and infiltration are the parameters for determining the amount of water which is stored in the aquifer.

Recharge from rainfall in monsoon Season: This is calculated by comparing the results of two different methods as given below.

Table 31: Recharge by Water Level Fluctuation Method

RECHARGE IN BUFFER ZONE BY WATER LEVEL FLUCTUATION METHOD	
	Monsoon Season
Description of items	Quantity
1.Total Area (Ha)	40164
2. Water Table Fluctuation (m)	1
3. Specific Yield	0.03
4. Total Groundwater Storage [(1) * (2) * (3)] (HAM)	1205

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Table 32: Recharge by Rainfall Infiltration Factor Method

RECHARGE IN BUFFER ZONE BY RAINFALL INFILTRATION FACTOR METHOD	
Description of items	Quantity
1.Total Area (Ha)	40164
2. Average Annual Rainfall Monsoon Season (mm)	3089.2
3. Rainfall infiltration factor	0.07
4. Rainfall recharge in Buffer zone by Rainfall Infiltration Factor Method (HAM)	8685

As per the recommendations of Groundwater Estimation Committee (GEC), 2015, if the difference between the two, expressed as a percentage of rainfall infiltration method is greater than or equal to -20% or less than or equal to +20 %, then the recharge is taken as the value estimated by the water table fluctuation method. If it is less than -20%, then it is taken as 0.8 times the value estimated by rainfall infiltration factor method. If it is greater than +20%, then recharge is taken as equal to 1.2 times the value estimated by rainfall infiltration factor method.

Table 33: Rainfall Recharge

RAINFALL RECHARGE IN BUFFER ZONE AFTER COMPARING RESULTS FROM WATER LEVEL FLUCTUATION METHOD AND RAINFALL INFILTRATION FACTOR METHOD	
Description of items	Quantity
1. Rainfall Recharge during monsoon season in Buffer Zone	1205
a) By Water Level Fluctuation Method (HAM)	8685
b) By Rainfall Infiltration Factor Method (HAM)	-86
1. Difference between (1a) and (1b) expressed as a percentage of (1b), 'PD' [$\{(1a) - (1b) / (1b)\} * 100$]	
3. Rainfall Recharge in the Buffer Zone during monsoon season (HAM) [= (1a) if 'PD' is between -20 and +20% = 0.8 * (1b) if 'PD' is less than -20% = 1.20 * (1b) if 'PD' is greater than +20%]	6948

Table 34: Recharge by Rainfall Infiltration Factor (Non-Monsoon Season)

Non Monsoon Season	
RECHARGE IN BUFFER ZONE BY RAINFALL INFILTRATION FACTOR METHOD	
Description of items	Quantity
1.Total Area (HAM)	40164
2. Total Annual Rainfall Non-monsoon Season(mm)	324
3. Rainfall infiltration factor	0.07
4. Rainfall recharge in Buffer zone by Rainfall Infiltration Factor Method(HAM)	910

Table 35: Draft Due to Domestic Utilization

Draft Due to Domestic Utilisation	
Population of Study Area	101136
Census Year	2011
Current Year	2026
Annual Growth Rate	1.38

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Projected Population	122071
Groundwater requirement (HAM)	267
Next two years	2028
Projected Population	124863
Groundwater requirement (HAM)	273

All the other parameters were calculated on pro rata basis and adjusted with intellectual judgments made for the study area considering its demography and geography. The summary of the Groundwater resources of the study area as per GWRE Goa 2023-24 is given below

Therefore, the stage of groundwater resource development calculated as per GEC 2015 is 7% which comes under safe categorization.

RECOMMENDATIONS AND SUGGESTION

- ❖ Awareness program about the conservation of ground water resources to make the population aware.
- ❖ Establish a comprehensive groundwater monitoring network to track changes in groundwater levels over time. Regular monitoring will help in identifying trends, potential issues, and the effectiveness of management measures.
- ❖ The water level monitoring needs to be increased in the study area.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Table 36 Groundwater Resources of the Study Area

S. N O.	Name	Area(Ha)	Ground Water recharge (HAM)				Total Annual Ground water Recharge (HAM)	Total Natural Discharge (HAM)	Annual Extractable GW Resource (HAM)	Current Annual Groundwater Extraction (HAM)				Annual I GW Allocation for (HAM) Domestic Use as on 2027	Net Ground Water Availability for future use (HAM)	Stage of Ground water Extraction (%)	Category
			Monsoon Season		Non- Monsoon					Irrigation	Industrial	Domestic	Total				
			Recharge from rainfall	Recharge from other Source	Recharge from rainfall	Recharge from other Source											
1	South Goa	194609	19826	436	165	1492	21919	4384	17535	926	375	2172	3473	2248	13986	20	Safe
2	Dharbandora	4458	1520	84	12	14	1,630	326	1,304	55	0.9	86	142	86	1,162	11	Safe
3	Study Area	40164.16	6948	753.8	910	123	8735	2937	11749	491	8	267	767	273	10,982	7	Safe

*Source: GEC Dashboard 2024//GWRA Goa 2024

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

7.2 Impact on Surface water sources

There is no natural drainage, stream, or nallah present within the mine lease area. However, the Khandepar River flows at a minimum distance of approximately 10 m from the lease boundary.

Although the river does not pass through the lease area, mining operations such as excavation, overburden handling, haul road movement, and beneficiation activities may pose a potential indirect risk to the river in the absence of adequate safeguards, particularly during the monsoon season.

Potential Impacts

- Increased surface runoff carrying suspended solids during heavy rainfall.
- Possible siltation of the Khandepar River, if runoff from mine areas is not properly controlled.
- Risk of oil and grease contamination from machinery and vehicle movement.

Monitoring

Periodic surface water quality monitoring of the Khandepar River at upstream and downstream locations will be carried out to ensure compliance with applicable standards.

7.3 Impact on Water Quality

The proposed mining and associated crushing and beneficiation activities at Codli Mineral Block-XII may have potential implications on groundwater quality primarily due to excavation activities, overburden handling, and management of mine water and process water. However, considering the geological setting and the adoption of adequate environmental safeguards, the impacts on groundwater quality are expected to be minimal and localized.

Potential Impacts

- Seepage of suspended solids into subsurface formations from mine pits and overburden dumps during monsoon.
- Possible contamination from oil, grease, and hydrocarbons due to operation and maintenance of heavy machinery.
- Localized changes in groundwater quality parameters, particularly turbidity and iron content, if mine water is not adequately treated.
- Risk of percolation from beneficiation process water in the absence of proper lining and recycling systems.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

Monitoring

Periodic groundwater quality monitoring will be carried out through existing and/or designated observation wells around the lease area. Monitoring parameters will include pH, TDS, iron, heavy metals, oil & grease, and other relevant indicators as per CPCB/SPCB guidelines.

7.4 Mitigation measures

- Mining pits, overburden dumps, crusher areas, and beneficiation plant premises will be provided with proper drainage, garland drains, and sedimentation systems to prevent uncontrolled percolation of contaminated runoff into the subsurface.
- A no-mining and no-dumping safety buffer zone will be maintained along the river boundary as per statutory norms.
- Peripheral garland drains will be constructed along the lease boundary facing the river to intercept and divert runoff away from the Khandepar River.
- Wet beneficiation plants will operate under a closed-loop water circulation system, ensuring 100% recycling of process water and zero liquid discharge outside the mine lease area.
- Settling ponds, sumps, and sedimentation tanks will be properly lined to prevent seepage of suspended solids and contaminants into groundwater.
- Oil and grease traps will be installed at workshops, vehicle maintenance areas, and equipment parking zones to prevent hydrocarbon contamination.
- Fuel and lubricant storage areas will be developed on impervious concrete platforms with spill containment arrangements and proper handling procedures.
- No untreated mine water, wastewater, or effluent will be allowed to percolate into the ground or be discharged outside the lease area.
- Progressive stabilization of overburden dumps through terracing, compaction, and plantation will be undertaken to minimize erosion, leaching, and infiltration.
- Regular groundwater quality monitoring will be carried out in and around the lease area to detect any change in groundwater quality and enable timely corrective measures.

8 Saline water disposal Strategies (In case of saline water abstraction)

The proposed Codli Mineral Block - XII, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa). The project is being developed by JSW Steel Limited and this does not fall under saline zone as per GWRA 2024 categorization. Therefore, this section on disposal strategies of saline water is not required.

9 Any other details pertaining to the project.

All the requisite details of the proposed project have been furnished in the relevant sections above. Any additional information, as may be deemed necessary by the competent authority, shall be submitted as and when required.

10 Summary and Conclusion

- JSW Steel limited is proposing Codli Mineral Block - XII, Auctioned Block Area: 377.0881 ha with Iron Ore production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).
- The land use/land cover analysis of the 40,164.16-ha study area indicates that forest is the dominant land use category, occupying 20,635.41 ha (51.38%), reflecting the predominantly forested nature of the region. Vegetation/Plantation is the second largest category, covering 12,052.10 ha (30.00%), followed by agricultural land, which accounts for 2,532.53 ha (6.31%) of the total area. Among the remaining land use classes, open scrub land/wasteland/dump occupies 1,374.44 ha (3.42%), while human settlements and mine infrastructure cover 1,267.34 ha (3.16%). Surface water bodies, including mine sumps, constitute 1,039.05 ha (2.59%) of the study area. The existing mine area covers 627.23 ha (1.56%), and the road network occupies 527.55 ha (1.31%). Industrial land use is relatively limited, covering 82.15 ha (0.20%), whereas the railway network occupies only 25.36 ha (0.07%) of the total study area.
- The study area features undulating terrain with low to moderately dissected denudational/structural hills and valleys, showing drainage incision, structural control, aligned ridges, and narrow valleys. A moderately dissected structural lower plateau appears as a partially preserved higher-level surface with scarps and entrenched streams. Elevations range from 347 m AMSL in the north-eastern part to 0 m AMSL in the south-western part, while the mining area spans 109 m amsl (highest) to -76 m amsl (lowest).
- Geomorphologically, predominantly hilly terrain with denudational/structural landforms, younger/older coastal plains toward the south/southeast, low-moderately dissected denudational hills/valleys in central/western sectors, structural hills/valleys in northeast/southwest, and patchy moderately dissected structural lower plateaus near Codli/Karmane. Pediment-pediplain complexes and older coastal plains dominate southern/southwestern margins.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

- Rivers like Khandepar River (SE-NW) and Zuvari (S-SSW) show dominant flow orientations, with tributaries (Ragada, Jamboti, Udai, Kale, Panduranga Nal as) maintaining robust connectivity. The buffer zone exhibits a pronounced dendritic drainage pattern with intricately interlinked 1st–5th order streams.
- The depth to groundwater level during the pre-monsoon period ranges from 3.0 to 16.0 m bgl, whereas during the post-monsoon period it ranges from 2.0 to 15.0 m bgl. The deepest groundwater level was observed at the Mine Site (16.0 m bgl during pre-monsoon and 15.0 m bgl during post-monsoon), while the shallowest groundwater levels were recorded at Kajumal (3.0 m bgl and 2.0 m bgl) and Dabal (3.5 m bgl and 2.5 m bgl).
- The corresponding groundwater table elevation varies from 28.0 to 49.0 m AMSL during the pre-monsoon season and from 29.0 to 50.0 m AMSL during the post-monsoon season. The highest groundwater table elevation was observed at Kalay (49.0 m AMSL pre-monsoon and 50.0 m AMSL post-monsoon), whereas the lowest groundwater table elevation was recorded at Panchvadi (28.0 m AMSL pre-monsoon and 29.0 m AMSL post-monsoon).
- As per analytical calculations, the total rainwater that can be dewatered from the mine pits during the 2nd year of the plan period is estimated to be about 219.5 m³/day, considering an average annual rainfall of 3412.77 mm/year (Source: Customized Rainfall Information System, IMD Hydromet Division) and accounting for 70% losses during handling and wall runoff.
- As per the numerical groundwater modelling, after commencement of mining operations, the seepage in Year-2 is estimated to be about 736 m³/day, which is higher than the analytical estimate and therefore has been considered for the application. The rainfall contribution calculated analytically in Year-2 is about 1560 m³/day, and the combined total water availability from seepage and rainfall is approximately 2296 m³/day.
- The model calibration results indicate a good agreement between the simulated and observed groundwater levels, with statistical performance indicators showing RMSE: 1.69 m, NRMSE: 9.64 %, Correlation coefficient: 0.97. The obtained RMSE and NRMSE values are well within the acceptable limits of ≤ 5 m and $\leq 10\%$, respectively, as recommended for groundwater models.
- The groundwater modelling results indicate that the drawdown generated due to mine seepage remains localized around the mine pit. The simulated maximum drawdown at the mine site is estimated to be 2.6 m in the year 2025, which gradually increases to 2.51 m in 2028 and 1.72 m in 2035 due to progressive mining activities and increased pit depth. The drawdown profile along the west–east section shows that the cone of depression is concentrated within the mine lease area and rapidly diminishes away from the pit.
- A comparison between the regional CGWB hydrograph data of Colem station and the groundwater model calibration results shows consistent behaviour, with both indicating stable to slightly rising groundwater levels in the modelled area.

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa)

- According to the groundwater resource estimation of the study area (10kms), it was found to have a groundwater extraction stage of 7 % and thus the study area (10 kms) falls under Safe category.
- The total water requirement for the project is estimated at 18,132 KLD. Out of this, 1,716 KLD of make-up water will be required for the beneficiation plant, domestic use, road water sprinkling, firefighting, greenbelt/plantation development, and dust suppression activities
- Domestic Waste water generated from the office toilets will be disposed-off in soak pit via septic tank and Waste water generated from the workshop will be treated in ETP and used for dust suppression.

11 BIBLIOGRAPHY

- Aquifer mapping report Goa District 2025, CGWB
- Dynamic Groundwater Resources Of Goa - 2024
- Census of India, 2011
- Drainage & DEM (adopted from USGS SRTM data)
- Geological map, Geomorphological Map (adopted from Bhukosh, Geological Survey of India)
- Groundwater estimation committee, Govt. of India (2015)
- India Water Resources Information System (India WRIS)
- RAMSAR Site Information Service <https://rsis Ramsar.org/>

Block-XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha at Village: Codli, Taluka: Dharbandora,
District: South Goa (Goa)

12 ACCREDITATION CERTIFICATE

	Quality Council of India National Accreditation Board for Education and Training ITPI Building, 6th Floor, 4 - A, Ring Road, I P Estate, New Delhi - 110002		
CERTIFICATE OF ACCREDITATION Under the QCI-NABET Scheme for Ground Water Consultant Organisation 			
<u>M/s J.M. EnviroNet Private Limited</u> Address: Unit No. 1517, Tower - B, EMAAR DIGITAL GREENS, Golf Course Extension Road, Sector-61, Gurugram-122011 (Haryana)			
S.No.	SCOPE COVERAGE		
	Industrial Use	Mining Projects	Infrastructure Projects
1	Hydrogeological report: Comprehensive report on groundwater condition/situation		
2	Impact Assessment Reports with modelling studies		

Note: Names of approved Project Coordinators and Technical Area Experts are mentioned in IA AC Minutes dated Sep 09, 2021 on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in NABET's letter of accreditation bearing no. QCI/NABET/ENV/GWCO/ACO/21/51 dated Sep 23, 2021. The accreditation needs to be renewed before the expiry date by M/s J.M. EnviroNet Private Limited following due process of assessment.


 Sr. Director, NABET
 Issue Date : Sep 23, 2021


 Certificate No.
 NABET/GWCO/IA/GW018

Valid Upto
 Sep 08, 2026

TRAFFIC STUDY REPORT

FOR

**Block - XII Codli Mineral Block,
Auctioned Block Area: 377.0881 ha**

With Iron Ore Production 3.50 Million TPA, OB/Waste 8.21

Million TPA (Total Excavation: 11.71 Million TPA)

**Along with Installation 04 Crusher (3 Primary Crusher of 1 x 250
TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600
TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet
Beneficiation Plant with Throughput Capacity 3.50 Million TPA**

At

**Village: Codli, Taluka: Dharbandora,
District: South Goa (Goa)**

APPLICANT



JSW Steel Limited

**JSW Centre, Bandra Kurla Complex,
Near MMRDA Grounds, Bandra East,
Mumbai -400051 (Maharashtra)**

Email: baswaraj.dalgade@jsw.in

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TRAFFIC STUDY REPORT

1.0 INTRODUCTION

JSW Steel limited is proposing Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Under the provision of EIA Notification, 2006 and its subsequent amendments, the application for the grant of Terms of Reference (ToR) was submitted on Parivesh 2.0 web portal of MoEF&CC on 13.03.2026 and the project was considered in 5th meeting of the Expert Appraisal Committee EAC (Non-coal Mining) and Technical Presentation was held on 23.04.2026 (Agenda Item No. 4). The ToR was issued vide file no. J-11015/49/2025-IA.II(NCM), dated 18.05.2026.

2.0 PURPOSE OF THE REPORT

This traffic study report evaluates how existing and future traffic conditions will be affected by a proposed development or roadway change. It identifies potential congestion or safety issues and recommends needed improvements. The report helps planners and decision-makers ensure safe, efficient, and well-designed transportation systems.

The traffic study has been carried out according to IRC Guidelines (IRC: 64-1990) in compliance with the ToR Conditions given below:

As per Specific ToR Point No. 5 “PP shall submit a comprehensive transportation and material handling plan, including route map, traffic assessment, habitation impact (100 m on both sides), number of trips, vehicle capacity, road dimensions, traffic load, carrying capacity, and SOP for transportation from mine to destination” and

As per Specific ToR Point No. 22 “PP needs to submit a detailed transportation and material handling plan as part of the EIA/EMP, covering transportation from Mine to Capxem Jetty and Proposed Railway Sidings Via SH-7 & other connecting road. The plan shall clearly indicate the mode-wise breakup of material transport (conveyor/rail/road), measures for dust suppression and pollution control, traffic management, and mitigation of impacts on nearby habitation” and

As per Standard ToR Point No. 32 (Mining of Mineral) “Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines” and

As per Standard ToR Point No. 1.40 (Mineral Beneficiation) “Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of

the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered”.

3.0 PROJECT DETAILS

Table - 1
Brief description of the project

S.N.	Particulars	Details
A.	Nature of project	Opencast Fully Mechanized Iron Ore Mine
B.	Size of project	
1.	Area	377.0881 ha (Govt. Revenue Land: 236.3482 ha, Private Land: 58.9087 ha, Alvara Land: 15.8626, Forest Land: 65.9686 ha)
2.	Project Proposal	Iron Ore: 3.50 Million TPA OB/Waste: 8.21 Million TPA Total Production: 11.71 Million TPA Crusher: 1 x 250 TPH & 2 x 90 TPH - Primary Crusher & 150 TPH of Secondary Crusher Dry Beneficiation/Screening Plant: 600 TPH Wet Beneficiation Plant: 2 x 300 TPH
C	Project Location	
1.	Villages	Codli
2.	Tehsil	Dharbandora
3.	District	South Goa
4.	State	Goa
5.	Location Coordinates	Latitude: 15°21'15.638" N to 15°19'42.607" N Longitude: 74°7'10.922" E to 74°8'39.034" E
6.	SOI Toposheet No.	Core Zone: D43C3/ 48I/3 Buffer Zone: D43C3, D43B15, D43C4/ 48I/3, 48E/15, 48I/4
D	Environmental Settings Details (with approx. aerial distance & direction from the mine boundary)	
1.	Nearest Village	Codli (Adjacent in North Direction)
2.	Nearest Town / City	Sanvarem (~7.5 km in SSW Direction)
3.	Nearest School	Immaculate Conception High School (~0.2 Km in NW Direction)
4.	Nearest State/ National Highway	➤ SH-7 (Adjacent in WNW Direction) ➤ NH-748 (~3.0 km in NNE Direction)
5.	Nearest Railway Station	Sanvarem Chuch Railway Station (~7.8 km in SSW Direction)
6.	Nearest Airport	Dabolim International Airport (~30.0 km in WNW Direction)

S.N.	Particulars	Details																											
7.	National Park, Wildlife Sanctuaries, Biosphere Reserves, Wildlife corridors, Tiger/Elephant Reserves etc. within 10 Km radius study area	There are no National Park, Biosphere reserve or corridor present within 10 Km radius of study area. 2 Wildlife sanctuaries are present that are: ➤ Bhagvan Mahavir Wildlife (~1.52 Km in SE Direction) & ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction). ➤ Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction) & ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction).																											
8.	Reserve/Protected Forest within 10 Km radius study area	Unclassified Forest – Core zone Reserve Forest – ~0.5 Km in ENE Direction, ~1.0 Km in West Direction, ~2.5 Km in West Direction, ~4.0 Km in South Direction, ~6.5 Km in WSW Direction, ~7.0 Km in NNE Direction, ~8.0 Km in WSW Direction, ~8.5 Km in NW Direction, ~9.0 Km in West Direction.																											
9.	Water bodies within 10 Km radius study area	There is total 8 water bodies present within 10 km of study area: <table border="1"> <thead> <tr> <th>S.N.</th><th>Water Body</th><th>Distance & Direction</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Khandepar River</td><td>Adjacent in North Direction</td></tr> <tr> <td>2.</td><td>Kale Nala</td><td>~0.7 km in ESE Direction</td></tr> <tr> <td>3.</td><td>Udnai Nala</td><td>~1.5 km in West Direction</td></tr> <tr> <td>4.</td><td>Panduranga Nala</td><td>~5.0 km in SW Direction</td></tr> <tr> <td>5.</td><td>Ragada Nala</td><td>~7.0 km in NNE Direction</td></tr> <tr> <td>6.</td><td>Sanguem or Zuvari River</td><td>~8.0 km in South Direction</td></tr> <tr> <td>7.</td><td>Jamboli Nala</td><td>~9.0 km in NE Direction</td></tr> <tr> <td>8.</td><td>Paroda River</td><td>~9.0 km in SSW Direction</td></tr> </tbody> </table>	S.N.	Water Body	Distance & Direction	1.	Khandepar River	Adjacent in North Direction	2.	Kale Nala	~0.7 km in ESE Direction	3.	Udnai Nala	~1.5 km in West Direction	4.	Panduranga Nala	~5.0 km in SW Direction	5.	Ragada Nala	~7.0 km in NNE Direction	6.	Sanguem or Zuvari River	~8.0 km in South Direction	7.	Jamboli Nala	~9.0 km in NE Direction	8.	Paroda River	~9.0 km in SSW Direction
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7.	Jamboli Nala	~9.0 km in NE Direction																											
8.	Paroda River	~9.0 km in SSW Direction																											
10.	Critically Polluted Area	No, the Site doesn't fall under the critically polluted area.																											
11.	Seismic Zone	Zone – III as per IS: 1893 (Part-I): 2002																											
E.	Requirement of the Project																												
1.	Total Water requirement	1716 KLD (Mine Sump Water and Well water for Domestic Purpose)																											
2.	Power requirement	3.2 MW (Goa Electricity Department)																											
3.	Manpower requirement	154 Persons																											
F	Cost Details																												
1.	Total Project Cost	Rs. 500 Crores																											

Source: Pre-Feasibility Study Report

4.0 PROPOSED MINING TECHNOLOGY & TRANSPORTATION DETAILS

Mining will be carried out by fully mechanized opencast mining method (by Shovel-Dumper combination) without drilling and blasting. Height of Benches will be 7.0 m (maximum) and width of Benches will be kept 9.0 m (minimum). Ultimate pit slope will be maintained at 45°. All operations of mining will be done by deployment of Heavy Earth Moving Machineries for without deep hole drilling, excavation, loading, crushing, screening, iron ore beneficiation & transport to end users. No drilling and blasting are proposed in this mining project. Loading is proposed to be with hydraulic excavator having bucket capacity of 4.0 m³ & 2.9 m³ and from mine face to crusher

will be transported by dumper of 40 tonnes and wheel loader 2.5 m³ capacity. Waste generated will be transported to waste dumps present in the mine site. Crushing of Iron ore will be done in Primary Crusher of 90 TPH & 250 TPH and Secondary Crusher 150 TPH capacity which will be installed within the lease area. All the Fines generated from the crushing will be loaded by loader of 2.5 m³ capacity & transported through dumpers and after that transported through tippers of 11.5 Tonnes via road to the jetties and Proposed Railway Sidings to end users.

The Iron ore mined out from this mine will be supplied to JSW Steel Plant and or sold in open market like Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant.

No change is envisaged in the proposed mining method/technology and mining will be carried out as per IBM approved Mining Plan.

5.0 TOTAL MATERIAL HANDLING

Total material handling will be 11.71 Million TPA (Iron Ore: 3.50 Million TPA and OB/Waste: 8.21 Million TPA) and Details of the same are given below in the following table:

Table - 2
Total Handling for Impact Assessment

S. N.	Particular	Million TPA	Normative (300 days)		Peak Stage (+20%)	
			TPD	TPH	TPD	TPH
1	Iron Ore	3.5	11667	556	14001	667
2	OB/Waste	8.21	27367	1303	32840	1564
Total Excavation		11.71	39034	1859	46841	2231

At Peak Stage (+20%)

In case of shut down/breakdown/major maintenance in crusher production of mine may be suspended temporarily and due this short fall may create in Iron ore stock in plant side; therefore, to cover up this short fall, considered 20% maximum production as compared to daily production & meanwhile in that period development work - removal of Waste etc. considered at 20% maximum as compared to daily capacity. However, the annual production will remain same i.e., Iron ore 3.5 Million TPA, 8.21 Million TPA OB/Waste.

After considering the 20% increase in the Iron Ore production per day will be 14000 tonnes, OB/Waste will be 32840 tonnes; thus, total handling will be 46840 TPD (at Peak Stage). The same has been considered for air quality modelling.

5.1 EXISTING TRANSPORT INFRASTRUCTURE AND PROPOSED TRANSPORTATION ROUTE

Traffic survey has been conducted at the 3 connecting road i.e., ~ 14 Km in length with ~8 m to 12 m width of Codli to Capxem Route, ~ 9.8 km in length with 7 m width of Codli to Costi Route and ~ 11.1 km in length with 7 m width of Puskar Yard Road Route at the project site. The traffic survey monitoring was done in the month of May, 2025 to predict the future traffic growth and the load on the road and surroundings due to proposed mining project. The points of study were decided on the basis of transportation route of mineral.

The traffic study was conducted at 11 points along three different routes to assess the impact of the proposed project. Initially, four points on the Codli–Capxem route are common for all three routes. After Point 4, one route branches toward Costi, referred to as the Codli–Costi route, which is 3.5 km long and includes three traffic study locations. From the same junction of Point 4, the route continues to Point 5, from which the third route known as the Puskar Yard Road route which extends for approximately 2.6 km, with one traffic study location along it.

The details of Route of transportation from the proposed Mine Site up to Jetties and Proposed Railway Siding (via Road) are given in below:

Table - 3
Details of proposed Transportation Routes

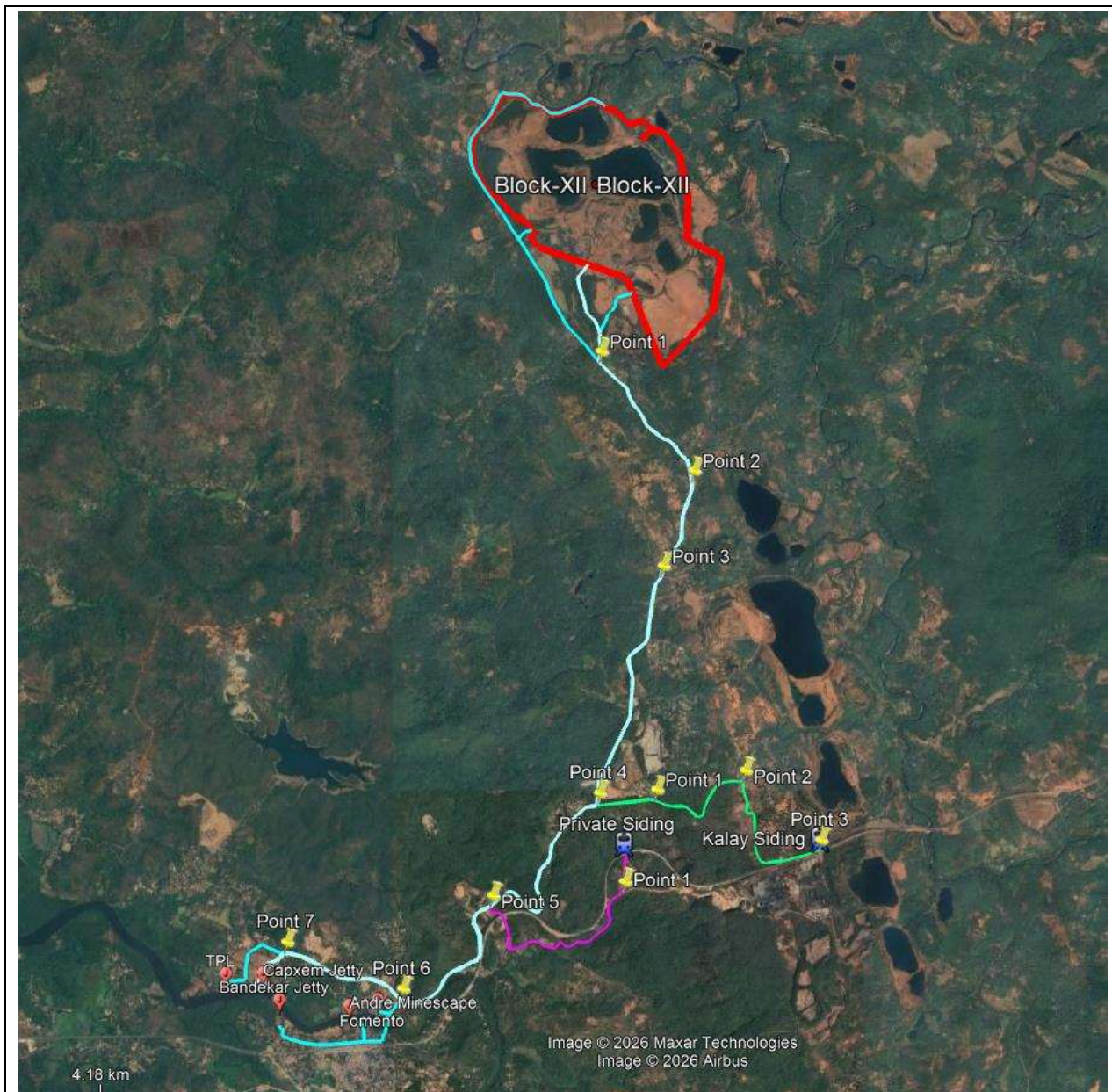
S.N.	Road Name	Transportation Method	Road Length	Avg. Road Width
1.	SH – 7 (Road connecting mine lease to Capxem)	Capxem Jetty, Andre Minescape, Bandekar Jetty, TPL and Fomento	~14.0 Km	8-12 m
2.	Village Road (Connected SH-7 to Costi)	Kalay Siding	~3.5 Km	7 m
3.	Village Road (Connected SH-7 to Pauskar Yard)	Private Siding	~2.6 Km	7 m
4.	Village Road (Connected SH-7 to TPL)	TPL	~0.65 Km	9 m
5.	Village Road (Connected SH-7 to Capxem Jetty)	Capxem Jetty	~0.4 Km	9 m
6.	Village Road (Connected SH-7 to Fomento, Andre Minescape and Bandekar Jetty)	Fomento, Andre Minescape & Bandekar Jetty	~2.0 Km	7 – 9 m

A National Highway - 748 is also passing from ~3.0 Km in NNE direction which connects to the mine site by State Highway - 7. The nearest Railway Station is Sanvardem Church Railway Station which is at about 7.8 Km from the Codli Iron Ore mine in SSW direction and it is connected by road. The nearest Goa International Airport (Dabolim Airport) is situated at a distance of 30.0 Kms in WNW direction from the lease area.

The points of study were decided on the basis of transportation route of mineral. Map showing survey locations are given in figure 1.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Traffic Study Report



Mine Lease Boundary		Codli to Capxem Route	
Codli to Costi Route		Puskar Yard Road Route	
Traffic Study Points			

Figure 1 - Google Earth Image Showing the Transportation Route and Traffic Survey Points

The details of traffic survey locations are given below: -

Table - 4
Details of Traffic Survey Locations

S.N.	Name of Location	Coordinates	Width (in m)	Type of Road
Codli to Capxem Route				
1.	Traffic Survey Point No. 1	15°19'43" N, 74°7'58" E	8.0 m (Shoulders 1.0 m each side)	State Highway (Two Lane Undivided -Bituminous Top)

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Traffic Study Report

2.	Traffic Survey Point No. 2	15°19'2" N, 74°8'29" E	8.5 m (Shoulders 1.0 m each side)	State Highway (Two Lane Undivided -Bituminous Top)
3.	Traffic Survey Point No. 3	15°18'31" N, 74°8'18" E	10.0 m (Shoulders 1.5 m each side)	State Highway (Two Lane Undivided -Bituminous Top)
4.	Traffic Survey Point No. 4	15°17'14" N, 74°7'55" E	9.5 m (Shoulders 1.0 m each side)	State Highway (Two Lane Undivided -Bituminous Top)
5.	Traffic Survey Point No. 5	15°16'40" N, 74°7'18" E	8.0 m (Shoulders 1.0 m each side)	State Highway (Two Lane Undivided -Bituminous Top)
6.	Traffic Survey Point No. 6	15°16'8" N, 74°6'47" E	12.0 m (Shoulders 1.0 m each side)	State Highway (Two Lane Undivided -Bituminous Top)
7.	Traffic Survey Point No. 7	15°16'24" N, 74°6'4" E	12.0 m (Shoulders 1.0 m each side)	State Highway (Two Lane Undivided -Bituminous Top)
Codli to Costi Route				
7.	Traffic Survey Point No. 1	15°17'14" N, 74°7'56" E	7.0 m (Shoulders 1.0 m each side)	Village Road (Two Lane Undivided -Bituminous Top)
8.	Traffic Survey Point No. 2	15°17'22" N, 74°8'46" E	7.0 m (Shoulders 1.0 m each side)	Village Road (Two Lane Undivided -Bituminous Top)
9.	Traffic Survey Point No. 3	15°16'58" N, 74°9'13" E	7.0 m (Shoulders 1.0 m each side)	Village Road (Two Lane Undivided -Bituminous Top)
Puskar Yard Road Route				
10.	Traffic Survey Point No. 1	15°16'44" N, 74°8'4" E	7.0 m	Single Lane (Public Road)

6.0 TRAFFIC COUNT METHODOLOGY

Traffic density was monitored continuously for 24 hours by visual observation and counting of vehicles for the six categories, viz., Motor cycle/scooter, Passenger car/van/Auto-rickshaw, Tractors, Buses/Trucks, Trailers and Cycles. In view of the proposed Block - XII Codli Iron Ore Mine, the traffic survey was done to review the future traffic growth and the load on the route from the Mine Site to the end users.

Hence, to account for the interaction of different kinds of vehicles moving on the route, the capacity of the roads has been converted into Passenger Car Unit as per IRC: 064:1990 guidelines for Rural areas, the current traffic load was found after applying the conversion factors.

Note: No. of Vehicles have been considered from 08:00 hrs. to 20:00 hrs. for the period allowed for transportation as per standard Operating Procedure (SOP) devised by DMG and GSPCB.

6.1. EXISTING TRAFFIC SCENARIO ON CODLI TO CAPXEM ROUTE

At Traffic Survey Point No. 1

Table - 5
Traffic Volume Count at Codli to Capxem Route (Point No. 1.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	1032
2	Passenger car, Auto-rickshaw or pickup van	380
3	Agricultural Tractor, Light Commercial Vehicle	204
4	Truck or Bus	122
5	Truck-trailer, Agricultural Tractor-trailer	15
Total		1753

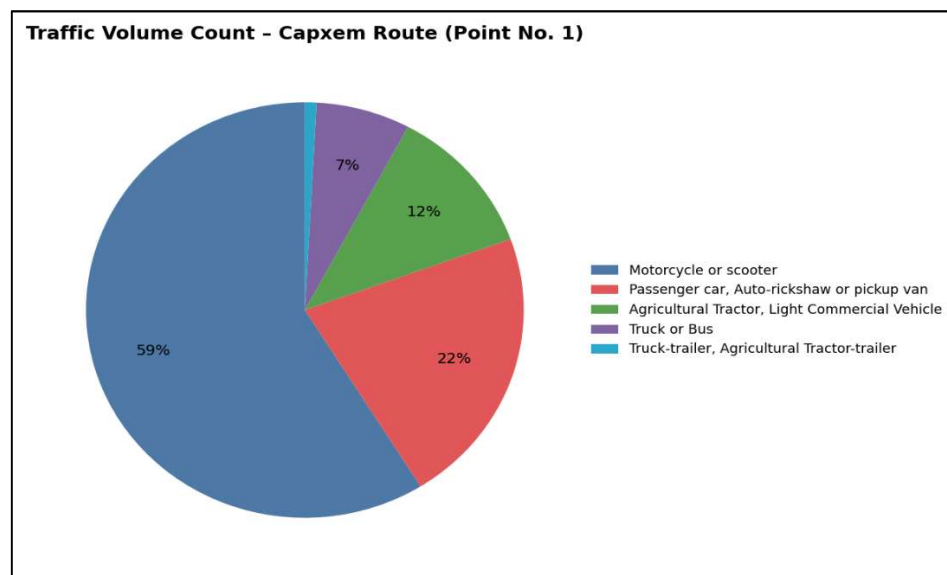


Figure 2 – Traffic Volume Count at Codli to Capxem Route (Point No. 1.)

Table - 6
No. of Vehicles with Respect to PCU for Codli to Capxem Route (Point No. 1.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	1032	0.5	516
2	Passenger car, Auto-rickshaw or pickup van	380	1.0	380
3	Agricultural Tractor, Light Commercial Vehicle	204	1.5	306
4	Truck or Bus	122	3.0	366
5	Truck-trailer, Agricultural Tractor-trailer	15	4.5	68
Total		1753		1636

At Traffic Survey Point No. 2.

Table - 7
Traffic Volume Count at Codli to Capxem Route (Point No. 2.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	968
2	Passenger car, Auto-rickshaw or pickup van	470
3	Agricultural Tractor, Light Commercial Vehicle	175
4	Truck or Bus	180
5	Truck-trailer, Agricultural Tractor-trailer	15
Total		1808

Traffic Volume Count - Capxem Route (Point No. 2)

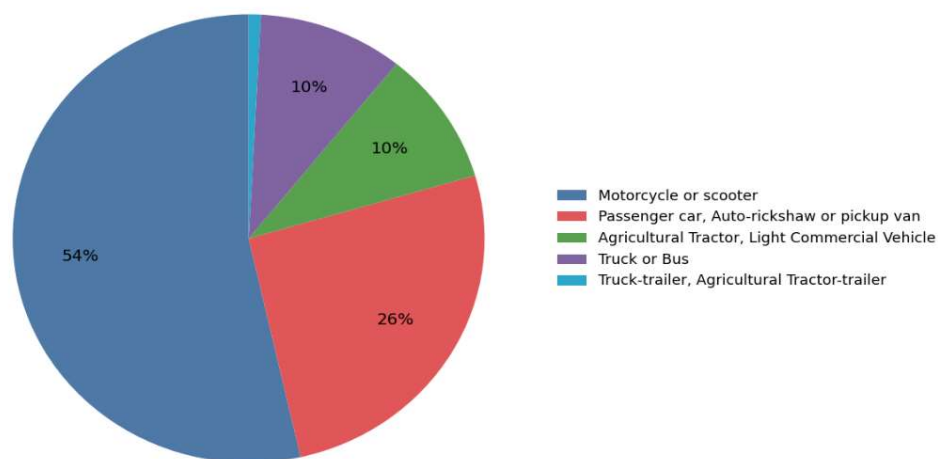


Figure 3 – Traffic Volume Count at Codli to Capxem Route (Point No. 2.)

Table - 8
No. of Vehicles with Respect to PCU for Codli to Capxem Route (Point No. 2.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	968	0.5	484
2	Passenger car, Auto-rickshaw or pickup vans	470	1.0	470
3	Agricultural Tractor, Light Commercial Vehicle	175	1.5	262.5
4	Truck or Bus	180	3.0	540
5	Truck-trailer, Agricultural Tractor-trailer	15	4.5	67.5
Total		1808		1824

At Traffic Survey Point No. 3.

Table - 9
Traffic Volume Count at Codli to Capxem Route (Point No. 3.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	772
2	Passenger car, Auto-rickshaw or pickup van	490
3	Agricultural Tractor, Light Commercial Vehicle	157
4	Truck or Bus	141
5	Truck-trailer, Agricultural Tractor-trailer	15
Total		1875

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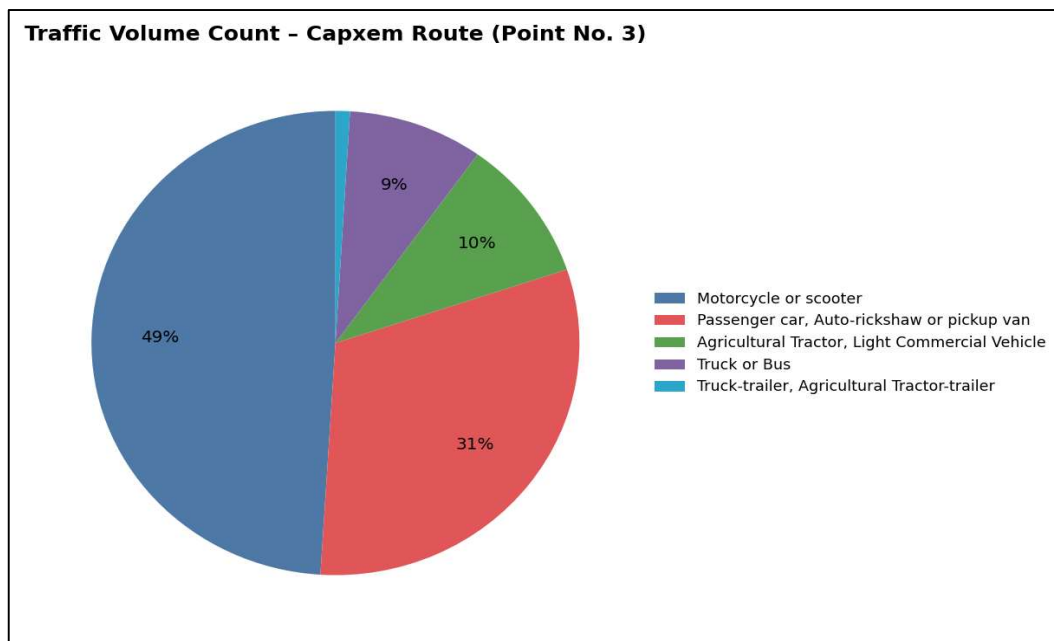


Figure 4- Traffic Volume Count at Codli to Capxem Route (Point No. 3.)

Table - 10
No. of Vehicles with Respect to PCU for Codli to Capxem Route (Point No. 3.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	772	0.5	386
2	Passenger car, Auto-rickshaw or pickup van	490	1.0	490
3	Agricultural Tractor, Light Commercial Vehicle	157	1.5	235.5
4	Truck or Bus	141	3.0	423
5	Truck-trailer, Agricultural Tractor-trailer	15	4.5	67.5
Total		1575		1602

At Traffic Survey Point No. 4.

Table - 11
Traffic Volume Count at Codli to Capxem Route (Point No. 4.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	804
2	Passenger car, Auto-rickshaw or pickup van	560
3	Agricultural Tractor, Light Commercial Vehicle	136
4	Truck or Bus	117
6	Truck-trailer, Agricultural Tractor-trailer	15
Total		1632

Traffic Volume Count - Capxem Route (Point No. 4)

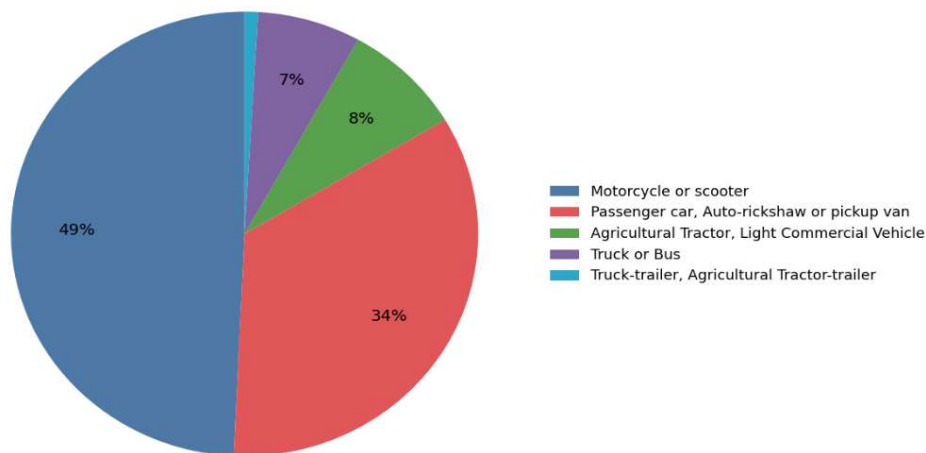


Figure 5 – Traffic Volume Count at Codli to Capxem Route (Point No. 4.)

Table - 12
No. of Vehicles with Respect to PCU for Codli to Capxem Route (Point No. 4.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	804	0.5	402
2	Passenger car, Auto-rickshaw or pickup van	560	1.0	560
3	Agricultural Tractor, Light Commercial Vehicle	136	1.5	204
4	Truck or Bus	117	3.0	351
5	Truck-trailer, Agricultural Tractor-trailer	15	4.5	68
Total		1632		1585

At Traffic Survey Point No. 5.

Table - 13
Traffic Volume Count at Codli to Capxem Route (Point No. 5.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	963
2	Passenger car, Auto-rickshaw or pickup van	650
3	Agricultural Tractor, Light Commercial Vehicle	136
4	Truck or Bus	182
5	Truck-trailer, Agricultural Tractor-trailer	15
Total		1946

Traffic Volume Count - Capxem Route (Point No. 5)

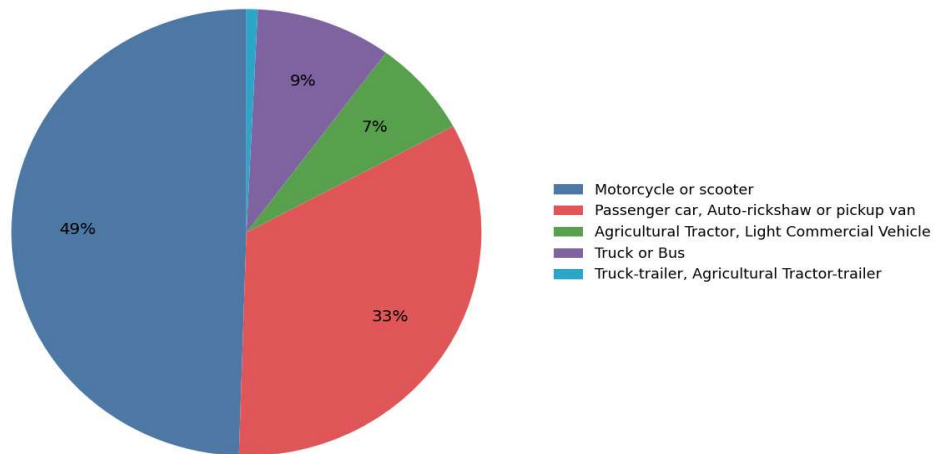


Figure 6 – Traffic Volume Count at Codli to Capxem Route (Point No. 5.)

Table - 14
No. of Vehicles with Respect to PCU for Codli to Capxem Route (Point No.5.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	963	0.5	481.5
2	Passenger car, Auto-rickshaw or pickup van	650	1.0	650
3	Agricultural Tractor, Light Commercial Vehicle	136	1.5	204
4	Truck or Bus	182	3.0	546
5	Truck-trailer, Agricultural Tractor-trailer	15	4.5	67.5
Total		1946		1949

At Traffic Survey Point No. 6.

Table - 15
Traffic Volume Count at Codli to Capxem Route (Point No. 6.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	1170
2	Passenger car, Auto-rickshaw or pickup van	668
3	Agricultural Tractor, Light Commercial Vehicle	136
4	Truck or Bus	205
5	Truck-trailer, Agricultural Tractor-trailer	16
Total		2195

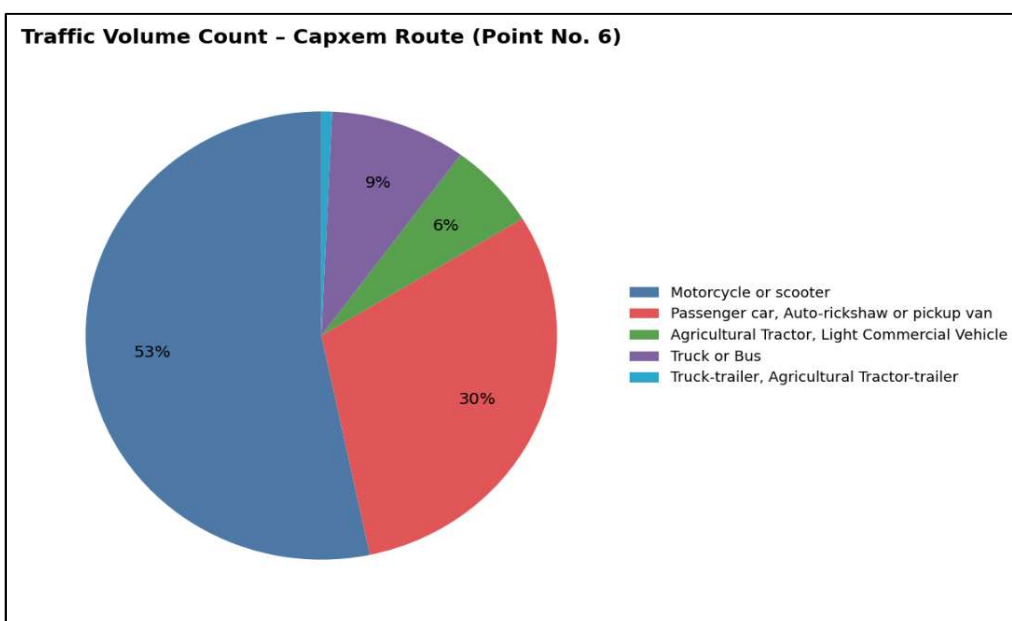


Figure 7 – Traffic Volume Count at Codli to Capxem Route (Point No. 6.)

Table - 16
No. of Vehicles with Respect to PCU for Codli to Capxem Route (Point No. 6.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	1170	0.5	585
2	Passenger car, Auto-rickshaw or pickup van	668	1.0	668
3	Agricultural Tractor, Light Commercial Vehicle	136	1.5	204
4	Truck or Bus	205	3.0	615
5	Truck-trailer, Agricultural Tractor-trailer	16	4.5	72
Total		2195		2144

At Traffic Survey Point No. 7.

Table - 17
Traffic Volume Count at Codli to Capxem Route (Point No. 7.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	977
2	Passenger car, Auto-rickshaw or pickup van	708
3	Agricultural Tractor, Light Commercial Vehicle	136
4	Truck or Bus	205
5	Truck-trailer, Agricultural Tractor-trailer	25
Total		2051

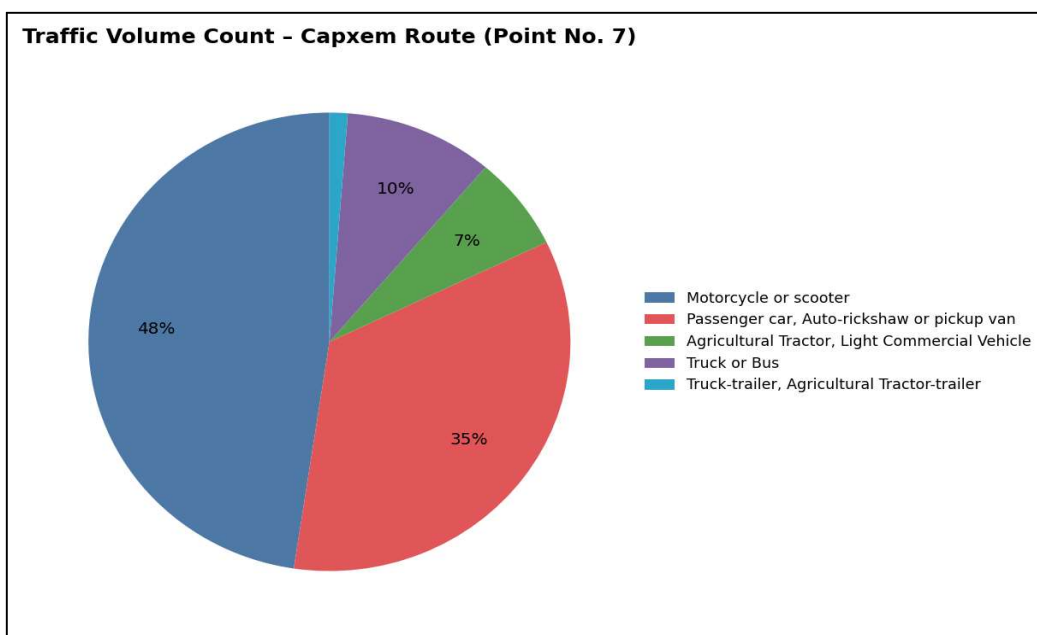


Figure 8 – Traffic Volume Count at Codli to Capxem Route (Point No. 7.)

Table - 18
No. of Vehicles with Respect to PCU for Codli to Capxem Route (Point No. 7.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	977	0.5	488.5
2	Passenger car, Auto-rickshaw or pickup van	708	1.0	708
3	Agricultural Tractor, Light Commercial Vehicle	136	1.5	204
4	Truck or Bus	205	3.0	615
5	Truck-trailer, Agricultural Tractor-trailer	25	4.5	112.5
Total		2051		2128

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Traffic Study Report

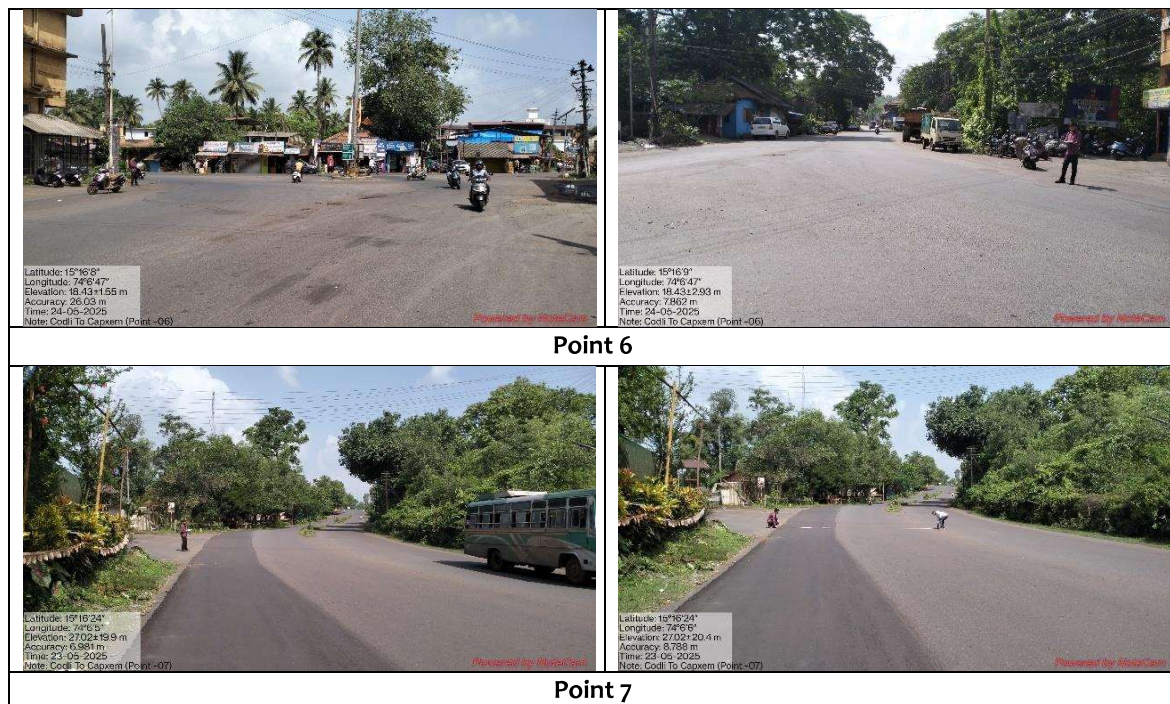


Figure 9 – Geo-tagged photographs showing Traffic Study Survey at Codli to Capxem Route

6.2. EXISTING TRAFFIC SCENARIO ON CODLI TO COSTI ROUTE

At Traffic Survey Point No. 1.

Table - 19
Traffic Volume Count at Codli to Costi Route (Point No. 1.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	251
2	Passenger car, Auto-rickshaw or pickup van	236
3	Agricultural Tractor, Light Commercial Vehicle	45
4	Truck or Bus	0
5	Truck-trailer, Agricultural Tractor-trailer	40
Total		572

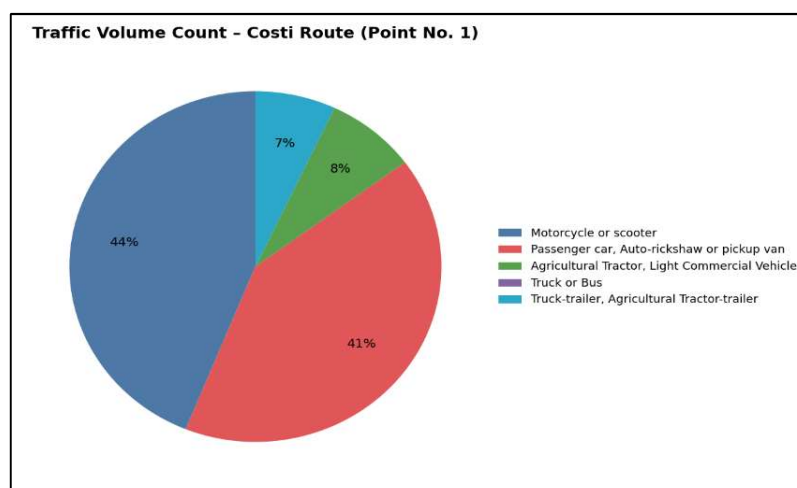


Figure 10 – Traffic Volume Count at Codli to Costi Route (Point No. 1.)

Table - 20
No. of Vehicles with Respect to PCU for Codli to Costi Route (Point No. 1.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	251	0.5	125.5
2	Passenger car, Auto-rickshaw or pickup van	236	1.0	236
3	Agricultural Tractor, Light Commercial Vehicle	45	1.5	67.5
4	Truck or Bus	0	3.0	0
5	Truck-trailer, Agricultural Tractor-trailer	40	4.5	180
Total		572		609

At Traffic Survey Point No. 2.

Table - 21
Traffic Volume Count at Codli to Costi Route (Point No. 2.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	289
2	Passenger car, Auto-rickshaw or pickup van	236
3	Agricultural Tractor, Light Commercial Vehicle	50
4	Truck or Bus	0
5	Truck-trailer, Agricultural Tractor-trailer	35
Total		610

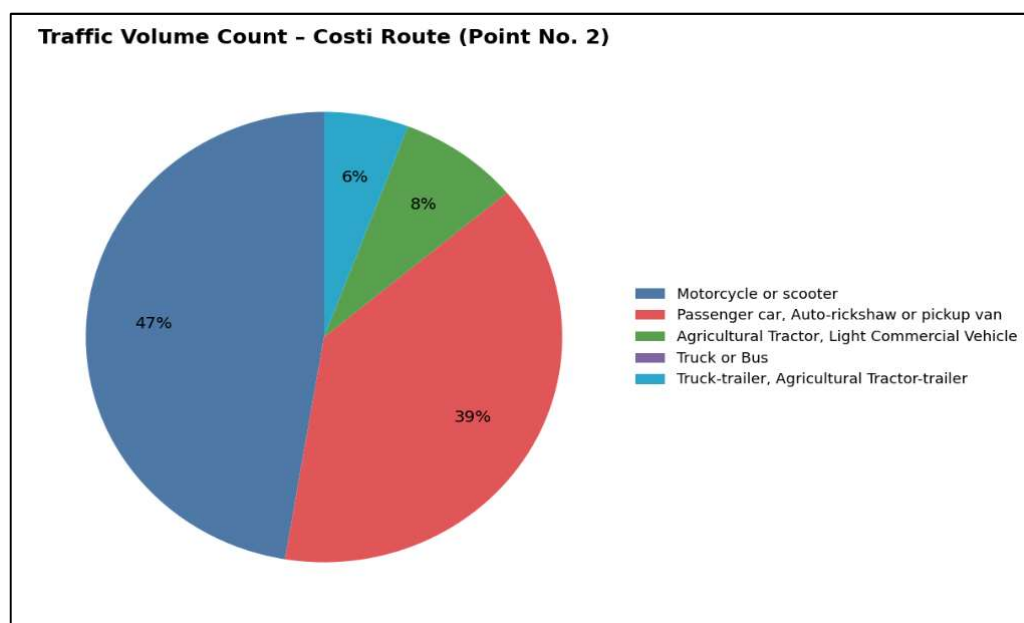


Figure 11 – Traffic Volume Count at Codli to Costi Route (Point No. 2.)

Table - 22
No. of Vehicles with Respect to PCU for Codli to Costi Route (Point No. 2.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	289	0.5	144.5
2	Passenger car, Auto-rickshaw or pickup van	236	1.0	236
3	Agricultural Tractor, Light Commercial Vehicle	50	1.5	75
4	Truck or Bus	0	3.0	0
5	Truck-trailer, Agricultural Tractor-trailer	35	4.5	157.5
Total		610		613

At Traffic Survey Point No. 3.

Table - 23
Traffic Volume Count at Codli to Costi Route (Point No. 3.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	186
2	Passenger car, Auto-rickshaw or pickup van	136
3	Agricultural Tractor, Light Commercial Vehicle	0
4	Truck or Bus	4
5	Truck-trailer, Agricultural Tractor-trailer	38
Total		364

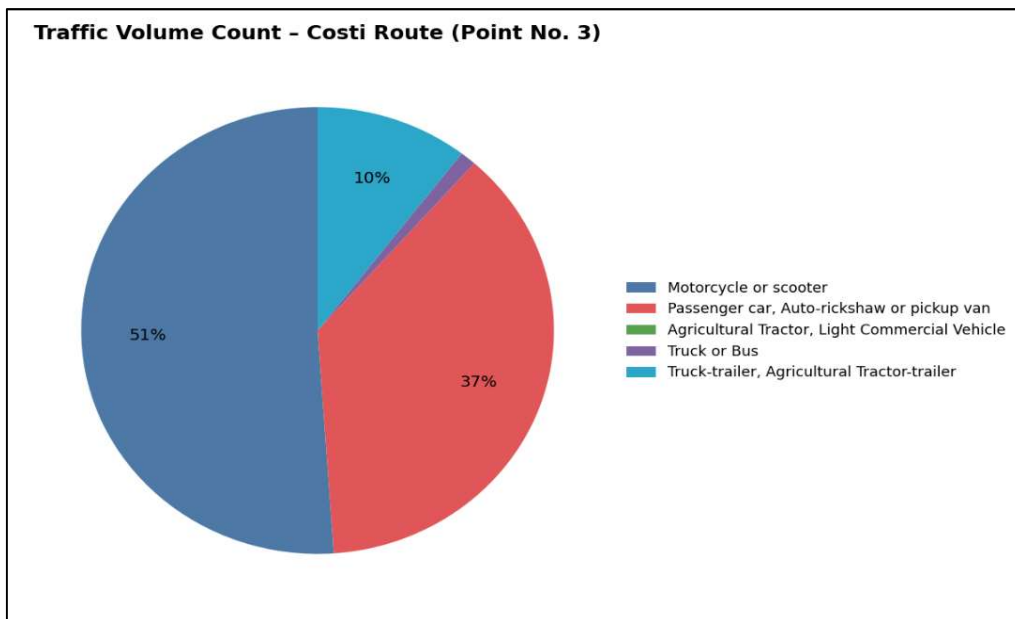


Figure 12 – Traffic Volume Count at Codli to Costi Route (Point No. 3.)

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 24
No. of Vehicles with Respect to PCU for Codli to Costi Route (Point No. 3.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	186	0.5	93
2	Passenger car, Auto-rickshaw or pickup van	136	1.0	136
3	Agricultural Tractor, Light Commercial Vehicle	0	1.5	0
4	Truck or Bus	4	3.0	12
5	Truck-trailer, Agricultural Tractor-trailer	38	4.5	171
Total		364		412



Figure 13 – Geo-tagged photographs showing Traffic Study Survey at Codli to Costi Route

6.3. EXISTING TRAFFIC SCENARIO ON ROAD PAUSKAR YARD ROUTE

At Traffic Survey Point No. 1.

Table - 25

Traffic Volume Count at Road Pauskar Yard Route (Point No. 1.)

S.N.	Type of Vehicle	No. of Vehicles / Day
1	Motorcycle or scooter	0
2	Passenger car, Auto-rickshaw or pickup van	0
3	Agricultural Tractor, Light Commercial Vehicle	0
4	Truck or Bus	0
5	Truck-trailer, Agricultural Tractor-trailer	243
Total		243

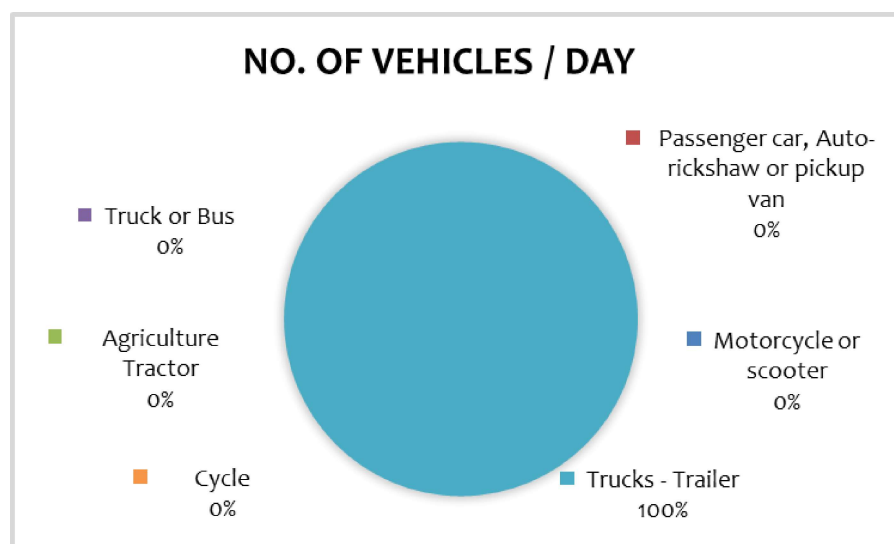


Figure 14 – Traffic Volume Count at Road Pauskar Yard Route (Point No. 1.)

Table - 26

No. of Vehicles with Respect to PCU for Road Pauskar Yard Route (Point No. 1.)

S.N.	Vehicle Type	Number of Vehicles / Days	Passenger Car Unit (PCU) Factor	Total Number of Vehicle (PCU) / Day
1	Motorcycle or scooter	0	0.5	0
2	Passenger car, Auto-rickshaw or pickup van	0	1	0
3	Agricultural Tractor, Light Commercial Vehicle	0	1.5	0
4	Truck or Bus	0	3	0
5	Truck-trailer, Agricultural Tractor-trailer	243	4.5	1093.5
Total		243		1093.5

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Traffic Study Report



Point 1

Figure 15 – Geo-tagged photographs showing Traffic Study Survey at Road Pauskar Yard Route

7.0 EXISTING TRAFFIC SCENARIO AND LOS

The Recommended Design Service Volume as per Guidelines for Capacity of Roads in Rural areas - IRC: 064-1990 is given below:

Table – 27
Recommended Design Service Volume as per Guidelines for Capacity of Roads in Rural areas - IRC: 064-1990

S. No.	Terrain	Curvature (Degrees per Kilometre)	Design Service Volume in PCU/Day (for Two Lane Road)	Design Service Volume in PCU/Day (for Single Lane Road)
1.	Plain	Low (0-50)	15000	2000
		High (above 51)	12500	1900
2.	Rolling	Low (0-100)	11000	1800
		High (above 101)	10000	1700
3.	Hilly	Low (0-200)	7000	1600
		High (above 201)	5000	1400

* Recommended Design Service Volumes for Two lane roads (IRC: 064-1990)

The existing scenario and LOS (Level of Service) have been calculated for the Traffic survey locations for all routes as per the IRC guidelines and the details are given below:

Table - 28
Existing Traffic Scenario & Level of Service

ROAD	Volume (PCU/Day)	C (DSV in PCU/Day)	EXISTING V/C RATIO	LOS
1. Codli to Capxem Route				
Point No. 1	1635.5	15000	0.11	A
Point No. 2	1824	15000	0.12	A
Point No. 3	1602	15000	0.11	A
Point No. 4	1585	15000	0.11	A
Point No. 5	1949	15000	0.13	A
Point No. 6	2144	15000	0.14	A
Point No. 7	2128	15000	0.14	A

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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2. Codli to Costi Route

Point No. 1	609	15000	0.04	A
Point No. 2	613	15000	0.04	A
Point No. 3	412	15000	0.03	A

3. Road Pauskar Yard Route

Point No. 1	1094	15000	0.07	A
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*Recommended Service Volume for two lane road and single lane road as per IRC guidelines for capacity of rural roads in plain areas (IRC 064-1990).

Table - 29
Capacity as per IRC: 064-1990

V/C	LOS (Level of Service)	Performance
0.0-0.2	A	Excellent
0.2-0.4	B	Very Good
0.4-0.6	C	Good/ Average/Fair
0.6-0.8	D	Poor
0.8-1.0	E	Very Poor
>1.0	F	Highly Unstable (Free Flow = 0)

8.0 PROPOSED TRAFFIC DENSITY AND LOS DURING THE PERIOD OF MINE OPERATIONS

Two scenarios have been considered for the transportation of Iron Ore, i.e., transportation through jetties and railway sidings. In the initial scenario, a total quantity of 3.5 Million TPA of Iron Ore will be transported through jetties until the railway siding becomes operational. Subsequently, upon commissioning of the railway siding, 1.5 Million TPA of Iron Ore will be transported through the railway mode. Accordingly, the quantity of Iron Ore transported by jetties will be reduced, which will consequently result in a reduction in emissions associated with road transportation.

In first to fifth year of operation, proposed traffic density has been given below:

Table - 30
During Plan period of mine operations (3.5 MTPA) through Road via Jetty

S.N.	Particular	Details at Normative Capacity	Details at Peak Stage @20%
1.	Capacity of mine (TPA)	3500000	3500000
2.	No. of working days	237	237
3.	Capacity of tippers for Transportation of Mineral (Tonnes)	11.5	11.5
4.	Transportation of Mineral (Tonnes per day)	14767.9	17721.5
5.	No. of trips (filled)	1284.17	1541.00
6.	No. of trips/day (to & from)	2568.3	3082.0
7.	Increase in PCU's per hour for roads as per IRC: 064-1990 guidelines	7705.0	9246.0

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation of Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 31
During Plan period of mine operations (1.5 MTPA) through Road via Railway Sliding

S.N.	Particular	Details at Normative Capacity	Details at Peak Stage @20%
1.	Capacity of mine (TPA)	1500000	1500000
2.	No. of working days	237	237
3.	Capacity of tippers for Transportation of Mineral (Tonnes)	11.5	11.5
4.	Transportation of Mineral (Tonnes per day)	6329.1	7594.9
5.	No. of trips (filled)	550.36	660.43
6.	No. of trips/day (to & from)	1100.7	1320.9
7.	Increase in PCU's per hour for roads as per IRC: 064-1990 guidelines	3302	3963

The modified Traffic scenario and LOS values after expansion for traffic survey locations at all three routes are given below:

Table - 32
Modified Traffic Scenario & LOS (At Normative Capacity)

S.N.	Locations	Increased PCUs	V	C	Modified V/C Ratio	LOS
1. Codli to Capxem Route						
1.	Point 1	7705	9341	15000	0.62	D
2.	Point 2	7705	9529	15000	0.64	D
3.	Point 3	7705	9307	15000	0.62	D
4.	Point 4	7705	9290	15000	0.62	D
5.	Point 5	7705	9654	15000	0.64	D
6.	Point 6	7705	9849	15000	0.66	D
7.	Point 7	7705	9833	15000	0.66	D
2. Codli to Costi Route						
1.	Point 1	3963	3911	15000	0.26	B
2.	Point 2	3963	3915	15000	0.26	B
3.	Point 3	3963	3714	15000	0.25	B
3. Road Pauskar Yard Route						
1.	Point 1	3963	4396	15000	0.29	B

Table - 33
Modified Traffic Scenario & LOS (At Peak Stage @20%)

S.N.	Locations	Increased PCUs	V	C	Modified V/C Ratio	LOS
1. Codli to Capxem Route						
1.	Point 1	9246	10882	15000	0.73	D
2.	Point 2	9246	11070	15000	0.74	D
3.	Point 3	9246	10848	15000	0.72	D
4.	Point 4	9246	10831	15000	0.72	D

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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5.	Point 5	9246	11195	15000	0.75	D
6.	Point 6	9246	11390	15000	0.76	D
7.	Point 7	9246	11374	15000	0.76	D
2. Codli to Costi Route						
1.	Point 1	3963	4572	15000	0.30	B
2.	Point 2	3963	4576	15000	0.31	B
3.	Point 3	3963	4375	15000	0.29	B
3. Road Pauskar Yard Route						
1.	Point 1	3963	5056	15000	0.34	B

The traffic survey indicates that the existing traffic conditions along the Codli–Capxem Route, Codli–Costi Route and Pauskar Yard Route are satisfactory, with sufficient road capacity to accommodate the existing traffic. With the addition of the proposed mineral transportation traffic, the traffic volume and PCU loading on the road network will increase. The Codli–Capxem Route will experience comparatively higher traffic loading and is expected to operate at LOS-D under the normal operating condition. The Codli–Costi Route and Pauskar Yard Route will continue to operate at a comparatively better LOS-B. During the peak-stage condition, considering the additional increase in traffic movement, the V/C ratio will increase further and the road sections will operate at LOS-D. This indicates increased utilization of the available road capacity and a corresponding reduction in traffic operating efficiency. The proposed transportation activity is therefore expected to have a moderate and manageable impact on the existing road infrastructure. To ensure safe and efficient movement of mineral transport vehicles, road strengthening and regular maintenance, proper traffic regulation, prevention of overloading, speed control, traffic-safety measures and effective coordination with the concerned authorities will be implemented. Overall, the existing road network can accommodate the proposed traffic with appropriate infrastructure strengthening and traffic-management measures.

9.0 CARRYING-CAPACITY ASSESSMENT AS PER THE IIT (ISM) DHANBAD

Particular	Capacity
Total carrying capacity of Codli–Costi Cluster	4.69 MTPA
Codli Mineral Block production	3.50 MTPA
Kalay Mineral Block production	0.75 MTPA
Total proposed transportation	4.25 MTPA
Balance carrying capacity	0.44 MTPA

As per the IIT (ISM) Dhanbad carrying-capacity assessment, the total carrying capacity of the Codli–Costi cluster is 4.69 MTPA. The proposed production capacity of the Codli Mineral Block is 3.50 MTPA, while the production capacity considered for the Kalay Mineral Block is 0.75 MTPA. Thus, the combined mineral production/transportation requirement from the two mineral blocks is 4.25 MTPA, which is within the assessed carrying capacity of 4.69 MTPA. The proposed

transportation will utilize approximately 90.6% of the assessed carrying capacity, leaving a balance carrying capacity of about 0.44 MTPA. Therefore, the combined transportation requirement of Codli and Kalay Mineral Blocks can be accommodated within the overall carrying capacity of the Codli–Costi cluster, subject to compliance with route-wise capacity restrictions and prescribed traffic-management measures.

10.0 TRAFFIC PROJECTION DUE TO INCREASED TRAFFIC MOVEMENT

- Due to the proposed project, there will be addition of Heavy and Light motor vehicles in the existing traffic load.
- During the plan period, the production capacity of the mine is 3.5 Million TPA. Mineral transportation is considered through the road network using 11.5-tonne capacity tippers, with provision for transportation through the proposed railway siding. The road-transport calculations in the correction sheet consider 237 working days and a 20% peak-stage increase.
- The LOS value for the traffic survey conducted for Codli to Capxem Route is ‘D’, Codli to Costi route is ‘B’ or Codli to Road Paukar Yard route is ‘B’.
- The corrected existing V/C ratios for the seven Codli–Capxem points are 0.109, 0.122, 0.107, 0.106, 0.130, 0.143 and 0.142, all falling in LOS category “A” (Excellent).
- The corrected existing V/C ratios for the three Codli–Costi points are 0.041, 0.041 and 0.027, all falling in LOS category “A” (Excellent).
- The corrected existing V/C ratio for the Road Pauskar Yard point is 0.073, falling in LOS category “A” (Excellent).

The modified Traffic scenarios and LOS values for traffic survey locations have been calculated in order to assess the additional traffic load on transportation route. Based in the modified LOS values for all traffic locations on Codli to Capxem Route, Codli to Costi Route and Road Pauskar Yard route LOS will decrease. Hence, the company will strengthen the road first wherever required, after which transportation will be carried out.

Conclusion:

As per the corrected V/C ratios and LOS values, the proposed mineral transportation will increase the traffic load on the existing road network. Road strengthening, traffic-management measures, maintenance and safety controls will therefore be implemented to minimize the impact on existing road infrastructure.

JSW Steel Limited has proposed mitigation/protection measures which will be adopted during transportation of mineral, to minimize the impact on the traffic scenario and the Road network such as internal and nearby roads will be periodically maintained to facilitate the safe and pollution free transportation services, if required. There will be a change in the traffic density after the proposed project. The company will also take appropriate and adequate mitigation measures to the best possible extent to minimize the impacts due to Noise, fugitive dust & Gaseous Emissions.

Recommendations & Suggestions:

- In the proposed Block -XII Codli Iron Ore Mine, the transportation of the Iron Ore will be done via SH-7 and connecting Village Road; up to Capxem, TPL, Fomento, Andre Minescape and Bandekar Jetty or by proposed Railway Sidings.
- While the modified Level of Service (LOS) values have been derived by accounting for both normative and peak capacities to anticipate worst-case scenarios, it is advisable that mineral transportation be undertaken at normative capacity. This approach ensures operational efficiency while allowing flexibility to accommodate occasional exigencies.
- Mineral transportation will be carried out in strict compliance with the Standard Operating Procedure (SOP) prescribed by DMG and GSPCB.
- It is advisable to have 1.5 m width of paved shoulders with a provision of 1.0 m earthen shoulders on the roads to be utilized for transportation of mineral.
- Monitoring stations along the transportation Route will be identified in consultation with Goa State Pollution Control Board.
- Plantation will be done along the roads to minimize the impacts due to generation of dust and noise during transportation.
- Plant species such as *Albizia lebbbeck* (Siris, Karo Sirish), *Alstonia scholaris* (Satani) *Azadirachta indica* (Neem), *Artocarpus heterophyllus* (Jackfruit), *Dalbergia sissoo* (Shisham), *Ficus religiosa* (Peepal, Piplo), *Syzygium cumini* (Jamun), *Terminalia tomentosa* (Marat (Matti), *Terminalia arjuna* (Arjun), etc. have been suggested for plantation along the roads. Besides these species, other native and fruit bearing species will also be planted in consultation with horticulture & local Forest Department.

11.0 IMPACT ON HABITATION LOCATED WITHIN 100 M FROM THE CENTRE OF ROAD ON BOTH SIDES

The habitation located within a distance of 100 m from the centre line on both sides of the road are Village Codli, Village Savargal, Village Morkani, Village Bandoli, Village Santona, Village Rumbrem, Sanvardem that may experience impacts due to increased transportation activities associated with the project. The likely impacts are summarized below:

- **Air Pollution:** Movement of mineral transportation vehicles may generate dust emissions, particularly during dry weather conditions, which can affect the ambient air quality in nearby residential areas.
- **Noise Pollution:** Increased vehicular movement may lead to higher noise levels due to engine operation, honking, loading/unloading activities and road vibrations, causing disturbance to nearby inhabitants.
- **Traffic congestion and safety risks:** Additional transportation vehicles may increase traffic density, leading to congestion, inconvenience to local commuters and potential road safety concerns for pedestrians and residents.
- **Road vibration:** Continuous movement of heavy vehicles may create vibrations, especially on village or narrow roads, which may affect nearby structures over a prolonged period.

- **Impact on human health:** Prolonged exposure to dust and noise may cause discomfort and minor health-related issues to the local population if adequate mitigation measures are not adopted.
- **Impact on daily activities:** Local residents, schools, shops and community facilities situated near the road corridor may face temporary disturbances during transportation hours.

Mitigation measures for the same are given below:

- Transportation will be done under rules and guidelines prescribed by DMG.
- Vehicles will comply with applicable emission norms and possess valid Pollution Under Control (PUC) certificates.
- All mineral-carrying trucks will be covered with tarpaulin to prevent spillage and fugitive dust emissions.
- The transportation road will be maintained in good condition to minimize dust generation and vehicle-induced vibrations.
- Overloading of vehicles will be strictly prohibited to prevent material spillage and road deterioration.
- Wheel washing/cleaning facilities will be provided at the mine exit to prevent mud and dust from being carried onto public roads.
- Unnecessary honking will be prohibited near villages, schools, hospitals and other sensitive receptors. Vehicles will be fitted with properly functioning silencers.
- Adequate warning signboards, speed breakers, reflective road markings, and cautionary signs will be provided at critical locations.
- Drivers will be trained on safe driving practices, adherence to speed limits, and road safety regulations.
- Awareness programs on road safety will be conducted for nearby communities, and coordination will be maintained with local authorities for effective traffic management.
- Regular air quality and noise level monitoring will be done.

12.0 MEASURES FOR TRANSPORTATION

The following necessary mitigation measures will be adopted during transportation of Iron Ore:

- Widening and strengthening works will be done public road (s) to increase load-bearing capacity and safety before the beginning of transportation of the mineral and this will be done in consultation with the concerned authorities.
- Plantation will be done along the dedicated transportation route and also at railway sidings.
- Transportation vehicles will be properly maintained to minimize the exhaust emission.
- The company will explore the feasibility of incorporating Electric Vehicles during transportation of mineral which may facilitate in reducing the environmental impacts in line with sustainability targets and regulatory requirements.
- Prior approval for transportation route and Transit permit will be taken from Directorate of Mines & Geology before the commencement of the Transportation activities.

- Wheel-washing facilities will be installed at exit points of mines to avoid transporting mud and dust onto public roads.
- Regular road repairs, pothole fixing and shoulder tar-sealing improve safety for all road users. This will also reduce wear-and-tear from heavy truck loads.
- Regular tests will be carried out to check exhaust emission and PUC certification of transportation vehicles at prescribed interval.
- Transportation trucks will be loaded with prescribed capacity and covered with tarpaulin before leaving mines premises.
- Regular monitoring of the emission levels will be done.
- Clear signages will be installed indicating heavy vehicle movement zones, speed limits and pedestrian crossings.
- Traffic Marshals will be provided for regulating movement of vehicles as well as for safety of persons.
- Training will be given to all drivers about safe and environment friendly driving.
- Regular water sprinkling on mine haul roads during transportation and also at transfer points.
- Used of fixed dust suppression system on haul roads.
- Dedicated manpower will be provided to clean the ore spillage on the public road by manual sweeping and washing.
- Use of mechanised road sweeping machine for cleaning the public road and also at railway sidings.
- Overloading and Over-speeding will be avoided.
- Proper maintenance, oiling and greasing of vehicles will be done.
- All haul roads within mines will be maintained properly by using motor grader & soil compactor in order to minimize the impact of mineral transportation.
- Un-necessary blowing of horn will be avoided.
- Installation of metal windscreens at Railway Sidings.
- Greenbelt and Plantation will be done along ML boundary, waste dumps, tailing dam area, near utility area and railway sidings.
- Proper protective and safety measures will be implemented along the railway route in accordance with the guidelines and safety requirements prescribed by the Ministry of Railways.
- Regular air quality monitoring will be done.

SOP for Mineral transportation is enclosed as **Annexure I**.

13.0 CONCLUSION

From the study of existing traffic scenario and the associated impacts caused due to additional traffic during operational phase of proposed Block -XII Codli Mineral Block, it can be concluded that the present road network is good enough to bear the increased traffic load.

The internal and nearby roads will be periodically maintained to facilitate the safe and pollution free transportation services, if required. There will be significant change occurs in the traffic density after the proposed project. However, the company will take all the appropriate and adequate mitigation measures to the best possible extent to minimize the impacts due to Noise, fugitive dust & Gaseous Emissions.

In the proposed Block -XII Codli Mineral Block, the transportation of the Iron Ore will be done via SH-7 and connecting Village Road; up to Capxem Jetty, TPL, Fomento, Andre Minescape and Bandekar Jetty or Railway Sidings. However, JSW Steel Limited will also explore the possibility of other better ways of evacuating the material in consultation with Goa State Pollution Control Board or the State Mining Department.

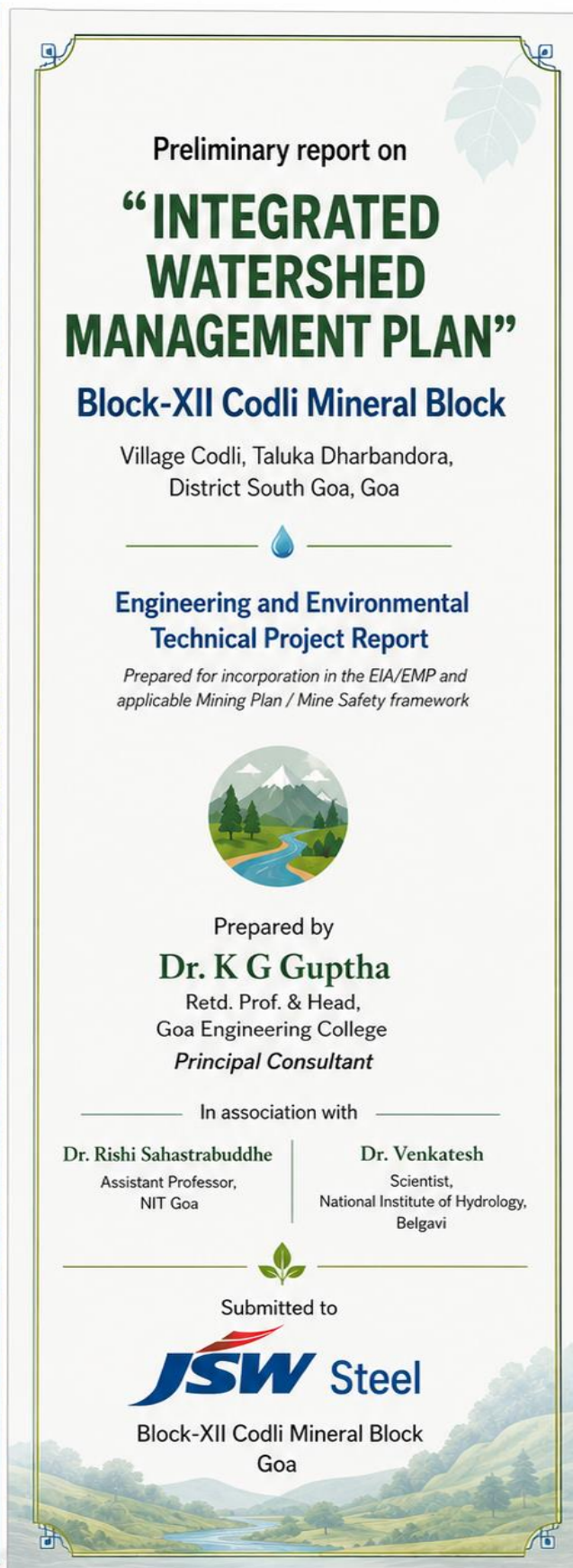
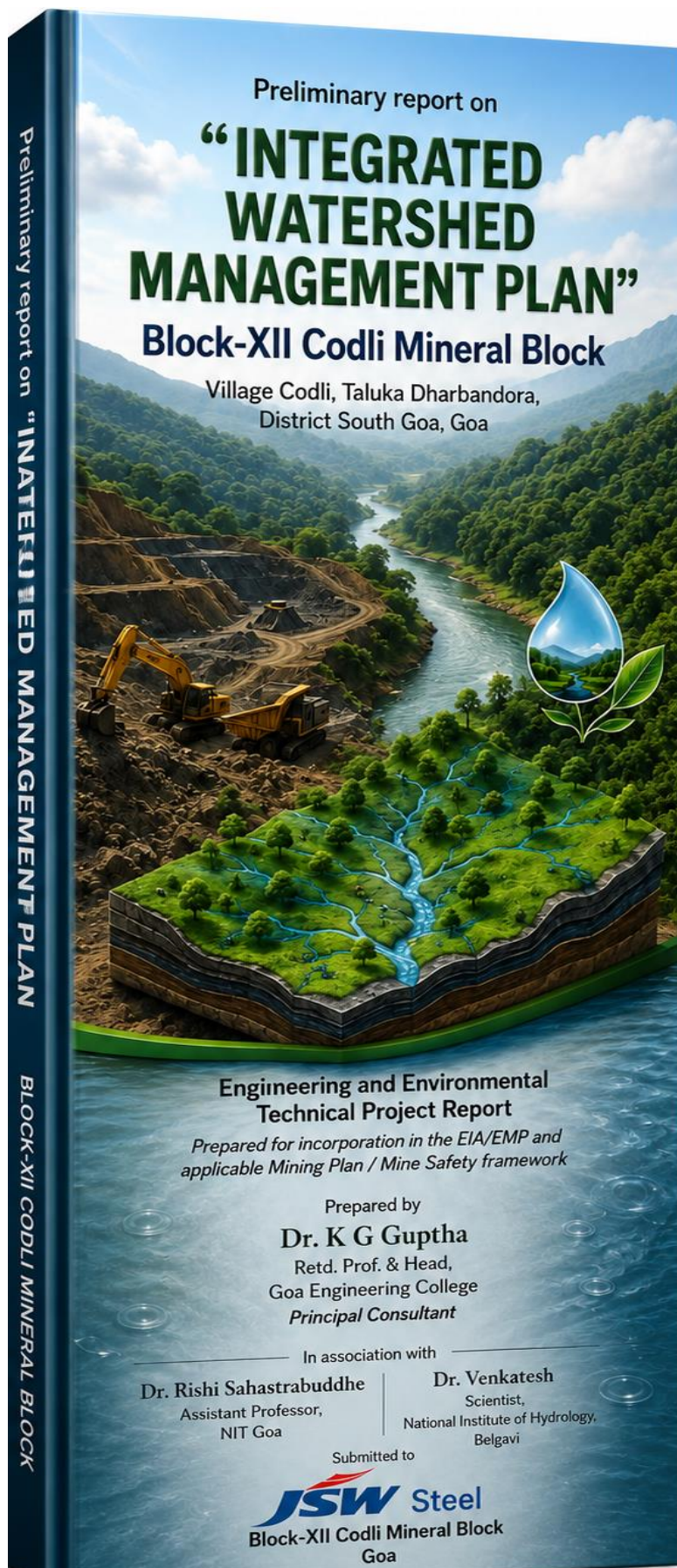
SOP Transportation

In terms of Hon'ble High Court of Bombay at Goa and as per the order dated 29.06.2024, in Writ Petition (PIL) No. 06/2024, the following Standard Operating Procedure (SOP) devised by DMG and GSPCB will be followed by the Project Proponent:

1. The PP will first approach the Directorate of Mines and Geology for approval of the route of transportation.
2. Upon approval, the PP will apply to the GSPCB for setting up monitoring stations on the route. After the GSPCB sets up the stations, the PP will then apply to the DMG for transit permits.
3. The PP upon receiving transit permit shall ensure that all conditions of transportation are adhered and complied with.
4. All trucks carrying ore shall be registered with the Directorate of Mines & Geology and fitted with GPS.
5. The timing of the Ore Transportation along the designated route shall be from 8.00 am to 1.00 pm with a break from 1.00 pm to 2.00 pm and then transportation will continue from 2.00 pm to 5.45 pm from the source location.
6. Above transportation, timings along the designated routes will be strictly followed with.

In terms of recommendations made by Goa State Pollution Control Board Officials, the following safeguard measures will be taken by the Project Proponent for pollution control during transportation:

1. The truck/tippers engaged in transportation of ore will be kept with sufficient free board after filling the cargo box to avoid spillage.
2. All trucks/tippers engaged in the transportation of ore will be covered with tarpaulin.
3. In case of break down of loaded trucks/tippers unloading of ore at the road side shall be strictly avoided.
4. The roads within mining lease areas shall be sprinkled with water to suppress dust pollution.



1. INTRODUCTION

Integrated watershed management in the Block-XII Codli Mineral Block is essential because the mining area is situated within a complex natural drainage and hydrogeological environment, with the Khandepar River system occurring in close proximity to the northern side of the mining block. The surrounding terrain is characterised by undulating to rugged topography, natural drainage channels, forest and open-jungle areas, agricultural land and other land-use categories that collectively influence rainfall interception, surface runoff, infiltration, groundwater recharge and sediment movement.

The proposed mining activities will progressively modify the existing ground profile through excavation, development of benches, haul roads, waste-dump areas, mineral handling and associated infrastructure. Such modifications can alter natural drainage pathways, increase the concentration and velocity of surface runoff, expose soil and weathered materials to erosion, and influence the existing groundwater regime. Consequently, watershed management cannot be confined to the mining lease alone and needs to consider the relationship between the upper catchment, intervening drainage network, mine-disturbed areas and downstream receiving water bodies.

A particular area of concern is the northern river-facing portion of the Block-XII lease. The river is reported to occur at a very short distance from the lease boundary, making the relationship between river stage, floodplain conditions, groundwater levels and mine excavation hydraulically significant. The possibility of water reaching the mine may arise through different mechanisms, including direct surface-water/flood ingress, seepage from the river through permeable riverbed or bank materials, groundwater movement influenced by the river, or preferential movement through weathered, fractured or structurally disturbed geological zones.

The regional topography and groundwater regime are therefore important considerations in evaluating the potential for water ingress. The terrain exhibits an overall regional fall towards the southwest, while the groundwater information indicates hydraulic gradients that require careful interpretation at the local scale. In particular, the reported groundwater-flow descriptions indicate different regional directions in different portions of the assessment. This is significant because the direction and magnitude of the hydraulic gradient determine whether the river can act as a source of groundwater recharge to the mine area or whether groundwater generally moves away from the mine towards the regional drainage system.

The hydrogeological setting comprises a relatively permeable shallow lateritic/weathered aquifer overlying deeper weathered and fractured geological formations having comparatively lower permeability. Although the relatively low-permeability formations may restrict vertical groundwater movement, their hydraulic behaviour can be modified locally by joints, fractures, faults, weathered zones and other discontinuities. Such features may provide preferential pathways that cannot be adequately represented by a regional interpretation based solely on lithology.

The mine excavation is also a significant hydraulic feature. As mining progresses, the pit floor will be developed substantially below the surrounding natural ground levels. Dewatering of such an excavation can create a hydraulic sink and modify the local groundwater gradient. Therefore, the relationship between the river, aquifer system and mine pit must be assessed under both natural and mining-induced groundwater conditions, particularly during the monsoon when rainfall recharge and river stages increase substantially.

From the watershed perspective, the primary objective is to retain rainfall and runoff within the natural catchment system as far as practicable, promote infiltration where environmentally and geotechnically appropriate, minimise accelerated soil erosion, intercept sediment before it enters natural drainage channels, maintain the hydraulic continuity of existing streams and nalas, and protect the Khandepar River and associated water bodies. From the mine-safety perspective, the objective is to ensure that the mine is protected against credible flooding, seepage and inundation scenarios and that adequate monitoring and emergency-response arrangements are established.

The assessment therefore requires an integrated approach comprising watershed delineation, catchment characterisation, surface-water assessment, groundwater assessment, river hydraulics, geological and structural interpretation, erosion and sediment assessment, and evaluation of the interaction between the river and the mine excavation.

It is important that the assessment distinguishes between **regional groundwater seepage into the mine and actual river-derived water ingress**. The presence of groundwater inflow into the pit does not, by itself, establish hydraulic connectivity with the river. Similarly, the absence of a significant modelled regional response does not conclusively eliminate the possibility of a localised river-connected pathway. The final determination must consequently be based on the combined interpretation of topography, river levels, groundwater heads, geological structure, seasonal behaviour and hydraulic modelling.

Accordingly, the present study adopts a **ridge-to-valley and source-to-sink approach**, in which the catchment is considered as an interconnected hydrological system. The assessment of watershed behaviour, catchment treatment and river ingress is consequently required to be undertaken together, so that measures intended to control runoff or protect the mine do not inadvertently alter natural drainage, increase flood levels, concentrate seepage or create new hydraulic pathways.

The final engineering assessment will establish the authenticated High Flood Level (HFL), river cross-sections, design flood discharge, flood conveyance characteristics, local groundwater gradients, potential river-aquifer connectivity, scour conditions and the contribution, if any, of river water to mine inflow. These parameters will form the basis for finalising the river-protection system, drainage arrangements, CAT measures, groundwater-management measures and mine inundation-safety provisions.

The **central engineering question**, therefore, is not merely whether the river is geographically close to Block-XII, but whether the combination of **topography, river stage, geological structure, aquifer characteristics and mining-induced hydraulic gradients** can establish a credible pathway for water movement from the river or its floodplain into the mine excavation. This question forms the principal basis for the Integrated Watershed Management Plan, Catchment Area Treatment Plan and River Ingress Study.

2. PROJECT AND AREA PROFILE

Block-XII Codli Mineral Block is located at **Codli Village, Dharbandora Taluka, South Goa**, within a region characterised by forested uplands, agricultural areas, natural drainage channels, valleys and riverine features. The geographical setting is particularly important for the present assessment because the proposed mining operation will be developed within an already functioning natural watershed system. The relationship between the existing terrain, drainage network, groundwater regime and proposed mine excavation therefore forms the fundamental basis for assessing watershed behaviour, catchment treatment requirements and the possibility of water ingress into the mine.

The mining block covers an **auctioned/lease area of 377.0881 ha**, while the broader environmental and hydrological assessment extends over a **10-km study area of approximately 40,164.16 ha**. The larger study area is significant because rainfall occurring outside the mining lease can contribute to surface runoff, groundwater recharge and sediment transport affecting the project area. Accordingly, watershed and catchment behaviour cannot be assessed solely with reference to the lease boundary.

The proposed mining operation represents a substantial scale of material excavation, with an indicated **iron-ore production capacity of 3.50 million tonnes per annum**, approximately **8.21 million tonnes per annum of overburden/waste**, and consequently approximately **11.71 million tonnes per annum of total excavation**. Such extensive excavation and associated mining infrastructure have the potential to modify natural ground levels, surface-drainage pathways, infiltration characteristics and the local groundwater regime. These changes need to be assessed in conjunction with the existing watershed and river system.

The **Khandepar River** is the most important surface-water feature in relation to the northern side of Block-XII. The reported minimum separation between the river and the mining lease boundary is approximately **10 m at the closest northern interface**. This limited separation makes the northern side particularly significant for assessment of flood levels, river-bank stability, seepage, groundwater interaction, erosion, scour and the possibility of water ingress into the mine excavation.

The area receives substantial monsoon rainfall, with an average annual rainfall of approximately **3,412.77 mm** reported for the study area. Such high rainfall, combined with the undulating to rugged terrain and natural drainage network, can generate substantial seasonal runoff. The hydrological response will vary according to slope, soil characteristics, vegetation cover, drainage density and the extent of human and mining disturbance. Forested areas generally provide greater rainfall interception and infiltration, whereas exposed mine surfaces, haul roads, waste dumps and compacted areas may generate comparatively rapid runoff and increased sediment transport.

Parameter	Project-specific information
Mining block	Block-XII Codli Mineral Block
Location	Codli Village, Dharbandora Taluka, South Goa, Goa

Auctioned block / lease area	377.0881 ha
10-km study area	40,164.16 ha within 10-km radius
Proposed iron ore production	3.50 million TPA iron ore
OB / waste generation	8.21 million TPA OB/waste
Total excavation	11.71 million TPA total excavation
Critical northern water body	Khandepar River / Dudhsagar–Khandepar river system
Closest reported river–lease separation	approximately 10 m at the closest reported northern lease interface
Average annual rainfall	3,412.77 mm/year average annual rainfall reported in the supplied hydrogeological report
Modelled groundwater seepage	approximately 736 m ³ /day model-calculated groundwater seepage
Modelled maximum drawdown	maximum modelled drawdown approximately 2.60 m (2025), 2.51 m (2028), and 1.72 m (2035)

The wider study area is predominantly natural/semi-natural. Forest/open jungle occupies approximately 76.36% of the 10-km area, followed by agriculture at 8.88%, scrub/wasteland at 3.17%, human settlement/mine infrastructure at 3.09%, surface-water bodies/mine sumps at 2.57%, existing mine area at 1.67%, mangroves at 1.64%, roads at 1.34%, plantations at 0.99%, industries at 0.22% and railway infrastructure at 0.07%. This land-cover composition is a major advantage for watershed resilience, but it also means that the mine must be managed as a disturbance within a much larger natural hydrological system.

The Block-XII Codli Mineral Block is located in a hydrologically sensitive portion of South Goa. The 10-km study area is approximately 40,164.16 ha and is dominated by forest/open-jungle cover. The mine is proposed as a fully mechanised opencast iron-ore operation, and progressive excavation, waste handling, haul roads and mineral processing can alter the natural partitioning of rainfall between infiltration, runoff and groundwater recharge.

The northern boundary is the controlling environmental and safety interface because the Khandepar river system is reported to approach the lease to within about 10 m. The watershed plan therefore cannot be limited to water harvesting structures inside the mine. It must conserve upstream source areas, maintain drainage connectivity, protect river corridors, control sediment, preserve recharge where appropriate, and prevent mine drainage from creating new hydraulic pathways.

The supplied ToR specifically requires an integrated watershed management plan, CAT Plan, river impact assessment, river ingress study and a river-facing embankment 3 m above authenticated HFL. The watershed plan is therefore the umbrella document linking the surface-water, groundwater, CAT, river-protection and mine-safety systems.

ToR Implications and Compliance Matrix

Specific ToR	Implication	Required output
ToR 1.4 – Integrated watershed management	Protect and conserve water bodies in the lease and study area; consult WRD.	GIS watershed plan, drainage/water-body protection, monitoring and implementation programme.
ToR 1.4(A) – CAT Plan	Protect river ecological/hydrological integrity and control erosion/sediment.	Site-specific CAT plan with priority micro-watersheds, engineering and biological measures.

ToR 1.4(B) – River/nala impacts	Assess hydrological, hydrogeological and aquatic implications.	Baseline, impact assessment, mitigation and monitoring.
ToR 1.4(C) – River ingress	Determine likelihood and magnitude of water inflow into mine.	River ingress risk assessment, hydraulic/hydrogeological modelling and emergency controls.
ToR 1.4(D) – Embankment	Stone-pitched river-facing protection with crest 3 m above authenticated HFL.	HFL datum, hydraulic design, geotechnical design, drawings and maintenance plan.
ToR 1.19 – Northern side water ingress	Specific scientific study of river-side ingress from north.	Piezometric transect, structural mapping, connectivity assessment and local MODFLOW refinement.
ToR 1.47 – CAT by reputed institute	Independent multidisciplinary quality assurance is expected.	Institutional review/endorsement and recorded WRD recommendations.

3. Objectives

The watershed management assessment for Block-XII is intended to establish a comprehensive understanding of the relationship between the **natural terrain, rainfall, surface drainage, groundwater system, mining activities and the Khandepar River**. Since the proposed mining area forms only a part of the larger drainage system, the watershed needs to be considered as an interconnected hydrological unit extending from the upstream catchment and recharge areas through the intervening drainage network to the downstream receiving system.

The objective of the study is therefore not limited to controlling runoff generated within the mining lease. It is intended to establish a scientifically sound framework for **conserving the existing watershed, maintaining natural drainage connectivity, controlling erosion and sediment transport, protecting water resources and ensuring that mining-induced changes do not adversely affect the surrounding hydrological regime**.

Particular attention is required in the northern portion of the block because of the close proximity of the **Khandepar River**. Changes in surface drainage, groundwater levels, pit dewatering and runoff concentration may influence the hydraulic relationship between the mine and the river. The watershed assessment should consequently provide the hydrological and spatial framework required for the subsequent **Catchment Area Treatment Plan and River Ingress Study**. The study shall accordingly pursue the following objectives:

- a. Delineate the watershed, sub-watershed and micro-watershed structure governing runoff to the Khandepar/Dudhsagar river system and associated nalas.
- b. Establish a spatial water balance linking rainfall, infiltration, runoff, groundwater recharge, mine-water generation and downstream discharge.
- c. Protect natural rivers, nalas, drainage channels, recharge zones and riparian corridors from adverse project-induced changes.
- d. Maintain natural drainage connectivity and avoid uncontrolled diversion, ponding or concentration of runoff.
- e. Reduce erosion and sediment delivery from excavation, overburden, stockpiles, haul roads and infrastructure.
- f. Integrate mine-water management with the regional watershed rather than treating pit dewatering and runoff as independent systems.
- g. Provide a scientific basis for the CAT Plan and the northern river-ingress study.
- h. Create a monitoring and adaptive-management framework with measurable thresholds and annual monsoon review.

4. Salient Geographical and Hydrological Features

The supplied DEM analysis describes undulating to rugged denudational and structural hills separated by narrow valleys. The 10-km terrain is reported to range from about 431 m AMSL in the north-east to about 0 m AMSL in the south-west, indicating an overall regional southwestward topographic fall. The mine lease has existing elevations from about 109 m AMSL to –76 m AMSL, with the negative level representing existing excavation. These values demonstrate that mine-pit geometry is substantially below surrounding terrain and therefore must be separated analytically from the natural pre-mining surface when interpreting catchment behaviour.

The drainage analysis identifies a dendritic network with 1st- to 4th-order streams and connected tributary systems. The source hydrogeological report identifies the Dudhsagar/Khandepar system as the critical northern water body and also lists Kale Nala, Udnai Nala, Panduranga Nala, Ragada Nala, Jamboli Nala, the Sanguem/Zuari system and Paroda River.

The watershed is therefore best understood as a ridge-to-valley system: high-elevation forested source areas regulate runoff; intermediate slopes concentrate flow; disturbed mine surfaces can increase runoff and sediment; and the Khandepar river corridor is the critical receiving and safety-sensitive reach.

5. Catchment and Watershed Delineation

The watershed boundary shall be derived from a hydrologically corrected high-resolution DEM using flow direction, flow accumulation and stream extraction. The project drone DTM/DSM and DGPS lease survey should be used to replace coarse regional elevation data wherever the mine boundary, river bank, floodplain, drainage outlets and pit geometry control decisions.

- a. Delineate the regional watershed contributing to the Khandepar/Dudhsagar reach adjoining the mine.
- b. Delineate sub-catchments draining directly toward the northern river-facing side and those draining toward other nalas.
- c. Separate clean catchments from mine-affected catchments.
- d. Identify ridge lines, valley lines, natural drainage crossings and local depressions.

- e. Generate slope classes and flow-length maps to identify rapid runoff zones.
- f. Overlay LULC, geology, soil, drainage density and mining disturbance.
- g. Map all existing water bodies, mine sumps, ponds, seasonal channels and riparian areas.
- h. Create a common GIS geodatabase to be used by the CAT, River Ingress and Mine Water Management plans.

The watershed map should be maintained as a living operational layer. Any future change in pit limits, waste-dump footprint, haul-road alignment, plant drainage or reclamation should trigger a drainage-connectivity review.

6. Water Balance and Hydrological Response

The hydrogeological report uses an average annual rainfall of 3,412.77 mm/year average annual rainfall reported in the supplied hydrogeological report. At the mine scale, rainfall falling on the pit can become a direct water-management quantity, whereas rainfall over forested catchments has different interception, infiltration and runoff characteristics. The watershed plan should therefore avoid applying a single runoff coefficient to the entire 10-km area.

Water-balance component	Codli-specific treatment
Rainfall	Use authenticated IMD/WRD rainfall series, including event rainfall and intensity-duration characteristics.
Interception/infiltration	Differentiate forest, agriculture, laterite, exposed mine surfaces and compacted roads.
Surface runoff	Route through DEM-derived drainage and project drains; identify direct-to-river pathways.
Groundwater recharge	Use observed water-level fluctuation, soil/aquifer properties and GEC methodology; retain uncertainty.
Mine seepage	approximately 736 m ³ /day model-calculated groundwater seepage reported by the numerical model; separate regional and river-derived components.
Pit rainfall accumulation	Use pit geometry and event rainfall; do not confuse annual rainfall volume with dewaterable water.
Sediment	Estimate source-to-sink sediment delivery and prioritise treatment before natural drainage entry.
Discharge/reuse	Maximise internal reuse and ensure any discharge complies with statutory water-quality requirements.

The supplied hydrogeological report reports combined Year-2 seepage and rainfall water availability of about 2,296 m³/day. This is a mine-water planning quantity, not evidence of river ingress. The watershed plan must preserve this distinction and require water-quality and hydraulic monitoring at all discharge points.

7. Watershed Conservation and Management Measures

The watershed-management measures for Block-XII shall be based on the principle that mining-related interventions must be integrated with the existing natural drainage and ecological system rather than being implemented as isolated measures within the mining lease. The predominantly forested character of the surrounding catchment provides an important natural mechanism for rainfall interception, infiltration, soil protection and regulation of runoff. These natural functions should be retained wherever practicable, while areas disturbed by mining should be progressively stabilised and brought back into a controlled hydrological condition.

The proposed management strategy shall follow a **ridge-to-valley approach**, beginning with conservation and treatment of upper catchment areas and progressing through slope and drainage management to sediment interception and protection of the receiving **Khandepar River**. Particular attention shall be given to maintaining the existing nala network and preventing mining-related drainage from creating new or uncontrolled flow paths.

The measures proposed below are intended to function as an integrated system. Clean catchment runoff should be kept separate from mine-affected water wherever practicable; runoff from disturbed areas should be collected, conveyed and treated in a controlled manner; sediment should be intercepted before reaching natural drainage channels; and concentrated discharge should be released only through adequately protected outlets. All structural measures should be based on site-specific hydrological, hydraulic and geotechnical calculations rather than standard dimensions adopted without verification.

- a. Conserve intact forest/open-jungle areas, particularly on upper slopes and recharge-sensitive terrain.
- b. Apply ridge-to-valley treatment: source conservation, contour measures, slope stabilisation, drainage control and sediment interception.
- c. Maintain natural nala alignments and avoid unnecessary channelisation.
- d. Provide clean-water diversion drains around disturbed mine areas.
- e. Use garland drains to intercept upslope runoff before it enters pits or waste areas.
- f. Provide sedimentation ponds, silt traps, check dams or gabion structures at hydraulically justified locations.
- g. Progressively reclaim exposed slopes with native vegetation and erosion-control systems.
- h. Protect riparian zones and avoid encroachment into the active river channel or flood conveyance area.
- i. Use controlled discharge outlets with energy dissipation where concentrated runoff is unavoidable.
- j. Integrate mine drainage, groundwater dewatering, CAT measures and river protection into one water-management plan.

8. Monitoring and Adaptive Management

The effectiveness of the Integrated Watershed Management Plan will depend not only on the implementation of physical and biological measures but also on their **continuous monitoring, performance evaluation and timely corrective action**. The hydrological behaviour of the Block-XII area is expected to vary substantially between pre-monsoon, monsoon and post-monsoon periods. Consequently,

monitoring shall be designed to identify changes in rainfall, river stage, groundwater levels, mine inflow, sediment transport, drainage performance and the condition of river-protection structures.

Particular importance shall be given to the **Khandepar River–groundwater–mine interface**, since changes in river stage or groundwater head may provide an early indication of altered hydraulic connectivity or increased water-ingress risk. Similarly, monitoring of pit inflow should be compared with the anticipated design inflow and available pumping capacity so that abnormal increases can be identified at an early stage.

The monitoring programme shall operate on an **early-warning and adaptive-management principle**. Normal observations should establish baseline trends, while predefined trigger levels should initiate progressively stronger inspection, investigation or mitigation measures. Monitoring should include routine pre-monsoon inspections, intensified surveillance during the monsoon, event-based observations following high-intensity rainfall or major river-stage events, and post-monsoon assessment.

The following parameters should constitute the minimum monitoring framework for the watershed and mine-water management system:

Parameter	Minimum monitoring purpose	Trigger / response principle
Rainfall	Detect extreme monsoon events	Increase inspection and readiness when thresholds are reached.
River stage	Flood/HFL surveillance	Predefined warning/danger levels linked to DGMS response.
Piezometric head	Detect river–aquifer response	Investigate rapid changes or gradient reversal.
Pit inflow	Operational water safety	Compare against design and standby pumping capacity.
Turbidity/TSS	Sediment control	Inspect silt traps and treatment systems.
Embankment condition	Structural protection	Immediate inspection after major flood events.
Drain capacity	Runoff conveyance	Pre-monsoon cleaning and post-event inspection.
Groundwater quality	Detect mining influence	Trend analysis and corrective action.

9. ENGINEERING CONCLUSIONS

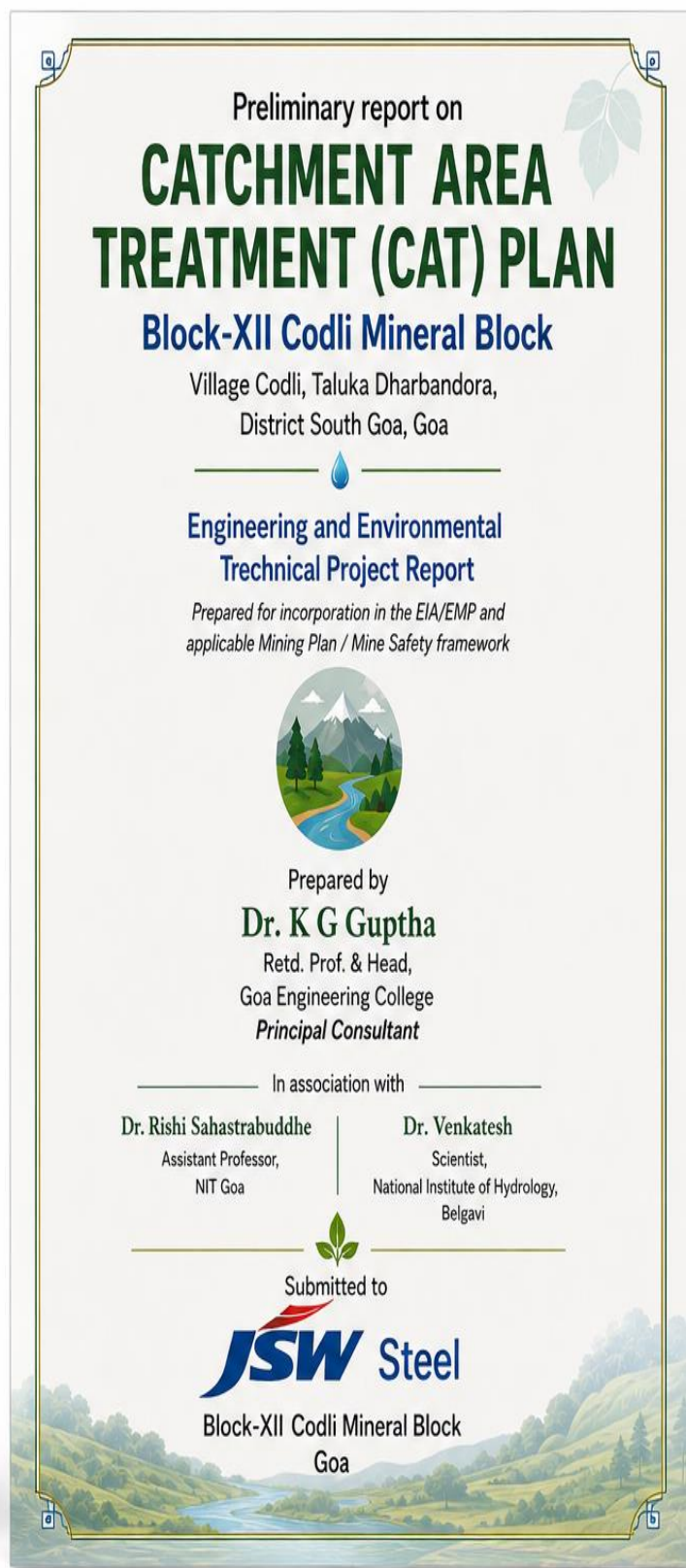
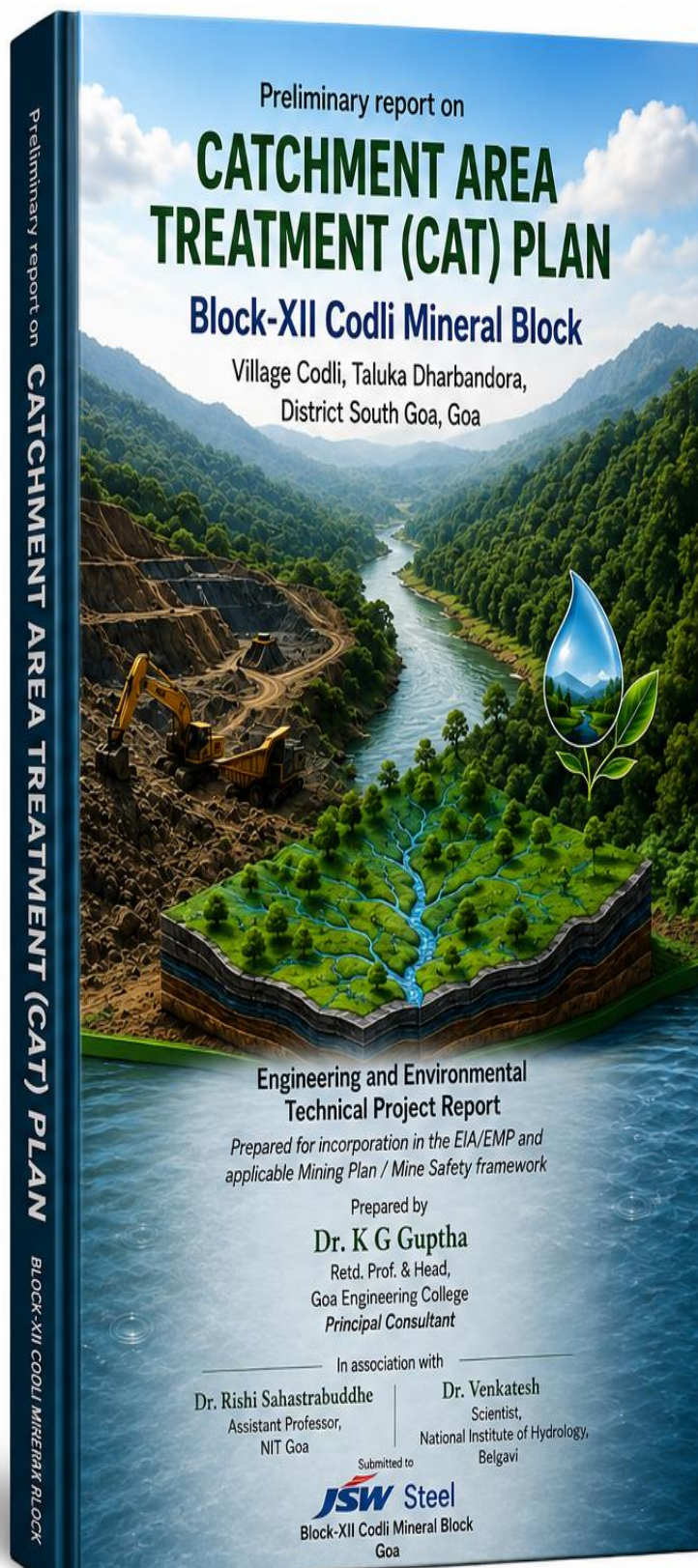
- a. The regional topography indicates a broad fall toward the southwest, while the mine contains deep existing/proposed excavations. This means local pit topography can dominate drainage behaviour even where the wider watershed slopes elsewhere.

- b. The Khandepar river system is immediately adjacent to the northern lease interface. The approximately 10 m separation makes the northern side a critical hydraulic boundary, but distance alone cannot establish river ingress or its absence.
- c. The lateritic shallow aquifer is relatively permeable, while the deeper phyllitic/manganiferous clay system is much less permeable. The latter can act as an aquitard, but fractures, joints, weathered zones or riverbed permeability can provide preferential pathways.
- d. The supplied groundwater model predicts approximately 736 m³/day seepage and a Radius of Influence within the lease under the modelled conditions. This supports a localized regional-groundwater interpretation, but it does not quantify the river-derived fraction of pit inflow.
- e. The supplied documents contain inconsistent descriptions of regional groundwater-flow direction. This is a material technical deficiency. The final watershed and river-ingress conclusions should not rely on either directional statement until the common datum and piezometric network are reconciled.
- f. The most defensible present conclusion is therefore: direct surface-water ingress is not demonstrated by the supplied data, but river-connected groundwater ingress remains a credible mechanism requiring field verification, HFL/flood modelling and local MODFLOW refinement.
- g. Watershed management should be designed to reduce peak runoff, erosion and sediment delivery while preserving natural drainage. It must not create artificial drainage pathways toward the mine or the river.

The river-facing embankment will be designed only after WRD-authenticated HFL and surveyed geometry are available; the ToR requirement of 3 m above HFL is a controlling project criterion. Further studies and interpretation would establish the necessary watershed management plan.

References and Source Documents

1. Preliminary Project Report on Integrated Watershed Management Plan, Block-XII Codli Mineral Block, supplied project document.
2. Comprehensive Hydrogeological Report along with Groundwater Modelling Report, Block-XII Codli Mineral Block, dated 09.07.2026.
3. Detailed Scope of Work for Integrated Watershed Management Plan, River Ingress Study and Catchment Area Treatment (CAT) Plan for Block-XII Codli Mineral Block.
4. Specific Terms of Reference issued by MoEF&CC for the Codli project, including ToR Points 1.4, 1.19 and 1.47.
5. BIS IS 19744:2026 – Preparation of Catchment Area Treatment (CAT) Plan — Guidelines.
6. Environment (Protection) Act, 1986; EIA Notification, 2006 and applicable amendments/Standard ToR.
7. Water (Prevention and Control of Pollution) Act, 1974 and applicable rules/requirements.
8. DGMS Technical Circular No. 2 of 2024 – Precautions against danger of inundation in mines.
9. Metalliferous Mines Regulations, 1961, including provisions concerning danger from inundation/water.
10. CGWB National Compilation on Dynamic Ground Water Resources of India, 2024 and Goa/Dharbandora assessment material.
11. Government of Goa / Goa State Pollution Control Board material on the Khandepar River, including the River Rejuvenation Action Plan.
12. BIS IS 1498:1970; IS 7894:1975; IS 14680:2024; IS 14961:2024; IS 1893 series and other applicable current standards.
13. Relevant CWC/WRD hydrological and flood-estimation guidance and authenticated records to be obtained during final design.



Executive Summary

This revised Catchment Area Treatment Plan is prepared specifically for Block–XII Codli Mineral Block and is intended to replace a generic or document-compilation approach with a lease-specific, source-to-sink watershed management framework. The principal environmental sensitivity is the northern interface of the mining lease with the Khandepar/Khandepar river system, reported at approximately 10 m from the lease boundary at the closest point. The project proposes fully mechanized opencast iron-ore mining at 3.50 million tonnes per annum, with 8.21 million tonnes per annum of overburden/waste and total excavation of 11.71 million tonnes per annum.

A critical project-specific finding is that no natural stream, nallah or perennial drainage has been reported within the mining lease itself. Consequently, the CAT objective is not to 'treat streams inside the lease' but to prevent mine-generated runoff, eroded soil, overburden and suspended solids from entering the natural drainage network and ultimately affecting the Khandepar/Khandepar river system and other identified water bodies in the 10-km study area.

The plan adopts IS 19744:2026 as the principal CAT planning framework, with GIS-based catchment delineation, erosion-intensity mapping, Silt Yield Index (SYI) based prioritisation, source control, biological stabilisation, engineered drainage and sediment interception, and performance-based monitoring. The CAT system shall be integrated with the Environmental Clearance conditions, forest-diversion requirements, State Water Resources Department requirements, Directorate of Mines & Geology (Goa) requirements and DGMS mine-water/inundation safety requirements.

1. General Description of the Project Area

Block–XII Codli Mineral Block is located at Codli Village in Dharbandora Taluka, South Goa, Goa. The auctioned mining block covers 377.0881 ha. The land composition reported for the lease comprises approximately 236.3482 ha Government Revenue Land, 58.9087 ha private land, 15.8626 ha Alvara land and 65.9686 ha forest land. The proposed project is a fully mechanized opencast iron-ore mine.

The proposed production is 3.50 MTPA of iron ore. The associated overburden/waste generation is approximately 8.21 MTPA, giving total excavation of approximately 11.71 MTPA. The project configuration includes primary and secondary crushing and dry and wet beneficiation facilities. These activities create different runoff and sediment source classes and therefore require differentiated CAT measures rather than one uniform treatment package.

The 10-km study area is approximately 40,164.16 ha. The baseline land-cover assessment indicates a predominantly natural/semi-natural landscape, with forest/open jungle forming approximately 76.36% of the study area. Agriculture, scrub/wasteland, settlement and mine infrastructure, surface-water bodies/mine sumps, roads, plantations, mangroves, industries and railway infrastructure form the remaining land-cover classes.

Parameter	Codli-specific description
Mining block	Block–XII Codli Mineral Block
Location	Codli Village, Dharbandora Taluka, South Goa, Goa
Lease / auctioned area	377.0881 ha
Project type	Fully mechanized opencast iron-ore mine
Iron-ore production	3.50 million tonnes per annum
OB / waste	8.21 million tonnes per annum
Total excavation	11.71 million tonnes per annum
Closest major natural water interface	Khandepar/Khandepar river system, approximately 10 m from the northern lease boundary at the closest reported location
Annual rainfall	Approximately 3,412.77 mm/year as reported for the project study area
Modelled groundwater seepage	Approximately 736 m ³ /day
Groundwater assessment category	Study-area assessment reported as Safe
Topographic character	Dissected ridge-and-valley terrain; mine workings form a local topographic depression relative to surrounding ground
Natural drainage within lease	No natural stream, nallah or natural drainage reported within the mine lease

The absence of a natural drainage channel inside the lease is a major design constraint. Mine drainage must therefore be treated as an artificial hydraulic system and shall not be allowed to establish uncontrolled connections with natural channels. The northern river interface must be considered simultaneously as a sediment, flood-conveyance and groundwater interface.

2. Terms of Reference (ToR) Implications and Compliance Requirements

The project-specific ToR requires the CAT Plan to be integrated with watershed management, protection and conservation of water bodies, assessment of river/nallah impacts, evaluation of possible river ingress into the mine and an independently reviewed CAT programme. The following compliance matrix converts those requirements into Codli-specific deliverables.

ToR regulatory requirement	Codli-specific implication	Required CAT / design response
ToR 1.4 – Integrated watershed management	Protect and conserve water bodies in the lease and study area; integrate watershed, surface-water and groundwater considerations.	GIS catchment delineation; inventory of water bodies; source-to-sink sediment plan; WRD consultation; monitoring and implementation schedule.
ToR 1.4(A) – CAT Plan	Ecological and hydrological protection of Khandepar/Khandepar and control of mining-related erosion and sediment.	Micro-watershed prioritisation; biological treatment; engineered drainage; sediment-retention chain; river protection.

ToR 1.4(B) – River/nallah impacts	Mining, overburden handling, roads and beneficiation may increase runoff, TSS and hydrocarbon risk during intense monsoon rainfall.	Upstream/downstream water-quality monitoring; event-based inspections; source controls; controlled discharge only after treatment.
ToR 1.4(C) – River ingress	Northern lease boundary is close to the river system; pit excavation is below surrounding terrain.	Piezometric transects, river-stage monitoring, seepage accounting, hydraulic connectivity assessment and emergency mine-water controls.
ToR 1.4(D) – River-facing embankment	Any river-facing protection must not obstruct flood conveyance and must be tied to authenticated HFL and hydraulic design.	Surveyed cross-sections, authenticated HFL, design flood, scour assessment, geotechnical design and stone pitching/other protection where required.
ToR 1.19 – Northern-side ingress	Potential hydraulic connectivity between river and mine must be scientifically resolved.	Local groundwater model refinement, structural/geological mapping, synchronized river and piezometer monitoring and conservative trigger levels.
ToR 1.47 – Reputed institute	CAT quality assurance and multidisciplinary review are required.	Independent review of GIS prioritisation, hydraulic calculations, river-interface design and monitoring programme.
MoEF&CC / EIA framework	Mining projects of this scale require prior environmental clearance and compliance with stipulated EC conditions.	CAT measures shall be embedded in EIA/EMP commitments and implemented as enforceable environmental controls.
Forest / land-diversion framework	65.9686 ha forest land is reported within the lease.	No CAT work on forest land shall be executed outside approved land-use/diversion permissions; native restoration and compensatory measures shall follow the applicable forest approval conditions.
Water-resources regulation	River and natural drainage protection requires State WRD coordination.	No alteration of natural river channel, flood conveyance or drainage without WRD concurrence and authenticated hydraulic data.
DGMS mine-safety framework	Inundation and uncontrolled water entry are mine-safety hazards.	Mine-water system, rainfall/runoff, river-stage and groundwater triggers shall be incorporated into the statutory mine safety and emergency preparedness system.

3. Objectives and Treatment Philosophy

- Prevent mine-generated soil, overburden and sediment from entering natural drainage and the Khandepar river system.
- Maintain the natural hydrological function of the largely forested catchment surrounding Codli.

- c. Separate clean catchment runoff from mine-affected water wherever practicable.
- d. Reduce runoff velocity and erosive energy on mine slopes, dumps, roads, benches and exposed surfaces.
- e. Intercept sediment progressively at source, slope, drain, outlet and receiving-water interface.
- f. Progressively rehabilitate disturbed land rather than postponing erosion control until mine closure.
- g. Protect the northern river corridor without constricting natural flood conveyance.
- h. Integrate CAT, mine-water management, progressive reclamation and river-ingress risk management.
- i. Make every structural intervention measurable, GIS-referenced, hydraulically justified and maintainable.

The governing treatment sequence for Codli shall be: treat the source → slow runoff → control erosion → trap sediment → safely convey excess water → protect the receiving river. Engineering structures are not substitutes for source stabilisation and progressive rehabilitation; they are to be used where runoff energy, slope condition or sediment load exceeds the capacity of biological measures.

4. Area and Catchment Profile

The CAT planning domain shall comprise the mining lease and the hydrologically connected catchments that can receive runoff or sediment originating from the lease. The nominal 10-km study area is approximately 40,164.16 ha. The catchment contains a high proportion of intact forest/open jungle, which should be treated as a conservation asset rather than as an area available for compensatory structural works.

Land-cover class	Approx. area (ha)	Approx. share	CAT implication
Forest / open jungle	30,668.88	76.36%	Conserve; avoid disturbance; assisted natural regeneration only where degraded.
Agriculture	3,564.89	8.88%	Contour and vegetative measures where erosion risk is demonstrated.
Scrub / wasteland	1,271.74	3.17%	Targeted soil and moisture conservation and revegetation.
Settlement / mine infrastructure	1,243.38	3.09%	Storm-water separation and controlled discharge.
Surface-water bodies / mine sumps	1,033.77	2.57%	Protect storage, prevent sediment entry, maintain safe overflow.
Existing mine area	670.53	1.67%	Primary controllable sediment source; progressive reclamation.
Other classes	Balance	≈4.26%	Roads, plantations, mangroves, industries and railway require localised controls.

The CAT boundary shall ultimately be based on actual drainage divides rather than an arbitrary circular buffer. A 10-km study area is useful for environmental assessment and water-body inventory, but engineering CAT implementation shall follow hydrologic connectivity.

5. Methodology for CAT Planning

The CAT plan shall be prepared and periodically updated through the following reproducible workflow:

- Establish an authenticated base using DGPS/DGNSS survey, mine lease coordinates, current mine plan, Survey of India topographic information and current high-resolution satellite data.
- Develop a corrected DEM/DTM and derive flow direction, flow accumulation, stream order, slope, relief and drainage density.
- Delineate watersheds, sub-watersheds and micro-watersheds draining toward the Khandepar/Khandepar system and other identified receiving water bodies.
- Map mining disturbance: pits, benches, overburden dumps, stockpiles, haul roads, crusher/beneficiation areas, workshops and drainage outlets.
- Characterise soils and exposed mine materials for texture, permeability/infiltration, erodibility, depth and engineering behaviour.
- Compile authenticated rainfall and storm-event data and identify high-intensity rainfall periods relevant to design and inspection.
- Prepare erosion-intensity mapping units using slope, soil, land use/land cover, rainfall erosivity, drainage and mining disturbance.
- Calculate Silt Yield Index (SYI) and rank micro-watersheds using the methodology of IS 19744:2026.
- Assign treatment measures according to erosion severity, runoff concentration, sediment-delivery pathway and hydraulic energy.
- Hydraulically verify every drain, check structure, silt trap, outlet and river-facing protection measure.
- Prepare GIS-linked drawings, quantities, design notes, inspection schedules, maintenance requirements and monitoring indicators.
- Undertake multidisciplinary review with State WRD and a reputed independent institution before final statutory adoption and after major mine-plan changes.

IS 19744:2026 provides the framework for delineation, identification of degraded areas, prioritisation and treatment. It recognises GIS/remote sensing, field validation and Silt Yield Index-based sub-watershed prioritisation. For Codli, the SYI shall be calculated from actual GIS-derived mapping units and shall not be replaced by assumed priority labels.

6. Micro-Watershed Prioritization

The preliminary P1–P4 categories below are management classes for Codli. They are not final mapped boundaries. Final boundaries shall be generated from authenticated terrain, soil, LULC, drainage and mining-disturbance data and the SYI methodology of IS 19744:2026.

Priority	Codli-specific characteristic	trigger	/	Treatment requirement	Typical monitoring
P1 – Very High	Steep disturbed mine slopes; active gullies; dump toes; concentrated flow with direct/short sediment path to Khandepar/Khandepar or a			Immediate source stabilisation; lined/armoured drainage; gully control; silt retention; rapid revegetation; protected outlet.	Rain-event inspection; turbidity/TSS; structural condition;

	receiving nala.		sediment storage.
P2 – High	Moderately steep disturbed areas, exposed roads, dump surfaces and drainage concentration zones.	Contour measures; check/gabion structures; toe drains; slope protection; progressive vegetation.	Monthly monsoon inspection; pre/post-monsoon survey.
P3 – Moderate	Agricultural/scrub or partially disturbed catchments with moderate erosion/runoff potential.	Contour bunding/trenching; vegetative barriers; soil-moisture conservation; selective gully treatment.	Seasonal vegetation and erosion survey.
P4 – Low / Conservation	Intact forest and naturally stable terrain with low sediment-delivery potential.	Avoid disturbance; assisted natural regeneration only where necessary; conservation monitoring.	Annual ecological and drainage review.

For reference, IS 19744:2026 categorises sub-watersheds using SYI as Very High (>1300), High (1200–1299), Medium (1100–1199), Low (1000–1099) and Very Low (<1000). These thresholds shall be applied only after the Codli GIS dataset and mapping-unit calculations are completed.

7. Mine-Specific CAT Measures for Codli

Source / activity	Codli risk	Required treatment	Design / control requirement
Pit rim and mine slopes	Concentrated monsoon runoff, slope erosion and uncontrolled flow toward pit or external drainage.	Garland drains, catch drains, bench drains, controlled outlets and energy dissipation.	Design for authenticated design rainfall/runoff; no discharge toward unstable slopes or river without treatment.
Overburden / waste dumps	High sediment yield from exposed faces and dump toes.	Topsoil segregation; toe drains; contour drains; surface cover; benches; sediment traps; progressive revegetation.	Slope stability, drainage capacity, filter compatibility, scour and outlet protection.
Haul roads	Rill/gully erosion and sediment transport during intense rainfall.	Cross-drains, side drains, rolling dips where appropriate, silt traps and protected road outlets.	Maintain safe traffic geometry; prevent drainage discharge onto dump faces or natural channels without treatment.

Crusher / beneficiation areas	Fine sediment and process-water interaction.	Impervious/contained drainage where required; settling systems; reuse/recirculation; no untreated stormwater discharge.	Separate clean and contaminated water systems.
Stockpiles	Fine material mobilisation and sediment-laden runoff.	Perimeter drains, bunding, cover/stabilisation and silt interception.	Maintain freeboard and emergency overflow.
Lease boundary – northern interface	Very short hydraulic pathway to Khandepar/Khandepar system; flood and groundwater sensitivity.	Riparian buffer protection; sediment-control chain; river-stage and groundwater monitoring; no uncontrolled outlet.	Authenticated HFL, river cross-sections, scour and hydraulic assessment before permanent river-facing works.
Progressively rehabilitated areas	Bare soil during transition period.	Topsoil replacement, contour preparation, native grass/vegetation, mulch and biodegradable erosion mats where needed.	Vegetation establishment and erosion performance targets.

8. Biological and Ecological Treatment

Because forest/open jungle constitutes approximately 76.36% of the 10-km study area, the first biological CAT measure for Codli is conservation of existing vegetation. Plantation shall not be treated as a substitute for retaining intact natural forest. Biological treatment shall concentrate on mine-disturbed surfaces, degraded patches and locations where vegetation can reduce splash erosion, improve soil surface stability and trap sediment.

- Use locally appropriate native tree, shrub and grass species selected for lateritic/iron-ore-area soils and the high-rainfall Goa climate.
- Use assisted natural regeneration where rootstock and natural seed sources are present.
- Establish native grass cover on exposed dump slopes, road verges and drainage margins before the high-intensity monsoon period.
- Use contour vegetative strips and brush barriers only where they do not create ponding or destabilise slopes.
- Restore riparian vegetation in consultation with the State Forest Department and WRD, with no obstruction to flood conveyance.
- Use mulching, coir/jute or other biodegradable erosion-control mats where rapid surface stabilisation is necessary.
- Prohibit invasive or ecologically unsuitable species in riparian and natural-forest interfaces.
- Integrate biological treatment with progressive mine reclamation, topsoil management and slope geometry; do not rely on plantation alone to control high-energy runoff.

19. Engineering CAT Measures and Design Controls

Measure	Primary function	Codli design controls
Contour bund / trench	Reduce slope runoff velocity and promote infiltration.	Slope, soil permeability, storage, freeboard, overflow and safe outlet.
Gully plug	Arrest active or incipient gully erosion.	Peak flow, foundation, overtopping, downstream scour and accessibility.
Brushwood / loose-boulder check dam	Small-channel energy and sediment control.	Channel grade, stone size, keying, stability and maintenance.
Gabion check / grade-control structure	Robust channel grade and sediment control.	Foundation, scour, wire/stone durability, overflow, apron and end protection.
Silt trap / settling pond	Intercept mine-derived sediment before natural drainage.	Storage, settling, bypass, freeboard, emergency overflow, access for desilting.
Garland / diversion drain	Separate clean catchment water from mine-affected water.	Catchment area, rainfall intensity, hydraulic capacity, freeboard, lining and protected outlet.
Toe drain	Control seepage and protect dump/embankment toe.	Filter, hydraulic gradient, discharge capacity, clogging and outlet protection.
Protected outlet / energy dissipator	Prevent downstream erosion at concentrated discharge points.	Velocity, shear stress, energy dissipation, downstream channel stability.
River-facing protection	Protect lease-side interface without reducing flood conveyance.	Authenticated HFL, design flood, cross-sections, scour, geotechnical stability and WRD concurrence.

No structural CAT measure shall be constructed merely because a generic schedule recommends a check dam, bund or drain. Each structure shall have a defined hydraulic purpose, design catchment, design discharge, foundation condition, freeboard, downstream protection, access for inspection and maintenance, and a mapped outlet. Where a structure is intended to control water pressure or inrush risk within the mine, the statutory DGMS requirements for water-control structures and mine safety shall also apply.

10. Sediment Management Applicable to Water Bodies, Rivers and Nalas

The project baseline identifies eight principal water bodies within the 10-km study area. The hydrogeological baseline also reports no natural drainage within the mine lease, while the Khandepar River is adjacent to the northern boundary. Accordingly, the following inventory shall form the minimum receiving-water monitoring and sediment-management register. Distances are indicative baseline values measured from the project site/centre point as reported in the environmental baseline and shall be verified by the final GIS survey.

Sl. No.	Water body / drainage	Approx. distance & direction	Codli CAT relevance	Required control / monitoring
1	Khandepar River / Khandepar river system	Adjacent north; approx. 10 m from lease boundary at closest reported interface	Critical receiving water; direct sensitivity to mine runoff, sediment, flood conveyance and possible hydraulic/groundwater interaction.	Upstream/downstream TSS/turbidity, pH, EC, Fe and other EC-required parameters; river stage; event inspections; no untreated discharge; authenticated HFL and hydraulic study.
2	Kale Nala	Approx. 0.7 km ESE	Nearest listed nala after the northern river interface; potential regional sediment pathway depending on actual drainage connectivity.	GIS connectivity confirmation; baseline and monsoon TSS/turbidity; protect natural channel; intercept mine-derived sediment upstream of channel.
3	Udnai Nala	Approx. 1.5 km west	Potential receiving drainage within the wider catchment.	Confirm catchment connectivity; inspect after high rainfall; maintain sediment traps on connected mine-road pathways.
4	Panduranga Nala	Approx. 5.0 km SW	Regional downstream water body; relevant to cumulative watershed condition rather than direct lease discharge unless GIS confirms connectivity.	Annual catchment review; event-based water-quality checks where connectivity is demonstrated.
5	Ragada Nala	Approx. 7.0 km NNE	Regional drainage; potential cumulative sediment pathway.	GIS verification and periodic monitoring; no diversion or obstruction.
6	Sanguem / Zuvari River	Approx. 8.0 km south	Regional river system; useful as a wider catchment reference and background water-quality indicator.	Periodic water-quality comparison; maintain natural drainage and avoid project-related sediment contribution.
7	Jamboli Nala	Approx. 9.0 km NE	Regional receiving drainage; baseline sampling was undertaken.	Maintain baseline station and use seasonal/event-based comparison where hydrologically connected.
8	Paroda River	Approx. 9.0 km SSW	Regional river system; relevant to wider watershed monitoring.	Periodic reference monitoring and GIS connectivity review.

The principal sediment-management principle is source control. Sediment controls shall be placed upstream of natural channels wherever practicable. Sediment shall not be intentionally deposited in the active river or nala bed as a CAT measure. All silt traps and settling facilities shall have adequate storage, accessible desilting arrangements, safe bypass/emergency overflow and a documented disposal/reuse route for removed sediment.

The May 2025 surface-water baseline reported generally acceptable water-quality conditions for the sampled nearby water bodies, with reported pH values of 6.72–7.65, low BOD/COD, and generally low TSS. This baseline shall be treated as a reference condition; it shall not be interpreted as proof that future mine discharge will be compliant. Performance shall be demonstrated through upstream/downstream and event-based monitoring.

12. Monitoring, Maintenance and Institutional Governance

Parameter activity	Minimum frequency / trigger	Responsible function	Escalation / action
Mine and catchment drains	Pre-monsoon; monthly in monsoon; immediately after major rainfall	Mine civil + environment team	Clear blockage; repair erosion; verify outlet and freeboard.
Silt traps / check dams / settling ponds	Before monsoon and whenever 50–70% of effective storage is consumed	Mine water-management team	Desilt, repair, restore storage; document removed sediment.
Dump and slope condition	Monthly in monsoon; quarterly otherwise; after unusual rainfall	Mining + geotechnical/environment team	Stabilise cracks, rills, seepage or erosion before continued exposure.
Vegetation / rehabilitation	Monthly during establishment; quarterly after establishment	Environment + rehabilitation team	Replant failed areas; repair erosion before vegetation-only treatment is relied upon.
Khandepar/Khandepar water quality	At least monthly during critical periods; event-based after major discharge/rainfall	Environment laboratory / approved agency	Investigate upstream/downstream change; stop/contain abnormal mine discharge.
TSS / turbidity sediment trend	Routine and event-based	Environmental monitoring team	Trend analysis against baseline and upstream reference.
River stage / HFL-related observations	Continuous/automatic where practicable; manual verification during high flows	Hydrology + safety team with WRD coordination	Trigger flood/inundation response; protect mine and river conveyance.
Groundwater levels / piezometers	Monthly, with increased frequency in monsoon/high-risk periods	Hydrogeology team	Compare with model; investigate unexpected drawdown or hydraulic connection.
Micro-watershed GIS review	Annual and after major mine-plan/drainage changes	GIS/hydrology team	Re-rank priority areas and revise CAT measures.

Independent CAT performance audit	Annual pre-monsoon	Reputed multidisciplinary institution	Corrective-action register and closure tracking.
WRD coordination	At design stage, annual review and whenever river/flood works are proposed	Project proponent designated liaison	Obtain documented technical recommendations/concurrence where required.
DMG / Directorate of Mines & Geology compliance	As per lease, mining-plan and statutory inspection cycle	Mine management	Close observations and maintain statutory records.
DGMS inundation review	Before monsoon and after major flood/inundation event	Mine Manager / Safety Department	Update mine-water risk assessment and emergency controls.

12. Institutional and Legal Governance Framework

Authority / framework	Codli CAT responsibility
MoEF&CC / PARIVESH	Environmental Clearance, project-specific ToR and EC-condition compliance; review of EIA/EMP commitments and statutory environmental safeguards.
State Environment Impact Assessment / appraisal mechanism, as applicable	Appraisal and compliance oversight where jurisdiction applies to the project approval pathway.
Directorate of Mines & Geology, Government of Goa (DMG)	Mineral concession/lease administration, approved mining plan interface, production/excavation controls and State mining-law compliance.
Directorate General of Mines Safety (DGMS)	Mine safety, water/inundation risk, mine-water control, statutory safety provisions and review of structures affecting mine water/inrush risk.
Goa State Pollution Control Board	Consent and pollution-control requirements; surface-water/effluent monitoring and compliance reporting under applicable water-pollution law.
State Water Resources Department (WRD), Goa	Natural drainage, river/flood conveyance, HFL, cross-sections, river protection and any intervention affecting water resources.
Forest Department / competent forest authority	Protection/diversion conditions for forest land; ecological restoration and native vegetation measures within approved permissions.
Wildlife authorities / NBWL-related framework where applicable	Compliance with protected-area/ESZ requirements because protected areas and ESZs are reported within the wider study area.
BIS / IS 19744:2026	Principal technical framework for CAT delineation, erosion

	identification, SYI prioritisation, treatment selection and monitoring.
BIS soil / geotechnical / structural standards	Use applicable current IS standards for soil classification, geotechnical design, hydraulic/structural works and seismic considerations.
CWC / authenticated hydrological guidance	Hydrologic/flood-estimation methods and design-flood information where adopted by WRD/competent authority.

The Environment (Protection) Act, 1986 and EIA Notification, 2006 provide the overarching environmental-clearance framework. Water pollution and discharge controls shall comply with the Water (Prevention and Control of Pollution) Act, 1974 and applicable consent conditions. Forest diversion, where applicable, shall comply with the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 as amended and the applicable rules/guidelines. Mine-water and inundation controls shall be coordinated with DGMS requirements, including the DGMS Technical Circular No. 2 of 2024 on precautions against danger of inundation in mines and applicable Metalliferous Mines Regulations.

The final design package should reference the current editions of applicable Indian Standards, including IS 19744:2026 for CAT planning and other relevant IS codes for soil classification, hydraulic structures, geotechnical works, seismic considerations and material durability. Where an IS code is cited for a design calculation, the exact edition and clause used shall be stated on the calculation sheet.

13. Design Controls and Non-Negotiable Conditions for Codli

- No CAT structure shall block, divert or artificially connect a natural drainage channel without documented hydraulic justification and competent-authority approval.
- No mine runoff containing significant suspended solids shall be allowed to discharge untreated into the Khandepar/Khandepar river system or any natural nala.
- The northern river interface shall be treated as a combined flood, sediment and groundwater-control zone.
- The 3 m crest-above-HFL requirement identified in the project-specific ToR shall not be translated into construction dimensions until the HFL is authenticated by the competent authority and the river cross-sections and hydraulic calculations are completed.
- No final conclusion of 'no river ingress' shall be adopted until the differing groundwater-gradient interpretations are reconciled through a common datum, synchronized observations and locally refined modelling.
- All sediment-retention structures shall be designed for access, desilting, safe overflow and failure consequences.
- Progressive reclamation shall be scheduled ahead of the monsoon wherever exposed surfaces can be stabilised.
- CAT implementation drawings shall carry coordinates, chainage/reference, catchment area, design discharge, dimensions, material specification, foundation requirements, outlet details and maintenance responsibility.
- Every annual CAT review shall identify structures that have failed, sediment-storage capacity consumed, vegetation establishment achieved and corrective works completed.

15. Conclusions Specific to Block–XII Codli

- a. Codli has a high inherent catchment-resilience component because approximately 76.36% of the 10-km study area is forest/open jungle. The first priority is therefore conservation of intact forest and natural drainage, not compensatory construction.
- b. The principal direct receiving-water sensitivity is the Khandepar/Khandepar river system immediately north of the lease. The reported minimum separation of approximately 10 m makes this a high-consequence interface requiring a higher level of hydraulic and geotechnical control than ordinary internal mine drains.
- c. No natural stream, nallah or natural drainage is reported within the mining lease. The mine drainage network must therefore remain an engineered, controlled system and must not be allowed to create new uncontrolled drainage pathways.
- d. The proposed 3.50 MTPA iron-ore production and 8.21 MTPA overburden/waste generation create substantial potential sediment sources at dumps, exposed mine surfaces, haul roads, stockpiles and processing areas. Source stabilisation must therefore be the dominant CAT principle.
- e. The eight identified water bodies in the 10-km study area shall be maintained in the CAT water-body register, but treatment priorities shall be governed by actual hydrologic connectivity rather than radial distance alone.
- f. The CAT plan shall use IS 19744:2026, including GIS-based delineation and SYI prioritisation. Final P1–P4 micro-watershed boundaries shall not be declared until the required field-validated GIS analysis is complete.
- g. The northern river interface cannot be addressed by sediment control alone. Flood conveyance, authenticated HFL, scour, groundwater connectivity and mine inundation safety must be integrated into the design.
- h. All river-facing and water-control structures must be reviewed against WRD requirements and DGMS mine-safety requirements in addition to the environmental-clearance framework.
- i. The CAT Plan shall be treated as a living management system. Its performance shall be judged by reduced sediment delivery, controlled runoff, preserved natural drainage, successful progressive vegetation and absence of adverse hydraulic effects on the Khandepar/Khandepar river corridor—not by the number of check dams or plantations installed.
- j. Before statutory finalisation, the project proponent shall close the identified design data gaps: authenticated HFL, surveyed river cross-sections, design flood discharge, detailed scour depth, final embankment geotechnical parameters, verified drainage connectivity and a reconciled river-groundwater interaction model.

16. Applicable Legal, Regulatory and Technical References

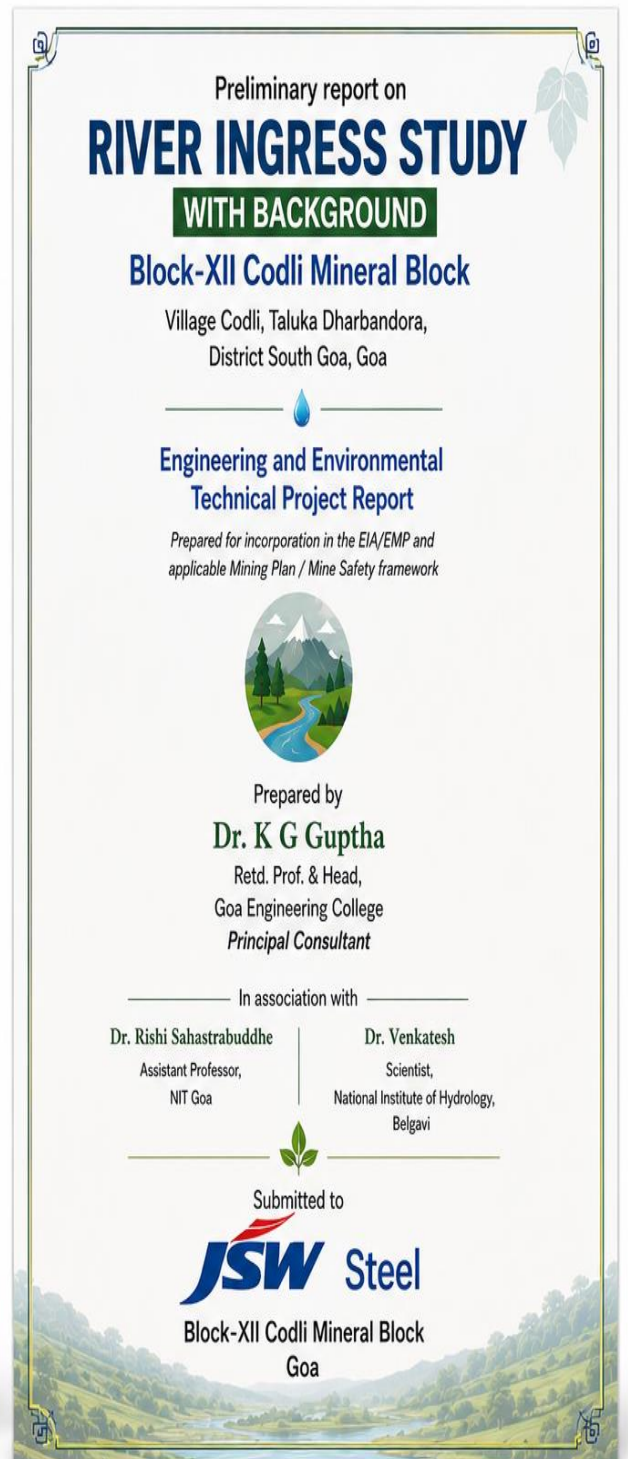
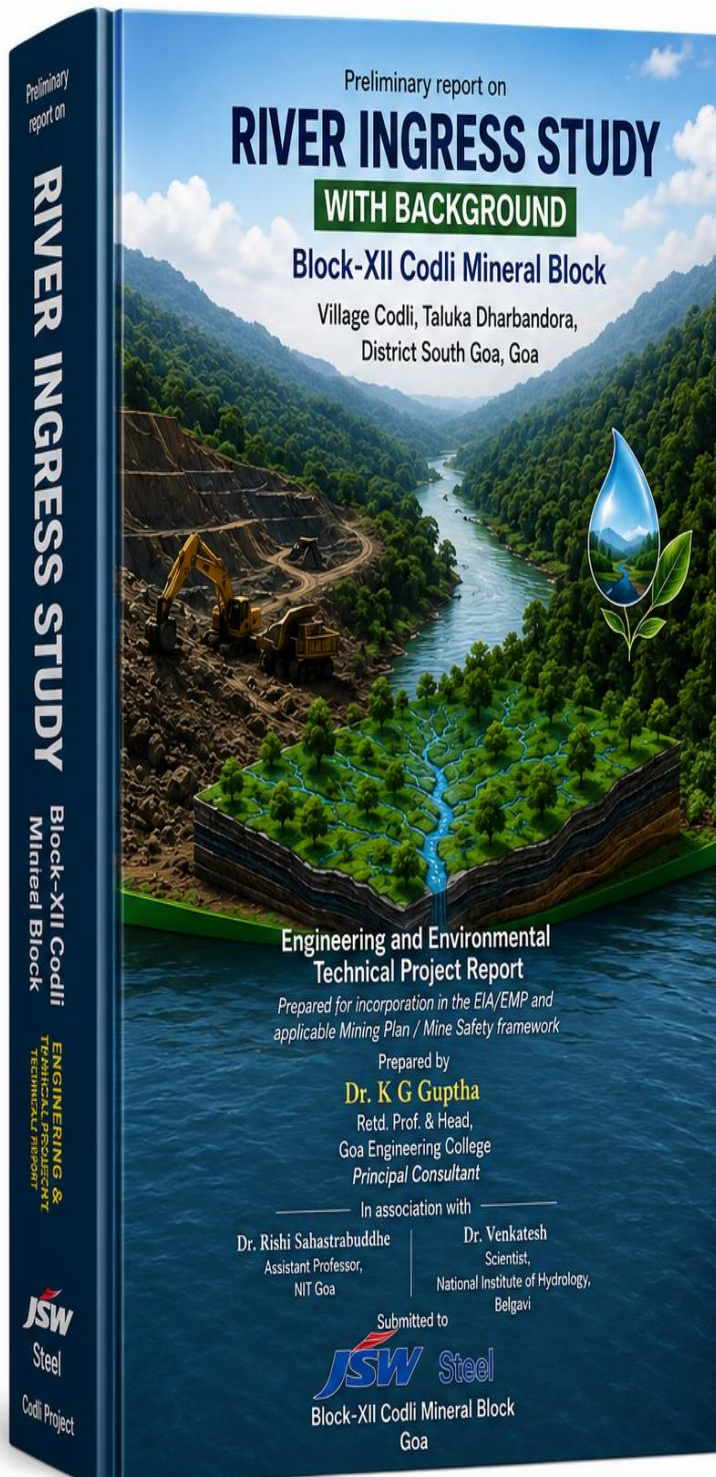
- a. Environment (Protection) Act, 1986 and applicable rules/notifications.
- b. Environment Impact Assessment Notification, 2006 (S.O. 1533(E), 14 September 2006) and applicable amendments/circulars/standard ToR.
- c. Project-specific MoEF&CC Terms of Reference for Block–XII Codli Mineral Block, including the watershed/CAT, river/nallah impact, river-ingress and independent-review requirements.
- d. Water (Prevention and Control of Pollution) Act, 1974 and applicable rules, standards and consent conditions.

- e. Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 as amended, and applicable rules/guidelines for forest diversion.
- f. Wild Life (Protection) Act, 1972 and applicable Eco-Sensitive Zone / protected-area requirements, where applicable to project activities.
- g. Mines Act / occupational mine-safety framework and applicable DGMS legislation.
- h. Metalliferous Mines Regulations, 1961, as applicable to the mine and subject to the prevailing statutory framework.
- i. DGMS Technical Circular No. 2 of 2024 – Precautions against danger of inundation in mines.
- j. BIS IS 19744:2026 – Preparation of Catchment Area Treatment (CAT) Plan — Guidelines.
- k. Applicable current BIS standards for soil classification, geotechnical investigation/design, hydraulic structures, drainage, erosion control and seismic design, including relevant provisions of IS 1498, IS 7894, IS 14680, IS 14961 and IS 1893 series as appropriate to the specific design.
- l. Relevant CWC and State WRD hydrological/flood-estimation guidance and authenticated river records.
- m. Applicable Goa mining, environmental, forest and water-resource orders, lease conditions and statutory directions issued by competent authorities.

16. Engineering Qualification and Data-Closure Note

This CAT Plan is a project-specific planning and management framework. It deliberately does not invent design flood discharge, authenticated HFL, river cross-section geometry, detailed scour depth, final dump geotechnical parameters or a quantified river-derived component of pit inflow where those values require field survey or competent-authority records. Those parameters shall be inserted into the final construction drawings and design calculations after validation by the competent technical authority.

The revised report removes the earlier 'supplied project documents/source-control' presentation from the report body. The report is intentionally written as a standalone Codli CAT Plan, while the project baseline information, statutory ToR requirements and technical standards have been incorporated into the relevant subject headings.



1. General Description of the Codli Project Area

This section establishes the physical, mining and environmental setting before examining river ingress. The purpose is to ensure that the ingress assessment is interpreted in relation to the actual Codli lease, its excavation geometry, the northern river interface and the surrounding catchment rather than as a generic mine-water study.

Block–XII Codli Mineral Block is located at Codli Village, Dharbandora Taluka, South Goa, Goa. The auctioned mining block covers 377.0881 ha and is proposed as a fully mechanized opencast iron-ore mine. The project proposal comprises 3.50 million tonnes per annum of iron ore production, approximately 8.21 million tonnes per annum of overburden/waste generation and approximately 11.71 million tonnes per annum of total excavation. The processing configuration includes crushing and dry/wet beneficiation facilities.

The project lies in a hilly and dissected terrain within the wider Western Ghats-influenced landscape. The 10-km study area is approximately 40,164.16 ha and is predominantly natural or semi-natural. Forest/open jungle accounts for approximately 76.36% of the study area. This means that the mine must be considered as a discrete hydraulic disturbance within a much larger natural drainage and groundwater system.

The critical feature for this River Ingress Study is the northern boundary, where the Khandepar/Dudhsagar river system is reported to be approximately 10 m from the lease boundary at the closest point. The mine is progressively excavated to elevations substantially below the surrounding ground surface. The combination of a nearby river and deep opencast excavation makes the northern interface a high-consequence external-water risk zone requiring independent hydraulic, hydrogeological, geotechnical and mine-safety verification.

2. Codli Mining Lease and River Interface Profile

The following profile identifies the parameters that directly control river-ingress risk at Codli. These parameters are not merely descriptive; they determine the hydraulic head difference, possible flow pathways, flood exposure and consequences of an uncontrolled water connection.

Parameter	Codli-specific condition
Mining block	Block–XII Codli Mineral Block
Location	Codli Village, Dharbandora Taluka, South Goa, Goa
Lease / auctioned area	377.0881 ha
Land composition	236.3482 ha Government Revenue Land; 58.9087 ha Private Land; 15.8626 ha Alvara Land; 65.9686 ha Forest Land
Mining method	Fully mechanized opencast iron-ore mining
Iron-ore production	3.50 MTPA
OB / waste	8.21 MTPA
Total excavation	11.71 MTPA
Annual rainfall	Approximately 3,412.77 mm/year
Closest river interface	Khandepar / Dudhsagar river system, approximately 10 m from the northern lease boundary at the closest reported interface
Modelled groundwater seepage	Approximately 736 m ³ /day
Applied dewatering quantity in hydrogeological assessment	Approximately 2,296 m ³ /day, comprising modelled seepage plus rainfall accumulation

Modelled maximum drawdown	Approximately 2.60 m (2025), 2.51 m (2028), and 1.72 m (2035), under the stated model assumptions
Existing mine topographic range	Approximately 109 m AMSL to –76 m AMSL; the negative elevation represents the existing excavated pit rather than original natural ground
Regional land cover	Forest/open jungle approximately 76.36% of the 10-km study area
Seismic setting reported in project baseline	Zone III in the project baseline; final structural design shall use the current applicable seismic standard and project-specific design parameters

The reported 10-m separation is a screening-level critical distance and shall not be treated as a hydraulic separation distance. Hydraulic connectivity depends on river stage, riverbed elevation and permeability, bank/floodplain geometry, groundwater head, geological structures and the final pit geometry. A 10-m horizontal distance alone cannot establish either the presence or absence of river ingress.

3. Regulatory, Statutory and ToR Framework

River ingress at Codli has dual significance: it is an environmental and water-resource issue and, simultaneously, a mine-safety and inundation issue. The assessment must therefore satisfy the environmental-clearance framework, water-resource requirements, mining regulations, DGMS safety directions and applicable Indian Standards. The following framework is to govern investigation, design, operation and monitoring.

Authority / instrument	Codli-specific implication
MoEF&CC / EIA Notification, 2006	The 377.0881-ha mining project falls within the environmental-clearance framework for mining. River, groundwater, drainage, ecological and cumulative impacts must be addressed through the EIA/EMP and stipulated EC conditions.
Project-specific MoEF&CC ToR – Point 1.4	Requires integrated watershed management and protection/conservation of water bodies, with appropriate technical assessment and coordination with the competent water-resource authority.
ToR 1.4(B)	Requires assessment of impacts on rivers/nalas and associated hydrological, hydrogeological and aquatic conditions.
ToR 1.4(C)	Requires determination of the likelihood and magnitude of river-water ingress into the mine and appropriate prevention/mitigation.
ToR 1.4(D)	Requires river-facing stone-pitched protection with crest 3 m above the authenticated HFL; the HFL must therefore be an authenticated engineering datum.
ToR 1.19	Requires a specific scientific study of possible water ingress from the northern river side; this report addresses that requirement through a river-to-mine investigation framework.
ToR 1.47	Requires CAT work/technical review by a reputed institution; the river-ingress findings should be independently reviewed as part of multidisciplinary assurance.

Directorate of Mines & Geology, Goa	Mining lease, approved mining plan, mine geometry, production/excavation controls and statutory mineral-development requirements.
DGMS	Mine-water/inundation risk, water barriers/protection, warning and withdrawal procedures, emergency preparedness and safe operation of the opencast mine.
State Water Resources Department, Goa	Authentication of HFL, river cross-sections, flood records and review of any work affecting river channel, flood conveyance or river protection.
Goa State Pollution Control Board	Water-quality, discharge and pollution-control requirements under applicable consent and water-pollution legislation.
Forest authorities	Compliance with forest-land diversion/approval conditions for the reported 65.9686 ha forest component and protection of natural drainage/vegetation within approved permissions.
BIS IS 19744:2026	Technical framework for CAT planning; relevant to watershed protection and sediment/runoff controls associated with the river interface.
Applicable BIS geotechnical/hydraulic/seismic standards	Use current applicable editions for soil classification, embankment/slope stability, drainage, hydraulic works, erosion protection and seismic design.

The Environment (Protection) Act, 1986 provides the overarching environmental statutory framework, while the EIA Notification, 2006 establishes prior environmental-clearance requirements for scheduled projects. The Mines Act framework expressly provides for precautions against irruption or inrush of water into mine workings. DGMS Technical Circular No. 2 of 2024 specifically addresses precautions against danger of inundation in mines. These requirements shall be incorporated into the Codli mine-water and emergency-management system.

The current BIS publication record confirms IS 19744:2026 as the guideline for Preparation of Catchment Area Treatment (CAT) Plan. It shall be used for CAT-related watershed treatment, while river-ingress design shall additionally rely on current applicable hydraulic, geotechnical and structural standards.

4. Purpose, Scope and Objectives of the River Ingress Study

The purpose of this section is to define exactly what the Codli study must prove or disprove. The study is not intended merely to state that the river is nearby or that groundwater modelling predicts a limited radius of influence. It must establish whether a credible hydraulic pathway exists under present, monsoon, ultimate-pit and adverse structural conditions.

- Determine whether direct hydraulic connectivity exists between the Khandepar/Dudhsagar river system and the Codli mine excavation.
- Determine whether river water can reach the mine indirectly through the shallow lateritic aquifer or deeper fractured/weathered formations.
- Identify faults, joints, fractures, shear zones, weathered corridors or permeable contacts that could create preferential pathways.
- Establish the natural hydraulic gradient between river, groundwater system and mine excavation using a common vertical datum.

- e. Determine whether mine dewatering can reverse, strengthen or otherwise modify the natural river-to-mine or mine-to-river hydraulic gradient.
- f. Separate total mine inflow, as far as technically practicable, into regional groundwater, rainfall/runoff accumulation and any river-connected component.
- g. Assess river stage, monsoon recharge, authenticated HFL, progressive mine depth, ultimate pit condition and combined worst-case conditions.
- h. Provide the hydraulic and geotechnical basis for the river-facing protection and associated drainage/seepage-control system.
- i. Establish measurable monitoring thresholds, warning levels, danger levels and emergency actions compatible with DGMS requirements.
- j. Provide a defensible final risk classification rather than an unsupported categorical 'no river ingress' statement.

5. General Hydrogeological, Geological and Geomorphological Setting

River ingress is controlled by the interaction between surface-water hydraulics and the geological/hydrogeological framework. The Codli setting comprises a shallow weathered/lateritic system over deeper phyllitic, manganiferous and fractured formations; consequently, the assessment must distinguish matrix permeability from structural permeability.

The Codli mineral block belongs to the Bicholim Group of the Dharwar Supergroup. The local mineralised sequence includes lateritic cover, iron ore, phyllitic and manganiferous clay horizons and altered intrusive/weathered zones. Existing mining has exposed the ore-bearing formations and created deep excavated voids. The geological setting therefore contains both low-permeability clay-rich horizons and potentially permeable weathered/fractured pathways.

Two principal groundwater systems are recognised in the project hydrogeological assessment: Aquifer-I, a shallow unconfined weathered/lateritic system with an average lateritic thickness of approximately 20 m; and Aquifer-II, a deeper fractured/weathered system associated with metasedimentary and phyllitic formations. The lateritic aquifer is comparatively permeable, while the clay-rich phyllitic/manganiferous horizons act as a relative aquitard. However, the presence of fractures, joints and weathered corridors means that lithology alone cannot eliminate the possibility of local hydraulic connectivity.

The wider terrain is undulating to hilly and structurally controlled, with drainage generally following topographic gradients. The 10-km study area contains the Dudhsagar/Khandepar system and several tributary nalas. For river-ingress purposes, the northern river-facing reach is the controlling interface; the other drainage features are relevant primarily for regional groundwater and flood context unless detailed GIS/hydraulic connectivity demonstrates a direct pathway to the mine.

Water body / drainage	Approximate location from mine	reported	Relevance to river-ingress assessment
Dudhsagar / Khandepar River system	Adjacent	north; approximately 10 m from lease boundary at closest interface	Primary external-water risk zone; requires river stage, HFL, floodplain, riverbed and groundwater connectivity assessment.
Kale Nala	~0.7 km ESE		Regional drainage; assess only for hydraulic connectivity to the mine and cumulative drainage effects.
Udnai Nala	~1.5 km west		Regional drainage; relevant to catchment and

		surface-water interaction.
Panduranga Nala	~5.0 km SW	Regional receiving drainage; cumulative watershed context.
Ragada Nala	~7.0 km NNE	Regional drainage; relevant where GIS connectivity is established.
Sanguem / Zuari River	~8.0 km south	Regional river system; wider groundwater/drainage context.
Jamboli Nala	~9.0 km NE	Regional drainage; background/cumulative context.
Paroda River	~9.0 km SSW	Regional river system; wider catchment context.

6. Existing Evidence and Critical Review of Groundwater Modelling

The existing groundwater model is useful for understanding regional behaviour and estimating mine-water demand, but its limitations are particularly important at Codli because the critical river–lease separation is only about 10 m. A regional model result must not be treated as proof of local hydraulic disconnection.

Evidence parameter	/	Reported condition	Codli engineering interpretation
Modelled seepage	pit	≈736 m ³ /day	Represents modelled groundwater inflow under stated assumptions; it is not equivalent to river-derived inflow.
Calibration		RMSE ≈1.52 m; NRMSE ≈7.24%; correlation ≈0.99	Indicates useful regional calibration, but does not by itself resolve a 10-m river–mine interface.
Modelled drawdown		≈2.60 m (2025); ≈2.51 m (2028); ≈1.72 m (2035)	Modelled drawdown is localized under model assumptions; local verification is required.
Radius of influence	of	Reported within mine lease	Supports limited regional influence in the model, but cannot exclude a narrow preferential pathway.
River representation		River package; river stage assumed 1 m below bank and riverbed 4 m below stage	These are controlling assumptions and require field verification.
Grid resolution		250 m × 250 m	Suitable for regional behaviour but too coarse by itself to prove absence of a local fracture/weathered corridor between river and mine.
Optimized K		Aquifer-I ≈6 m/day; Aquifer-II ≈0.2 m/day	Local values near the northern interface require verification.

The most important technical limitation is spatial scale. A 250 m grid cell may represent regional groundwater behaviour but cannot resolve a narrow fracture, weathered corridor, permeable contact or riverbed segment between a river and a mine boundary separated by approximately 10 m. The regional model should therefore be retained as the framework and locally refined/nested at the northern interface using field-derived geometry, river stage, riverbed elevation, conductance and structural information.

The reported groundwater-gradient descriptions also require reconciliation before they are used as evidence. A common vertical datum, synchronized river/piezometer observations and locally calibrated groundwater heads shall be used to establish whether the actual gradient is river-to-mine, mine-to-river or seasonally variable.

7. Codli-Specific Field Investigation Methodology

The field programme is the decisive stage of the river-ingress study. Because the river is immediately adjacent to the northern lease boundary, the investigation must be designed around the river-to-pit transect rather than relying only on regional monitoring wells.

1. Establish a common survey datum and accurately survey the river thalweg, left and right banks, floodplain, lease boundary, mine crest, pit rim, benches and relevant pit-bottom elevations using DGPS/RTK or equivalent survey control.
2. Survey multiple river cross-sections upstream, opposite the mine-facing reach and downstream, together with a longitudinal river profile extending sufficiently beyond the immediate interface to capture hydraulic controls.
3. Obtain authenticated HFL, historical flood marks and river-stage records from the competent water-resource authority and convert all observations to the same vertical datum.
4. Install a river-to-mine piezometric transect comprising river bank, intermediate ground, lease boundary and mine/pit influence-zone locations, with nested piezometers where the shallow and deeper systems need to be separated.
5. Monitor river stage, groundwater head, pit water level, rainfall and dewatering discharge continuously or at suitably high frequency during critical monsoon events.
6. Map lithology, laterite thickness, phyllite/manganiferous clay, weathering, joints, faults, shear zones, foliation and altered intrusive bodies along the northern interface.
7. Characterise riverbed and bank materials and determine permeability/hydraulic properties where necessary to quantify possible riverbed leakage.
8. Collect river water and groundwater samples at matched times to compare hydrochemical signatures and identify potential river-derived components.
9. Refine the groundwater model at the northern interface using surveyed river geometry, riverbed elevation, HFL, conductance and verified structural zones.
10. Undertake 1D/2D hydraulic flood modelling to determine flood depth, velocity and extent at the lease boundary under authenticated HFL and relevant design scenarios.
11. Carry out sensitivity analyses for permeability, riverbed conductance, hydraulic head, pit depth and dewatering rate.
12. Prepare an integrated mine-water balance distinguishing rainfall accumulation, regional groundwater seepage and any demonstrable river-connected component.

The investigation shall be seasonal. A single pre-monsoon water-level survey cannot establish the year-round hydraulic relationship. The strongest evidence will be the time-lagged response of piezometers to changes in river stage, particularly during high-flow and intense-rainfall events.

8. River Ingress Mechanisms Applicable to Codli

The possible ingress mechanisms at Codli are separated below because each requires different evidence and different preventive measures. The absence of evidence for one mechanism must not be interpreted as proof that the other mechanisms are absent.

Mechanism	Codli-specific pathway	Required evidence	Primary	preventive
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			control
Direct floodwater ingress	River/floodplain water reaches the lease or pit through low ground, drainage or overtopping during high river stage.	Authenticated HFL, floodplain levels, cross-sections, 1D/2D model, site inspection.	River-facing protection, controlled drainage, adequate freeboard and flood-conveyance-compatible embankment.
Riverbed seepage	River water enters permeable riverbed/alluvium/laterite and migrates toward the mine.	Riverbed elevation/K, river-stage response, nested piezometers, hydrochemistry, local groundwater model.	Maintain safe hydraulic separation; monitor heads; control drawdown where required; local cut-off/seepage-control design if demonstrated.
Groundwater-mediated ingress	River recharges shallow aquifer and mine dewatering lowers head toward the pit.	Piezometric gradients, seasonal response, MODFLOW river package, water balance.	Manage dewatering; maintain monitoring and trigger levels; design seepage-control measures where needed.
Structural ingress	Fault, fracture, joint, shear zone or weathered corridor connects river-side permeable material to mine.	Detailed geological mapping, borehole/geophysical evidence where justified, hydraulic testing, sensitivity modelling.	Avoid/modify mine geometry where warranted; local grouting/cut-off or drainage controls only after verified engineering assessment.
Combined monsoon ingress	High rainfall simultaneously increases river stage, recharge, groundwater head and pit water demand.	High-frequency event monitoring and combined worst-case modelling.	Integrated flood protection, standby pumping, emergency drainage and DGMS-compatible withdrawal procedures.

9. Required Hydraulic and Hydrogeological Scenarios

The final Codli risk classification shall be based on scenario testing rather than a single steady-state model. The following scenarios cover the normal operating condition through credible combined worst-case conditions.

Scenario	Codli condition to be simulated	Decision question
S1 – Existing condition	Natural river stage, groundwater regime and existing mine geometry.	Is there evidence of present river–groundwater–mine connectivity?
S2 – Normal mining	Planned excavation and normal dewatering.	Does routine dewatering alter the northern hydraulic gradient?
S3 – Monsoon	Increased recharge plus elevated river stage.	Does monsoon recharge increase river-side head or mine inflow?
S4 – High river stage	Elevated river stage with saturated near-river ground.	Is there a credible flood/groundwater connection?
S5 – HFL	Authenticated HFL with planned mine dewatering.	Does the HFL condition threaten the lease/pit under the approved protection geometry?

S6 Ultimate pit	–	Ultimate excavation and associated groundwater response.	Does increasing pit depth materially increase river-side capture potential?
S7 Structural pathway	–	Higher permeability along mapped fracture/fault/weathered corridor.	Could a preferential pathway produce unacceptable inflow?
S8 Combined worst case	–	Extreme rainfall/recharge + HFL + ultimate pit + adverse permeability + dewatering.	Is the residual risk manageable with the proposed protection and emergency system?

10. HFL, Flood Modelling and River-Facing Embankment

The river-facing protection is a critical safety interface at Codli. The project-specific ToR identifies a crest 3 m above authenticated HFL. That requirement cannot be implemented correctly until the HFL, datum, river geometry and design hydraulic conditions are established by the competent authority and verified through engineering analysis.

- WRD-authenticated HFL shall govern wherever officially available; historical flood marks shall be surveyed and reduced to the same datum.
- CWC or other competent hydrological records may be used where relevant and officially available, but shall not override the competent State record without reconciliation.
- The hydraulic model shall corroborate the adopted HFL and shall not be used to invent an HFL in the absence of authenticated records.
- Model existing condition, mine-development condition and mine-plus-protection condition to demonstrate that the proposed protection does not cause unacceptable upstream flood-level rise or adverse flood redistribution.
- Determine design flood depth, velocity, tractive stress, scour potential and flow concentration at the river-facing reach.
- Design stone pitching/riprap, filter, toe protection, launching apron where required, drainage and foundation treatment based on calculated hydraulic and geotechnical demands.
- Check slope stability under saturated, seepage, rapid-water-level-change and seismic conditions using applicable current Indian Standards and project-specific parameters.
- Provide inspection access and a safe drainage system on the mine side of the protection.
- Do not treat the 3-m crest criterion as the only defence; combine it with river-stage monitoring, controlled mine drainage, seepage monitoring, standby pumping and emergency procedures.

For embankment stability, IS 7894:1975 is relevant where an earth-embankment stability analysis is applicable; associated current BIS standards for soil classification, drainage and seismic design shall be used as applicable. The final design shall state the exact current editions adopted and shall be supported by site-specific geotechnical parameters.

11. DGMS Inundation-Safety Integration

- At Codli, river ingress cannot be treated only as an environmental compliance issue because an uncontrolled external-water connection could become a life-safety event. Mine-water management, river monitoring, emergency pumping and withdrawal procedures must therefore form one integrated system under the mine manager's statutory safety responsibility.*

- b. Maintain permanent river-stage reference marks and danger-level markers linked to the adopted survey datum.
- c. Carry out a documented inundation-risk review before each monsoon and after material changes to pit geometry, river protection or mine drainage.
- d. Maintain continuous or high-frequency river-stage and rainfall monitoring during critical rainfall/high-flow periods.
- e. Define warning, danger and evacuation triggers from the validated hydraulic model and the mine's statutory safety management system.
- f. Maintain standby pumping and emergency drainage capacity for credible inflow scenarios, including combined monsoon and high-river-stage conditions.
- g. Keep emergency access to the river-facing protection, pumping installations and critical drainage structures.
- h. Inspect the embankment crest, pitching, toe, drains, seepage, settlement, cracking and scour after major rainfall/flood events.
- i. Integrate river-stage and mine-water triggers with operational restrictions, personnel withdrawal and emergency communication procedures.
- j. Maintain auditable records of inspections, water levels, pump discharge, rainfall, trigger exceedances and corrective actions.

DGMS Technical Circular No. 2 of 2024 specifically concerns precautions against danger of inundation in mines. The Mines Act framework also provides for precautions against irruption or inrush of water into mine workings. The Codli Mine Water Management Plan shall therefore cross-reference the approved hydraulic risk assessment and statutory DGMS requirements rather than operating as a separate environmental document.

12. Monitoring, Instrumentation and Interpretation

Monitoring shall be designed to answer the river-ingress question directly. A large number of observations is not useful unless the observations are synchronized and capable of distinguishing river-stage response, regional groundwater behaviour and pit dewatering effects.

Observation parameter	/ Diagnostic value	Codli action
River stage vs piezometric head	Rapid, proportionate and time-lagged response can indicate hydraulic connectivity.	Compare river bank, intermediate, lease-boundary and pit-influence piezometers.
River stage vs pit inflow	Correlation may indicate river-connected contribution, but lag and rainfall must be separated.	Maintain synchronized river-stage, rainfall, pump-discharge and pit-level records.
Groundwater gradient	Determines whether natural flow is river-to-mine, mine-to-river or variable.	Calculate gradients using a common datum in each monitoring event.
Hydrochemistry	Can distinguish river-derived water from regional groundwater where signatures are sufficiently different.	Use matched river and groundwater samples during contrasting flow conditions.
Structural mapping	Identifies preferential pathways not captured by coarse numerical cells.	Update geological model and numerical sensitivity cases.
Seasonal reversal	Tests whether the river behaves as gaining or losing in different	Maintain pre-monsoon, monsoon and post-monsoon datasets.

	seasons.	
Pumping response	Tests whether dewatering changes the river-side hydraulic contribution.	Undertake controlled step-response/observation analysis only under approved mine-safety conditions.
Rainfall vs pit inflow	Separates direct rainfall accumulation from groundwater/river-connected inflow.	Maintain event-based water balance.

Monitoring results shall be interpreted using time series, not isolated readings. The key evidentiary test is whether a statistically and physically credible river-stage signal appears in the mine-side piezometers and/or pit inflow after accounting for rainfall, pumping and seasonal groundwater variation.

13. River-Ingress Risk Classification and Decision Criteria

The present evidence supports neither an unconditional 'river ingress' finding nor an unconditional 'no river ingress' finding. A staged classification is therefore appropriate until the northern interface is verified.

Risk class	Codli decision criterion	Required management response
Low / demonstrated separation	No credible flood pathway; no measurable river-stage response in nested piezometers; local model confirms separation under design scenarios.	Routine monitoring and periodic verification.
Moderate / controlled connectivity	Hydraulic interaction exists but predicted inflow and flood exposure remain within engineered controls with adequate safety margin.	Continuous monitoring, defined trigger levels, controlled dewatering and maintained protection.
High / credible preferential connection	River-stage or structural evidence indicates a significant hydraulic pathway, or modelled adverse scenario produces unacceptable inflow.	Immediate engineering review; strengthen cut-off/drainage/protection; restrict mining geometry if required.
Critical / inundation-prone	Flood or river-connected inflow could overwhelm available mine-water controls or compromise safe evacuation.	Stop/withdraw as required by statutory safety procedures; activate emergency system; redesign protection and mine-water controls before resumption.

On the evidence presently available, the defensible interim classification is 'Risk requiring verification and engineered prevention'. The final classification shall be assigned only after authenticated HFL, field monitoring, local geological/hydraulic verification and calibrated local modelling are completed.

14. Codli Mine-Water Management and Preventive Engineering

River-ingress prevention is strongest when external water is kept out of the excavation and mine water is controlled internally. The following measures are to be incorporated into the mine-water management system specifically for the northern Codli interface.

Control	Codli requirement
Clean-water diversion	Intercept clean catchment runoff before it enters disturbed mine areas and route it through stable, protected outlets.
Mine drainage	Collect and convey mine-affected water through controlled drains/sumps; prevent uncontrolled discharge toward the river.
Pit sump capacity	Provide storage and pumping capacity for credible groundwater plus rainfall accumulation, with emergency reserve.
River-facing embankment	Construct only after authenticated HFL, river cross-sections, design flood, scour and geotechnical parameters are established.
Seepage control	Where connectivity is demonstrated, design local cut-off, drainage or other control measures based on verified permeability and pathway geometry.
Overburden/dump protection	Stabilise exposed surfaces and provide toe/garland drainage so sediment-laden runoff cannot reach natural drainage.
Haul-road drainage	Use cross-drains, side drains, energy dissipation and sediment traps to prevent concentrated erosion toward the northern interface.
Sediment control	Provide staged silt traps/settling facilities upstream of natural drainage; maintain adequate freeboard and desilting access.
Emergency pumping	Maintain independent standby pumping capacity and power arrangements for credible high-inflow scenarios.
Progressive rehabilitation	Stabilise and vegetate disturbed areas before the monsoon wherever practicable to reduce runoff and sediment generation.

15. Institutional Governance, Responsibilities and Reporting

Because river ingress crosses environmental, water-resource and mine-safety jurisdictions, governance must be clearly assigned. No single department should be expected to validate the complete risk independently; the final decision should be based on coordinated technical evidence.

Authority / function	Specific Codli responsibility
MoEF&CC / competent EC authority	Review and enforce EC/ToR commitments concerning river, groundwater, CAT, watershed and environmental protection.
Directorate of Mines & Geology, Goa	Ensure consistency with lease conditions, approved mining plan, mine geometry and statutory mineral-development requirements.
DGMS	Oversee statutory mine-safety aspects associated with inundation, water inrush, emergency preparedness and safe operation.
Water Resources Department, Goa	Authenticate HFL and relevant river records; review hydraulic and river-protection interventions affecting public water resources/flood conveyance.
Goa State Pollution Control Board	Regulate water pollution/discharge and review environmental monitoring and consent conditions.
Forest Department / competent forest authority	Regulate activities and restoration on forest land and ensure compliance with forest approvals.
Project Proponent / Mine Manager	Implement the approved controls, maintain mine-water records, ensure statutory safety procedures and close corrective actions.
Environmental / hydrogeological team	Maintain monitoring network, water-quality records, groundwater/rainfall/rivers-stage time series and annual interpretation.

Independent institution	reputed	Periodically audit the river-ingress evidence, numerical model, hydraulic design and monitoring interpretation.
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A joint annual pre-monsoon review shall be undertaken before each monsoon. Any material change in pit depth, mine boundary, river protection, dewatering rate or observed river/piezometric response shall trigger an interim technical review rather than waiting for the annual cycle.

16. Conclusions Specific to Block–XII Codli

The conclusions below are deliberately limited to what can be established from the available Codli project information and the engineering implications of the reported site conditions. They avoid a categorical conclusion where field verification is still necessary.

- a. The northern side of Block–XII Codli is a credible external-water risk zone because the Khandepar/Dudhsagar river system is reported to be approximately 10 m from the lease boundary at the closest point and the mine is progressively excavated to substantially lower elevations.
- b. The present evidence does not demonstrate direct floodwater entry into the mine. However, direct flood ingress remains a credible worst-case mechanism if river stage, floodplain geometry or an unprotected hydraulic route permits water to reach the lease or pit.
- c. The reported modelled groundwater seepage of approximately 736 m³/day represents total modelled groundwater inflow under the stated assumptions. It shall not be labelled as river ingress and cannot, by itself, demonstrate that river ingress is impossible.
- d. The shallow lateritic aquifer is relatively permeable and capable of transmitting recharge, while the deeper clay-rich phyllitic/manganiferous sequence is comparatively less permeable. This reduces the likelihood of simple vertical connection but does not eliminate preferential pathways through fractures, joints, weathered zones or altered intrusive contacts.
- e. The 250 m × 250 m regional model grid is useful for regional groundwater behaviour but is not sufficiently fine by itself to prove hydraulic separation across a river–lease interface of approximately 10 m. A locally refined/nested model is required.
- f. The reported groundwater-gradient descriptions must be reconciled using a common vertical datum and synchronized river/piezometer observations before regional gradients are used as evidence for the direction of river–mine flow.
- g. Riverbed seepage and groundwater-mediated ingress remain technically plausible and require dedicated field verification through nested piezometers, river-stage monitoring, hydrochemistry, geological/structural mapping and local numerical modelling.
- h. The 3 m-above-authenticated-HFL river-facing protection requirement in the project ToR is a minimum protection criterion and shall not be treated as the sole defence against inundation. Flood conveyance, scour, seepage, drainage, pumping and emergency controls must be integrated.
- i. Until the HFL, river geometry, hydraulic connectivity and local model are verified, the defensible interim classification for Codli is 'Risk requiring verification and engineered prevention'.
- j. Final mining progression adjacent to the northern interface should be conditional on completion and acceptance of the required hydraulic/geotechnical verification and on operation of the approved monitoring and emergency-response system.

17. Final Action and Decision Matrix

The following actions convert the study findings into a statutory and engineering closure programme. The order is important: field data and competent-authority records must precede final embankment dimensions and final river-ingress classification.

Issue	Required action	Acceptance / decision basis	Lead authority / function
River nomenclature and jurisdiction	Confirm project reach and nomenclature and jurisdiction with WRD.	Official WRD record.	WRD / Project Proponent
HFL	Obtain authenticated HFL and historical flood marks tied to common datum.	Authenticated WRD datum and hydraulic verification.	WRD / Hydrology Team
River geometry	DGPS cross-sections and longitudinal profile.	Surveyed hydraulic model.	Project / Independent survey team
Flood exposure	Run 1D/2D hydraulic model for existing and project conditions.	Flood depth, velocity and extent at mine boundary; no unacceptable hydraulic obstruction.	Hydrology + WRD review
Hydraulic connectivity	Install river-to-mine nested piezometers and synchronized river-stage monitoring.	Seasonal and event-based head response.	Hydrogeology Team
Structural pathways	Map faults/fractures/weathering; test significant zones where justified.	Geological and hydraulic evidence.	Geology / Hydrogeology Team
Groundwater model	Locally refine/nest northern interface.	Calibrated model using field-derived river geometry and heads.	Hydrogeology + Independent reviewer
Embankment	Design after HFL, flood and scour determination.	Hydraulic + geotechnical calculations; applicable IS standards.	Civil/Geotechnical + WRD review
Mine safety	Set warning/danger/evacuation triggers and emergency capacity.	DGMS-compatible inundation risk assessment.	Mine Manager / DGMS framework
Monitoring	Integrate river, piezometer, rainfall, pit level and pumping records.	Auditable time-series database and annual interpretation.	Environment + Mine Water Team
Long-term control	Integrate findings into Mine Water Management Plan and annual monsoon review.	Adaptive management and closure of corrective actions.	Project Proponent / Independent reviewer

18. Engineering Qualification and Data-Closure Requirements

This report is a technical decision framework, not a substitute for statutory survey records or final construction calculations. The following parameters must be closed before the river-facing protection is issued for construction and before a final categorical river-ingress conclusion is adopted.

- a. WRD-authenticated HFL and flood history linked to a common vertical datum.
- b. Surveyed river thalweg, bank lines, floodplain levels and multiple cross-sections.
- c. Design flood discharge and hydraulic boundary conditions for the adopted return-period/design basis.
- d. Scour assessment and riverbed material/permeability characterisation.
- e. Verified northern-interface geological and structural mapping.
- f. Nested river-to-mine piezometric data covering shallow and deeper aquifers.
- g. Locally refined/nested groundwater model calibrated to the observed river and piezometric response.
- h. Verified geotechnical parameters for the river-facing embankment, foundation and protection system.
- i. Final mine-water balance separating rainfall accumulation, regional groundwater and any demonstrable river-connected component.
- j. DGMS-compatible warning, danger, evacuation and emergency-pumping thresholds.

No numerical value for HFL, design flood, scour depth, embankment dimensions or river-derived inflow has been invented in this revised report where the project information does not establish the value. Such values shall be inserted only after field verification and competent-authority acceptance.

Applicable Legal and Technical References

This revised report intentionally does not reproduce a 'supplied project documents' list. The references below are the governing legal, regulatory and technical instruments relevant to the Codli river-ingress decision and final design.

- a. Environment (Protection) Act, 1986 and applicable rules/notifications.
- b. Environment Impact Assessment Notification, 2006 (S.O. 1533(E), 14 September 2006), as amended and applicable to the project.
- c. Project-specific MoEF&CC Terms of Reference for Block–XII Codli Mineral Block, including requirements concerning integrated watershed management, river/nala impacts, river ingress, river-facing protection and independent technical review.
- d. Water (Prevention and Control of Pollution) Act, 1974 and applicable rules, standards and consent conditions.
- e. Mines Act, 1952, including statutory provisions concerning safety and precautions against irruption/inrush of water.
- f. Metalliferous Mines Regulations, 1961, as applicable to the mine and prevailing statutory framework.
- g. DGMS Technical Circular No. 2 of 2024 – Precautions against danger of inundation in mines.
- h. BIS IS 19744:2026 – Preparation of Catchment Area Treatment (CAT) Plan — Guidelines.
- i. Applicable current BIS standards for soil classification and geotechnical investigation/design, including IS 1498 where applicable.

- j. IS 7894:1975 – Code of Practice for Stability Analysis of Earth Dams, where applicable to earth-embankment stability assessment.
- k. Applicable current BIS standards for drainage, hydraulic structures, erosion protection and river-training works, selected according to the final design configuration.
- l. Applicable current IS 1893 series for seismic design/analysis, using the edition legally/currently applicable at the time of final structural design.
- m. Relevant Central Water Commission and Goa Water Resources Department hydrological/flood-estimation guidance and authenticated records.
- n. Applicable forest-diversion and wildlife / Eco-Sensitive Zone requirements where project activities fall within their jurisdiction.
- o. Applicable Goa mining, environmental and water-resource orders, lease conditions and statutory directions issued by competent authorities.

CUMULATIVE IMPACT ASSESSMENT REPORT FOR

**Block - XII Codli Mineral Block,
Auctioned Block Area: 377.0881 ha**

With Iron Ore production 3.50 Million TPA, OB/Waste 8.21

Million TPA (Total Excavation: 11.71 Million TPA)

**Along with Installation 04 Crusher (3 Primary Crusher of 1 x 250
TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600**

**TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet
Beneficiation Plant with Throughput Capacity 3.50 Million TPA**

At

**Village: Codli, Taluka: Dharbandora,
District: South Goa (Goa)**

APPLICANT



JSW Steel Limited

**JSW Centre, Bandra Kurla Complex,
Near MMRDA Grounds, Bandra East,**

Mumbai -400051 (Maharashtra)

Email: baswaraj.dalgade@jsw.in

CHAPTER - 1

1.1 INTRODUCTION

JSW Steel Limited has proposed Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) and submitted the ToR Application online on PARIVESH 2.0 Web Portal on 13.03.2026 for obtaining the Environment Clearance.

1.2 PROJECT BACKGROUND

The proposal was considered for Technical Presentation for ToR during 5th meeting of the Expert Appraisal Committee EAC (Non-coal Mining) and Technical Presentation was held on 23.04.2026 (Agenda Item No. 4). The ToR Letter was issued vide file no. J-11015/49/2025-IA.II(NCM), dated 18.05.2026.

1.3 PURPOSE OF THE REPORT

In compliance with Specific ToR Point No. 1.46 for “Mining of Minerals” stating that, **“PP is required to conduct a cumulative impact assessment including the adjacent mines. This assessment should encompass key factors, including water requirements, air, water, noise pollution levels, power consumption, transportation logistics, waste management practices, and the combined emissions load from projects effects on flora & fauna, etc. EMP should be prepared accordingly”** and In compliance with Standard ToR Point No. 1.17 for “Mineral Beneficiation” stating that, **“Cumulative impact study of both Beneficiation Plant with suggested mitigation measures as per the study should be described”**. A comprehensive Cumulative Impact Assessment Report has been prepared to evaluate the combined environmental impacts arising from the development and operation of both mining projects.

The assessment has been undertaken considering the simultaneous operation of the Block - XII Codli Mineral Block (Auctioned Block Area: 377.0881 ha) and its cumulative influence on the surrounding environment. The study evaluates the aggregate impacts on key environmental components including water requirements, air, water, noise pollution levels, power consumption, transportation logistics, waste management practices and the combined emissions load from projects effects on flora & fauna etc. The Cumulative Impact Assessment of the following key environmental parameters has been carried out and discussed in detail in the subsequent sections.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

1.4 ENVIRONMENT SETTING OF THE STUDY AREA

Table – 1
Environmental Settings of the Study Area

S.N.	Particulars	Details																											
1.	Nearest State/National Highway	➤ SH-7 (Adjacent in WNW Direction) ➤ NH-748 (~3.0 Km in NNE Direction)																											
2.	Nearest Railway Station	Sanvardem Chuch Railway Station (~7.8 Km in SSW Direction)																											
3.	Airport	Dabolim International Airport (~30.0 Km in WNW Direction)																											
4.	Nearest Town / City	Sanvardem (~7.5 Km in SSW Direction)																											
5.	Wildlife Sanctuary, National Park, Biosphere Reserves within 10 km radius study area	There are no National Park, Biosphere Reserve or Corridor present within 10 Km of radius study area. 2 Wildlife Sanctuaries are present: ➤ Bhagvan Mahavir Wildlife Sanctuary (~1.52 Km in SE Direction) ➤ Bondla Wildlife Sanctuary (~6.5 Km in NNW Direction)																											
6.	Eco Sensitive Zone	➤ ESZ of Bhagvan Mahavir Wildlife Sanctuary (~0.52 Km in SE Direction) ➤ ESZ of Bondla Wildlife Sanctuary (~5.5 Km in NNW Direction) Authenticated Map from DCF, Goa indicating the shortest distance between the ESZ of Wildlife Sanctuaries and Mine Lease Boundary was obtained on 10.10.2025. Copy of the same is enclosed as Annexure VI.																											
7.	Reserve Forests (RF) / Protected Forest (PF) within 10 km radius study area	Unclassified Forest – Core zone Reserve Forest – ~0.5 Km in ENE Direction, ~1.0 Km in West Direction, ~2.5 Km in West Direction, ~4.0 Km in South Direction, ~6.5 Km in WSW Direction, ~7.0 Km in NNE Direction, ~8.0 Km in WSW Direction, ~8.5 Km in NW Direction, ~9.0 Km in West Direction.																											
8.	Water bodies within 10 km radius study area	There is total 8 water bodies present within 10 km of study area: <table> <tr> <th>S.N.</th><th>Water Body</th><th>Distance & Direction</th></tr> <tr> <td>1.</td><td>Khandepar River</td><td>Adjacent in North Direction</td></tr> <tr> <td>2.</td><td>Kale Nala</td><td>~ 0.7 Km in ESE Direction</td></tr> <tr> <td>3.</td><td>Udnai Nala</td><td>~ 1.5 Km in West Direction</td></tr> <tr> <td>4.</td><td>Panduranga Nala</td><td>~ 5.0 Km in SW Direction</td></tr> <tr> <td>5.</td><td>Ragada Nala</td><td>~ 7.0 Km in NNE Direction</td></tr> <tr> <td>6.</td><td>Sanguem or Zuvari River</td><td>~ 8.0 Km in South Direction</td></tr> <tr> <td>7.</td><td>Jamboli Nala</td><td>~ 9.0 Km in NE Direction</td></tr> <tr> <td>8.</td><td>Paroda River</td><td>~ 9.0 Km in SSW Direction</td></tr> </table>	S.N.	Water Body	Distance & Direction	1.	Khandepar River	Adjacent in North Direction	2.	Kale Nala	~ 0.7 Km in ESE Direction	3.	Udnai Nala	~ 1.5 Km in West Direction	4.	Panduranga Nala	~ 5.0 Km in SW Direction	5.	Ragada Nala	~ 7.0 Km in NNE Direction	6.	Sanguem or Zuvari River	~ 8.0 Km in South Direction	7.	Jamboli Nala	~ 9.0 Km in NE Direction	8.	Paroda River	~ 9.0 Km in SSW Direction
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7.	Jamboli Nala	~ 9.0 Km in NE Direction																											
8.	Paroda River	~ 9.0 Km in SSW Direction																											
9.	Critically Polluted Area	No, the Site doesn't fall under the critically polluted area																											
10.	Seismic Zone	Zone – III as per IS: 1893 (Part-I): 2016																											

Source: Preliminary Site Visit, SOI Toposheet & PARIVESH 2.0 Web Portal

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

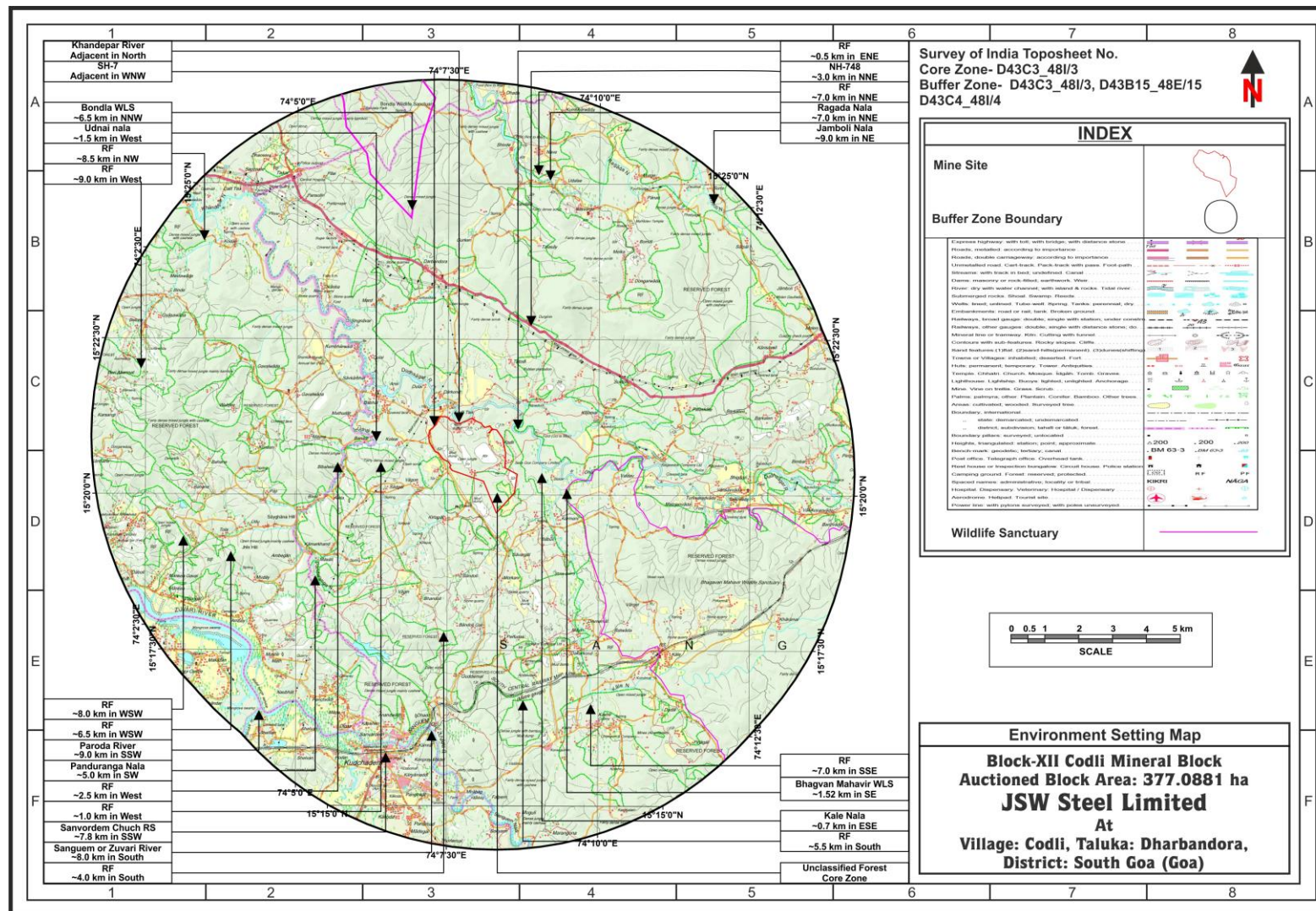


Figure 1: Map Showing Environmental Settings of the 10 km Radius of the Study Area

1.5 REGIONAL PROFILE OF THE AREA

The block area geographically falls between N 15°21'15.638" N to 15°19'42.607" N" latitude and 74°7'10.922" E to 74°8'39.034" E longitude and Toposheet No. D43C3/ 48I/3. The nearest railway station is Sanvardem Chuch Railway Station at a distance of ~7.8 Km in SSW Direction from proposed mine site.

Topography

Codli Mineral block is situated in the central crest portion of Daucona Codli hillock. The area is gently sloping towards NNE & SSW. The mining lease is disposed in a general northwest-southeast direction. Almost entire lease hold area is broken-up and put to use for mining and allied operations. The highest elevation within mining lease is on rehabilitated dump towards the southwest part at 109 m AMSL and the lowest portion at -76 m AMSL towards the northeast part of the lease which was achieved during mining operation in the past and now it is partly filled with silt & water.

Drainage Pattern

The Khandepar River flows towards northern part of the block, flowing from SE to NW. However, the block area is devoid of any perennial surface water body. The area receives approximately about 3500-4000 mm of rainfall every year. Monsoon run-off is channelized and collected into settling ponds / pits through a network of drains.

Climate

The area is characterized by extreme climate with very hot (38°C) summer and very cold winter (16°C). It experiences tropical and humid climate which shows three distinct seasons viz. summer, rainy and winter. The summer is hot and humid starting from March and continues till end of May. May is the hottest month of this region. The rainy season lasts from early June to end of September. October and November are the post monsoon months followed by a cold winter which lasts till end of February.

Rainfall

The annual average rainfall in the region is around 3239.672mm (average of last 25 years rainfall data from 2000-2024) varying from minimum 2367.6 mm in 2001 to maximum 4787.8 mm in 2024.

The list of existing industries and mines in the 10 km radius of the mine site is summarized in the table given below:

Table – 2
Existing Industries and Mines falling in the 10 km Study Area

S.N.	Industries/Mines	Type of Industry/Mine	Approx. Distance (Mine Boundary) and direction from (Centre point of the Mine site)	Status Operational/ Non-operational
1.	Kalay Mineral Block IV	Iron Ore Mine	~3.0 Km in the SSE Direction	Operational
2.	Sociedade de fomento Industrial Pvt. Ltd.	Iron Ore Mine	~3.2 Km in SSE Direction	Operational
3.	Shraddha Ispat Private Limited (Sponge Division)	Steel Industry	~5.7 Km in SSE Direction	Operational

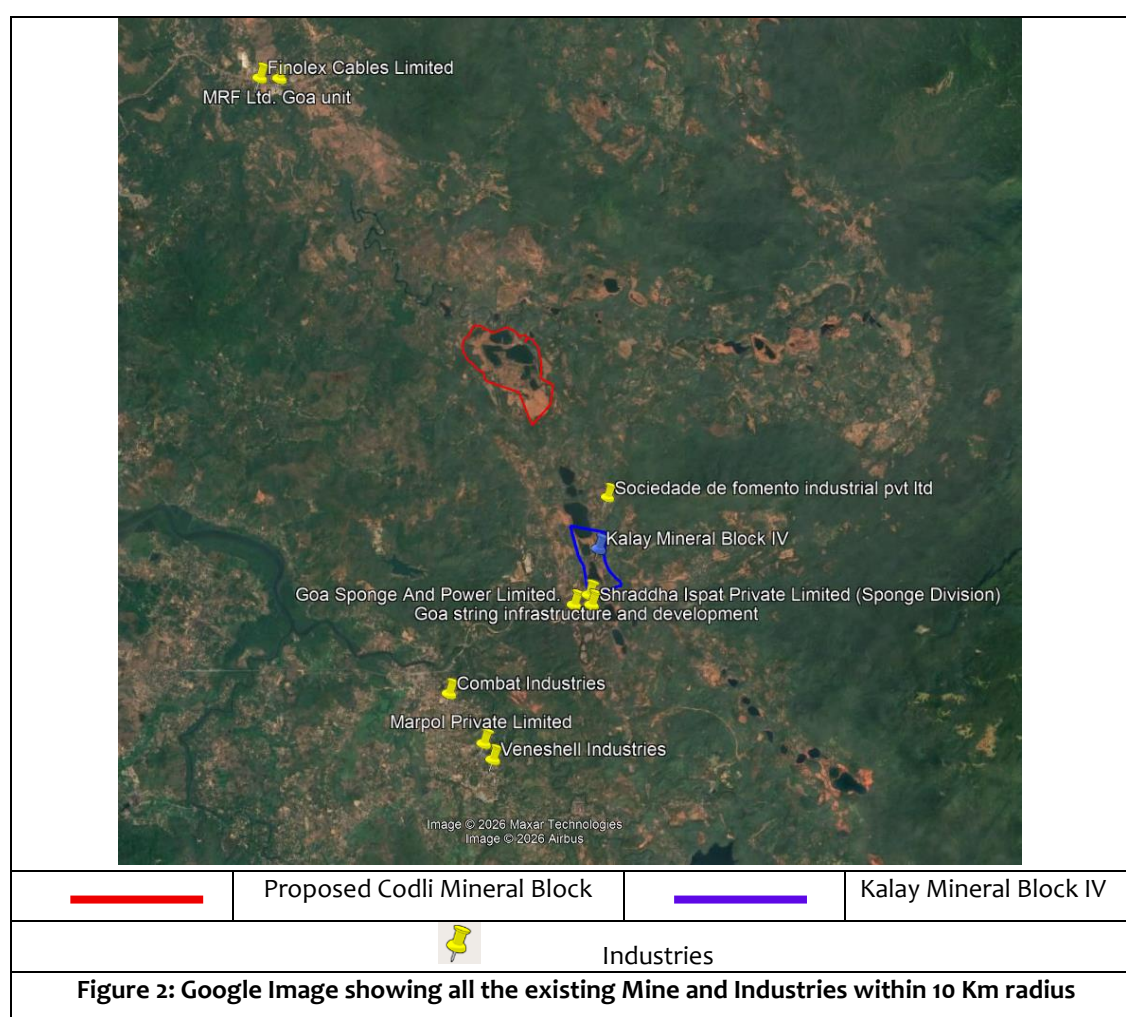
Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

4.	Goa Sponge and Power Limited	Steel Industry	~5.7 Km in SSE Direction	Operational
5.	Combat Industries	Manufacturer	~8.5 Km in SSW Direction	Operational
6.	Madras Rubber Factory 620 Plant	Manufacturer	~8.8 Km in NW Direction	Operational
7.	Finolex Cables Limited	Cable Company	~9.4 Km in NW Direction	Operational
8.	Marpol Private Limited	Manufacturer	~9.5 Km in SSW Direction	Operational
9.	Veneshell Industries	Manufacturer	~10.0 Km in SSW Direction	Operational

Source: Field Survey, Google Earth Pro

Google Earth Pro image showing locations of all the existing industries and mines present within the 10 km radius of the mine block is shown below:



Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment



Figure 3: Photographs showing the existing Mine and Industries within 10 Km radius

1.6 CUMULATIVE IMPACT ASSESSMENT

The cumulative impact assessment has been carried out in two ways:

- Assessment of the impacts associated with the existing operational mines and industries/plants within the study area, and
- Assessment of the cumulative impacts due to the proposed mines and industries within the study area.

Block XII Codli Mineral Block is the only proposed mine within the 10 km study area. All other mines and industries within the 10 km study area are operational and their existing impacts have already been accounted for in the Baseline Environmental Study. Therefore, the anticipated impacts attributable to the proposed project are considered only for Block XII Codli Mineral Block. The impacts of the proposed mine and existing mine/industries have been assessed and predicted for various environmental parameters, including air quality, noise, water, and other relevant parameters and the assessment results are presented in the subsequent sections of the report.

Scope of Work for the Cumulative Impact Assessment study:

- The major components of the study would be the assessment of various activities in the region, estimation of assimilative capacity and supportive capacity leading to delineation of appropriate environment management plan for sustainable development of the region.
- Identification of various activities viz. industrial, commercial, residential, transport, construction etc. in the region.
- Quantification of waste generation due to various activities.
- Prediction of impacts due to various activities on different receiving environments, viz. air, water bodies (rivers, lakes, ponds, reservoirs, ground water etc.), land (soil, agriculture, land use pattern).

CHAPTER - 2

2.1 APPROACH & METHODOLOGY OF THE STUDY

The cumulative study of the mines has been considered for assessment of the Cumulative Impact Assessment of the ecosystem. The baseline environmental quality has been assessed through field studies within the impact zone for various components of the environment, viz. air, noise, water, micro-meteorology, land and eco-biodiversity, socio- economy. The main objectives of the study are:

- Assess Present Environmental Quality and the Environmental Impacts.
- To Identify Environmentally Significant Factors that could preclude Project development.
- To achieve these objectives, a team of functional area experts monitored the environmental parameters within the core zone and buffer zone (10 km. radial distance of proposed mine) in accordance with the Guidelines issued by the Ministry of Environment, Forests & Climate Change (MoEF&CC), Govt. of India.

For the present study, the project site is considered as a core zone and the area lying within 10 km radius from the boundary of the ML area is considered as a buffer zone.

Secondary data has been collected from various source to study the physical and biological environment as well as demography of the area to determine Mine management & Allied Activities (Operation, Dump management, technology adopted in operational mine, Transportation, Reclamation etc. proposed or operational) for proposed block. The baseline data collected from the core area and the buffer area has been considered here as the primary data. Methodology used for the study is given in the below.

Table - 3
Methodology of the Study

Parameter	Methodology	Instrument Used	Data Collection	
			Secondary Data	Primary Data
Air Quality	Ambient Air monitoring (24 hourly samples), twice a week for PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO. Meteorological Parameters, Wind Speed, Wind Direction, Relative Humidity, Temperature, Precipitation, etc. Air Pollution dispersion Models. IS-5182, (CPCB guidelines for measurement of Ambient Air Pollutants)	Respirable Dust Sampler with attachment for Gaseous Pollutant Envirotech Model APM460, Fine Particulate Matter (FPM) Sampler, Dry and Wet Bulb Thermometer, Micro Meteorological Station, Global Positioning System (GPS). AEROMOD	Historical data on climatologically parameters, CPCB, SPCB, IMD	EIA/ EMP Report
Water	Physiographic studies of the proposed Iron Ore Block and its surroundings with the help of latest Google Images, site visit, GPS Survey etc. Standard Limits:	Resistivity meter, water level indicator, piezometer, GPS. PH meter, EC meter, BOD Sampler, Handheld open-	CGWB data, BHUVAN, WRIS	EIA/EMP Report & Baseline Data

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

	Surface Water - IS:2296 Ground Water - IS:10500:2015 Sampling Methodology IS:3025, APHA	mouth bottle sampler etc.		
Soil	Sampling methodology and analysis - IS:2720	AGUER	District Soil health card	Site survey and baseline data collection
Noise	IS:9989 (Assessment of noise with respect to community response)	Sound Level Meter	CPCB/PCB	Site survey and baseline data collection
Land	Use of Remote Sensing Technology to analysis the impact on land on the project area and study area using GPS survey, ground truthing, reconnaissance survey etc.	GPS, DGPS, Total Station, RKS, Drone, etc.	Survey of India toposheet, administrative atlas, zoning atlas, master plan, zoning plan, ESZIS atlas, Soil Atlas, Hydro Geology Atlas, etc.	Satellite imagery through NRSC, BHUVAN, Google Earth and site survey etc. of EIA/EMP Report
Social and Economic	A judgmental and purposive sampling method. Questionnaire based pre-structured Feedback Surveys and Interviews.	---	Census 2011 records, District Statistical Handbook, Revenue data from Mine Department. Tehsil Data	Site survey and baseline data collection by EDII, Ahmedabad
Ecology and Biodiversity	Inventory Method, Quadrant Method, Pollard Walk Point Sampling etc.	Binocular GPS, Tree Caliper measuring tap rope, Quadrates for herbs	Forest Working Plans	Site survey and baseline data collection

2.2 METHODOLOGY FOR AMBIENT AIR POLLUTION

Baseline data as a secondary data will be used to evaluate the major impact due to Air Pollution, Water Pollution in the surrounding area of Dharbandora of South Goa.

Methodology for Air Quality

The Gaussian Dispersion Modeling (GDM) is used for prediction of dispersion of air emission and the computation of Ground Level Concentration (GLC) up to a specified distance from source. The fundamental equation of GDM is given below:

$$c(x, y, z) = \frac{Q}{2\pi\sigma_y\sigma_zu} \exp\left(\frac{-y^2}{2\sigma_y^2}\right) \left(\exp\left(\frac{-(z-h)^2}{2\sigma_z^2}\right) + \exp\left(\frac{-(z+h)^2}{2\sigma_z^2}\right) \right)$$

where,

c is a concentration at a given position; Q is the source term;

x is the downwind;

y is the crosswind;

z is the vertical direction;

u is the wind speed at the h height of the release;

σ_y , σ_z deviations describe the crosswind and vertical mixing of the pollutant.

The above equation describes a mixing process that results in a Gaussian concentration distribution both in crosswind and in vertical direction, centered at the line downwind from the source. Gravitational settling and chemical or radioactive decays are neglected.

The model computes the pollutant concentration dispersed in micrograms per cubic meter for any point source with the location coordinated at x, y and z. The “Gaussian Dispersion Model” version formed the basic framework of the computer model used for the computations of concentration of pollutants at ground level.

2.3 METHODOLOGY FOR WATER

To evaluate the impact on water quality of the Dharbandora region of South Goa, Secondary monitoring data includes the groundwater and surface monitoring and reports analysis.

2.4 METHODOLOGY OF SOIL

As per the Secondary monitoring data, Soil sampling was carried out and samples were collected from 08 locations to understand the soil quality locations in and around the mine lease area were selected for soil sampling. The homogenized samples were analyzed for physical and chemical characteristics.

2.5 METHODOLOGY OF NOISE

The noise can cause adverse effects on human’s mental and physical health. The noise levels are one of the indicators to be focused on in view of Cumulative Impact Assessment. It is crucial to evaluate the present noise levels and compare it with the future noise levels after many developmental activities. The Ambient Noise Quality Standards as per Noise Pollution (Regulation and Control) Rules, 2000 was as followed:

Category of Area/ Zone	Limits in dB (A) Leq	
	Day Time	Night Time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence	50	40

The mean values were taken for reporting. Ambient noise levels were compared with Noise Pollution (Regulation & Control) Rules, 2000 in respect of noise.

2.6 METHODOLOGY FOR LAND USE STUDY

2.6.1 Tools and Resources

The Land use Land cover study carried out using Digital Image Processing and Digital Image Interpretation techniques. The Image Processing and Geographical Information Systems software will be used for the Spatial Analysis. In order to meet the project requirements, the high-resolution satellite data of the study area acquired from National Remote Sensing Centre (NRSC). Basic Details of the Purchased data are as follows:

Satellite: IRS Resourcesat-2A Sensor: LISS 4

Spatial Resolution: 23.5m No. of Bands = 3

UTM Zone No = 43N

The bands used as input data for the current study have these following features:

Band 2: 0.52 - 0.59 μm (Green): This band corresponds to the green reflectance of healthy vegetation and is spanning the region between the blue and red chlorophyll absorption bands.

Band 3: 0.62 - 0.68 μm (Red): This red chlorophyll absorption band of healthy green vegetation is one of the most important bands for vegetation discrimination. In addition, it is useful for soil boundary and geological boundary mapping. Band 3 may exhibit more contrast than bands 1 and 2 because the effect of the atmosphere is reduced. The 0.69 m cut-off represents the beginning of a spectral region from 0.68 to 0.75 m where vegetation reflectance crossovers occur that can reduce the accuracy of vegetation studies.

Band 4: 0.77 - 0.86 μm (Near Infrared): For reasons discussed above, the lower cut- off for this band was placed above 0.75 m. This band is especially responsive to the amount of vegetation biomass present in a scene. It is useful for identification of vegetation types and emphasizes soil-crop and land-water contrasts.

2.6.2 Pre-processing of Satellite Data

In the present study geo-coded Ortho-rectified IRS P-6 LISS-IV satellite image having a resolution 5.8 m spatial resolution and a swath of 70 km.

All the processing will be done on ERDAS Imagine and Arc GIS software. A hybrid classification approach will be adopted for the purpose. Supervised classification will be performed on the imagery to delineate land use/land cover classes.

The IRS P-6 LISS-IV data geometrically corrected with respect to Survey of India topo- sheets. To carry out the geo-referencing, ground control points (GCPs) have been identified on the maps and raw satellite data. The coefficients for two co-ordinate transformation equations have been computed based on polynomial regression between GCPs on map and satellite data. Alternate GCPs were generated till the Root Mean Square (RMS) error became less than 0.5 pixels.

2.6.3 Visual Interpretation and Land Use Mapping

Fundamental characteristics seen on the images have aided in the visual interpretation of satellite imagery. These are tone/color, size, shape, texture, pattern, location, association, resolution and season. Visual interpretation is subjective and differs from person to person and also upon the season, scale, spectral bands, spatial resolution, overall image contrast & quality of the data. Several

parameters like terrain, climatic conditions, socio-economic trends and environmental influences etc. play a vital role in the existence of various land use categories.

2.6.4 Land Use Land Cover Classification

Digital image processing was carried out to delineate various land use/land cover categories in the lease area viz. built-up area, forests, scrub land and water bodies etc. by assigning necessary training sets, which was identified based on tone, texture, size, shape pattern and location information. Necessary care was taken to identify proper land use class, where there is conflict between the signatures of various classes. The interpreted map was verified on ground at limited points and final land use/land cover map was prepared. The buffer zone was broadly classified into forest areas, built-up areas, agriculture areas and other land with or without scrubs.

The limitations of Remote Sensing, Image Processing, Geographical Information Systems, Cartography and GPS are mentioned below: One season data sometimes give same spectral response of different objects creates confusion in image analysis and sub classification. Sometimes one season or one-time data is unable to show sub-classification in the study area.

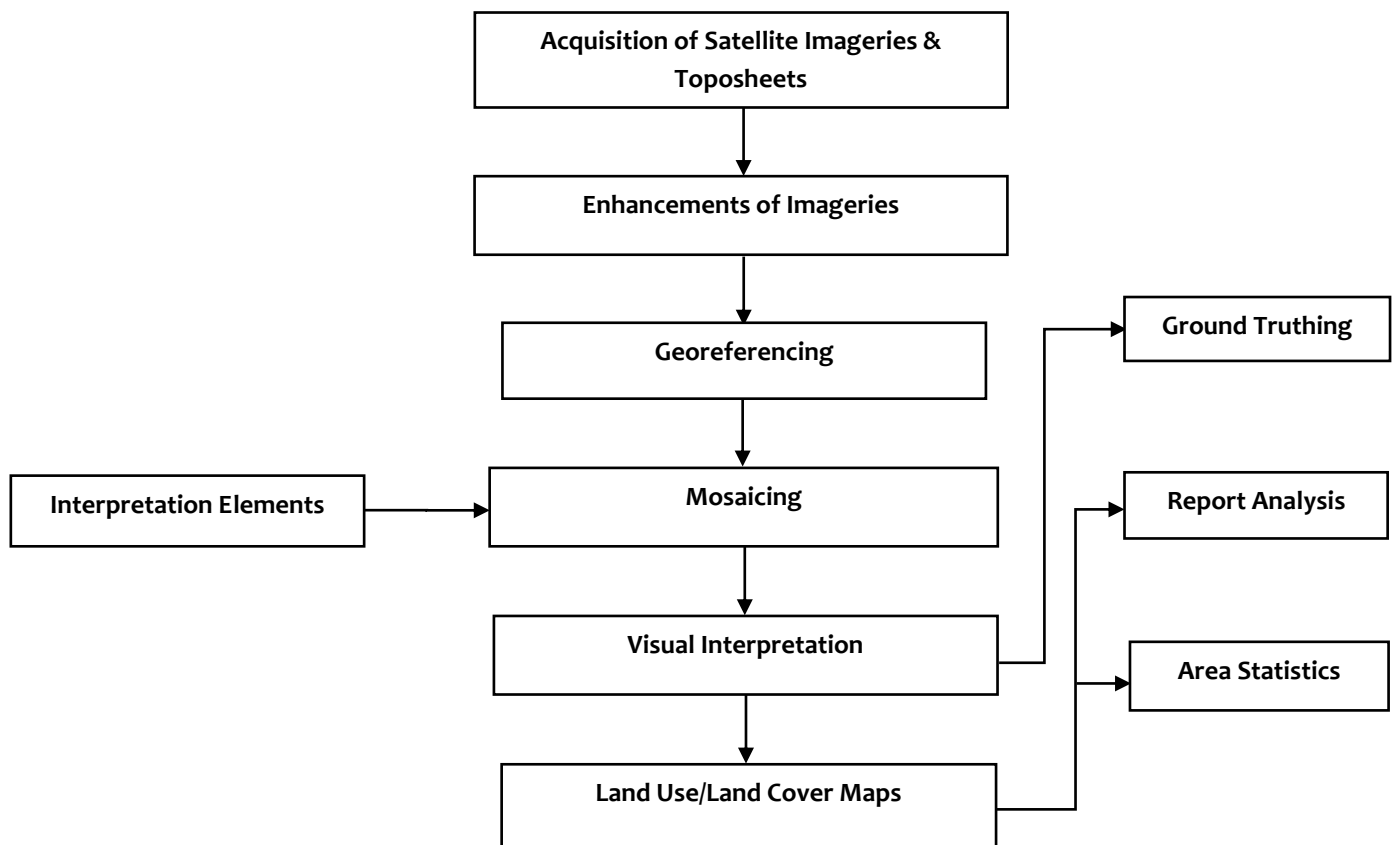


Figure 4: Methodology Flow Chart

2.7 SOCIO ECONOMIC ASPECTS (METHODOLOGY AND APPROACH)

The detailed Socio-economic study is considered here as a source of primary data.

2.7.1 Sampling Method

A judgmental and purposive sampling method was used for choosing respondents of various sections of the society. Judgmental and purposive sampling method includes the right cases from the total population that helps to fulfill the purpose of study.

For the study, both qualitative and quantitative methods were adopted. Data regarding the field area were collected both from primary as well as secondary sources.

- Primary sources include data collected through direct field sampling, observations based on schedules, questionnaires etc.
- Secondary source includes Census 2011 records, District Statistical Handbook literatures, documents from district etc.
- Data regarding mining, revenue generated by mining practices etc. will be collected from the Mine Department.

∞ Primary Data Collection

- The Socio-economic survey was carried out in the nearby human inhabitations (villages) of Proposed mine sites in order to study the existing resources of the area, land use, social structure of the community, employment patterns, income generation activities, dependency on forests and species preferred by the local people along with information on other related environmental and socioeconomic aspects.
- Detailed information on demography, labor allocation and employment, health and perceptions of change in the local environment was elicited through the interviews.
- The study was performed in Proposed mine site by using Questionnaire based pre- structured Feedback Surveys and Interviews.

∞ Secondary Data Collection

Preparation of Work Plan including information collected from secondary sources, profile of the study site, criteria for assessment etc.

Secondary data obtained from the sources was verified during the primary survey carried out in the study area.

2.7.2 Data Collection Techniques Used for Socio Economic Survey

- The sample frame of this study consists of communities within the 10 km of mining site.
- Quantitative and qualitative data collection techniques namely Participatory Rural Appraisal (PRA) tools, direct observations through questionnaire-based surveys through villagers' meetings were employed.

Participatory Rural Appraisal: Face-to-face interview conducted with the villagers to obtain information regarding household heads, live stocks, income, dependency on forest, impacts of mining, choice of species for reclamation from nearby communities in the study area.

Direct Observation: Direct observations were used throughout the pre-structured questionnaire-based survey.

2.8 METHODOLOGY FOR ECOLOGY AND BIODIVERSITY

The floral assessment for the project affected area and its buffer zone was based on field survey of the area.

Inventory Method: Forest inventory methodology was adopted to evaluate the floral diversity of core and buffer zone. A forest inventory is *“an attempt to describe the quantity and quality of forest trees and many of the characteristics of the land area upon which the trees are grown.”* The objective this floral inventory of the study area, is to provide complete checklist of floristic structure in the study area for formulating effective management and conservation measures.

Quadrat Method: The study was aimed at enumeration of the available plant resources and obtaining a broad representation of the existing floristic variations in the project affected area and surrounding buffer areas. Enumeration of the plant wealth was done by surveying the area through walking followed by collection and identification of plant specimens. A Phyto-sociological aspect of the study was carried out by perambulating and sampling through quadrates method. Sample plots will be selected in such a way to get maximum representation of different types of vegetation and plots will be laid out in different parts of the areas within the project affected area and surrounding buffer area. Selection of sites for vegetation data has been done by random sampling procedure. Accordingly, equal number of quadrates of 10 m x 10 m for the study of tree layer in the project affected area and surrounding buffer area was laid. Within these sample plots, subplots of 3 m x 3 m will be laid out randomly for studying the shrub layer and regeneration of tree species. For information on ground layer including herbaceous species, quadrates of 1 m x 1 m size were laid out within the tree quadrate.

All species encountered during the transect walk has been recorded and their herbarium specimens prepared for identification and future use. The girth at breast height (GBH) of all individuals in each quadrate was measured for all species of trees and woody climbers. All individuals with GBH > 10 cm were considered and recorded as trees (Parthasarathy and Karthikeyan, 1997). Individuals below 10 cm GBH will be considered as saplings and shrubs. This concept will be tested further during the fieldwork. Basal area of plants will be measured following Philips (1959).

The primary data recorded on number of individuals in a species and girths was utilized to derive secondary attributes like density and frequency following standard phytosociological methods of Misra (1968). Relative values were calculated following Philips (1959). Important Value Index (IVI) will be calculated by adding up relative frequency, relative density and relative dominance (Curtis, 1959). In the case of shrubs, herbs and saplings; IVI has been calculated based only on relative values, i.e., relative frequency and relative density. Formulae used for various calculations are:

$$\text{Quadrates Density} = \frac{\text{Total number of individuals of a species in all the}}{\text{Total number of quadrats studied}}$$

$$\text{Frequency (\%)} = \frac{\text{Total number of Quadrats in which species occurred}}{\text{Total number of Quadrats studied}} \times 100$$

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all Quadrates}}{\text{Total number of Quadrats in which species occurred}}$$

$$\text{Mean Basal Area} = \frac{C^2}{4\pi} \quad (C = \text{Mean of the circumference})$$

$$\text{Total Basal Area} = \text{Mean basal area} \times \text{Density}$$

$$\text{Mean of the Circumference (C)} = \frac{\text{Sum of all cbh of a species}}{\text{Total number of individuals of a species}}$$

$$\text{Relative Dominance} = \frac{\text{Total basal cover of a species}}{\text{Total basal cover of all species}} \times 100$$

$$\text{Relative Density} = \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$$

$$\text{Importance Value Index (IVI)} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Dominance}$$

“**The Shannon–Wiener Index (H')**, also referred to as the species diversity index, is a measure of community complexity. When properly calculated, the Shannon–Wiener Diversity Index generally ranges from 0, indicating very low community complexity, to 4 and above, indicating high community complexity. Species diversity (H') was computed following the Shannon and Wiener (1963) information index using the following formula:”

$$H' = - \sum_{i=1}^S P_i \ln(P_i)$$

Where, H' = Shannon–Wiener Diversity Index, S = total number of species, and P_i = proportion of individuals belonging to the *i*th species (P_i=n_i/N).

2.8.1 Methodology for Faunal Diversity Assessment

A linear transect of 1.0 km each was chosen for sampling at each site. Each transect was trekked for 1.5 hr for the sampling of faunal diversity through the following methods for different categories. For the sampling of butterflies, the standard ‘**Pollard Walk**’ method was employed and all the species recorded daily. Voucher specimens of the species that could not be identified in the field have been collected using a butterfly net besides photographing them.

For bird’s sampling, ‘**Point Sampling**’ along the fixed transect (Foot trails) will be carried out. All the species of birds was observed through a binocular and identified with the help of field guidebook and photographs.

For the sampling of mammals, direct count on open width (20m) transect was used. In addition, information on recent sightings/records of mammals by the villagers/locals was collected. For carnivores, indirect sampling will be carried out and the mammals were identified by foot marks,

faeces and other marks/sign created by them. In case of reptiles mainly lizards will be sampled by direct count on open width transects.

The study of fauna takes substantial amount of time to understand the specific faunal characteristic of area. The assessment of fauna was done by extensive field survey of the area. During survey, the presence of wildlife was also being inhabitants depending on animal sightings and the frequency of their visits in the project area was confirmed from forest department, Wildlife Department etc.

2.8.2 Methodology for Aquatic Diversity Assessment

The fauna and flora of the nala and rivers were regularly and carefully recorded during the period of visit. The floral samples were collected and brought to the lab and identified using standard keys. In the case of fauna, fishes and crustaceans were collected using dragnets or cast nets, fixed in 10% formalin, brought to the laboratory and identified using Fauna of British India. The occurrence of different fauna and flora during the period of study was tabulated and presented.

CHAPTER – 3

3.1 BASELINE ENVIRONMENT STATUS

The baseline environmental status of a cluster mine represents the prevailing conditions of various environmental components, including air quality, noise levels, water resources, soil characteristics, ecology and biodiversity, as well as the socio-economic environment. The process of impact identification begins with the systematic collection of baseline data encompassing ambient air quality, micro-meteorological conditions, ground and surface water quality, ambient noise levels, soil quality, land use patterns, biological diversity, socio-economic parameters, geology, and hydrology within a defined study area, extending within the study zone of 10 km radius.

3.2 STUDY PERIOD

Baseline data of various environmental components/ parameters were collected in the core as well as the buffer zone during the study period i.e., Summer Season (March to May, 2025) to assess the present scenario of the area. Sampling, preservation, transportation & storage of samples were carried out by J.M. EnviroLab Pvt. Ltd. under the supervision of concerned EC/FAE.

Ambient air quality monitoring has been carried out within a 10 km study area to determine the baseline concentration of various air pollutants in the ambient air. The ambient air quality depends upon the emission sources, meteorological conditions and the background concentration of specific pollutants. Ambient air quality monitoring is done to determine the general background concentration levels. The prime objective of the ambient air quality study is to assess the existing air quality of the study area and to establish the existing ambient air quality within the study area and its conformity to NAAQS.

3.3 AMBIENT AIR ENVIRONMENT

The Baseline Environmental Study for the proposed project area was carried out during the Summer Season from March to May 2025, considering the prevailing environmental conditions of the study area. In addition to the proposed project, the influence of existing operational mines and industries located within the study area, as listed in Table No. 1, has been considered for assessing the cumulative environmental scenario. The existing sources and their associated activities may contribute to the overall environmental conditions of the region; therefore, their influence has been accounted for while interpreting the baseline monitoring results.

The cumulative environmental assessment has been carried out with respect to key environmental parameters, including ambient air quality, noise levels, soil quality, groundwater quality and groundwater level, and surface water quality. The monitoring results obtained during the baseline period represent the prevailing environmental conditions under the influence of the existing operational activities in the study area. Accordingly, the detailed baseline results and assessment of

the environmental parameters, considering the influence of the existing operational mines and industries are presented in the following sections.

3.3.1 Metrological Condition of the Area

Micro-meteorological data from the project site during the air quality survey period is a vital component of the air pollution study. This data has been obtained from both primary and secondary sources.

Table - 4
Meteorology at Site
Study Period: Summer Season (March to May, 2025)

Month	Temperature (°C)		Relative Humidity (%)		Wind Speed (m/sec.)	
	Min.	Max.	Min.	Max.	Min.	Max.
March, 2025	19.4	35.5	60	73	0.3	9.3
April, 2025	22.7	34.9	68	71	0.3	6.8
May, 2025	22.7	35.3	76	82	0.3	5.9

Source: Meteorological Station at Site

Source of Air Pollution

The sources of air pollution in the region are dust emission from unpaved roads, domestic fuel burning, vehicular traffic, agricultural activities, industries and mining activities etc.

Monitoring Locations

Monitoring locations were selected for AAQ Monitoring keeping in view the pre-dominant wind direction prevailing in the area based on the previous IMD source.

It can be observed that the dominant wind direction prevailing in the area during the study period was from North West Direction followed by West.

Villages/locations have been selected in the downwind direction as well as in the upwind direction for AAQ monitoring from the mine site.

Monitoring locations selected for Ambient Air Quality Monitoring during the study period are given in Table - 5:

Table - 5
Ambient Air Quality Monitoring and Noise Level Monitoring Locations
Study Period: Summer Season (March to May, 2025)

Location Code	Monitoring Locations	Tentative Distance (from mining lease boundary) & direction (from center point)	Selection Criteria
SAN1	Mine Site	-	Core Zone
SAN2	Village Codli	~0.4 Km in SW direction	Near Habitation from ML Boundary
SAN3	Within 500 meters	~0.5 Km in SE direction	Within 500 meters

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

SAN4	Village Dabal	~0.5 Km in NW direction	Upwind direction of pre-dominant Wind
SAN5	Village Sangod	~3.8 Km in NE direction	Near Habitation In the study Area
SAN6	Village Darbandora	~4.0 Km in North direction	Nearby habitation of National Highway-748
SAN7	Village Konsen	~5.4 Km in West direction	Upwind direction of dominant Wind
SAN8	Village Kale	~6.5 Km in SE direction	Downwind direction of pre-dominant wind & Within Bhagvan Mahavir WLS
SAN9	Village Shigao	~6.7 Km in East direction	Nearby ESZ of Bhagwan Mahavir WLS in the study area
SAN10	Village Panchvadi	~7.2 Km in SW direction	Nearby Zuvari River in the study area
SAN11	Village Sanvardem	~7.3 Km in South direction	Densely populated habitation in the study area

Source: SOI Toposheet and Field Survey

3.3.2 Ambient Air Quality Monitoring

Monitoring locations for Ambient Air Quality (AAQ) were selected considering the predominant wind direction during the Summer Season (March to May 2025), based on the previous IMD data, along with the accessibility of the selected monitoring sites. The predominant wind direction during the study period was from the North West direction. The second dominant wind direction was observed to be from West. Accordingly, Villages/locations were selected in both upwind and downwind directions with respect to the mine site to adequately assess the prevailing ambient air quality. AAQ monitoring was carried out at 11 locations within the study area during the baseline study period.

The results of the Ambient Air Quality (AAQ) monitoring conducted at the selected locations within the study area to assess the cumulative impact of existing operational mines are presented below:

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

Table - 6
Ambient Air Quality Monitoring Results
Study Period: Summer Season (March to May, 2025)

Location Code	Sampling Locations	Parameters																		
		PM2.5 (µg/m3)		PM10 (µg/m3)		Nitrogen Dioxide (µg/m3)		Sulphur Dioxide (µg/m3)		Carbon Monoxide (mg/m3)		Benzo(a) Pyrene (ng/m3)	Ozone (µg/m³)		Lead (µg/m³)	Ammonia (µg/m³)		Benzene (µg/m³)	Arsenic (ng/m³)	Nickel (ng/m3)
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.		Min.	Max.			
SAN1	Mine Site	21.8	28.5	37.6	50.9	14.4	19.7	6.5	10.2	BDL	BDL	BDL	9.1	19.6	BDL	7.8	14.2	BDL	BDL	BDL
SAN2	Village Codli	20.3	32.2	41.5	55.4	15.3	23.1	5.1	13.4	BDL	BDL	BDL	10.2	20.2	BDL	10.1	19.1	BDL	BDL	BDL
SAN3	Within 500 m	19.0	26.3	34.1	46.2	9.4	16.0	4.2	10.7	BDL	BDL	BDL	7.4	15.0	BDL	10.4	21.0	BDL	BDL	BDL
SAN4	Village Dabal	25.9	36.4	44.5	64.6	13.6	22.2	7.6	13.1	BDL	BDL	BDL	13.7	22.0	BDL	11.5	24.3	BDL	BDL	BDL
SAN5	Village Sangod	17.2	29.8	33.0	45.3	9.0	15.7	4.1	10.1	BDL	BDL	BDL	11.5	18.4	BDL	7.3	18.6	BDL	BDL	BDL
SAN6	Village Darbandora	22.5	33.4	41.3	59.0	11.4	19.5	7.6	12.9	BDL	BDL	BDL	7.0	15.1	BDL	8.5	22.2	BDL	BDL	BDL
SAN7	Village Konsen	15.3	25.6	36.5	51.0	10.2	17.6	4.5	10.2	BDL	BDL	BDL	5.6	11.4	BDL	15.0	24.3	BDL	BDL	BDL
SAN8	Village Kale	27.5	39.8	48.6	65.9	13.3	24.8	8.9	14.0	0.51	0.67	BDL	13.5	25.7	BDL	16.4	29.0	BDL	BDL	BDL
SAN9	Village Shigao	22.1	34.2	38.3	57.4	10.4	17.4	6.0	11.9	BDL	BDL	BDL	10.1	17.2	BDL	10.1	21.2	BDL	BDL	BDL
SAN10	Village Panchvadi	26.6	36.7	44.2	63.0	13.6	20.2	7.2	12.6	BDL	BDL	BDL	8.4	20.0	BDL	13.3	26.7	BDL	BDL	BDL
SAN11	Village Sanvordem	30.8	40.1	51.6	72.9	16.9	26.4	9.3	14.5	0.55	0.72	BDL	15.9	26.0	BDL	7.0	19.0	BDL	BDL	BDL
Detection Limit								4.0		0.5		0.5	1.0		0.02	1.0		0.5	1.0	0.5
NAAQS* (24 Hourly)		60		100		80		80		4**		1***	180**		1	400		5***	1***	20***

Source: Ambient Air Quality Monitoring Results from JM EnviroLab Pvt. Ltd.

*NAAQS - National Ambient Air Quality Standards; Schedule-VII, [Rule 3 (3B)], [Part-II-sec.-3(i)] 16.11.2009, ** - 1 Hourly & *** - Annually

3.3.3 Air Quality Index

An air quality index (AQI) is a number used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast to become. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects.

There are six AQI categories, namely Good, Satisfactory, moderately polluted, Poor, Very Poor, and Severe. The AQI for proposed project is considering five pollutants (PM₁₀, PM_{2.5}, NO₂, SO₂ and CO) for which short-term (up to 24-hourly averaging period) National Ambient Air Quality Standards are prescribed. Based on the measured ambient concentrations, corresponding standards and likely health impact, a sub-index is calculated for each of these pollutants. The worst sub-index reflects overall AQI.

AQI has been calculated by using the following formula.

$$I = [I_{high} - I_{low} / C_{high} - C_{low}] (C - C_{low}) + I_{low}$$

where

I - The Air Quality Index

C - The pollutant concentration

C_{low} - The concentration breakpoint that is $\leq C$ *C_{high}* - The concentration breakpoint that is $\geq C$ *I_{low}*

- The index breakpoint corresponding to *C_{low}* *I_{high}* - The index breakpoint corresponding to *C_{high}*

The AQI values and corresponding ambient concentrations (health breakpoints) as well as associated likely health impacts of pollutants are as follows.

Table -7
AQI Category Based on Pollutants Concentration (PM₁₀)

AQI	Associated Health Impacts
Good (0-50)	Minimal Impact
Satisfactory (51-100)	May cause minor breathing discomfort to sensitive people.
Moderate (101-200)	May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.
Poor (201-300)	May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease
Very Poor (301-400)	May cause respiratory illness to the people on prolonged exposure. Effect May be more pronounced in people with lung and heart diseases.
Severe (401-500)	May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.

(Ref: Associated Health Effects taken by the MoEF&CC.)

In the present table, only PM₁₀ has been considered. The Air Quality Index (AQI) was calculated for 11 locations for the baseline study period: the Summer Season (March to May, 2025).

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

Table - 8
Sub-Index Values for Air Pollutant (PM₁₀) at Selected Sites
Baseline Study Period: Summer Season (March to May, 2025)

Site	Conc.	Sub-Index	Category	Color	Health Impact
A-1	50.9	51	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-2	55.4	55	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-3	46.2	46	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-4	64.6	65	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-5	45.3	45	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-6	59.0	59	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-7	51.0	51	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-8	65.9	66	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-9	57.4	57	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-10	63.0	63	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-11	72.9	73	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.

Source: EIA/EMP Report

Table - 9
AQI Category Based on Pollutants Concentration (PM_{2.5})

AQI	Associated Health Impacts
Good (0-30)	Minimal Impact
Satisfactory (31-60)	May cause minor breathing discomfort to sensitive people.
Moderate (61-90)	May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.
Poor (91-120)	May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease
Very Poor (121-250)	May cause respiratory illness to the people on prolonged exposure. Effect May be more pronounced in people with lung and heart diseases.
Severe (>250)	May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.

(Ref: Associated Health Effects taken by the MoEF&CC.)

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

In the present table, only PM₁₀ has been considered. The Air Quality Index (AQI) was calculated for 11 locations for the baseline study period: the Summer Season (March to May, 2025).

Table -10
Sub-Index Values for Air Pollutant (PM_{2.5}) at Selected Sites
Baseline Study Period: Summer Season (March to May, 2025)

Site	Conc.	Sub-Index	Category	Color	Health Impact
A-1	28.5	29	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-2	32.2	32	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-3	26.3	26	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-4	36.4	36	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-5	29.8	30	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-6	33.4	33	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-7	25.6	26	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-8	39.8	40	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-9	34.2	34	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-10	36.7	37	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.
A-11	40.1	40	Satisfactory	Light Green	May cause minor breathing discomfort to sensitive people.

Source: EIA/EMP Report

From the above interpretation of Air Quality Index for study area responsible parameter for pollution is PM₁₀ & PM_{2.5}. The AQI of study area falls under satisfactory categorization as per the data obtained during baseline studies. The health impact due to this AQI is less and it may only cause minor breathing discomfort to sensitive people.

3.4 AIR QUALITY MODELING

Opencast mining involves excavation, loading/unloading, hauling, crushing, Iron ore beneficiation, transportation via road to jetties or railway sidings, movement of HEMMs etc. Particulate Matter less than 10 microns (PM₁₀) and less than 2.5 microns (PM_{2.5}) are the main source of pollution due to the mining activities operations. Large quantities of dust get air borne and is carried away from overburden dumps induced by wind blow.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

3.4.1 Emission Rate as per Material Handled

The emissions in the present case have been computed using empirical factor given in “Indian Mining and Engineering Journal”. The details of emissions computed from mining operations proposed in both the leases are given below:

Table - 11
Emission rate as per material handled

S.N.	Activity	Category of Source	Emission Rate		Emission Load	
			Values	Unit	Kg/day	Contribution (%)
1	Iron Ore Loading	Point	0.58401	g/s	44.15	0.33
2	OB/Waste Loading	Point	0.66103	g/s	49.97	0.38
3	Haul Road & transport to Jetty and Railway Sidings	Line	0.023479	g/s/m	5325.04	40.13
4	Iron Ore Unloading	Point	0.904927	g/s	68.41	0.52
5	OB/ Waste Unloading	Point	0.753321	g/s	56.95	0.43
6	Exposed Pit Surface	Area	3.1611E-05	g/s/m ²	7196.91	54.23
7	Exposed Waste Dump	Area	1.01970E-04	g/s/m ²	529.60	3.99
Total SPM Load (kg/day)					13271.04	100%
Uncontrolled (Without EMP)						
SPM Emission (g/s)					175.54	-
PM ₁₀ Emission Rate @50 % of SPM (g/s)					87.77	-
PM _{2.5} Emission Rate @ 40% of PM ₁₀ (g/s)					35.11	-
SO ₂ Emission Rate (g/s)					1.18	-
NO ₂ Emission Rate (g/s)					0.63	-
Controlled (With EMP)						
PM ₁₀ Emission Rate @80 % efficient mitigations measures (g/s)					17.55	-
PM _{2.5} Emission Rate @80 % efficient mitigations measures (g/s)					7.02	-

Source: CMFRI, 1998; Chakraborty et al. 2002

In the present case, model simulations have been carried out for mining project and also cumulative for proposed mine and other existing mine nearby to obtain an optimum description of variations in concentration over the site in 10 km radius covering 16 directions

Table – 12
Predicted incremental concentration due to the proposed mine

Criteria Pollutants	Value at Mine Site(µg/m ³)	Predicted incremental GLC(µg/m ³)	Total GLC (µg/m ³)	Prescribed Standards Value in µg/m ³
PM ₁₀	50.9	3.38	54.28	100
PM _{2.5}	28.5	1.35	29.85	60
NO _x	19.7	1.58	21.28	80
SO ₂	10.2	1.47	11.67	80

Source: Isoleths & Ambient Air Quality Monitoring Results

The incremental concentrations have been estimated based on mathematical emission data-based modelling. For each time scale i.e., for 24 hrs, the model computes the maximum GLC observed during the period over all the measurement points. In the present case, model simulations have been carried out for proposed mining project and also cumulative for proposed mine and other existing mine nearby to obtain an optimum description of variations in concentration over the site in 10 km radius covering 16 directions.

For PM₁₀, PM_{2.5}, SO₂, & NO₂, maximum predicted incremental concentration for Block XII Codli Mineral Block is found to be 3.38 µg/m³, 1.35 µg/m³, 1.47 µg/m³ & 1.58 µg/m³.

3.5 NOISE ENVIRONMENT

Noise is defined as unwanted sound that may interfere with speech communication, cause annoyance, affect concentration and work efficiency, and disturb sleep, thereby influencing the quality of the human environment. Several sources contribute to the ambient noise levels within the 10 km study area, including road traffic, existing mines and plants, human activities in nearby villages, agricultural activities, and other existing activities in the vicinity of the mine site.

Monitoring Locations

The noise recording stations were located within 11 km radius of the study area. A total of 11 locations were fixed for the recording of noise levels around the mine site. The locations were selected based on the upwind, downwind, sensitive locations and residential area factors. Locations selected for noise level monitoring are given in table 5.

The baseline noise levels so obtained will be used in predicting the incremental noise levels due to operation of projects in cluster form.

Noise monitoring has been carried out for the period from Summer Season (March to May, 2025) during day and night time and Leq values have then been computed hourly. Day time & Night time monitoring was conducted from 6 a.m. to 10 p.m. and from 10 p.m. to 6 a.m., respectively.

Ambient noise levels were measured using integrated sound level meter (SLM) Lutron (SL-4001).

SLM was mounted on a tripod as per the standard methodology for noise measurements. Special care was taken for not making noise during the measurement and ensuring the least amount of reflective from our body to the meter. Noise levels were recorded as per IS: 9989 entitled "Assessment of noise with respect to community response" methodology. Noise levels were recorded at approximately 1.5 meter above the ground level and about 3 m away from walls, buildings or other sound reflecting sources.

Table - 13
Ambient Noise Level Monitoring Results
Study Period: Summer Season (March to May, 2025)

Location Code	Locations	Category of Area	Noise Levels dB Leq (A)	
			Day Time (06:00 AM to 10:00 PM)	Night Time (10:00 PM to 06:00 AM)
SAN1	Mine Site	I	47.2	38.1
SAN2	Village Codli	R	50.4	39.6
SAN3	Within 500 meters	R	46.2	38.7
SAN4	Village Dabal	R	51.9	40.6
SAN5	Village Sangod	R	48.3	38.8
SAN6	Village Darbandora	R	51.8	40.7
SAN7	Village Konsen	R	49.6	38.1
SAN8	Village Kale	R	53.8	42.9
SAN9	Village Shigao	R	51.0	40.5
SAN10	Village Panchvadi	R	51.6	41.2
SAN11	Village Sanvardem	R	56.8	44.4

Source: Ambient Noise Level Monitoring

3.6 Water Environment

Sample were collected manually from various type of sampling location with respect to Surface water & Groundwater. The sources of water sampling are as under:

Surface Water: The samples were collected from water bodies (Rivers/Nallahs).

Drinking Water/Ground water: Samples have been collected from Open well and Borewells.

3.6.1 SURFACE WATER QUALITY

Surface Water Sampling has been carried out below mention 8 sampling Locations.

Table - 14
Surface Water Sampling Locations
Study Period: Summer Season (March to May, 2025)

Station Code	Sampling Location	Distance & direction from proposed Mine Site
SW 1	Khandepar River	Adjacent in North direction
SW 2	Kale Nala	0.7 km in ESE direction
SW 3	Udnai Nala	1.5 km in West direction
SW 4	Panduranga Nala	5.0 km in SW direction
SW 5	Ragada Nala	7.0 km in NNE direction
SW 6	Sanguem or Zuari River	8.0 km in South direction
SW 7	Paroda River	9.0 km in SSW direction
SW 8	Jamboli Nala	9.0 km in NE direction

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

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Table - 15
Surface Water Quality Monitoring Results
Study Period: Summer Season (March to May, 2025)

S.N.	Parameters	Unit	Sample Locations							
			Khandepar River SW1	Kale Nala SW2	Udnai Nala SW3	Panduranga Nala SW4	Ragada Nala SW5	Sanguem or Zuvari River SW6	Paroda River SW7	Jamboli Nala SW8
1.	pH (at 25°C)	--	7.65	6.88	6.88	6.79	6.72	6.72	6.78	6.91
2.	Odour	--	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3.	Total Hardness as CaCO ₃	mg/l	40.0	30.0	25.0	15.0	15.0	64.0	45.0	20.0
4.	Calcium as Ca	mg/l	10.86	7.93	5.95	3.97	3.97	11.9	13.89	5.95
5.	Alkalinity as CaCO ₃	mg/l	42.2	27.6	19.82	15.82	17.1	50.37	31.1	22.37
6.	Chloride as Cl	mg/l	4.89	4.89	6.45	3.26	4.34	20.46	16.12	7.34
7.	Magnesium as Mg	mg/l	3.73	2.48	2.46	1.24	1.24	8.33	2.51	1.25
8.	Total Dissolved Solids	mg/l	71.0	52.0	48.0	24.0	34.0	101.0	74.0	47.0
9.	Sulphate as SO ₄	mg/l	1.3	3.04	3.74	1.3	2.15	7.5	6.09	1.42
10.	Fluoride as F	mg/l	BDL (DL 0.05)							
11.	Iron as Fe	mg/l	0.38	0.23	0.73	0.27	0.27	0.50	0.46	0.24
12.	Zinc as Zn	mg/l	0.02	0.04	0.02	0.20	0.05	0.02	0.03	0.02
13.	Total Suspended Solid	mg/l	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	2.0	BDL (DL 1.0)	BDL (DL 1.0)
14.	BOD	mg/l	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	2.8	1.3	BDL (DL 1.0)
15.	COD	mg/l	4.0	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	BDL (DL 1.0)	16.0	10.0	BDL (DL 1.0)
16.	Sodium as Na	mg/l	3.0	3.0	5.0	3.0	4.0	9.0	6.0	5.0
17.	Potassium as K	mg/l	1.0	1.0	1.0	BDL (DL 1.0)	1.0	2.0	1.0	2.0
18.	Conductivity	µs/cm	108.0	78.0	74.0	38.0	53.0	151.0	111.0	72.0
19.	Dissolve Oxygen	mg/l	7.8	7.5	7.6	7.7	7.8	7.5	7.1	7.3
20.	Total Coliform	MPN/100ml	110	90	70	50	80	170	140	70

BDL – Below Detection Limit, DL- Detection Limit

Source: Surface Water Analysis Report

Note: Surface water quality was also analyzed for Colour, Turbidity, Residual free Chlorine, Cyanide, Nitrate, Aluminium, Boron, Phenolic Compounds, Anionic Detergents, Hexa Chromium, Copper, Manganese, Lead, Selenium, Arsenic, Mercury, Phosphate and Nickel were found below detection limit.

3.6.2 GROUND WATER QUALITY

Ground water as well as potable water samples were collected from the available water resources within core zone and also 10 Km radius study area i.e. from Borewell and open wells. The samples from different sites were collected and tested.

The quality of ground water was studied by collecting 10 water samples. The water samples were collected from Open-wells and Borewells. Details of ground water and soil sampling locations and their distance and directions are given below:

Table - 16

Ground Water & Soil Sampling Locations

Study Period: Summer Season (March to May, 2025)

Location Code	Sampling Location	Tentative distance (from mining lease boundary) & direction (from centre point)
SGWS 1	Mine Site	Core area
SGWS 2	Village Codli	0.4 km in WSW direction
SGWS 3	Village Kirlapal	1.3. km in SSW direction
SGWS 4	Village Karmane	1.5 km in SE direction
SGWS 5	Village Dabal	2.0 km in WNW direction
SGWS 6	Village Kajumal	3.0 km in ENE direction
SGWS 7	Village Darbandora	4.0 km in North direction
SGWS 8	Village Konsen	5.4 km in West direction
SGWS 9	Village Panchvadi	7.2 km in SW direction
SGWS 10	Village Sanvardem	7.3 km in South direction

Source: SOI Toposheet & field Survey

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

Table - 17
Ground Water Analysis
Study Period: Summer Season (March to May, 2025)

S.N.	Parameter	Unit	Sampling Location										Specification as per IS 10500- 2012	
			SGWS1	SGWS2	SGWS3	SGWS4	SGWS5	SGWS6	SGWS7	SGWS8	SGWS9	SGWS10	Requirement Acceptable Limit	Permissible Limit in the Absence of Alternate Source
			Mine Site	Village Codli	Village Kirlapal	Village Karmane	Village Darbandora	Village Sanvardem	Village Dabal	Village Kajumal	Village Konsen	Village Panchvadi		
1.	pH (at 25°C)	-	7.26	6.91	6.85	6.80	6.89	6.61	6.60	6.93	7.11	6.41	6.5-8.5	No Relaxation
2.	Odour	-	Agreeable										Agreeable	Agreeable
3.	Taste	-	Agreeable										Agreeable	Agreeable
4.	Total Hardness as CaCO ₃	mg/l	52.0	40.0	58.0	45.0	82.0	70.4	35.0	144.0	218.0	40.0	200	600
5.	Calcium as Ca	mg/l	11.2	8.4	12.6	10.3	16.8	14.9	7.93	39.68	61.50	3.97	75	200
6.	Alkalinity as CaCO ₃	mg/l	45.6	31.65	47.47	31.1	60.2	52.2	31.65	130.4	221.5	36.92	200	600
7.	Chloride as Cl	mg/l	12.23	14.68	12.10	14.2	20.7	24.3	16.57	12.23	12.23	11.68	250	1000
8.	Magnesium as Mg	mg/l	5.8	4.6	6.43	4.7	9.7	8.1	3.69	10.91	15.66	7.03	30	100
9.	Total Dissolved Solids	mg/l	96.00	68.0	102.0	86.0	123.0	134.0	98.0	167.0	255.0	72.0	500	2000
10.	Sulphate as SO ₄	mg/l	5.41	2.82	3.8	1.85	8.65	12.06	5.43	2.93	4.56	8.04	200	400
11.	Fluoride as F	mg/l	0.36	0.07	0.54	0.36	0.23	0.29	0.11	0.16	0.22	0.21	1.0	1.5
12.	Nitrate as NO ₃ -N	mg/l	1.87	0.88	1.35	0.43	0.32	1.34	0.43	0.86	0.92	0.18	45	No Relaxation
13.	Iron as Fe	mg/l	0.26	0.58	0.33	0.19	0.15	0.23	0.33	0.42	0.24	0.14	1.0	No Relaxation
14.	Sodium as Na	mg/l	8.0	6.0	5.0	4.0	7.0	11.0	11.0	3.0	13.0	10.0	--	--
15.	Potassium as K	mg/l	1.0	1.0	1.0	1.0	3.0	6.0	1.0	BDL (DL 1.0)	2.0	2.0	--	--
16.	Conductivity	µS/cm	140.0	102.0	150.0	136.0	202.0	218.0	152.0	237.0	370.0	104.0	--	--

BDL - Below Detectable Limit, DL - Detection Level

Source - Ground Water Analysis Report, JM EnviroLab Pvt. Ltd.

Note: Ground water quality was also analyzed for Colour, Turbidity, Cyanide, Aluminium, Phenolic Compounds, Boron, Anionic Detergents as MBAS, Hexa Chromium, Chromium, Zinc, Copper, Manganese, Cadmium, Lead, Arsenic, Mercury, Phosphate, Nickel and Total Suspended Solid were found below detection limit.

3.6.3 SOIL ENVIRONMENT

The present study on soil quality establishes the baseline characteristics in the study area surrounding the project site. Representative soil samples were collected from 10 different specified locations during Summer Season within the study area of the mine site. Sampling Locations selected for Soil quality sampling are given in table 15. Standard procedures were followed for the sampling and analysis of physico-chemical parameters. The important physical, chemical parameter concentrations were determined from all samples.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

Table - 18
Soil Quality Analysis Results
Study Period: Summer Season (March to May, 2025)

S.N.	PARAMETER	Unit	Sampling Location									
			SGWS1 Mine Site	SGWS2 Village Codli	SGWS3 Village Kirlapal	SGWS4 Village Karmane	SGWS5 Village Kajumal	SGWS6 Village Darbandora	SGWS7 Village Konsen	SGWS8 Village Panchavadi	SGWS9 Village Sanvardem	SGWS10 Village Dabal
1.	pH (at 25°C)	-	5.63	5.99	5.52	5.66	6.07	5.54	5.56	7.17	7.21	6.94
2.	Conductivity	mS/cm	0.06	0.09	0.05	0.10	0.04	0.08	0.04	0.07	0.09	0.16
3.	Soil Texture	-	Clay	Sandy Loam	Clay	Clay	Sandy Loam	Silt Loam	Silt loam	Clay	Loamy Sand	Clay
a)	Sand	%	15.0	62.0	12.0	14.0	60.0	20.0	21.0	16.0	73.0	13
b)	Silt	%	21.0	32.0	30.0	22.0	33.0	74.0	74.0	18.0	17.0	21
c)	Clay	%	64.0	6.0	58.0	64.0	7.0	6.0	5.0	66.0	10.0	66
4.	Colour	-	Brown	Brown	Brown	Brown	Brown	Reddish Brown	Dull Yelloish Brown	Brown	Reddish Brown	Brown
5.	Bulk Density	gm/cc	1.22	1.57	1.26	1.19	1.57	1.43	1.45	1.18	1.63	1.36
6.	Porosity	%	51.97	37.70	49.60	52.59	37.45	43.25	42.46	52.80	36.33	45.60
7.	Water Holding Capacity	%	49.94	31.56	44.47	51.60	30.49	40.33	37.96	50.22	25.63	40.38
8.	Chloride	mg/kg	513.42	401.72	403.50	325.02	298.01	787.92	563.02	410.21	539.10	623.49
9.	Potassium	kg/hect	132.74	122.09	110.81	188.09	77.73	133.51	114.54	122.44	94.43	357.22
10.	Sodium	mg/kg	49.38	39.64	44.52	54.33	34.70	39.73	34.79	44.72	29.75	54.82
11.	Calcium	mg/kg	370.52	289.14	329.92	288.24	247.97	286.84	365.76	414.25	224.02	1038.65
12.	Magnesium as Mg	mg/kg	199.85	130.25	193.09	164.93	175.23	150.75	175.43	125.68	150.17	226.89
13.	Organic Matter	%	0.69	0.59	1.04	0.99	0.88	1.17	1.23	1.08	0.72	1.21
14.	Organic Carbon	%	0.40	0.34	0.60	0.57	0.51	0.68	0.71	0.63	0.42	0.78
15.	Available Nitrogen as N	kg/hect	231.22	208.57	219.91	246.81	210.55	255.54	261.35	218.91	187.08	316.15
16.	Available Phosphorus	kg/hect	9.03	10.43	14.11	12.97	9.22	17.23	13.04	33.48	14.85	26.80
17.	Zinc as Zn	mg/kg	44.12	34.83	29.03	49.95	43.47	44.77	26.69	58.68	35.33	36.82
18.	Manganese as Mn	mg/kg	1697.68	1151.32	785.10	1364.30	2617.65	1638.41	196.38	1702.74	2486.98	2117.25
19.	Lead as Pb	mg/kg	27.82	11.77	22.77	29.78	38.74	8.57	13.35	16.35	44.63	13.57
20.	Chromium as Cr	mg/kg	13.59	9.04	21.29	24.01	8.51	25.72	8.58	27.52	26.03	8.72
21.	Copper as Cu	mg/kg	39.32	28.06	31.93	35.54	32.13	40.01	40.04	74.07	33.47	15.50

Source: Soil Quality Analysis results from JM EnviroLab Pvt. Ltd.

Note: Soil quality was also analyzed for Cadmium which were found below detection limit (DL 5.0 mg/kg).

3.10 Transportation Logistics

Movement of dumpers for mineral transport from mine face to crusher may emit gaseous emissions which will be maintained within the mine premises by using efficient control measures. The Iron ore will be transported to crushers (3 Primary Crushers: 1 x 250 TPH & 2 x 90 TPH capacity and 1 Secondary crusher: 150 TPH) with the help of 40 Tonnes capacity dumpers via Haul Road. Total trips of 40 Tonnes capacity of dumpers required for transport of 11667 TPD Iron Ore from mine face to crusher will be 292 numbers (one sided).

The Iron ore mined out from this Mine will be supplied to JSW Steel Plant and or sold in open market like Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant. Transportation of iron ore from mine to end users will be by road via tippers.

The Iron Ore will be transported from Mine to Jetties or Railway Siding via SH-7 and connecting Village Road through tippers of 11.5 Tonnes capacity via road.

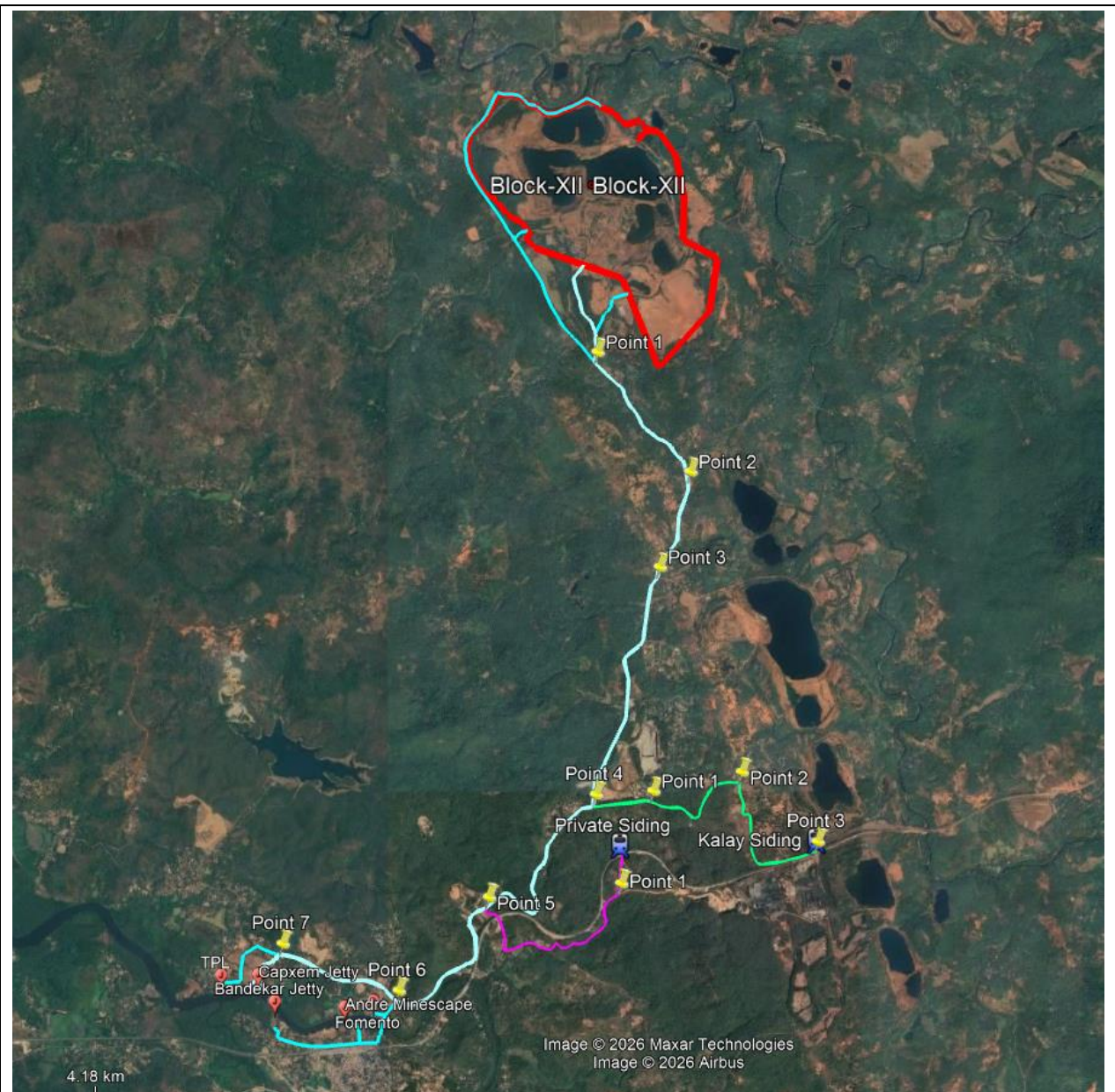
Table – 19
Details of proposed Transportation Routes

S.N.	Road Name	Transportation Method	Road Length	Avg. Road Width
1.	SH – 7 (Road connecting mine lease to Capxem)	Capxem Jetty, Andre Minescape, Bandekar Jetty, TPL and Fomento	~14.0 Km	8-12 m
2.	Village Road (Connected SH-7 to Costi)	Kalay Siding	~3.5 Km	7 m
3.	Village Road (Connected SH-7 to Pauskar Yard)	Private Siding	~2.6 Km	7 m
4.	Village Road (Connected SH-7 to TPL)	TPL	~0.65 Km	9 m
5.	Village Road (Connected SH-7 to Capxem Jetty)	Capxem Jetty	~0.4 Km	9 m
6.	Village Road (Connected SH-7 to Fomento, Andre Minescape and Bandekar Jetty)	Fomento, Andre Minescape & Bandekar Jetty	~2.0 Km	7 – 9 m

Two scenarios have been considered for the transportation of Iron Ore, i.e., transportation through jetties and railway sidings. In the initial scenario, a total quantity of 3.5 Million TPA of Iron Ore will be transported through jetties until the railway siding becomes operational. Subsequently, upon commissioning of the railway siding, 1.5 Million TPA of Iron Ore will be transported through the railway mode. Accordingly, the quantity of Iron Ore transported by jetties will be reduced, which will consequently result in a reduction in emissions associated with road transportation.

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Cumulative Impact Assessment



Mine Lease Boundary		Codli to Capxem Route	
Codli to Costi Route		Puskar Yard Road Route	
Traffic Study Points			

Figure 5: Google Earth Image Showing the Transportation Route & Traffic Survey Points

3.11 CARRYING-CAPACITY ASSESSMENT AS PER THE IIT (ISM) DHANBAD

Particular	Capacity
Total carrying capacity of Codli–Costi Cluster	4.69 MTPA
Codli Mineral Block production	3.50 MTPA
Kalay Mineral Block production	0.75 MTPA
Total proposed transportation	4.25 MTPA
Balance carrying capacity	0.44 MTPA

As per the IIT (ISM) Dhanbad carrying-capacity assessment, the total carrying capacity of the Codli – Costi cluster is 4.69 MTPA. The proposed production capacity of the Codli Mineral Block is 3.50 MTPA, while the production capacity considered for the Kalay Mineral Block is 0.75 MTPA. Thus, the combined mineral production/transportation requirement from the two mineral blocks is 4.25 MTPA, which is within the assessed carrying capacity of 4.69 MTPA. The proposed transportation will utilize approximately 90.6% of the assessed carrying capacity, leaving a balance carrying capacity of about 0.44 MTPA. Therefore, the combined transportation requirement of Codli and Kalay Mineral Blocks can be accommodated within the overall carrying capacity of the Codli–Costi cluster, subject to compliance with route-wise capacity restrictions and prescribed traffic-management measures.

3.12 POWER REQUIREMENT

Total power requirement for the proposed mining project will be 3.2 MW. The required power will be met from Goa Electricity Department and power will be supplied for mining operations, mineral beneficiation unit and other functional buildings. For emergency power back-up, 10 D. G. sets of 20Kva each, are proposed to be installed.

JSW Steel Limited has also proposed a provision for production of Solar energy to the tune of 100 KW which will be installed within first 3-4 years and the solar power will be used in providing the sufficient power for street lights, office etc. in the mine lease area.

JSW also proposed to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption.

Fuel Requirement

The details regarding fuel requirement are given below:

Table – 20
Details of Fuel Requirement

S.N.	Particular	Detail
1.	Fuel	HSD
2.	Quantity per Annum	21.84
3.	Source	Nearby Pump
4.	Mode of Transport	Road
5.	Distance of Source from Proposed Mine Site	~30 Km
6.	Type of Linkage (Linkage / Fuel Supply Agreement / e-auction / MoU / LOA / Captive / Open market / Others)	Open Market

Source: JSW Steel Ltd.

Steps to be taken for reduction of diesel consumption:

1. Purchase of most fuel-efficient equipment
2. Regular repair and schedule maintenance of equipment
3. Regular Checking and air inflation of tyres of dumpers
4. Reduction in idle running of equipment along with Strict Monitoring & Control on equipment
5. Maintaining optimum lead & lift for transportation to ensure minimum fuel consumption.

6. Regular repair and maintenance of haul roads grading, bench floor, ramps & maintenance for diesel conservation in transportation
7. Installation of Engine auto idling device in all HEMMs so that engine comes down to low RPM when machine remains idle.
8. Educating Excavator and Dumper operators to operate in “Economy Mode” instead of “Power Mode”.
9. Good fragmentation of blasting material which will help in reduction of specific fuel consumption (Litr/T)
10. Optimizing the time spent by vehicles during the following instances:
 - Vehicle Travelling while empty
 - Loading & Unloading
 - Vehicle Stopped while loaded
 - Vehicle Travelling while loaded
 - Vehicle stopped while empty
11. Improving blast fragmentation to reduce stress on excavators and thereby fuel savings.
12. Training to HEMM operators on fuel conservation techniques.

The company will also explore the provision of use of electrically/LPG/CNG based machinery and HEMMs trucks for the operation and transportation of Iron Ore.

In compliance with the Specific ToR condition, JSW Steel Limited shall explore the feasibility of utilizing renewable energy for project-related infrastructure. In this regard, the Company shall consider augmentation of solar power capacity and the feasibility of a solar-powered jetty for mineral transportation, if found technically and economically viable. It is also proposed to install rooftop solar panels with a capacity of 100 kW at suitable project facilities and will explore additional renewable energy opportunities to increase the share of renewable energy consumption.

3.13 ECOLOGY AND BIODIVERSITY

A primary field survey was carried out within 10 km radius impact zone in and around the project area to study the floral and faunal diversity of the terrestrial and aquatic environment of the study area.

Floral diversity:

The study area exhibits a rich diversity of flora, including Trees, Shrubs, Herbs, Grasses and Climer. The presence of various tree species from families like Fabaceae, Anacardiaceae, Moraceae, Meliaceae and others contributes to the ecological complexity. Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026, there are 114 floral species were recorded within the 10 km radius study area. These include 75 Tree species, 15 Shrub species, 16 Herb species, 6 Grass species and 2 Climber species.

Faunal diversity:

Based on the primary field observations and available secondary information including Management Plan of - Bhagwan-Mahavir NP & WLS, Goa and suggestion provided by DFO, South Goa, vide Letter No. 6/FCA-100/Mines/SGM/DCFS/TECH/2026-27/995, dated 20.07.2026, these species include 18 of Species Mammals, 60 Species of Birds, 08 Species of Reptiles, 4 Species of Amphibians, 8 Species of Butterflies and 03 Aquatic Species. Also, based on the secondary information including Management Plan of Bhagwan-Mahavir NP & WLS, there are Tiger (*Panthera tigris*), Gour (*Bos gaurus*) etc. present within the WLS area.

There are 19 species listed under Schedule I [Including 10 Mammals, 04 Reptiles and 05 Avi Fauna (Birds)]: *Bos gaurus* (Gaur / Indian Bison), *Canis aureus* (Golden Jackel), *Cuon alpinus* (Wild dog /Dhole), *Hystrix indica* (Indian Crested Porcupine), *Macaca radiata* (Bonnet Macaque), *Melursus ursinus* (Sloth bear), *Moschiola indica* (Mouse deer), *Panthera pardus* (Leopard), *Ratufa indica* (Malabar giant squirrel), *Urva edwardsii* (Grey Mongoose), *Crocodylus palustris* (Marsh crocodile), *Naja naja* (Indian Cobra), *Ptyas mucosa* (Rat Snake), *Varanus bengalensis* (Monitor Lizard), *Accipiter badius* (Shikra), *Haliastur indus* (Brahminy Kite), *Nisaetus cirrhatus* (Crested Hawk Eagle), *Pavo cristatus* (Indian Peafowl) and *Strix leptogrammica* (Brown Wood Owl) species as per the Wildlife (Protection) Amendment Act, 2022, found within the study area of Project Site.

Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crusher (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

Cumulative Impact Assessment

CHAPTER – 4

4.1 Recommendations for Common Mitigation Measures

Component	Study component/Action Plan	Responsibility
Physical	Annual Third-Party Audit for compliance of Environmental Clearance conditions.	User Agency
	Stringent Air pollution control measures will be undertaken including development of greenbelt along Safety zone, installation of wind breaking screens at stock yards, automated continuous dust suppression arrangements at loading points, unloading points, etc. Installation of Continuous Ambient Air Quality Stations (CAAQMS) to be connected with servers of monitoring agencies etc.	Respective User agencies monitored by concerned Govt. agency
	Zero discharge condition for mining activity implemented. Third Party Annual Audit of surface water management measures including drainage network, sedimentation pond, rainwater harvesting etc.	Respective User agencies monitored by concerned Govt. agency
Biological	Annual Third-Party Audit for compliance of Forest Clearance conditions including compensatory afforestation, wildlife conservation plan etc.	State forest department & wildlife department
	Third-party evaluation of mine-area plantations and completion of greenbelt along safety zone.	
	Year-wise plantation plans shall be prepared to replicate and restore the biodiversity of the land being utilized for mining activities.	Respective User agencies monitored by concerned Govt. agency
Socio-Economic	Need Based Assessment, HDI & SROI studies to be undertaken through reputed organizations of the field for implementation of CSR Activities.	Respective User agencies monitored by concerned Govt. agency
	Audit on Implementation of Socio-economic plan to be done Annually through third party organization.	Respective User agencies monitored by concerned Govt. agency
Mining Technology	Mineral extraction will be done using Eco-friendly techniques. Controlled Blasting Technique (only daytime) shall be done.	Respective User agencies
	Mineral Transportation will include Pit to crusher through dumpers and crushed Iron Ore will be transported to the Beneficiation plant and sent to the JSWSL plant.	Respective User agencies
	Progressive Mine Closure measures including technical & biological reclamation will be implemented religiously with Third Party Audit through agency.	Respective User agencies

4.2 Recommendation & Conclusion for Cumulative Impact Assessment of the Area

4.2.1 Air Environment

The open-pit mining activity will produce substantial amounts of particulate matter (PM) and small amounts of SO₂, NO_x, and CO, mainly from HEMMs and fuel oil combustion. CO in the mine primarily comes from heavy and light vehicles movement. All vehicles must be properly maintained, and their exhaust systems will undergo regular tests to check for pollution levels.

Results of the research show that the levels of Air quality parameters all fall within acceptable limits. Mining operations can still proceed sustainably by following the mitigation measure outlined in the Environmental Clearance, while taking into consideration the recommendations outlined in paragraph above. The baseline air quality monitoring stations are analyzed for high 24-hour concentrations by choosing discrete Cartesian receptors in the modeling area, with 10 receptor points specifically selected for the calculation.

The air quality in the study area is classified as good, satisfactory and moderate based on the data collected during baseline research. Because the project and activities of cluster mine implementation, the AQI index in some locations will transition from satisfactory to moderate.

The following actions are recommended to reduce the fugitive dust from various activities:

No drilling and blasting is proposed for mine operations.

- The volume of dust rising from dumps by the action of wind will be controlled significantly by planting grasses on slopes and native plants on dumps soon after their formation / attaining final profile.
- Haul roads will be the major source of dust in the opencast mines. To overcome the problems of dust generation from mine haul roads, Water spraying on haul roads and permanent transport routes at required frequencies.
- Avenue plantation along roads.
- No village road shall be used for mineral transportation. All industrial roads should be black topped and managed effectively with timely repair and maintenance.
- Effective dust suppression measures will be taken up at crusher. The crusher house will be enclosed to the extent possible and dust suppression arrangement will be provided at suitable locations. All conveyors, screens, crusher etc. will be provided with covers to avoid fugitive dust during operation. Some of the measures proposed to be adopted at crushing plant in order to control dust emission include:
 - Height of mineral fall to be minimized at all mineral transfer points,
 - Internal lining of chutes and bins will be done to take care of abrasion & dust and
 - Continuous water spraying arrangements will be made for dust suppression.
- The additional control measures on dump like thick plantation, stabilization and additional green belt along the boundary is recommended to control the dust concentrations.

4.2.2 Water Environment

The results of the research indicate that the water parameters are within acceptable limits. The study results show that Iron Ore block will not adversely affect the groundwater around the mine site because of groundwater recharge methods and natural recharge from mining activities. Considering this, it can be inferred that the research possesses adequate and lasting capability when it comes to groundwater.

Measures to Reduce Water Pollution

To prevent surface water contamination, following control measures are proposed in Environmental Management Plan:

- Waste water generated from workshop will be treated in oil & grease separator will be used for dust suppression. Waste water generated from wheel wash system will also be recycled.
- Domestic waste water generated from mine office, toilets & canteen will be Disposed in soak pit via septic Tank.
- Mist fog system (Atomized Water Sprinkler) will be installed at crusher hopper.
- Use of wetting agents is recommended to reduce water consumption.
- During monsoon, mine wash-off from pits will be arrested by series of check dams and silt settling ponds. The check dams & check bunds will be de-silted well before monsoon season every year.
- Garland drain (Dimensions: L* W*D= 1682 m x 1.0 m x 1.0 m) having a series of siltation pond will be provided at the toe of the dumps, to channelize the runoff water from dumps into the water reservoir (i.e. mined out pits).
- All the garland drains at the toe of the dump are proposed to be connected with a series of settling ponds which will ultimately allow the setting of silt from the water.
- Retaining wall (Dimensions: L* W*D= 1682 m x 1.5 m x 3.0 m) will be constructed around waste dump to control the surface run off.
- Catch drains and siltation ponds will also be constructed within the area to check flow of surface runoff as well as to prevent siltation of natural courses.
- The rainwater falling directly into the mine pits will be stored and used for plantation & dust suppression.

4.2.3 Biodiversity conservation

The preservation of Wildlife relies on the holistic ecosystem approach. It is not possible to accomplish it on its own, just by changing, increasing, or adding one or a few parameters or components. Sustaining Wildlife habitat in its most natural state is necessary for long-term maintenance. This involves maintaining both the non-living and living parts.

However, Wildlife conservation Plan has been carried out in the current mining lease area under the following categories:

- Rigid fire protection
- Prevention of grazing and creation of waterholes

- Prevention of illicit felling of fuel wood/timber
- Prevention of man animal conflict
- Augmentation of available water
- Providing salt licks
- Training and awareness program
- Carryout eco-development works in order to change the hostile attitude of villagers
- Checks and controls on the movement of vehicles in and out of the mine
- Planting a green belt
- Compensatory afforestation

The current proposed measures will not just safeguard the core area completely but also enhance the ecological situation in the buffer zone. Therefore, the mining operation will adequately counterbalance the effects caused by mining.

4.2.4 Mine closure and reclamation

Reclamation of overburden dumps:

The following activities will be taken up for reclamation of Waste dumps.

- Stabilization of overburden dumps
- Construction of retaining walls
- Construction of drain for drainage
- Provision of jute mesh for facilitating grass or vegetative growth on slopes
- Plantation mixed with indigenous and fast-growing plant species.
- Revegetation in ex-mining lands not only protects the mine soil from degradation due to erosion but also improves the quality of the mine soil itself. Improving the quality of mine soil does not solely come from trees but also from the legume cover crops.
- Afforestation and reclamation should be carried out in a way that promotes the growth of fruit-bearing trees, which will draw wildlife and preserve the region's biodiversity.
- The degraded area will be reclaimed and rehabilitated with local species of plantation in a phased manner.
- Plantation will be carried out in waste dumps.
- Encouraging the growth of medicinal plants is also vital for the welfare of the surrounding villages. The vetiver plantations may also be encouraged because, in addition to their medicinal potential, the grass species has a high anchoring strength.
- A Greenbelt will be created along the mine boundary to Intercept dust, gaseous pollutants and noise.

While carrying out mining activities, it is important to follow recommended mining parameters to ensure the stability of benches, high walls and dumps. Examining the fencing of mine working, landslides, and cracks between benches must be done systematically. Maintaining wide and well-graded roads on benches is necessary to ensure there is enough space for spreading blasted rock and for the smooth movement of mining and transport equipment.

4.3 Justification for Requirement of Opening of Iron Ore Mine vis-à-vis Demand

Steel production is the primary driver of iron ore demand. India's growing steel sector relies heavily on iron ore as its main raw material. Iron ore production in India is essential to support domestic steel manufacturing, infrastructure development, and economic growth, while also serving export markets. Demand for Iron and Steel is set to continue given the strong growth expectations for the residential and commercial building industry. Goa is primarily known for its significant iron ore availability, which has been the backbone of its mining industry and economy. The state has a moderate variety of other minerals, including bauxite, manganese ore, and various minor construction minerals like laterite and river sand. Mining in Goa today is synonymous with iron ore mining. The Goa iron ore is exported to China, Japan, Taiwan, South Korea and Eastern European Countries. Iron ore mining in Goa is completely in the private sector. The Iron ore deposits are distributed over the Northern, Southern and Central Blocks of Goa. The Northern Block deposits are richer both in terms of quality and quantity of the ore, as compared to the Southern and Central Blocks. The Iron ore produced from Codli Mineral Block - XII Iron Ore Mine will be supplied to JSW Steel Plant or sold in open market. Normal Iron ore will be only subjected to dry screening and dispatch from mine whereas low grade iron ore and siliceous ore will be fed to wet beneficiation plant to attain a product of +54% Fe and then supplied to JSW Steel Plant or sold in open market. Maximum part of the produced material will be supplied to JSW Steel Plant. To some extent ore will also be sold in domestic market to Blast Furnace Industries, Sponge Iron Industries and other industries having Sinter Plant or exported.

4.4 Conclusions

In the block, the concentration of PM, SO₂, and NO_x falls comfortably within the acceptable limits. Nonetheless, the RSPM levels in the region are close to the highest allowable limit for an industrial zone. Particulate Matter could potentially hit its peak level in the future because of build-up. Hence, more steps need to be taken from the Environmental Management Plan to improve climate change and decrease industrial pollution.

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J. M. EnviroNet Pvt. Ltd., Gurugram

Unit No. 1517, Tower – B, Emaar Digital Greens, Golf Course Ext. Road, Sector – 61, Gurugram-122011, Haryana

J. M. Environet Pvt. Ltd., Gurugram is Re-Accredited (RA5) as Category-A organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations (Version 3), for the preparation of EIA/EMP reports in the sectors listed below, as per the specified categories

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1.	Mining of minerals including opencast / underground mining	1	1 (a) (i)	A
2.	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
3.	River Valley projects	3	1(c)	A
4.	Thermal power plants	4	1 (d)	A
5.	Coal washeries	6	2 (a)	A
6.	Mineral beneficiation	7	2 (b)	A
7.	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
8.	Cement plants	9	3 (b)	A
9.	Petroleum refining industry	10	4 (a)	A
10.	Coke oven plants	11	4 (b)	A
11.	Chlor-alkali industry	13	4 (d)	A
12.	Soda ash Industry	14	4 (e)	A
13.	Chemical fertilizers	16	5 (a)	A
14.	Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	18	5 (c)	A
15.	Manmade fibers manufacturing	19	5 (d)	A
16.	Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes)	20	5 (e)	A
17.	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	21	5 (f)	A
18.	Distilleries	22	5 (g)	A
19.	Pulp & paper industry excluding manufacturing of paper from wastepaper and manufacture of paper from ready pulp without bleaching	24	5 (i)	A
20.	Sugar Industry	25	5 (j)	B
21.	Industrial estates/ parks/ complexes/areas, export processing Zones(EPZs), Special Economic Zones(SEZs), Biotech Parks, Leather Complexes	31	7 (c)	A
22.	Ports, harbours, break waters and dredging	33	7 (e)	A
23.	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
24.	Building and construction projects	38	8 (a)	B
25.	Townships and Area development projects	39	8 (b)	B

Note: Names of approved experts and sectors are mentioned in RAAC minutes dated July 30, 2026, 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/ACO/26/4166 dated August 06, 2026. The accreditation needs to be renewed before the expiry date by J. M. Environet Pvt. Ltd., Gurugram following due process of assessment.

Valid up to
August 07, 2029



Certificate No.
NABET/EIA/26-29/RA 0504

Issue Date
August 06, 2026

Varinder Kanwar
Prof (Dr) Varinder S Kanwar
(CEO – NABET)

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



**National Accreditation Board for
Testing and Calibration Laboratories**

CERTIFICATE OF ACCREDITATION

J.M. ENVIRO LAB PRIVATE LIMITED

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

424, GROUND FLOOR, UDYOG VIHAR PHASE-IV, GURUGRAM, HARYANA, INDIA

in the field of

TESTING

Certificate Number: TC-6821

Issue Date: 24/05/2025

Valid Until: 23/05/2029

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: J.M. ENVIRO LAB PRIVATE LIMITED

Signed for and on behalf of NABL




Anuja Anand
Director


N. Venkateswaran
Chief Executive Officer



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

UNDERTAKING

I, Ambarish Volvoikar hereby give this undertaking that **JSW Steel Limited** is proposing Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crushers (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa).

There is no litigation pending against the project and/or any direction/order passed by any Court of Law against the project and/or land in which the project is proposed and that for any such litigation whatsoever, the sole responsibilities will be borne by the Company.

Date: 12.03.2026

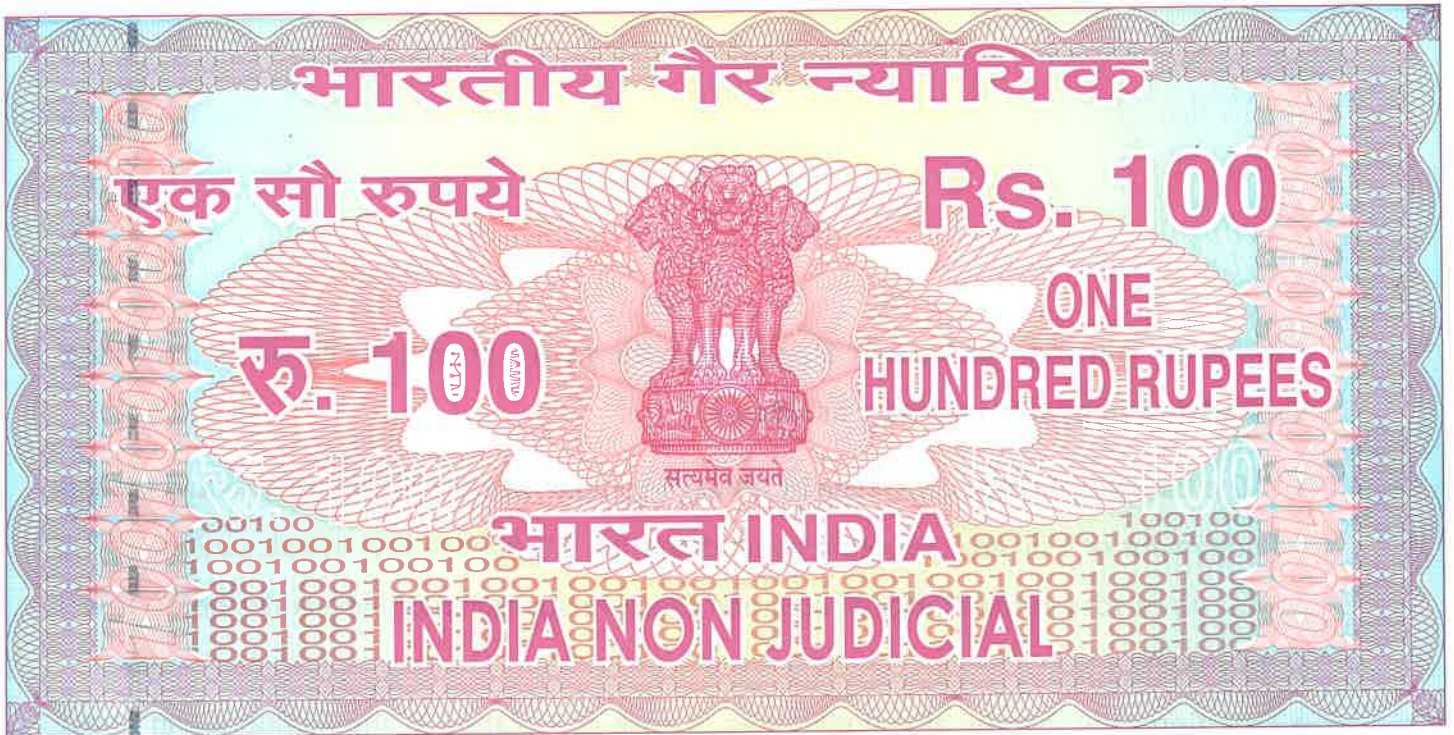
Place: Panjim

For JSW Steel Limited

(Authorized Signatory)



Part of O. P. Jindal Group



गोवा GOA

DATE 13/3/26 SR. NO. 10747 VALUE 100/-

C 223133

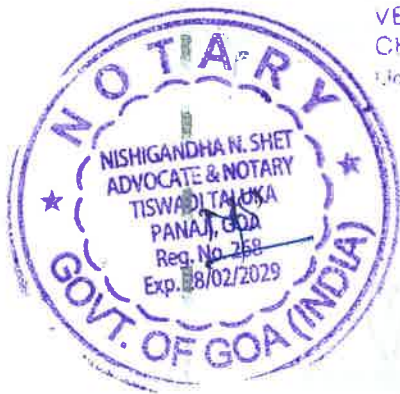
NAME OF PURCHASER JSW Steel Limited

RESIDENT OF Panaji PURPOSE

PLACE OF VENDOR, PANAJI

VENDOR SIGN.
CHANDRAKANT PATIL
Lic. No. AG/STP/VEN/LIC/23/2004

PURCHASER SIGN



AFFIDAVIT

Environmental Clearance for Block - XII Codli Mineral Block, Auctioned Block Area: 377.0881 ha with Iron Ore Production 3.50 Million TPA, OB/Waste 8.21 Million TPA (Total Excavation: 11.71 Million TPA) along with Installation 04 Crushers (3 Primary Crusher of 1 x 250 TPH & 2 x 90 TPH and 1 Secondary Crusher of 150 TPH) and 600 TPH Dry Processing/Screening Plant & 2 x 300 TPH Wet Beneficiation Plant with Throughput Capacity 3.50 Million TPA located at Village: Codli, Taluka: Dharbandora, District: South Goa (Goa) by JSW Steel Limited.

I Ambarish Volvoikar Authorized Signatory of the above project on behalf of **JSW Steel Limited** do hereby solemnly state as follows:

1. "The Company hereby undertake by affidavit comply with all the statutory requirement & judgement of Hon'able Supreme court dated the 2nd August 2017 in writ petition (Civil) No. 114 of 2014 in the matter of common cause versus Union of India & Ors before grant of ToR/EC.
2. The Company, hereby also undertaken in case of violation if any mentioned in above undertaking, the ToR/Environmental Clearance shall be liable to be terminated forthwith.
3. The Company hereby undertake by affidavit that the Environmental Clearance will not be operational till such time that the Company complies with all statutory requirement & judgement of Hon'ble Supreme Court dated the 2nd August 2017 in writ petition (Civil) No. 114 of 2014 in the matter of common cause versus union of India & Ors as applicable.

The Company, further undertake that the contents of this declaration are true and correct to best knowledge & belief, that nothing has been concealed.

Date: 13.03.2026

Place: Panjim

Nishu
Nishigandha N. Shet
Advocate & Notary
Tiswadi Taluka
Panaji - Goa
Reg No. 981

SOLEMNLY AFFIRMED AND VERIFIED
BEFORE ME BY Ambarish Volvoikar
WHO IS IDENTIFIED BEFORE ME BY on basis
of Driving Licence No. WHOM I KNOW:
SR. No. 38841 DATED 13/03/2026
GABTR-2010-0066569


Signature

